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JUN 2010

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Date: JUN 03 2010
Refer To: EP2010-0261

James Bearzi, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Submittal of the Completion Reports for Pueblo Canyon Grade-Control Structure and Gage Station E060.1 and DP Canyon Grade-Control Structure and Gage Station E039.1

Dear Mr. Bearzi:

Enclosed please find two hard copies with electronic files of the Completion Report for Pueblo Canyon Grade-Control Structure and Gage Station E060.1 and the Completion Report for DP Canyon Grade-Control Structure and Gage Station E039.1.

This submittal fulfills the requirements in Comments 9a and 9d of the Approval with Modifications Supplemental Interim Measures Work Plan (SIWP), dated February 20, 2009, and the Approval of Extension Request, Completion of Stream Gages E039.1 and E060.1 located in Los Alamos Watershed, dated February 16, 2010. Construction of the Pueblo and DP Canyons grade-control structures was completed on January 26, 2010. Existing gage stations E039 and E060 were redesigned as supercritical flumes and relocated downstream of the DP and Pueblo Canyon grade-controls structures, respectively. Gage Station E039.1 was completed on May 4, 2010, and Gage Station E060.1 was completed on May 18, 2010. Along with a narrative of the construction activities, the completion reports also include a geotechnical engineering study, as-built drawings, and photo documentation. The Hydrologic Engineering Center–River Analysis System hydraulic analysis of both structures was updated from the September 2009 design submitted to the New Mexico Environment Department based on value-engineered changes to the structures as well as a 2-ft increase in the height of the Pueblo Canyon grade-control structure low-flow weir.

If you have any questions, please contact Steve Veenis at (505) 667-0013 (veenis@lanl.gov) or Cheryl Rodriguez at (505) 665-5330 (crodriguez2@doeal.gov).

Sincerely,

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Michael J. Graham, Associate Director
Environmental Programs
Los Alamos National Laboratory

Sincerely,

Cheryl J. Rodriguez for

David R. Gregory, Project Director
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33645

MG/DG/

Enclosures: Two hard copies with electronic files:
(1) Completion Report for Pueblo Canyon Grade-Control Structure and Gage Station E060.1 (LA-UR-10-0937)
(2) Completion Report for DP Canyon Grade-Control Structure and Gage Station E039.1 (LA-UR-10-3300)

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LA-UR-10-0937
June 2010
EP2010-0135

Completion Report for Pueblo Canyon Grade-Control Structure and Gage Station E060.1

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

Los Alamos National Laboratory, operated by Los Alamos National Security, LLC, for the U.S. Department of Energy under Contract No. DE-AC52-06NA25396, has prepared this document pursuant to the Compliance Order on Consent, signed March 1, 2005. The Compliance Order on Consent contains requirements for the investigation and cleanup, including corrective action, of contamination at Los Alamos National Laboratory. The U.S. government has rights to use, reproduce, and distribute this document. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.

LA-UR-10-0937
EP2010-0135

Completion Report for Pueblo Canyon Grade-Control Structure and Gage Station E060.1

June 2010

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EXECUTIVE SUMMARY

This report was prepared by Kellogg Brown and Root Services, Inc. (KBR), and Post, Buckley, Schuh, and Jernigan, Inc. (PBS&J), for the U.S. Department of Energy (DOE) Los Alamos Site Office and Los Alamos National Laboratory (LANL or the Laboratory) to document and summarize the design, analysis, and construction of the Pueblo Canyon grade-control structure and associated stream gage E060.1. This report addresses engineering and site exploration activities, deviations from the original design, permitting, and construction activities.

The Los Alamos and Pueblo watershed, including the canyons and their tributaries, encompasses several former and current technical areas of the Laboratory. In 2004, the Los Alamos and Pueblo Canyons Investigation Report presented investigations of the nature, extent, transport, and potential risk from chemicals of potential concern in the watershed. Following a notice of disapproval from the New Mexico Environment Department (NMED) in 2005, DOE and the University of California prepared a supplemental investigation report for Los Alamos and Pueblo Canyons. In 2007, NMED issued an approval with direction for this report, with requests that the Laboratory conduct actions to mitigate the transport of polychlorinated biphenyls (PCBs) in stormwater. The February 2008 Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons presented interim actions to mitigate PCB transport. NMED issued an approval with modifications to the interim measure work plan, resulting in a supplemental interim measure work plan. The Pueblo Canyon grade-control structure was presented in the supplemental plan as an additional mitigation measure to reduce contaminant transport within the Los Alamos and Pueblo watershed.

This Pueblo Canyon project consisted of the construction of a grade-control structure that raises the level of the stream bed in an area downstream of headcuts that have degraded an existing wetland. The primary goal of this structure is to induce channel aggradation (sediment deposition) upstream of the structure and stabilize the upstream wetland by preventing further headcut migration. The approximate location of the Pueblo Canyon grade-control structure is north of NM 502, approximately 400 ft downstream of the existing New Mexico Department of Transportation's maintenance facility. The reinstalled and upgraded gage E060.1 is located 320 ft downstream of the structure. In this location the flume and gage can measure the efficiency of the grade-control structure. The downstream location also incorporates the stabilization of two nickpoints located downstream of the grade-control structure.

Construction of the grade-control structure began October 26, 2009, and was completed January 26, 2010. A letter submitted to NMED on February 5, 2010, gave notice of the grade-control structure completion and requested extensions for the dates to complete construction of stream gage E060.1 and submit the completion report. In a letter dated February 16, 2010, NMED approved the requested extension for both stream gage completion and completion report to June 3, 2010. Stream gage E060.1 construction was completed March 11, 2010. Final rip-rap installation was completed May 18, 2010, and the entire site was seeded May 19, 2010.

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Acronyms and Abbreviations

2-D	two-dimensional
3-D	three-dimensional
CMP	corrugated metal pipe
CQC	contractor quality control
DOE	Department of Energy (U.S.)
EPA	Environmental Protection Agency (U.S.)
FFA	flood frequency analysis
KBR	Kellogg Brown and Root Services, Inc.
HDC	hydraulic design chart
HEC-FFA	Hydrologic Engineering Center Flood Frequency Analysis (U.S. Army Corps of Engineers statistical computer program)
HEC-RAS	Hydrologic Engineering Center River Analysis System (U.S. Army Corps of Engineers surface model)
IMWP	interim measure work plan
LANL	Los Alamos National Laboratory
LIDAR	light detection and ranging
NGVD	National Geodetic Vertical Datum
NMED	New Mexico Environment Department
NOAA	National Oceanic and Atmospheric Administration
PBS&J	Post, Buckley, Schuh, and Jernigan, Inc.

PCB	polychlorinated biphenyl
PM	project manager
PVC	polyvinyl chloride
SDIC	Security, Disaster, Infrastructure Construction (USACE multiple-award task-order contract)
SIMWP	supplemental interim measure work plan
SWPPP	stormwater pollution prevention plan
TA	technical area
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

1.0 PROJECT OBJECTIVES

The Los Alamos and Pueblo watershed, including the canyons and their tributaries, encompasses several former and current technical areas of Los Alamos National Laboratory (LANL or the Laboratory). The Los Alamos and Pueblo Canyons Investigation Report (LANL 2004, 087390) presented investigations of the nature, extent, transport, and potential risk from chemicals of potential concern in the watershed. Following a notice of disapproval from the New Mexico Environment Department (NMED) (2005, 088463), the Laboratory prepared a supplemental investigation report for Los Alamos and Pueblo Canyons (LANL 2005, 091818). NMED issued an approval with direction for this report (2007, 098284), with requests that actions be conducted to mitigate the transport of polychlorinated biphenyls (PCBs) in stormwater. The February 2008 Interim Measure Work Plan (IMWP) to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons (LANL 2008, 101714) presented interim actions to mitigate PCB transport. NMED issued an approval with modifications to the IMWP (NMED 2008, 103007), resulting in a supplemental IMWP (SIMWP) (LANL 2008, 105716; NMED 2009, 105014). The Pueblo Canyon grade-control structure is an additional mitigation measure identified in the SIMWP to reduce contaminant transport within the Los Alamos and Pueblo watershed. In order to monitor the effectiveness of the structure for mitigating sediment transport, relocation of stream gage E060 was included as part of the grade-control structure work. Figure 1.0-1 shows sediment transport mitigation sites in Los Alamos and Pueblo Canyons, highlighting the Pueblo Canyon grade-control structure and the relocated stream gage E060.1.

The project consisted of the construction of a grade-control structure and the relocation of stream gage E060 (now named stream gage E060.1) within the Laboratory's Technical Area 74 (TA-74) in the vicinity of Los Alamos, New Mexico. The grade-control structure is located within Pueblo Canyon and is referred to as the Pueblo Canyon grade-control structure. The approximate location of the structure is 360 ft downstream of the previous E060 gaging station location. The new location for stream gage E060.1 is approximately 320 ft downstream of the structure. See Figure 1.0-2 and Appendix A for the location of the structure and relocated stream gage E060.1.

The structure is part of remedial actions taken to reduce the migration of contaminated sediment. A beneficial result of the grade control is the stabilization, expansion, and enhancement of wetland areas upstream of the structure.

The Pueblo Canyon grade-control structure was designed to induce upstream aggradation (sediment deposition) to fill the channel, to establish a new grade that provides stability to the channel headcuts, and to aid in the development of an enhanced wetland environment. The headcut regions were replaced with a broad aggraded wetland surface where floodwaters will spread and further increase sediment deposition. Contaminated materials from areas downstream of the structure were used to provide backfill against the new structure. This material was used to establish an adaptable base level above the preconstruction channel elevation and close to the historic channel level before channel degradation. Aggradation within the channel upstream of the structure will reduce erosion of contaminated stream banks and overbank areas during significant storm events. Flood flows will more frequently spill into the overbank areas and through deposition will bury existing contaminated floodplain deposits. These actions will also contribute to enhanced and sustainable wetlands.

In order to simplify the design, reduce costs, and still provide a stable, safe structure, the structure was designed and constructed to ensure that it did not fall under New Mexico Safe Dams regulations. Under these rules and regulations, a structure is classified as a dam when the structure is more than 10 ft in height (measured from original channel elevation to the top of the low spillway) or is capable of impounding more than 10 acre-ft of water. The Pueblo Canyon grade-control structure does not exceed

either of these limitations. The design and final as-built height of structure is 6 ft at the low-flow weir and 7 ft at the overflow weir, as measured from the stream-channel elevation. Maximum impoundment at the low-flow weir is 0.75 acre-ft and at the overflow weir is 1.05 acre-ft.

The objective of locating stream gage E060.1 downstream of the structure is to monitor the efficiency of the structure for mitigating sediment transport.

2.0 DESIGN

2.1 General

2.1.1 Grade-Control Structure

The Pueblo Canyon grade-control structure is composed of gabion baskets with a 30-ft low-flow weir, centered perpendicular to the stream centerline. The low-flow weir was designed to carry storm runoff from a 5-yr storm event. An overflow weir was also incorporated into the structure to handle flow capacities up to the 100-yr storm without overtopping the structure. The total length of the overflow, including the low-flow weir, is 168 ft. The height of the low-flow weir crest was initially designed to be 3 ft below the height of crest of the overflow weir and 4 ft above the stream centerline. The height of the low-flow weir was modified to 1 ft below the height of the overflow weir at the request of NMED to induce greater aggradation upstream of the structure. See Figure 2.1-1 and Appendix A, sheet C-200.

Since the gabion structure would be unsupported, it was designed to provide sufficient mass to prevent slippage and overturning. The design of the structure also provides for the raising of water surface elevations behind the structure during more frequent flood events (5-yr) such that the sediment deposition occurs immediately upstream of the structure and yet minimizes the backwater effects of the less frequent flood events (50- to 100-yr).

The structure design also includes buttress gabions upstream of the weir. The upstream buttress gabions protect the main gabion structure from flow that may contain boulders, trees, and other debris. The top of the grade-control structure was designed to direct flow onto the gabion benches below the top elevation. Downstream buttress gabions also provide energy dissipation of flows. With flows directed to the stilling-basin floor, energy will also be dissipated through the benches.

The upstream face of the structure was wrapped in a geotextile material to minimize the transport of fine sediments during the early stages of operation as well as to reduce the flow of water through the structure. The type of geotextile material was based on gradation analysis of the stream sediment. The material was buried by backfill, using streambed material to stabilize the geotextile and to add impermeability. In addition, a 3-in. concrete cap was applied to the low-flow and overflow crests to protect against potential damage from scouring and debris (Figures 2.1-2 and 2.1-3).

The structure also includes a 220-ft rip-rap armored earthen berm (using New Mexico Department of Transportation wire-enclosed Class A rip-rap) (Figures 2.1-4 and 2.1-5). The elevation of the berm is designed to capture all flow up to the 100-yr flood once sedimentation in the channel is maximized. The berm extends north until it ties back into a common elevation in the canyon (Appendix A).

A perforated and slotted riser pipe was constructed approximately 32 ft upstream of the structure to assist in releasing water stored upstream (Figure 2.1-6). One side consists of removable wood boards placed in slots. The remaining riser pipe is a perforated corrugated metal pipe (CMP) to allow water to enter the pipe. This pipe is connected to an outfall pipe that goes through the gabion structure to the stilling basin. The top wood board is placed at the elevation of the low-flow weir or higher to ensure that maximum

water surface elevations are achieved to induce sediment settling. After a storm event, the perforations on the pipe will allow dewatering behind the weir. However, if the rate of dewatering is not sufficient to meet standards or the perforations get plugged by debris, wood boards can be removed as needed to accelerate the dewatering process.

2.1.2 Stream Gage

The new stream gage, E060.1, was originally designed to be located within the grade-control structure. However, during construction, the location was changed to provide more accurate measurements and to better monitor the efficiency of the grade-control structure. The stream gage's concrete supercritical-flow flume design measures flow up to 350 cubic ft per second (cfs) (Figure 2.1-7). The determination of the stream-gage location, approximately 320 ft downstream of the grade-control structure stilling basin, was based on topographic conditions, on-site investigations, and stream geometry. The U. S. Geological Survey (USGS) publication "Techniques of Water Resources Investigations of United States Geological Survey," Chapter A14, Use of Flumes in Measuring Discharge, (Kilpatrick and Schneider 1983, 109514), was used to develop a flume design to accommodate measuring equipment and instrumentation. The final design, the result of the collaboration of design, construction, and environmental professionals, was subjected to a thorough review by Laboratory and U.S. Department of Energy (DOE) personnel. Design details and as-built information are contained in Appendix A.

2.2 Site Selection/Exploration

2.2.1 Grade-Control Structure

The grade-control structure location was chosen to meet the overall project objectives and also provide an efficient and value-engineered structure. During the initial design process, adjustments were made to the structure to reduce the overall length by taking advantage of existing topography.

The general area in which the structure was to be constructed was determined primarily by U.S. Army Corps of Engineers (USACE), DOE, and Laboratory input to meet the principal objectives for the project. During the design process, more detailed topographic information was obtained and a geotechnical exploration was performed. The geotechnical exploration and subsequent report provided information on subsurface soil and bedrock conditions; groundwater conditions; structure support; lateral earth pressures; and earthwork recommendations (see Appendix B for the geotechnical engineering report).

The final site selection was based on a variety of additional factors including hydrologic/hydraulic effectiveness, existing topography, vegetation, on-site investigations, and value engineering. Two factors were considered as the primary focus:

- **Hydraulic Effectiveness**. During the modeling and design process, the positions of the structure longitudinally along the canyon and laterally within the canyon were evaluated. Factors such as turbulence of flow, erosion mitigation, sediment containment, and structural stability were considered. Upstream and downstream channel conditions played a significant role in the design based on the model analysis of the effectiveness of the proposed upstream channel aggradation.
- **Existing Topography**. Significant material excavation and fill were necessary to construct the grade-control structure. Personnel and equipment access during construction and operation were also considered. Once a preliminary structure design was complete, the gabion configuration was fitted into the existing topography of several of the preliminary locations that were identified by field surveys. Each potential site was then evaluated based on the amount of material to be excavated and filled, ease of access, and position in reference to significant contour changes in the canyon.

Once the final location was determined, an additional field visit was performed to ensure no other existing conditions were overlooked.

2.2.2 Stream Gage

Greater accuracy in flow measurements and sediment data were factors that contributed to the choice of a supercritical-flow flume design for the stream gage. The new stream gage measures flow up to 350 cfs. The flume has specific dimensions, is trapezoidal in shape, and requires a 5% channel slope and a straight approach and exit for proper operation. The distance from the structure was also an important consideration. Location of the gage station was driven by

- channel geometry and topographic conditions, so that the approach to and exit from the flume would be fairly straight and that minimal channel disturbance would be required to construct the flume, and
- a distance from the structure that would allow water exiting the structure to calm before entering the flume but would not be too far to prevent accurate sediment disposition measurements.

Appendix A provides as-built drawings of the grade-control structure and stream gage.

2.3 Hydrologic/Hydraulic Modeling

2.3.1 General

The Pueblo Canyon watershed is within the semiarid higher-elevation mountains of New Mexico and contains an ephemeral stream system. The watershed includes areas of variable vegetation density, rock outcrops, and urbanization. Flood-flow frequency estimates for the structure locations were based on statistical analysis based on historical stream-gage information within the project area and the regional USGS regression formulas (USGS 2000, 109515) and the USACE statistical computer program Hydraulic Engineering Center Flood Frequency Analysis (HEC-FFA) (USACE 1992, 109512).

A hydrologic analysis was performed to provide design parameters for the proposed grade-control structure. The initial analysis, performed in August 2009, was based on stream-gage data, topographic information, a site visit, and the geomorphic and climatologic conditions of the project area. This initial analysis was used to develop the conceptual and preliminary construction plans. Additional light detection and ranging (LIDAR) survey data was obtained during the final phases of design. This provided a more detailed and accurate surface model than was previously available. The new LIDAR data and final design dimensions, which included changes to weir elevations and approach conditions, were used to run a second analysis with the HEC River Analysis System (HEC-RAS) model (USACE 2008, 109518) in December 2009. The results of the new model verified that the final design and as-built structure met the original project objectives. Results of the HEC-RAS analysis are included in Appendix C.

2.3.2 Flood Frequency Analysis Results

Table 2.3-1 presents the FFA results for the Pueblo Canyon project site. The fourth column in the table is based upon the USACE statistical computer program HEC-FFA.

The Pueblo Canyon basin is largely undeveloped, which favors the USGS regression (USGS 2000, 109515). Of the two USGS regression equation sets, Small and Rural, the USGS Small regression equations are most appropriate, considering the basin size. The Pueblo Canyon FFA is based on statistical analysis of a very short record base. Since the stream gage is located very near the proposed

project location, no adjustments to the results were deemed necessary. Although the FFA results are more conservative, the USGS Small regression results were adopted. To accommodate the uncertainty at the high flows, a safety factor was incorporated by raising the side walls of the structure above the design elevation required to contain the 100-yr flood.

Waltemeyer (2008, 109516) updated the regression equations and with these equations, the 100-yr peak discharge is 2925 cfs, whereas the USGS Small value is 2740 cfs for Pueblo Canyon. Although 2,740 cfs isused for the 100-yr design flow, 2925 cfs was checked in the HEC-RAS models. This discharge resulted in a water surface elevation for the proposed condition that slightly encroached on the freeboard but did not overtop the structure.

2.3.3 Development of the HEC-RAS Hydraulic Models

To determine the hydraulic effects of the proposed structures, HEC-RAS models were developed. The HEC-RAS Version 4.0 models were initially constructed using shape (.shp) files provided by the Laboratory. The 2-dimensional (2-D) data were then converted to 3-D data and geographic information system techniques were used for cross-section development. Existing conditions models were constructed and calibrated to the best extent, and water surface elevations for the 2-, 5-, 10-, 50-, and 100-yr peak-flood discharges were simulated and plotted. All subsequent models used these peak-flood discharges. This initial model was used to develop a base design and plan for the structure. Additional survey data were collected for the site. Based on the new data, new cross sections were prepared and the final, revised, and refined current model was developed.

A proposed conditions model (with grade control), without accumulated sedimentation behind the structure, was constructed, simulated, and plotted. The HEC-RAS in-line weir option was used to model the grade-control structure. Proposed conditions models, with sedimentation, were created to simulate the change in the streambed elevations due to anticipated long-term deposition of sediment upstream of the grade-control structures (described in section 2.4). These three conditions–existing, grade-control structure without sediment deposits, and grade-control structure with sediment deposits–were compared and analyzed. Cross-section layouts, profiles, cross sections, and tabular results for each model condition are included in Appendix C.

2.3.4 Grade-Control Structure Stilling-Basin Design

The stilling-basin length and end-sill height were determined using the USACE Hydraulic Design Chart (HDC) Number 623 (USACE 1959, 109511) based upon the 100-yr flood. HDC 623 develops empirical relationships between the design-critical depth of the approach flow to the height between the weir crest and the top of the end sill in order to size the length of the stilling basin as well as the height of the end sill.

For the empirical relationship of HDC 623 to be successful, the tailwater depth beyond the end sill is recommended to be between 1.25 to 1.67 times that of the approach flow-critical depth. For Pueblo Canyon, the design discharge tailwater would need to be approximately 2½ to 3 ft above the top of the end sill. The HEC-RAS results showed the tailwater conditions were met.

2.3.5 Grade-Control Structure Low-flow Weir Design

A low-flow rectangular weir was sized to induce the design volumes and location of deposition in the upstream area. The width and depth of the weir were estimated using regime equations (Copeland 1994, 109508) and assuming that the 5-yr discharge is a “channel forming” discharge, a common practice for arid to semiarid regions. The regime width and depth dimensions for the 5-yr flood were used as initial

guides and adjusted to meet multiple objectives such as accommodating standard gabion sizes and physical site restrictions and minimizing the structure footprint. The weir was laterally placed where the natural thalweg of the stream is located. The height of the weir above the natural ground was determined by examining the design deposition slope (described in section 2.4) and adjusting it vertically to maximize deposition on the overbank sediments, safely pass the 100-yr flood above the weir, and still be a stable structure. The initial height of the low-flow weir was 4 ft above the existing ground. To account for the sediment placed on the upstream side of the structure, and at the request of NMED, the height of the low-flow weir was raised by 2 ft, making the height above the existing ground elevation 6 ft, or 2 ft above the fill elevation behind the structure. The height of the low-flow weir can be varied as described in section 2.5.

2.4 Sediment Deposition Profile Analysis

The profile of the anticipated sedimentation behind the grade-control structure was based upon equilibrium slope analyses (Pemberton and Lara 1984, 109509) and engineering judgment to select an appropriate slope. The equilibrium slope is the theoretical slope that the stream would eventually reach. This slope is projected upstream, starting at the low-flow weir notch elevation, to determine the depths that would cover the contaminated sediments in the floodplain and the potential wetland extents. This deposition profile was used to adjust the cross-section geometry in the HEC-RAS models to determine the water surface elevations for the varied-frequency floods. The deposition profile predicts the water surface profiles for ultimate conditions.

2.5 Adaptive Management Features

2.5.1 Adjustable Weir Crest Height

Predictions of the sediment deposition in the upstream overbank areas can vary because of variations in the stream flow, changes in the sediment characteristics, varying equilibrium slopes, and other factors. To enhance operational flexibility, an additional vertical column of gabions was added to the structure, increasing the thickness of the upper weir foundation. The thicker foundation makes it possible to increase the low-flow weir crest by progressively adding gabions or gabion mattresses up to the crest of the 100-yr overflow. This gives opportunities to accelerate the deposition and to increase or decrease the sediment deposition elevations in the areas upstream of the structure. The initial design crest of the low-flow weir is 1 ft above the existing ground but can go as high as 7 ft. Any additional gabions also increase the structural integrity of the structure.

2.5.2 Adjustable Riser Pipe

When a flow event occurs, the structure causes an impoundment of the water and allows settling of the sediment. After the event has receded and the majority of the suspended sediment has settled, the standing water must be released downstream. A perforated and slotted riser pipe, placed approximately 32 ft upstream of the structure, assists in these functions. The upstream face consists of removable wood boards placed in slots, while the remainder of the riser pipe is perforated CMP. This pipe is connected to an outfall pipe that goes through the gabion structure out to the stilling basin. The height of the riser pipe is the same as the top of the overflow weir to allow for adjustments if the low-flow weir elevation is increased to the height of the overflow weir. Varying the elevation of the top board enables maximum retention of water behind the structure, inducing sediment settlement, or allows for accelerated dewatering.

2.6 Engineering

2.6.1 Grade-Control Structure

Since the gabion grade-control structure is unsupported and acts as a retaining structure, the gabion design required sufficient mass to prevent sliding and overturning. The design of the structure required raising the water surface elevations for the more frequent flood events (5-yr) such that significant sediment deposition will now occur immediately upstream of the structure, minimizing potential backwater effects of the rare flood events (50- to 100-yr) and ensuring the 100-yr flood does not overtop the structure.

The 5-yr flow was used to design a low-flow weir. The 100-yr flow was used to determine the dimensions of the rest of the structure (the overflow weir and confinement walls) and to calculate the energy dissipation (stilling) basin dimensions and end-sill heights. A 50-yr design was considered, but since the increase in design heights to contain the 100-yr event was small (0.5 feet or less), the design was based upon the 100-yr peak-flood event. This resulted in a minimal increase in cost as well as provided additional structural safety. Structural integrity of the grade-control structures, with and without saturated sediment against the upstream face, was evaluated by a licensed structural engineer.

The structure design included additional gabions upstream of the low-flow weir. The purpose of these gabions is to raise the flow of water approaching the weir for better efficiency; to prevent damage of the main gabion structure and weirs from flow that may contain large rocks, trees, and other debris; and to provide additional structural mass to prevent sliding and overturning. The lower and upper weirs direct flow into buttress gabions downstream. These gabions dissipate flow energy and also provide additional structural mass to prevent sliding and overturning.

The structure design is composed of gabions consisting of 6- to 9-in.-diameter rock enclosed in wire baskets. Whenever possible, standard 3-ft x 3-ft x 6-ft gabions were used. Structure dimensions and embedment elevations were conservatively adjusted to eliminate the need for nonstandard-size gabions. See Appendix A for as-built drawings.

2.6.2 Stream Gage

The supercritical-flow flume is a concrete structure approximately 19 ft wide at the entrance, 15 ft wide at the exit, 15 ft in length, and 4 ft in depth. The width of the channel downstream of the structure posed a few challenges regarding the location of the flume. Several factors were considered in determining the flume location, including minimal disturbance to the downstream channel, overall design and construction costs, providing a straight channel for entrance and exit, and minimal influence on the accuracy of instrument readings. The flume was placed 320 ft downstream of the structure.

Class A rip-rap armoring was added upstream, downstream, and along the edges of the flume to prevent water from undermining the flume, to minimize potential accumulation of additional sediment between the gabion structure and flume, and to protect the stream channel from potential erosion. To maintain flow through the flume and provide accurate measurements, the Class A rip rap on the downstream is a minimum of 4 in. below the bottom of the flume. This elevation difference allows unimpeded flow from the flume.

Class B rip rap, made up of larger rocks, was placed upstream of the Class A rip rap at the flume entrance to stabilize two nickpoints located between the structure and the flume and to provide protection to the channel bank. Since Class B rip rap requires a minimum 18 in. recess into the channel, the Class B rip rap also provides erosion protection for the channel.

Three polyvinyl chloride (PVC) pipes are embedded into the south wall of the flume at varying heights. The PVC pipes daylight into a CMP stilling well. As the water levels in the flume reach the pipe openings, the water is conveyed to the stilling well. Equipment used in measuring water flow and in sample collection is housed in and on top of the CMP. The height of the CMP was designed to keep the equipment above the water surface in the event of a 100-yr flow event. As-built drawings are provided in Appendix A. Equipment for collecting sampling and flow data was also installed at the stream gage E060.1.

2.7 Permitting

The Laboratory's Construction and Engineering group performed an internal review of the design model and the construction documents. To comply with Section 404/401 of the Clean Water Act, applications for Nationwide Permits 43 and 5 were filed with the NMED Surface Water Quality Bureau and the Albuquerque District of the USACE. Section 404 regulates discharges of dredged or filled material in waters of the United States. NMED certified the proposed discharges would not adversely affect water quality standards under Section 401. Local municipal permitting was not required for the proposed improvements.

A joint Notice of Intent (NOI) was submitted to the EPA by DOE and AS Horner (construction subcontractor) for review of the proposed construction activities. Per the NOI, a stormwater pollution prevention plan (SWPPP) was prepared and followed to ensure the use of best management practices and ensure maximum protection of the environment during and after construction. Erosion and sediment control measures were in accordance with NMED Watershed Protection and EPA Guidelines (EPA 2007, 109510) for stormwater pollution prevention. The protocols of the SWPPP conform to Laboratory requirements. This plan was prepared under the direction of a certified professional in erosion and sediment control. Designers coordinated with DOE and Laboratory environmental specialists to provide a SWPPP that was sensitive to the environment and provided maximum protection against the offsite transport of pollutants with particular attention to the protection of adjacent wetlands. The SWPPP will be maintained until final stabilization criteria are met per the NOI. At that time, a notice of termination will be submitted to close out the permitted construction activity.

2.8 Design Improvements/Deviations

The design process was relatively fluid and adaptive to the existing site conditions and Laboratory requirements. The following were the key design changes in the project:

- A riser pipe was designed and installed upstream of the structure to facilitate the sedimentation upstream of the structure while providing a means for discharging retained water though the structure. The riser pipe is adjustable so that it remains functional as sedimentation accumulates behind the structure.
- The riser pipe elevation was increased from the height of the low-flow weir crest to that of the overflow weir crest to allow for greater flexibility should the height of the structure increase.
- The structure was shifted to accommodate the existing topographic conditions and avoid Native American Reservation Lands adjacent to the project site.
- A stabilized construction-access unimproved road was constructed to reduce construction time and minimize site disturbance. This temporary road was restored to a natural state at the end of construction activities through hydro-seeding with a Laboratory-approved seed mix.

- A 3-in. concrete cap was added to the low-flow and overflow weirs to protect the gabions and reduce long-term maintenance.
- Class B rip rap was added downstream of the structure to ensure that flows exiting the stilling basin would not undermine the downstream side of the stilling-basin gabions.
- Additional Class A rip-rap stabilization was added to the southern slope upstream and downstream of the structure to provide additional erosion protection.
- Additional fill material was deposited upstream of the structure to hasten the creation of the wetland.

Constructability reviews by the construction subcontractor where completed before the initiation of construction. Therefore, no significant modifications occurred during the construction process. As-builts of the improvements detail the minor deviations (Appendix A).

3.0 CONSTRUCTION

3.1 General

Under contract with the USACE, Omaha District, Security, Disaster, Infrastructure Construction (SDIC) multiple-award task-order contract, KBR performed general contractor services, delivering the project using the design-build method. Construction of the Pueblo Canyon grade-control structure and stream gage E060.1 began on October 26, 2009. The grade-control structure was completed on January 26, 2010. Construction of the supercritical-flow flume and installation of the Class A rip rap upstream and downstream of the flume were completed on March 11, 2010. Because of freeze/thaw conditions, installation of Class B rip rap upstream of the flume was postponed until May 3, 2010, and was completed May 18, 2010. The entire site was seeded May 19, 2010. Appendix D presents photo documentation of construction activities.

3.2 Safety and Health

With the guidance and approval of the Omaha District of the USACE, and the Laboratory, the design-build contractor implemented a specific project safety plan to ensure the project met safety and health goals. All work and reports were accomplished in accordance with the USACE Safety and Health Requirements Manual EM 385-1-1 and Laboratory requirements. An activity hazard analysis was conducted for each definable feature of work. Consideration was given to work tasks and steps; hazards, concerns, and potential accidents; controls, preventive measures, and bounding conditions; reference documents; and training and qualification requirements. As a result, there were no loss-time accidents or incidents during the entire project.

3.3 Quality Control

With the guidance and approval of the Omaha District of the USACE, the design-build contractor implemented a contractor quality control (CQC) plan to ensure the project met quality construction goals. The plan was compliant with ISO 9001:2000 international quality standards and met the quality control requirements of the contract. The project quality manager used the quality management system and CQC plan to ensure adherence to USACE, SDIC requirements and standards.

The design-build contractor implemented the CQC as follows:

- Assigned ultimate responsibility for quality to the project manager (PM), who delegated responsibility to each level within the program organization, down to the individual craftsperson and worker. Each level was responsible for application and enforcement of policy within its respective area of authority.
- Provided a quality control supervisor who assisted the PM by administering the program and providing an independent analysis of the quality control program's results.
- Explained to each employee and subcontractor, through an orientation, the program, the individual's role in it, and his or her expected contribution. A primary goal of the quality improvement program was to promote a sense of pride in workmanship. Top management led this program and took a strong, active part in its implementation.
- Delegated to the quality control supervisor the necessary authority, such as stop-work authority, to make quality a viable program. This delegated authority for the quality function ensured that deficiencies were corrected.

4.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Copeland, R.R., September 1994. "Application of Channel Stability Methods – Case Studies," Technical Report HL-94-11, report prepared for the U.S. Army Corps of Engineers, Washington, D.C. (Copeland 1994, 109508)

EPA (U.S. Environmental Protection Agency), September 17, 2007. "Appendix A: SWPPP Template – Unauthorized States," Version 1.1, Washington, D.C. (EPA 2007, 109510)

Kilpatrick, F.A., and V.R. Schneider, 1983. "Techniques of Water-Resources Investigations of the United States Geological Survey, Chapter A14, Use of Flumes in Measuring Discharge," Book 3, Applications of Hydraulics, U.S. Geological Survey, Washington, D.C. (Kilpatrick and Schneider 1983, 109514)

LANL (Los Alamos National Laboratory), April 2004. "Los Alamos and Pueblo Canyons Investigation Report," Los Alamos National Laboratory document LA-UR-04-2714, Los Alamos, New Mexico. (LANL 2004, 087390)

LANL (Los Alamos National Laboratory), December 2005. "Los Alamos and Pueblo Canyons Supplemental Investigation Report," Los Alamos National Laboratory document LA-UR-05-9230, Los Alamos, New Mexico. (LANL 2005, 091818)

LANL (Los Alamos National Laboratory), February 2008. "Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," Los Alamos National Laboratory document LA-UR-08-1071, Los Alamos, New Mexico. (LANL 2008, 101714)

LANL (Los Alamos National Laboratory), October 2008. "Supplemental Interim Measures Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," Los Alamos National Laboratory document LA-UR-08-6588, Los Alamos, New Mexico. (LANL 2008, 105716)

NMED (New Mexico Environment Department), March 14, 2005. "Notice of Disapproval, Los Alamos and Pueblo Canyons Investigation Report," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and G.P. Nanos (LANL Director) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2005, 088463)

NMED (New Mexico Environment Department), August 30, 2007. "Approval with Direction, Los Alamos and Pueblo Canyons Supplemental Investigation Report," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2007, 098284)

NMED (New Mexico Environment Department), July 18, 2008. "Approval with Modifications, Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2008, 103007)

NMED (New Mexico Environment Department), February 20, 2009. "Approval with Modifications, Supplemental Interim Measure Work Plan (SIWP) to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 105014)

Pemberton, E.L., and J.M. Lara, January 1984. "Computing Degradation and Local Scour," Technical Guideline for Bureau of Reclamation, U.S. Department of the Interior, Denver, Colorado. (Pemberton and Lara 1984, 109509)

USACE (U.S. Army Corps of Engineers), May 1959. "Hydraulic Design Criteria, Artificial Channels – 600," excerpted from the *Corps of Engineers Hydraulic Design Criteria*, Washington, D.C. (USACE 1959, 109511)

USACE (U.S. Army Corps of Engineers), May 1992. "HEC-FFA Flood Frequency Analysis, User's Manual," Computer Program Documentation No. CPD-13, Washington, D.C. (USACE 1992, 109512)

USACE (U.S. Army Corps of Engineers), March 2008. "HEC-RAS River Analysis System, User's Manual," Version 4.0, Computer Program Documentation No. CPD-68, Washington, D.C. (USACE 2008, 109518)

USGS (U.S. Geological Survey), October 2000. "The National Flood-Frequency Program—Methods for Estimating Flood Magnitude and Frequency in Rural Areas in New Mexico, 2000," USGS Fact Sheet 055-00. (USGS 2000, 109515)

Waltemeyer, S.D., 2008. “Analysis of the Magnitude and Frequency of Peak Discharge and Maximum Observed Peak Discharge in New Mexico and Surrounding Areas,” report prepared for the U.S. Department of the Interior and the U.S. Geological Survey in cooperation with the New Mexico Department of Transportation, Scientific Investigations Report 2008-5119, Washington, D.C. (Waltemeyer 2008, 109516)

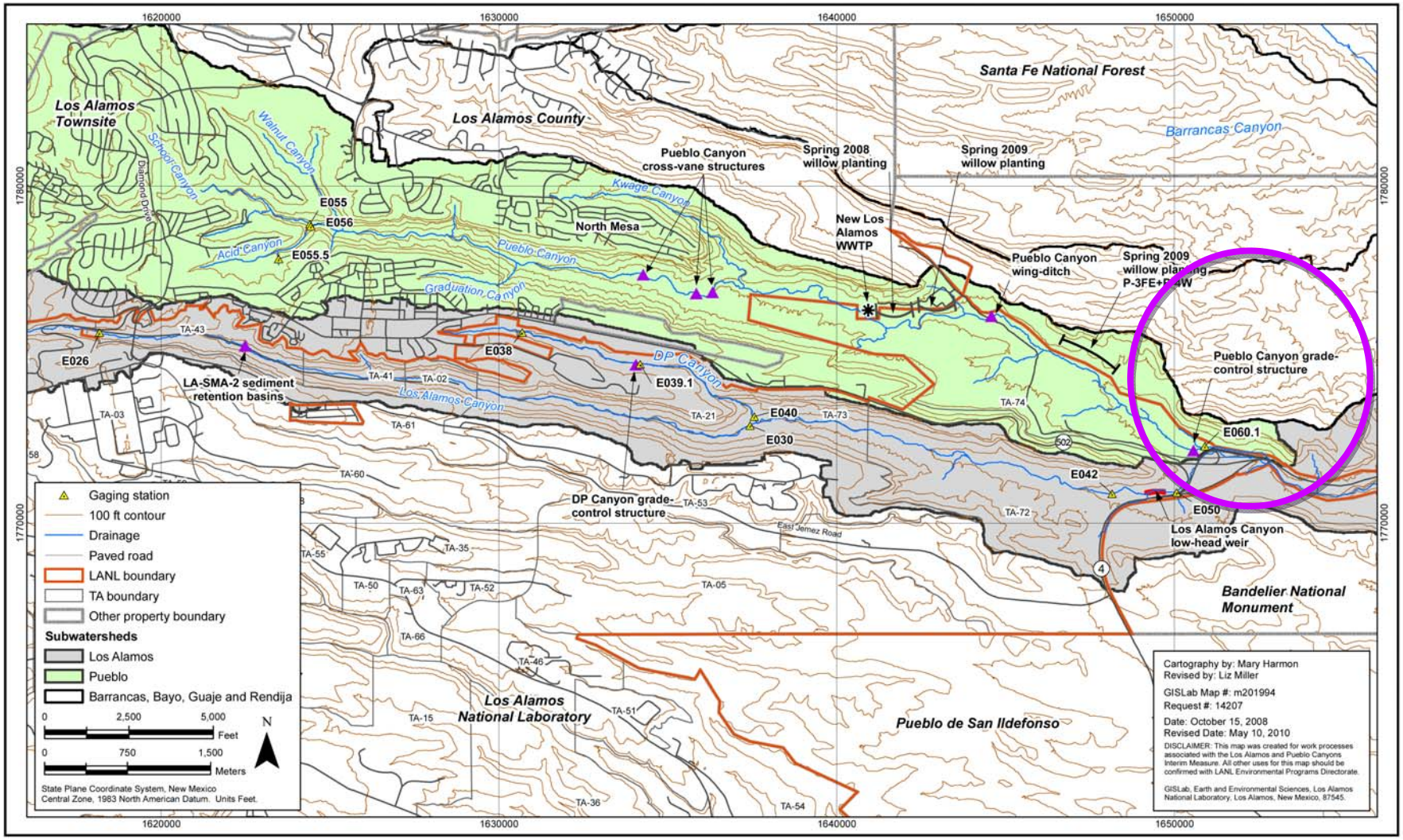


Figure 1.0-1 Sediment transport mitigation sites in Los Alamos and Pueblo Canyons, highlighting the site locations for the Pueblo Canyon grade-control structure and stream gage E060.1

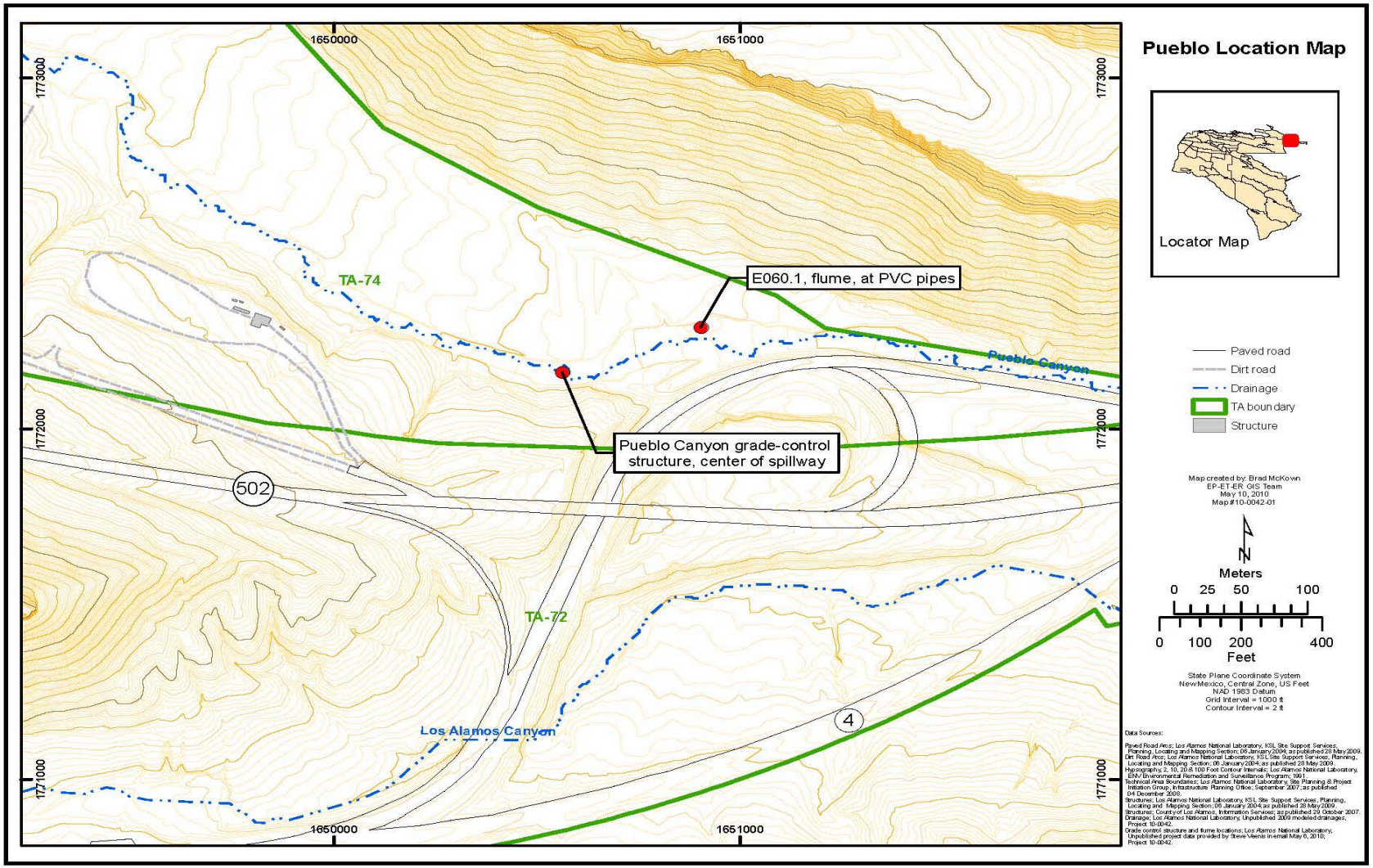


Figure 1.0-2 Pueblo Canyon grade-control structure and stream gage E060.1 site locations

Figure 2.1-1 Pueblo grade-control structure (looking north) showing entire length of weir and 1-ft difference between overflow and low-flow weir crests

Figure 2.1-2 Placement of concrete cap

Figure 2.1-3 Pueblo grade-control structure (looking south). Concrete cap on weir

Figure 2.1-4 Construction of Class A rip-rap armored earthen berm (looking north)

Figure 2.1-5 Class A armored earthen berm upon completion (looking north)

Figure 2.1-6 Riser pipe after extension

Figure 2.1-7 E060.1 stream-gage flume during construction

Table 2.3-1
Pueblo Canyon Flood Frequencies

Percent Chance Exceedance	USGS Small (cfs)[a]	USGS Rural (cfs)[b]	FFA[c] (cfs)
0.2 (500 yr)	4690	6340	5200
1 (100 yr)	2740	3380	3570
2 (50 yr)	2060	2440	2970
10 (10 yr)	932	1,000	1770
20 (5 yr)	593	591	1320
50 (2 yr)	245	225	768

Note: Equations used for determining basin discharges were based on the following references:

[a] Waltemeyer, S.D., 2008. "Analysis of the Magnitude and Frequency of Peak Discharge and Maximum Observed Peak Discharge in New Mexico and Surrounding Areas," report prepared for the U.S. Department of the Interior and the U.S. Geological Survey in cooperation with the New Mexico Department of Transportation, Scientific Investigations Report 2008-5119, Washington, D.C. (Waltemeyer 2008, 109516).

[b] USGS (U.S. Geological Survey), October 2000. "The National Flood-Frequency Program—Methods for Estimating Flood Magnitude and Frequency in Rural Areas in New Mexico, 2000," USGS Fact Sheet 055-00. (USGS 2000, 109515).

[c] USACE (U.S. Army Corps of Engineers), May 1992. "HEC-FFA Flood Frequency Analysis, User's Manual," Computer Program Documentation No. CPD-13, Washington, D.C. (USACE 1992, 109512).

Appendix A

As-Built Drawings

CONSTRUCTION PLANS FOR:

LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURE

FOR PUEBLO CANYON
LOS ALAMOS, NEW MEXICO

INDEX OF DRAWINGS

C-000 COVER SHEET
C-001 GENERAL NOTES

PUEBLO CANYON
C-101 EXISTING CONDITIONS
C-102 OVERALL SITE PLAN WITH AERIAL
C-103 ENLARGED SITE PLAN
C-104 EROSION CONTROL PLAN

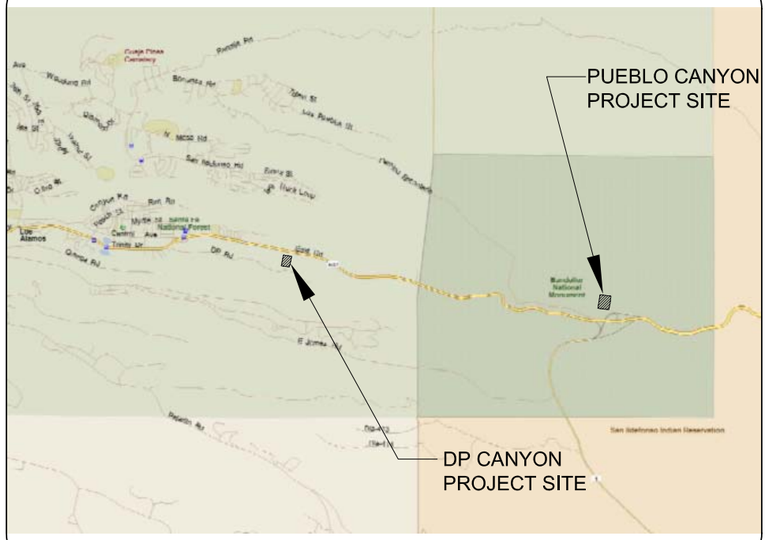
C-200 CROSS SECTIONS
C-201 CROSS SECTIONS
C-202 CROSS SECTIONS

~~DP CANYON~~ (NOT INCLUDED)
~~C-301 EXISTING CONDITIONS~~
~~C-302 OVERALL SITE PLAN WITH AERIAL~~
~~C-303 ENLARGED SITE PLAN~~
~~C-304 EROSION CONTROL PLAN~~

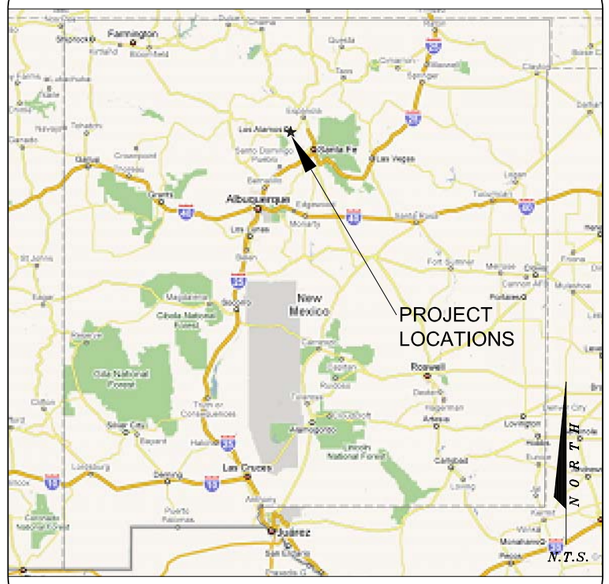
~~C-400 CROSS SECTIONS~~

C-500 GENERAL DETAILS
C-501 GENERAL DETAILS
C-502 S.W.P.P.P. DETAILS
C-503 S.W.P.P.P. DETAILS
C-504 S.W.P.P.P. DETAILS

LOCATION MAP



VICINITY MAP



DRAWINGS REVISED TO INCORPORATE CONTRACTOR AS-BUILT INFORMATION. REVISIONS ARE INDICATED AS REVISION 1 WHERE APPLICABLE. 1

PREPARED FOR:
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05/05/2010	C-000,C-200,C-501	JVC

REVISIONS

LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURE

JOB NO.100005632

DATE: 10/13/2009 SHT. 1 OF 14

User Name: 22190
Drawing Name: \\SARFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-000 - COVER.dwg May 24, 2010 - 10:26am

GENERAL CONSTRUCTION NOTES

1. ALL ELEVATIONS REFER TO THE NORTH AMERICAN DATUM (1983).

2. LOCATIONS, ELEVATIONS, AND DIMENSIONS OF EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES ARE SHOWN ACCORDING TO THE BEST INFORMATION AVAILABLE AT THE TIME OF PREPARATION OF THESE PLANS. THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS, AND DIMENSIONS OF ALL EXISTING UTILITIES, STRUCTURES AND OTHER FEATURES AFFECTING THIS WORK PRIOR TO CONSTRUCTION.

3. THE CONTRACTOR SHALL CHECK PLANS FOR CONFLICTS AND DISCREPANCIES PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL NOTIFY THE OWNER'S ENGINEER OF ANY CONFLICT BEFORE PERFORMING ANY WORK IN THE AFFECTED AREA.

4. THE CONTRACTOR SHALL EXERCISE EXTREME CAUTION IN AREAS OF BURIED UTILITIES AND SHALL PROVIDE AT LEAST 48 HOURS NOTICE TO THE VARIOUS UTILITY COMPANIES IN ORDER TO PERMIT MARKING THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES IN ADVANCE OF CONSTRUCTION.

5. ANY WELLS DISCOVERED DURING EXCAVATION, EARTHMOVING OR CONSTRUCTION MUST BE REPORTED TO THE APPROPRIATE GOVERNMENTAL AGENCY OFFICE WITHIN 24 HOURS OF DISCOVERY.

6. IT IS THE CONTRACTOR'S RESPONSIBILITY TO BECOME FAMILIAR WITH THE PERMIT AND INSPECTION REQUIREMENTS OF THE VARIOUS GOVERNMENTAL AGENCIES. THE CONTRACTOR SHALL SCHEDULE INSPECTIONS ACCORDING TO AGENCY INSTRUCTION.

7. ALL SPECIFICATIONS AND DOCUMENTS REFERRED TO SHALL BE OF LATEST REVISIONS AND/OR LATEST EDITION.

8. ALL WORK PERFORMED SHALL COMPLY WITH THE REGULATIONS AND ORDINANCES OF THE GOVERNMENTAL AGENCIES HAVING JURISDICTION OVER THE WORK.

9. CONTRACTOR SHALL SUBMIT FOR APPROVAL TO THE OWNER'S ENGINEER SHOP DRAWINGS ON ALL PRECAST AND MANUFACTURED ITEMS PRIOR TO ORDERING MATERIALS. FAILURE TO OBTAIN APPROVAL BEFORE INSTALLATION MAY RESULT IN REMOVAL AND REPLACEMENT AT CONTRACTOR'S EXPENSE.

10. AT LEAST 3 WORKING DAYS PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL NOTIFY THE OWNER AND APPROPRIATE AGENCIES. NOTIFICATION SHALL INCLUDE THE CONTRACTOR'S NAME, STARTING DATE, PROJECTED SCHEDULE, AND OTHER INFORMATION AS REQUIRED. ANY WORK PERFORMED PRIOR TO NOTIFYING THE OWNER OR WITHOUT AGENCY INSPECTOR PRESENT MAY BE SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.

11. ALL DISTURBED AREAS WITHIN PUBLIC RIGHT-OF-WAY ARE TO BE RESTORED TO ORIGINAL CONDITION OR BETTER.

12. THE CONTRACTOR IS RESPONSIBLE FOR THE REPAIR AND/OR REPLACEMENT OF ALL PROPERTY, ABOVE AND BELOW GROUND, AFFECTED BY THIS WORK. ALL PROPERTY SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN EXISTING CONDITIONS BEFORE CONSTRUCTION COMMENCED UNLESS SPECIFICALLY EXEMPTED BY THE PLANS. ADDITIONAL COSTS ARE INCIDENTAL TO OTHER CONSTRUCTION.

13. ALL DISTURBED AREAS ASSOCIATED WITH CONSTRUCTION, WHICH ARE NOT TO BE SODDED, ARE TO BE SEEDED AND MULCHED TO THE NEW MEXICO DEPARTMENT OF TRANSPORTATION STANDARDS AND MAINTAINED UNTIL A SATISFACTORY STAND OF GRASS ACCEPTABLE TO THE OWNER HAS BEEN OBTAINED. ANY WASHOUTS, REGRADING, RESEEDING, GRASSING, AND OTHER EROSION WORK REQUIRED, WILL BE PERFORMED BY THE CONTRACTOR/SUBCONTRACTOR UNTIL THE SYSTEM IS ACCEPTED FOR MAINTENANCE BY THE OWNER.

15. AS-BUILT DRAWINGS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RECORDING INFORMATION ON A SET OF THE APPROVED PLANS CONCURRENTLY WITH CONSTRUCTION PROGRESS. WITHIN TWO (2) WEEKS FOLLOWING FINAL INSPECTION THE CONTRACTOR SHALL SUBMIT ONE (1) SET OF AS-BUILT DRAWINGS TO THE ENGINEER. THE FINAL RECORD DRAWINGS SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS:

A. DRAWINGS TO BE LEGIBLY MARKED TO RECORD ACTUAL CONSTRUCTION.
B. DRAWINGS SHALL SHOW ACTUAL LOCATION OF ALL UNDERGROUND WORK.
C. DRAWINGS SHALL CLEARLY SHOW ALL FIELD CHANGES OF DIMENSION AND DETAIL INCLUDING CHANGES MADE BY FIELD ORDER OR BY CHANGE ORDER.
D. DRAWINGS SHALL CLEARLY SHOW ALL DETAILS NOT ON ORIGINAL CONTRACT DRAWINGS BUT CONSTRUCTED IN THE FIELD. ALL EQUIPMENT AND PIPING RELOCATION SHALL BE CLEARLY SHOWN.
E. LOCATIONS OF ALL FEATURES SHALL BE SHOWN.
F. DRAWINGS TO BE SIGNED AND SEALED BY A LICENSED SURVEYOR.

16. ALL CONCRETE STRUCTURES SHALL BE MADE OF 3000 PSI CONCRETE PER DOT STANDARD SPECIFICATIONS UNLESS OTHERWISE NOTED ON THE PLANS.

SITE CLEARING PREPARATION NOTES

1. THE CONTRACTOR IS TO PREPARE THE SITE PRIOR TO BEGINNING INFRASTRUCTURE CONSTRUCTION IN ACCORDANCE WITH SOILS TESTING REPORT.

2. CONTRACTOR SHALL CLEAR AND GRUB ONLY THOSE PORTIONS OF THE SITE NECESSARY FOR CONSTRUCTION. DISTURBED AREAS WILL BE SEEDED, MULCHED, OR PLANTED WITH OTHER APPROVED LANDSCAPE MATERIAL IMMEDIATELY FOLLOWING CONSTRUCTION.

3. THE TOP 4" TO 6" OF GROUND REMOVED DURING CLEARING AND GRUBBING SHALL BE STOCKPILED AT A SITE DESIGNATED BY THE OWNER TO BE USED FOR LANDSCAPING PURPOSES, UNLESS OTHERWISE DIRECTED BY THE OWNER.

4. ALL CONSTRUCTION DEBRIS AND OTHER WASTE MATERIAL SHALL BE DISPOSED OF OFF-SITE IN ACCORDANCE WITH APPLICABLE REGULATIONS.

5. CONTRACTOR TO OBTAIN ALL NECESSARY PERMITS AND APPROVALS PRIOR TO BEGINNING WORK.

6. THE LOCATION OF ALL EXISTING UTILITIES SHOWN ON THE PLANS HAVE BEEN DETERMINED FROM THE BEST INFORMATION AVAILABLE AND ARE GIVEN FOR THE CONVENIENCE OF THE CONTRACTOR/SUBCONTRACTOR. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR ACCURACY PRIOR TO THE START OF ANY CONSTRUCTION ACTIVITY. IT SHALL BE THE CONTRACTOR'S/SUBCONTRACTOR'S RESPONSIBILITY TO NOTIFY THE VARIOUS UTILITIES AND TO MAKE THE NECESSARY ARRANGEMENTS FOR ANY RELOCATIONS OF THESE UTILITIES WITH THE OWNER OF THE UTILITY. THE CONTRACTOR/SUBCONTRACTOR SHALL EXERCISE CAUTION WHEN CROSSING ANY UNDERGROUND UTILITY, WHETHER SHOWN ON THE PLANS OR LOCATED BY THE UTILITY COMPANY. ALL UTILITIES WHICH INTERFACE WITH THE PROPOSED CONSTRUCTION SHALL BE RELOCATED BY THE RESPECTIVE UTILITY COMPANIES AND THE CONTRACTOR/SUBCONTRACTOR SHALL COOPERATE WITH THE UTILITY COMPANIES DURING RELOCATION OPERATIONS. ANY DELAY OR INCONVENIENCE CAUSED TO THE CONTRACTOR/SUBCONTRACTOR BY THE VARIOUS UTILITIES SHALL BE INCIDENTAL TO THE CONTRACT AND NO EXTRA COMPENSATION WILL BE ALLOWED.

7. ALTHOUGH NOT ANTICIPATED, THE LOCATION OF ANY EXISTING UNDERGROUND UTILITY LINES, WELLS OR OTHER BURIED PIPING OR STRUCTURES ASSOCIATED WITH PAST SITE USE WITHIN THE CONSTRUCTION AREA SHOULD BE ESTABLISHED PRIOR TO CONSTRUCTION. PROVISIONS SHOULD THEN BE MADE TO RELOCATE ANY INTERFERING UTILITY LINES WITHIN THE CONSTRUCTION AREA TO APPROPRIATE LOCATIONS. IN THIS REGARD, IT SHOULD BE NOTED THAT IF ABANDONED UNDERGROUND PIPES ARE NOT PROPERLY REMOVED OR PLUGGED, THEY MAY SERVE AS CONDUITS FOR SUBSURFACE EROSION, WHICH SUBSEQUENTLY MAY RESULT IN EXCESSIVE SETTLEMENTS.

8. SITE CLEARING, GRUBBING AND DEMOLITION SHALL INCLUDE THE REMOVAL OF TREES, GROUND BRUSH, ORGANIC SOILS, ROOT MATS, EXISTING STRUCTURES, PAVEMENT, UTILITIES OR OTHER DELETERIOUS MATERIALS ENCOUNTERED. CLEARING AND GRUBBING SHALL BE REVIEWED BY THE OWNER'S REPRESENTATIVE PRIOR TO BEGINNING CONSTRUCTION AT THE SITE. AS A MINIMUM, THE CLEARING OPERATIONS SHALL EXTEND AT LEAST 5 FEET BEYOND THE BUILDING PERIMETERS. ANY EXCAVATIONS OR CAVITIES FORMED BY THE REMOVAL OF ORGANIC MATERIAL, GROUND BRUSH OR STUMPS SHOULD BE FILLED WITH CLEAN, COMPACTED STRUCTURAL FILL.

GRADING AND EROSION CONTROL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING EXCAVATIONS AGAINST COLLAPSE AND WILL PROVIDE BRACING SHEETING OR SHORING AS NECESSARY. TRENCHES SHALL BE KEPT DRY WHILE PIPE AND APPURTENANCES ARE BEING PLACED. DEWATERING SHALL BE USED AS REQUIRED.

2. CONTRACTOR IS TO PROVIDE EROSION CONTROL BARRIERS (HAY BALES OR SILTATION CURTAIN) TO PREVENT SILTATION OF ADJACENT PROPERTY, STREETS, STORM SEWERS, WATERWAYS, AND EXISTING WETLANDS PER THE CONSTRUCTION DRAWINGS. IN ADDITION, CONTRACTOR SHALL CONSTRUCT A TEMPORARY CONSTRUCTION EXIT (SEE DETAILS) IN AREAS WHERE CONSTRUCTION RELATED TRAFFIC IS TO ENTER AND EXIT THE SITE. IF, IN THE OPINION OF THE OWNER'S REPRESENTATIVE OR GOVERNMENTAL AGENCY THAT EXCESSIVE QUANTITIES OF EARTH ARE TRANSPORTED OFF-SITE EITHER BY NATURAL DRAINAGE OR BY VEHICULAR TRAFFIC, THE CONTRACTOR IS TO REMOVE SAID EARTH TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE AND/OR GOVERNING OFFICIALS. SEE SWPPP NARRATIVE FOR ADDITIONAL INFORMATION.

3. IF WIND EROSION BECOMES SIGNIFICANT DURING CONSTRUCTION, THE CONTRACTOR SHALL STABILIZE THE AFFECTED AREA USING SPRINKLING, IRRIGATION, OR OTHER ACCEPTABLE METHODS.

4. THERE IS TO BE NO DISCHARGE (I.E. PUMPING, SHEET FLOW, SWALE, DITCH, ETC.) INTO EXISTING DITCHES OR CANALS WITHOUT THE USE OF SETTLING PONDS. IF THE CONTRACTOR DESIRES TO DISCHARGE INTO THE EXISTING DITCHES OR CANALS A SETTLING POND PLAN PREPARED BY THE CONTRACTOR MUST BE SUBMITTED TO AND APPROVED BY THE OWNER'S REPRESENTATIVE AND APPROPRIATE GOVERNMENTAL AGENCY PRIOR TO CONSTRUCTION.

GRADING AND EROSION CONTROL NOTES (CONT'D)

5. ANY VEGETATION FROM CLEARING/GRUBBING SHALL BE DISPOSED OF OFF-SITE.

6. SITE CONDITIONS
   A. DP CANYON. SURFACE SOILS CONSIST OF SILTY SANDS (SM) TO A DEPTH OF ABOUT 3 TO 4 FEET, VOLCANIC TUFF BEDROCK WAS ENCOUNTERED BELOW THE SILTY SAND AND EXTENDED DOWN TO THE DEPTH OF BORING TERMINATION (APPROXIMATE 15 FEET). TUFF BEDROCK VARIED FROM NON-WELDED TO STRONGLY WELDED.

   B. PUEBLO CANYON. SURFACE AND SUBSURFACE SOILS CONSIST OF WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM), POORLY GRADED SAND WITH GRAVEL (SP), SILTY SAND (SM), AND SANDY SILT (ML) TO THE FULL DEPTH OF EXPLORATION (SEE SOILS REPORT)

7. IT IS ANTICIPATED THAT SHALLOW EXCAVATIONS IN SOME AREAS FOR THE PROPOSED CONSTRUCTION CAN BE ACCOMPLISHED WITH CONVENTIONAL EARTHMOVING EQUIPMENT. HOWEVER, VERY HARD BEDROCK MATERIALS, AND AUGER REFUSAL MATERIALS WERE ENCOUNTERED AT DEPTHS RANGING BETWEEN 2 AND 3 FEET BELOW EXISTING GROUND SURFACE. BASED UPON THE BORING AND TEST PIT DATA, THIS CONDITION APPEARS TO BE ASSOCIATED WITH THE DP CANYON SITE. DIFFICULT EXCAVATION TECHNIQUES MAY BE REQUIRED IN THIS AREA DEPENDING ON THE FINAL EXCAVATION DEPTHS. CONTRACTOR SHOULD REVIEW THE DATA AND INFORMATION CONTAINED IN THE GEOTECHNICAL REPORT TO DETERMINE THE APPROPRIATE EQUIPMENT REQUIRED TO ADVANCE THE EXCAVATIONS TO CONSTRUCTION DEPTHS.

8. SUBGRADE PREPARATION: EXPOSED AREAS WHICH WILL RECEIVE FILL OF THE INITIAL COURSE OF THE GABION STRUCTURE, ONCE PROPERLY CLEARED, SHOULD BE SCARIFIED TO A MINIMUM DEPTH OF 10 INCHES, CONDITIONED TO NEAR OPTIMUM MOISTURE CONTENT, AND COMPACTED.

9. FILL MATERIALS AND PLACEMENT: GENERALLY, CLEAN ON-SITE SOILS OR APPROVED IMPORTED MATERIALS MAY BE USED AS FILL MATERIAL (IF APPLICABLE) FOR THE SITE. THE FILL MATERIALS SHOULD CONFORM TO THE FOLLOWING:

GRADATION	PERCENT FINER BY WEIGHT ASTM C136)
6"	100
3"	70-100
NO. 4 SIEVE	50-100
NO. 200 SIEVE	35(MAX)
● LIQUID LIMIT	30 (MAX)
● PLASTICITY INDEX	12 (MAX)

FILL LIFTS SHOULD NOT EXCEED 10 INCHES LOOSE THICKNESS. IMPORTED SOILS SHOULD BE COMPACTED WITHIN A MOISTURE RANGE OF OPTIMUM 3 PERCENT ABOVE OPTIMUM IF THE MATERIALS HAVE A PI OF 5 OR MORE. ON-SITE SOILS AND IMPORT SOILS THAT HAVE A PI OF LESS THAN 5 SHOULD BE COMPACTED WITHIN A MOISTURE RANGE OF ±3 PERCENT OF OPTIMUM MOISTURE CONTENT.

10. DISTURBED AREAS, NOT DESIGNATED TO RECEIVE OTHER PERMANENT COVER, SHALL BE SEEDED IN ACCORDANCE WITH SECTION 632.2 OF THE NEW MEXICO DEPARTMENT OF TRANSPORTATION (NMDOT) STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES.

11. PROVIDE TEMPORARY TRAFFIC CONTROL DEVICES, AT PUEBLO CANYON, IN ACCORDANCE WITH NMDOT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES SECTION 702.

12. CONTRACTOR SHALL SUBMIT NPDES NOTICE OF INTENT (N.O.I.) A MINIMUM OF 7 DAYS PRIOR TO BEGINNING WORK.

13. CONTRACTOR SHALL SUBMIT NPDES NOTICE OF TERMINATION (N.O.T.) WITHIN 30 DAYS OF CONSTRUCTION COMPLETION.

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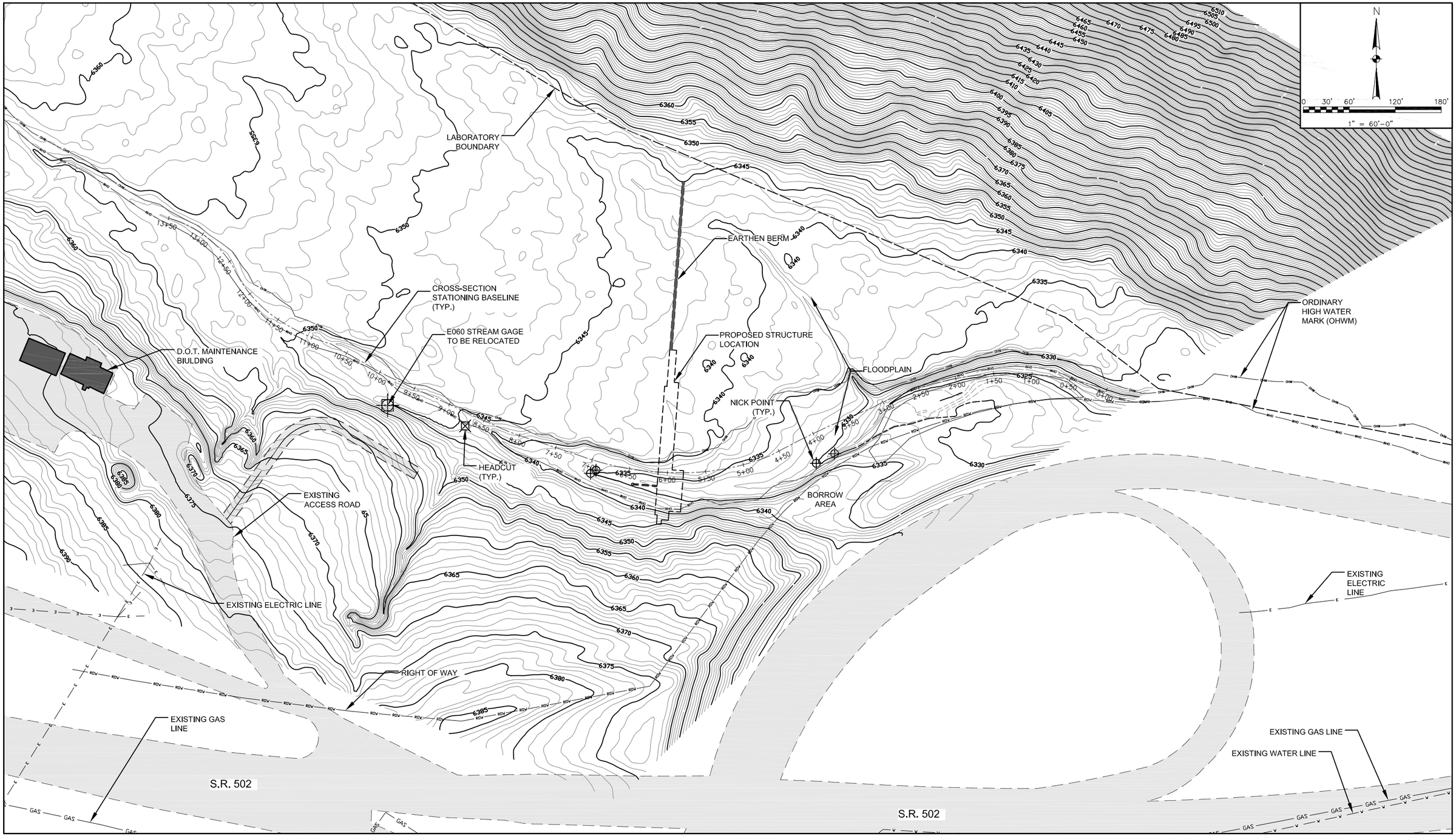
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	GENERAL NOTES
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS: 1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-001

User Name: 22190
Drawing Name: \\SAFFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-001 - GENERAL NOTES.dwg May 05, 2010 - 6:33pm



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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	PUEBLO CANYON EXISTING CONDITIONS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-101

User Name: 22190
Drawing Name: \\SAFESUI\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-101 - PUEBLO CANYON EXISTING CONDITIONS.dwg May 05, 2010 - 6:35pm

DISTURBED AREAS	
STRUCTURE	0.724 ACRES
ACCESS ROAD	0.593 ACRES
BORROW MATERIAL	0.252 ACRES
FILL MATERIAL	0.129 ACRES
LAYDOWN AREA	0.076 ACRES
TOTAL	1.729 ACRES
FILL WITHIN OHWM	
IMPACT AREA1	0.158 ACRES
IMPACT AREA 2	0.044 ACRES
TOTAL	0.202ACRES

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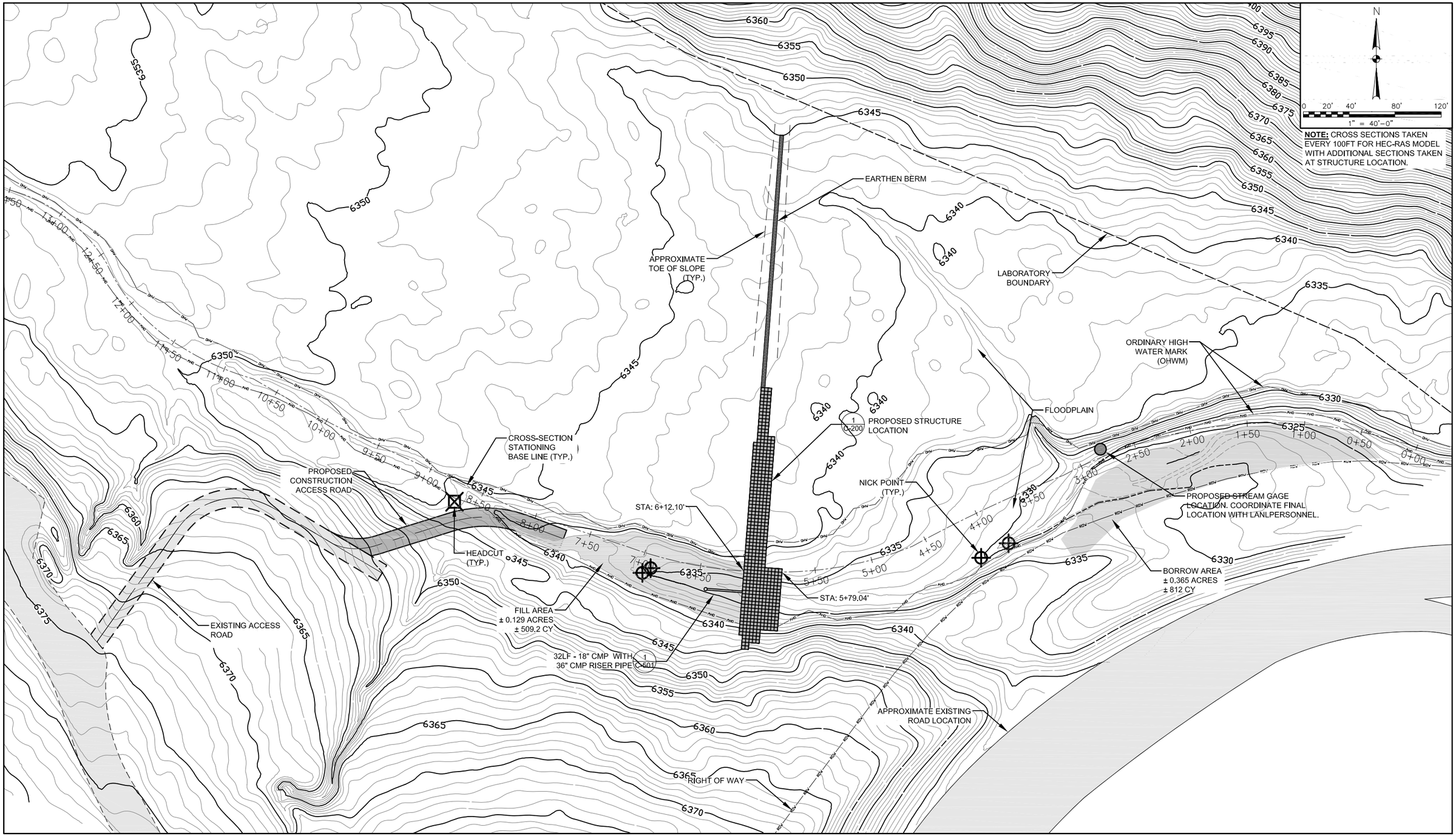
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	PUEBLO CANYON OVERALL SITE PLAN WITH AERIAL

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-102

User Name: 22190
Drawing Name: \\SAFFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-102 - PUEBLO CANYON OVERALL WITH AERIAL.dwg
May 06, 2010 - 10:17am



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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	PUEBLO CANYON ENLARGED SITE PLAN
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-103

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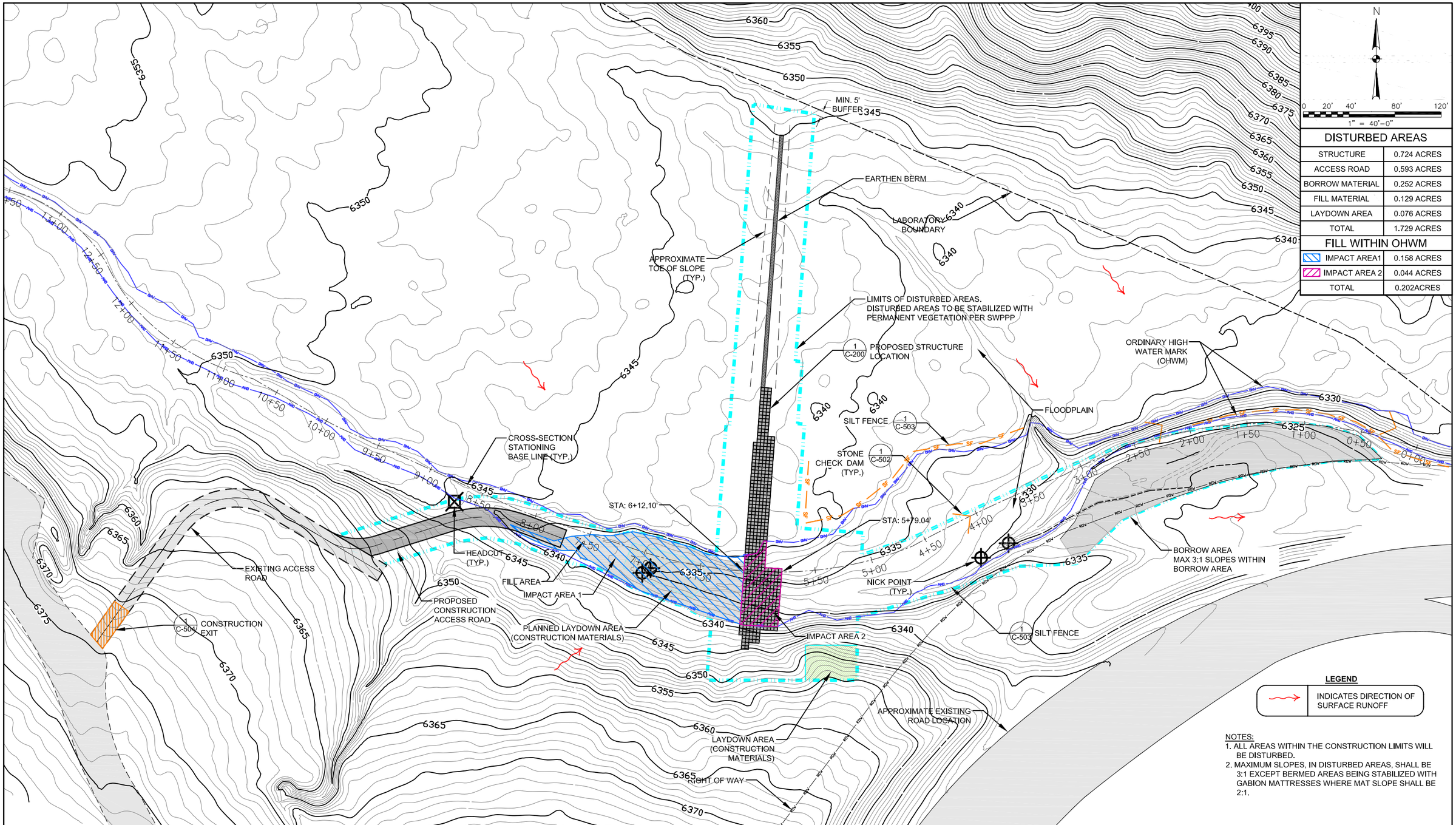

DISTURBED AREAS	
STRUCTURE	0.724 ACRES
ACCESS ROAD	0.593 ACRES
BORROW MATERIAL	0.252 ACRES
FILL MATERIAL	0.129 ACRES
LAYDOWN AREA	0.076 ACRES
TOTAL	1.729 ACRES
FILL WITHIN OHWM	
IMPACT AREA1	0.158 ACRES
IMPACT AREA 2	0.044 ACRES
TOTAL	0.202ACRES

LEGEND

→	INDICATES DIRECTION OF SURFACE RUNOFF

NOTES:
1. ALL AREAS WITHIN THE CONSTRUCTION LIMITS WILL BE DISTURBED.
2. MAXIMUM SLOPES, IN DISTURBED AREAS, SHALL BE 3:1 EXCEPT BERMED AREAS BEING STABILIZED WITH GABION MATTRESSES WHERE MAT SLOPE SHALL BE 2:1.

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	PUEBLO CANYON EROSION CONTROL PLAN
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
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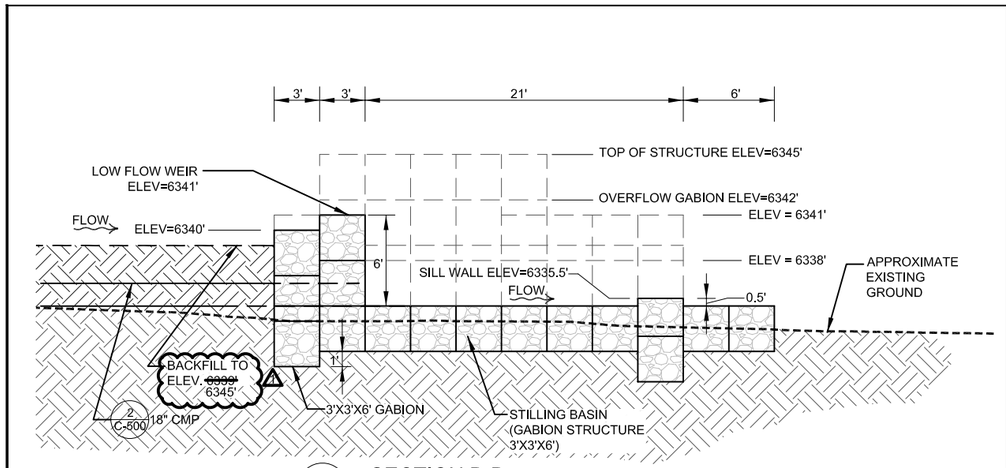
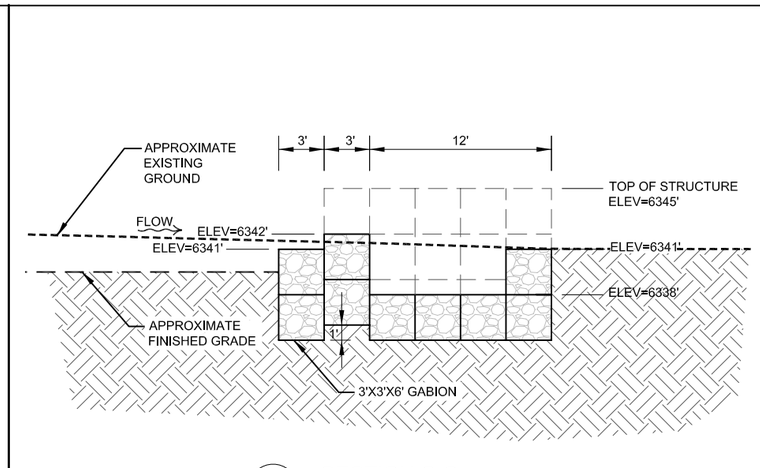
QC MS
SHEET C104

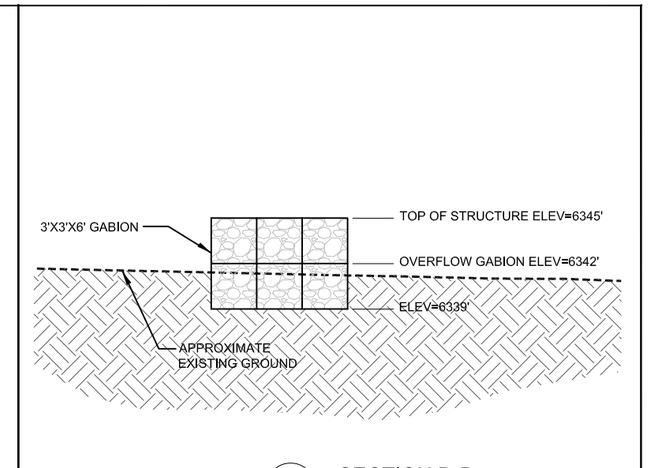
User Name: 23190
Drawing Name: \\SARFS01\COMMON\100005632 Los Alamos\Record Drawings\JP & Pueblo Canyon\S-100 - PUEBLO CANYON SWPPP SITE MAP.dwg
May 06, 2010 - 10:23am



B
SECTION B-B
C-200 C-200 SCALE: N.T.S.



C
SECTION C-C
C-200 C-200 SCALE: N.T.S.



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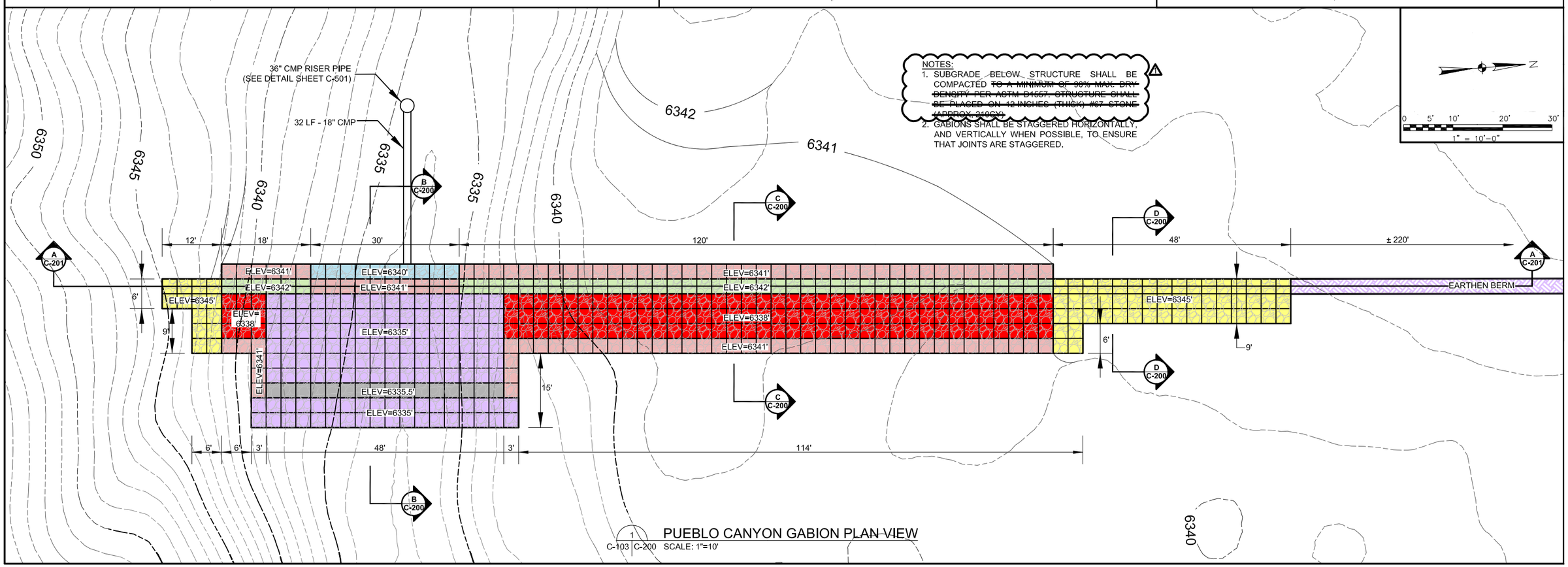
SECTION D-D
C-200 C-200 SCALE: N.T.S.



1
PUEBLO CANYON GABION PLAN VIEW
C-103 C-200 SCALE: 1"=10'

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	PUEBLO CANYON CROSS SECTIONS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
2
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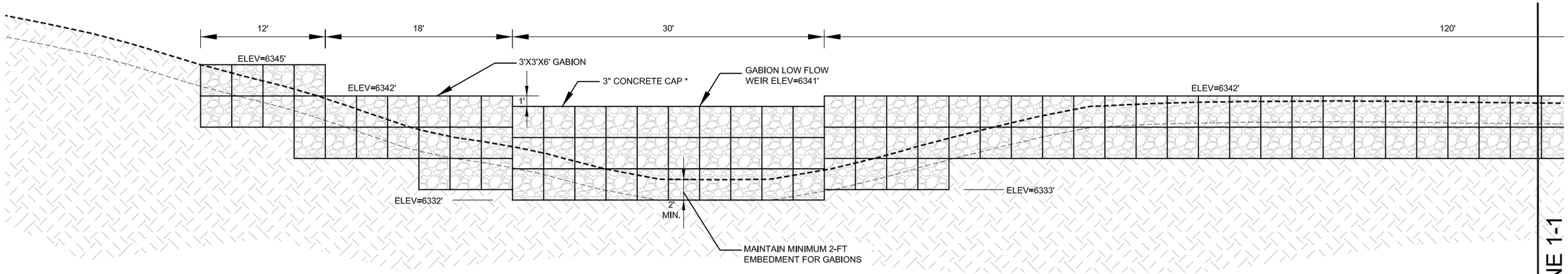
11
12

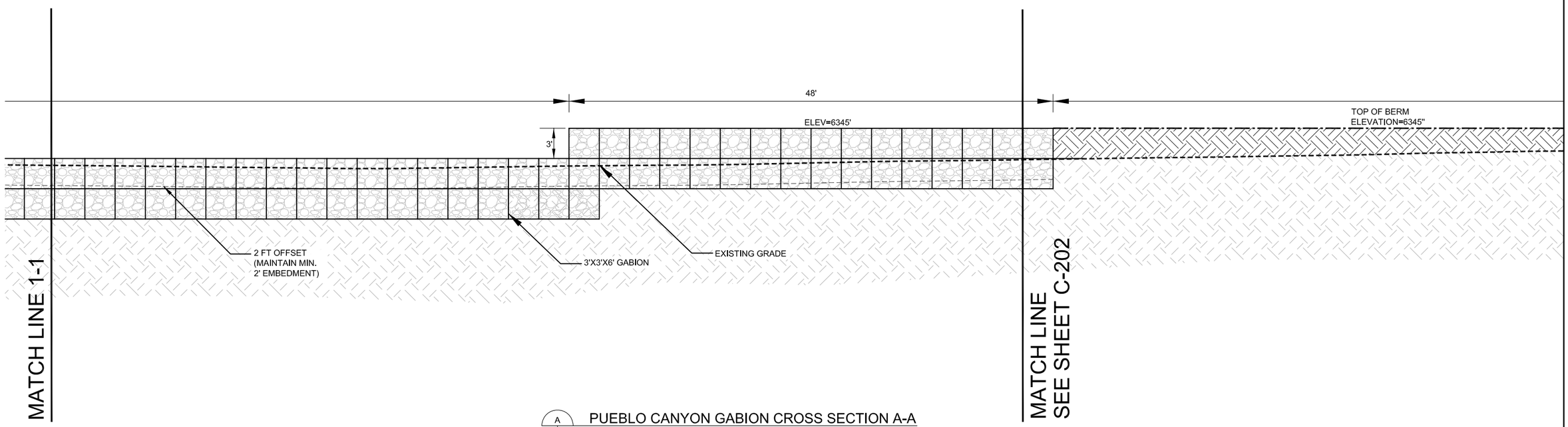
JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-200

User Name: 22190
Drawing Name: \\SAFESD1\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-200 - C-202 - PUEBLO CANYON CROSS SECTIONS.dwg
May 06, 2010 - 10:27am



* CAP LOW FLOW AND OVERFLOW WEIR WITH MIN. 4,000 PSI CONCRETE, EMBEDDED 5" INTO TOP GABION. PROVIDE ¾" CHAMFER AT EDGES AND INTEGRAL COLORS - CLIFFSIDE BROWN #6804 (OR APPROVED EQUAL) PER MANUFACTURER'S INSTRUCTIONS.

NOTE:
GABIONS SHALL BE STAGGERED VERTICALLY (TYPICAL)



A
C-200 | C-201 PUEBLO CANYON GABION CROSS SECTION A-A
SCALE: 1"=5'

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	PUEBLO CANYON CROSS SECTIONS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

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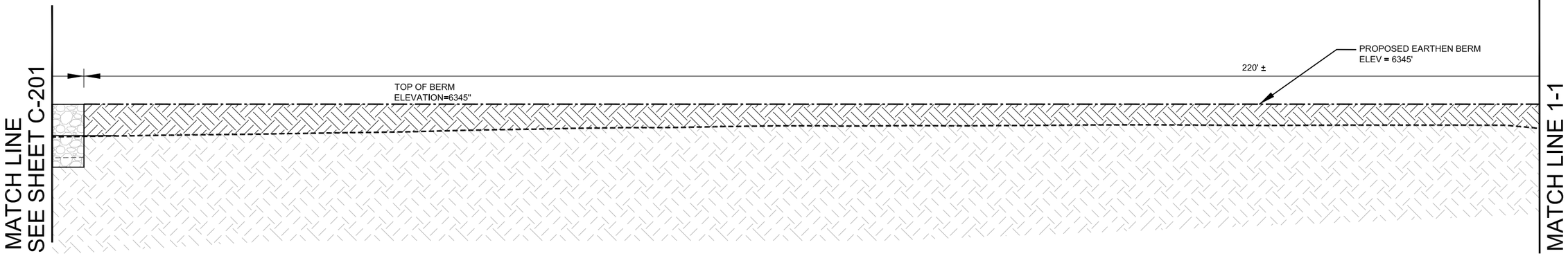
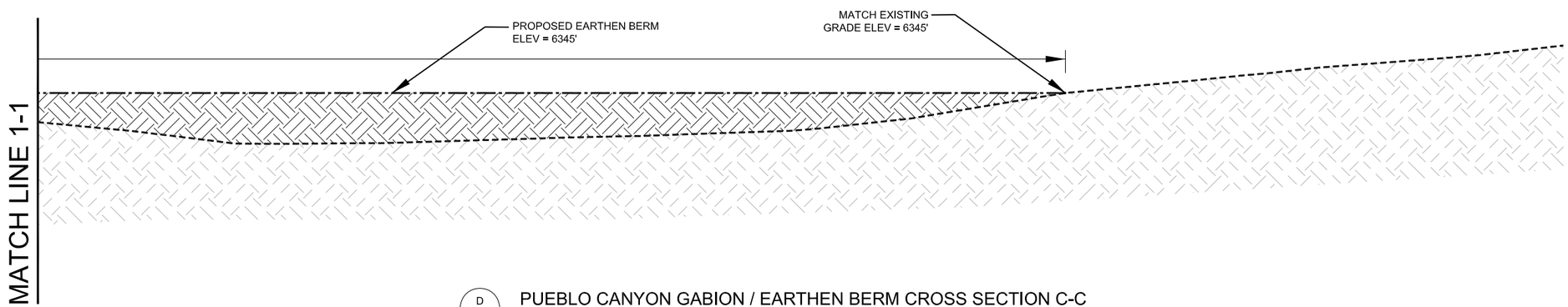
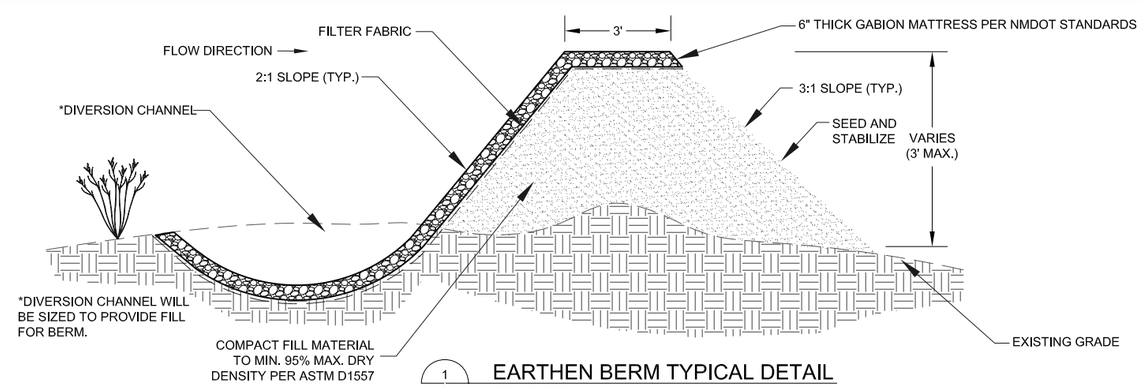
SHEET C-201

User Name: 22190
Drawing Name: \\SAFFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-200 - C-202 - PUEBLO CANYON CROSS SECTIONS.dwg May 05, 2010 - 6:45pm





D
C-200 C-202 PUEBLO CANYON GABION / EARTHEN BERM CROSS SECTION C-C
SCALE: 1"=5'



1 EARTHEN BERM TYPICAL DETAIL
SCALE: NTS

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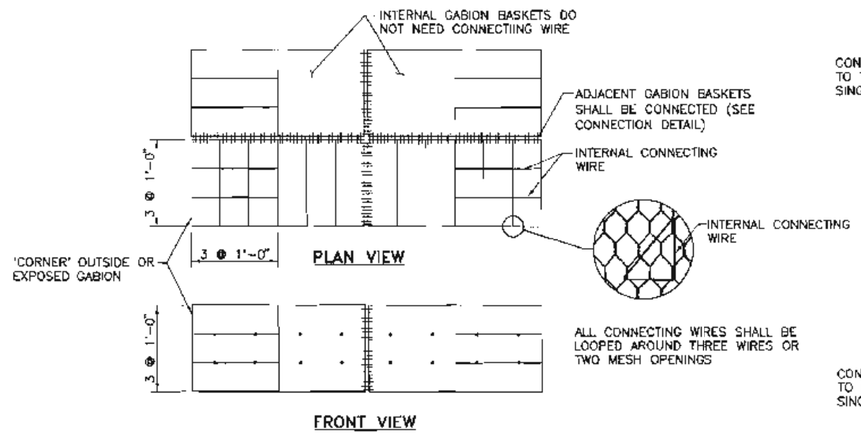
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	PUEBLO CANYON CROSS SECTIONS

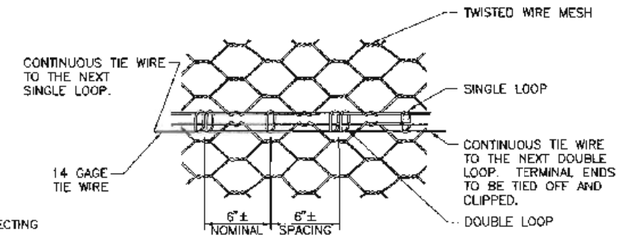
ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-202

User Name: 22190
Drawing Name: \\SAFR\01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-200 - C-202 - PUEBLO CANYON CROSS SECTIONS.dwg May 05, 2010 - 6:46pm

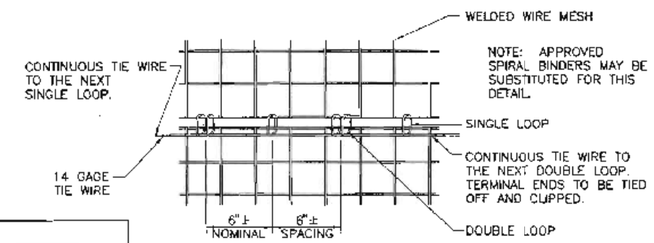


DETAILS OF 9 GAGE INTERNAL CONNECTING WIRES



(FOR USE W/ TWISTED MESH)

STANDARD JOINT CONNECTION DETAIL



(FOR USE W/ WELDED WIRE MESH)

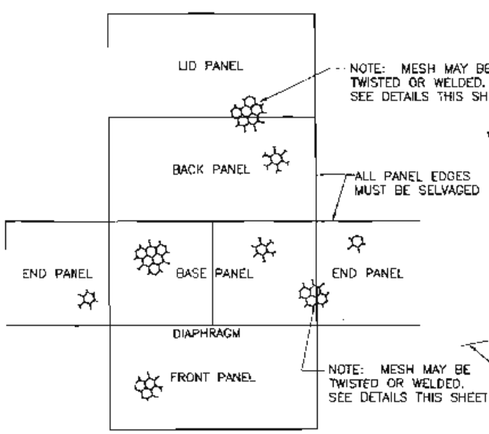
STANDARD JOINT CONNECTION DETAIL

GENERAL NOTES

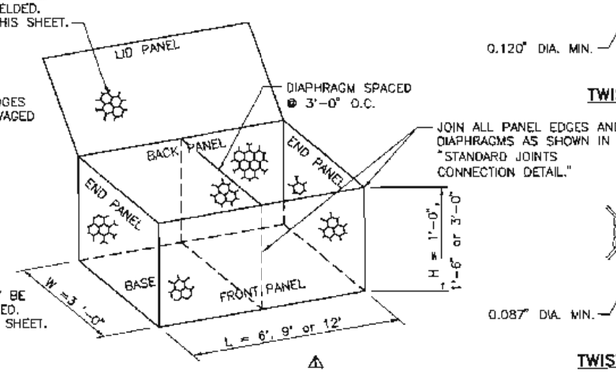
1. INTERNAL CONNECTING WIRES ARE TO BE INSTALLED ACROSS WIDTH OF INTERIOR GABIONS AND ACROSS WIDTH AND LENGTH OF END GABIONS.
2. INTERNAL CONNECTING WIRE, LACING WIRE AND GABION MESH SHALL BE GALVANIZED.
3. INTERNAL CONNECTING WIRES ARE REQUIRED ON ALL GABIONS 3'-0" HIGH AND ON ALL GABIONS 1'-6" HIGH WHEN USED TO BUILD VERTICAL STRUCTURES.
4. PREFORMED STIFFENERS (11 GAGE OR 9 GAGE) ARE AN ACCEPTABLE ALTERNATIVE TO INTERNAL CONNECTING WIRES. INSTALL THEM AS RECOMMENDED BY THE MANUFACTURER OR AS DIRECTED BY THE PROJECT MANAGER AT $\frac{1}{3}$ POINTS.
5. PLACE ROCK IN THE END GABION CELL FIRST, AND CONTINUE BY FILLING INTERIOR GABION CELLS.
6. FOR GABION DIMENSIONS, REFER TO THE TABLE "STANDARD GABION SIZES."
7. A JOINT CONNECTION MUST BE MADE WHERE ANY PANEL EDGE MEETS ANOTHER PANEL. THIS INCLUDES ADJACENT GABION BASKETS, INDIVIDUAL PANELS WITHIN A BASKET, DIAPHRAGM EDGES ETC. ALL JOINT CONNECTIONS SHALL BE MADE USING STANDARD TIE WIRE.
8. ALTERNATE JOINT CONNECTION PROCEDURES MAY BE USED PROVIDED THAT THE COMPLETED JOINT WILL DEVELOP A TENSILE STRENGTH OF NOT LESS THAN 1400 POUNDS PER FOOT. IF ALTERNATE JOINT CONNECTION PROCEDURES ARE USED THE CONTRACTOR SHALL SUBMIT TO THE PROJECT MANAGER CERTIFIED TEST REPORTS DEMONSTRATING THE ALTERNATE JOINT CONNECTIONS WILL MEET THE MINIMUM TENSILE STRENGTH REQUIREMENTS.

STANDARD REVETMENT MATTRESS SIZES				
LENGTH	WIDTH	HEIGHT	NUMBER OF CELLS	VOLUME CUBIC YARDS
FEET				
9'-0"	6'-0"	0'-6"	3	1.00
12'-0"	6'-0"	0'-6"	4	1.33
9'-0"	6'-0"	0'-9"	3	1.50
12'-0"	6'-0"	0'-9"	4	2.00

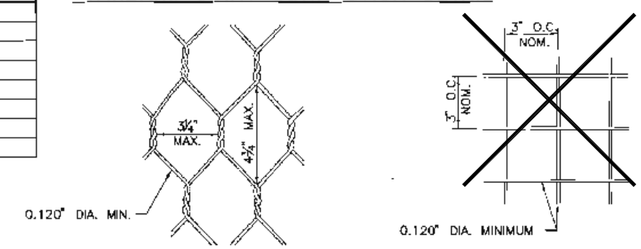
STANDARD GABION SIZES				
LENGTH	WIDTH	HEIGHT	NUMBER OF CELLS	VOLUME CUBIC YARDS
FEET				
6'-0"	3'-0"	3'-0"	2	2.00
9'-0"	3'-0"	3'-0"	3	3.00
12'-0"	3'-0"	3'-0"	4	4.00
6'-0"	3'-0"	1'-6"	2	1.00
9'-0"	3'-0"	1'-6"	3	1.50
12'-0"	3'-0"	1'-6"	4	2.00
6'-0"	3'-0"	1'-0"	2	0.66
9'-0"	3'-0"	1'-0"	3	1.00
12'-0"	3'-0"	1'-0"	4	1.33



TYPICAL FLAT LAYOUT OF GABION BASKET

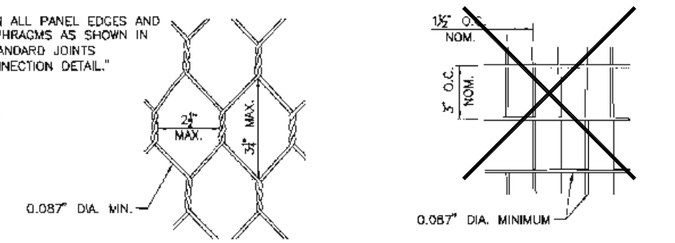


TYPICAL ASSEMBLED GABION BASKET



TWISTED MESH GABION

WELDED MESH GABION



TWISTED MESH MATTRESS

WELDED MESH MATTRESS

TYPICAL ACCEPTABLE MESH STYLES

SERIAL 602-05-2/2 SHEET 2 OF 2 MUST ACCOMPANY THIS SHEET.

NO.	DATE	REV. BY	DESCRIPTION
1	01/16/08	YML	CORRECTED L = 6', 9' or 12'

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO
DEPARTMENT OF TRANSPORTATION
STANDARD DRAWING

GABION
BASKET DETAILS

APPROVED Ray M. Trujillo 3-5-08
DESIGN ENGINEER DATE

DESIGNED BY TM DRAWN BY SKL CHECKED BY YML

602-05-1/2 SHEET 1 of 2

1 GABION BASKET DETAIL (NMDOT)
C-103 C-303 C-500 SCALE: NTS

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232
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Post Buckley Schuh & Jernigan, Inc., d/b/a PBS&J
5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

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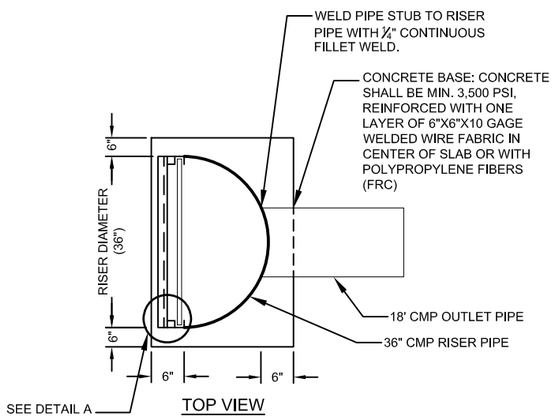
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	GENERAL DETAILS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

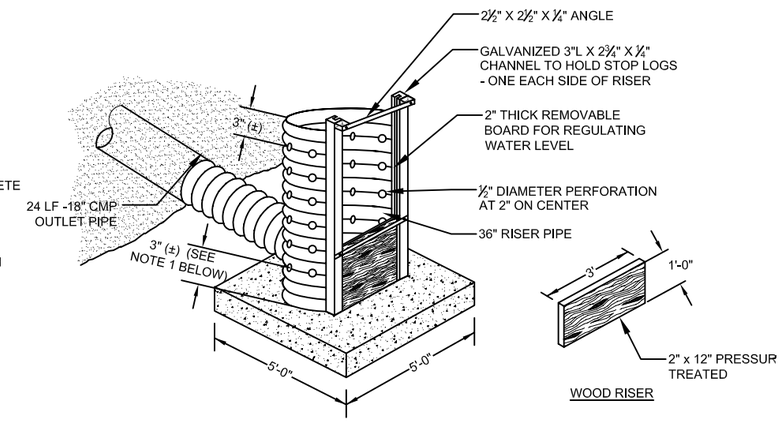
JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-500

User Name: 23190
Drawing Name: \\SAPFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-500 - C-501 - GENERAL DETAILS.dwg May 06, 2010 - 9:05am

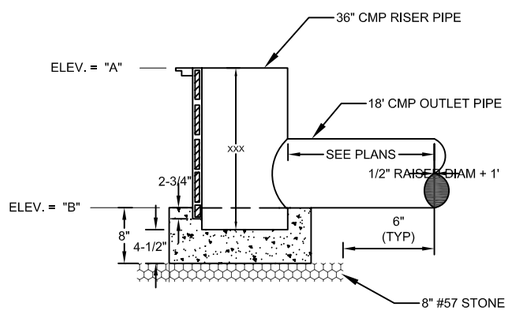
NOTE: ALL APPURTENANCES SHALL BE GALVANIZED, OR PAINTED WITH NOT LESS THAN TWO COATS OF ZINC OXIDE PAINT.



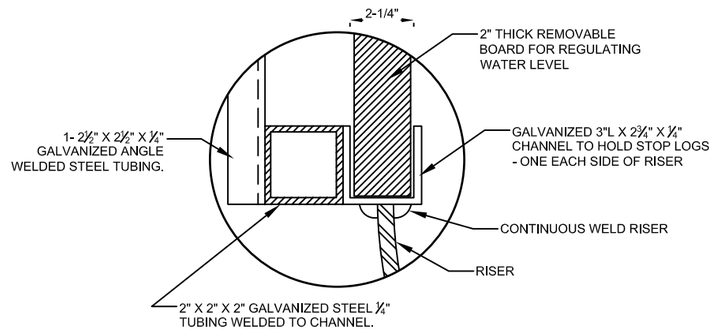
TOP VIEW



ISOMETRIC VIEW



CROSS SECTION OF RISER



DETAIL A

	DP CANYON	PUEBLO CANYON
ELEV "A"	~~7026.0'~~ 7029'	~~6341.0'~~ 6343'
ELEV "B"	7022.5'	6335.5'

NOTES:
1. AT PUEBLO CANYON PERFORATIONS SHALL NOT EXTEND BELOW ELEV. 6339'.
2. CMP SHALL BE FULLY COATED.

1
C-200 C-501 C-400

RISER PIPE DETAILS

SCALE: NTS

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5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

KBR

CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	GENERAL DETAILS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
2
3
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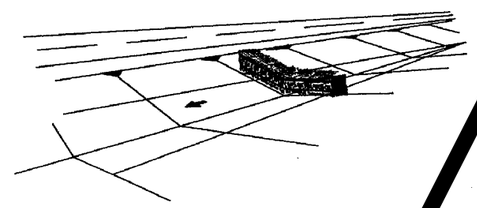
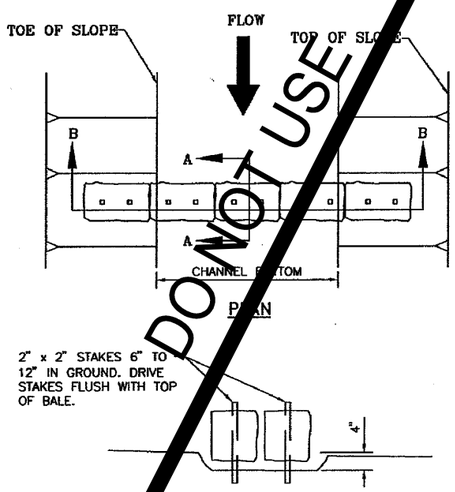
12

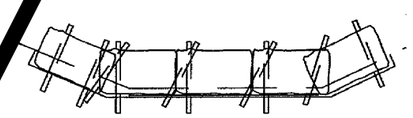
JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-501

User Name: 22190
Drawing Name: \\SARFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-500 - C-501 - GENERAL DETAILS.dwg May 06, 2010 - 9:06am



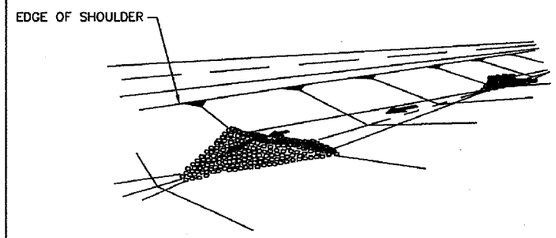


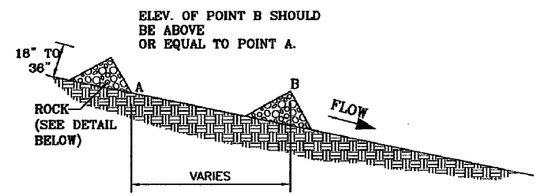
SECTION A–A

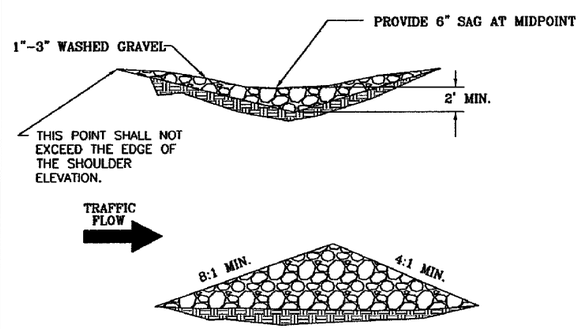


SECTION B–B

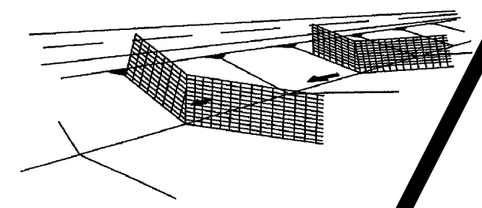
TYPE III
(STRAW BALE)

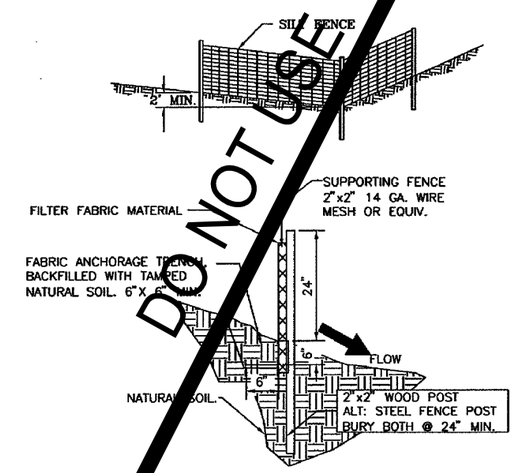






TYPE II
STONE DAM





TYPE I SILT FENCE

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO
DEPARTMENT OF TRANSPORTATION
STANDARD DRAWING

TEMPORARY EROSION & SEDIMENT CONTROL MEASURES
CHECK DAMS

APPROVED Raymunda VanHoose 11/29/06
DESIGN ENGINEER DATE

DESIGNED BY___ DRAWN BY ___ CHECKED BY ___

603–01–2/7 SHEET 2 OF 7

DO NOT USE

DO NOT USE

1 CHECK DAM DETAILS (NMDOT)
C-104 C-304 | C-502 SCALE: NTS

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232
Ph. (941) 378–0272
Post Buckley Schuh & Jernigan, Inc,. d/b/a PBS&J
5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

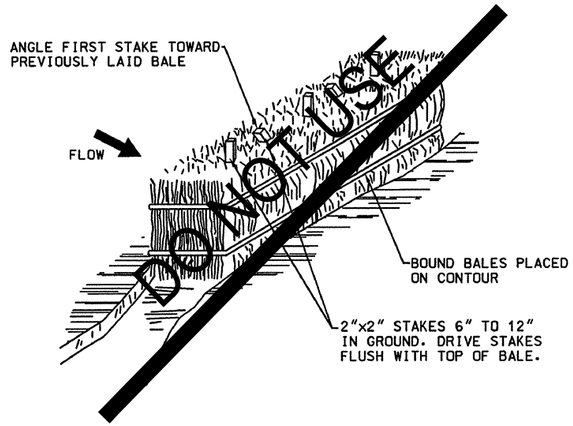
KBR

CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	S.W.P.P.P. DETAILS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

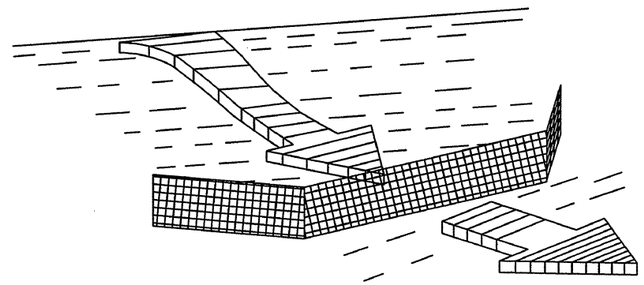
ORIGINAL DATE: 08/24/09
REVISIONS:
1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___ 11 ___ 12 ___

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-502

User Name: 22190
Drawing Name: \\SARFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-502 – C-504 – EROSION CONTROL DETAILS.dwg May 06, 2010 – 9:14am



TYPE II
STRAW BALE OPTION



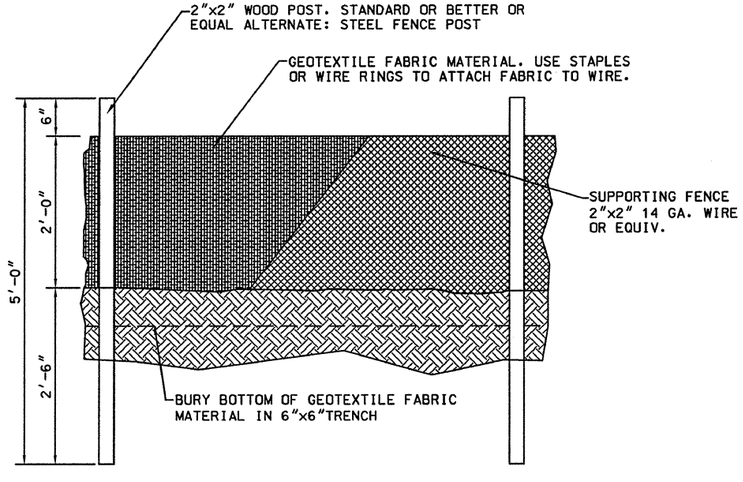
TYPE I
SILT FENCE

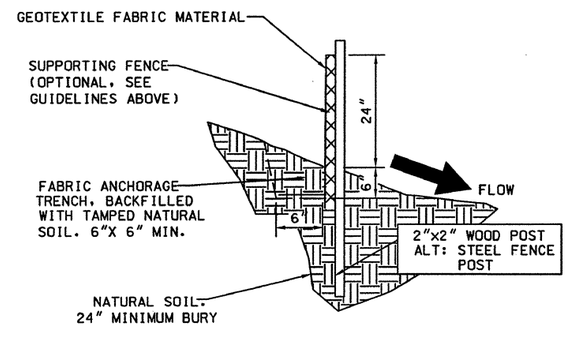
NOTES: SILT FENCE AND CHECK DAM

THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE POST SPACING FOR SILT FENCES TO MINIMIZE MAINTENANCE.

1. POST SPACING SHALL BE 4 FT. MAXIMUM WITHOUT SUPPORTING FENCE, 10 FT. MAXIMUM WITH SUPPORTING FENCE.
2. POSTS FOR 4 FT. MAXIMUM POST SPACING SHALL BE 2 INCH SQUARE NOMINAL SIZE OR HEAVIER WOOD POSTS, OR STANDARD "T" OR "U" SECTION STEEL POSTS WEIGHING NOT LESS THAN 2 LBS. PER. LINEAR FOOT.

   POSTS FOR 10 FT. MAXIMUM POST SPACING SHALL BE 4 INCH SQUARE NOMINAL SIZE OR HEAVIER WOOD POSTS, OR STEEL POSTS AS SPECIFIED ABOVE.
3. SUPPORTING FENCE SHALL BE WIRE MESH (14 GA. MIN., 1 INCH MAX. MESH OPENINGS), SNOW FENCE, PLASTIC FENCE OR APPROVED.
4. SUPPORTING FENCE SHALL BE FASTENED SECURELY TO POSTS WITH STAPLES OR WIRE TIES. GEOTEXTILE FABRIC SHALL BE FASTENED SECURELY TO SUPPORTING FENCE WITH WIRE TIES SPACED AT 2 FT. CENTERS ALONG THE TOP AND MID-SECTION. WHEN A SUPPORTING FENCE IS NOT USED, GEOTEXTILE FABRIC SHALL BE SECURELY FASTENED TO POSTS WITH STAPLES OR WIRE TIES.
5. ~~WHEN SILT FENCE IS USED FOR CHECK DAMS INSTALLED IN DITCHES, A SUPPORTING FENCE SHALL BE PROVIDED, WITH MAXIMUM POST SPACING OF 10 FT.~~
6. ~~STANDARD "T" OR "U" SECTION STEEL POSTS SHALL NOT BE USED WITHIN THE CONSTRUCTION CLEAR ZONE RECOVERY AREA.~~
7. ~~STRAW BALES ARE NOT INTENDED FOR USE ON NEW MEXICO DEPARTMENT OF TRANSPORTATION PROJECTS.~~





1 T.E.S.C.M. SILT FENCE (NMDOT)

C-104 C-503 C-304 SCALE: NTS

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO DEPARTMENT OF TRANSPORTATION STANDARD DRAWING

TEMPORARY EROSION & SEDIMENT CONTROL MEASURES SILT FENCE

APPROVED Raymundo Von Hoven 11/29/09
DESIGN ENGINEER DATE

DESIGNED BY___ DRAWN BY___ CHECKED BY___

603-01-3/7

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232
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Post Buckley Schuh & Jernigan, Inc,. d/b/a PBS&J
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FBPR Certificate of Authorization No.: 24

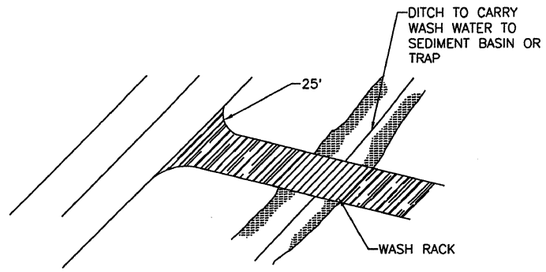
KBR

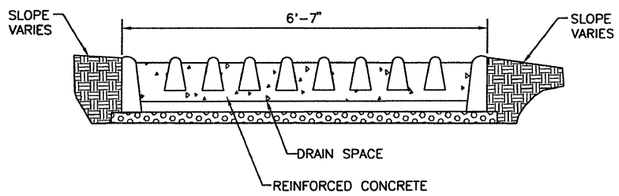
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	S.W.P.P.P. DETAILS

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

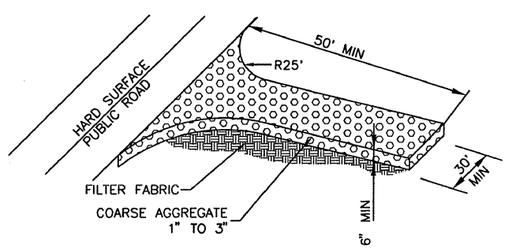
JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-503

User Name: 23190
Drawing Name: \\SAFESD1\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-502 - C-504 - EROSION CONTROL DETAILS.dwg May 06, 2010 - 9:16am

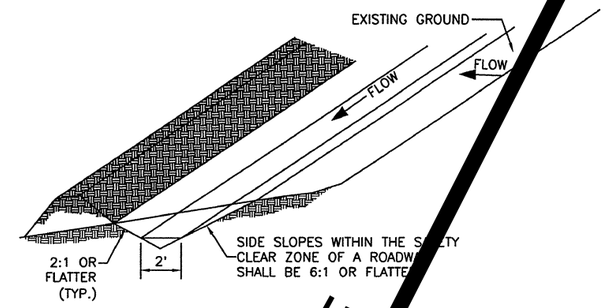




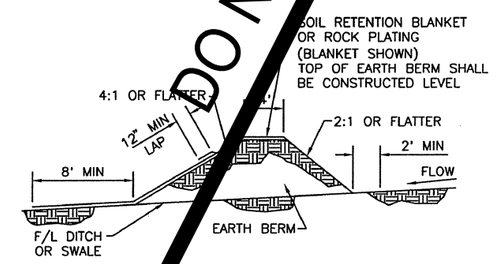
WASH RACK



OFFSITE TRACKING PREVENTION



TYPICAL SWALE CONFIGURATION



FILTER FABRIC DIVERSION DIKE

DO NOT USE

DIVERSION DIKE

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO DEPARTMENT OF TRANSPORTATION STANDARD DRAWING

T.E.S.C.M. OFFSITE TRACKING PREVENTION & DIVERSION DIKE

APPROVED Raymundo Van Hoven 11/24/09
DESIGN ENGINEER DATE

DESIGNED BY___ DRAWN BY ___ CHECKED BY ___

603-01-7/7 SHEET 7 OF 7

1 T.E.S.C.M. OFFSITE TRACKING PREVENTION (NMDOT)
C-104 | C-504 SCALE: NTS

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FBPR Certificate of Authorization No.: 24

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	S.W.P.P.P. DETAILS

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-504

User Name: 22190
Drawing Name: \\SAFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-502 - C-504 - EROSION CONTROL DETAILS.dwg May 06, 2010 - 9:18am

CONSTRUCTION PLANS FOR:

LOS ALAMOS NATIONAL LABORATORY STREAM GAGE

FOR PUEBLO CANYON
LOS ALAMOS, NEW MEXICO

INDEX OF DRAWINGS

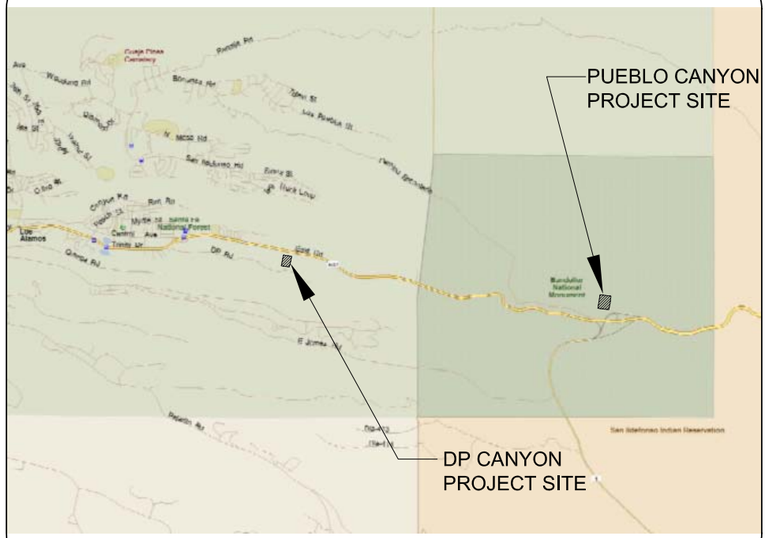
C-00 COVER SHEET

PUEBLO CANYON
C-01 OVERALL SITE/GRADING PLAN
C-02 SITE/GRADING ENLARGED PLAN
C-03 SITE/GRADING ENLARGED PLAN
C-04 STREAM GAGE PLAN AND PROFILE
C-05 STREAM GAGE TEMPORARY DIVERSION PLAN

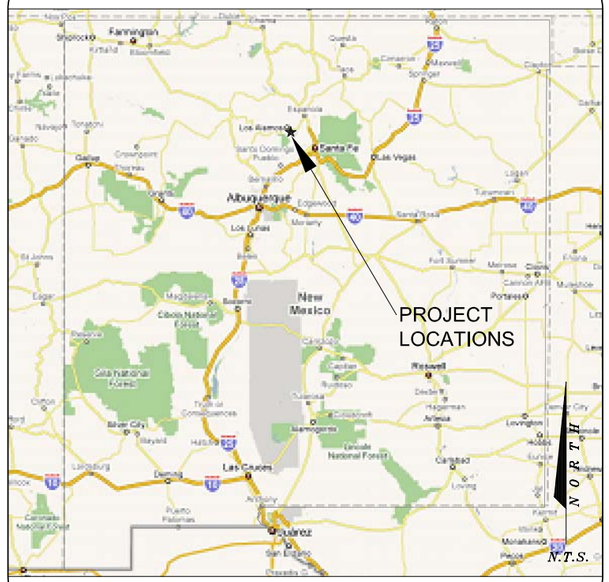
~~DP CANYON~~ (NOT INCLUDED)
~~C-06 OVERALL SITE/GRADING PLAN~~
~~C-07 SITE/GRADING ENLARGED PLAN~~
~~C-08 STREAM GAGE PLAN AND PROFILE~~
~~C-09 STREAM GAGE TEMPORARY DIVERSION PLAN~~

DETAILS
C-10 RIP RAP AND CHECK DAM DETAILS
SG-01 STREAM GAGE DETAILS
SG-02 STREAM GAGE DETAILS
SG-03 STREAM GAGE DETAILS

LOCATION MAP



VICINITY MAP



DRAWINGS REVISED TO INCORPORATE CONTRACTOR AS-BUILT INFORMATION. REVISIONS ARE INDICATED AS REVISION 1 WHERE APPLICABLE. 1

PREPARED FOR:
LOS ALAMOS NATIONAL LABORATORY
P.O. BOX 1663
LOS ALAMOS, NM 87545

PREPARED BY:

PBS&J
CONSULTING ENGINEERS
101 ARTHUR ANDERSEN PARKWAY, SUITE 260
SARASOTA, FLORIDA 34232
(941) 378-0272 (VOICE)
(941) 371-0297 (FAX)

KBR
GOVERNMENT AND INFRASTRUCTURE
2451 CRYSTAL DRIVE
ARLINGTON, VIRGINIA 22202
(703) 526-7500

DATE:	SHEETS	BY:
05/05/2010	C-01, C-10 SG-01 TO SG-03	JVC

REVISIONS

LOS ALAMOS NATIONAL LABORATORY STREAM GAGE

JOB NO. 100005632

DATE: 12/22/2009 SHT. 1 OF 10

User Name: 22190
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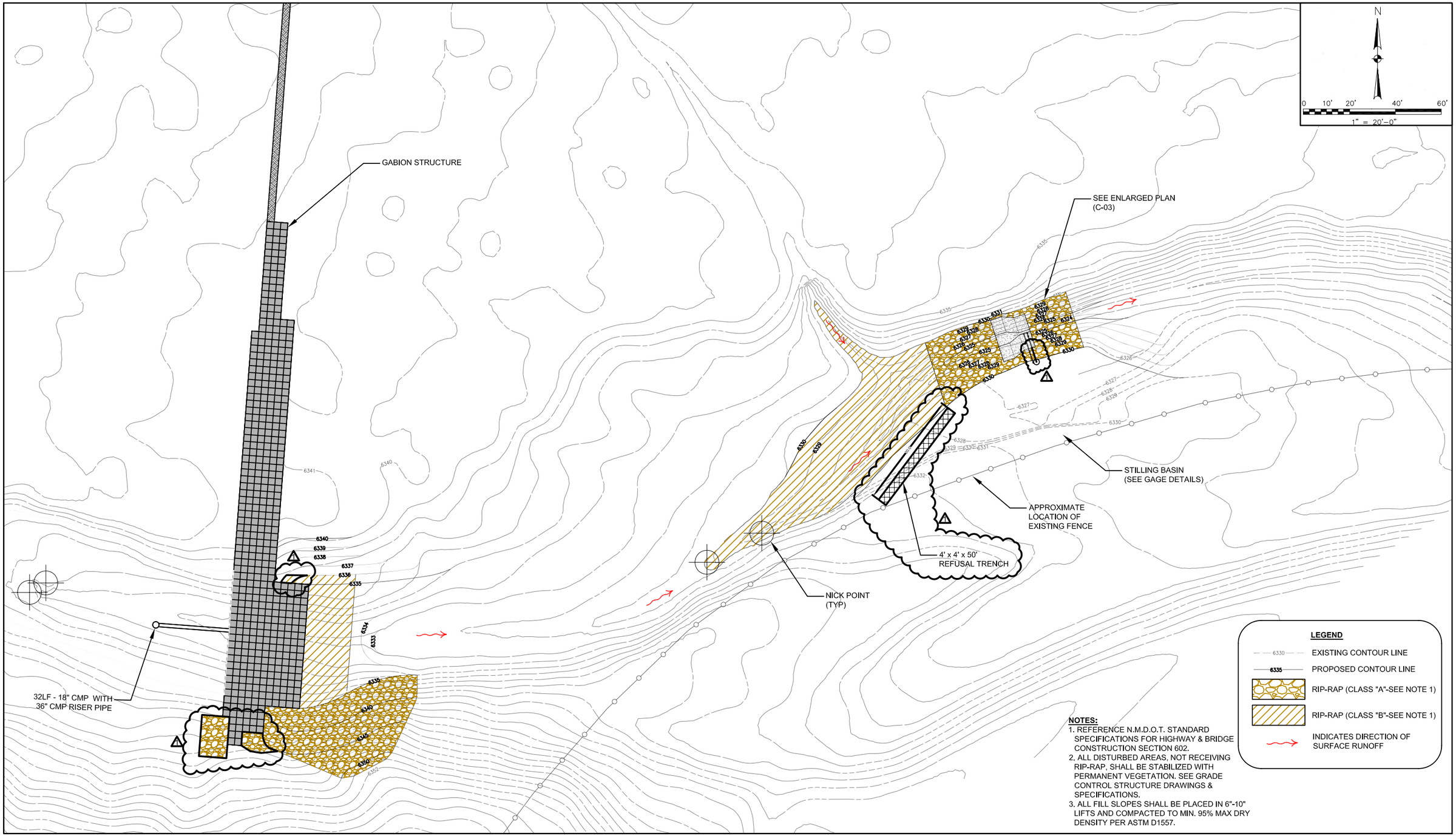

NOTES:

1. REFERENCE N.M.D.O.T. STANDARD SPECIFICATIONS FOR HIGHWAY & BRIDGE CONSTRUCTION SECTION 602.
2. ALL DISTURBED AREAS, NOT RECEIVING RIP-RAP, SHALL BE STABILIZED WITH PERMANENT VEGETATION. SEE GRADE CONTROL STRUCTURE DRAWINGS & SPECIFICATIONS.
3. ALL FILL SLOPES SHALL BE PLACED IN 6"-10" LIFTS AND COMPACTED TO MIN. 95% MAX DRY DENSITY PER ASTM D1557.

PBS&J
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FBPR Certificate of Authorization No.: 24

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	PUEBLO CANYON STREAM GAGE OVERALL SITE/GRADING PLAN

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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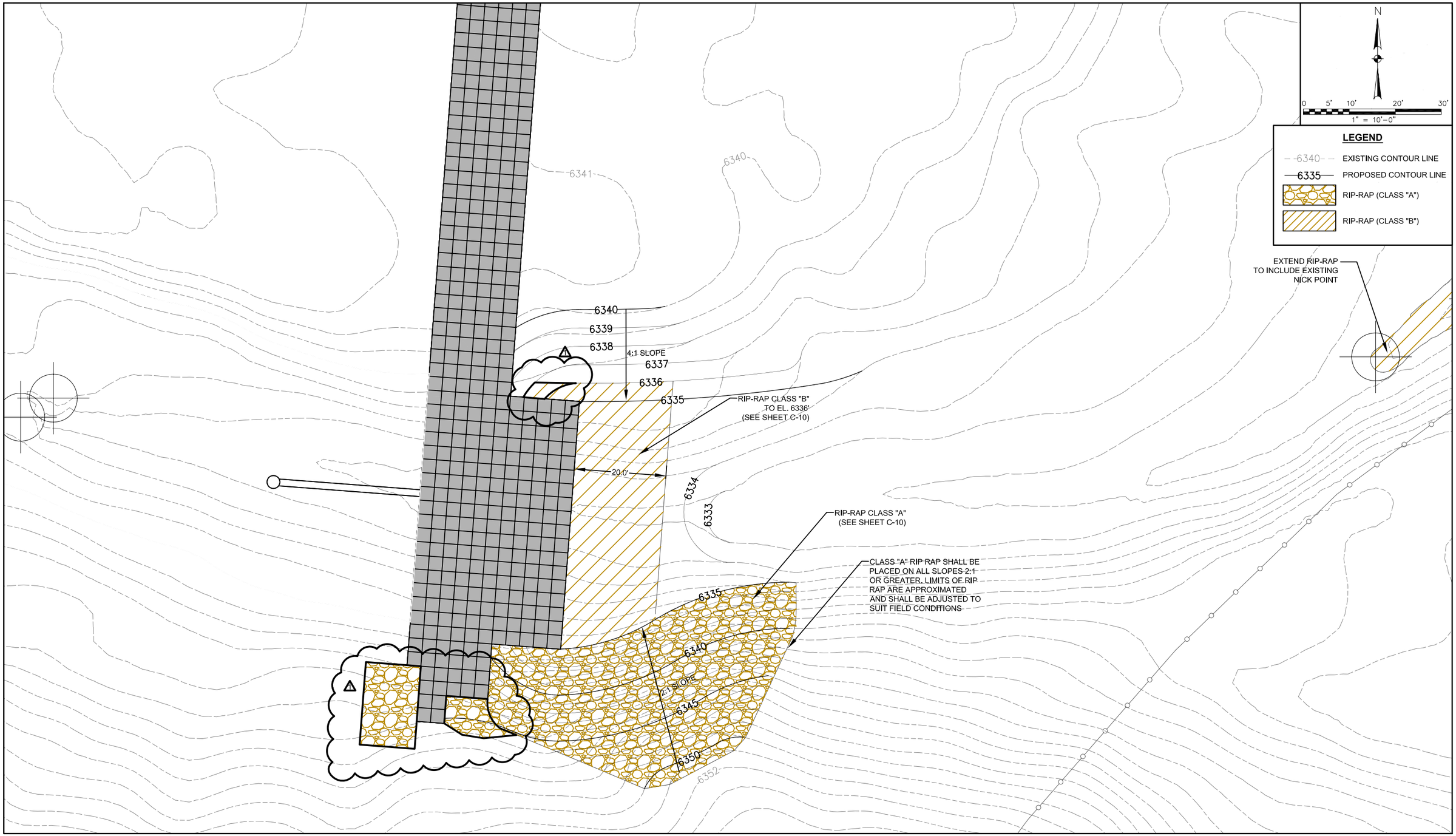
JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-01

User Name: 22190
Drawing Name: \\SAFS01\Common\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-01 - C-04 - Pueblo STREAM GAGE DETAILS.dwg May 11, 2010 - 2:45pm



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FBPR Certificate of Authorization No.: 24

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	PUEBLO CANYON STREAM GAGE
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	SITE/GRADING ENLARGED PLAN

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
2
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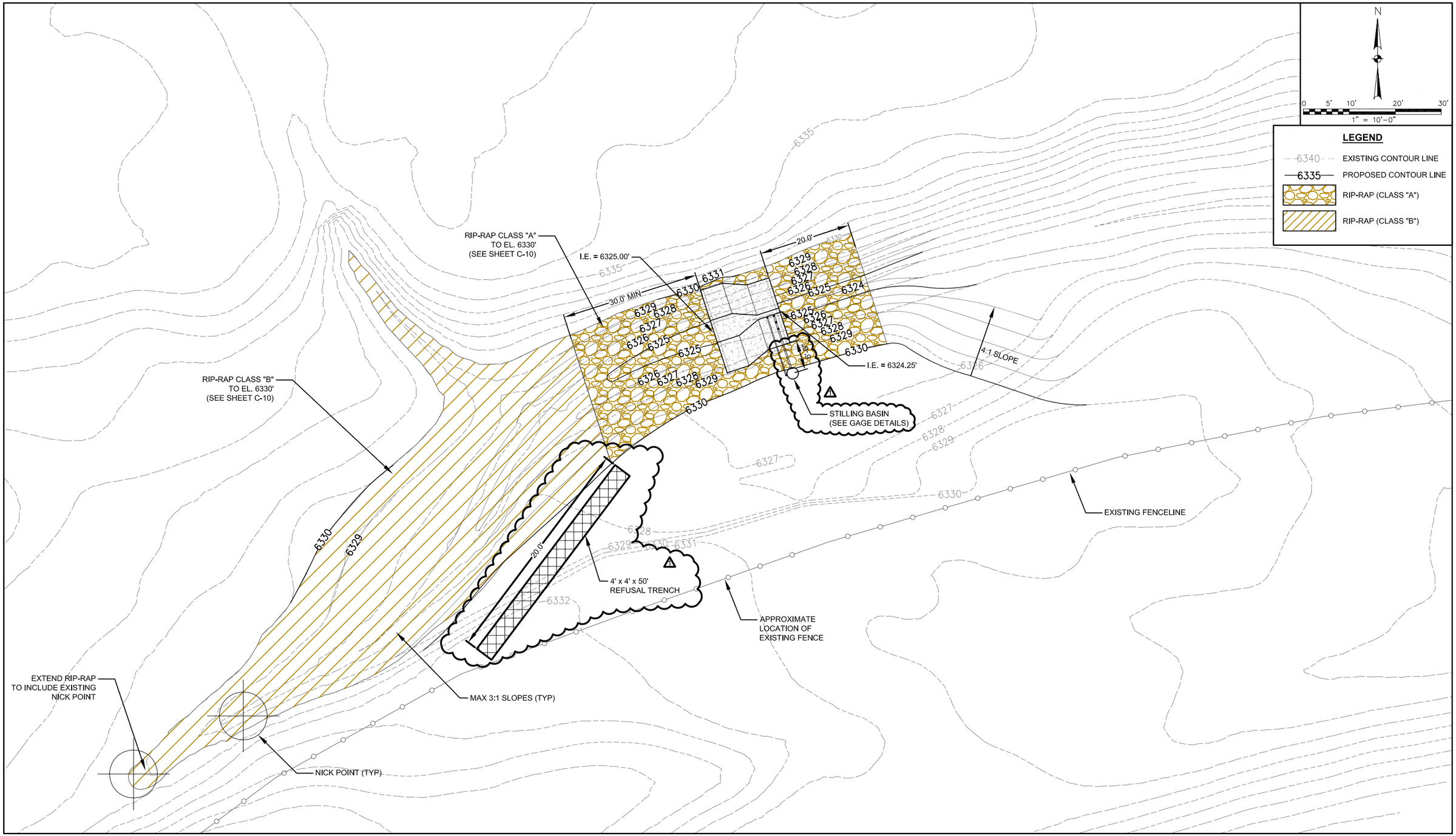
12

JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-02

User Name: Z2190
Drawing Name: \\SAFFS01\COMMON\100005632 Los Alamos\Record Drawings\UP & Pueblo Canyon\C-01 - C-04 - Pueblo STREAM GAGE DETAILS.dwg
May 06, 2010 - 9:42am



PBS&J
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FBPR Certificate of Authorization No.: 24

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	PUEBLO CANYON STREAM GAGE SITE/GRADING ENLARGED PLAN

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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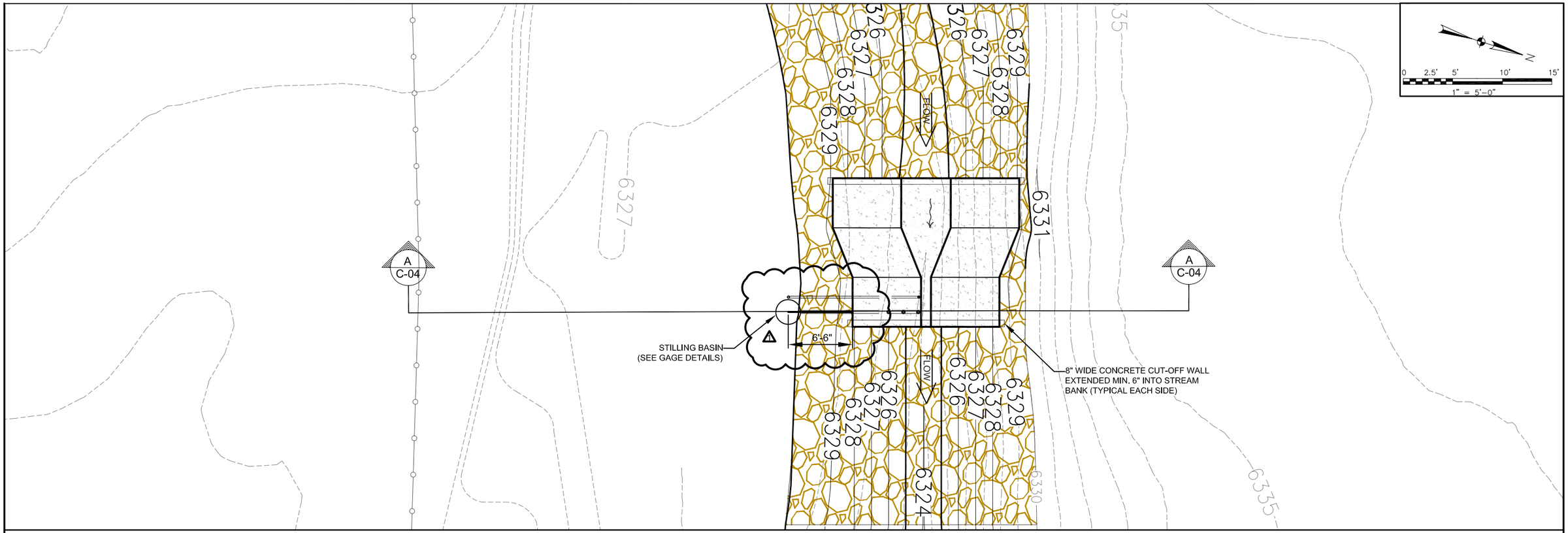
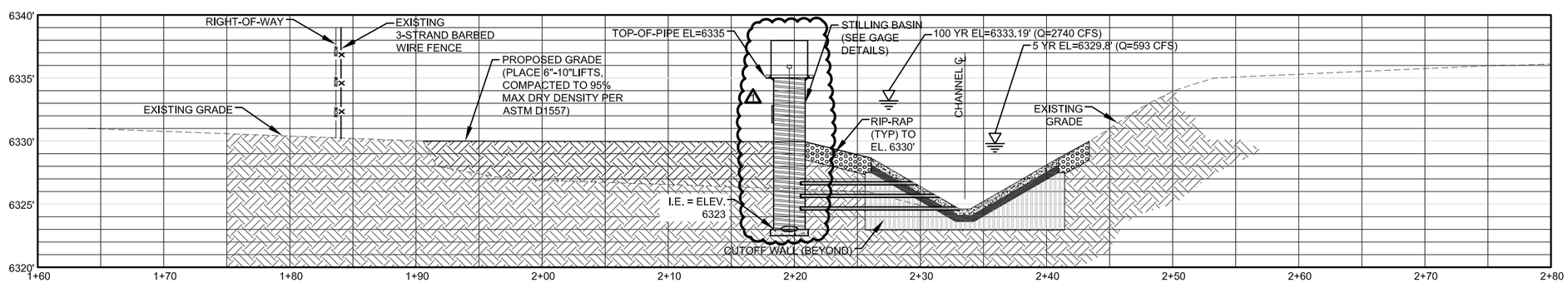
JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-03

User Name: 23190
Drawing Name: \\SAHFS01\Common\100005632 Los Alamos\Record Drawings\GP & Pueblo Canyon\C-01 - C-04 - Pueblo STREAM GAGE DETAILS.dwg May 11, 2010 - 2:46pm





A
C-04 C-04 CROSS SECTION A-A
SCALE: 1"=5'

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FBPR Certificate of Authorization No.: 24

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	PUEBLO CANYON STREAM GAGE PLAN AND PROFILE

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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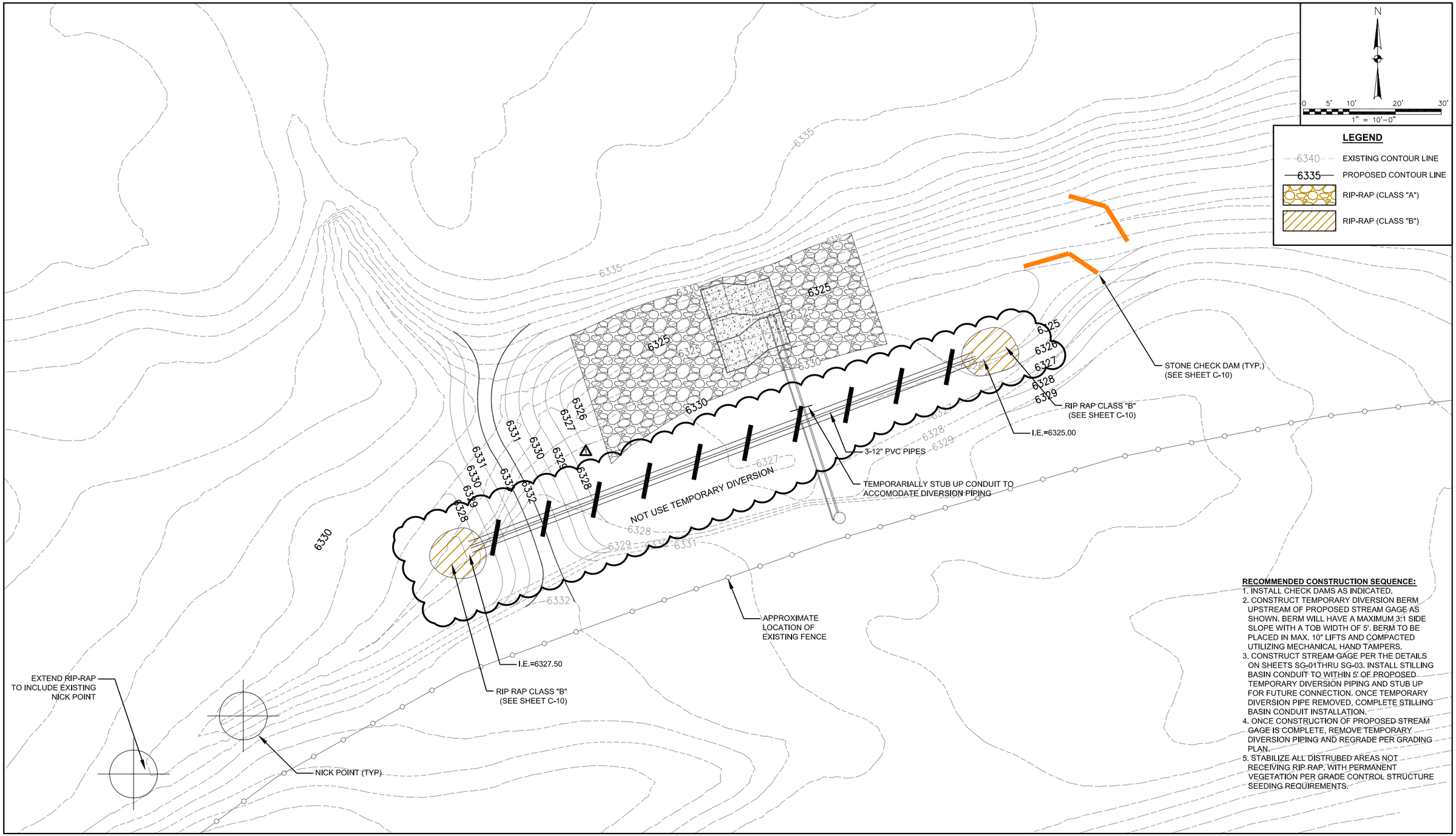
JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-04

User Name: 22190
Drawing Name: \\SAFFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-01 - C-04 - Pueblo STREAM GAGE DETAILS.dwg
May 06, 2010 - 9:53am



RECOMMENDED CONSTRUCTION SEQUENCE:

1. INSTALL CHECK DAMS AS INDICATED.
2. CONSTRUCT TEMPORARY DIVERSION BERM UPSTREAM OF PROPOSED STREAM GAGE AS SHOWN. BERM WILL HAVE A MAXIMUM 3:1 SIDE SLOPE WITH A TOB WIDTH OF 5'. BERM TO BE PLACED IN MAX. 10" LIFTS AND COMPACTED UTILIZING MECHANICAL HAND TAMPERS.
3. CONSTRUCT STREAM GAGE PER THE DETAILS ON SHEETS SG-01THRU SG-03. INSTALL STILLING BASIN CONDUIT TO WITHIN 5' OF PROPOSED TEMPORARY DIVERSION PIPING AND STUB UP FOR FUTURE CONNECTION. ONCE TEMPORARY DIVERSION PIPE REMOVED, COMPLETE STILLING BASIN CONDUIT INSTALLATION.
4. ONCE CONSTRUCTION OF PROPOSED STREAM GAGE IS COMPLETE, REMOVE TEMPORARY DIVERSION PIPING AND REGRADE PER GRADING PLAN.
5. STABILIZE ALL DISTRUBED AREAS NOT RECEIVING RIP RAP, WITH PERMANENT VEGETATION PER GRADE CONTROL STRUCTURE SEEDING REQUIREMENTS.

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	PUEBLO CANYON STREAM GAGE TEMPORARY DIVERSION AND EROSION CONTROL PLAN

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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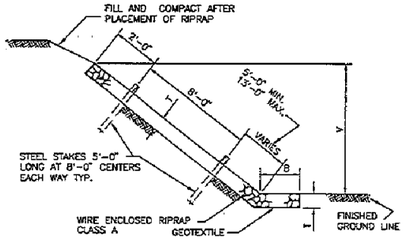
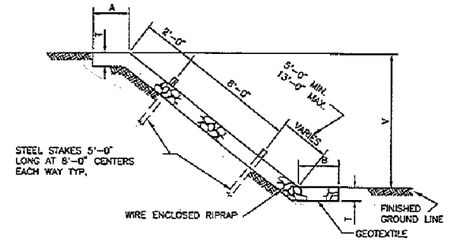
JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-05

User Name: 22190
Drawing Name: \\SAFESO1\COMMON\100005632 Los Alamos\Record Drawings\UP & Pueblo Canyon\C-05 - Pueblo STREAM GAGE BYPASS.dwg
May 06, 2010 - 9:51am



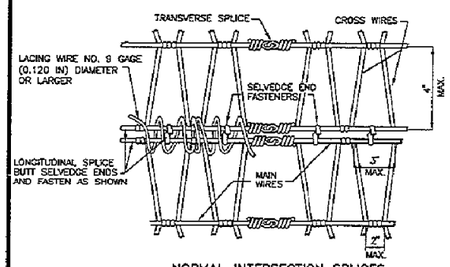
SECTION TYPE 1

QUANTITIES PER LINEAR FOOT	
SLOPE	RIPRAP CU. YARDS
1.5 : 1	$\frac{T}{27}(B + 1.803V + 0.303T)$
1.75 : 1	$\frac{T}{27}(B + 2.016V + 0.266T)$
2 : 1	$\frac{T}{27}(B + 2.236V + 0.236T)$
3 : 1	$\frac{T}{27}(B + 3.162V + 0.162T)$
4 : 1	$\frac{T}{27}(B + 4.123V + 0.123T)$

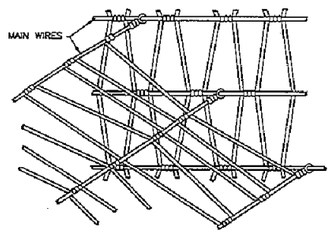


SECTION TYPE 2

QUANTITIES PER LINEAR FOOT	
SLOPE	RIPRAP CU. YARDS
1 : 1	$\frac{T}{27}(A + B + 1.414V)$
1.5 : 1	$\frac{T}{27}(A + B + 1.803V)$
1.75 : 1	$\frac{T}{27}(A + B + 2.016V)$
2 : 1	$\frac{T}{27}(A + B + 2.236V)$
3 : 1	$\frac{T}{27}(A + B + 3.162V)$
4 : 1	$\frac{T}{27}(A + B + 4.123V)$

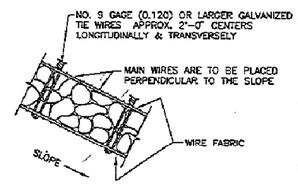


NORMAL INTERSECTION SPLICES



SKEWED INTERSECTION SPLICE

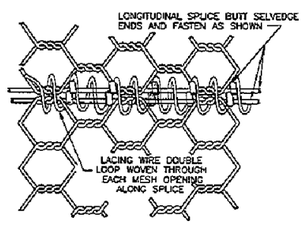
"W" MESH



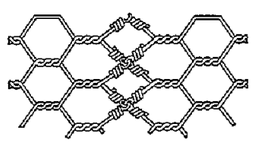
TYPICAL SECTION

GENERAL NOTES

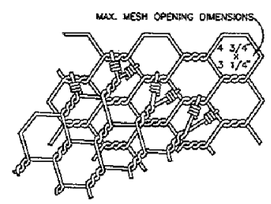
1. WIRE FABRIC FOR RIP RAP SHALL BE "W" OR HEXAGONAL MESH AND MEET THE REQUIREMENTS LISTED IN SECTION 602 OF THE STANDARD SPECIFICATIONS.
2. STEEL STAKES MAY BE RAILROAD RAILS WEIGHING NOT LESS THAN 30 LBS. PER YARD, 4" NOMINAL DIAMETER STANDARD STRENGTH GALVANIZED STEEL PIPE, OR L4"x4" x3/8" STEEL ANGLES. STEEL STAKES SHALL PROJECT 4" ABOVE TOP OF RIPRAP. STEEL STAKES ARE CONSIDERED INCIDENTAL TO THE COMPLETION OF THE WORK AND NO DIRECT MEASUREMENT OR PAYMENT WILL BE MADE THEREFOR.
3. IF LENGTH OF SLOPE IS 15 FEET OR LESS, ONLY ONE ROW OF STEEL STAKES 2 FEET FROM THE TOP EDGE OF RIPRAP WILL BE REQUIRED UNLESS OTHERWISE NOTED ON PLANS.
4. FOR DIMENSIONS A,B,V,&T SEE BRIDGE OR ROADWAY PLANS.
5. T=12" UNLESS OTHERWISE SHOWN ON PLANS. T= 18" AT BRIDGES.
6. FASTENERS FOR SPLICES AND/OR SELVEDGE END CONNECTORS MAY BE WIRE TIES, INTERLOCKING WIRE CLIPS, HOG RINGS, OR LACING WIRE. ONLY FASTENERS WHICH APPEAR ON THE DEPARTMENT'S "APPROVED PRODUCT LISTING" MAY BE USED.
7. LACING SHALL BE CONTINUOUS AS FAR AS IS PRACTICAL AND SHALL PASS THROUGH EACH MESH OPENING.
8. WHERE SPLICING IS NECESSARY, AN OVERLAP OF LACING OF AT LEAST 1 FOOT SHALL BE PROVIDED.



NORMAL INTERSECTION SPLICE



TRANSVERSE SPLICE



SKEWED INTERSECTION SPLICE

HEXAGONAL MESH

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO
DEPARTMENT OF TRANSPORTATION
STANDARD DRAWING

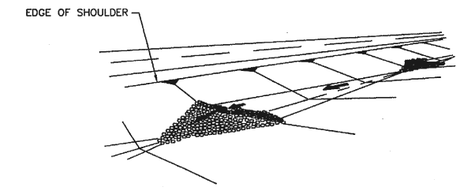
WIRE ENCLOSED RIPRAP
CLASS A

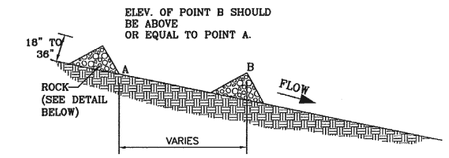
APPROVED DESIGN ENGINEER 11-27-09 DATE

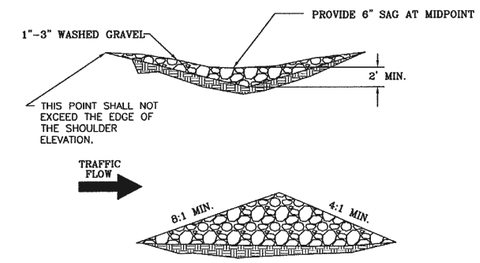
DESIGNED BY___ DRAWN BY ___ CHECKED BY ___

602-01-1/1

A C-10 | C-10 CLASS A RIP RAP DETAIL
SCALE: NTS

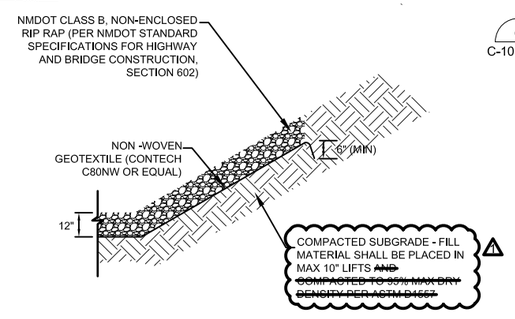






TYPE II
STONE DAM

C C-10 | C-10 CHECK DAM DETAIL (NMDOT)
SCALE: NTS



B C-10 | C-10 CLASS B RIP RAP DETAIL
SCALE: NTS

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	RIP RAP AND CHECK DAM DETAILS

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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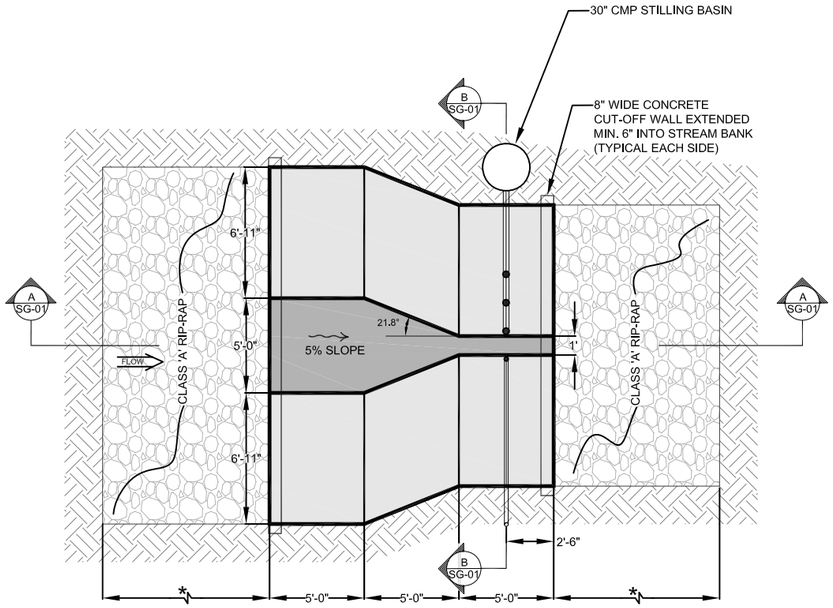
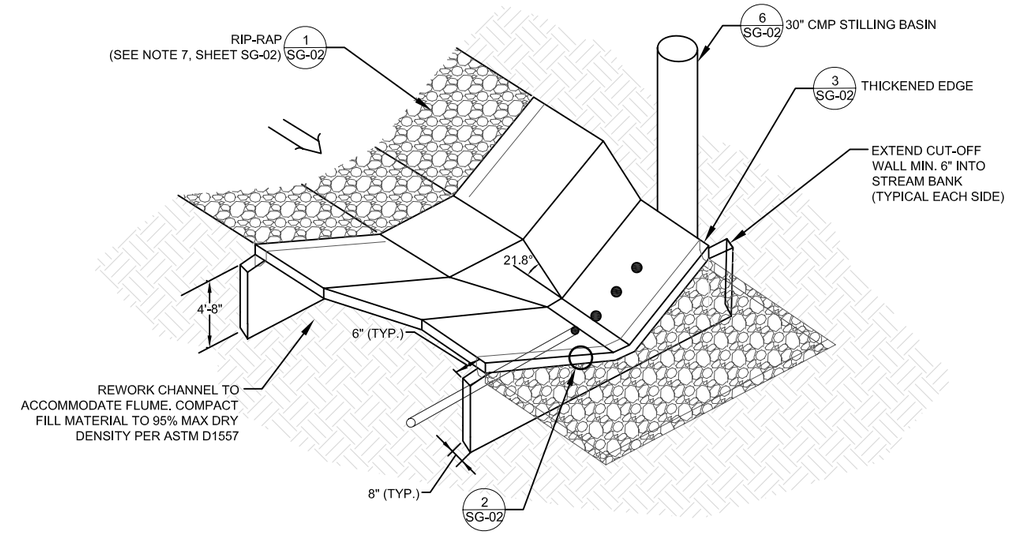
JOB NO. 100005632
DATE 12/22/09
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-10

User Name: 22190
Drawing Name: \\SAFFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\SC-01-03 AND C-10 DETAILS.dwg
May 06, 2010 - 10:02am

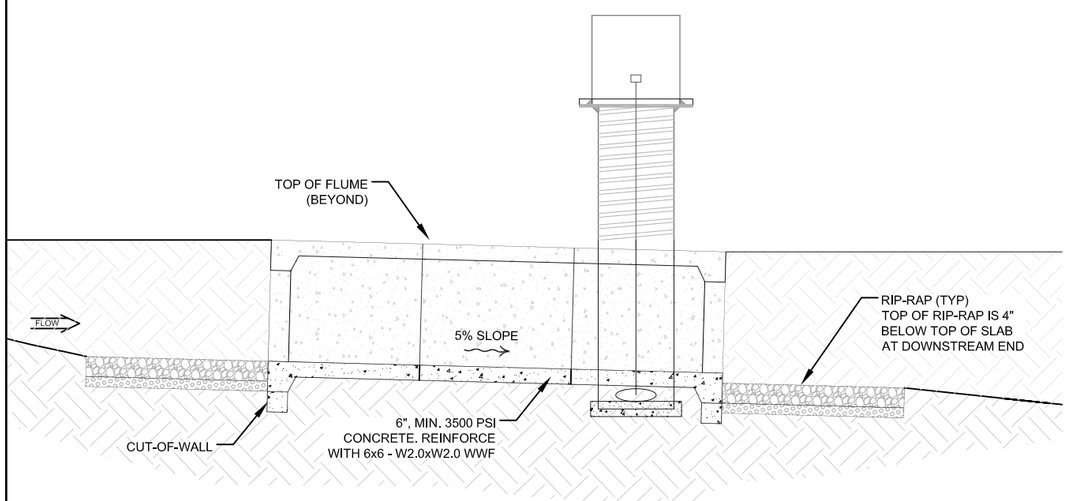


* RIP-RAP DIMENSIONS SHALL BE DETERMINED BASED ON LOCATION AND DESIGN CONDITIONS

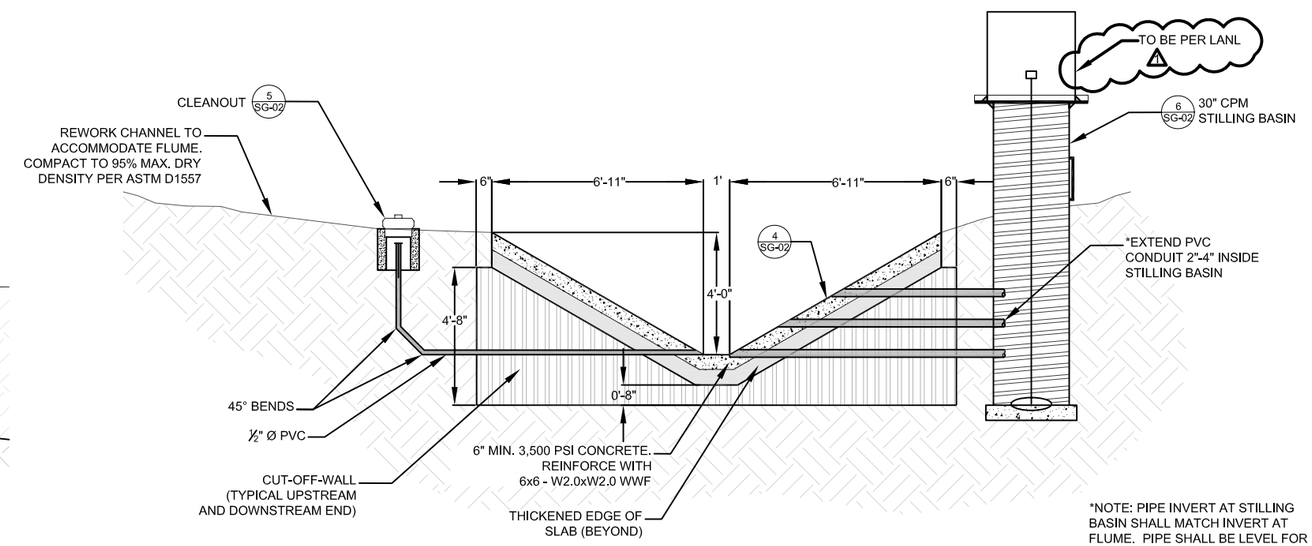
1 STREAM GAGE FLUME (PLAN VIEW)
SG-01 SCALE: N.T.S.



2 STREAM GAGE FLUME (ISOMETRIC VIEW)
SG-01 SCALE: NTS



A STREAM GAGE (SECTION THRU ℄)
SG-01 SG-01 SCALE: NTS



*NOTE: PIPE INVERT AT STILLING BASIN SHALL MATCH INVERT AT FLUME. PIPE SHALL BE LEVEL FOR ENTIRE LENGTH

B STREAM GAGE (SECTION B-B)
SG-01 SG-01 SCALE: NTS

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	STANDARD STREAM GAGE DETAILS (SHEET 1 OF 3)

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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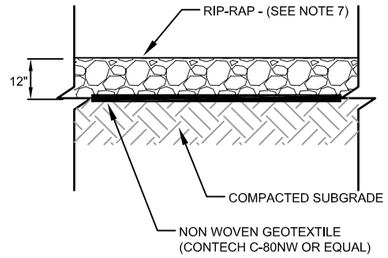
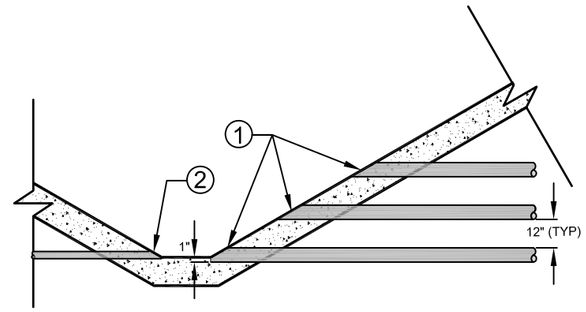
JOB NO. 100005632
DATE 12/22/09
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET SG-01

User Name: 22190
Drawing Name: \\SAFRS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\SG-01-03 AND C-10 DETAILS.dwg
May 06, 2010 - 10:02am



1 RIP-RAP
SG-01 | SG-02 SCALE: NTS



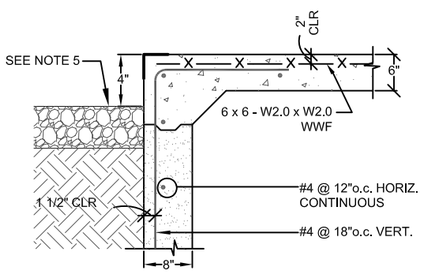
① 3-INCH Ø SCHEDULE 40 PVC. TRIM PIPE FLUSH WITH TOP OF SLAB. LOWER PIPE INVERT SHALL BE 1-INCH BELOW FLUME INVERT.

② ½-INCH Ø SCHEDULE 40 PVC. TRIM FLUSH WITH TOP OF SLAB. INVERT APPROX. ½-INCH ABOVE TOP OF SLAB.

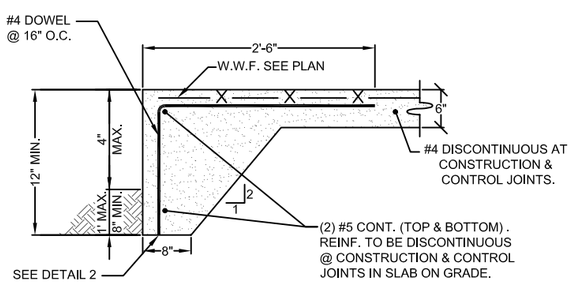
4 SECTION VIEW OF GAS PURGE STAGE MANOMETER CONDUIT & PIPE INTAKE
SG-01 | SG-02 SCALE: NTS

NOTES:

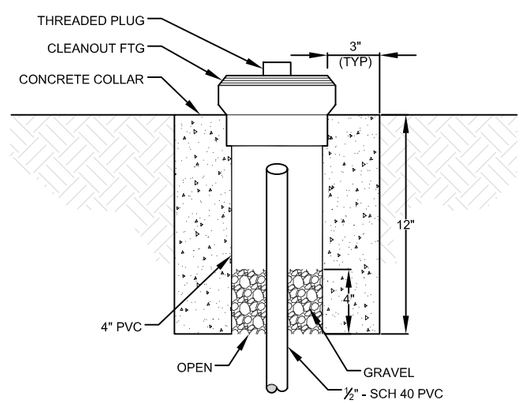
1. THE LENGTH OF STILLING WELL WILL BE DETERMINED DURING THE CONSTRUCTION OF THE STREAM GAGE.
2. METAL ENCLOSURE TO BE INSTALLED AS AN OPTION AT OWNER'S DIRECTION.
3. AS AN OPTION TO THE METAL ENCLOSURE INSTALL 3' x 3' x ¼" (t) METAL COVER PLATE. COVER PLATE SHALL BE PROVIDED WITH TWO HINGES AND A LOCKABLE HASP.
4. EXACT LOCATION OF ACCESS DOOR TO BE DETERMINED IN THE FIELD BY OWNER.
5. RIP-RAP SHALL BE FLUSH WITH TOP OF SLAB AT UPSTREAM END OF FLUME.
6. STILLING BASIN AND PIPE INTAKE SYSTEM MAY BE LOCATED EITHER SIDE OF FLUME. LOCATION TO BE DETERMINED BY OWNER ON A SITE SPECIFIC BASIS.
7. RIP-RAP SHALL BE DURABLE ROCKS OR ROUGH QUARRY STONE WITH NO MORE THAN 60% WEAR PER AASHTO T96. MINIMUM 70 TO 80 PERCENT OF STONE SHALL BE NO LESS THAN 4-INCHES AND NO MORE THAN 8-INCHES IN THE SMALLEST DIMENSION. RIP RAP SHALL BE CLASS A PER NMDOT STD. 602.



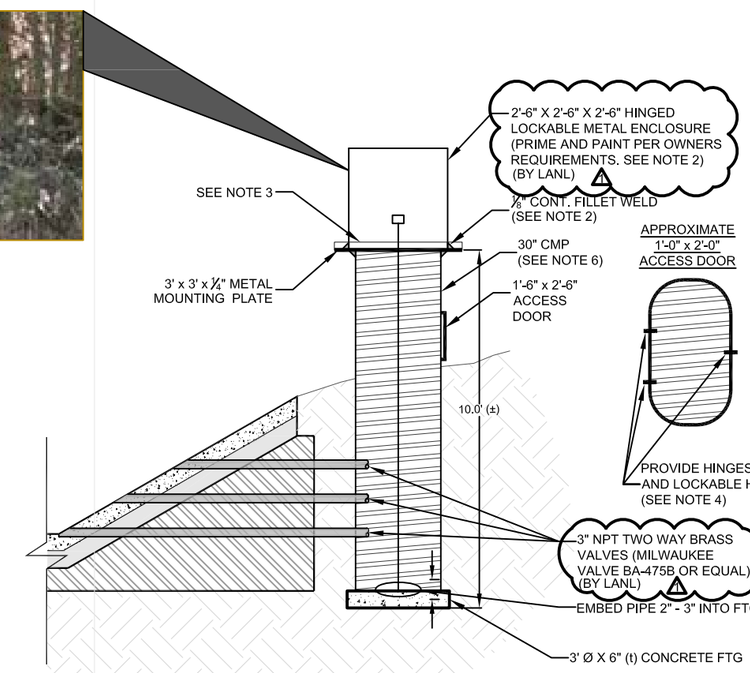
2 REBAR DETAIL
SG-01 | SG-02 SCALE: NTS



3 TYPICAL THICKENED EDGE
SG-01 | SG-02 SCALE: NTS



5 CLEANOUT DETAIL - GAS PURGE - STAGE MANOMETER CONDUIT
SG-01 | SG-02 SCALE: NTS



6 STILLING BASIN DETAIL
SG-01 | SG-02 SCALE: NTS

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	STANDARD STREAM GAGE DETAILS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	(SHEET 2 OF 3)

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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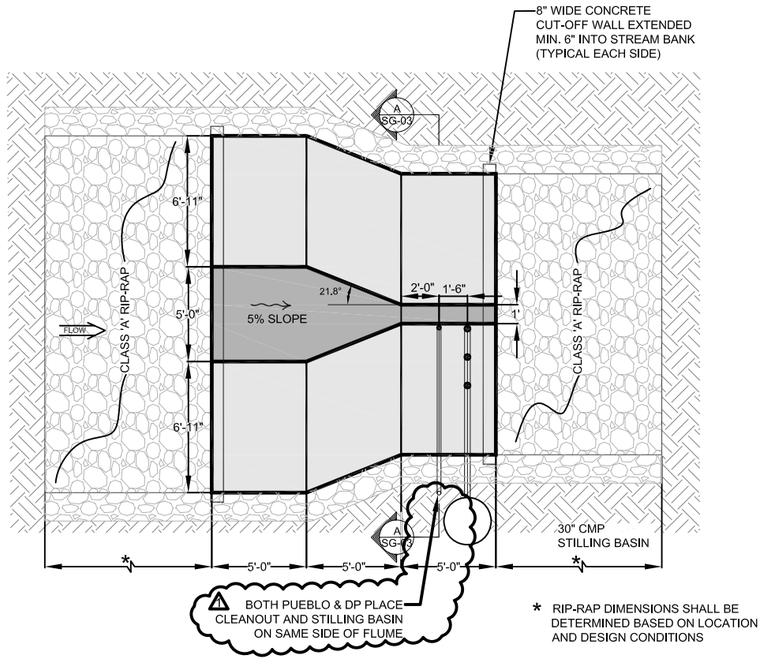
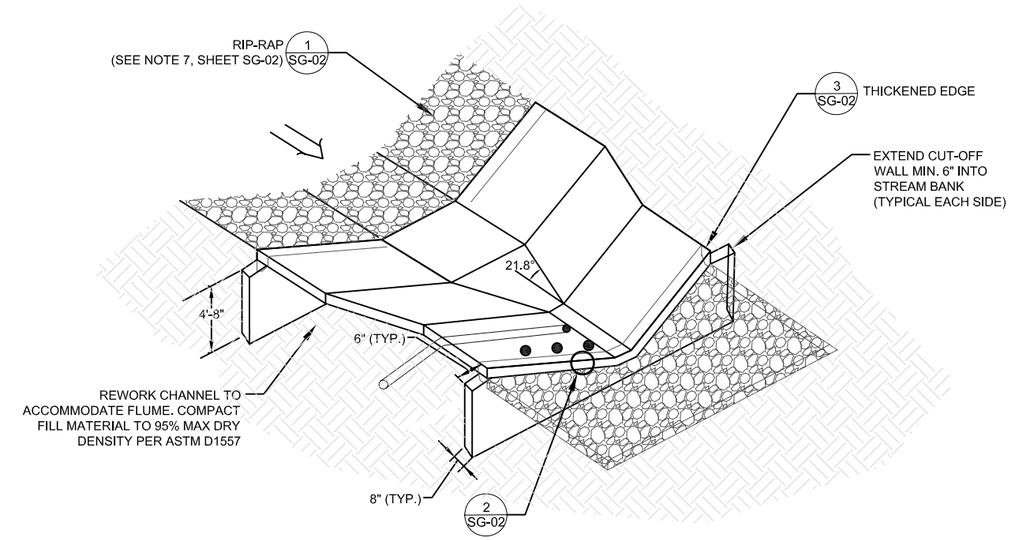
JOB NO. 100005632
DATE 12/22/09
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET SG-02

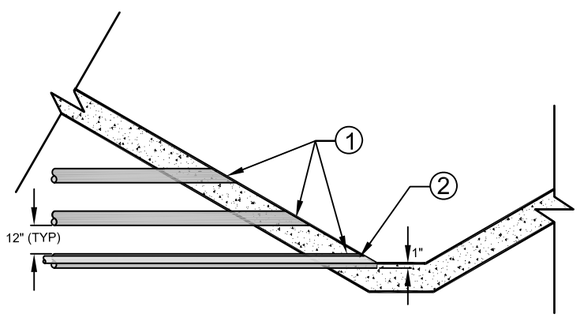
User Name: 22190
Drawing Name: \\SAFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\SG-01-03 AND C-10 DETAILS.dwg
May 06, 2010 - 10:03am



1 STREAM GAGE FLUME (PLAN VIEW)
SG-03 SCALE: N.T.S.



2 STREAM GAGE FLUME (ISOMETRIC VIEW)
SG-03 SCALE: NTS

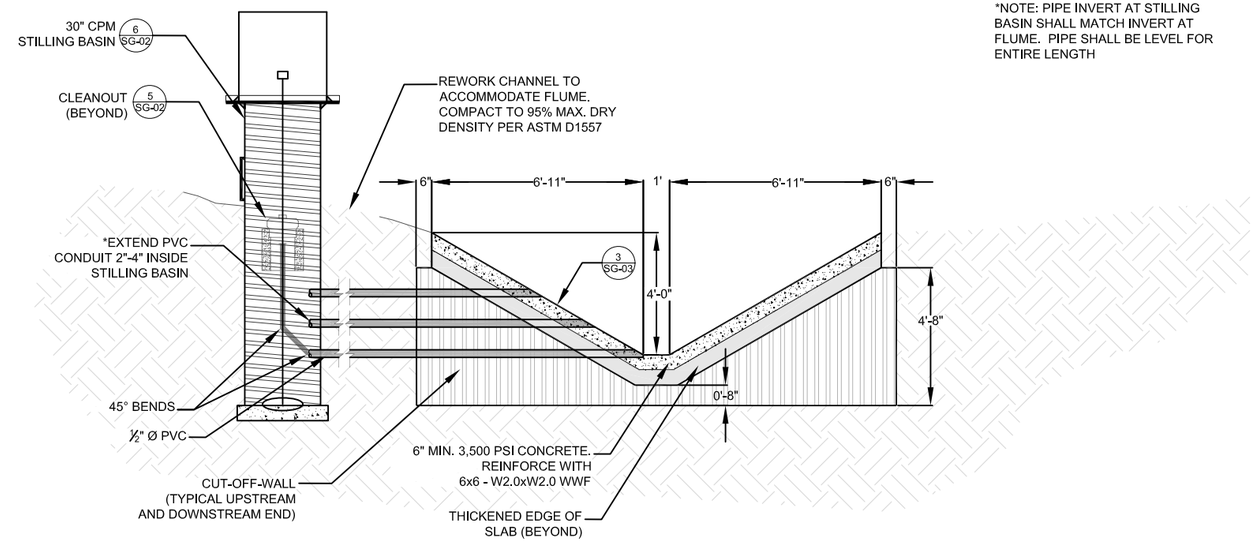


1 3-INCH Ø SCHEDULE 40 PVC. TRIM PIPE FLUSH WITH TOP OF SLAB. LOWER PIPE INVERT SHALL BE 1-INCH BELOW FLUME INVERT.

2 ½-INCH Ø SCHEDULE 40 PVC. TRIM FLUSH WITH TOP OF SLAB. INVERT APPROX. ½-INCH ABOVE TOP OF SLAB. (SEE PLAN VIEW)

3 SECTION VIEW OF GAS PURGE STAGE MANOMETER CONDUIT & PIPE INTAKE
SG-03 SG-03 SCALE: NTS

*NOTE: PIPE INVERT AT STILLING BASIN SHALL MATCH INVERT AT FLUME. PIPE SHALL BE LEVEL FOR ENTIRE LENGTH



A STREAM GAGE (SECTION B-B)
SG-03 SG-03 SCALE: NTS

PBS&J
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Post Buckley Schuh & Jernigan, Inc., d/b/a PBS&J
5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

KBR

CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	STANDARD STREAM GAGE DETAILS (OPTION)
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	(SHEET 3 OF 3)

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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JOB NO. 100005632
DATE 12/22/09
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET SG-03

User Name: 22190
Drawing Name: \\SAFESO1\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\SG-01-03 AND C-10 DETAILS.dwg
May 06, 2010 - 10:04am

Appendix B

Geotechnical Engineering Report
(on CD included with this document)

GEOTECHNICAL ENGINEERING REPORT

SEDIMENT GRADE CONTROL STRUCTURES
DP AND PUEBLO CANYONS
LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

TERRACON PROJECT NO. 66095039
August 31, 2009

Prepared for:

PBS&J
101Arthur Andersen Parkway, Suite 260
Sarasota, Florida 43232

Attn: Mr. R. Michael Peel, P.E.
Senior Project Manager

Prepared by:

TERRACON CONSULTANTS, INC.
4905 Hawkins NE
Albuquerque, New Mexico 87109
Phone: (505) 797-4287
Fax: (505) 797-4288

Terracon

August 31, 2009

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232

Attn: Mr. R. Michael Peel, P.E
Senior Project Manager

Re: Geotechnical Engineering Report
Sediment Grade Control Structures
DP and Pueblo Canyons
Los Alamos National Laboratory
Los Alamos County, New Mexico
Terracon Project No. 66095039

Dear Mr. Peel:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering exploration for the proposed sediment grade control structures in Los Alamos, New Mexico. This study was performed in general accordance with our revised Proposal No. P6609-0061 dated April 16, 2009.

The results of our engineering study, including the Area Map, Exploration Location Diagrams, laboratory test results, Logs of Borings and Test Pits, and the geotechnical recommendations needed to aid in the design and construction of the structures and other earth connected phases of this project are attached.

We appreciate being of service to you in the geotechnical engineering phase of this project, and are prepared to assist you during the construction phases as well. If you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact us.

Sincerely,

TERRACON CONSULTANTS, INC.

Meagan J. Duneman, E.I.
Staff Engineer

Michael E. Anderson, P.E.
Principal

MICHAEL E. ANDERSON
NEW MEXICO
12132
PROFESSIONAL ENGINEER

Copies to: Addressee (3 hard copies, 1-email)

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GEOTECHNICAL ENGINEERING REPORT
SEDIMENT GRADE CONTROL STRUCTURES
DP AND PUEBLO CANYONS
LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

TERRACON PROJECT NO. 66095039
August 31, 2009

INTRODUCTION

This report contains the results of our geotechnical engineering exploration for the proposed sediment grade control structures in Los Alamos, New Mexico. The location of the two sites with respect to the surrounding roads and general topography is shown on the Area Map, Figure A1 in Appendix A.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil/bedrock conditions,
- groundwater conditions,
- structure support,
- lateral earth pressures,
- earthwork.

The recommendations contained in this report are based upon results of field and laboratory testing, engineering analyses, experience with similar soil/bedrock conditions and structures, and our understanding of the proposed project.

PROPOSED CONSTRUCTION

Based on the provided information, we understand that the project will consist of the construction of sediment grade control structures at the Pueblo Canyon and DP Canyon sites. The structure at each site will consist of a gabion drop structure comprised of 3 feet wide, 3 feet long, and 6 feet deep units. The gabions will be embedded one course below the ground surface to prevent scouring and undermining the structures, along with providing stability. In addition, the upstream side will be wrapped in a geotextile filter fabric to minimize transport of fine sediments during early stages of use. The maximum height of the gabion drop structures will range from about 9 to 12 feet. The gabion drop structures will be designed to resist potential hydrostatic/flood loads and to resist overturning and sliding.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is

concerned about the potential for such contamination or pollution, other studies should be undertaken.

SITE OBSERVATIONS

During the site visits performed as part of the Kick-off meeting on August 11, 2009, it appeared that relatively shallow volcanic tuff bedrock was exposed within portions of the channel within the drainage at each proposed structure location.

Based upon our observations at the Pueblo Canyon site, the bedrock exposed at this location was weakly welded and "soft". In some cases several feet of alluvium is situated above the suspected bedrock. Accessibility to this site was fairly remote due to existing vegetation and trees and the lack of an access road to this area.

Based upon our visual observations, the bedrock exposed at the DP site was more strongly welded and harder than the Pueblo Canyon site. Existing piezometers had been installed in this area to observe shallow water conditions during storm events. It is our understanding that information associated with the installation of these piezometers indicates that bedrock is about 3 to 5 feet below existing site grade. Accessibility to this site was relatively good, via an unpaved and/or gravel surfaced road.

SITE EXPLORATION

The scope of the services performed for this project included site reconnaissance by a Terracon representative, a subsurface exploration program, laboratory testing and engineering analyses.

Field Exploration: A total of five (5) explorations were performed on August 19, 2009. The location, depths, and type of exploration are summarized in the following:

Location	Type of Exploration	Depth of Exploration (ft.)
DP Canyon – South Side	Boring (B-01)	15-1/2
DP Canyon - North Side	Test Pit (TP-01)	5-1/2*
Pueblo Canyon – Floodplain	Test Pit (TP-02)	9-1/2
Pueblo Canyon – Drainage	Test Pit (TP-03)	9-1/2
Pueblo Canyon – Channel	Test Pit (TP-04)	11

*Test pit refusal encountered

The approximate locations of the explorations are shown on the Exploration Location Diagrams, Figure A2a and A2b in Appendix A. The boring was advanced with a truck-mounted drilling rig, utilizing 7-½ inch outside-diameter hollow-stem augers. The test pits were performed with a rubber-tired backhoe using a 24-inch bucket.

The explorations were located in the field based upon the site plan prepared by PBS&J and measurements from existing site features. The accuracy of exploration locations should only be assumed to the level implied by the methods used to determine each.

Lithologic logs of the explorations were recorded by the Terracon representative during the drilling/excavation operations. At selected intervals within the boring, samples of the subsurface materials were taken by driving standard split-spoon or ring-barrel samplers. In addition, bulk disturbed samples were obtained at selected intervals in the test pits.

Penetration resistance measurements performed in the boring were obtained by driving the split-spoon and ring-barrel into the subsurface materials with a 140-pound hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency, relative density or hardness of the materials encountered.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the boring performed at the DP Canyon site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

In addition to obtaining penetration resistance measurements, bedrock core drilling operations were performed in the boring at the DP Canyon site, coring operations were performed. The bedrock was cored using NX coring methods. A minimum 10-foot core sample was obtained. Rock Quality Designation (RQD) was recorded for each 5-foot core run.

Groundwater conditions were evaluated in the explorations at the time of site exploration, and immediately upon completion of drilling/excavating.

Laboratory Testing: Samples retrieved during the field exploration were taken to the laboratory for observation by the project geotechnical engineer and were classified in general accordance with the Unified Soil Classification System and Rock Descriptions in Appendix C. At that time, an applicable laboratory testing program was formulated to determine the engineering properties of the subsurface materials and the field descriptions were confirmed or modified as necessary. Boring and Test Pit Logs were prepared and are presented in Appendix A.

Laboratory tests were conducted on selected soil and bedrock samples and are presented in Appendix B and on the Logs of Boring and Test Pits. The test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with applicable accepted standards.

Selected soil and/or bedrock samples were tested for the following engineering properties:

- Water Content
- Unconfined Compressive Strength
- Soluble Sulfates
- Resistivity
- Percent Fines/Gradation
- Plasticity Index
- Dry Density
- pH

SITE CONDITIONS

DP Canyon: The proposed site is located within an existing drainage north of DP Road and the TSTA Building. The site is undeveloped, with the exception of an unpaved and/or gravel surfaced access road that parallels the existing drainage. Existing piezometers were observed directly west of the project site. A gauge station and equipment shelters were observed directly south of the proposed site. Vegetation consisted of a sparse to heavy growth of native brush and grasses. The site generally slopes down to the east, along the existing drainage.

Pueblo Canyon: The proposed site is located within an existing drainage northwest of State Highway 502 and 4. The site is undeveloped. An unpaved and/or gravel surfaced road that parallels the existing drainage and gauge station are located upstream from the project site. In addition, a New Mexico Department of Transportation maintenance patrol yard is located northwest of the project site. Vegetation consisted of a sparse to heavy growth of native brush and grasses. The site generally slopes down to the south and southeast, along the existing drainage.

SUBSURFACE CONDITIONS

DP Canyon: As presented on the Log of Boring and Log of Test Pit, the surface soils consisted of silty sand (SM) to a depth of about 2 to 3 feet below existing site grade. Volcanic tuff bedrock was encountered below the silty sand and extended down to the full depth of exploration. Test pit excavation refusal was encountered in Test Pit TP-01at a depth of about 5-1/2 feet below existing site grade. The tuff bedrock varied from non-welded to strongly welded.

Pueblo Canyon: As presented on the Logs of Test Pits, the surface and subsurface soils consisted of well graded sand with silt and gravel (SW-SM), poorly graded sand with gravel (SP), silty sand (SM), and sandy silt (ML) to the full depth of exploration. Auger refusal was not encountered in the test pits.

Field and Laboratory Test Results: Correlation to field penetration test results indicates that the tuff bedrock varies from medium heard to very hard in hardness.

Laboratory test results indicate that the sands and silts are non-plastic in plasticity. Based upon our experience with similar soil conditions and our observations performed during drilling/excavation, it is our opinion that the sand soils will likely exhibit low to moderate compressibility under anticipated loads. Furthermore, it is our opinion that the sand soils will likely exhibit low to moderate potential for hydro-compaction when elevated in moisture content.

Results of the unconfined compressive strength testing performed on the tuff bedrock at a depth of about six feet below existing site grade, indicated a value of 112,032 pounds per square foot (778 pounds per square inch).

Results of the chemical laboratory testing, performed on two subsurface samples obtained within each site indicate that the soluble sulfate concentrations are about 17 mg/kg, the pH values range between 6.8 to 7.1, and the resistivities range between 10,900 to 27,400 ohms-cm.

Groundwater Conditions: Groundwater was not encountered in the explorations at the time of field exploration. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors.

Fluctuations in groundwater levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells, and periodic measurement of groundwater levels over a sufficient period of time. The possibility of groundwater fluctuations will need to be considered when developing design and construction plans for the project.

ENGINEERING ANALYSES AND RECOMMENDATIONS

Geotechnical Considerations: The sites appear suitable for the proposed construction. However, medium hard to very hard volcanic tuff bedrock was encountered at depths of about 2 to 3 feet below existing site grade at the DP Canyon site. Test pit excavation refusal was encountered at a depth of about 5-1/2 feet below existing site grade. Difficult excavation techniques may be required in this area depending on the final excavation depths. A qualified contractor should review the data and information contained in this report to determine the appropriate equipment required to advance the excavations to construction depths. It should be noted that a limited number of explorations were performed at both sites; therefore, the subsurface conditions encountered during construction could vary form those encountered as part of this study.

In addition, potentially compressible soils at shallow depths which show low to moderate tendency for compressibility at in-situ moisture contents and low to moderate tendency for hydro-compaction when elevated in moisture content will require particular attention in the design and construction.

Based on the geotechnical analyses, subsurface information and laboratory results, it is our opinion that the proposed structures can be supported on the existing soils or tuff bedrock at the sites.

Design and construction recommendations for structure support and other earth connected phases of the project are outlined below.

Structure Support: Based upon the boring and test pit information, and our experience with similar soil and bedrock conditions, the allowable bearing pressure of the sands is anticipated to be on the order of about 2,000 pounds per square foot (psf). A conservative allowable bearing pressure for the tuff bedrock is anticipated to be on the order of about 3,500 psf.

Total settlement of the structure designed to the maximum bearing pressure is estimated to be on the order of one to 2 inches. Due to the potential for unstable or very loose subgrade soils or seasonal groundwater at the base of the structures, a 12-inch gravel or rock layer may be required below the structures to provide a stable working/construction platform.

Foundation excavations and engineered fill placement should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Lateral Earth Pressures: The recommended equivalent fluid pressures for unrestrained foundation elements when using on-site soils as backfill are:

Active:

- Sand Soils ..... 35 psf/ft

Passive:

- Sand Soils ..... 390 psf/ft

Coefficient of base friction:

- Sand Soils 0.40*

*The coefficient of base friction should be reduced to 0.35 when used in conjunction with passive pressure.

Where the design includes restrained elements, the following equivalent fluid pressure is recommended:

At Rest:

- Sand Soils ..... 55 psf/ft

The above lateral earth pressures and coefficient do not include any factor of safety. Additional recommendations may be necessary if such conditions are to be included in the design.

Fill against the structures should be compacted to densities specified in the Earthwork section of this report. Compaction of each lift adjacent to structures should be accomplished with hand-operated tampers or other lightweight compactors. Overcompaction may cause higher lateral earth pressures which could result in movements.

Geotextile Filter Fabric: We recommend that a non-woven geotextile fabric be used to prevent the migration of fines from entering the Gabion structure. The fabric specified should be compatible with the on-site soils and meet minimum strength, permittivity, and flow rate requirements.

Earthwork:

- **General Considerations:** The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations and slabs are contingent upon following the recommendations outlined in this section.

  Earthwork on the project should be observed and evaluated by Terracon Consultants, Inc. The evaluation of earthwork should include observation and testing

of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

- **Site Preparation:** Strip and remove the existing vegetation, debris, and other deleterious materials from proposed structure areas. Exposed surfaces should be free of mounds and depressions, which could prevent uniform compaction.

  Stripped materials consisting of vegetation and organic materials should be wasted from the site, or used to revegetate landscaped areas or exposed slopes after completion of grading operations.

  If fill is placed in areas of the site where existing slopes are steeper than 5:1 (horizontal: vertical), the area should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be wide enough to accommodate compaction and earth moving equipment and to allow placement of horizontal lifts of fills.

  It is anticipated that shallow excavations in some areas for the proposed construction can be accomplished with conventional earthmoving equipment. However, very hard bedrock materials, and auger refusal materials were encountered at depths ranging between 2 and 3 feet below existing ground surface. Based upon the boring and test pit data, this condition appears to be associated with the DP Canyon site. Difficult excavation techniques may be required in this area depending on the final excavation depths. A qualified contractor should review the data and information contained in this report to determine the appropriate equipment required to advance the excavations to construction depths. It should be noted that a limited number of explorations were performed at both sites; therefore, the subsurface conditions encountered during construction could vary form those encountered as part of this study.

  Groundwater was not encountered to depths of about 5-1/2 to 11 feet below existing site grades. However, depending upon the season during construction, groundwater could be encountered at the project sites. Therefore, groundwater control measures could be required depending on the construction excavation depths.

  Based upon the subsurface conditions determined from the geotechnical exploration, it is our opinion that the shallow subgrade soils exposed during construction are anticipated to be relatively stable; however, groundwater could be encountered during construction. The stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unstable conditions develop, workability may be improved by scarifying and drying. Overexcavation of wet zones and replacement with granular materials may be necessary. Use of cement or geotextiles could also be considered as a stabilization technique. Laboratory

evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction. Lightweight excavation equipment may be required to reduce subgrade pumping.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

- **Subgrade Preparation:** Exposed areas which will receive fill of the initial course of the gabion structure, once properly cleared, should be scarified to a minimum depth of 10 inches, conditioned to near optimum moisture content, and compacted.

- **Fill Materials and Placement:** Generally, clean on-site soils or approved imported materials may be used as fill material (if applicable) for the site. The fill materials should conform to the following:

Gradation	Percent finer by weight (ASTM C136)
6"	100
3"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	35 (max)
• Liquid Limit	30 (max)
• Plasticity Index	12 (max)

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed 10 inches loose thickness. Recommended compaction criteria for engineered fill materials are as follows:

Material	Minimum Percent (ASTM D1557)
Scarified subgrade soils	90
Miscellaneous backfill (non-structural areas)	85

Imported soils should be compacted within a moisture range of optimum to 3 percent above optimum if the materials have a PI of 5 or more. On-site soils and import soils that have a PI of less than 5 should be compacted within a moisture range of +/-3 percent of optimum moisture content.

- **Excavation and Trench Construction:** Excavations into the on-site materials will likely encounter caving soils and possibly groundwater, depending upon the final depth of excavation. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

  The soils or bedrock to be penetrated by the proposed excavations may vary significantly across the site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

  As a safety measure, it is recommended that all vehicles and soil piles be kept to a minimum lateral distance from the crest of the slope equal to no less than the slope height. The exposed slope face should be protected against the elements.

  The contractor should retain a geotechnical engineer to monitor the soils/bedrock exposed in all excavations and provide engineering services for slopes. This will provide an opportunity to monitor the soil types encountered and to modify the excavation slopes as necessary. It also offers an opportunity to verify the stability of the excavation slopes during construction.

Additional Design and Construction Considerations:

- **Exterior Slab Design and Construction:** Exterior slabs-on-grade, exterior architectural features, and utilities founded on, or in fill/backfill or undisturbed soils may experience some movement due to the volume change of the backfill. To reduce the potential for damage caused by movement, we recommend:

  - using granular fill
  - minimizing moisture increases in the backfill/undisturbed soils
  - controlling moisture-density during placement of backfill
  - using designs which allow vertical movement between the exterior features and adjoining structural elements
  - placing effective control joints on relatively close centers

- **Corrosion Protection:** Results of the chemical laboratory testing, performed on two subsurface samples obtained within each site indicate that the soluble sulfate concentrations are about 17 mg/kg, the pH values range between 6.8 to 7.1, and the resistivities range between 10,900 to 27,400 ohms-cm.

Results of the chemical laboratory test results indicate that the soils tested have a mild potential for corrosion of concrete and a mild potential for corrosion of ferrous metals.

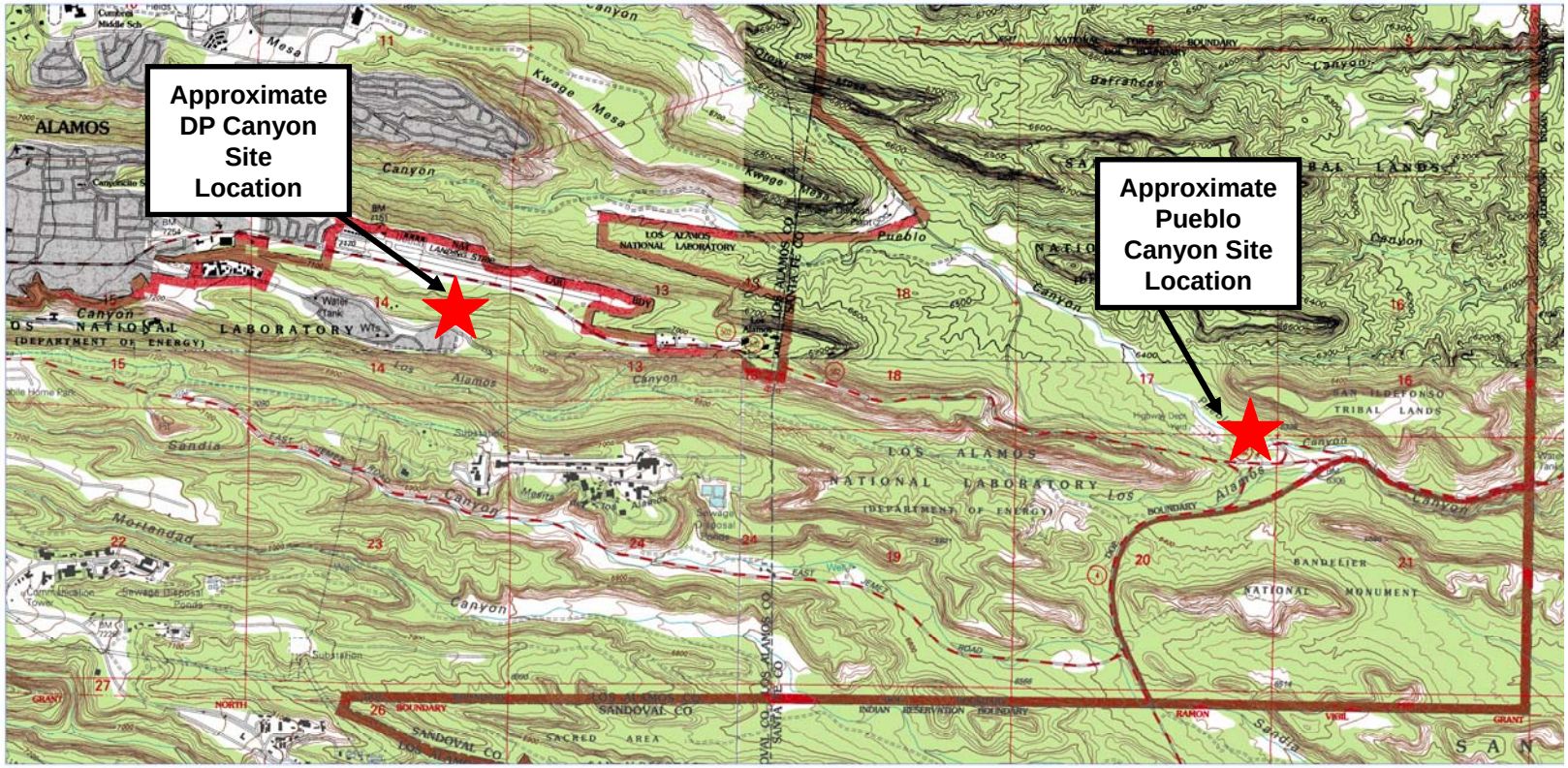
GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.



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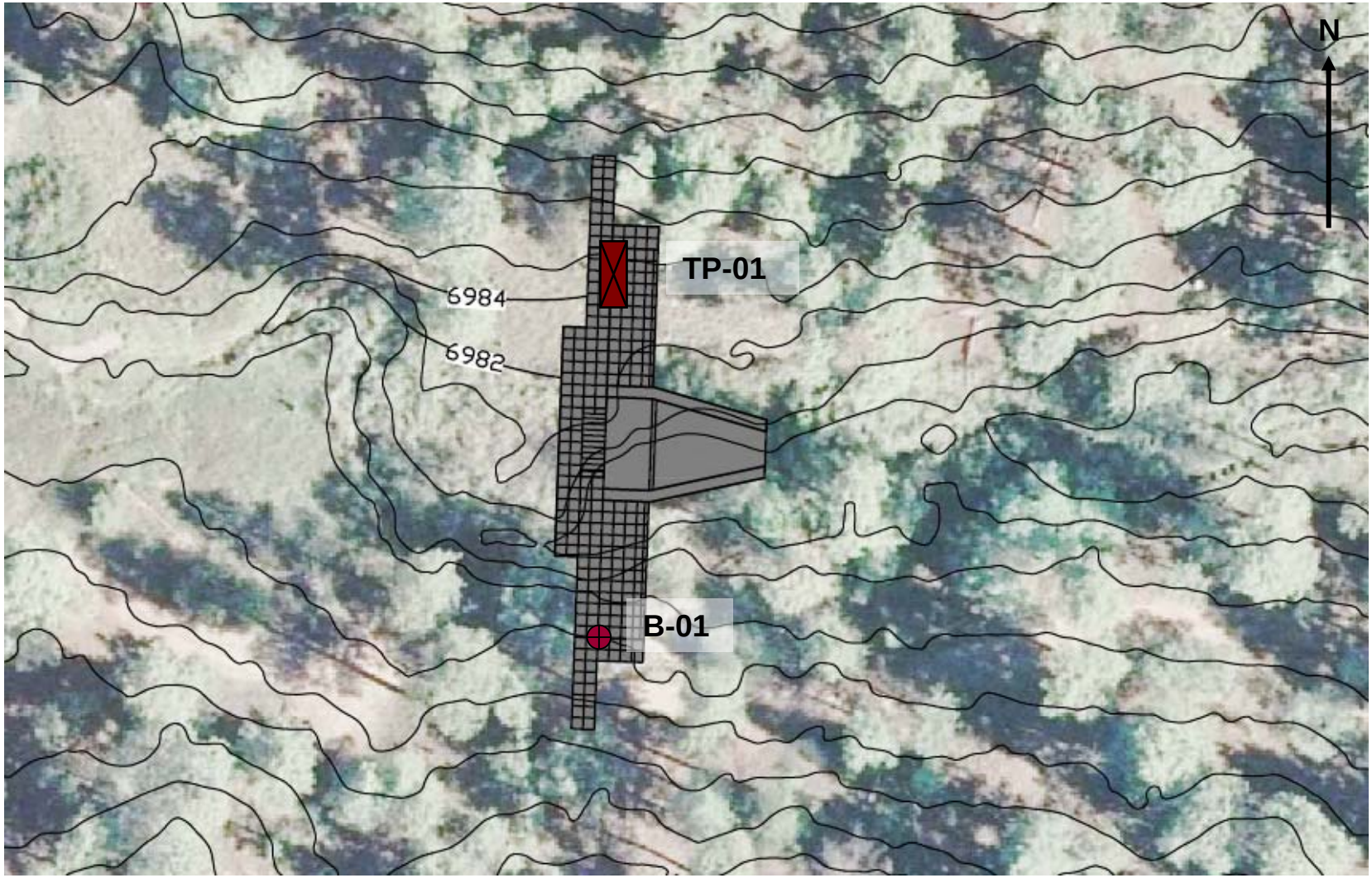
1000 0 2000 4000 6000 8000 10,000 Feet

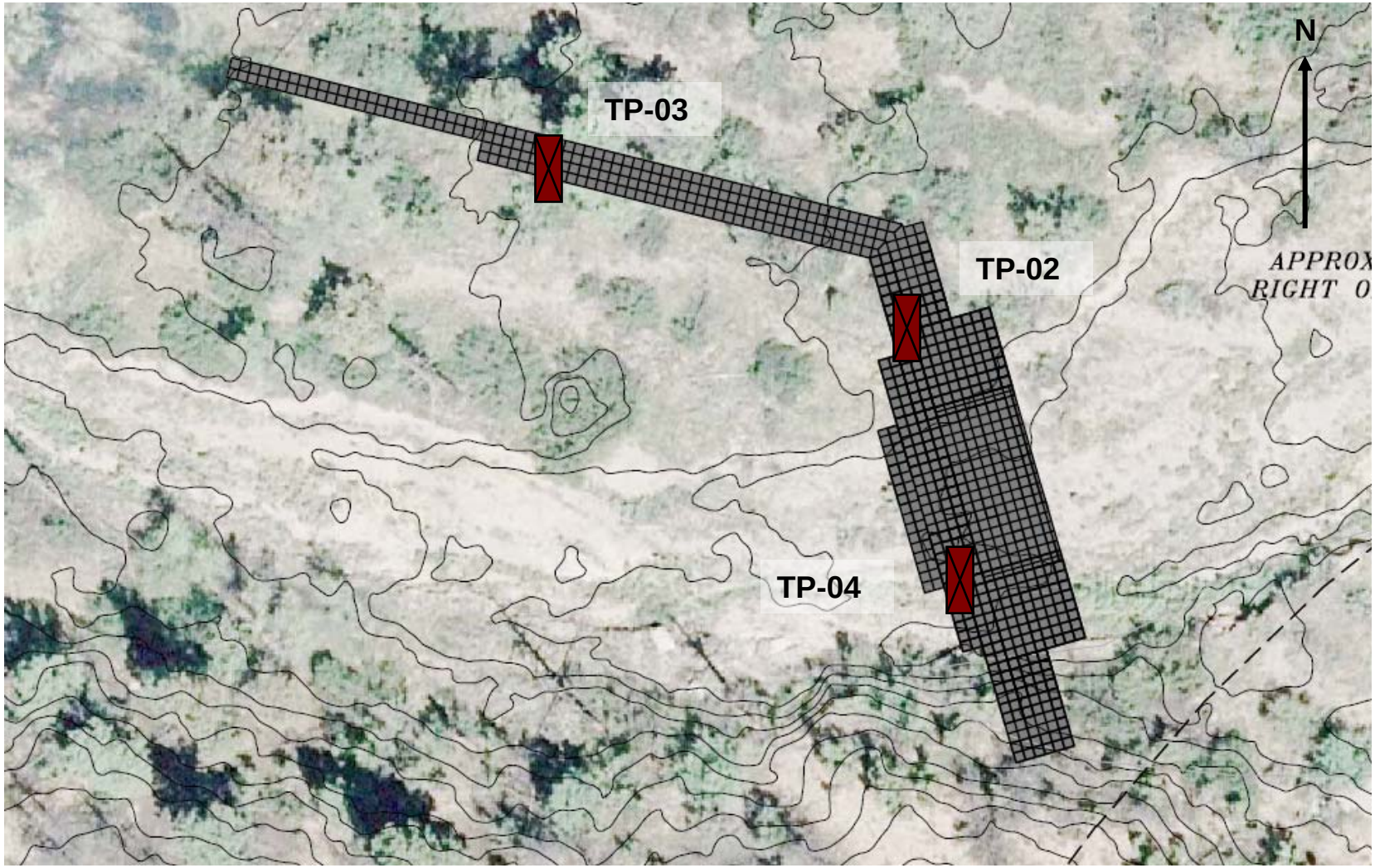
1,000 Meters 500 0 ½ 1 2 Kilometers

Source: USGS 7.5-Minute Topographic Maps "Puye", "Frijoles", "White Rock", and "Guaje Mountain", New Mexico, United States, dated 2002

Project Mngr: MJD	Project No. 66095039	Terracon Consulting Engineers and Scientists 4905 Hawkins St. NE Albuquerque, New Mexico 87109 Phone: 505.797.4287 Fax 505.797.4288	**AREA MAP**	FIG. No.
Drawn By:	Scale: As Shown		Sediment Grade Control Structures Pueblo Canyon Los Alamos County, New Mexico	A1
Checked By: MEA	File No.			
Approved By: MEA	Date: 8/2009			



Project Mngr: MJD	Project No. 66095039	Terracon Consulting Engineers and Scientists 4905 Hawkins St. NE Albuquerque, New Mexico 87109 Phone: 505.797.4287 Fax 505.797.4288	**EXPLORATION LOCATION DIAGRAM**	FIG. No.
Drawn By:	Scale: NTS		Sediment Grade Control Structures DP Canyon Los Alamos County, New Mexico	A2a
Checked By: MEA	File No.			
Approved By: MEA	Date: 8/2009			



Project Mngr: MJD	Project No. 66095039	Terracon Consulting Engineers and Scientists 4905 Hawkins St. NE Albuquerque, New Mexico 87109 Phone: 505.797.4287 Fax 505.797.4288	**EXPLORATION LOCATION DIAGRAM**	FIG. No.
Drawn By:	Scale: NTS		Sediment Grade Control Structures Pueblo Canyon Los Alamos County, New Mexico	A2b
Checked By: MEA	File No.			
Approved By: MEA	Date: 8/2009			

B-01

5.5 to 15.5 Feet

Project Mngr: MJD	Project No. 66095039	Terracon Consulting Engineers and Scientists 4905 Hawkins St. NE Albuquerque, New Mexico 87109 Phone: 505.797.4287 Fax 505.797.4288	**ROCK CORE PHOTOGRAPH**	FIG. No.
Drawn By:	Scale: NTS		Sediment Grade Control Structures Pueblo Canyon Los Alamos County, New Mexico	A3
Checked By: MEA	File No.			
Approved By: MEA	Date: 8/2009			

LOG OF BORING NO. B-01

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	SILTY SAND; trace gravel, brown									
2										
	VOLCANIC TUFF BEDROCK; grey, medium hard to very hard, slightly to very fractured, non- to strongly welded			1	RS	6	50	6	91	
				2	SS	14	50/0.4	5		
		5								
				3	C	100%	RQD 67%		101	112032
		10								
				4	C	95%	RQD 80%			
		15								
15.5										
	Boring Terminated at 15.5 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WD	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG	CME-75	FOREMAN	MJD
APPROVED	MEA	JOB #	66095039

LOG OF TEST PIT NO. TP-01

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	SILTY SAND; trace gravel, brown		SM	1	GRAB			4		
3										
	VOLCANIC TUFF BEDROCK; grey, non- to weakly welded			2	GRAB			2		
		5								
5.5										
	Test Pit Excavation Refusal at 5.5 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WE	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG		FOREMAN	MJD
APPROVED	MEA	JOB #	66095039

LOG OF TEST PIT NO. TP-02

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	WELL-GRADED SAND with SILT and GRAVEL; brown		SW SM	1	GRAB			2		
			SW SM	2	GRAB			4		
		5								
	6									
	SILTY SAND; trace gravel, brown		SM	3	GRAB			10		
	9.5									
	Test Pit Terminated at 9.5 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WE	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG		FOREMAN	MJD
APPROVED	MEA	JOB #	66095039

LOG OF TEST PIT NO. TP-03

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	SILTY SAND; trace gravel, brown									
2										
	POORLY GRADED SAND with GRAVEL; brown		SP	1	GRAB			4		
		5								
			SP	2	GRAB			9		
7										
	SILTY SAND; trace gravel, brown									
			SM	3	GRAB			5		
9.5										
	Test Pit Terminated at 9.5 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WE	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG		FOREMAN	MJD
APPROVED	MEA	JOB #	66095039

LOG OF TEST PIT NO. TP-04

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

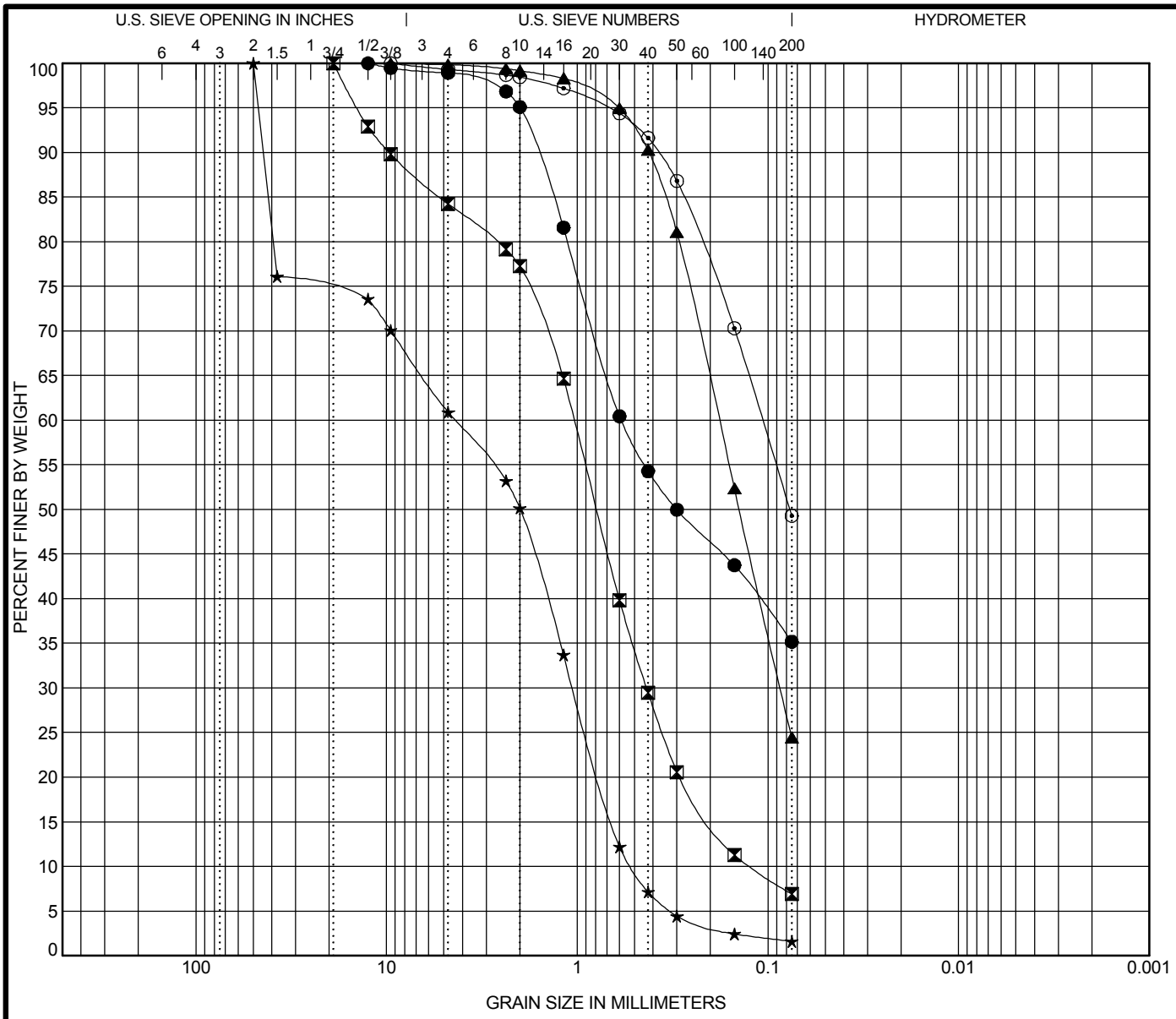
GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	SILTY SAND; trace gravel, brown		SM	1	GRAB			11		
			SM	2	GRAB			13		
			SM	3	GRAB			21		
		5								
			SM	4	GRAB			29		
	9 **SANDY SILT**; trace gravel, brown	10	ML	5	GRAB			26		
	11 Test Pit Terminated at 11 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WE	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG		FOREMAN	MJD
APPROVED	MEA	JOB #	66095039



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	TP-01	0.0ft	SILTY SAND(SM)	NP	NP	NP		
⊠	TP-02	4.0ft	WELL-GRADED SAND with SILT and GRAVEL(SW-SM)	NP	NP	NP	1.47	8.46
▲	TP-02	7.0ft	SILTY SAND(SM)	NP	NP	NP		
★	TP-03	2.0ft	POORLY GRADED SAND with GRAVEL(SP)	NP	NP	NP	0.49	8.47
⊙	TP-03	8.0ft	SILTY SAND(SM)	NP	NP	NP		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-01	0.0ft	12.5	0.585			1.1	63.8	35.2	
⊠	TP-02	4.0ft	19	1.039	0.433	0.123	15.8	77.3	6.9	
▲	TP-02	7.0ft	9.5	0.18	0.086		0.2	75.4	24.5	
★	TP-03	2.0ft	50	4.376	1.05	0.517	39.1	59.3	1.6	
⊙	TP-03	8.0ft	9.5	0.107			0.7	50.0	49.3	

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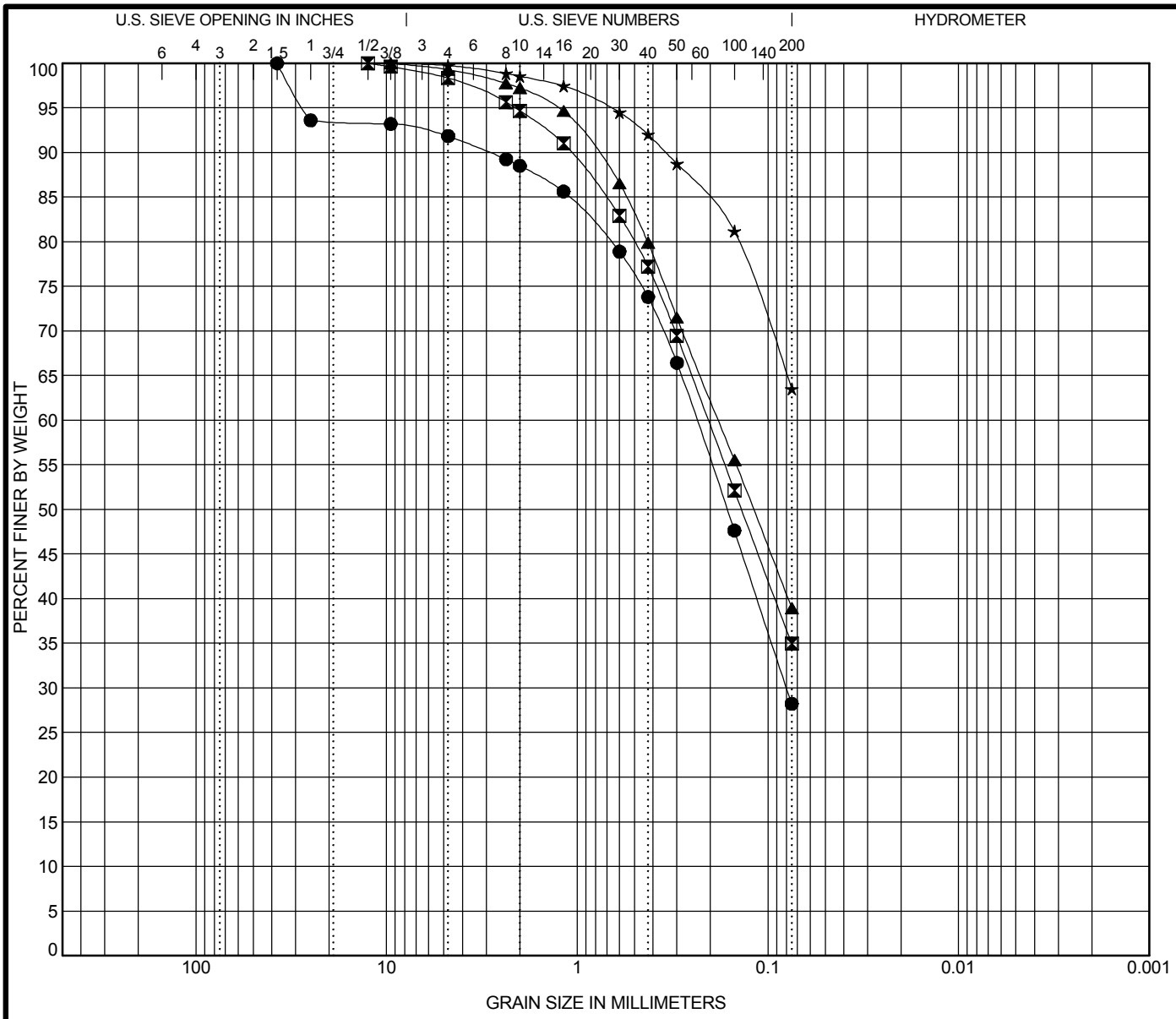
GRAIN SIZE DISTRIBUTION

Project: Sediment Grade Control Structures
Site: DP Canyon and Pueblo Canyon Los Alamos County, NM
Job #: 66095039
Date: 8-31-09

TC_GRAIN_SIZE 66095039.GPJ TERRACON.GDT 8/31/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**TP-04**	**0.0ft**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
⊠	**TP-04**	**2.0ft**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
▲	**TP-04**	**4.0ft**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
★	**TP-04**	**10.0ft**	**SANDY SILT(ML)**	**NP**	**NP**	**NP**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-04**	**0.0ft**	**37.5**	**0.237**	**0.08**		**8.2**	**63.6**	**28.2**	
⊠	**TP-04**	**2.0ft**	**12.5**	**0.205**			**1.6**	**63.4**	**35.0**	
▲	**TP-04**	**4.0ft**	**9.5**	**0.182**			**0.7**	**60.3**	**39.0**	
★	**TP-04**	**10.0ft**	**9.5**				**0.2**	**36.2**	**63.5**	

Terracon

GRAIN SIZE DISTRIBUTION

Project: Sediment Grade Control Structures
Site: DP Canyon and Pueblo Canyon Los Alamos County, NM
Job #: 66095039
Date: 8-31-09

TC GRAIN SIZE 66095039.GPJ TERRACON.GDT 8/31/09

Borehole	Depth ft	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	USCS Class-ification	Water Content (%)	Dry Unit Weight (pcf)	Satur-ation (%)	Void Ratio
B-01	2.0							6	91.1		
B-01	4.0							5			
B-01	6.0								101.5		
TP-01	0.0	NP	NP	NP	12.5	35	SM	4			
TP-01	3.0							2			
TP-02	0.0							2			
TP-02	4.0	NP	NP	NP	19	7	SW-SM	4			
TP-02	7.0	NP	NP	NP	9.5	24	SM	10			
TP-03	2.0	NP	NP	NP	50	2	SP	4			
TP-03	6.0							9			
TP-03	8.0	NP	NP	NP	9.5	49	SM	5			
TP-04	0.0	NP	NP	NP	37.5	28	SM	11			
TP-04	2.0	NP	NP	NP	12.5	35	SM	13			
TP-04	4.0	NP	NP	NP	9.5	39	SM	21			
TP-04	8.0							29			
TP-04	10.0	NP	NP	NP	9.5	64	ML	26			

Terracon

SUMMARY OF LABORATORY RESULTS

Project: Sediment Grade Control Structures
Site: DP Canyon and Pueblo Canyon Los Alamos County, NM
Job #: 66095039
Date: 8-31-09

HALL
ENVIRONMENTAL
ANALYSIS
LABORATORY

COVER LETTER

Friday, August 28, 2009

Michael Anderson
Terracon
4905 Hawkins, NE
Albuquerque, NM 87109

TEL: (505) 797-4287
FAX (505) 797-4288

RE: Sediment Grade Control Structures

Order No.: 0908325

Dear Michael Anderson:

Hall Environmental Analysis Laboratory, Inc. received 2 sample(s) on 8/20/2009 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. Below is a list of our accreditations. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites.

Reporting limits are determined by EPA methodology. No determination of compounds below these (denoted by the ND or < sign) has been made.

Please don't hesitate to contact HEAL for any additional information or clarifications.

Sincerely,

Andy Freeman, Laboratory Manager

NM Lab # NM9425
AZ license # AZ0682
ORELAP Lab # NM100001
Texas Lab# T104704424-08-TX

ACCREDITED IN ACCORDANCE WITH nelac

4901 Hawkins NE ■ Suite D ■ Albuquerque, NM 87109
505.345.3975 ■ Fax 505.345.4107
www.hallenvironmental.com

Hall Environmental Analysis Laboratory, Inc.

Date: *28-Aug-09*

CLIENT: Terracon
Lab Order: 0908325
Project: Sediment Grade Control Structures
Lab ID: 0908325-01

Client Sample ID: TP-01 @ 0-3'
Collection Date: 8/19/2009 12:00:00 PM
Date Received: 8/20/2009
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **TAF**
Sulfate	17	7.5		mg/Kg	5	8/21/2009 12:11:30 PM
SM4500-H+B: PH						Analyst: **KMS**
pH	7.11	0.1		pH Units	1	8/26/2009
RESISTIVITY						Analyst: **TAF**
Resistivity	10900	1.00		Ohms * cm	1	8/24/2009

Qualifiers:

*	Value exceeds Maximum Contaminant Level	B	Analyte detected in the associated Method Blank
E	Estimated value	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	MCL	Maximum Contaminant Level
ND	Not Detected at the Reporting Limit	RL	Reporting Limit
S	Spike recovery outside accepted recovery limits		

Hall Environmental Analysis Laboratory, Inc.

Date: *28-Aug-09*

CLIENT: Terracon
Lab Order: 0908325
Project: Sediment Grade Control Structures
Lab ID: 0908325-02

Client Sample ID: TP-02 @ 0-2'
Collection Date: 8/19/2009 3:00:00 PM
Date Received: 8/20/2009
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **TAF**
Sulfate	17	7.5		mg/Kg	5	8/22/2009 1:05:36 PM
SM4500-H+B: PH						Analyst: **KMS**
pH	6.86	0.1		pH Units	1	8/26/2009
RESISTIVITY						Analyst: **TAF**
Resistivity	27400	1.00		Ohms * cm	1	8/24/2009

Qualifiers:

*	Value exceeds Maximum Contaminant Level	B	Analyte detected in the associated Method Blank
E	Estimated value	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	MCL	Maximum Contaminant Level
ND	Not Detected at the Reporting Limit	RL	Reporting Limit
S	Spike recovery outside accepted recovery limits		

QA/QC SUMMARY REPORT

Client: Terracon
Project: Sediment Grade Control Structures

Work Order: 0908325

Analyte	Result	Units	PQL	SPK Va	SPK ref	%Rec	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Method: EPA Method 300.0: Anions											
Sample ID: 0908325-01AMSD		*MSD*				Batch ID:	**19935**	Analysis Date:		8/21/2009 12:46:20 PM	
Sulfate	42.63	mg/Kg	7.5	30	17.16	84.9	66.7	119	3.28	20	
Sample ID: MB-19935		*MBLK*				Batch ID:	**19935**	Analysis Date:		8/21/2009 11:36:41 AM	
Sulfate	ND	mg/Kg	1.5								
Sample ID: LCS-19935		*LCS*				Batch ID:	**19935**	Analysis Date:		8/21/2009 11:54:05 AM	
Sulfate	29.63	mg/Kg	1.5	30	0	98.8	90	110			
Sample ID: 0908325-01AMS		*MS*				Batch ID:	**19935**	Analysis Date:		8/21/2009 12:28:55 PM	
Sulfate	41.25	mg/Kg	7.5	30	17.16	80.3	66.7	119			

Qualifiers:

E	Estimated value	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
R	RPD outside accepted recovery limits	S	Spike recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Sample Receipt Checklist

Client Name **TER-ALB**

Date Received: **8/20/2009**

Work Order Number **0908325**

Received by: TLS

Sample ID labels checked by: TS
Initials

Checklist completed by: 18 8/20/09
Signature Date

Matrix:

Carrier name: Client drop-off

Shipping container/cooler in good condition?	Yes ☐	No ☐	Not Present ☑	
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☐	Not Shipped ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	N/A ☑	
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☑	No ☐		
Water - VOA vials have zero headspace?	No VOA vials submitted ☑	Yes ☐	No ☐	Number of preserved bottles checked for pH:
Water - Preservation labels on bottle and cap match?	Yes ☐	No ☐	N/A ☑	
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑	*<2 >12 unless noted below.*
Container/Temp Blank temperature?	**22.1°**	*<6° C Acceptable* If given sufficient time to cool.		

COMMENTS:

Client contacted _____ Date contacted: _____ Person contacted _____

Contacted by: _____ Regarding: _____

Comments: _____

Corrective Action _____

Chain-of-Custody Record

Client: Terracon

Mailing Address: 4905 Hawkins NE
ABQ, NM 87109

Phone #: (505) 797-4287

email or Fax#: mjdunneman@terracon.com

QA/QC Package:
☒ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other _____

☐ EDD (Type) _____

Turn-Around Time:
☒ Standard ☐ Rush _____

Project Name: Sediment Grade Control Structures

Project #: 66095039

Project Manager: Mike Anderson

Sampler: MJD

On Ice: ☐ Yes ☒ No

Sample Temperature: 02.1

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 0908305	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH Method 8015B (Gas/Diesel)	TPH (Method 418.1)	EDB (Method 504.1)	8310 (PNA or PAH)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	pH	Resistivity			Air Bubbles (Y or N)
8/19/09	12:00p	soil	TP-01 @ 0-3'	1/8oz	—	1								✓				✓	✓			
8/19/09	3:00p	soil	TP-02 @ 0-2'	1/8oz	—	2								✓				✓	✓			

Date:	Time:	Relinquished by:	Received by:	Date	Time
8/20/09	9:30a	Meagan Dunneman	[signature]	8/20/09	9:30
Date:	Time:	Relinquished by:	Received by: [signature]	Date	Time

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 3" O.D. ring samplers (RS) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per foot," and is not considered equivalent to the "Standard Penetration"or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 -15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
> 50	> 99	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

Terracon

GENERAL NOTES
Description of Rock Properties

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding and Foliation Spacing in Rock[a]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

Rock Quality Designator (RQD)[b]		Joint Openness Descriptors	
RQD, as a percentage	Diagnostic description	Openness	Descriptor
Exceeding 90	Excellent	No Visible Separation	Tight
90 – 75	Good	Less than 1/32 in.	Slightly Open
75 – 50	Fair	1/32 to 1/8 in.	Moderately Open
50 – 25	Poor	1/8 to 3/8 in.	Open
Less than 25	Very poor	3/8 in. to 0.1 ft.	Moderately Wide
		Greater than 0.1 ft.	Wide

a. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.
b. RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976.
U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			$PI < 4$ or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit - not dried			Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit - not dried			Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

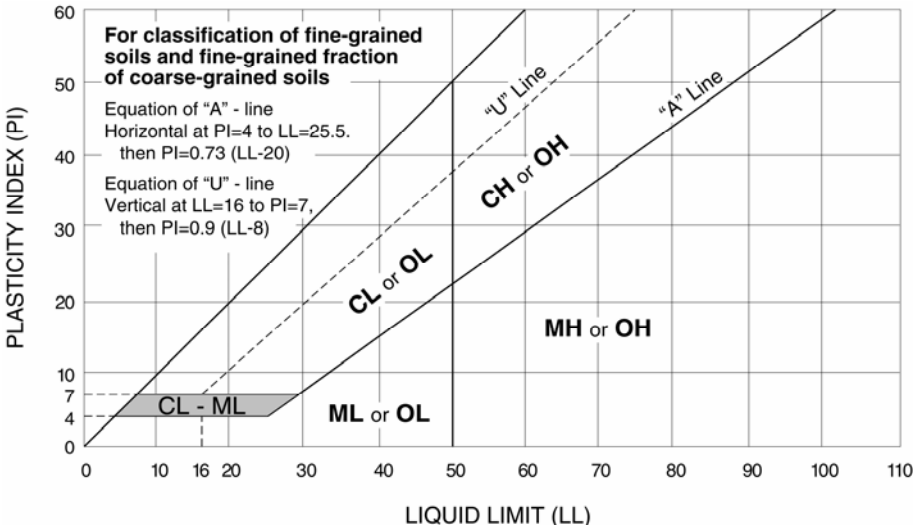
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

Appendix C

HEC-RAS Calculations
(on CD included with this document)

Los Alamos National Laboratory
Pueblo Canyon Grade Control Structure
HEC-RAS Revised Modeling Narrative
December 21, 2009

General Project Description

The project consists of the construction of a grade stabilization structure within the Department of Energy's Los Alamos National Laboratory (LANL) in the vicinity of Los Alamos, New Mexico. LANL consists of representatives from DOE and LANS. LANS is Los Alamos National Security, LLC., the M&O contractor for DOE at the LANL. The structure is located within Pueblo Canyon and referred to as the Pueblo Canyon grade control structure. The approximate location of the proposed Pueblo Canyon grade control structure is located approximately 400 feet downstream of the current E060 gauging station.

The proposed structure is part of remedial actions taken to reduce the migration of contaminated sediment. A beneficial result of the grade control is the expansion and enhancement of wetland areas upstream of the structure.

Development of the HEC-RAS Hydraulic Model

To determine the hydraulic effects of the proposed structure, a HEC-RAS model was developed. The HEC-RAS (Version 4.0) model was constructed using the most recent topographic data and GIS techniques for cross section development. An existing conditions model was constructed, calibrated to the best extent, and the water surface elevations for the 2-, 5-, 10-, 50-, and 100-year peak flood discharges were simulated and plotted. All subsequent models utilized these peak flood discharges. A proposed conditions model (with grade control), without accumulated sedimentation behind the structure, was constructed, simulated and plotted. The HEC-RAS In-line weir option was used to model the grade control structure. A proposed condition model, with sedimentation, was created to simulate the change in the streambed elevations due to anticipated long term deposition of sediment upstream of the grade control structure. These 3 conditions, existing, grade control structure without sediment deposits, and grade control structure with sediment deposits, were compared and analyzed. Results of the HEC-RAS hydraulic modeling analysis for the Pueblo Canyon structure is available immediately following in this Appendix.

The HEC-RAS model for the stream system was revised in December 2009 to reflect new topographic survey information which was made available, as well as changes in the design of the grade control structure for the stream and the addition of a flume just downstream of the grade control structure. Below is a brief description of the methodology and assumptions used in preparing the revised HEC-RAS model for Pueblo Canyon.

Pueblo Canyon

1. Existing Conditions

- Cross sections of the channel were taken from River Station (RS) 100 (approx. 510' downstream of proposed Gabion Grade Control Structure) to RS 2527.
- Cross section coordinates were taken perpendicular to the centerline of the stream from new topographic survey using AutoCAD Civil 3D.
- The sign convention of the cross sections is left to right looking downstream with the zero station on an assumed survey baseline.
- By iteratively running the HEC-RAS model, the Left Bank and Right Bank stations were set so that the 50-year water surface was at or just above the bank elevations.
- Manning's n values of 0.03 for the channel and 0.07 for left overbank (LOB) and right overbank (ROB) were selected.
- Contraction and expansion coefficients of 0.1 and 0.3, respectively, were assumed.
- Flow data used was as follows (see original project design report for background information):

2-year	245 cfs
5-year	593 cfs
10-year	932 cfs
50-year	2060 cfs
100-year	2740 cfs

In addition, a flow of 350 cfs was analyzed for design of the flume under proposed conditions.

2. Proposed Conditions

- Existing Conditions model cross sections between RS 320 and RS 179 were revised to define a proposed 5' to 1' bottom-width flume from RS 260 to RS 245, with 20' transitions from RS 280 to RS 260 upstream of the flume and from RS 245 to RS 225 downstream of the flume.
- A Gabion Grade Control Structure was added at RS 609, with the following characteristics:
    - Station and elevation coordinates defined to match the plans (30' low flow weir at crest el. 6341; 168' weir at crest el. 6342; top of weir at el. 6345).
    - Distance = 3.0' to upstream section at RS 612.
    - Width = 3.0.
    - Weir Coefficient – 3.0.
- Ineffective flow areas upstream of the Gabion Grade Control Structure were assumed to direct flow to the structure:
    - At RS 655: Station 288 Left; Station 552 Left
    - At RS 612: Station 386 Left; Station 554 Right

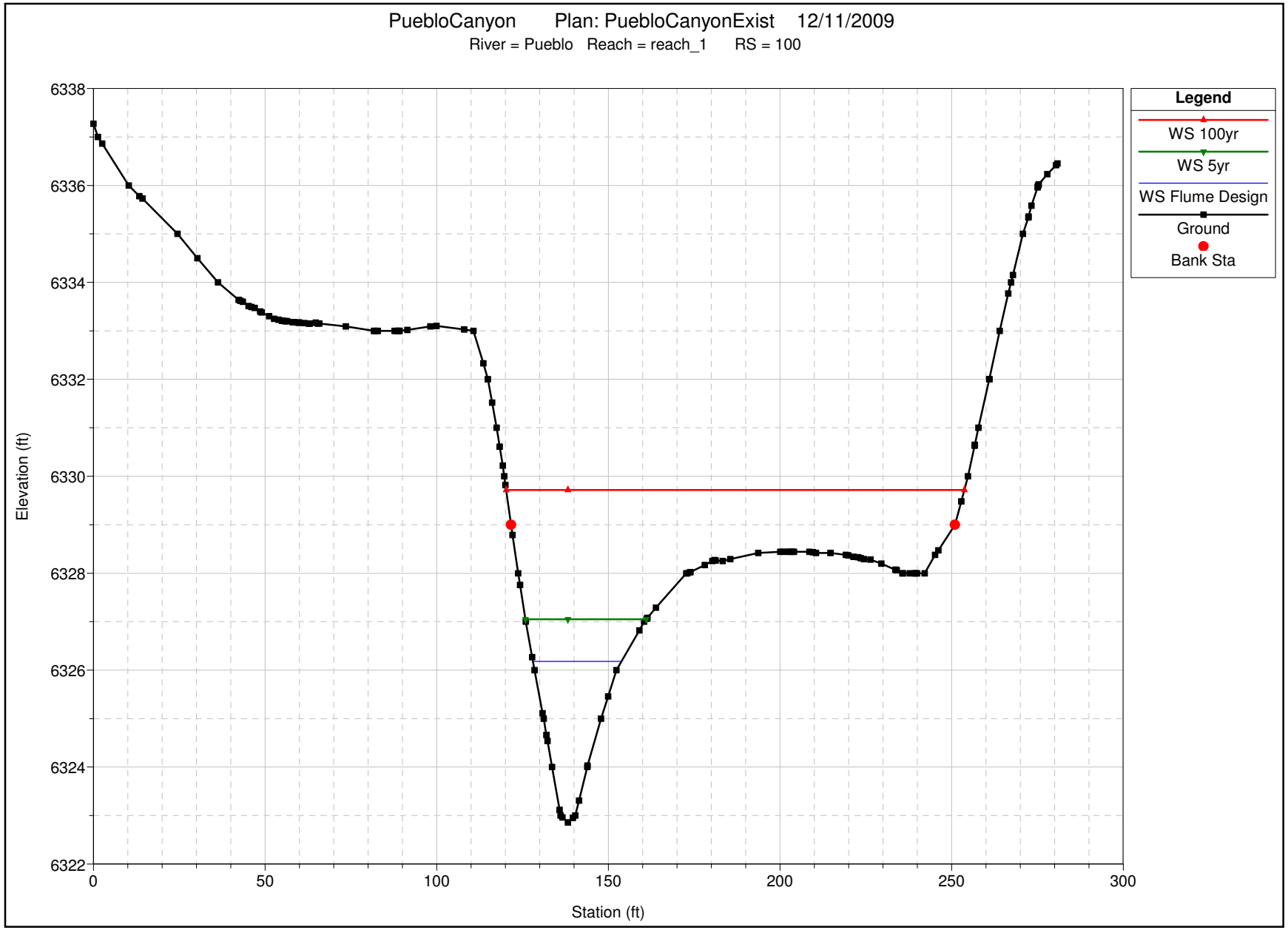
3. <u>Proposed Conditions with Sediment</u>

- Proposed Conditions model was revised to analyze the effects of a sediment fill slope of 0.9% (as in the original HEC-RAS analysis) from RS 612 just upstream of the proposed Gabion Grade Control Structure.
- The first analysis used a starting sediment elevation of 6339, which resulted in the sediment intersecting the channel bottom approx. 220' upstream of the structure.
- A second analysis used a starting sediment elevation near the Gabion Grade Control Structure equal to the low flow weir elevation of 6341 as in the original analysis. The sediment intersected the channel bottom approx. 310' upstream of the structure.

Pueblo Canyon

Existing Conditions

2527
2427
2327
2227
2127
2027
1827
1627
1527
1427
1328
1048
851
751
578
320
250
100
179
Reach_1
Pueblo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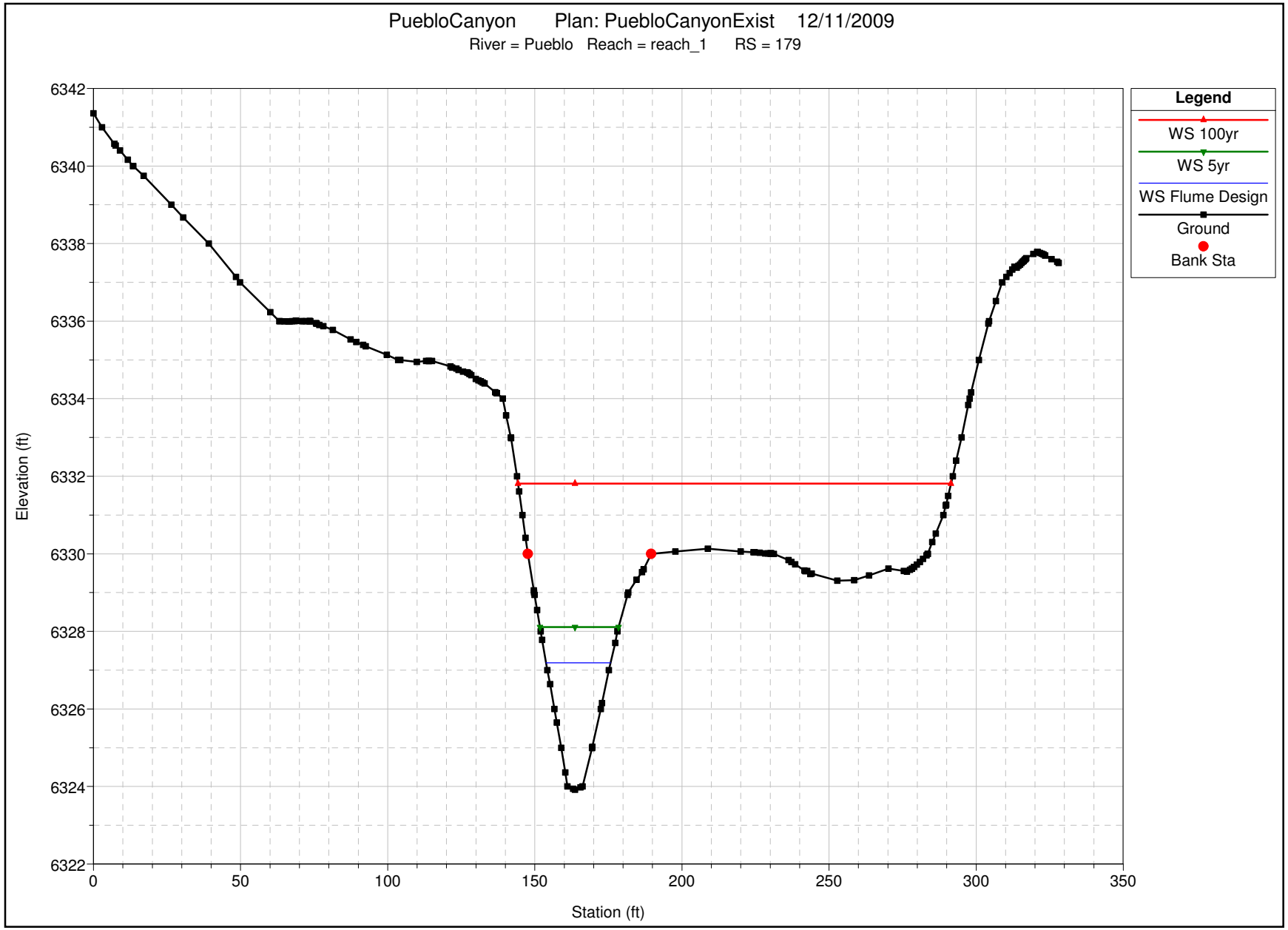
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6338
6336
6334
6332
6330
6328
6326
6324
6322
0
50
100
150
200
250
300
Station (ft)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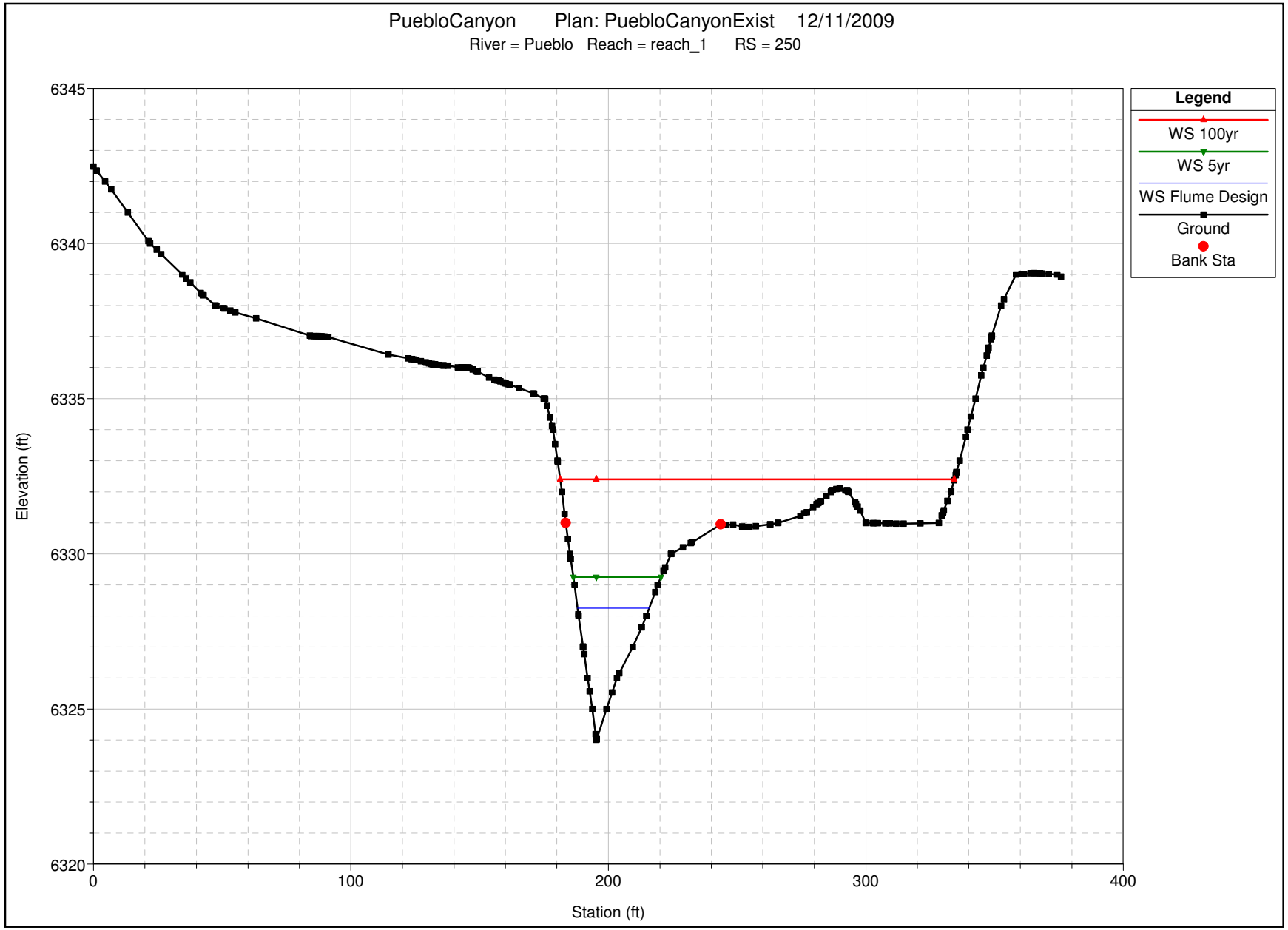
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
6322
0
50
100
150
200
250
300
350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Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
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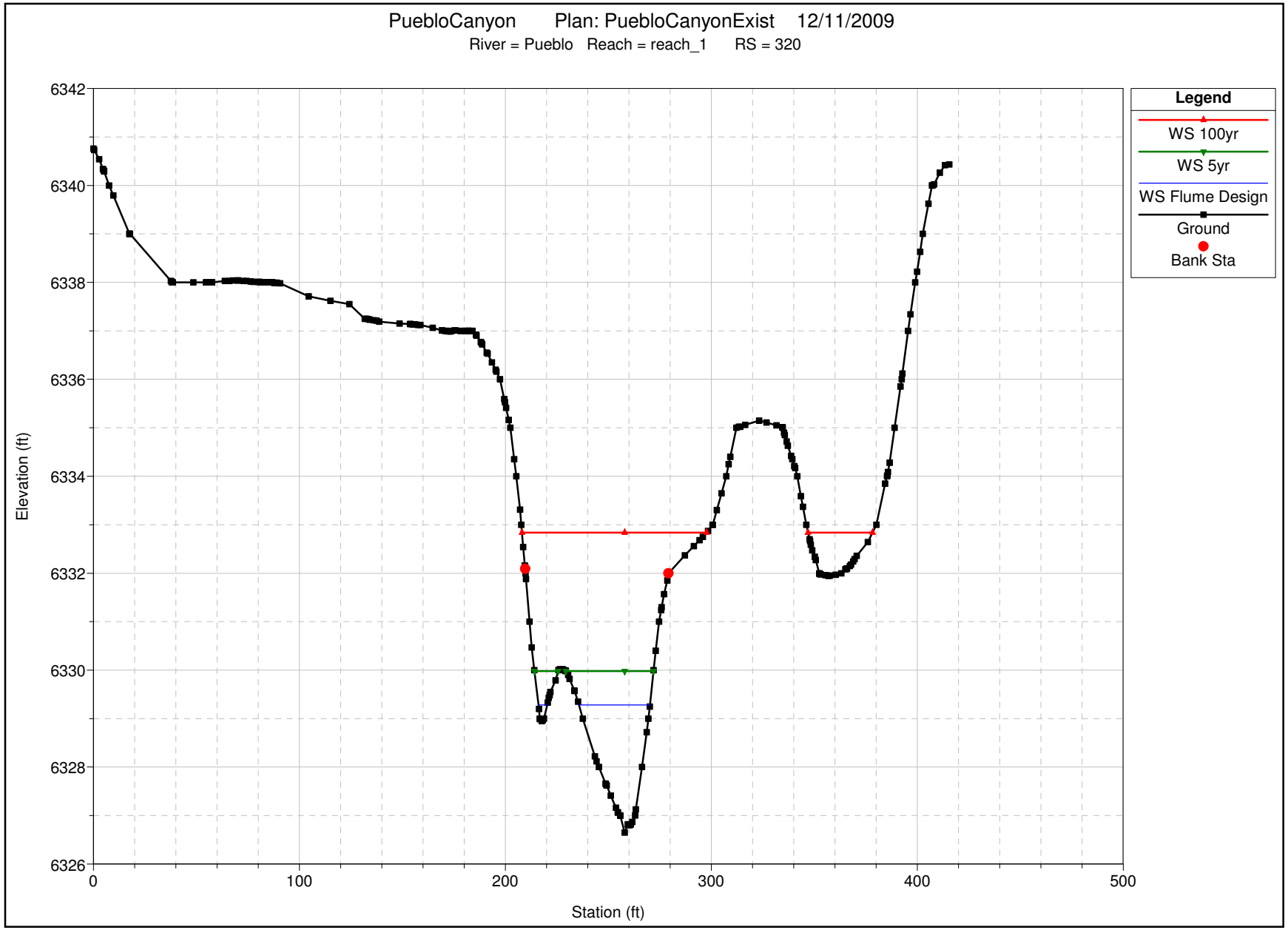
6340
6335
6330
6325
6320
0
100
200
300
400
Station (ft)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WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
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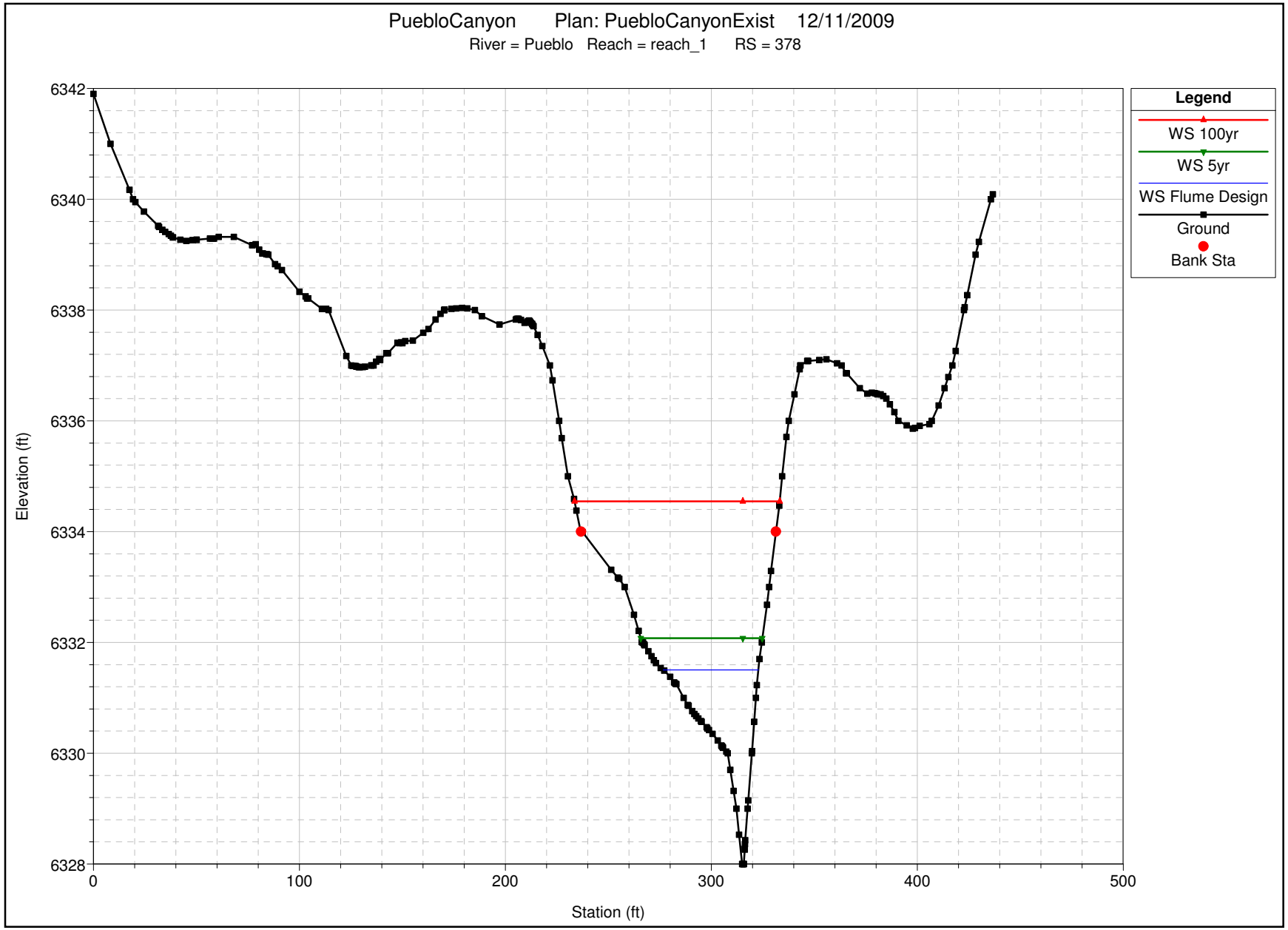
6338
6336
6334
6332
6330
6328
6326
0
100
200
300
400
500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Elevation (ft)
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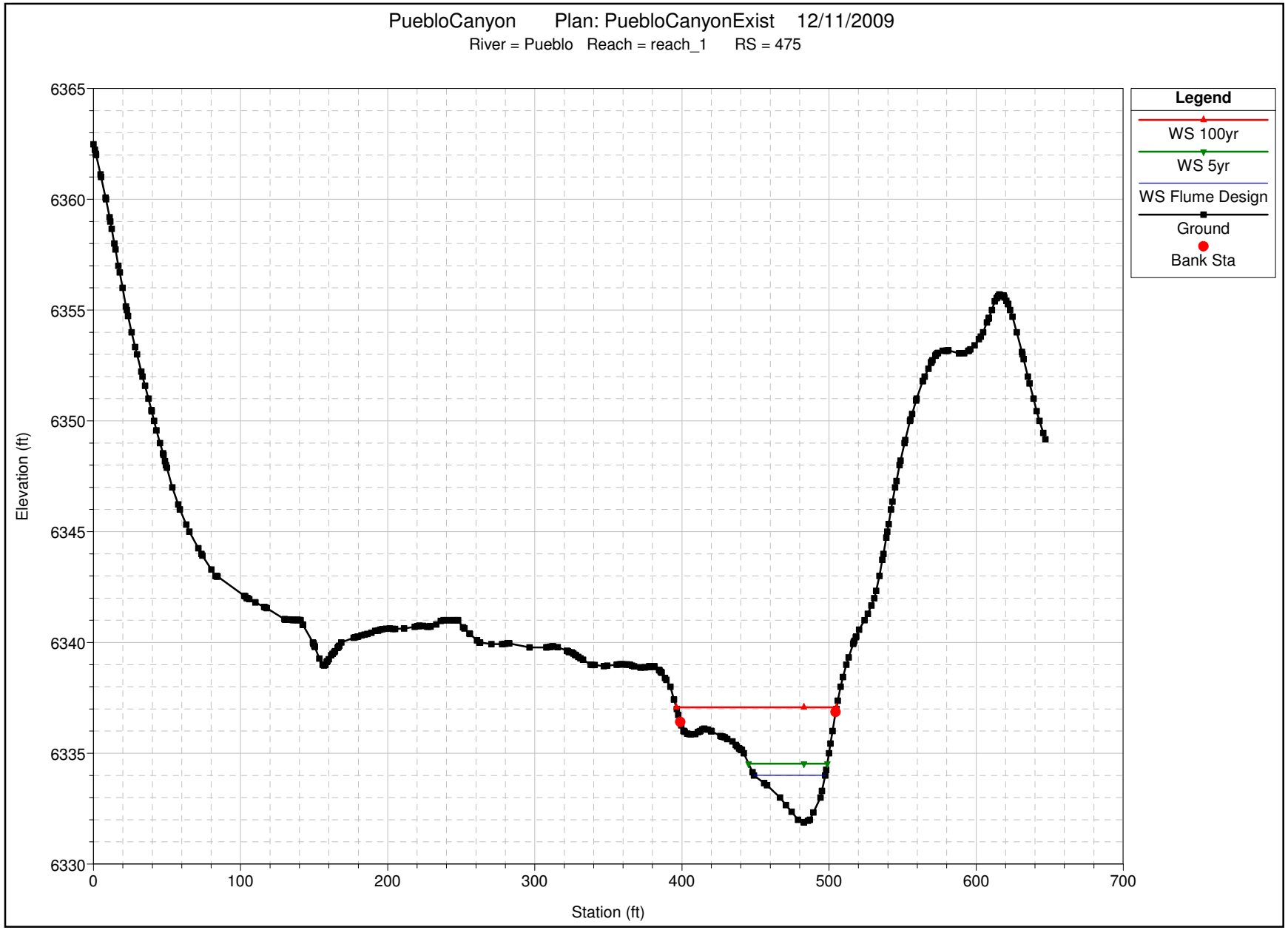
6338
6336
6334
6332
6330
6328
0
100
200
300
400
500
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta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Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
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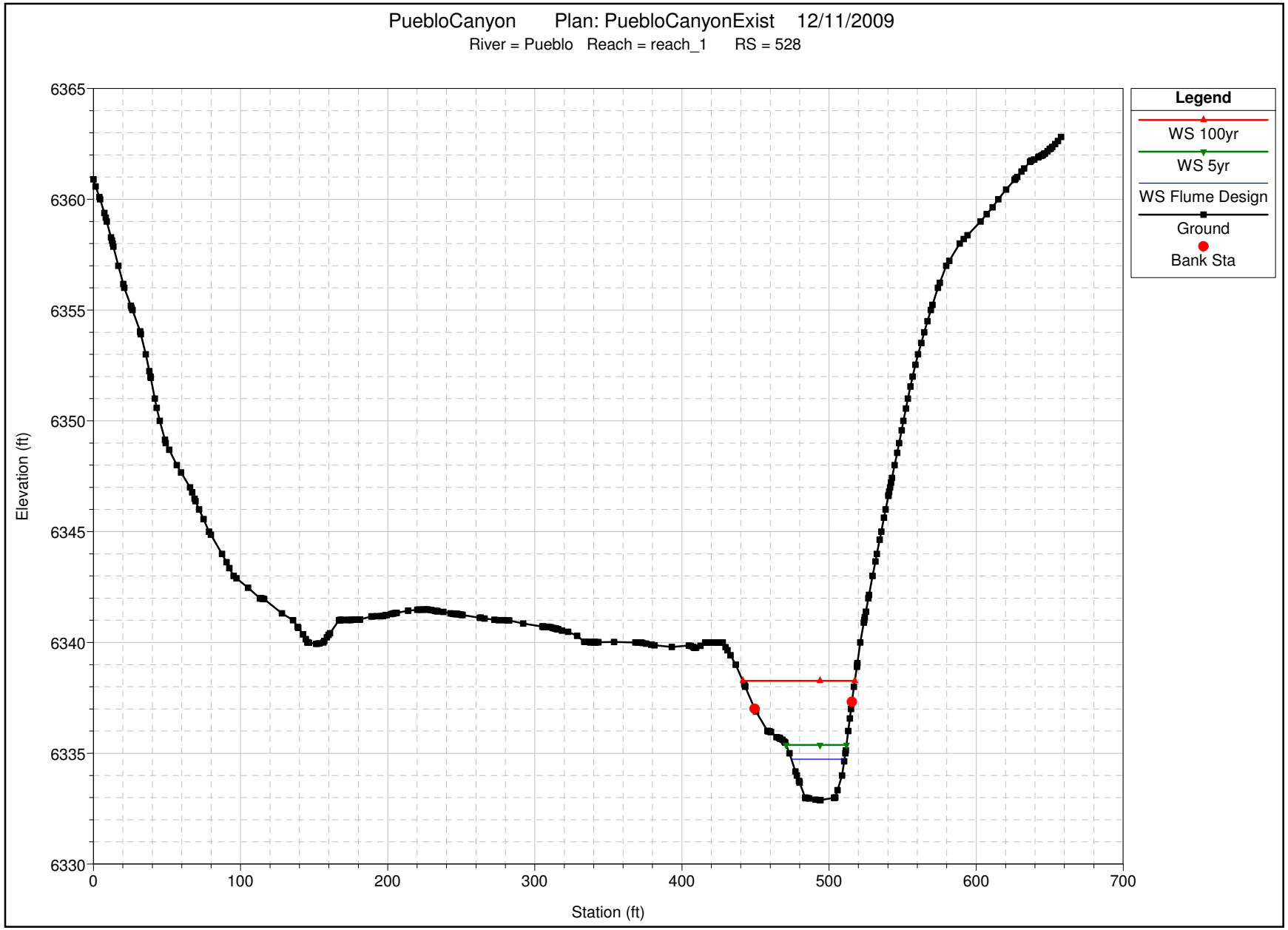
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700
Station (ft)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Elevation (ft)
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6360
6355
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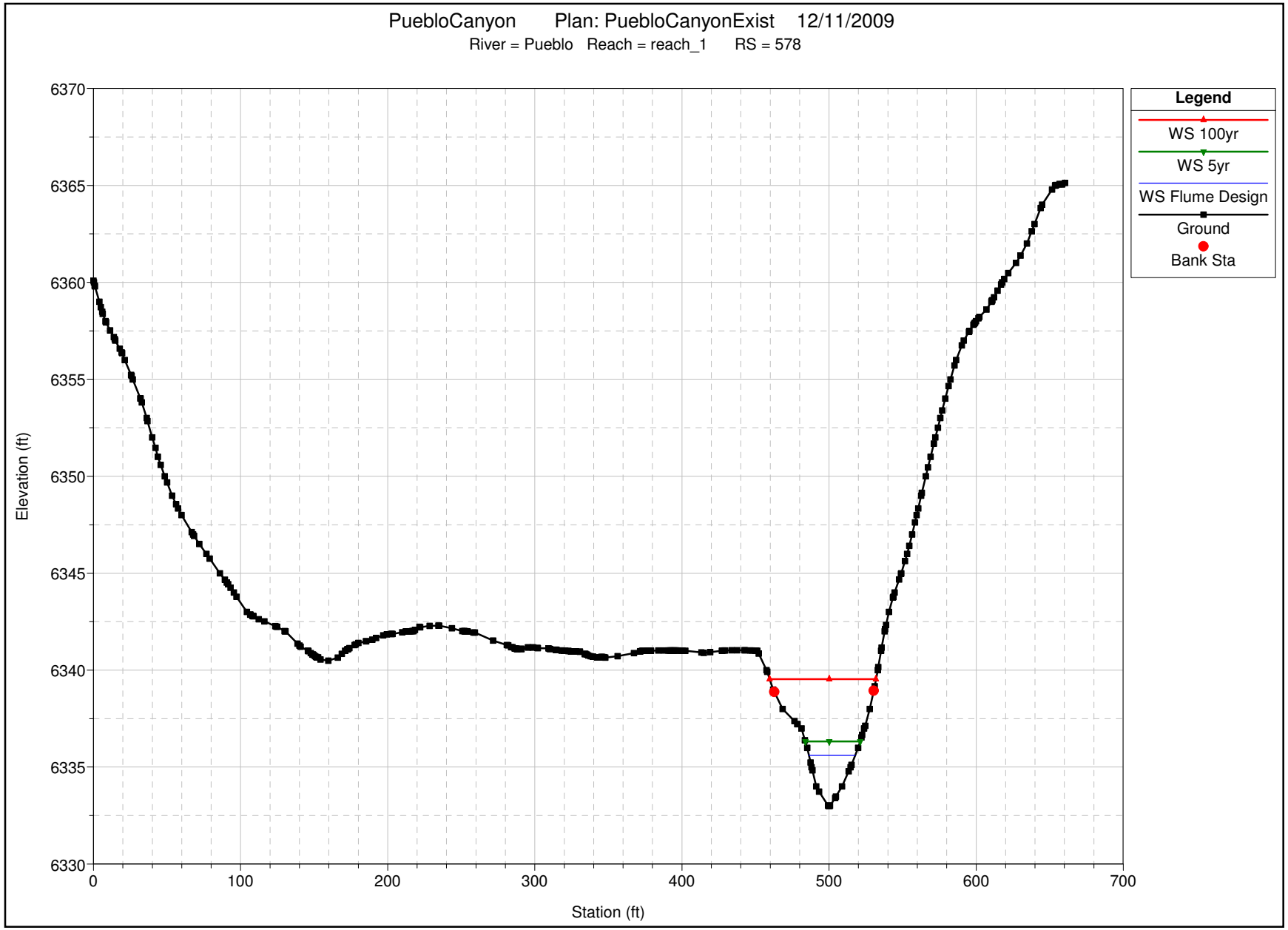
6340
6335
6330
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta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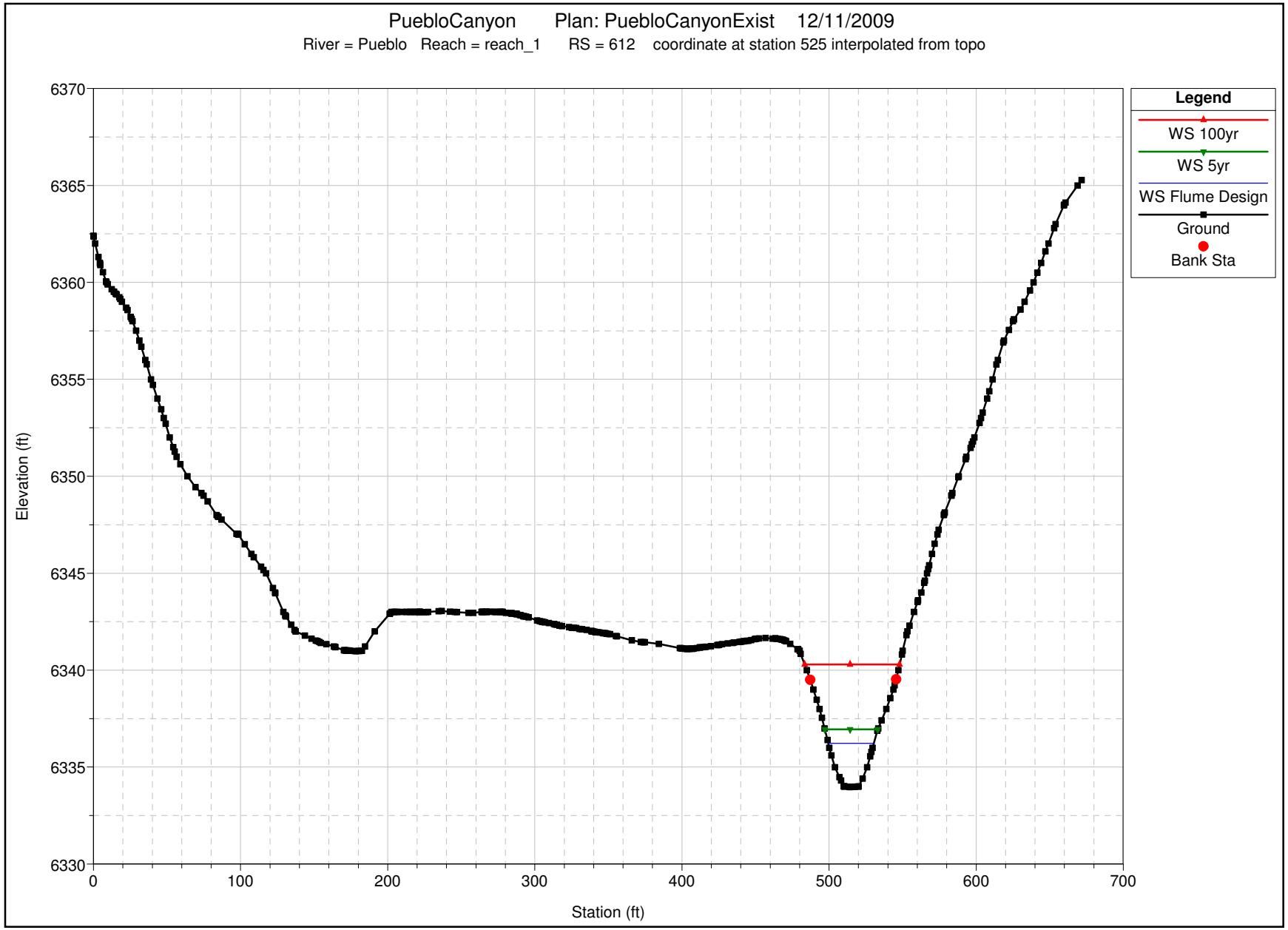
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6370
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700
Station (ft)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Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
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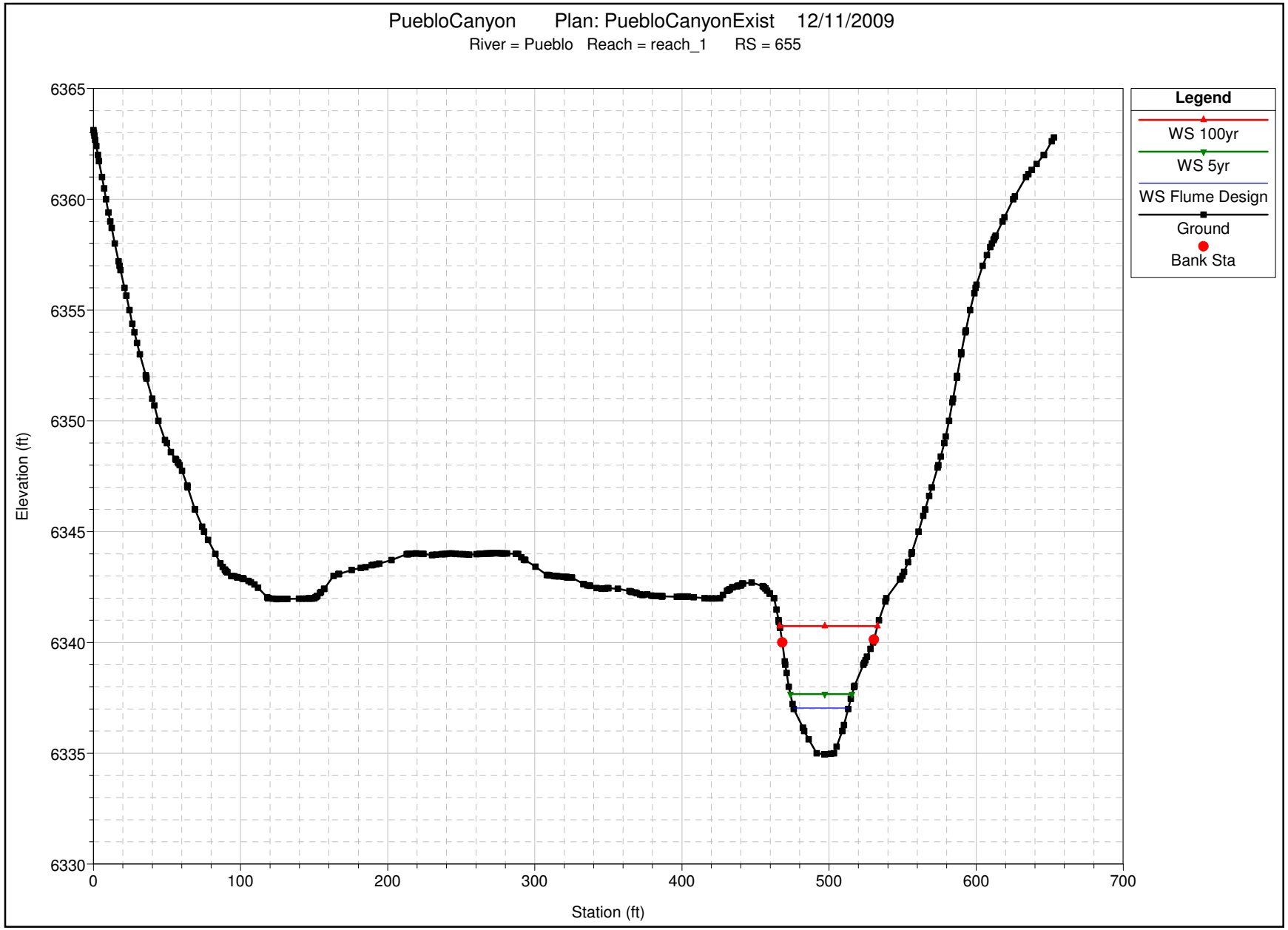
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700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Elevation (ft)
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6360
6355
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6340
6335
6330
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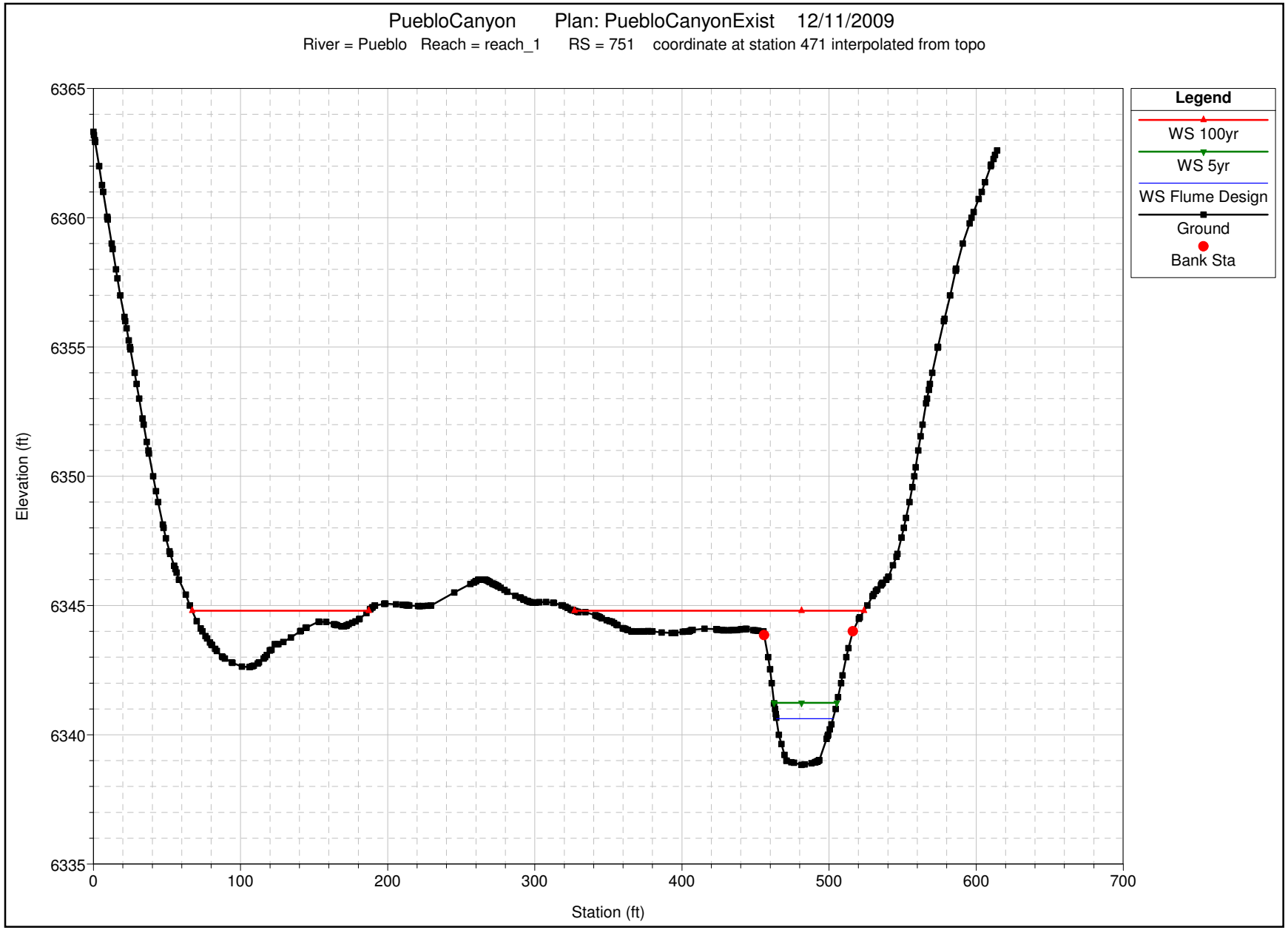
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta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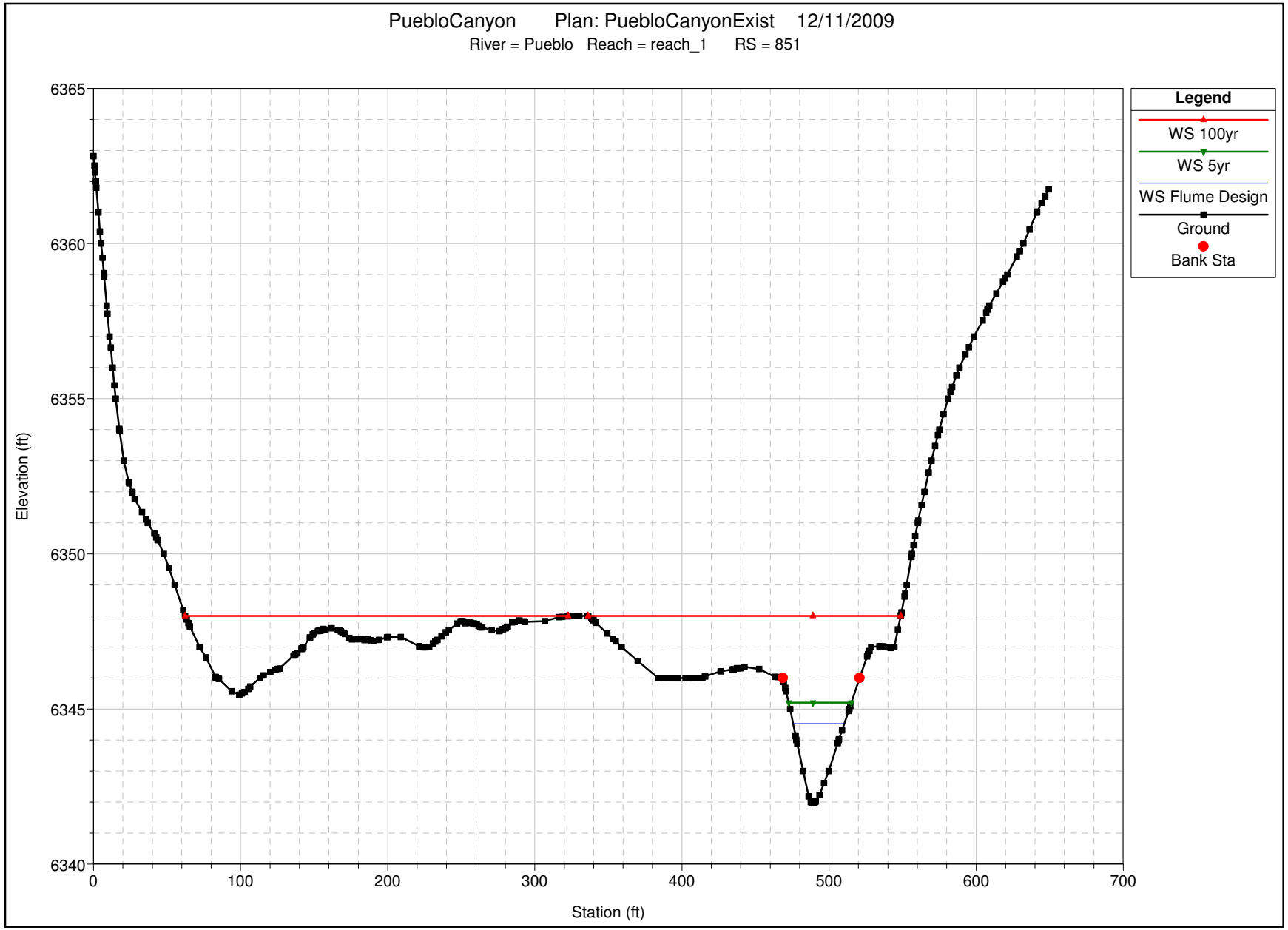
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6365
6360
6355
6350
6345
6340
6335
0
100
200
300
400
500
600
700
Station (ft)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Elevation (ft)
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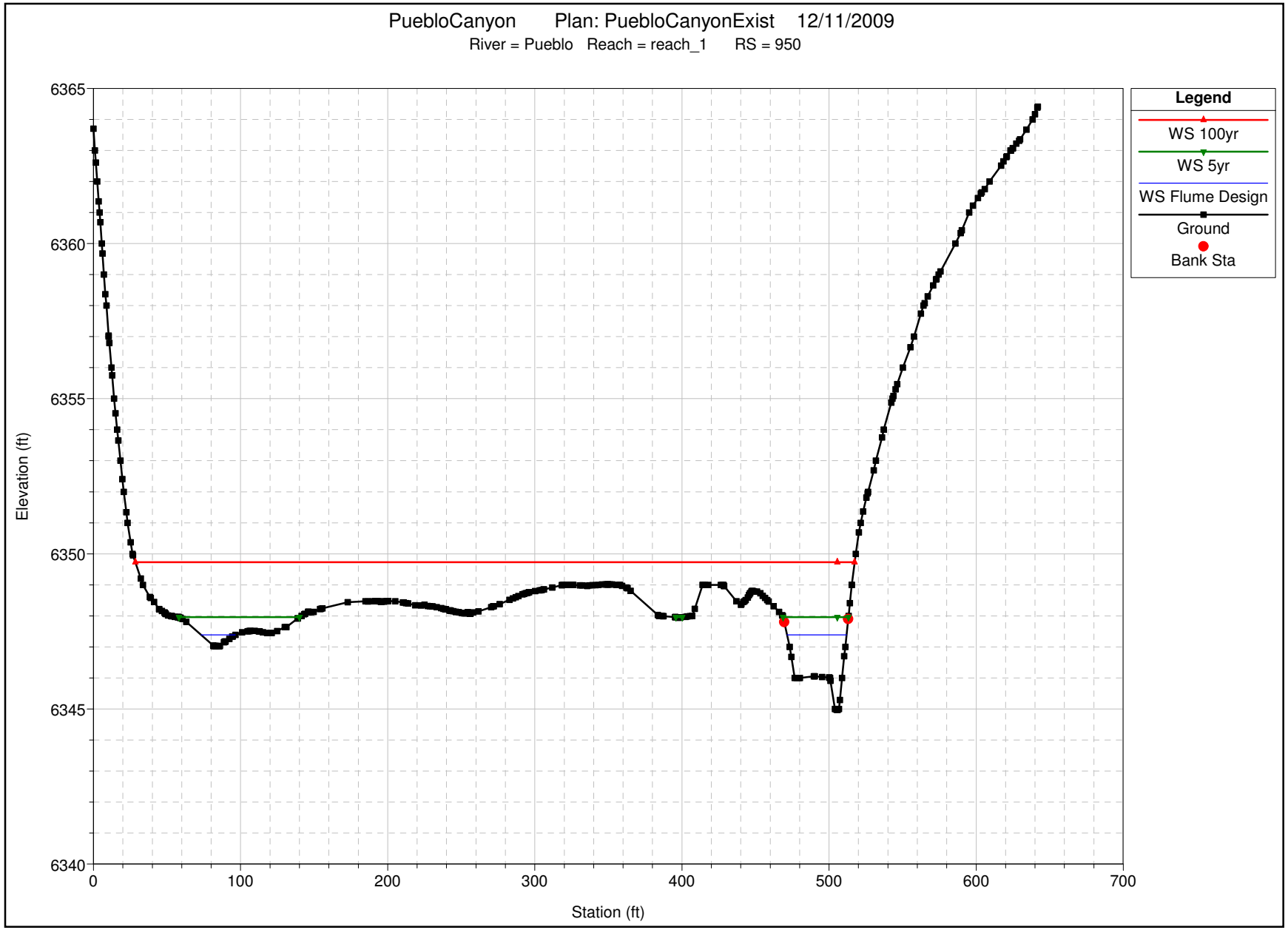
6360
6355
6350
6345
6340
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta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River = Pueblo Reach = reach_1 RS = 950
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
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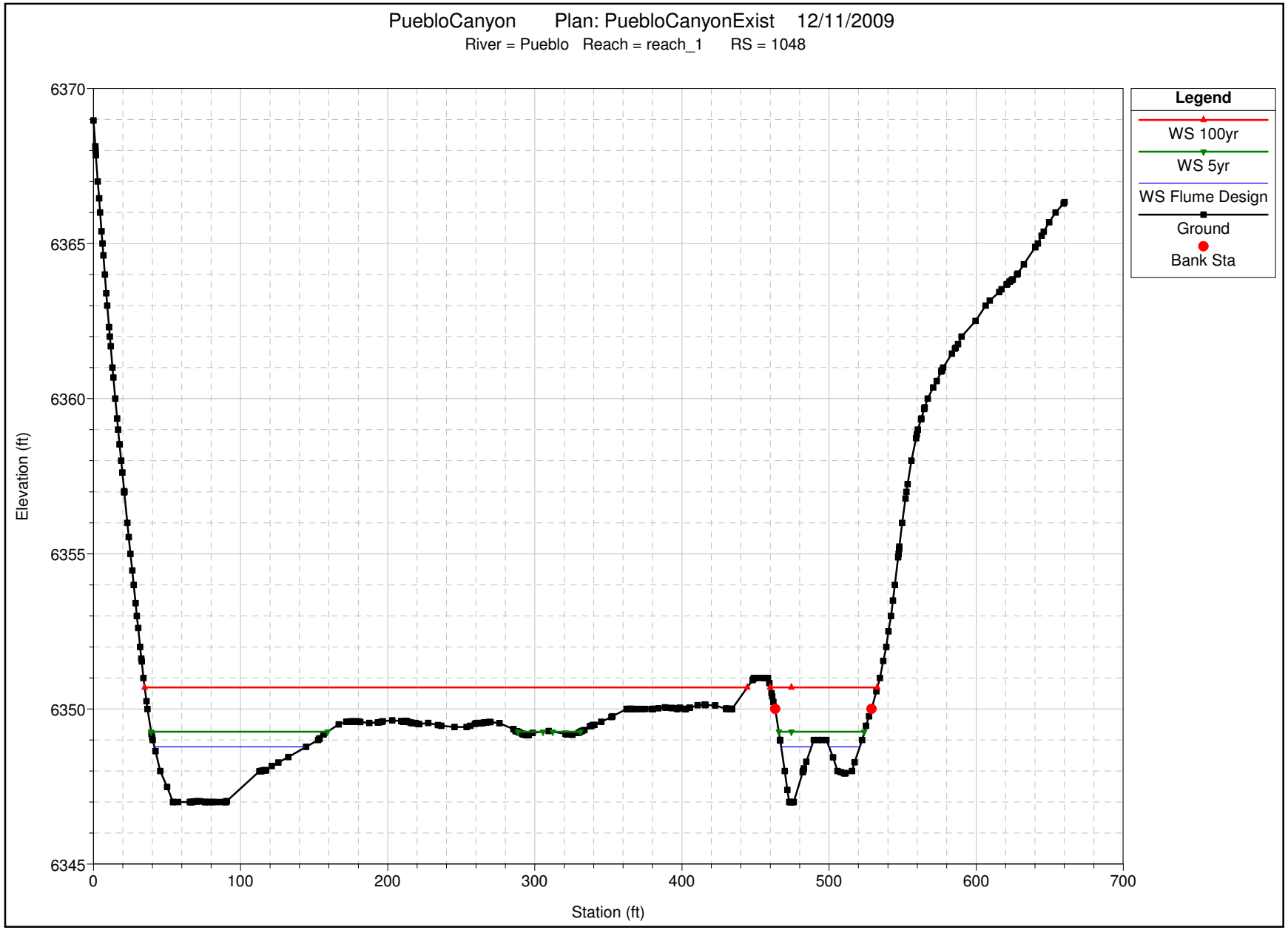
6360
6355
6350
6345
6340
Station (ft)
0
100
200
300
400
500
600
700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Elevation (ft)
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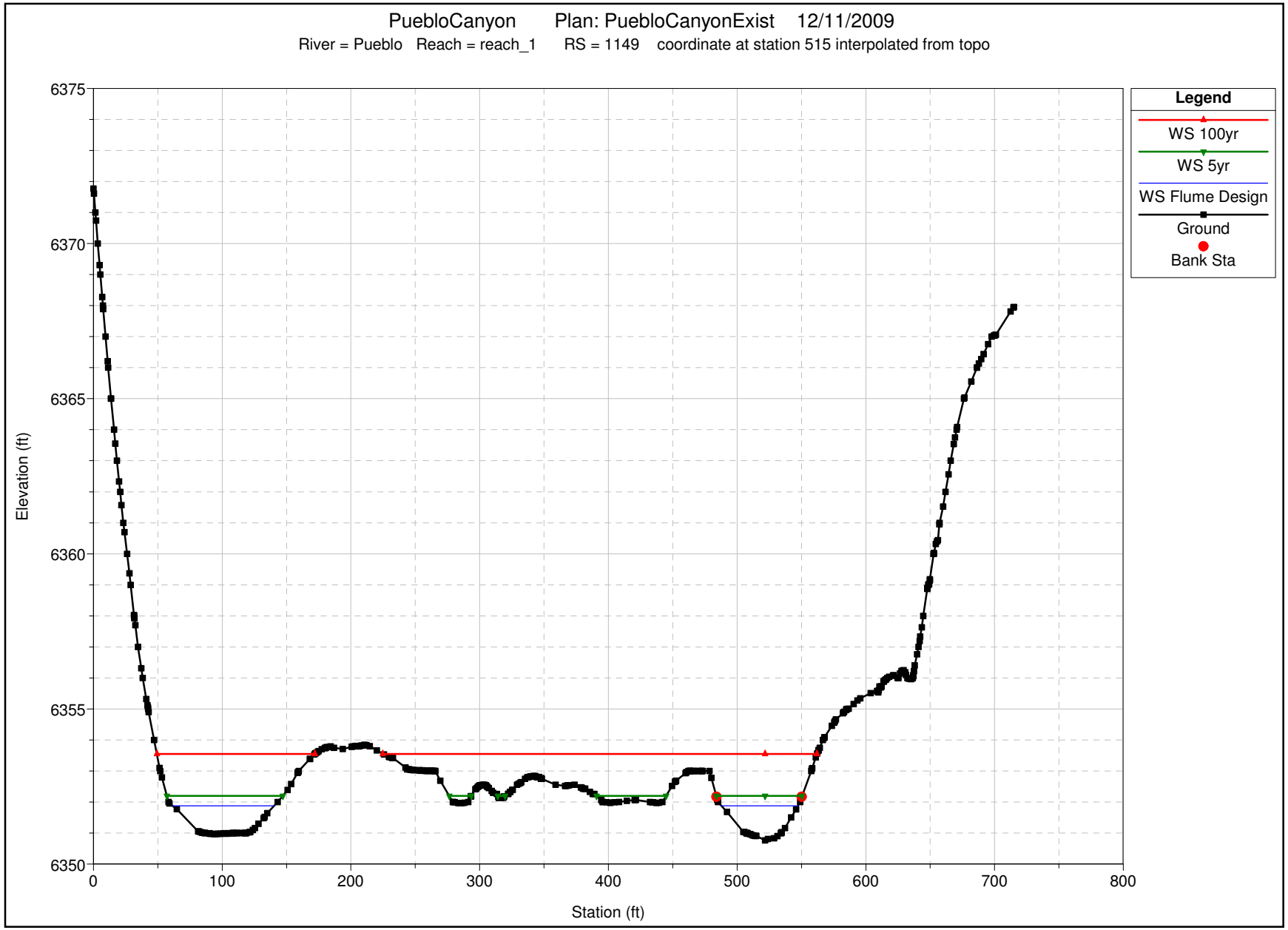
6365
6360
6355
6350
6345
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta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Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
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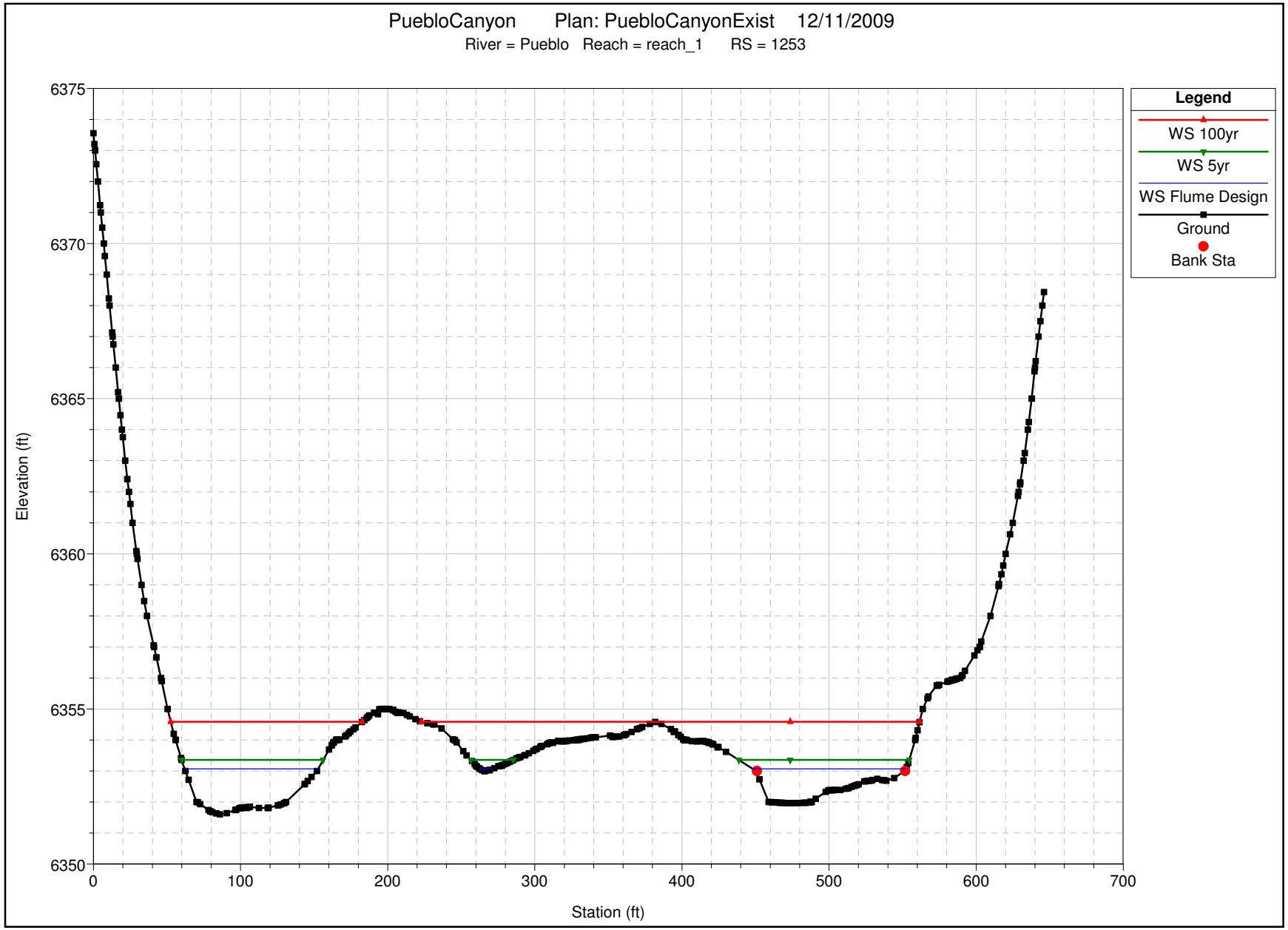
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
800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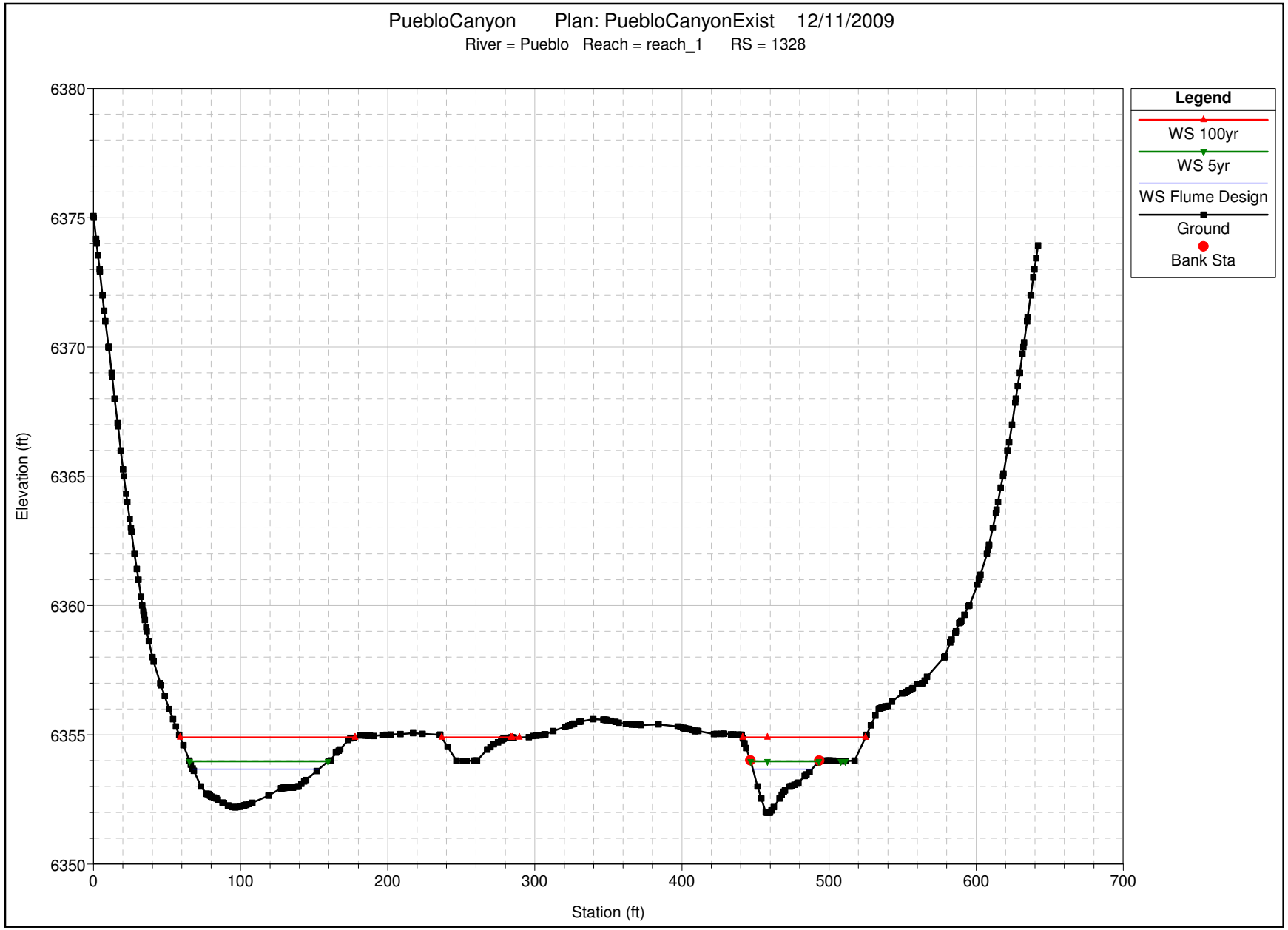
Elevation (ft)
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta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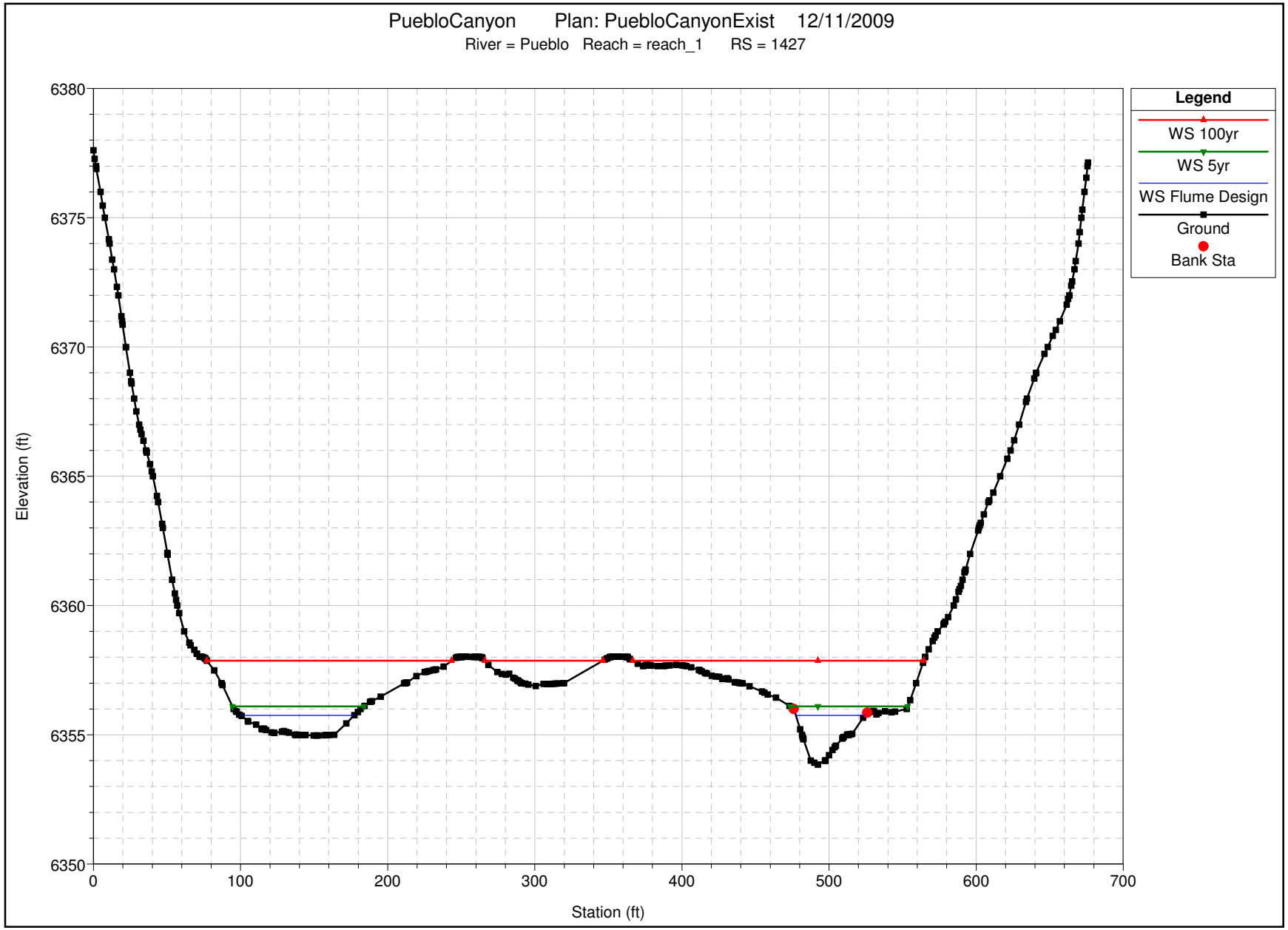
Elevation (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta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Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
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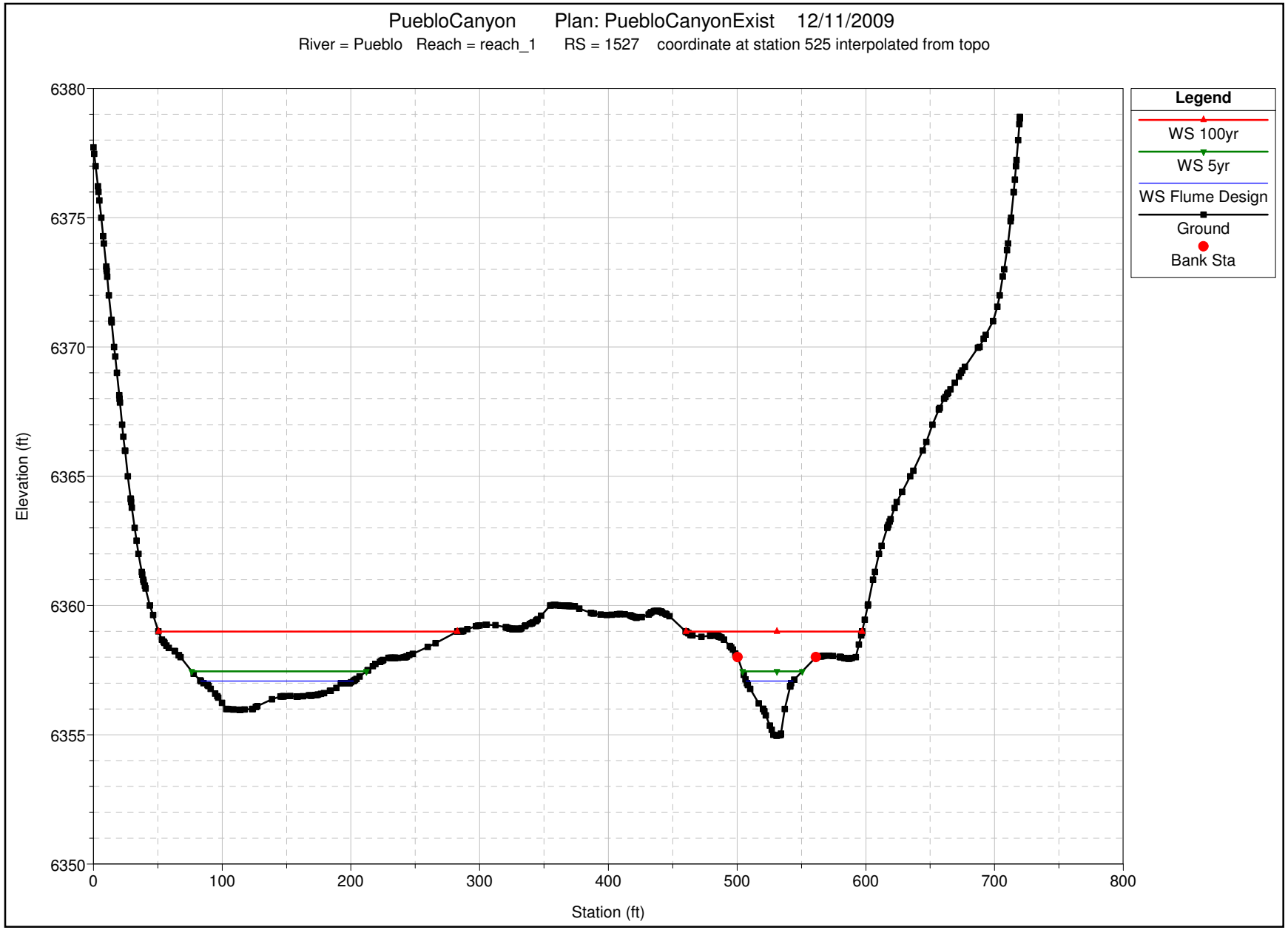
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)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Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6380
6375
6370
6365
6360
6355
6350
Station (ft)
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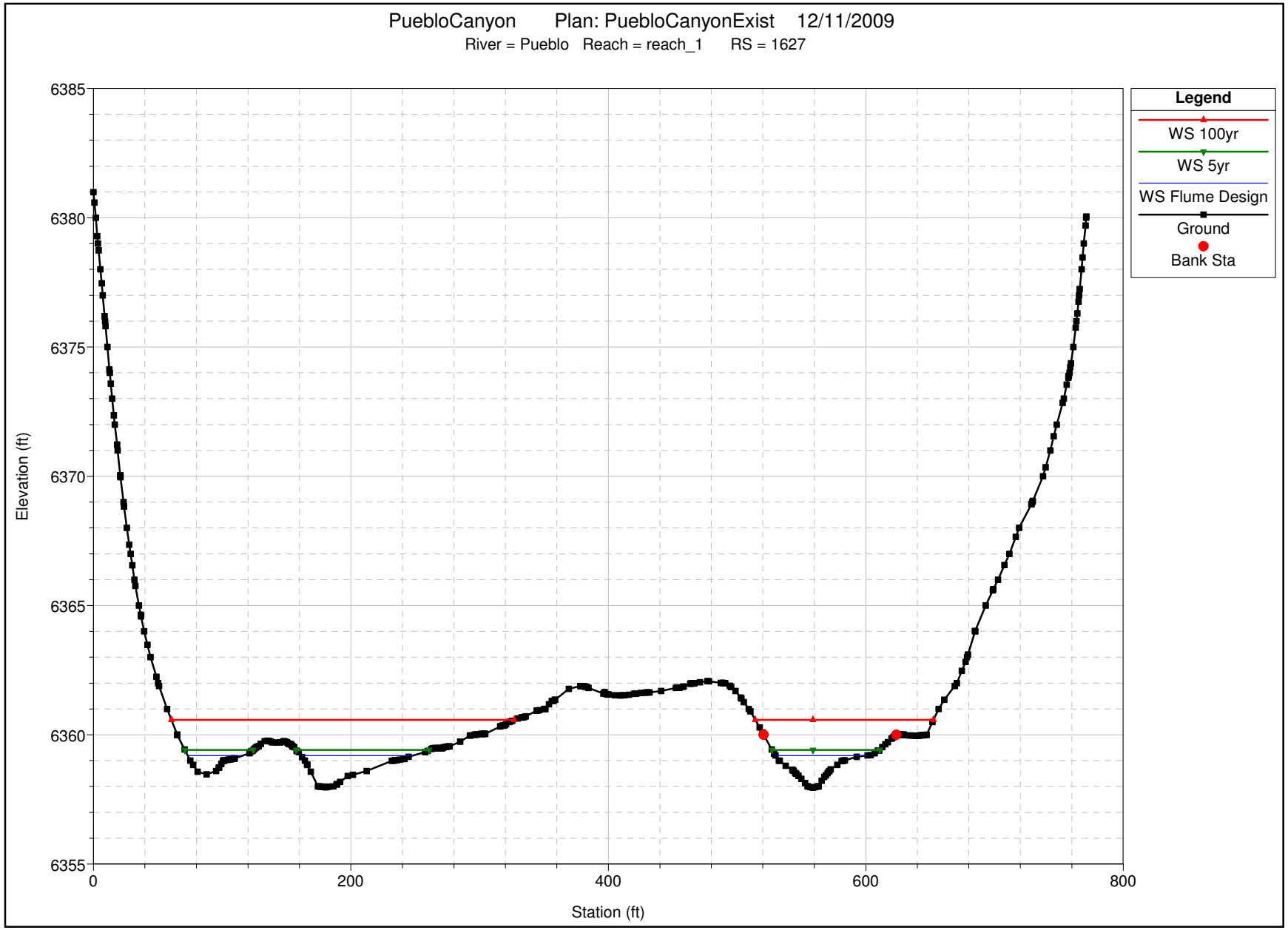
100
200
300
400
500
600
700
800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Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
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6370
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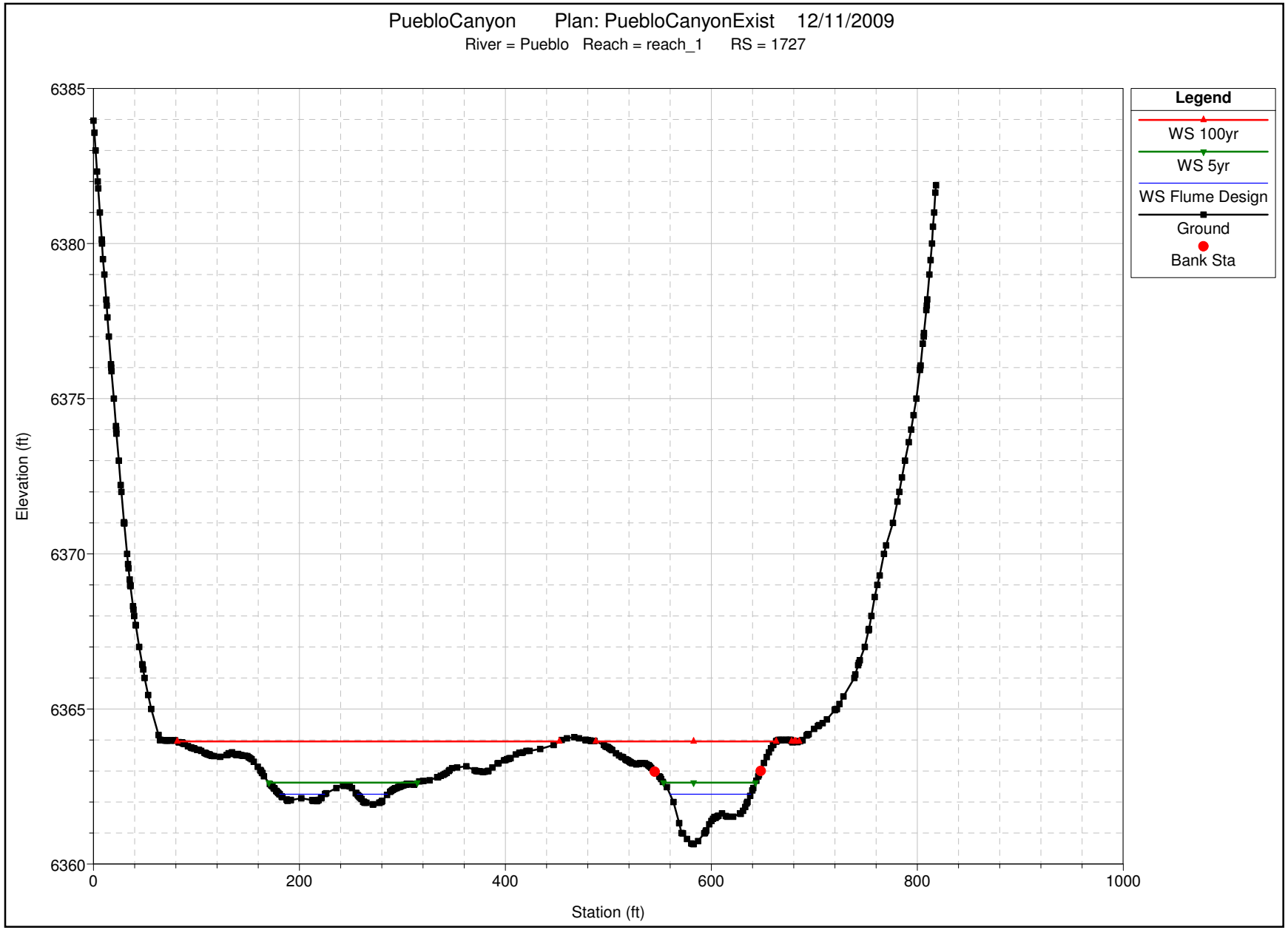
6360
6355
0
200
400
600
800
Station (ft)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Elevation (ft)
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6380
6375
6370
6365
6360
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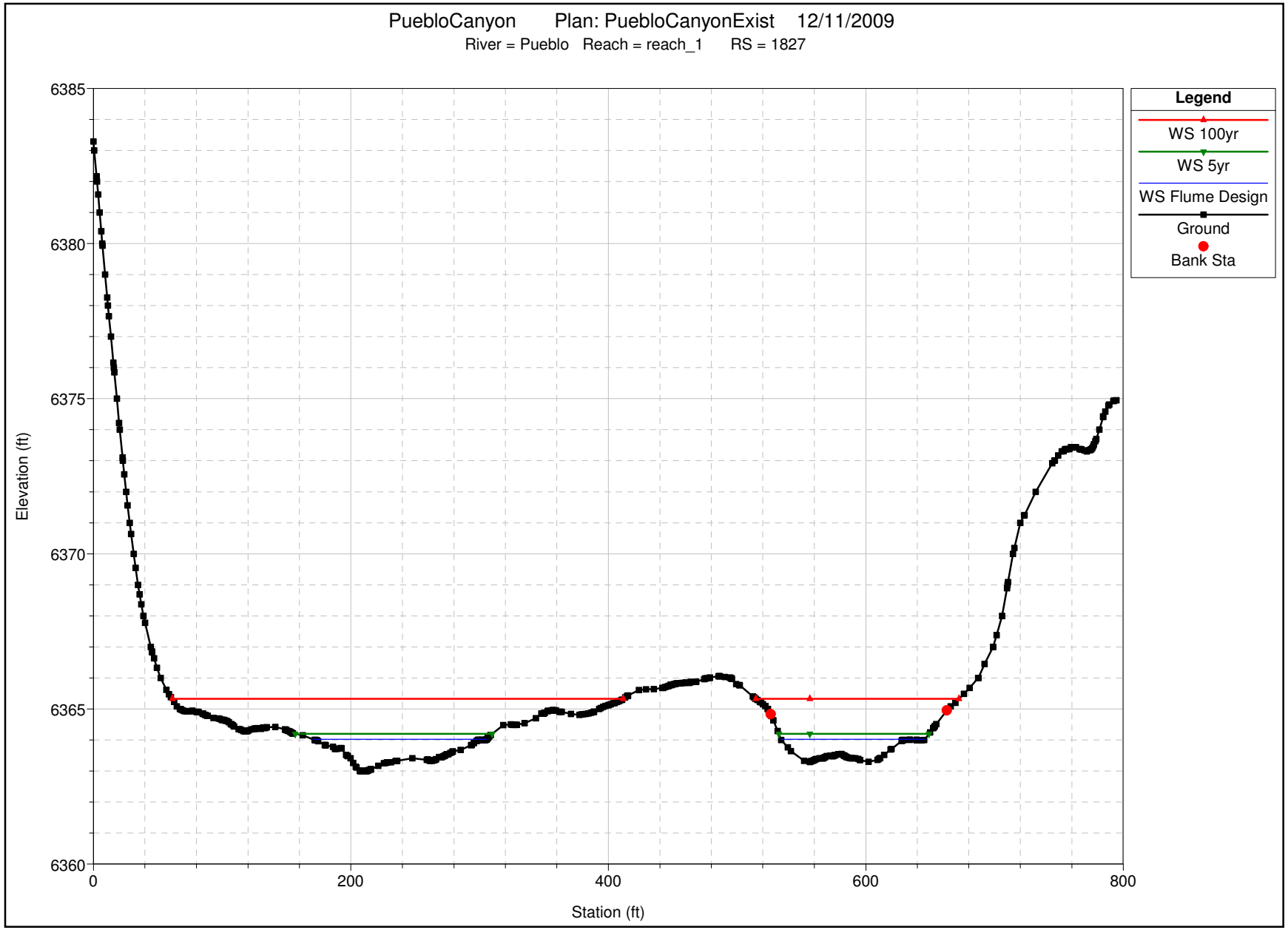
200
400
600
800
1000
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta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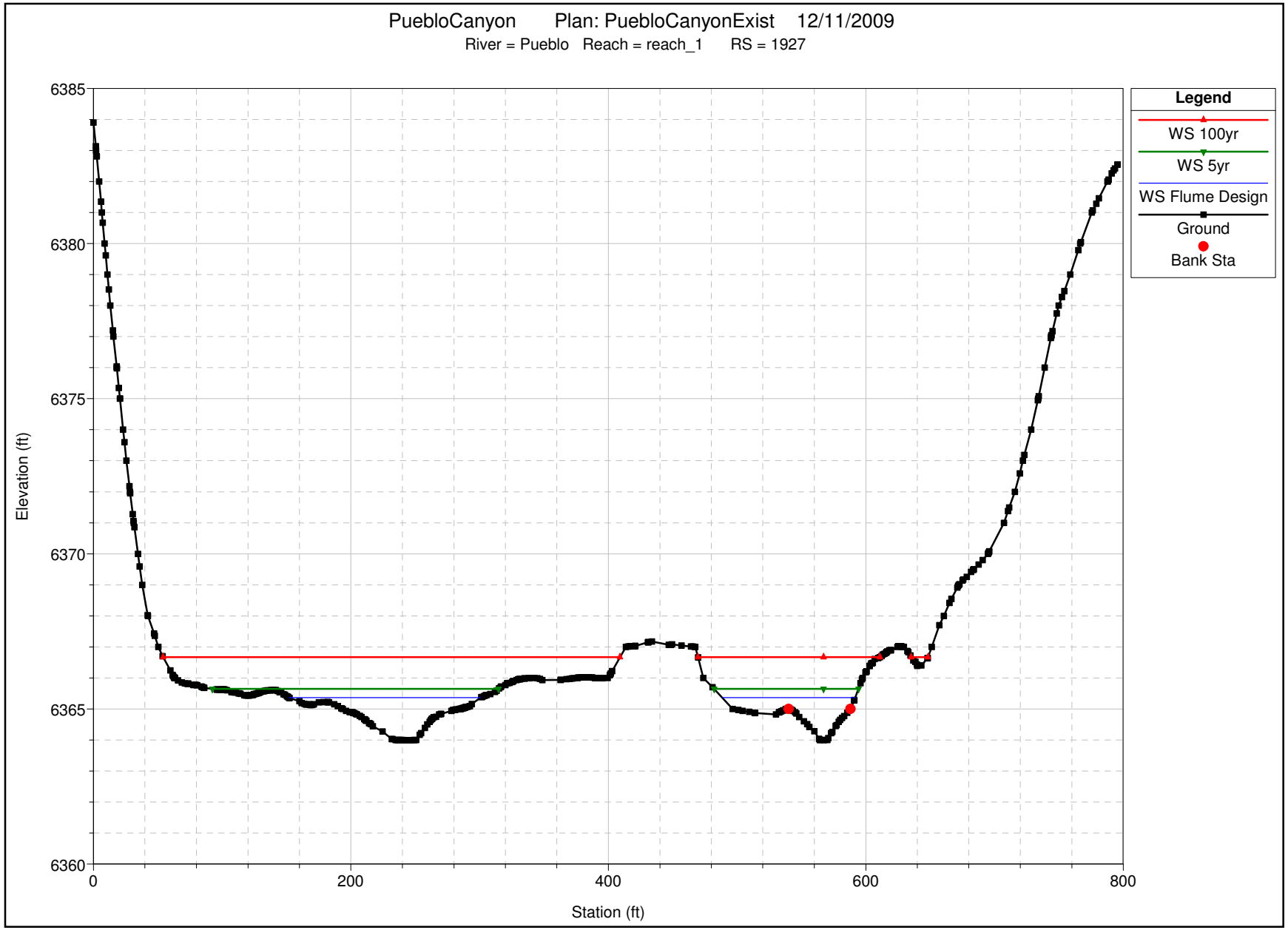
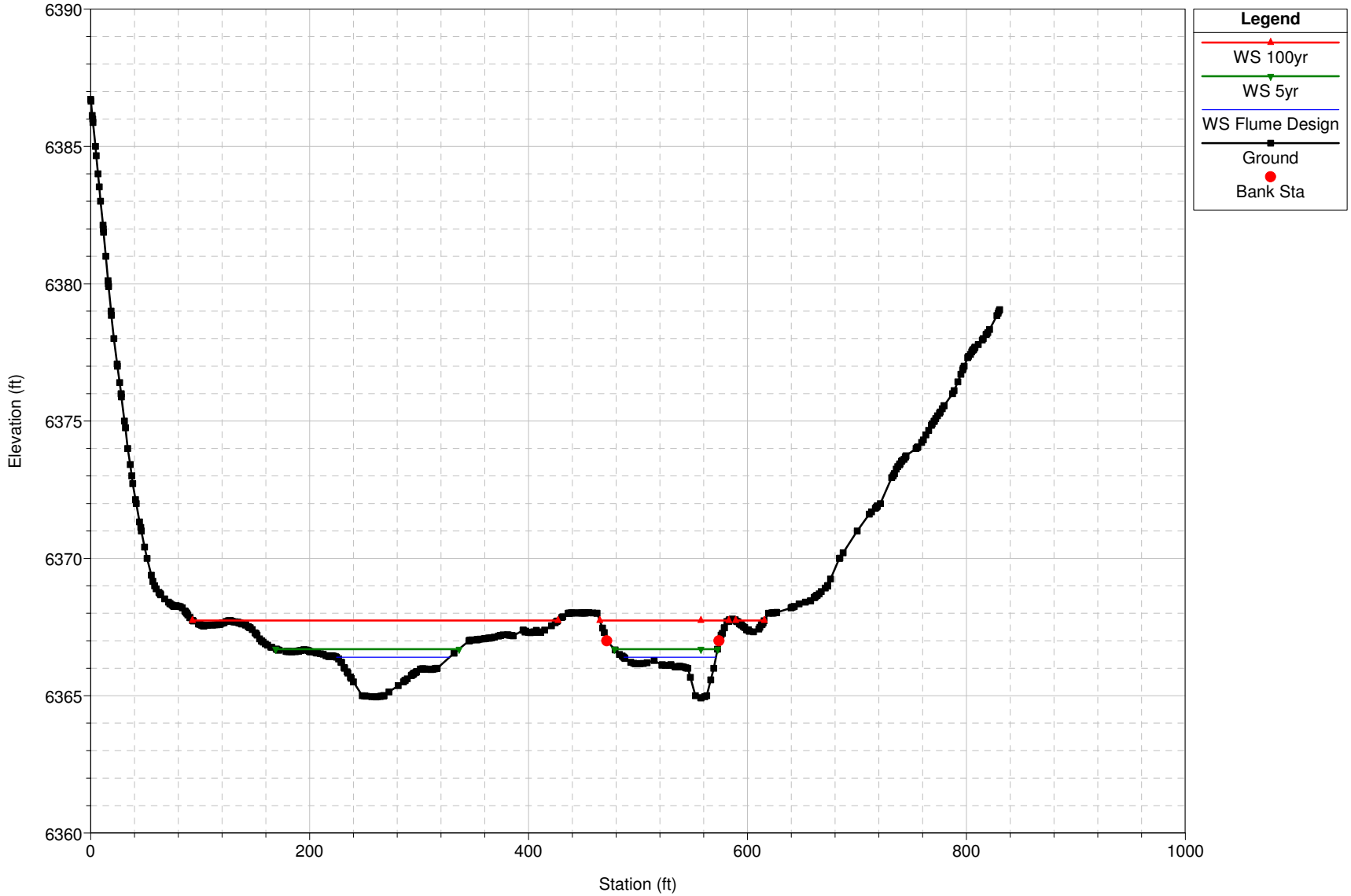
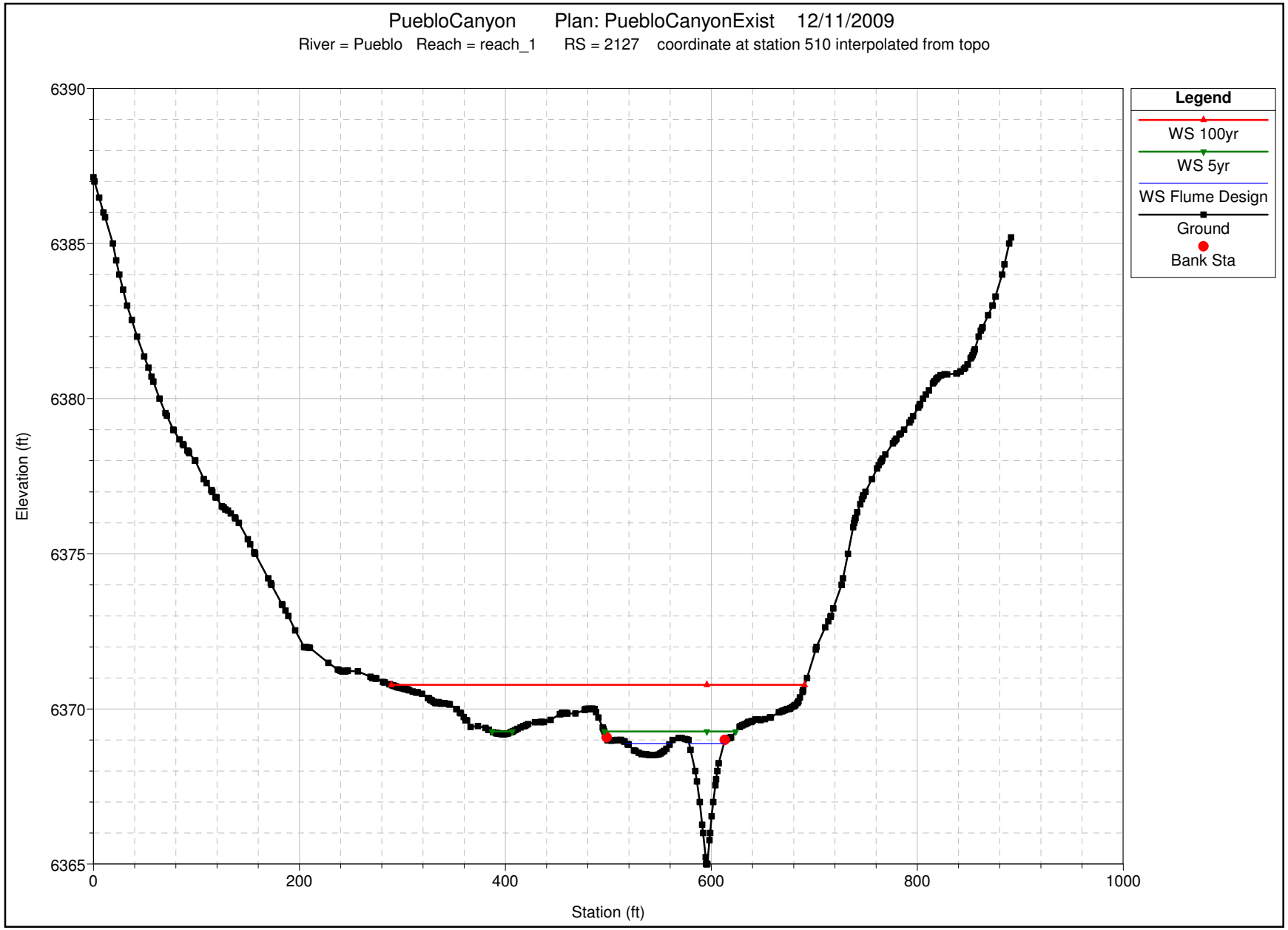
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
Station (ft)

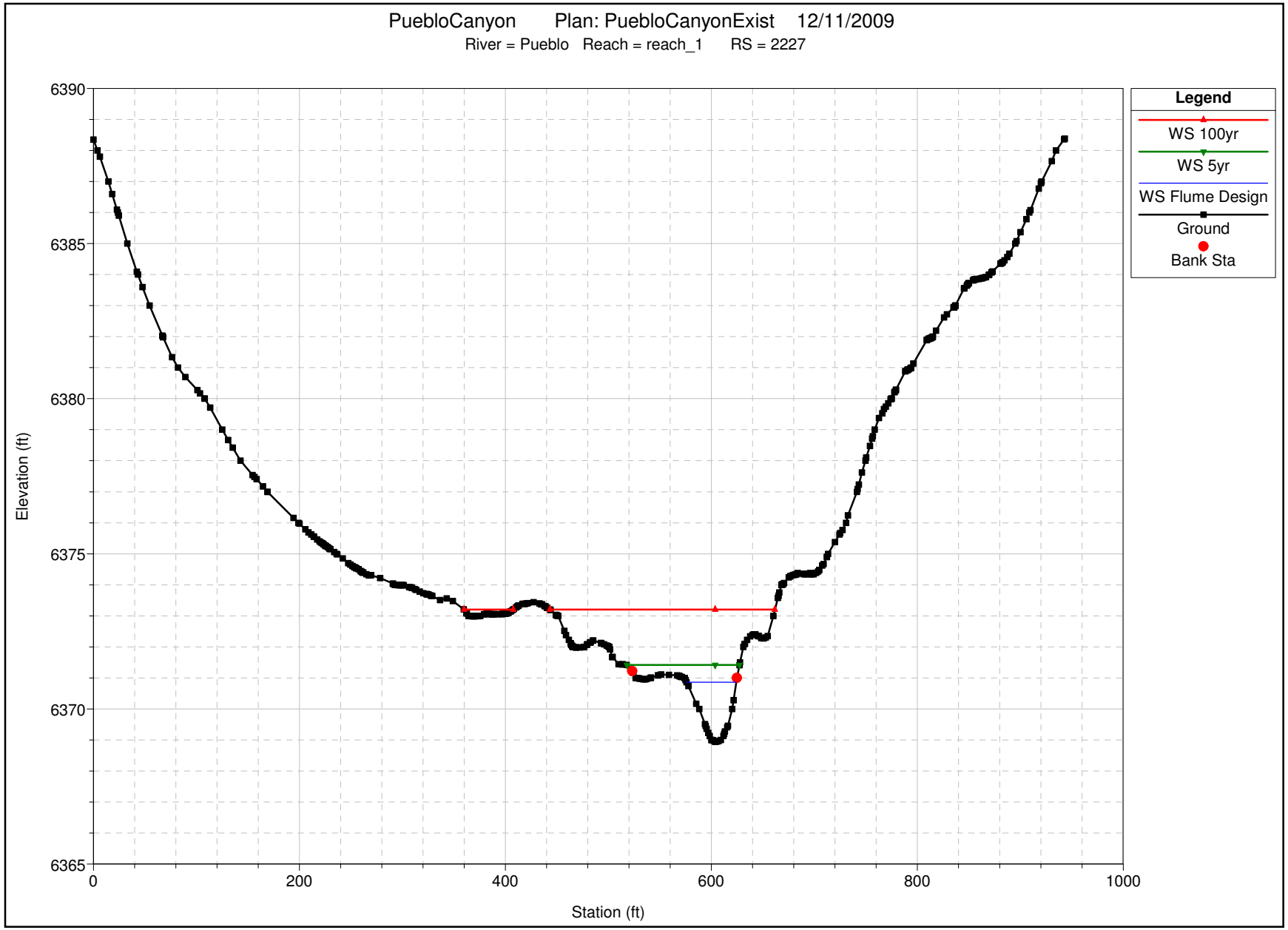

PuebloCanyon Plan: PuebloCanyonExist 12/11/2009
River = Pueblo Reach = reach_1 RS = 1927
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
Station (ft)

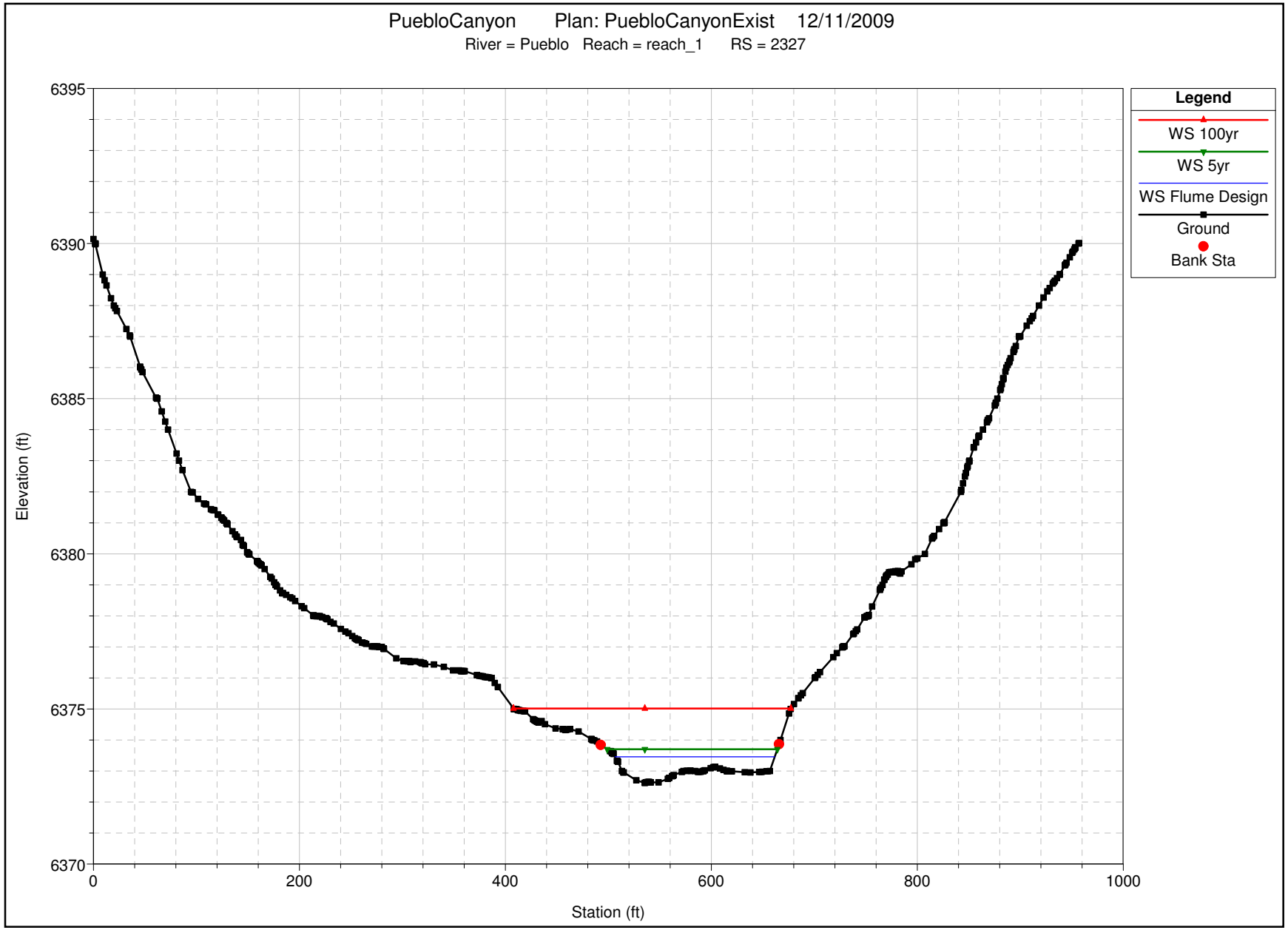
PuebloCanyon Plan: PuebloCanyonExist 12/11/2009

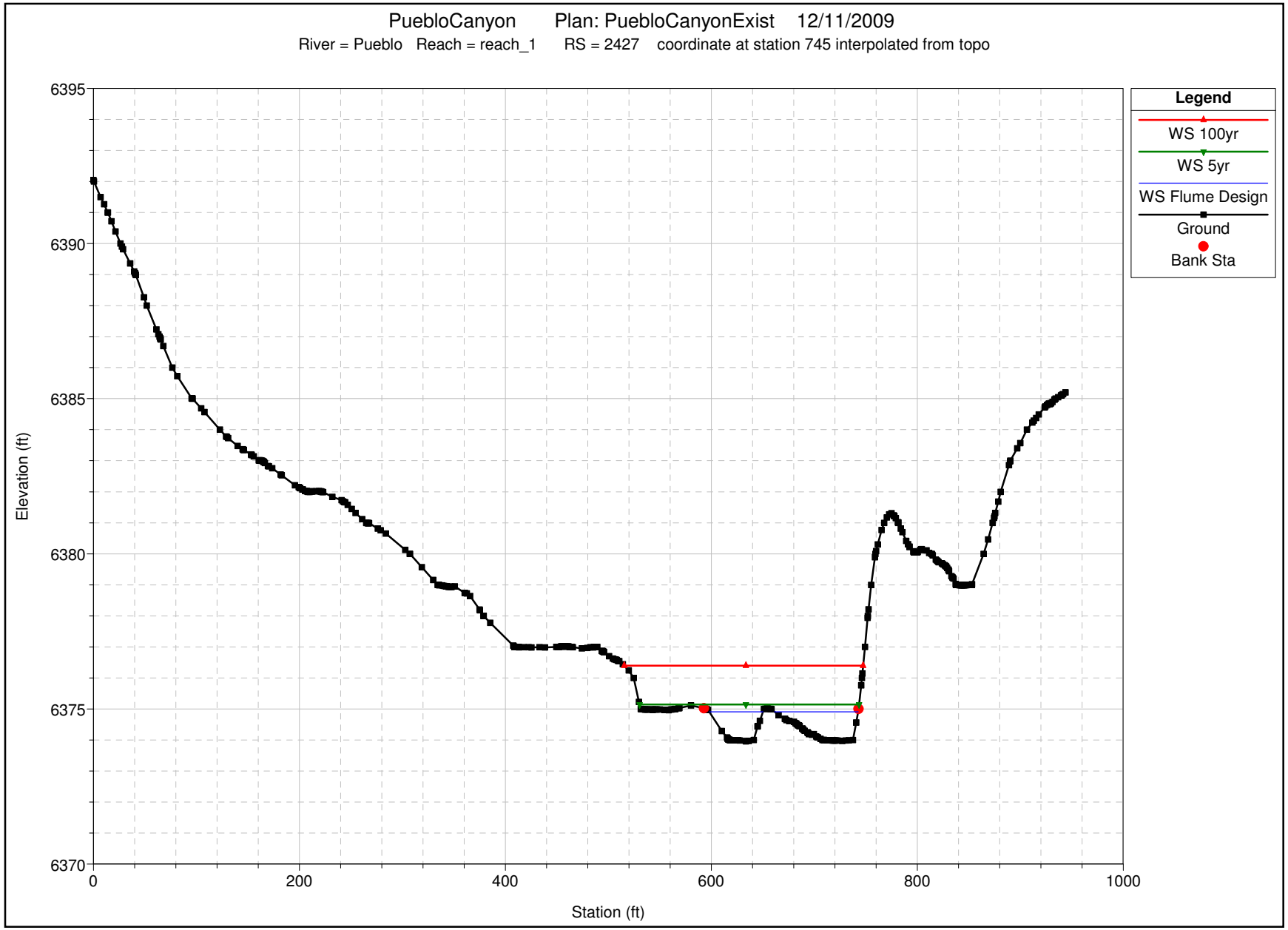
River = Pueblo Reach = reach_1 RS = 2027 coordinates at stations 491, 509, and 558 interpolated from topo

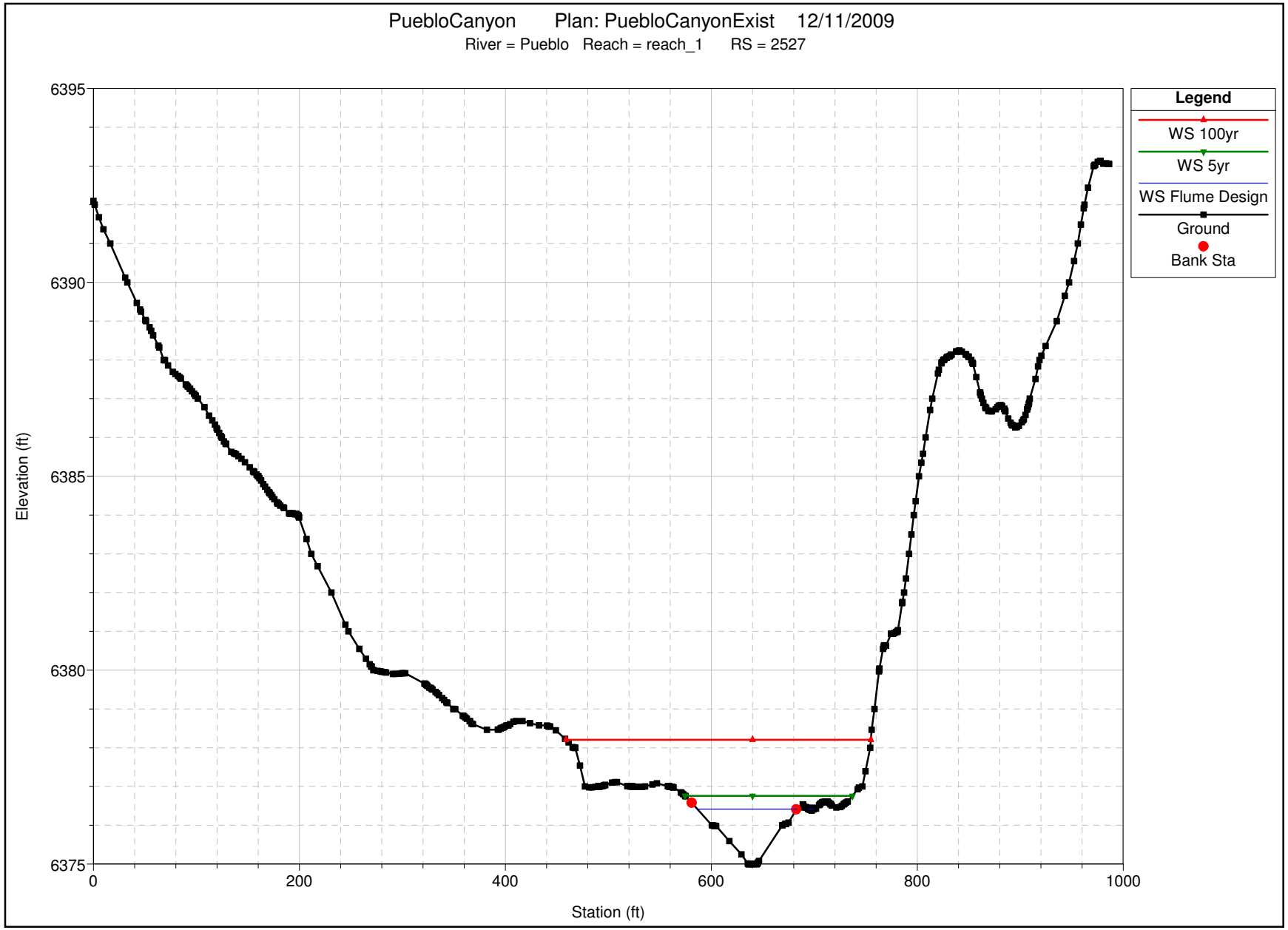


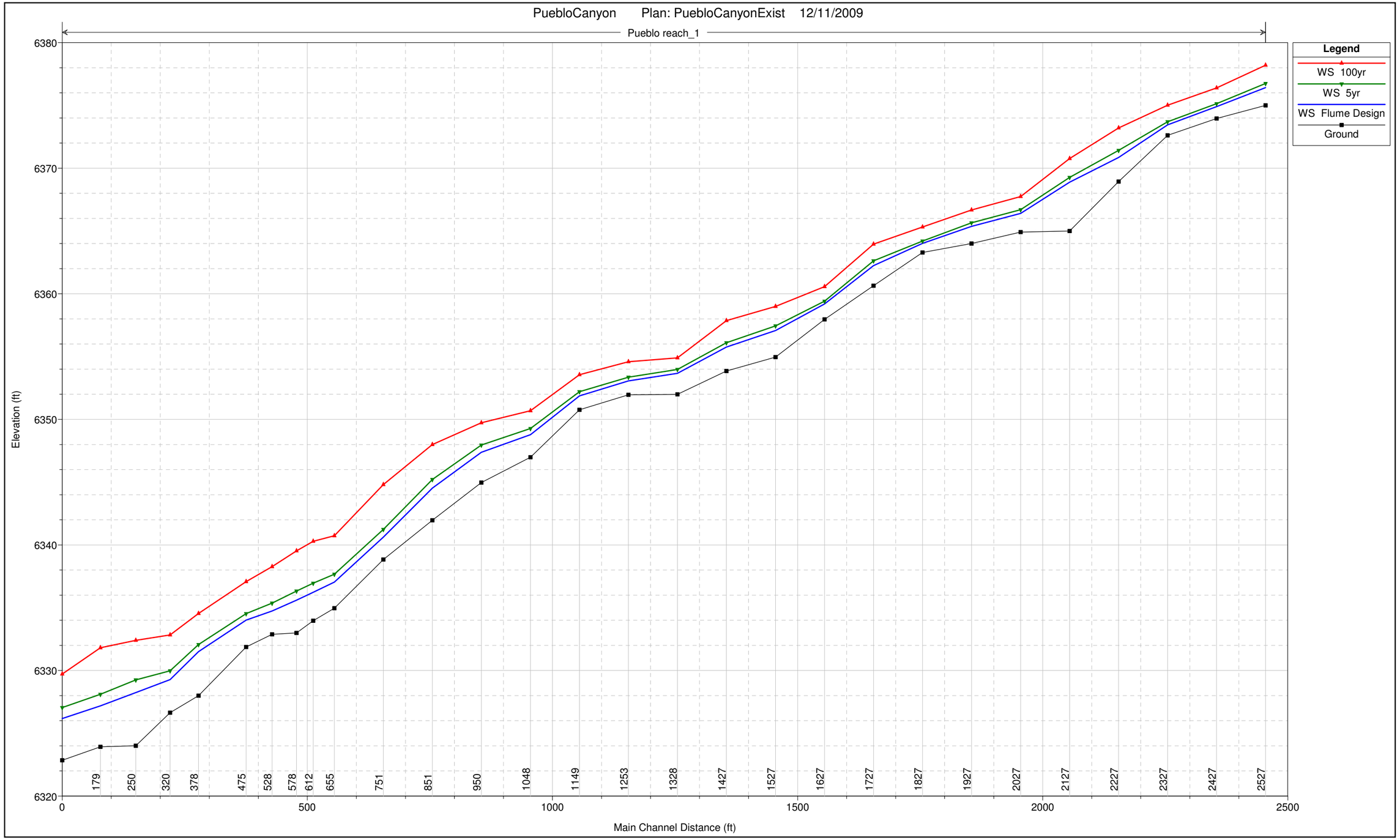

PuebloCanyon Plan: PuebloCanyonExist 12/11/2009
River = Pueblo Reach = reach_1 RS = 2127 coordinate at station 510 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6390
6385
6380
6375
6370
6365
Station (ft)
0
200
400
600
800
1000


PuebloCanyon Plan: PuebloCanyonExist 12/11/2009
River = Pueblo Reach = reach_1 RS = 2227
Elevation (ft)
6390
6385
6380
6375
6370
6365
0
200
400
600
800
1000
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta


PuebloCanyon Plan: PuebloCanyonExist 12/11/2009
River = Pueblo Reach = reach_1 RS = 2327
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
6370
0
200
400
600
800
1000
Station (ft)


PuebloCanyon Plan: PuebloCanyonExist 12/11/2009
River = Pueblo Reach = reach_1 RS = 2427 coordinate at station 745 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
6370
0
200
400
600
800
1000
Station (ft)


PuebloCanyon Plan: PuebloCanyonExist 12/11/2009
River = Pueblo Reach = reach_1 RS = 2527
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
Station (ft)
0
200
400
600
800
1000


PuebloCanyon Plan: PuebloCanyonExist 12/11/2009
Pueblo reach_1
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Elevation (ft)
6380
6370
6360
6350
6340
6330
6320
0
500
1000
1500
2000
2500
Main Channel Distance (ft)
179
250
320
378
475
528
578
612
655
751
851
950
1048
1149
1253
1328
1427
1527
1627
1727
1827
1927
2027
2127
2227
2327
2427
2527

HEC-RAS Plan: PuebloExist River: Pueblo Reach: reach_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	2527	2yr	245.00	6375.00	6376.23	6376.23	6376.55	0.015580	4.55	53.90	85.44	1.01
reach_1	2527	Flume Design	350.00	6375.00	6376.41	6376.41	6376.79	0.014787	4.93	71.09	100.15	1.01
reach_1	2527	5yr	593.00	6375.00	6376.76	6376.76	6377.22	0.011766	5.51	119.18	162.48	0.95
reach_1	2527	10yr	932.00	6375.00	6377.15	6377.15	6377.67	0.009075	5.99	199.18	271.94	0.88
reach_1	2527	50yr	2060.00	6375.00	6377.88	6377.88	6378.65	0.008634	7.70	402.95	284.23	0.92
reach_1	2527	100yr	2740.00	6375.00	6378.21	6378.21	6379.13	0.008882	8.57	496.55	295.93	0.96
reach_1	2427	2yr	245.00	6373.96	6374.77		6374.97	0.011096	3.55	69.05	123.00	0.83
reach_1	2427	Flume Design	350.00	6373.96	6374.91	6374.85	6375.16	0.011953	4.05	86.33	133.12	0.89
reach_1	2427	5yr	593.00	6373.96	6375.14	6375.14	6375.51	0.013110	4.89	128.21	213.08	0.96
reach_1	2427	10yr	932.00	6373.96	6375.41	6375.41	6375.88	0.011785	5.62	185.59	215.78	0.96
reach_1	2427	50yr	2060.00	6373.96	6376.06	6376.06	6376.85	0.010817	7.39	328.27	223.00	0.99
reach_1	2427	100yr	2740.00	6373.96	6376.40	6376.40	6377.34	0.010342	8.13	404.24	232.05	1.00
reach_1	2327	2yr	245.00	6372.62	6373.35	6373.35	6373.57	0.018109	3.78	64.90	152.21	1.02
reach_1	2327	Flume Design	350.00	6372.62	6373.46	6373.46	6373.74	0.017161	4.25	82.30	155.07	1.03
reach_1	2327	5yr	593.00	6372.62	6373.70	6373.70	6374.07	0.014757	4.89	121.18	165.15	1.01
reach_1	2327	10yr	932.00	6372.62	6373.96	6373.96	6374.45	0.013679	5.63	165.96	178.78	1.01
reach_1	2327	50yr	2060.00	6372.62	6374.67	6374.67	6375.43	0.010213	7.04	315.78	246.90	0.96
reach_1	2327	100yr	2740.00	6372.62	6375.02	6375.02	6375.90	0.009419	7.65	403.15	269.34	0.95
reach_1	2227	2yr	245.00	6368.94	6370.55	6370.55	6371.06	0.013435	5.73	42.75	42.69	1.01
reach_1	2227	Flume Design	350.00	6368.94	6370.86	6370.86	6371.45	0.012625	6.17	56.69	48.30	1.00
reach_1	2227	5yr	593.00	6368.94	6371.42	6371.42	6371.92	0.012966	5.71	104.84	109.61	1.00
reach_1	2227	10yr	932.00	6368.94	6371.78	6371.78	6372.44	0.011499	6.57	148.79	126.92	0.99
reach_1	2227	50yr	2060.00	6368.94	6372.77	6372.77	6373.71	0.008318	8.02	318.74	204.15	0.92
reach_1	2227	100yr	2740.00	6368.94	6373.21	6373.21	6374.28	0.007853	8.72	417.68	266.46	0.92
reach_1	2127	2yr	245.00	6365.00	6368.18	6368.18	6368.94	0.012406	6.99	35.04	23.65	1.01
reach_1	2127	Flume Design	350.00	6365.00	6368.89	6368.89	6369.32	0.013838	5.27	66.38	76.10	0.99
reach_1	2127	5yr	593.00	6365.00	6369.27	6369.27	6369.75	0.014227	5.57	109.10	147.31	1.02
reach_1	2127	10yr	932.00	6365.00	6369.64	6369.64	6370.20	0.010828	6.09	178.16	233.21	0.94
reach_1	2127	50yr	2060.00	6365.00	6370.45	6370.45	6371.16	0.008092	7.27	432.80	366.38	0.88
reach_1	2127	100yr	2740.00	6365.00	6370.78	6370.78	6371.58	0.008011	7.96	557.57	401.56	0.90
reach_1	2027	2yr	245.00	6364.92	6366.25	6366.16	6366.36	0.016014	3.35	97.61	169.87	0.94
reach_1	2027	Flume Design	350.00	6364.92	6366.40	6366.22	6366.55	0.015775	3.85	124.17	187.31	0.97
reach_1	2027	5yr	593.00	6364.92	6366.70	6366.39	6366.94	0.015192	4.90	190.29	261.98	1.02
reach_1	2027	10yr	932.00	6364.92	6366.98	6366.84	6367.29	0.013748	5.55	267.16	289.86	1.01
reach_1	2027	50yr	2060.00	6364.92	6367.55	6367.55	6368.16	0.014598	7.84	467.67	411.09	1.13
reach_1	2027	100yr	2740.00	6364.92	6367.74	6367.70	6368.60	0.017621	9.33	553.16	478.41	1.26
reach_1	1927	2yr	245.00	6364.00	6365.19		6365.34	0.010420	3.97	112.87	221.31	0.84
reach_1	1927	Flume Design	350.00	6364.00	6365.36		6365.55	0.010057	4.51	153.65	252.04	0.85
reach_1	1927	5yr	593.00	6364.00	6365.65		6365.91	0.010440	5.55	235.13	334.55	0.91
reach_1	1927	10yr	932.00	6364.00	6365.88	6365.83	6366.24	0.011883	6.70	318.22	377.94	1.00
reach_1	1927	50yr	2060.00	6364.00	6366.44	6366.44	6366.97	0.012871	8.74	573.74	486.06	1.11
reach_1	1927	100yr	2740.00	6364.00	6366.67	6366.67	6367.30	0.013553	9.67	689.07	509.44	1.16
reach_1	1827	2yr	245.00	6363.29	6363.91	6363.84	6364.06	0.018333	3.82	94.63	208.87	1.03
reach_1	1827	Flume Design	350.00	6363.29	6364.02	6363.96	6364.21	0.021802	4.24	119.11	246.51	1.12
reach_1	1827	5yr	593.00	6363.29	6364.20	6364.16	6364.50	0.023093	5.33	164.51	269.75	1.22
reach_1	1827	10yr	932.00	6363.29	6364.47	6364.47	6364.86	0.018706	5.95	245.88	334.05	1.16
reach_1	1827	50yr	2060.00	6363.29	6365.09	6365.09	6365.63	0.014089	7.15	494.28	476.38	1.09
reach_1	1827	100yr	2740.00	6363.29	6365.32	6365.32	6365.95	0.013566	7.83	611.98	508.07	1.10
reach_1	1727	2yr	245.00	6360.64	6362.01	6362.01	6362.37	0.015139	4.82	51.63	89.44	1.01
reach_1	1727	Flume Design	350.00	6360.64	6362.25	6362.25	6362.62	0.011858	4.94	81.94	151.73	0.93
reach_1	1727	5yr	593.00	6360.64	6362.63	6362.63	6363.03	0.010019	5.34	153.00	233.77	0.89
reach_1	1727	10yr	932.00	6360.64	6362.96	6362.96	6363.40	0.009759	5.82	240.82	282.30	0.90
reach_1	1727	50yr	2060.00	6360.64	6363.54	6363.54	6364.30	0.011485	8.02	446.13	437.21	1.04
reach_1	1727	100yr	2740.00	6360.64	6363.95	6363.95	6364.69	0.009089	8.15	650.72	551.89	0.95
reach_1	1627	2yr	245.00	6357.96	6359.00	6359.00	6359.29	0.028383	5.38	72.55	145.09	1.32
reach_1	1627	Flume Design	350.00	6357.96	6359.20	6359.20	6359.46	0.025264	5.16	106.50	200.24	1.25
reach_1	1627	5yr	593.00	6357.96	6359.41	6359.41	6359.78	0.026995	6.10	154.14	239.99	1.33
reach_1	1627	10yr	932.00	6357.96	6359.75	6359.75	6360.14	0.018589	6.27	246.23	308.45	1.17
reach_1	1627	50yr	2060.00	6357.96	6360.32	6360.32	6360.94	0.017035	8.01	447.30	386.57	1.20
reach_1	1627	100yr	2740.00	6357.96	6360.57	6360.57	6361.32	0.016715	8.87	547.24	404.71	1.22
reach_1	1527	2yr	245.00	6354.96	6356.87	6356.87	6357.19	0.011273	5.27	83.47	132.54	0.92
reach_1	1527	Flume Design	350.00	6354.96	6357.08	6357.08	6357.42	0.011859	5.69	113.30	155.04	0.96
reach_1	1527	5yr	593.00	6354.96	6357.45	6357.38	6357.80	0.012020	6.07	175.48	181.85	0.98
reach_1	1527	10yr	932.00	6354.96	6357.87	6357.70	6358.23	0.011059	6.29	257.68	211.75	0.96
reach_1	1527	50yr	2060.00	6354.96	6358.70	6358.47	6359.28	0.010291	8.17	492.92	324.97	1.00
reach_1	1527	100yr	2740.00	6354.96	6358.99	6358.86	6359.72	0.011119	9.27	594.77	368.98	1.06

HEC-RAS Plan: PuebloExist River: Pueblo Reach: reach_1 (Continued)

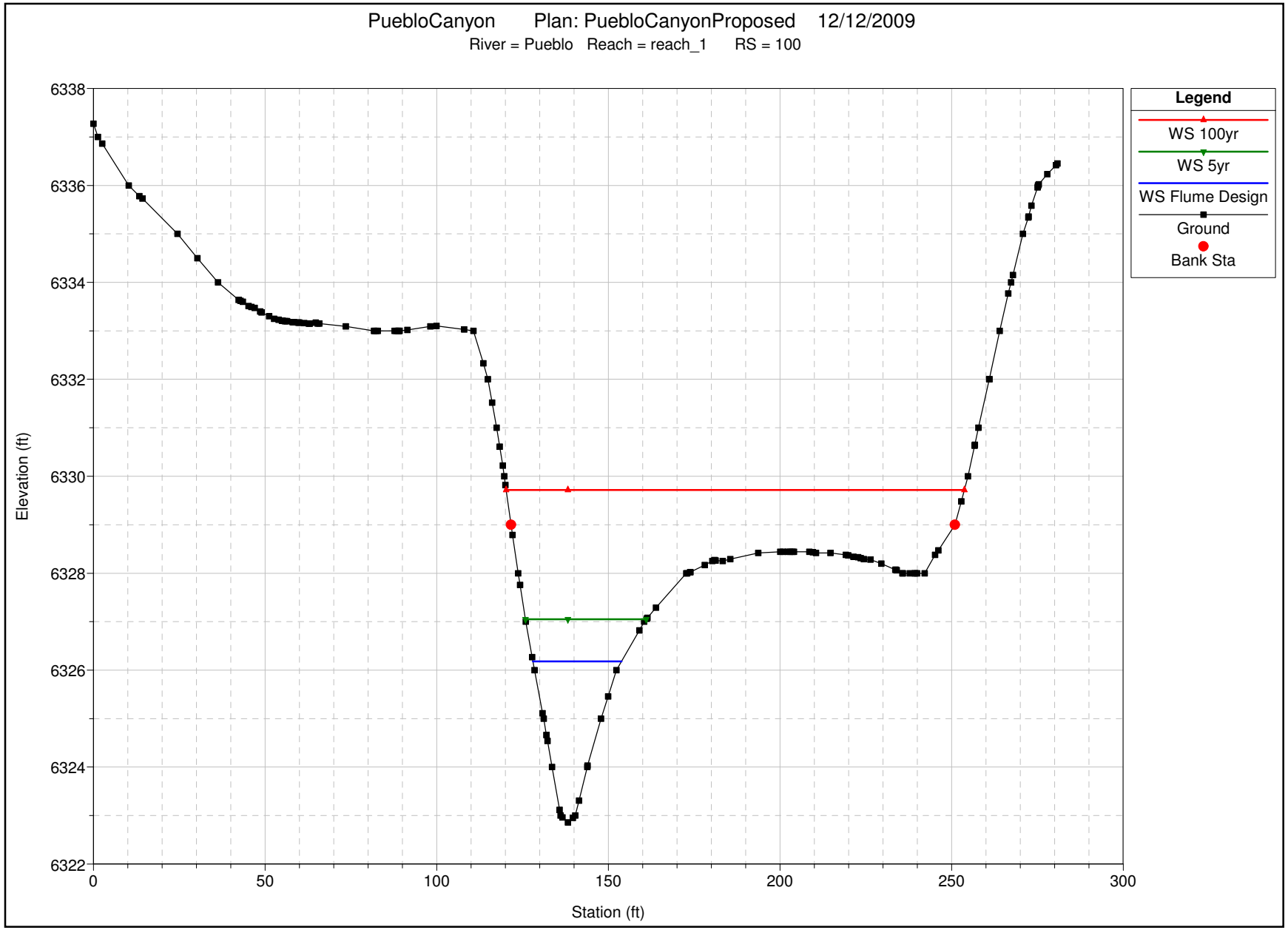
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	1427	2yr	245.00	6353.85	6355.54	6355.54	6355.89	0.011359	5.09	69.76	112.10	0.92
reach_1	1427	Flume Design	350.00	6353.85	6355.76	6355.76	6356.15	0.011470	5.56	94.77	124.22	0.94
reach_1	1427	5yr	593.00	6353.85	6356.10	6356.10	6356.61	0.011718	6.53	146.40	169.26	0.99
reach_1	1427	10yr	932.00	6353.85	6356.49	6356.49	6357.12	0.011056	7.49	216.55	198.45	1.00
reach_1	1427	50yr	2060.00	6353.85	6357.40	6357.40	6358.26	0.009839	9.38	454.06	343.75	1.02
reach_1	1427	100yr	2740.00	6353.85	6357.86	6357.86	6358.74	0.008699	9.82	637.16	444.45	0.98
reach_1	1328	2yr	245.00	6351.99	6353.50		6353.67	0.011926	4.40	90.80	116.88	0.90
reach_1	1328	Flume Design	350.00	6351.99	6353.67	6353.49	6353.90	0.013291	5.03	112.05	125.84	0.97
reach_1	1328	5yr	593.00	6351.99	6353.98	6353.81	6354.33	0.015483	6.18	153.04	143.72	1.08
reach_1	1328	10yr	932.00	6351.99	6354.27	6354.20	6354.81	0.017164	7.67	207.53	197.02	1.19
reach_1	1328	50yr	2060.00	6351.99	6354.91	6354.85	6356.02	0.021728	11.29	349.15	262.84	1.43
reach_1	1328	100yr	2740.00	6351.99	6354.90	6354.90	6356.88	0.039189	15.08	345.35	254.24	1.92
reach_1	1253	2yr	245.00	6351.96	6352.89		6352.95	0.005714	2.47	129.79	182.60	0.59
reach_1	1253	Flume Design	350.00	6351.96	6353.07		6353.16	0.005419	2.85	164.52	203.84	0.60
reach_1	1253	5yr	593.00	6351.96	6353.35		6353.50	0.005684	3.68	228.30	240.93	0.66
reach_1	1253	10yr	932.00	6351.96	6353.66		6353.88	0.005985	4.53	307.86	278.10	0.70
reach_1	1253	50yr	2060.00	6351.96	6354.30		6354.77	0.007642	6.70	528.12	417.61	0.85
reach_1	1253	100yr	2740.00	6351.96	6354.59		6355.18	0.008161	7.59	653.60	468.81	0.90
reach_1	1149	2yr	245.00	6350.76	6351.71	6351.71	6352.00	0.020139	5.05	71.97	124.20	1.14
reach_1	1149	Flume Design	350.00	6350.76	6351.87	6351.87	6352.22	0.020126	5.56	93.42	138.27	1.17
reach_1	1149	5yr	593.00	6350.76	6352.20	6352.20	6352.60	0.016441	6.12	154.87	233.79	1.11
reach_1	1149	10yr	932.00	6350.76	6352.51	6352.51	6353.00	0.014574	6.95	235.42	290.80	1.09
reach_1	1149	50yr	2060.00	6350.76	6353.26	6353.26	6353.88	0.011170	8.31	517.36	436.41	1.03
reach_1	1149	100yr	2740.00	6350.76	6353.55	6353.55	6354.26	0.011123	9.09	648.39	460.08	1.06
reach_1	1048	2yr	245.00	6346.99	6348.51		6348.59	0.007625	3.22	115.03	126.24	0.70
reach_1	1048	Flume Design	350.00	6346.99	6348.78		6348.89	0.007019	3.53	152.35	144.85	0.70
reach_1	1048	5yr	593.00	6346.99	6349.27		6349.40	0.006115	3.84	234.02	214.18	0.68
reach_1	1048	10yr	932.00	6346.99	6349.60		6349.80	0.007360	4.94	320.51	352.07	0.77
reach_1	1048	50yr	2060.00	6346.99	6350.36		6350.74	0.008473	7.03	638.74	473.05	0.89
reach_1	1048	100yr	2740.00	6346.99	6350.69		6351.10	0.007731	7.46	796.67	482.41	0.87
reach_1	950	2yr	245.00	6344.97	6347.03	6347.03	6347.58	0.013404	5.97	41.05	42.21	1.01
reach_1	950	Flume Design	350.00	6344.97	6347.39	6347.39	6348.00	0.011075	6.31	59.63	63.51	0.95
reach_1	950	5yr	593.00	6344.97	6347.96	6347.96	6348.64	0.008979	6.89	118.52	130.69	0.90
reach_1	950	10yr	932.00	6344.97	6348.69	6348.69	6349.19	0.004980	6.44	309.90	372.09	0.71
reach_1	950	50yr	2060.00	6344.97	6349.45	6349.45	6350.06	0.005648	8.15	651.55	486.22	0.79
reach_1	950	100yr	2740.00	6344.97	6349.73	6349.73	6350.41	0.006199	9.01	787.97	488.93	0.84
reach_1	851	2yr	245.00	6341.96	6344.14	6344.14	6344.78	0.012629	6.42	38.16	30.43	1.01
reach_1	851	Flume Design	350.00	6341.96	6344.52	6344.52	6345.27	0.012015	6.91	50.62	34.78	1.01
reach_1	851	5yr	593.00	6341.96	6345.21	6345.21	6346.13	0.011119	7.69	77.12	42.61	1.01
reach_1	851	10yr	932.00	6341.96	6346.02	6346.02	6347.00	0.009095	7.98	125.83	116.75	0.94
reach_1	851	50yr	2060.00	6341.96	6347.47	6347.47	6348.37	0.005314	8.52	460.65	352.21	0.78
reach_1	851	100yr	2740.00	6341.96	6348.00	6348.00	6348.92	0.004989	9.02	679.47	472.91	0.78
reach_1	751	2yr	245.00	6338.84	6340.31	6340.31	6340.87	0.012829	6.04	40.54	35.99	1.00
reach_1	751	Flume Design	350.00	6338.84	6340.63	6340.63	6341.32	0.012164	6.68	52.41	38.41	1.01
reach_1	751	5yr	593.00	6338.84	6341.24	6341.24	6342.15	0.011076	7.68	77.19	42.59	1.01
reach_1	751	10yr	932.00	6338.84	6341.91	6341.91	6343.08	0.010328	8.68	107.37	46.64	1.01
reach_1	751	50yr	2060.00	6338.84	6343.76	6343.76	6345.22	0.007711	9.81	242.93	116.50	0.93
reach_1	751	100yr	2740.00	6338.84	6344.80	6344.80	6345.96	0.004835	9.14	484.88	316.87	0.77
reach_1	655	2yr	245.00	6334.96	6336.69	6336.69	6337.29	0.012648	6.19	39.57	33.49	1.00
reach_1	655	Flume Design	350.00	6334.96	6337.04	6337.04	6337.74	0.012104	6.75	51.86	37.28	1.01
reach_1	655	5yr	593.00	6334.96	6337.67	6337.67	6338.59	0.011028	7.72	76.78	41.92	1.01
reach_1	655	10yr	932.00	6334.96	6338.37	6338.37	6339.52	0.010284	8.60	108.36	47.65	1.01
reach_1	655	50yr	2060.00	6334.96	6340.04	6340.04	6341.69	0.009288	10.30	200.01	62.00	1.01
reach_1	655	100yr	2740.00	6334.96	6340.74	6340.74	6342.70	0.008593	11.25	244.88	66.53	1.00
reach_1	612	2yr	245.00	6333.97	6335.83	6335.83	6336.51	0.012524	6.60	37.12	28.18	1.01
reach_1	612	Flume Design	350.00	6333.97	6336.23	6336.23	6337.03	0.011682	7.17	48.79	30.95	1.01
reach_1	612	5yr	593.00	6333.97	6336.95	6336.95	6337.98	0.010776	8.12	73.00	36.06	1.01
reach_1	612	10yr	932.00	6333.97	6337.75	6337.75	6338.98	0.010176	8.90	104.71	43.15	1.01
reach_1	612	50yr	2060.00	6333.97	6339.54	6339.54	6341.26	0.009201	10.50	196.17	58.68	1.01
reach_1	612	100yr	2740.00	6333.97	6340.29	6340.29	6342.31	0.008329	11.42	242.13	64.57	0.99
reach_1	578	2yr	245.00	6333.00	6335.21	6335.21	6335.88	0.012460	6.59	37.17	28.13	1.01
reach_1	578	Flume Design	350.00	6333.00	6335.60	6335.60	6336.40	0.011741	7.15	48.95	31.31	1.01
reach_1	578	5yr	593.00	6333.00	6336.33	6336.33	6337.33	0.010870	8.04	73.79	37.30	1.01
reach_1	578	10yr	932.00	6333.00	6337.13	6337.13	6338.32	0.010195	8.78	106.20	44.80	1.00
reach_1	578	50yr	2060.00	6333.00	6338.87	6338.87	6340.41	0.009320	9.98	206.44	67.23	1.00

HEC-RAS Plan: PuebloExist River: Pueblo Reach: reach_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	578	100yr	2740.00	6333.00	6339.53	6339.53	6341.38	0.008599	10.90	252.92	72.26	1.00
reach_1	528	2yr	245.00	6332.88	6334.39	6334.39	6334.99	0.012926	6.22	39.38	33.60	1.01
reach_1	528	Flume Design	350.00	6332.88	6334.74	6334.74	6335.45	0.011896	6.79	51.54	36.14	1.00
reach_1	528	5yr	593.00	6332.88	6335.37	6335.37	6336.32	0.011135	7.81	75.95	40.98	1.01
reach_1	528	10yr	932.00	6332.88	6336.17	6336.17	6337.19	0.010711	8.12	114.75	56.69	1.01
reach_1	528	50yr	2060.00	6332.88	6337.62	6337.62	6339.16	0.009142	9.98	207.56	70.72	1.00
reach_1	528	100yr	2740.00	6332.88	6338.27	6338.27	6340.13	0.008545	10.95	255.39	76.17	0.99
reach_1	475	2yr	245.00	6331.88	6333.71	6333.71	6334.22	0.013364	5.77	42.46	41.73	1.01
reach_1	475	Flume Design	350.00	6331.88	6334.01	6334.01	6334.61	0.013053	6.22	56.31	48.63	1.02
reach_1	475	5yr	593.00	6331.88	6334.53	6334.53	6335.33	0.011744	7.15	82.93	53.50	1.01
reach_1	475	10yr	932.00	6331.88	6335.14	6335.14	6336.12	0.010620	7.97	117.00	59.42	1.00
reach_1	475	50yr	2060.00	6331.88	6336.59	6336.59	6337.75	0.010253	8.63	238.85	105.71	1.01
reach_1	475	100yr	2740.00	6331.88	6337.08	6337.08	6338.46	0.009557	9.44	291.17	109.03	1.00
reach_1	378	2yr	245.00	6328.00	6331.15	6331.15	6331.71	0.013386	5.97	41.05	37.53	1.01
reach_1	378	Flume Design	350.00	6328.00	6331.50	6331.50	6332.12	0.013012	6.29	55.63	46.18	1.01
reach_1	378	5yr	593.00	6328.00	6332.08	6332.08	6332.81	0.012010	6.89	86.11	59.00	1.00
reach_1	378	10yr	932.00	6328.00	6332.63	6332.63	6333.56	0.011158	7.74	120.45	65.60	1.01
reach_1	378	50yr	2060.00	6328.00	6334.02	6334.02	6335.27	0.010227	8.96	230.01	95.00	1.01
reach_1	378	100yr	2740.00	6328.00	6334.55	6334.55	6336.04	0.009439	9.80	280.98	99.67	1.00
reach_1	320	2yr	245.00	6326.65	6328.87	6328.87	6329.51	0.012959	6.46	37.92	30.48	1.02
reach_1	320	Flume Design	350.00	6326.65	6329.28	6329.28	6329.97	0.012406	6.68	52.37	38.65	1.01
reach_1	320	5yr	593.00	6326.65	6329.98	6329.98	6330.75	0.011334	7.02	84.50	54.06	0.99
reach_1	320	10yr	932.00	6326.65	6330.93		6331.60	0.006078	6.57	141.86	62.58	0.77
reach_1	320	50yr	2060.00	6326.65	6332.49	6331.94	6333.56	0.005434	8.34	257.76	105.25	0.78
reach_1	320	100yr	2740.00	6326.65	6332.84	6332.70	6334.38	0.006920	10.02	297.45	120.97	0.90
reach_1	250	2yr	245.00	6324.01	6327.70		6328.23	0.007289	5.85	41.86	24.33	0.79
reach_1	250	Flume Design	350.00	6324.01	6328.25		6328.85	0.006662	6.23	56.20	27.80	0.77
reach_1	250	5yr	593.00	6324.01	6329.26		6329.97	0.005796	6.80	87.22	34.04	0.75
reach_1	250	10yr	932.00	6324.01	6330.43		6331.19	0.005595	6.97	133.64	49.36	0.75
reach_1	250	50yr	2060.00	6324.01	6331.74	6331.74	6333.09	0.007394	9.51	259.91	137.22	0.90
reach_1	250	100yr	2740.00	6324.01	6332.40	6332.40	6333.88	0.006684	10.16	357.49	153.06	0.88
reach_1	179	2yr	245.00	6323.92	6326.66	6326.66	6327.54	0.011997	7.51	32.63	19.04	1.01
reach_1	179	Flume Design	350.00	6323.92	6327.19	6327.19	6328.20	0.011346	8.04	43.51	21.92	1.01
reach_1	179	5yr	593.00	6323.92	6328.11	6328.11	6329.37	0.010641	8.99	65.97	26.73	1.01
reach_1	179	10yr	932.00	6323.92	6329.12	6329.12	6330.59	0.010123	9.73	95.77	33.21	1.01
reach_1	179	50yr	2060.00	6323.92	6331.23	6331.23	6332.52	0.005994	9.83	321.24	144.25	0.83
reach_1	179	100yr	2740.00	6323.92	6331.81	6331.81	6333.31	0.006160	10.84	406.33	147.18	0.86
reach_1	100	2yr	245.00	6322.86	6325.68	6325.68	6326.49	0.012143	7.20	34.01	21.57	1.01
reach_1	100	Flume Design	350.00	6322.86	6326.18	6326.18	6327.09	0.011668	7.64	45.79	25.82	1.01
reach_1	100	5yr	593.00	6322.86	6327.05	6327.05	6328.10	0.011019	8.21	72.25	35.21	1.01
reach_1	100	10yr	932.00	6322.86	6328.18	6328.18	6329.07	0.010914	7.55	123.50	68.60	0.99
reach_1	100	50yr	2060.00	6322.86	6329.30	6329.30	6330.31	0.011046	8.10	254.61	131.08	1.02
reach_1	100	100yr	2740.00	6322.86	6329.72	6329.72	6330.94	0.010235	8.87	310.23	133.51	1.01

Proposed Conditions

2527
2427
2327
2227
2127
reach_1
2027
1827
Pueblo
1627
1527
1427
1328
1048
851
751
578
320
280
100
179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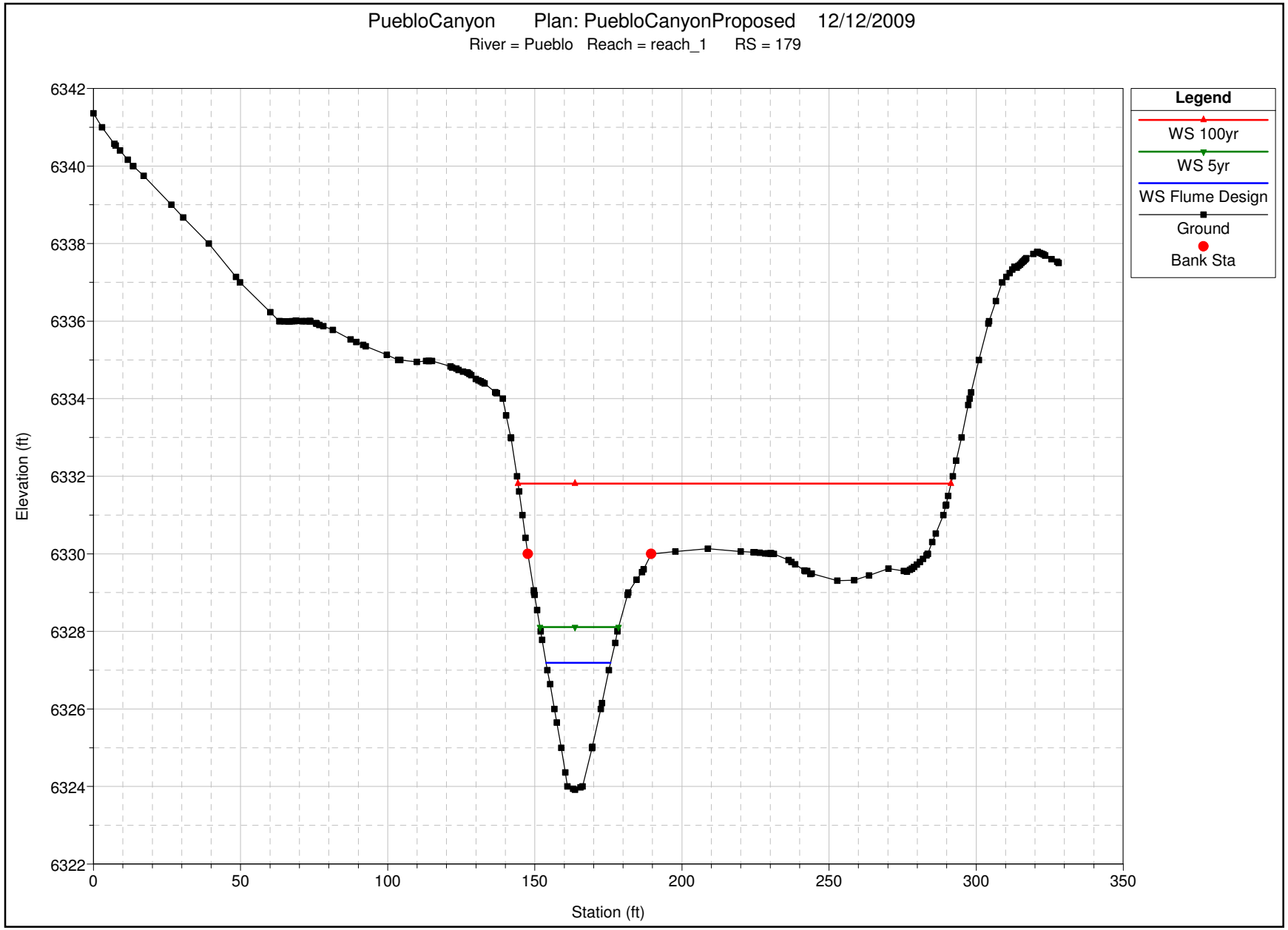
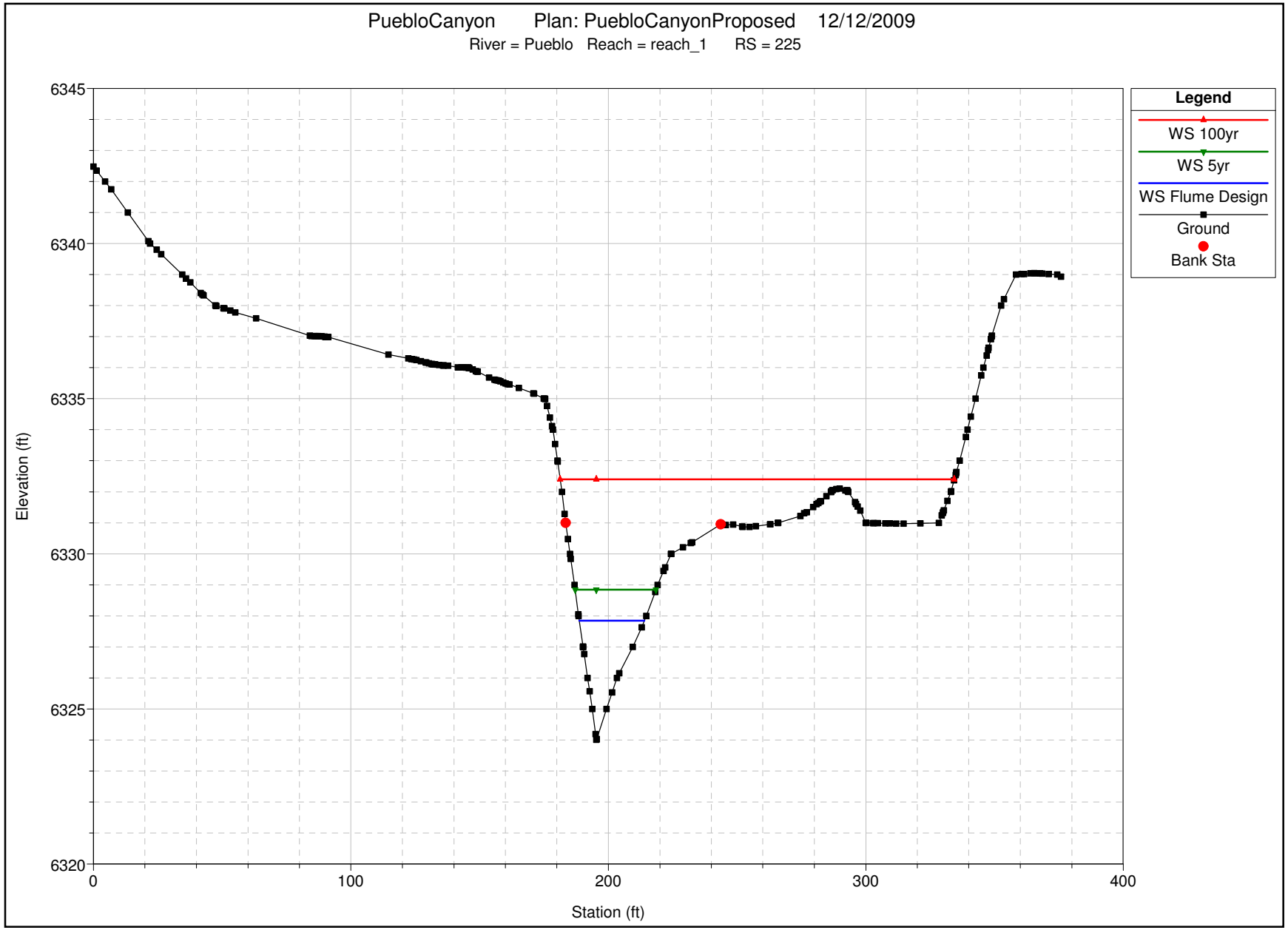
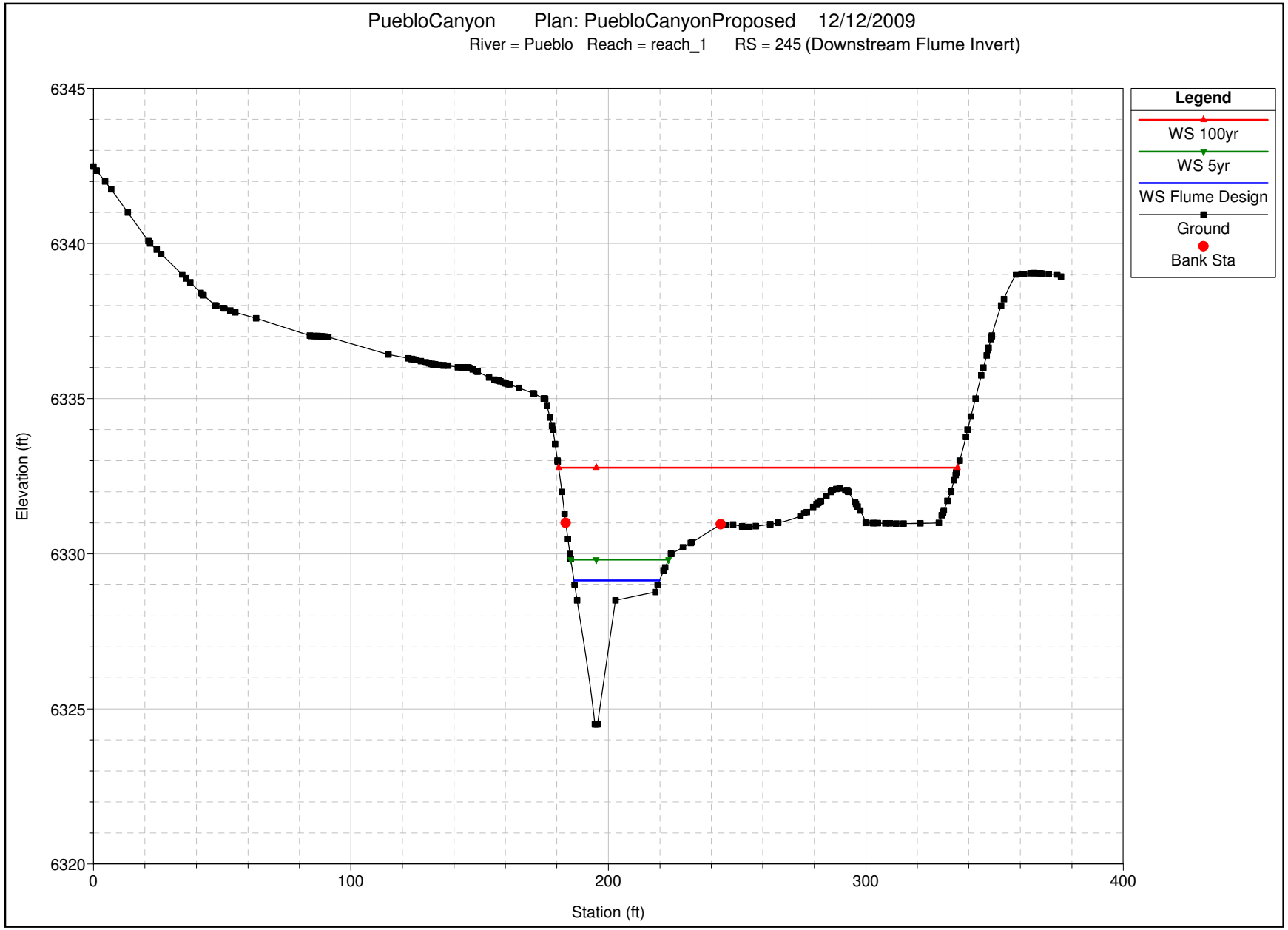
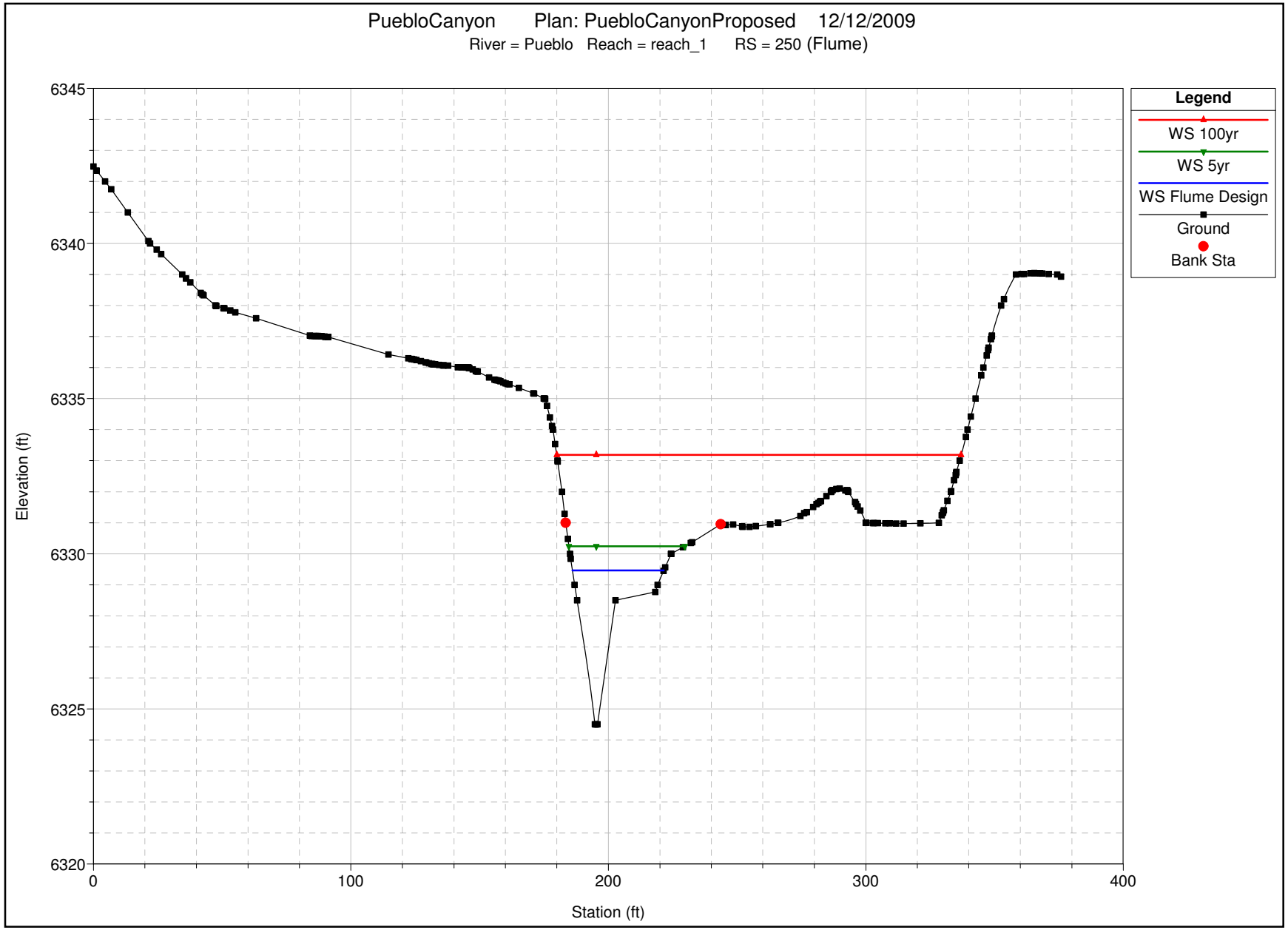
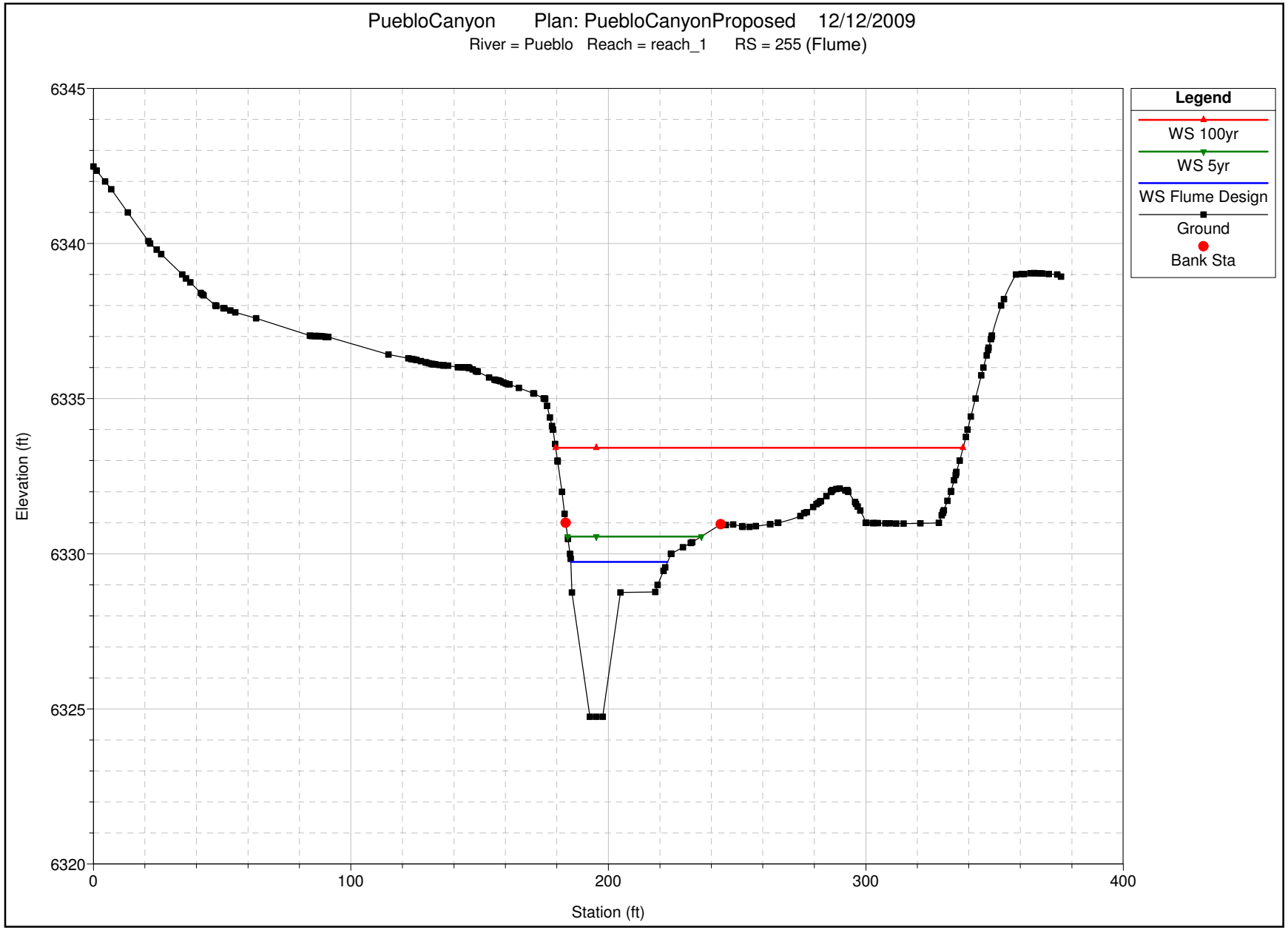
River = Pueblo Reach = reach_1 RS = 100
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6338
6336
6334
6332
6330
6328
6326
6324
6322
0
50
100
150
200
250
300

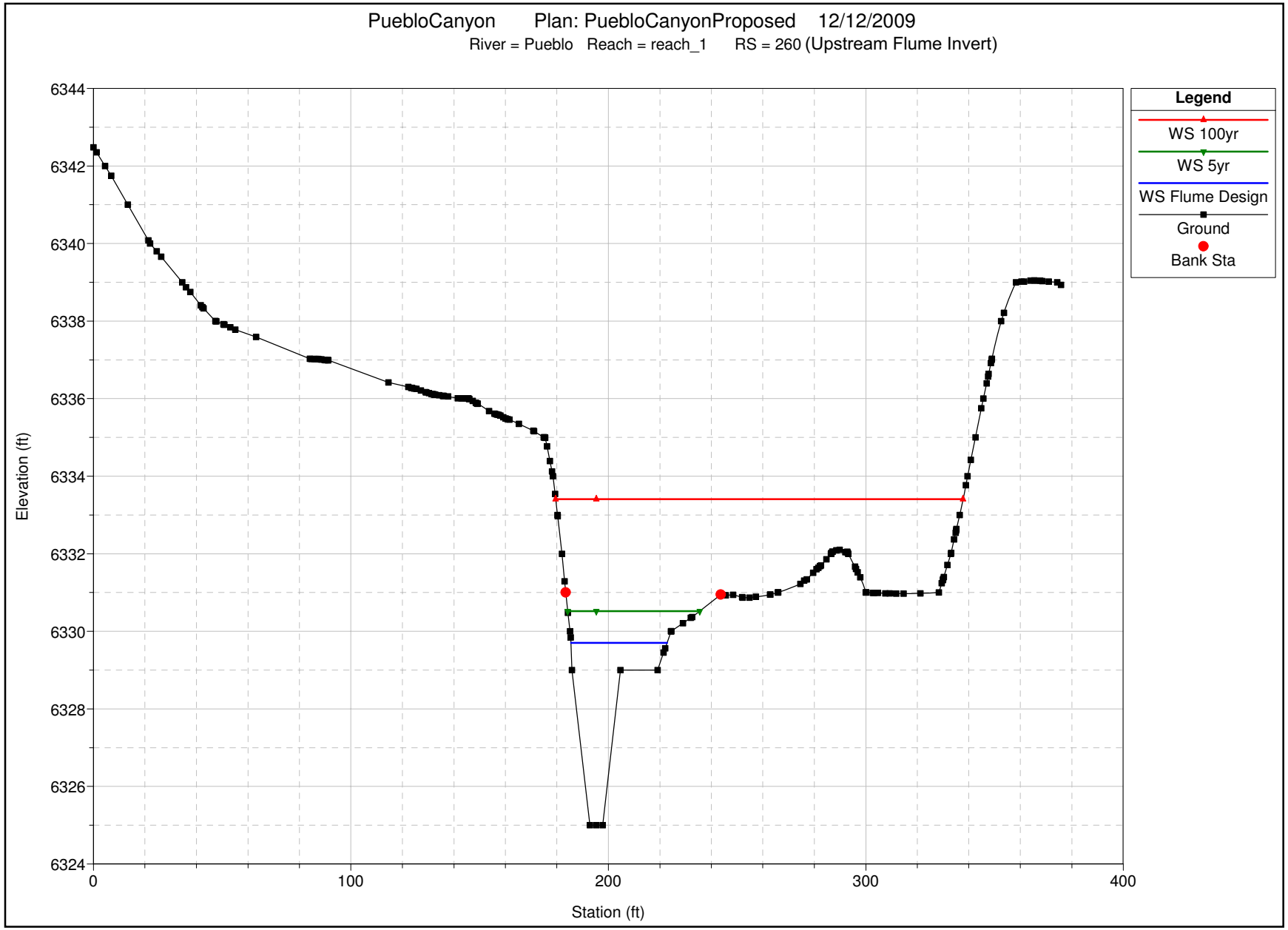

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 179
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
6322
0
50
100
150
200
250
300
350


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 225
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 245 (Downstream Flume Invert)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 250 (Flume)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 255 (Flume)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400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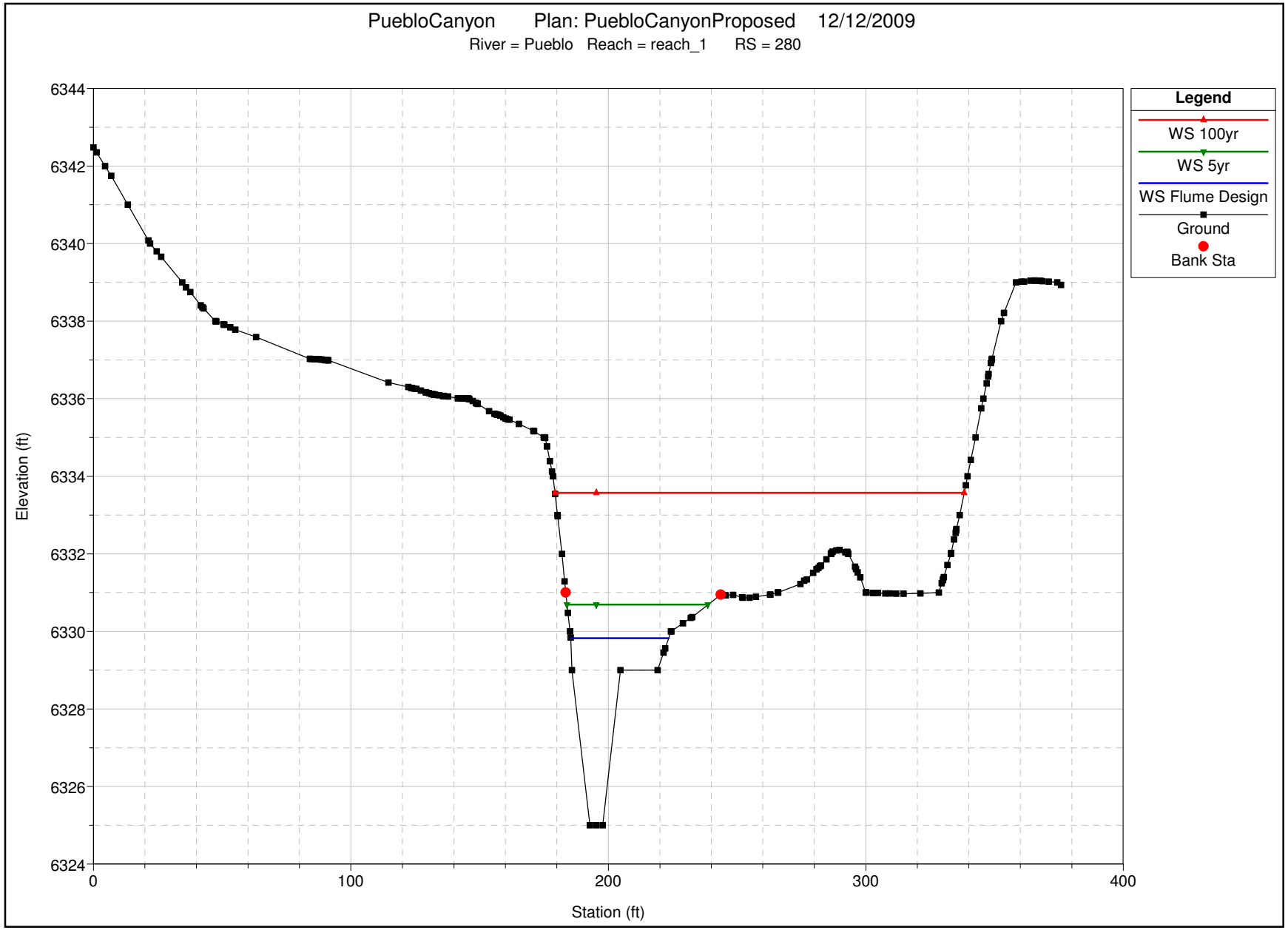
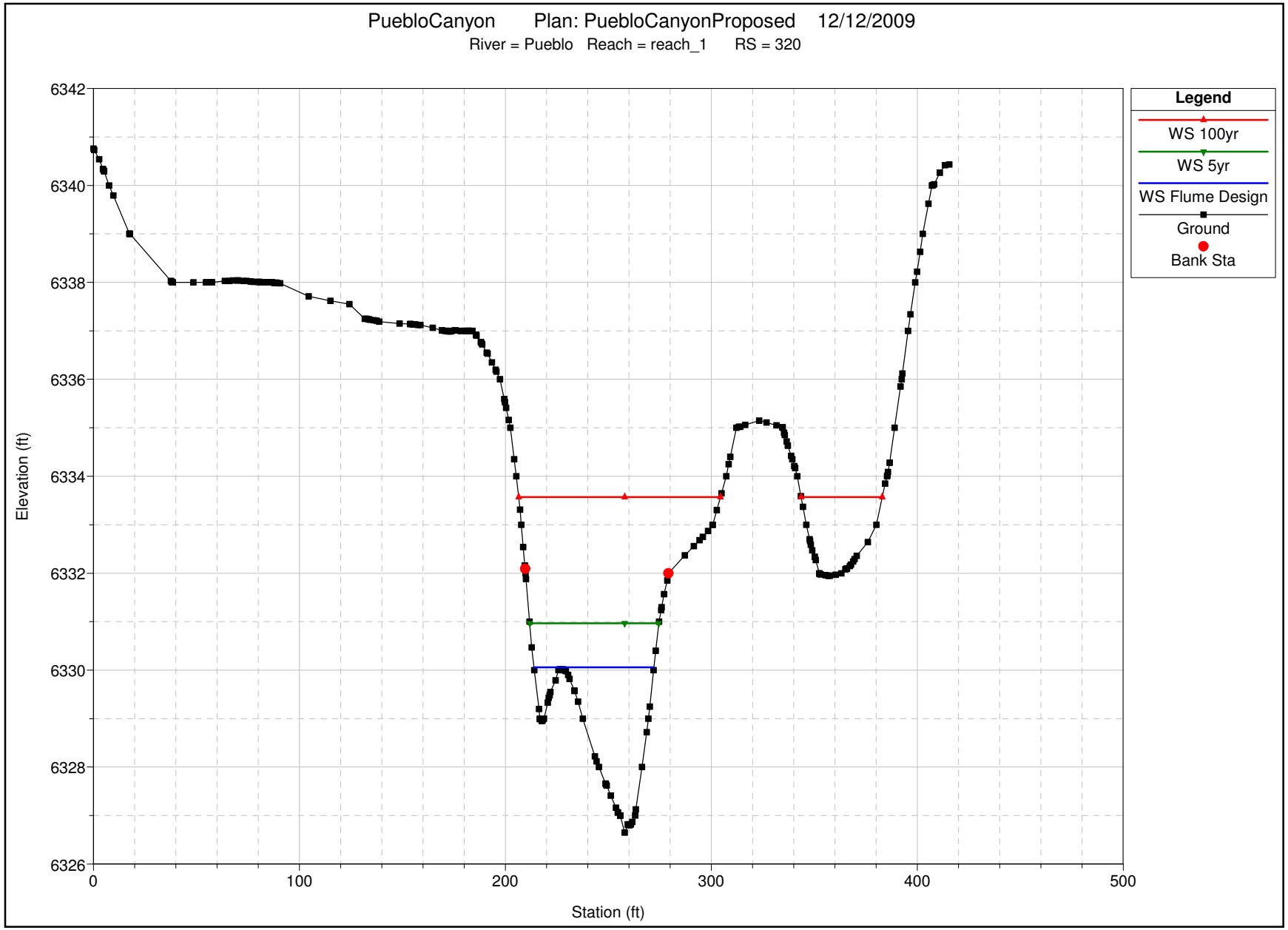
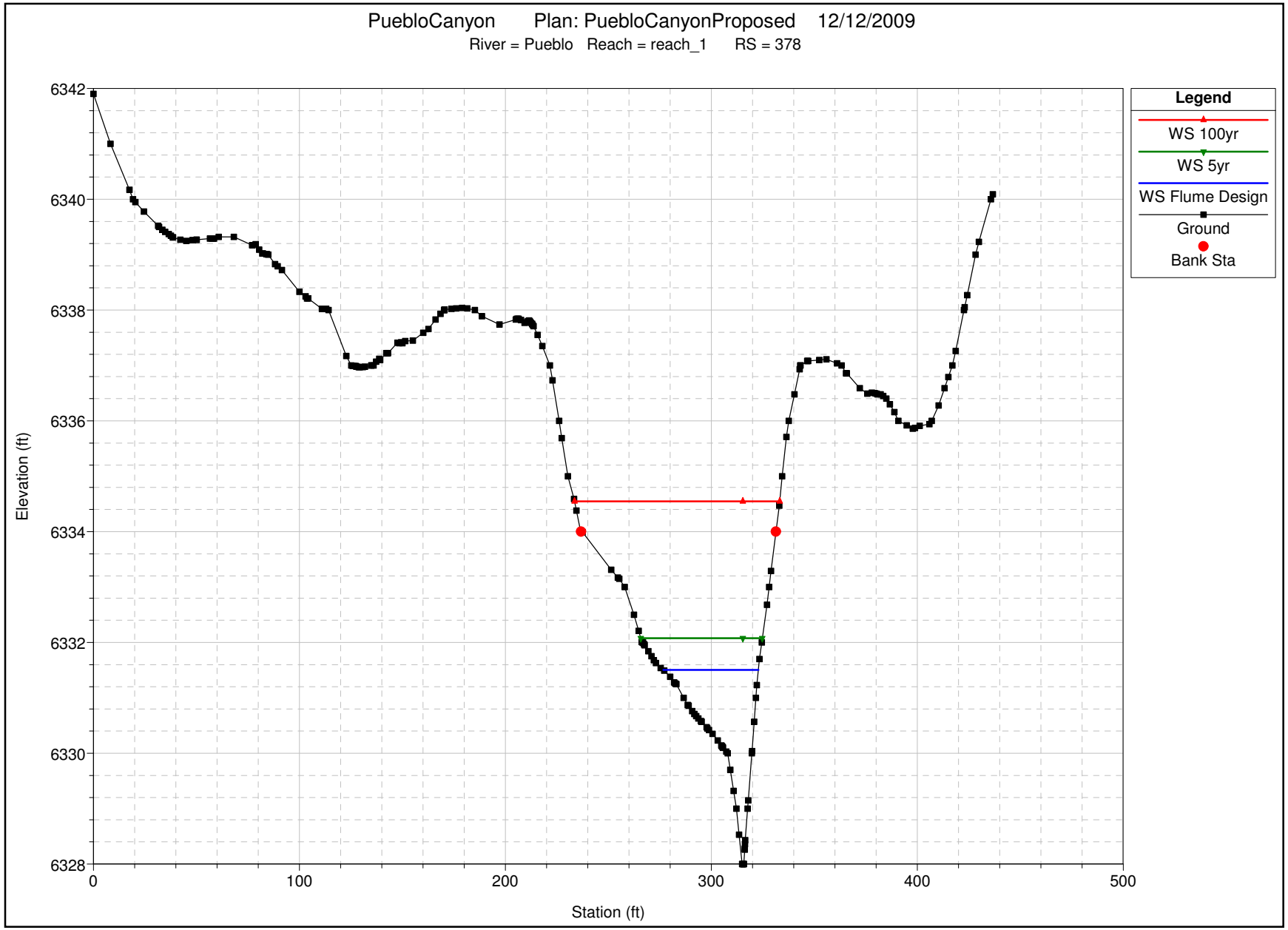
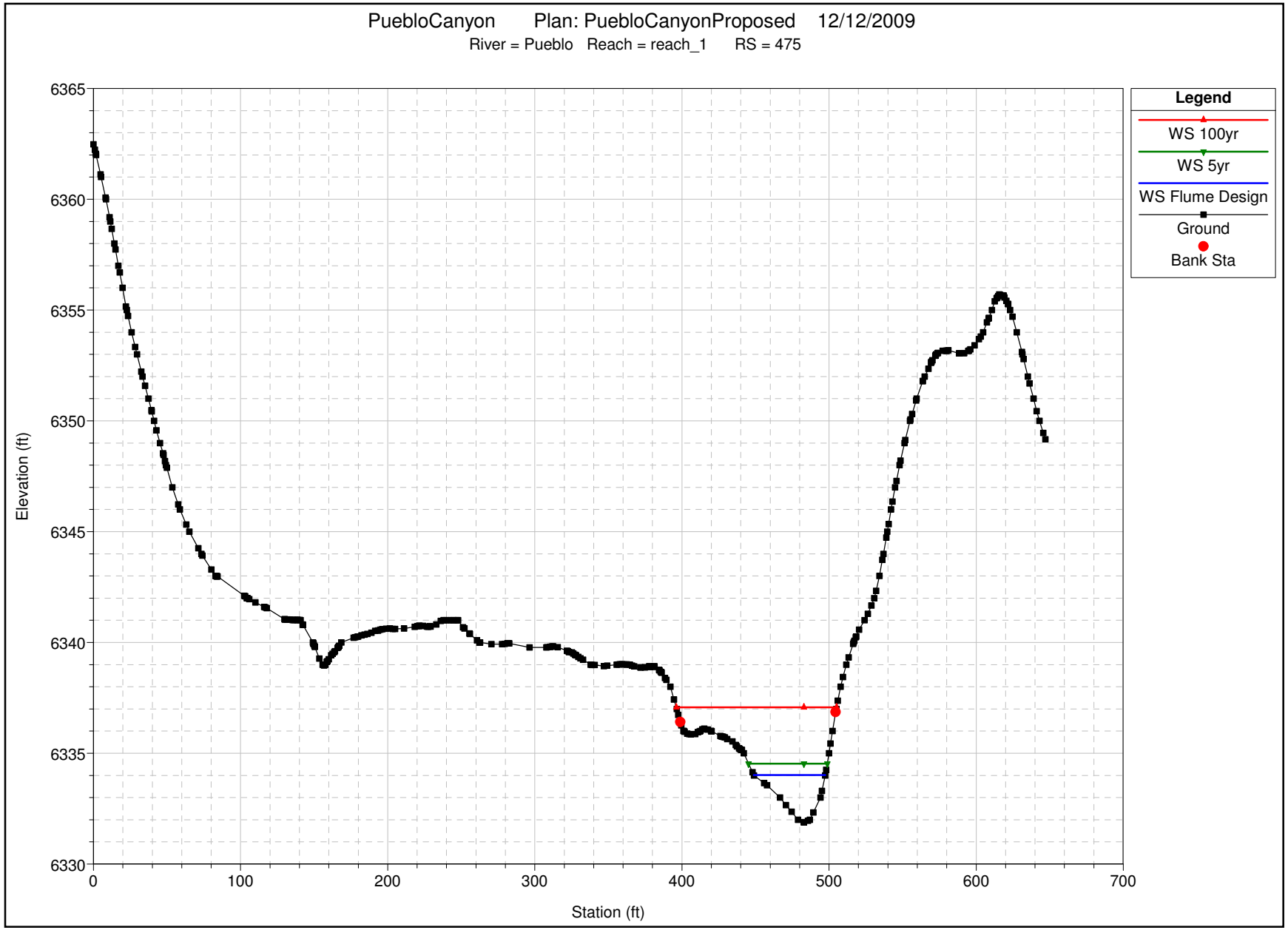
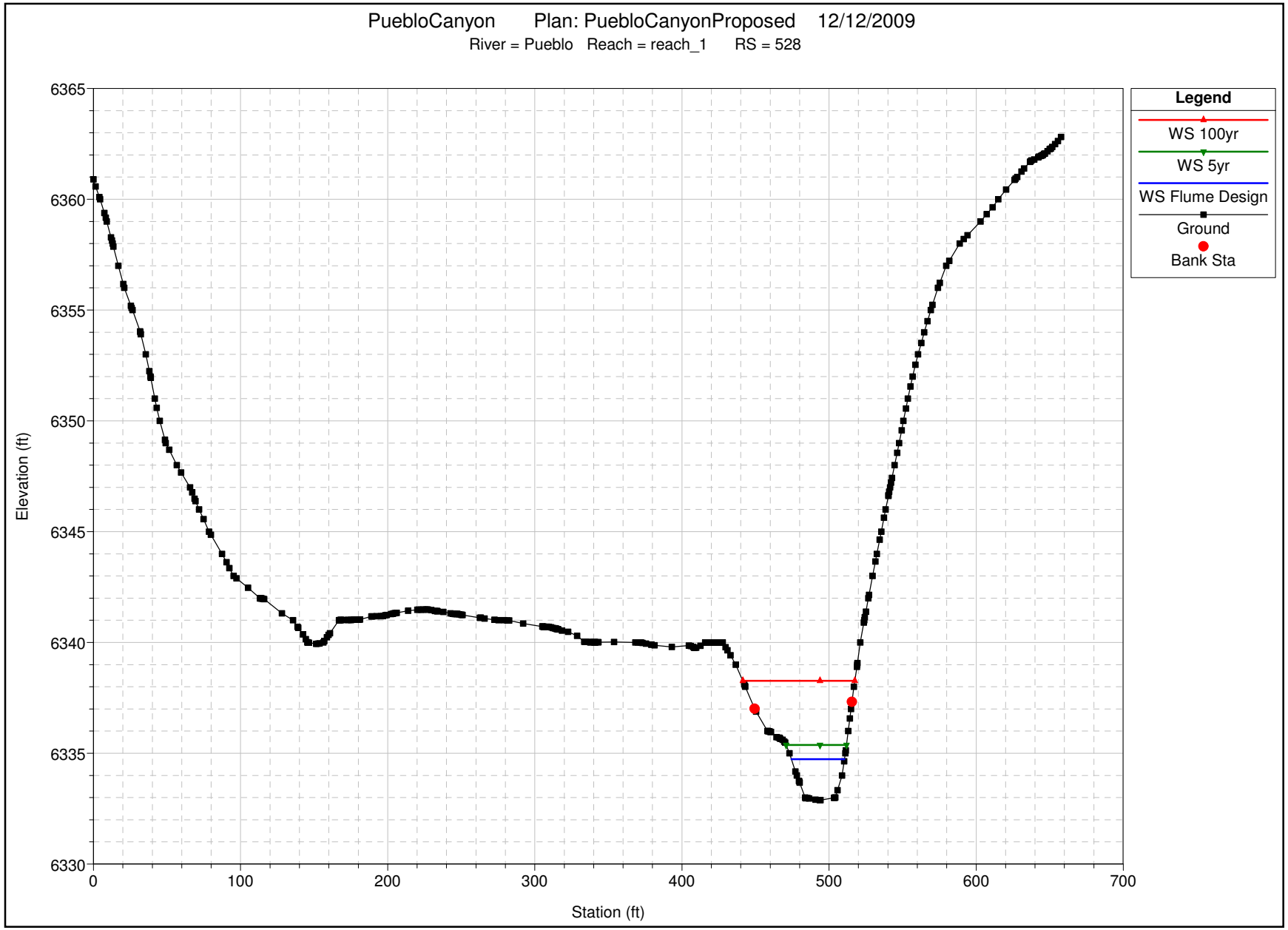
River = Pueblo Reach = reach_1 RS = 260 (Upstream Flume Invert)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6344
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
0
100
200
300
400

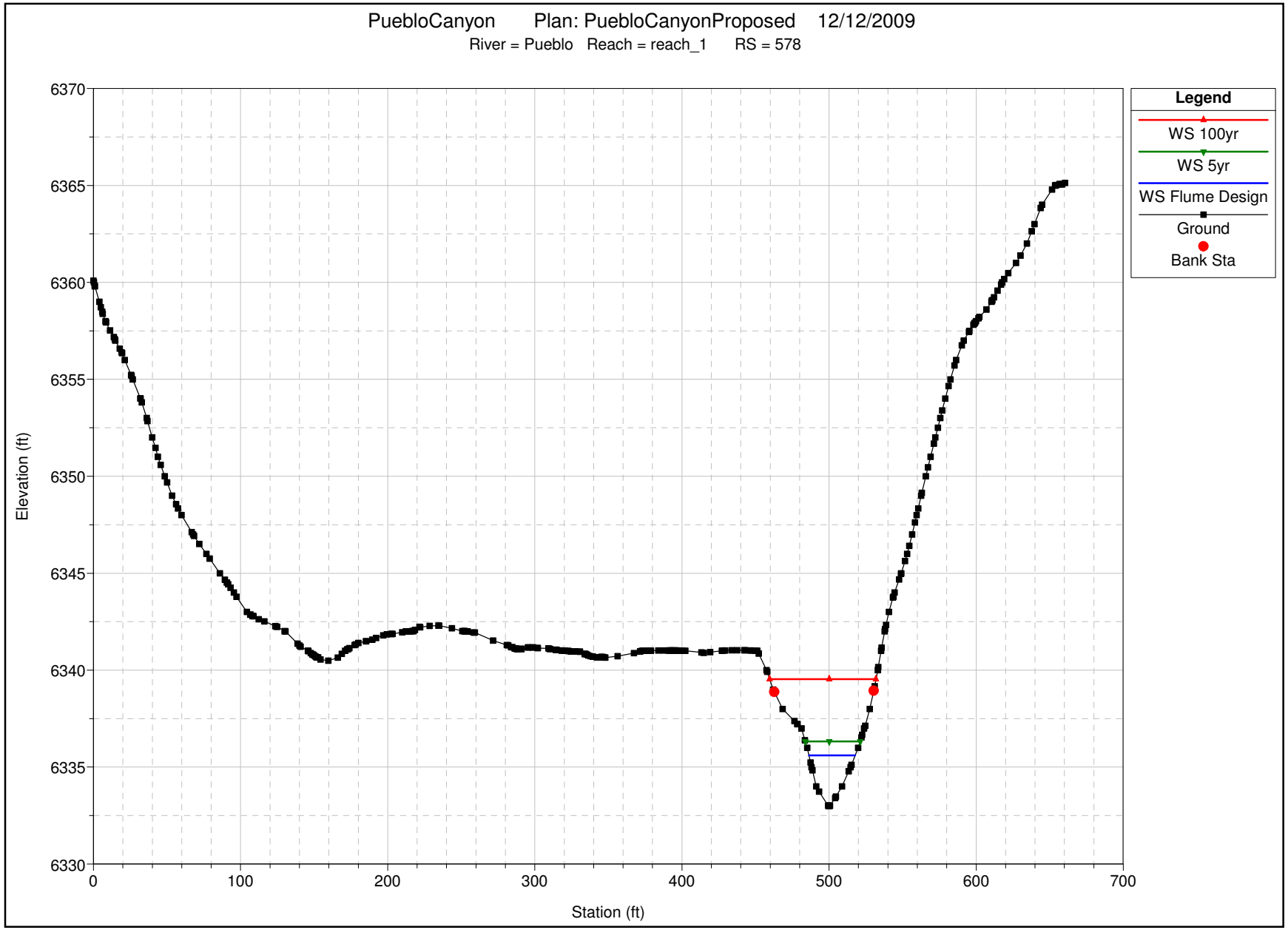

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 280
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6344
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
0
100
200
300
400


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 320
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6342
6340
6338
6336
6334
6332
6330
6328
6326
0
100
200
300
400
500


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 378
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6342
6340
6338
6336
6334
6332
6330
6328
0
100
200
300
400
500
Station (ft)

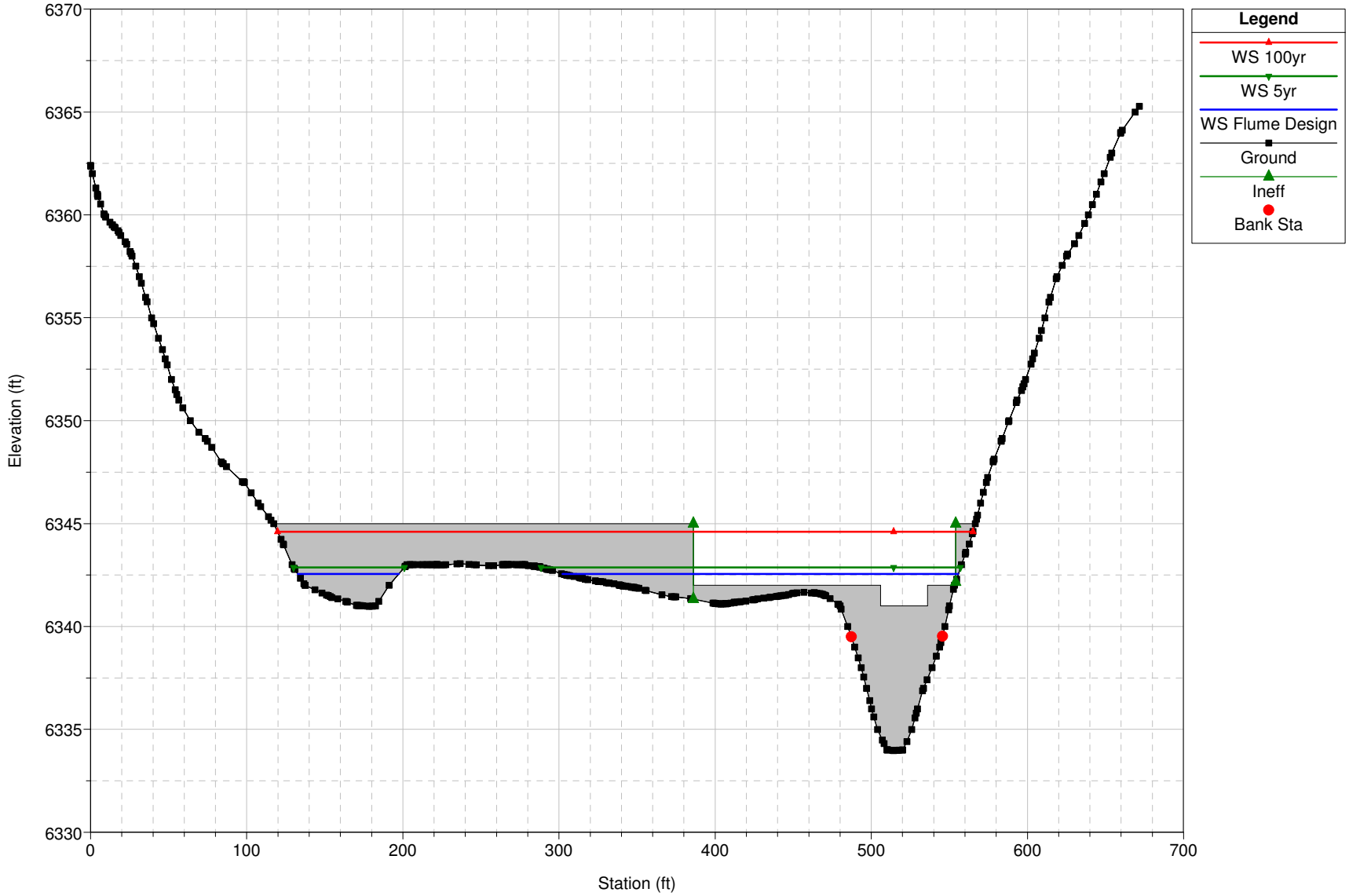

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 475
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700

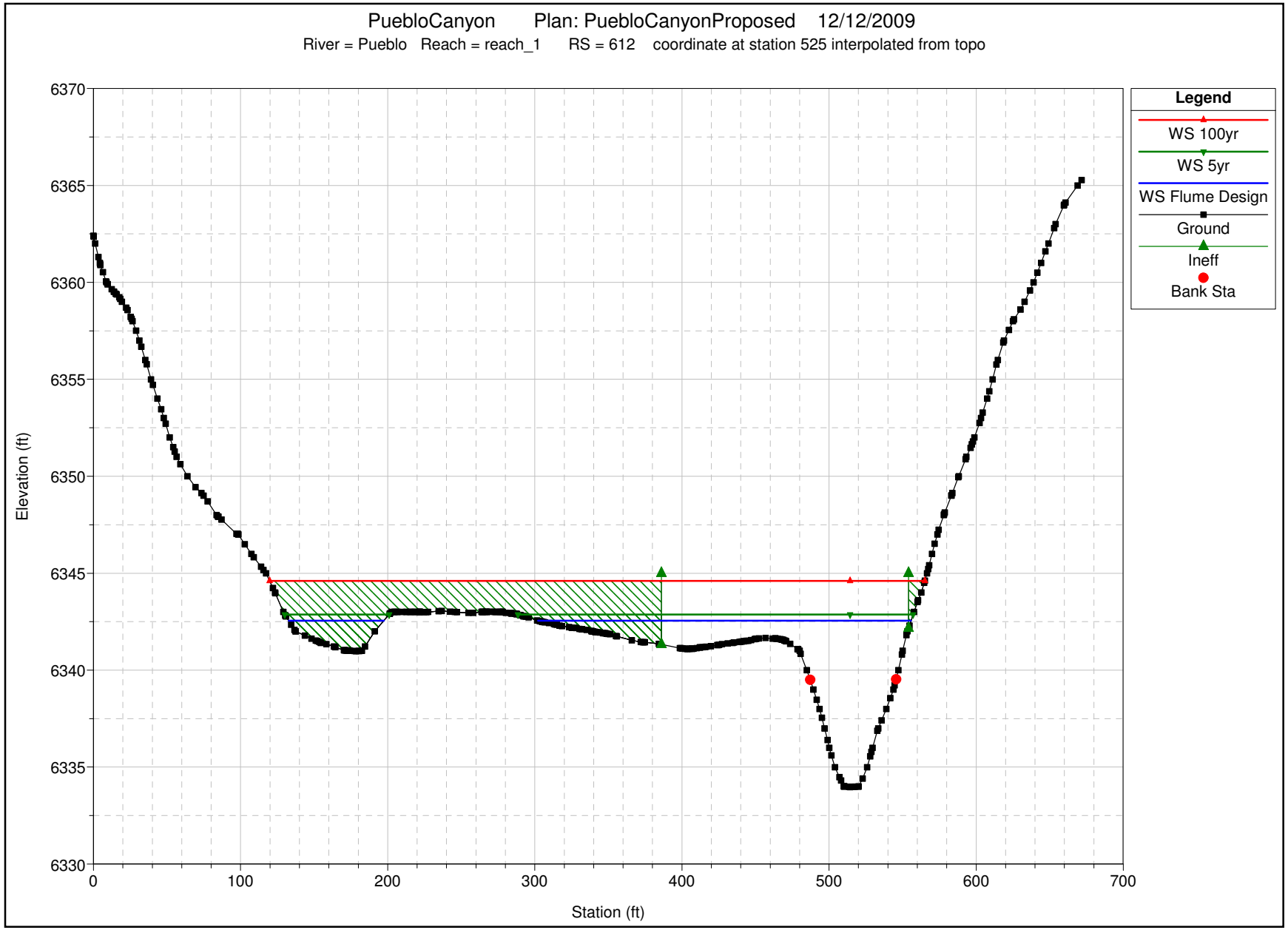

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 528
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700

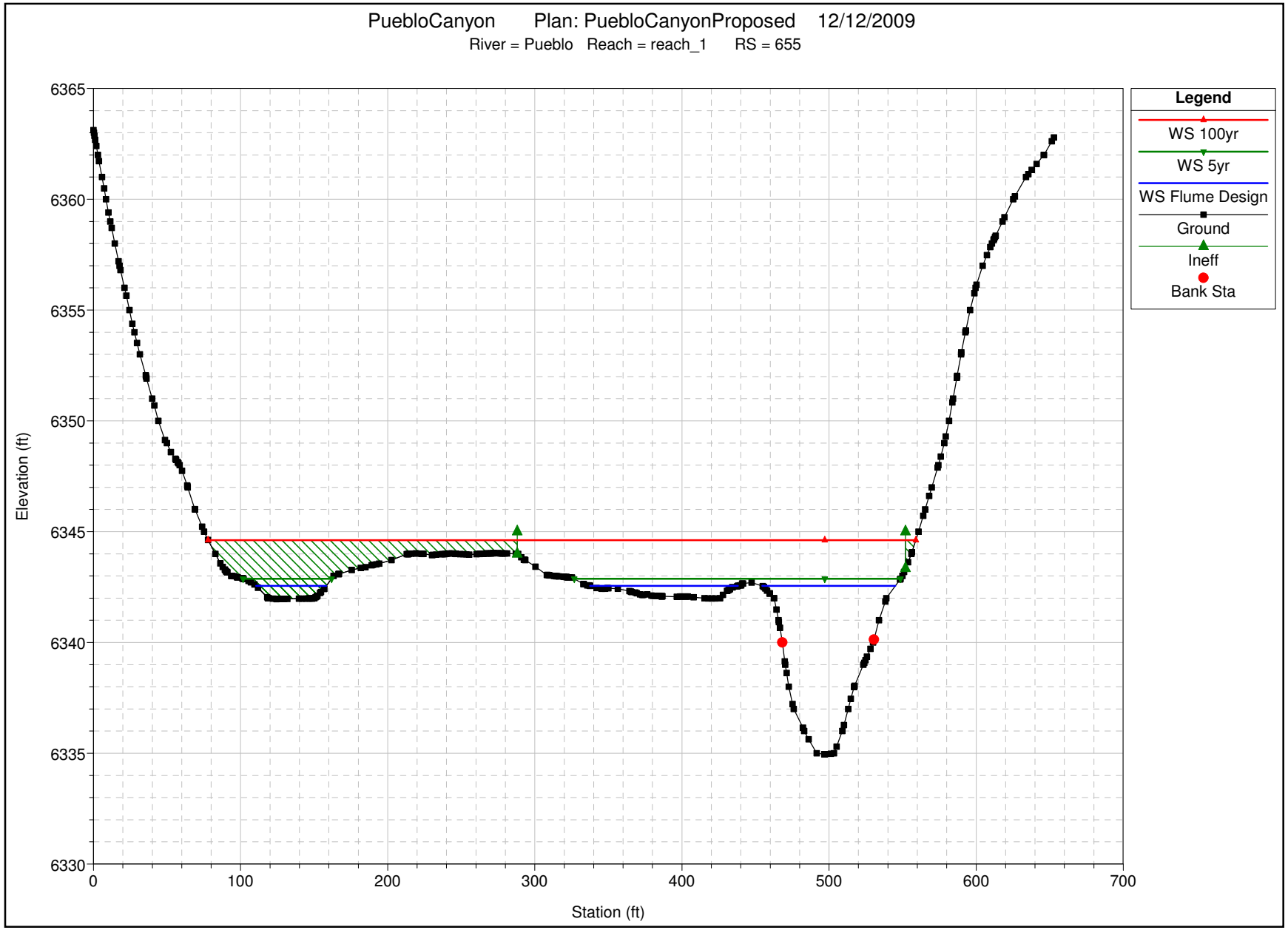

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 578
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6370
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009

River = Pueblo Reach = reach_1 RS = 609 IS Pueblo Canyon Gabion Grade Control Structure

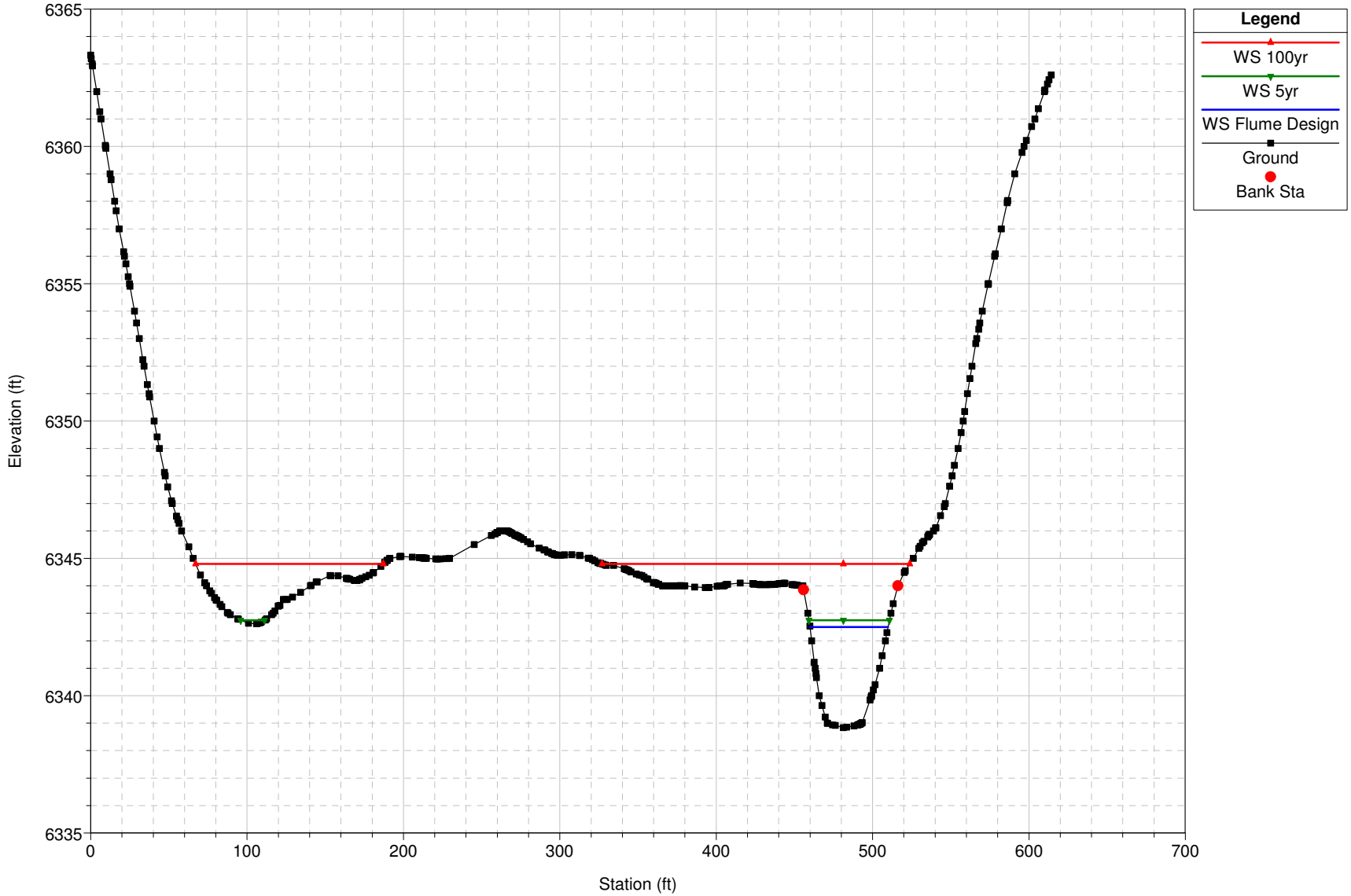


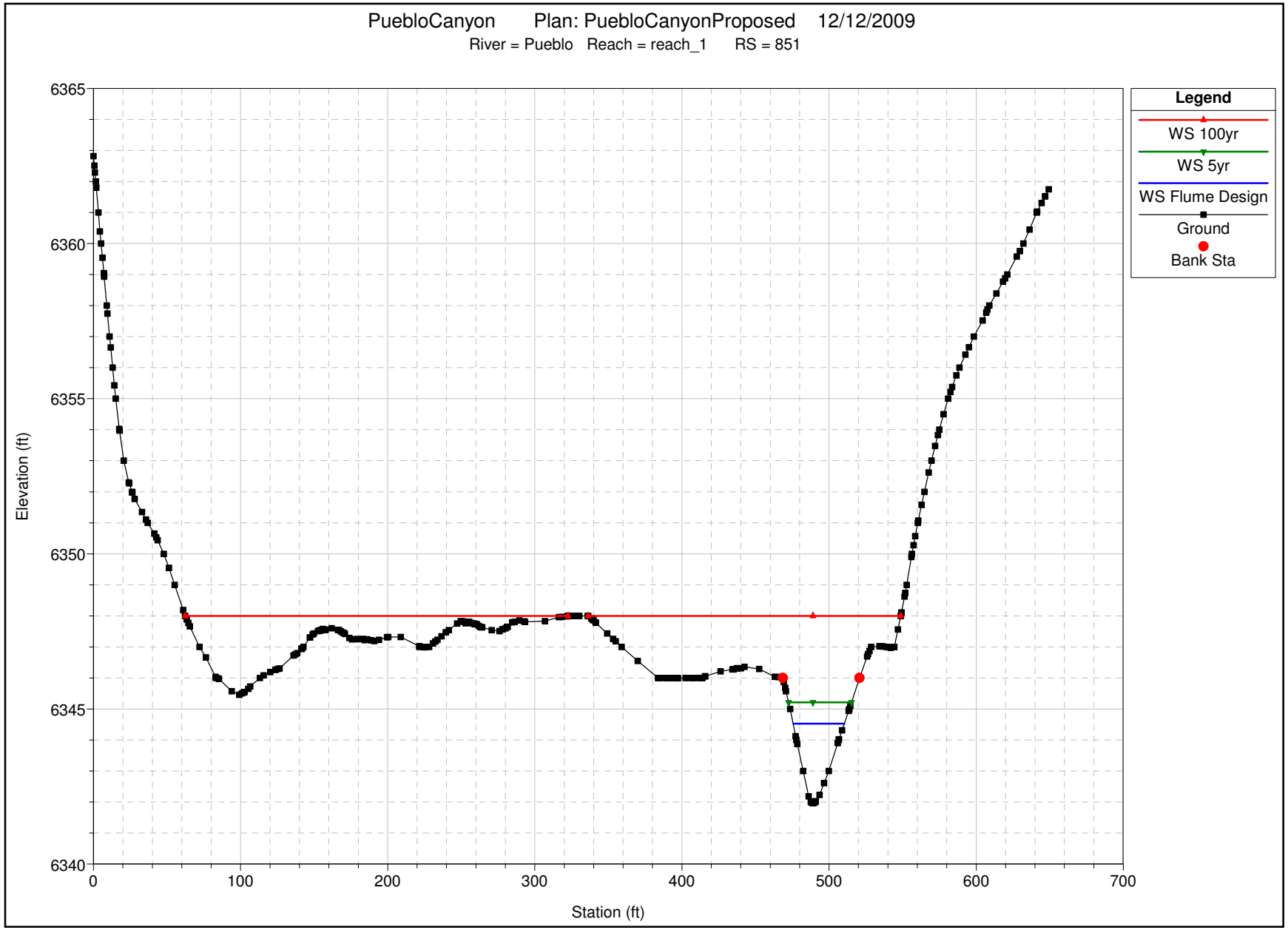

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 612 coordinate at station 525 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
6370
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700

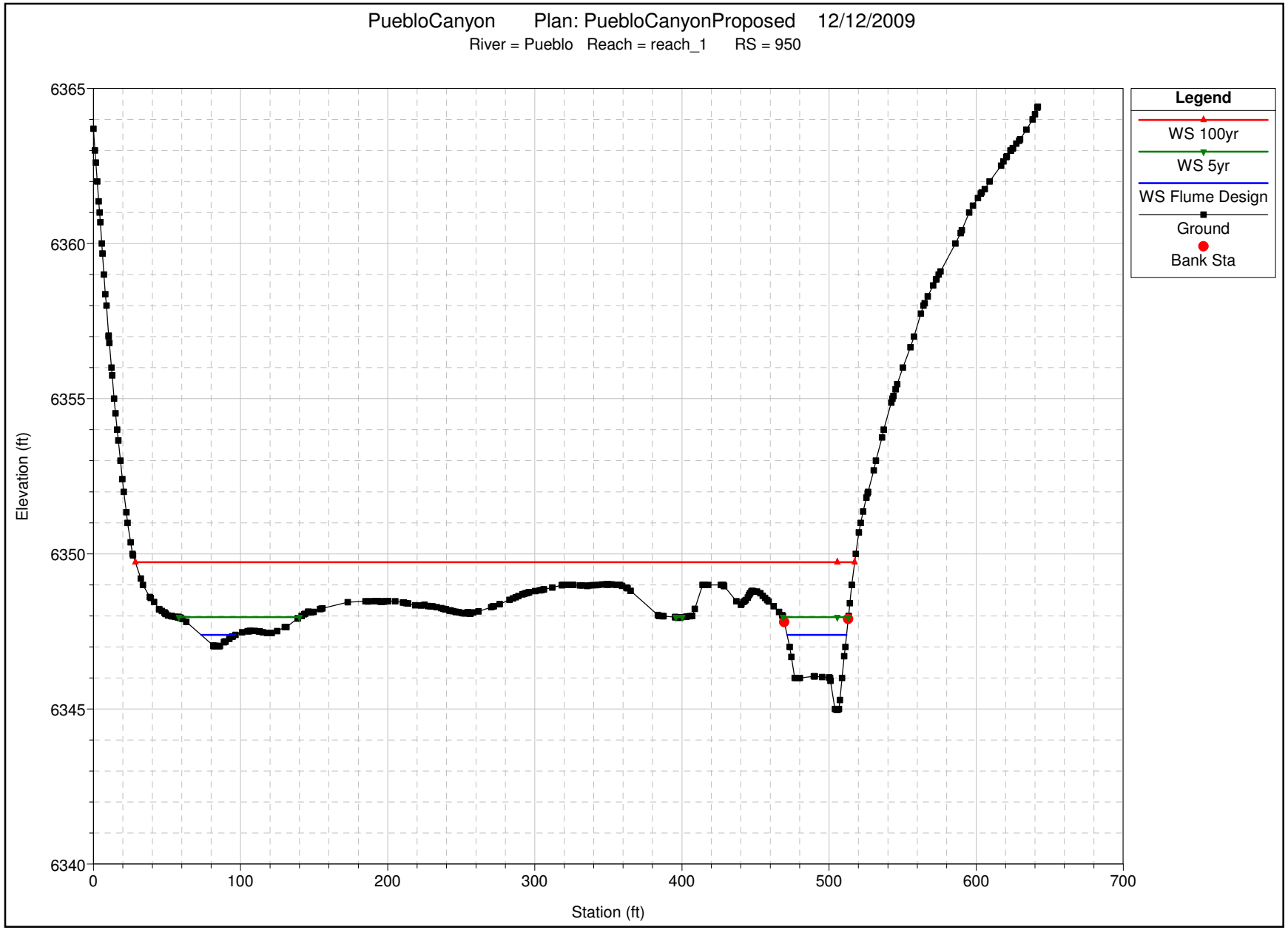

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 655
Elevation (ft)
Station (ft)
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Ineff
Bank Sta

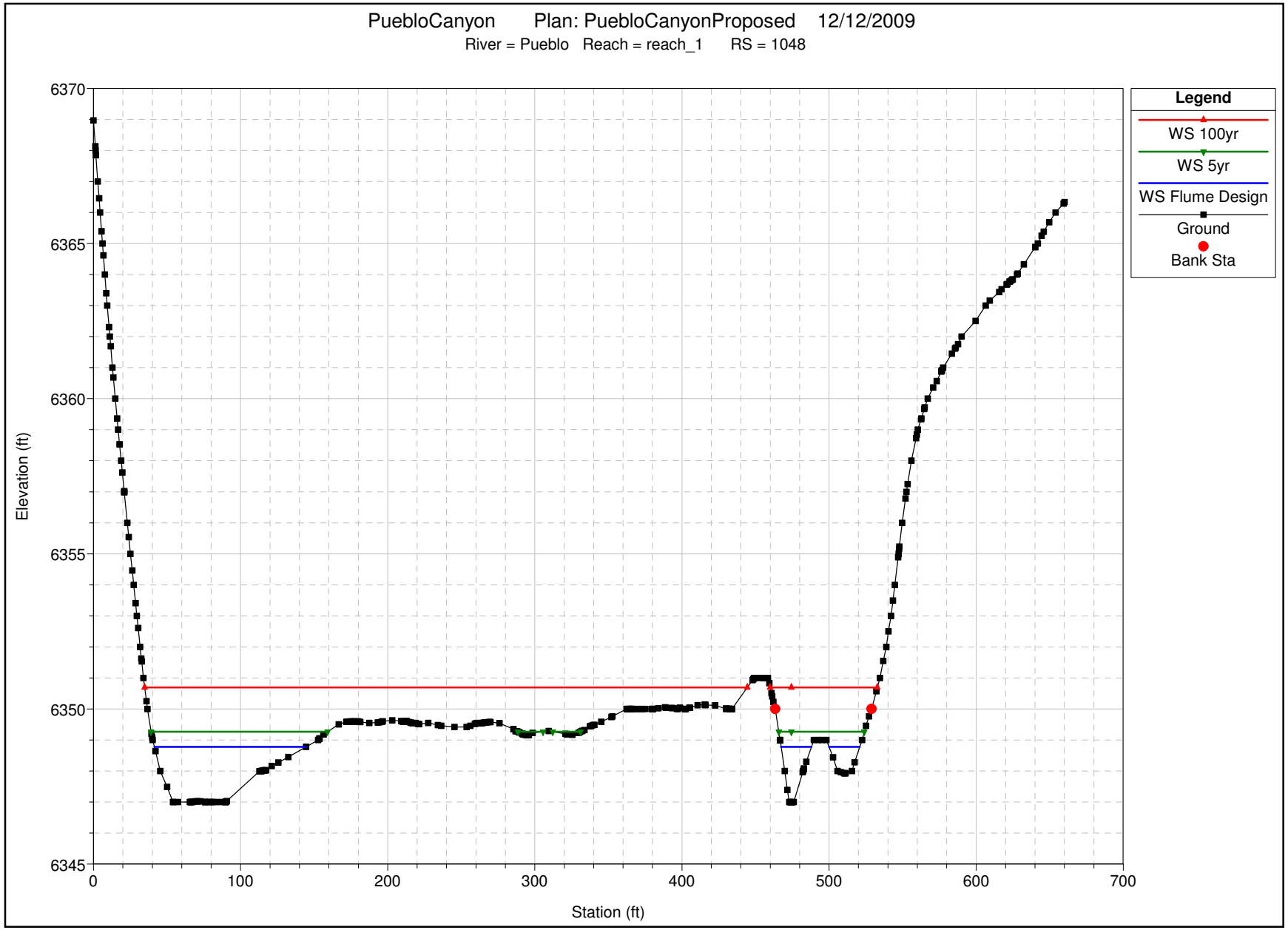
PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009

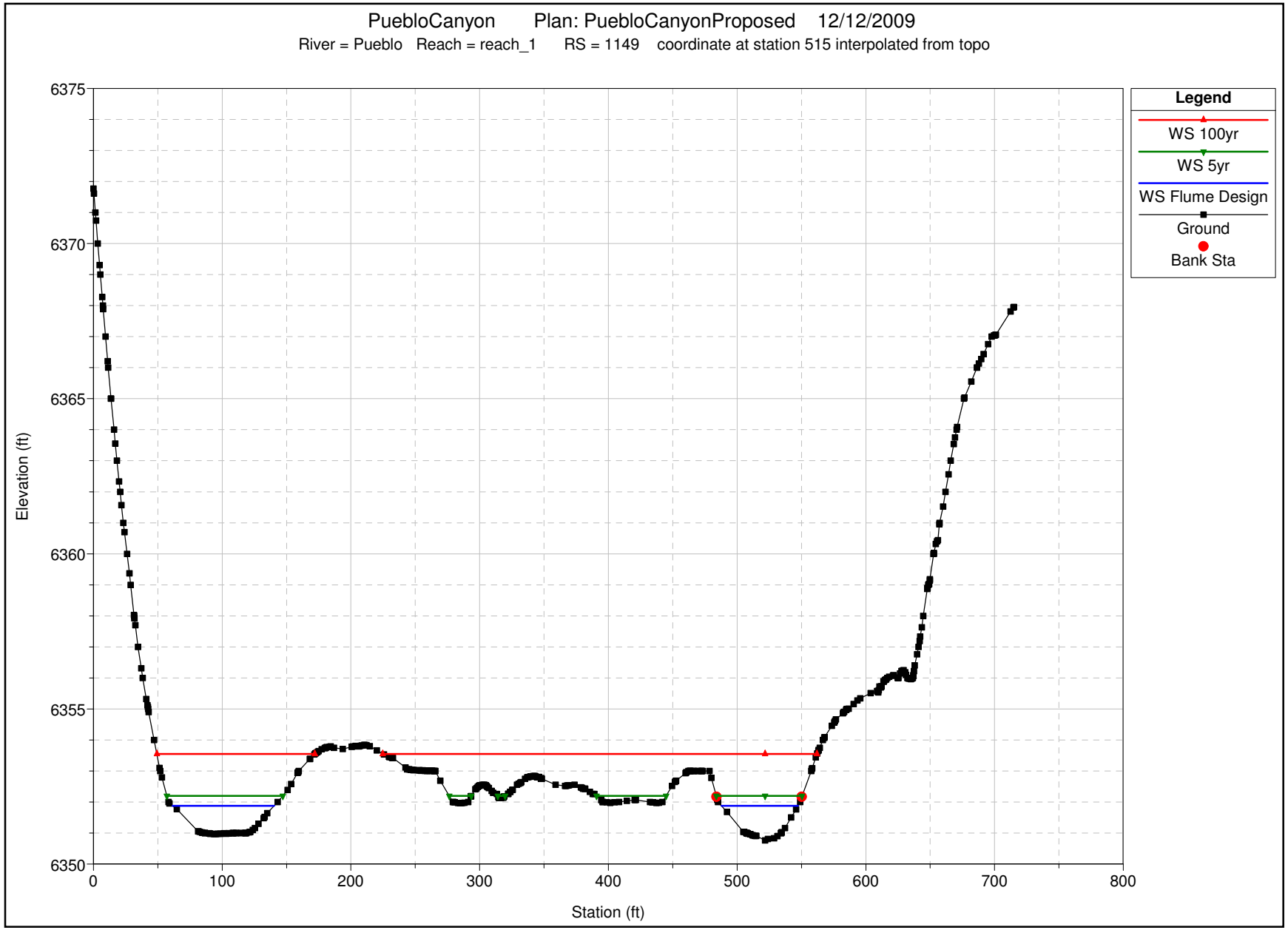
River = Pueblo Reach = reach_1 RS = 751 coordinate at station 471 interpolated from topo

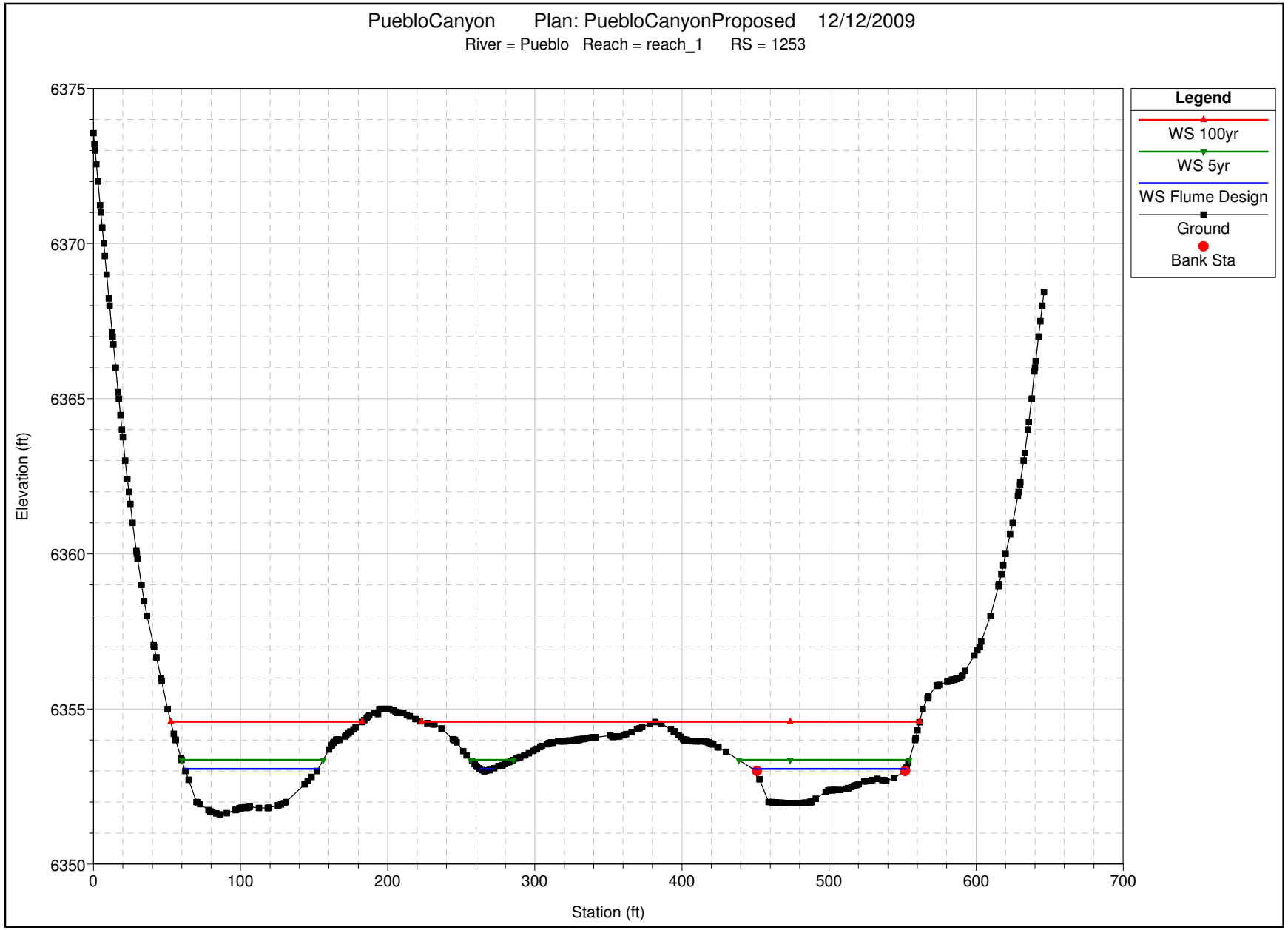


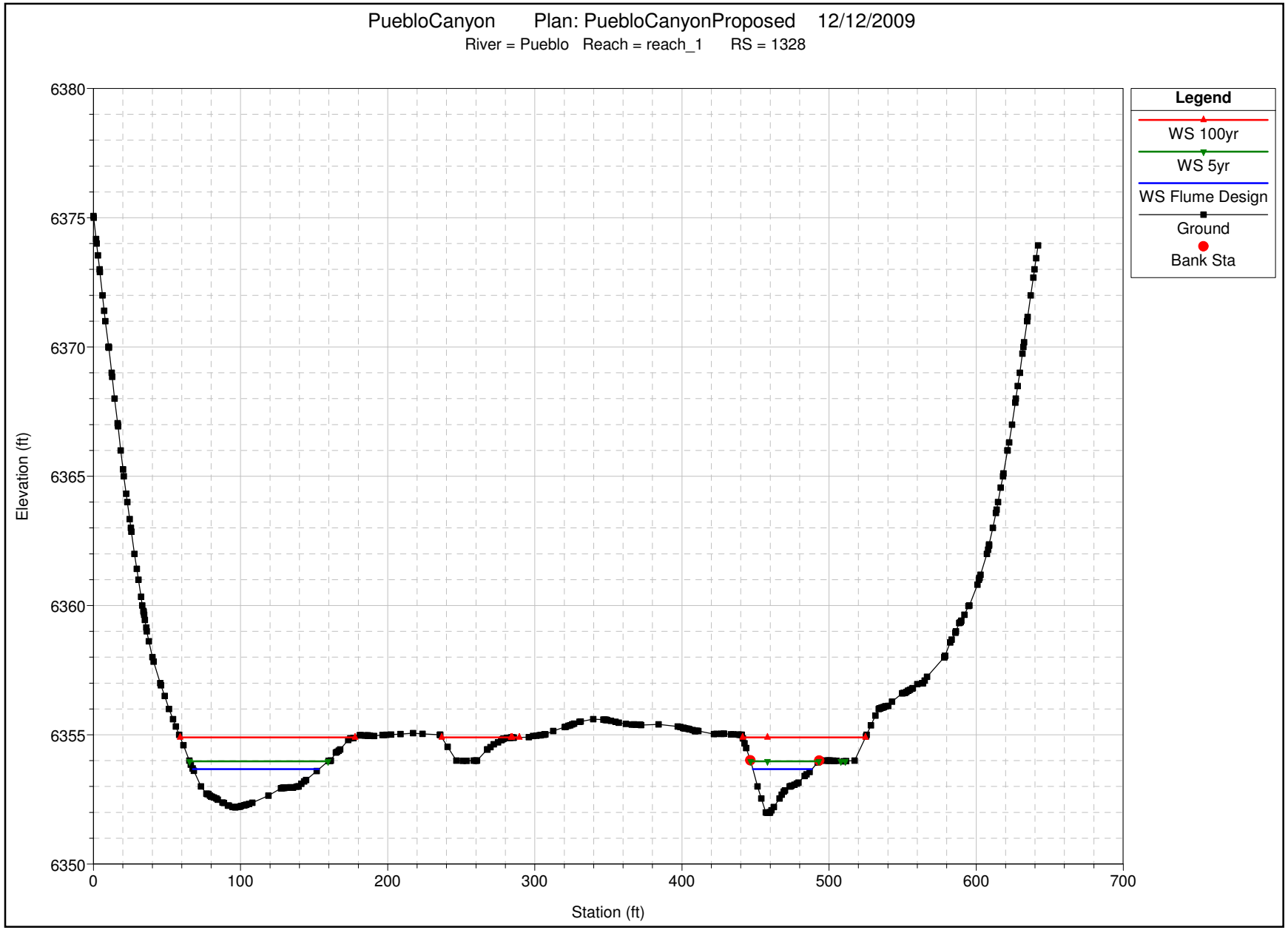

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 851
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6365
6360
6355
6350
6345
6340
0
100
200
300
400
500
600
700

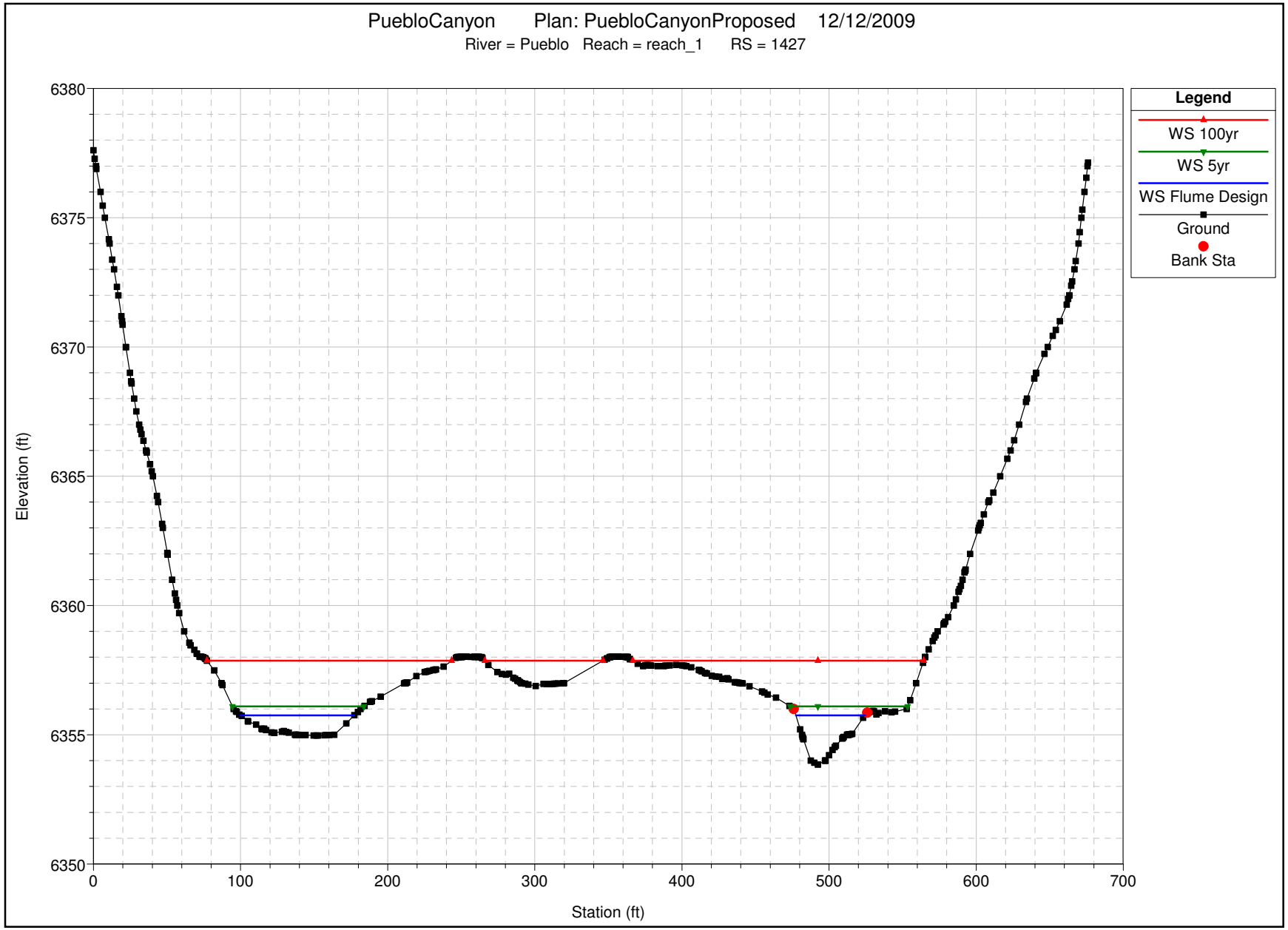

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 950
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6365
6360
6355
6350
6345
6340
0
100
200
300
400
500
600
700

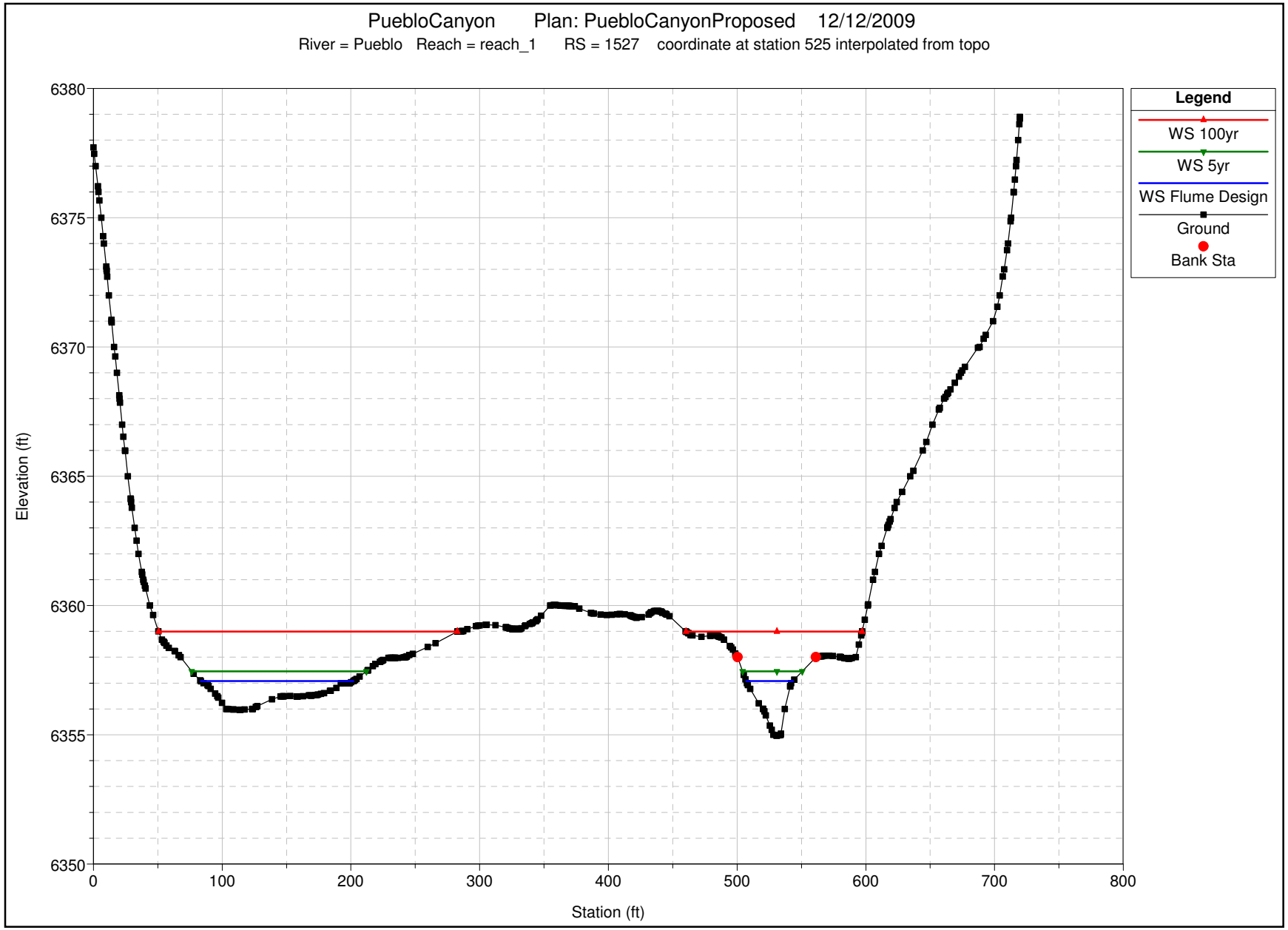

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1048
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6370
6365
6360
6355
6350
6345
0
100
200
300
400
500
600
700
Station (ft)

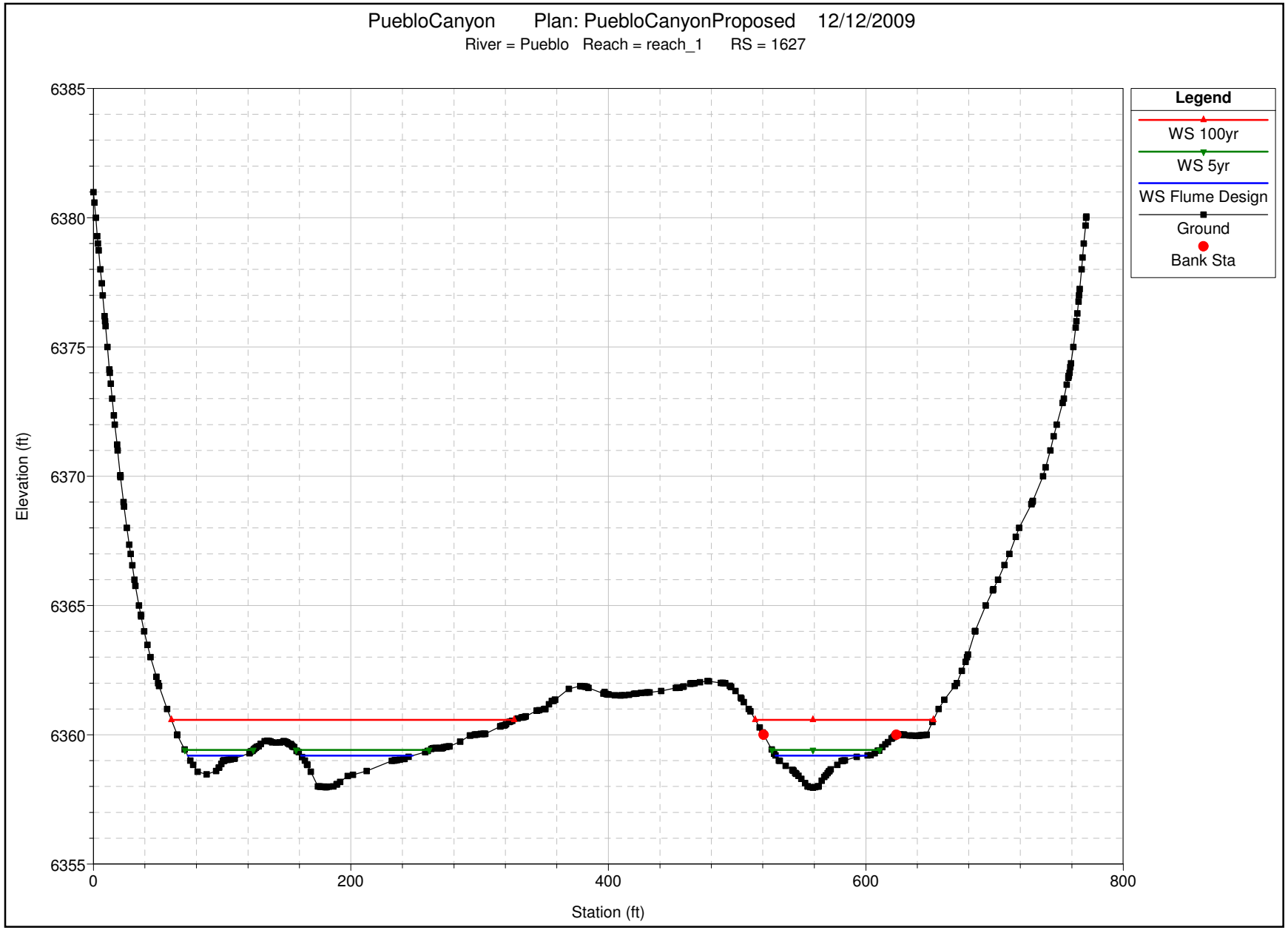

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1149 coordinate at station 515 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
800
Station (ft)

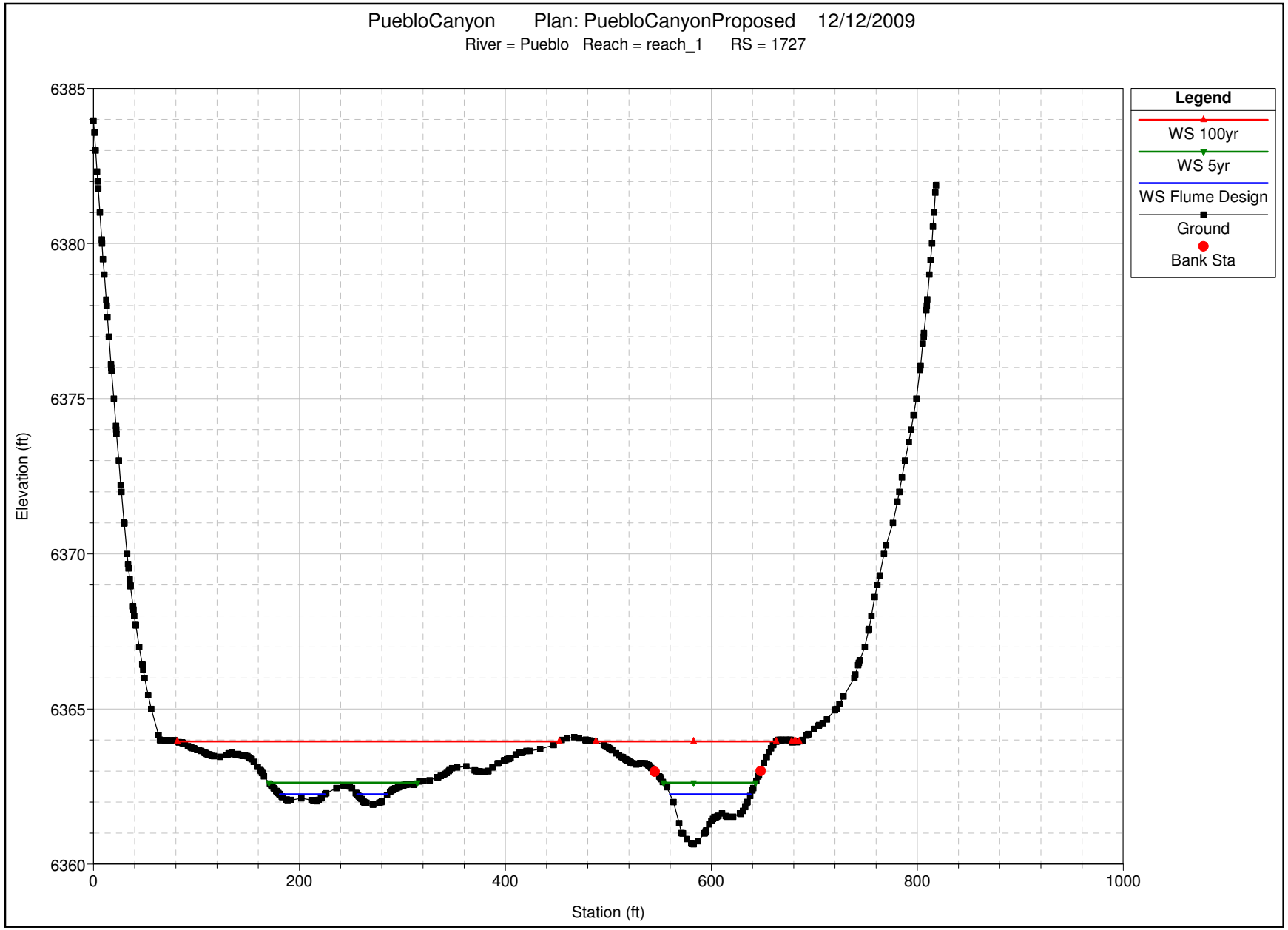

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1253
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700

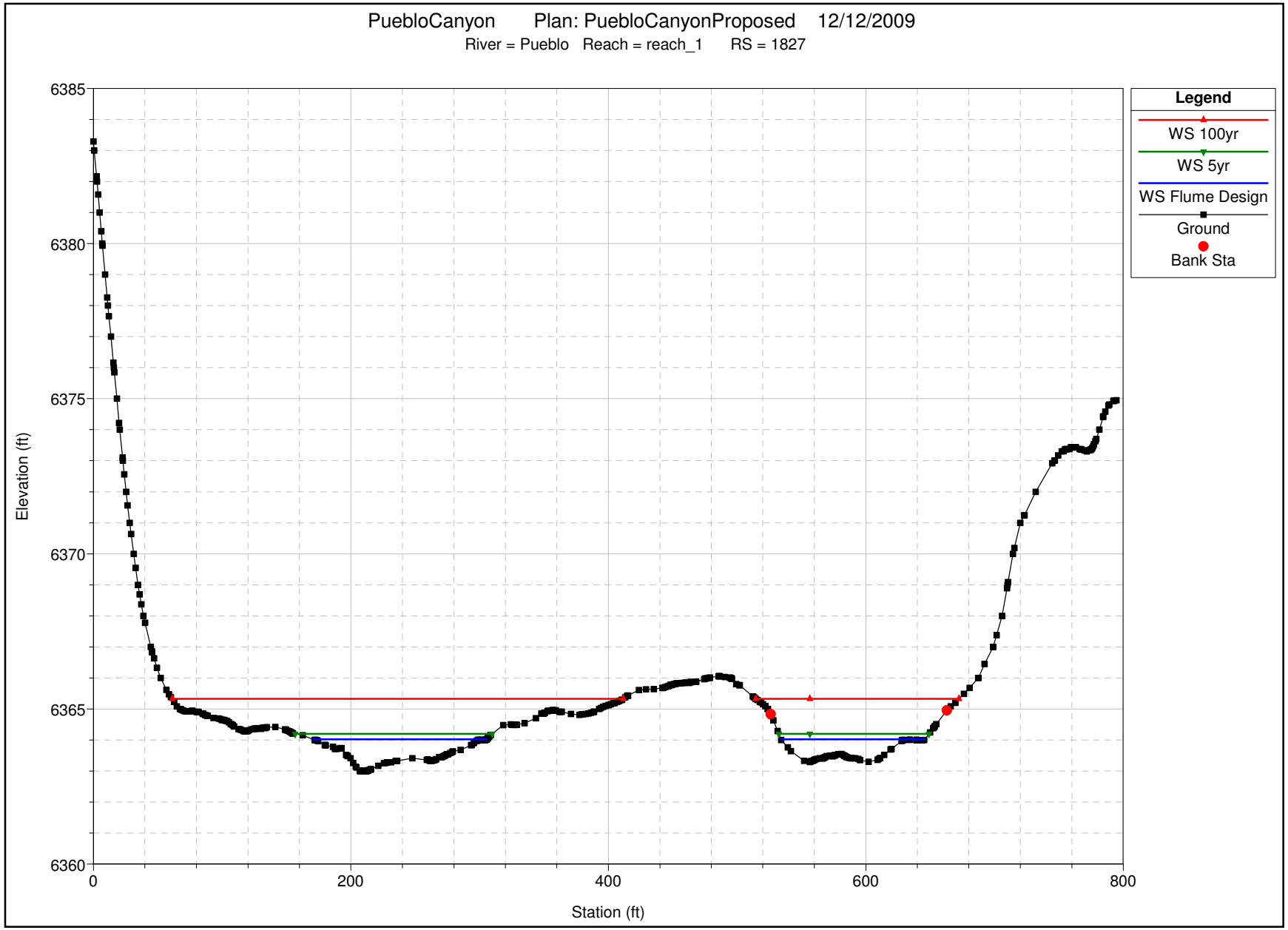

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1328
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)

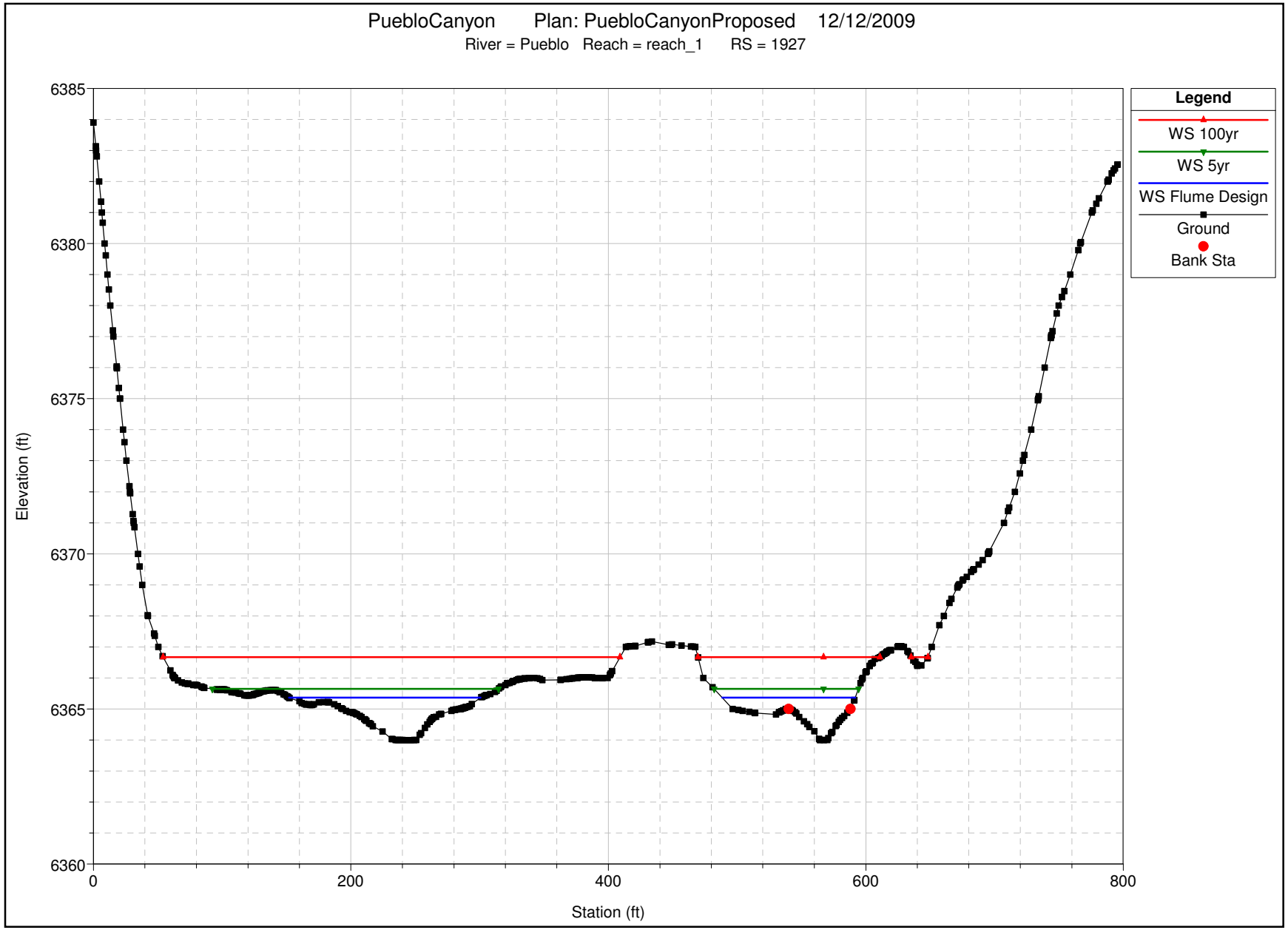

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1427
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1527 coordinate at station 525 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
800


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1627
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
6355
0
200
400
600
800
Station (ft)

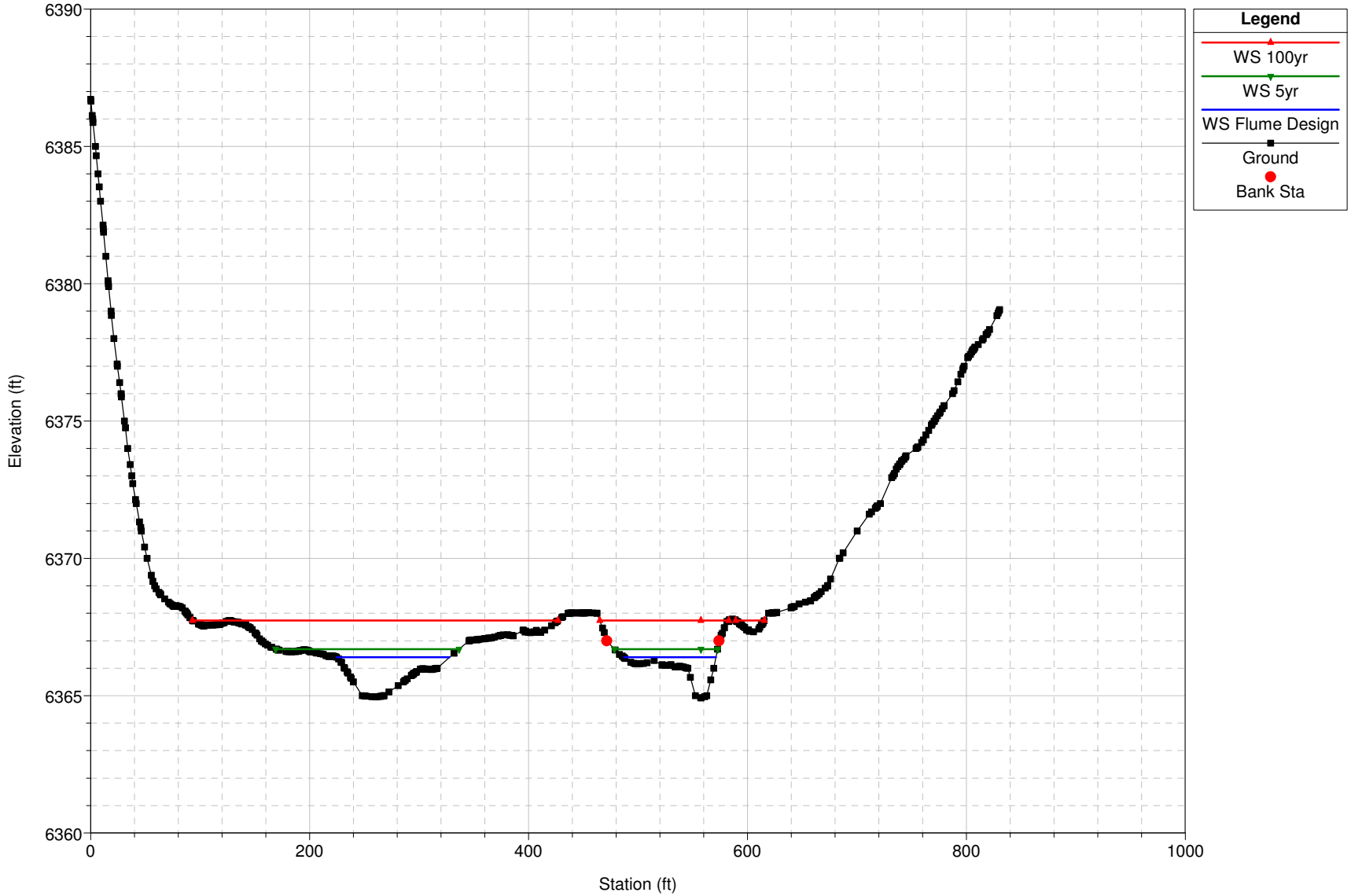

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1727
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
1000
Station (ft)

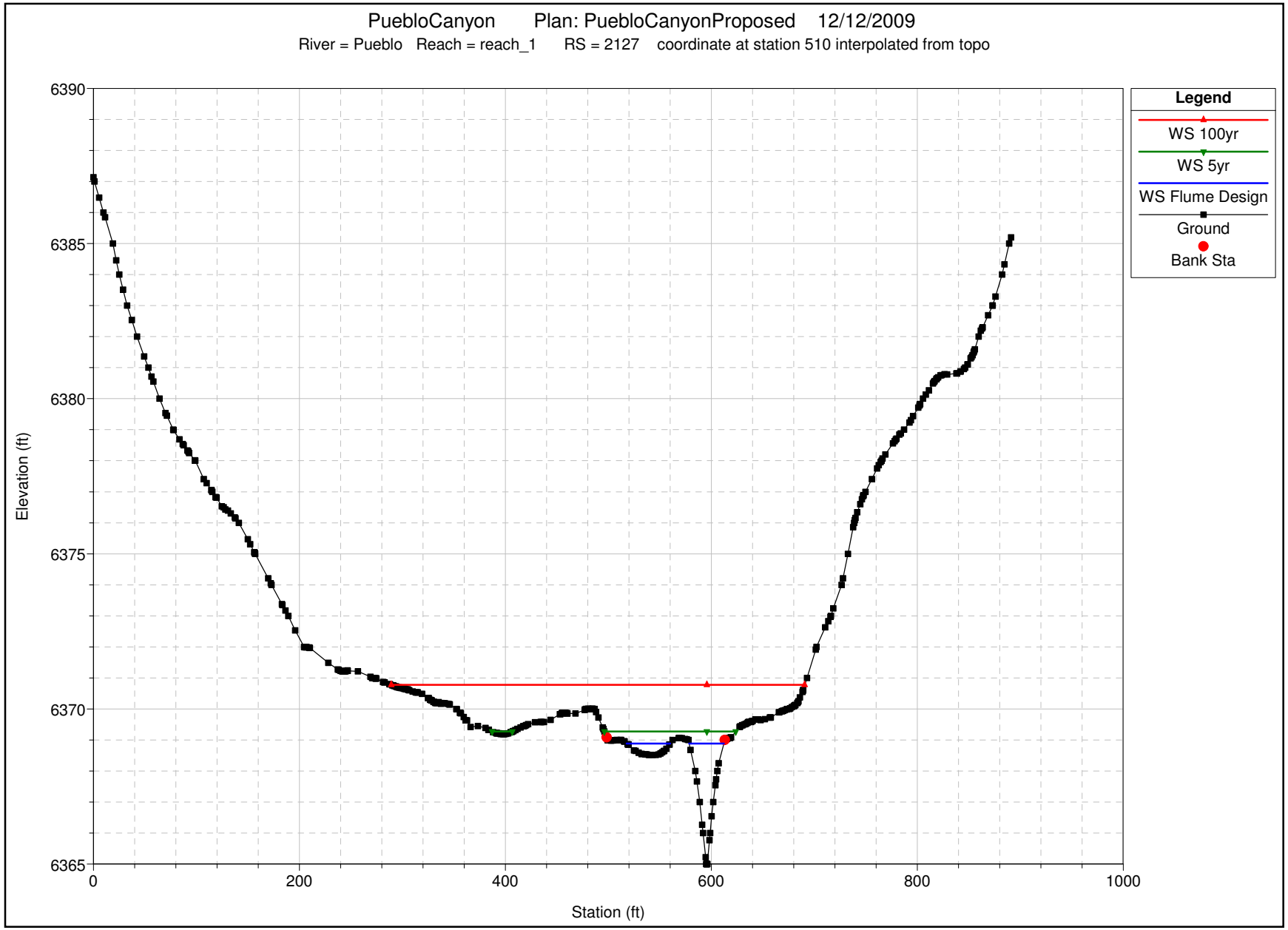

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1827
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
Station (ft)

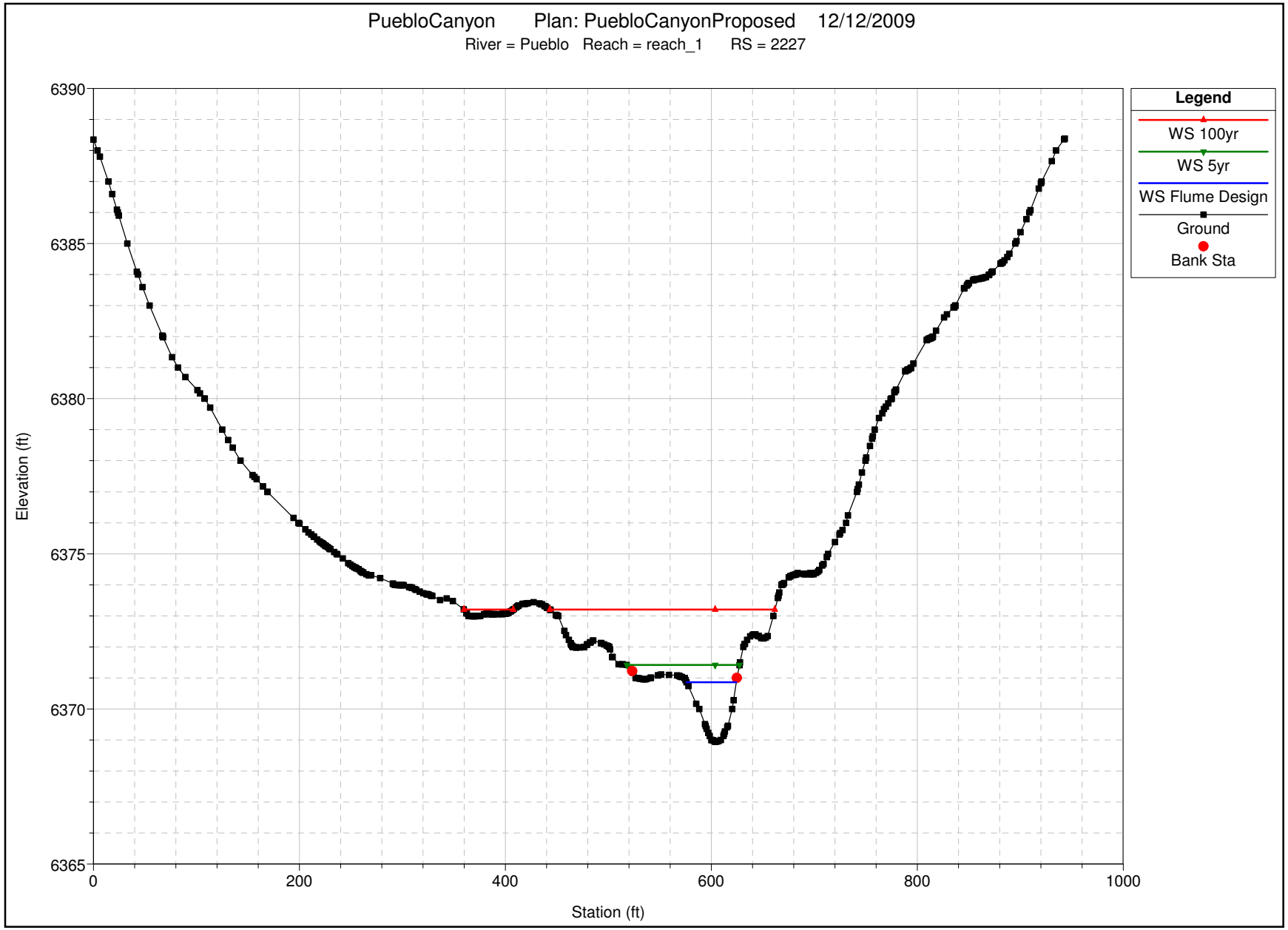

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 1927
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
Station (ft)

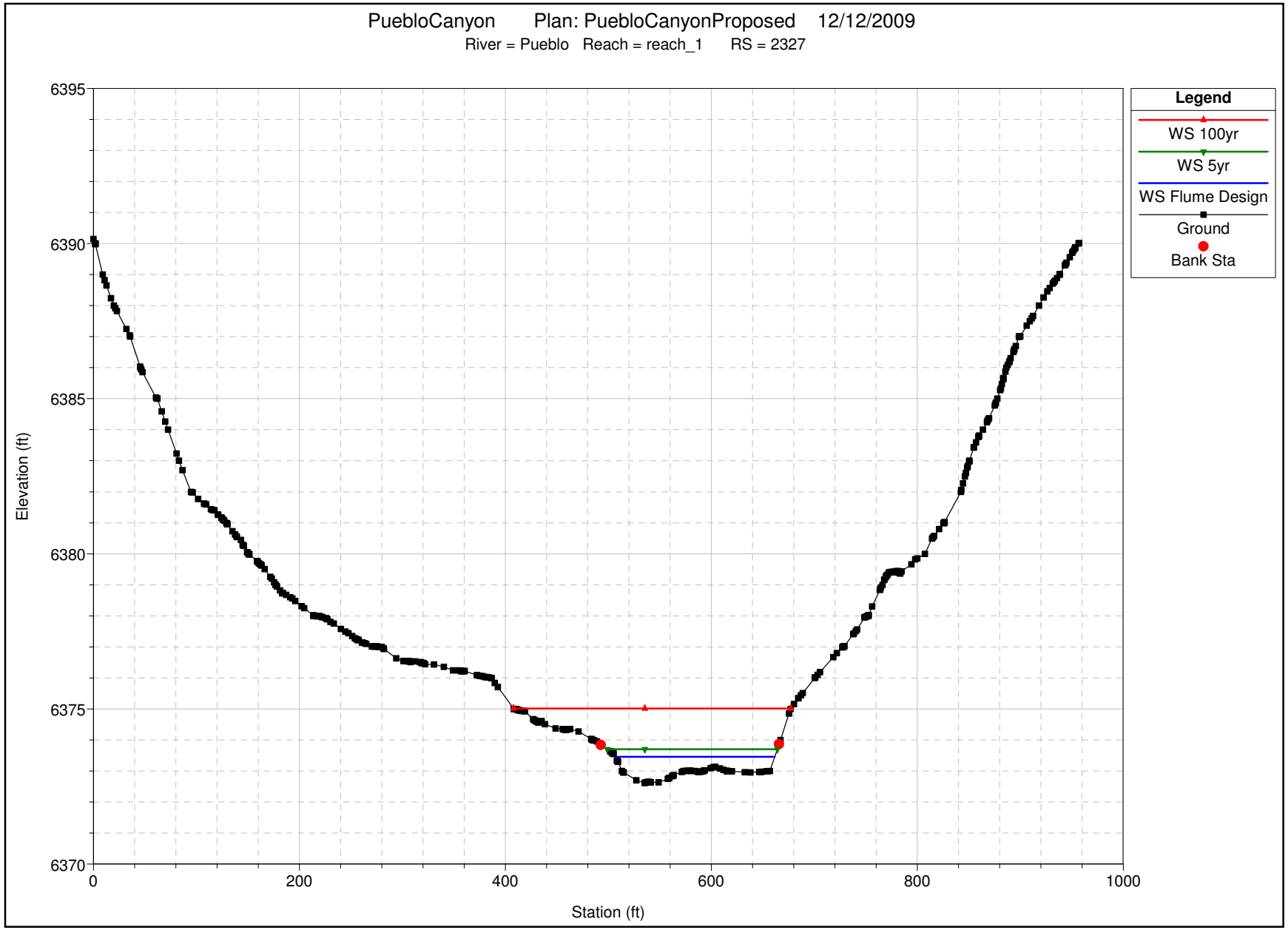
PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009

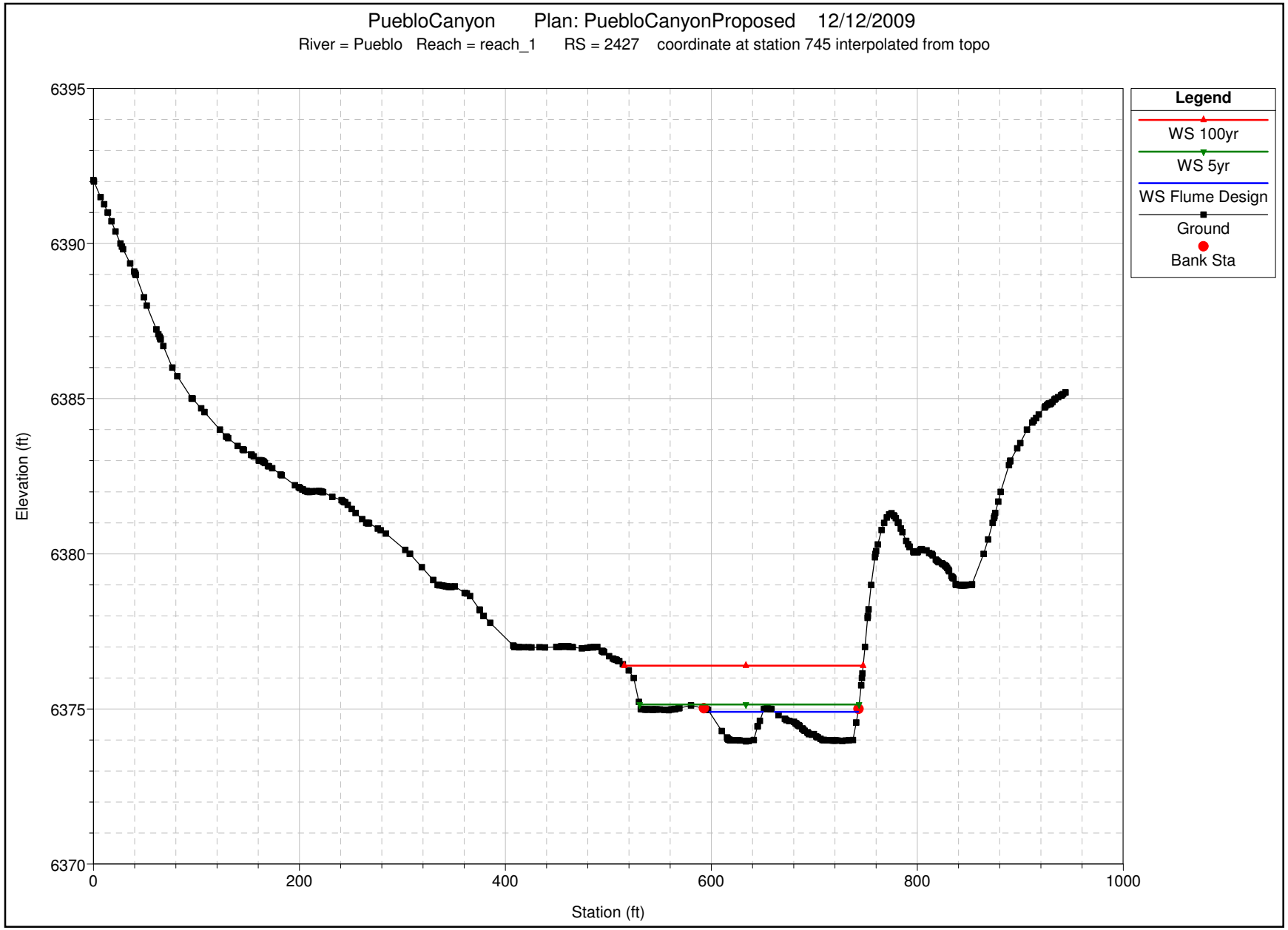
River = Pueblo Reach = reach_1 RS = 2027 coordinates at stations 491, 509, and 558 interpolated from topo

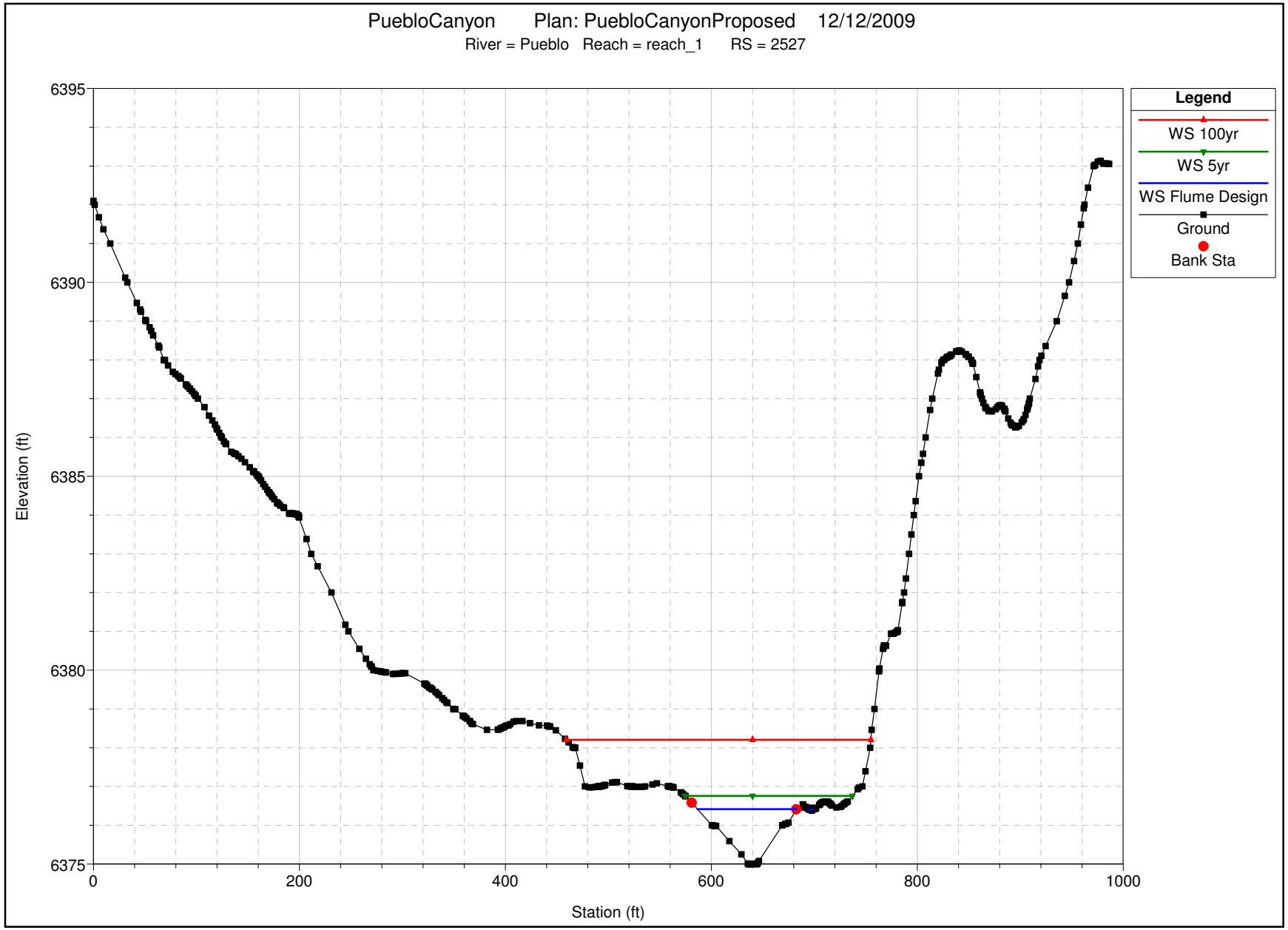


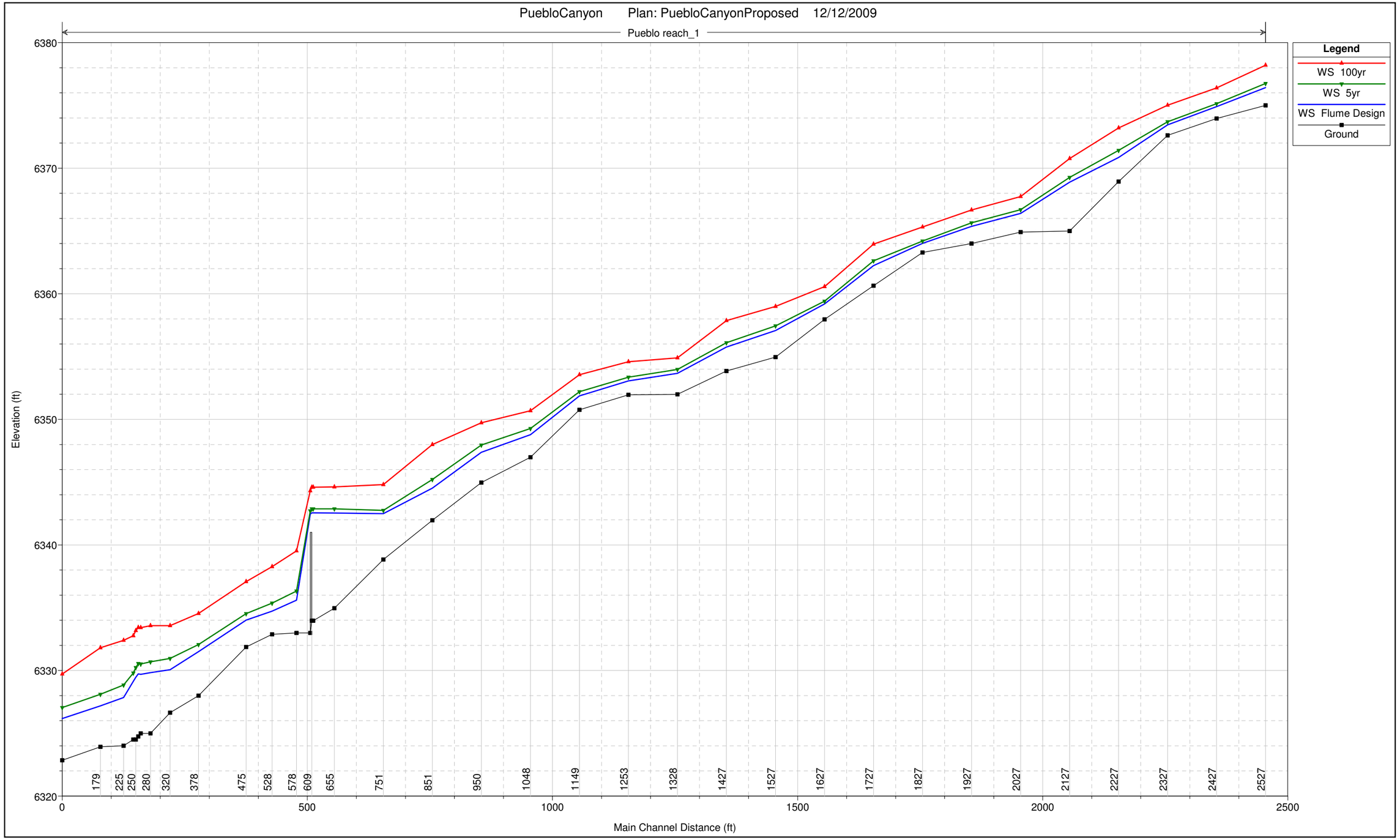

PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 2127 coordinate at station 510 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6390
6385
6380
6375
6370
6365
0
200
400
600
800
1000
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 2227
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6390
6385
6380
6375
6370
6365
0
200
400
600
800
1000
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 2327
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
6370
0
200
400
600
800
1000
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 2427 coordinate at station 745 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
6370
0
200
400
600
800
1000
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
River = Pueblo Reach = reach_1 RS = 2527
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
Station (ft)
0
200
400
600
800
1000


PuebloCanyon Plan: PuebloCanyonProposed 12/12/2009
Pueblo reach_1
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Elevation (ft)
6380
6370
6360
6350
6340
6330
6320
0
500
1000
1500
2000
2500
Main Channel Distance (ft)
179
225
250
280
320
378
475
528
578
609
655
751
851
950
1048
1149
1253
1328
1427
1527
1627
1727
1827
1927
2027
2127
2227
2327
2427
2527

HEC-RAS Plan: PuebloProp River: Pueblo Reach: reach_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	2527	Flume Design	350.00	6375.00	6376.41	6376.41	6376.79	0.014787	4.93	71.09	100.15	1.01
reach_1	2527	5yr	593.00	6375.00	6376.76	6376.76	6377.22	0.011766	5.51	119.18	162.48	0.95
reach_1	2527	100yr	2740.00	6375.00	6378.21	6378.21	6379.13	0.008882	8.57	496.55	295.93	0.96
reach_1	2427	Flume Design	350.00	6373.96	6374.91	6374.85	6375.16	0.011953	4.05	86.33	133.12	0.89
reach_1	2427	5yr	593.00	6373.96	6375.14	6375.14	6375.51	0.013110	4.89	128.21	213.08	0.96
reach_1	2427	100yr	2740.00	6373.96	6376.40	6376.40	6377.34	0.010342	8.13	404.24	232.05	1.00
reach_1	2327	Flume Design	350.00	6372.62	6373.46	6373.46	6373.74	0.017161	4.25	82.30	155.07	1.03
reach_1	2327	5yr	593.00	6372.62	6373.70	6373.70	6374.07	0.014757	4.89	121.18	165.15	1.01
reach_1	2327	100yr	2740.00	6372.62	6375.02	6375.02	6375.90	0.009419	7.65	403.15	269.34	0.95
reach_1	2227	Flume Design	350.00	6368.94	6370.86	6370.86	6371.45	0.012625	6.17	56.69	48.30	1.00
reach_1	2227	5yr	593.00	6368.94	6371.42	6371.42	6371.92	0.012966	5.71	104.84	109.61	1.00
reach_1	2227	100yr	2740.00	6368.94	6373.21	6373.21	6374.28	0.007853	8.72	417.68	266.46	0.92
reach_1	2127	Flume Design	350.00	6365.00	6368.89	6368.89	6369.32	0.013838	5.27	66.38	76.10	0.99
reach_1	2127	5yr	593.00	6365.00	6369.27	6369.27	6369.75	0.014227	5.57	109.10	147.31	1.02
reach_1	2127	100yr	2740.00	6365.00	6370.78	6370.78	6371.58	0.008011	7.96	557.57	401.56	0.90
reach_1	2027	Flume Design	350.00	6364.92	6366.40	6366.22	6366.55	0.015775	3.85	124.17	187.31	0.97
reach_1	2027	5yr	593.00	6364.92	6366.70	6366.39	6366.94	0.015192	4.90	190.29	261.98	1.02
reach_1	2027	100yr	2740.00	6364.92	6367.74	6367.70	6368.60	0.017621	9.33	553.16	478.41	1.26
reach_1	1927	Flume Design	350.00	6364.00	6365.36		6365.55	0.010057	4.51	153.65	252.04	0.85
reach_1	1927	5yr	593.00	6364.00	6365.65		6365.91	0.010440	5.55	235.13	334.55	0.91
reach_1	1927	100yr	2740.00	6364.00	6366.67	6366.67	6367.30	0.013553	9.67	689.07	509.44	1.16
reach_1	1827	Flume Design	350.00	6363.29	6364.02	6363.96	6364.21	0.021802	4.24	119.11	246.51	1.12
reach_1	1827	5yr	593.00	6363.29	6364.20	6364.16	6364.50	0.023093	5.33	164.51	269.75	1.22
reach_1	1827	100yr	2740.00	6363.29	6365.32	6365.32	6365.95	0.013566	7.83	611.98	508.07	1.10
reach_1	1727	Flume Design	350.00	6360.64	6362.25	6362.25	6362.62	0.011858	4.94	81.94	151.73	0.93
reach_1	1727	5yr	593.00	6360.64	6362.63	6362.63	6363.03	0.010019	5.34	153.00	233.77	0.89
reach_1	1727	100yr	2740.00	6360.64	6363.95	6363.95	6364.69	0.009089	8.15	650.72	551.89	0.95
reach_1	1627	Flume Design	350.00	6357.96	6359.20	6359.20	6359.46	0.025264	5.16	106.50	200.24	1.25
reach_1	1627	5yr	593.00	6357.96	6359.41	6359.41	6359.78	0.026995	6.10	154.14	239.99	1.33
reach_1	1627	100yr	2740.00	6357.96	6360.57	6360.57	6361.32	0.016715	8.87	547.24	404.71	1.22
reach_1	1527	Flume Design	350.00	6354.96	6357.08	6357.08	6357.42	0.011859	5.69	113.30	155.04	0.96
reach_1	1527	5yr	593.00	6354.96	6357.45	6357.38	6357.80	0.012020	6.07	175.48	181.85	0.98
reach_1	1527	100yr	2740.00	6354.96	6358.99	6358.86	6359.72	0.011119	9.27	594.77	368.98	1.06
reach_1	1427	Flume Design	350.00	6353.85	6355.76	6355.76	6356.15	0.011470	5.56	94.77	124.22	0.94
reach_1	1427	5yr	593.00	6353.85	6356.10	6356.10	6356.61	0.011718	6.53	146.40	169.26	0.99
reach_1	1427	100yr	2740.00	6353.85	6357.86	6357.86	6358.74	0.008699	9.82	637.16	444.45	0.98
reach_1	1328	Flume Design	350.00	6351.99	6353.67	6353.49	6353.90	0.013291	5.03	112.05	125.84	0.97
reach_1	1328	5yr	593.00	6351.99	6353.98	6353.81	6354.33	0.015483	6.18	153.04	143.72	1.08
reach_1	1328	100yr	2740.00	6351.99	6354.90	6354.90	6356.88	0.039189	15.08	345.35	254.24	1.92
reach_1	1253	Flume Design	350.00	6351.96	6353.07		6353.16	0.005419	2.85	164.52	203.84	0.60
reach_1	1253	5yr	593.00	6351.96	6353.35		6353.50	0.005684	3.68	228.30	240.93	0.66
reach_1	1253	100yr	2740.00	6351.96	6354.59		6355.18	0.008161	7.59	653.60	468.81	0.90
reach_1	1149	Flume Design	350.00	6350.76	6351.87	6351.87	6352.22	0.020126	5.56	93.42	138.27	1.17
reach_1	1149	5yr	593.00	6350.76	6352.20	6352.20	6352.60	0.016441	6.12	154.87	233.79	1.11
reach_1	1149	100yr	2740.00	6350.76	6353.55	6353.55	6354.26	0.011123	9.09	648.39	460.08	1.06
reach_1	1048	Flume Design	350.00	6346.99	6348.78		6348.89	0.007019	3.53	152.35	144.85	0.70
reach_1	1048	5yr	593.00	6346.99	6349.27		6349.40	0.006115	3.84	234.02	214.18	0.68
reach_1	1048	100yr	2740.00	6346.99	6350.69		6351.10	0.007731	7.46	796.67	482.41	0.87
reach_1	950	Flume Design	350.00	6344.97	6347.39	6347.39	6348.00	0.011075	6.31	59.63	63.51	0.95
reach_1	950	5yr	593.00	6344.97	6347.96	6347.96	6348.64	0.008979	6.89	118.52	130.69	0.90
reach_1	950	100yr	2740.00	6344.97	6349.73	6349.73	6350.41	0.006199	9.01	787.97	488.93	0.84
reach_1	851	Flume Design	350.00	6341.96	6344.52	6344.52	6345.27	0.012005	6.91	50.64	34.79	1.01
reach_1	851	5yr	593.00	6341.96	6345.22	6345.22	6346.13	0.011000	7.66	77.43	42.69	1.00
reach_1	851	100yr	2740.00	6341.96	6348.00	6348.00	6348.92	0.004989	9.02	679.47	472.91	0.78
reach_1	751	Flume Design	350.00	6338.84	6342.50		6342.60	0.000736	2.58	135.64	49.96	0.28
reach_1	751	5yr	593.00	6338.84	6342.75		6343.00	0.001634	4.00	149.53	66.83	0.42
reach_1	751	100yr	2740.00	6338.84	6344.80	6344.80	6345.96	0.004835	9.14	484.88	316.87	0.77

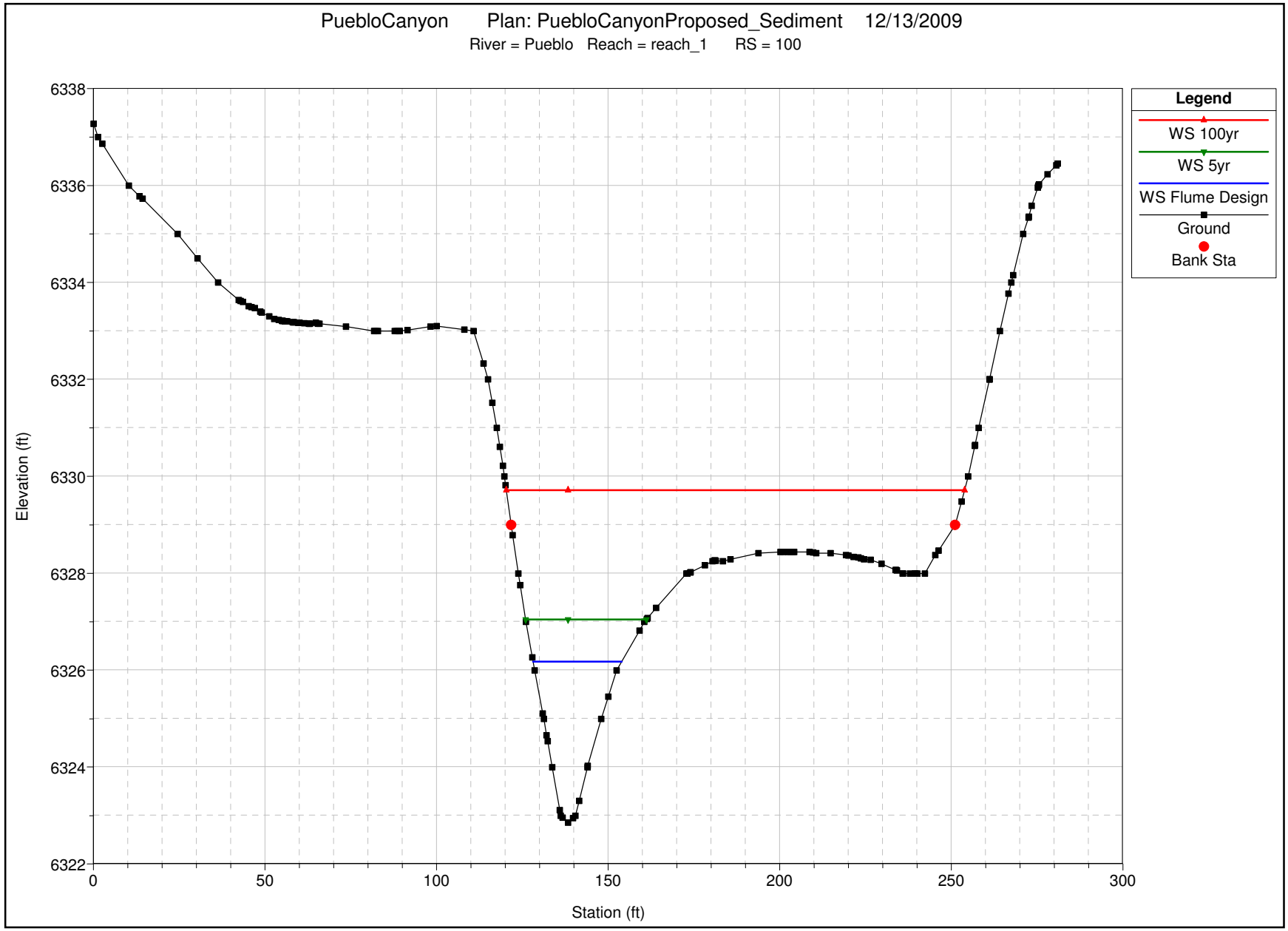
HEC-RAS Plan: PuebloProp River: Pueblo Reach: reach_1 (Continued)

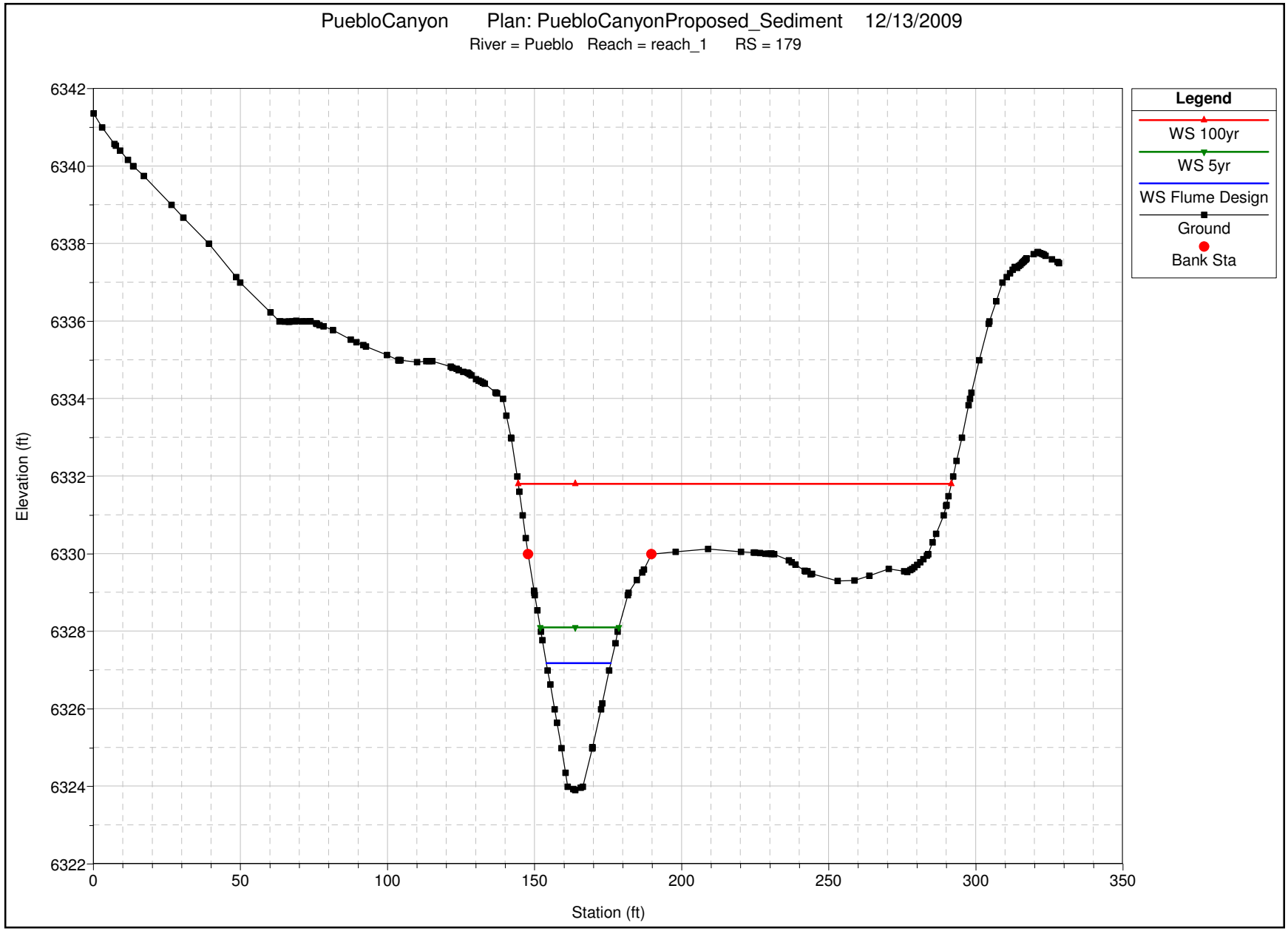
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	655	Flume Design	350.00	6334.96	6342.55	6337.04	6342.56	0.000038	0.97	414.50	238.42	0.07
reach_1	655	5yr	593.00	6334.96	6342.87	6337.70	6342.91	0.000089	1.53	482.43	281.84	0.11
reach_1	655	100yr	2740.00	6334.96	6344.62	6340.79	6344.93	0.000631	4.83	928.44	481.09	0.30
reach_1	612	Flume Design	350.00	6333.97	6342.55	6336.26	6342.56	0.000028	0.89	513.93	318.18	0.06
reach_1	612	5yr	593.00	6333.97	6342.87	6336.97	6342.90	0.000066	1.41	568.24	339.59	0.10
reach_1	612	100yr	2740.00	6333.97	6344.60	6340.27	6344.90	0.000552	4.74	858.63	445.42	0.29
reach_1	609		Inl Struct									
reach_1	578	Flume Design	350.00	6333.00	6335.60	6335.60	6336.40	0.011761	7.15	48.92	31.30	1.01
reach_1	578	5yr	593.00	6333.00	6336.33	6336.33	6337.33	0.010870	8.04	73.79	37.30	1.01
reach_1	578	100yr	2740.00	6333.00	6339.53	6339.53	6341.38	0.008599	10.90	252.92	72.26	1.00
reach_1	528	Flume Design	350.00	6332.88	6334.73	6334.73	6335.45	0.011980	6.81	51.42	36.12	1.01
reach_1	528	5yr	593.00	6332.88	6335.37	6335.37	6336.32	0.011135	7.81	75.95	40.98	1.01
reach_1	528	100yr	2740.00	6332.88	6338.27	6338.27	6340.13	0.008545	10.95	255.39	76.17	0.99
reach_1	475	Flume Design	350.00	6331.88	6334.02	6334.02	6334.61	0.012920	6.19	56.50	48.67	1.01
reach_1	475	5yr	593.00	6331.88	6334.53	6334.53	6335.33	0.011744	7.15	82.93	53.50	1.01
reach_1	475	100yr	2740.00	6331.88	6337.08	6337.08	6338.46	0.009557	9.44	291.17	109.03	1.00
reach_1	378	Flume Design	350.00	6328.00	6331.50	6331.50	6332.12	0.013055	6.30	55.54	46.10	1.01
reach_1	378	5yr	593.00	6328.00	6332.08	6332.08	6332.81	0.012022	6.89	86.08	58.99	1.00
reach_1	378	100yr	2740.00	6328.00	6334.55	6334.55	6336.04	0.009439	9.80	280.98	99.67	1.00
reach_1	320	Flume Design	350.00	6326.65	6330.06		6330.30	0.003662	3.93	89.01	58.23	0.56
reach_1	320	5yr	593.00	6326.65	6330.97		6331.23	0.002357	4.12	143.85	62.72	0.48
reach_1	320	100yr	2740.00	6326.65	6333.57		6334.59	0.003705	8.23	393.13	137.45	0.67
reach_1	280	Flume Design	350.00	6325.00	6329.83		6330.15	0.003582	4.54	77.16	38.09	0.56
reach_1	280	5yr	593.00	6325.00	6330.69		6331.09	0.004147	5.09	116.41	54.72	0.62
reach_1	280	100yr	2740.00	6325.00	6333.58		6334.39	0.003324	7.87	510.21	158.98	0.63
reach_1	260	Flume Design	350.00	6325.00	6329.70		6330.06	0.004311	4.83	72.40	37.36	0.61
reach_1	260	5yr	593.00	6325.00	6330.52		6330.99	0.004960	5.51	107.59	51.27	0.67
reach_1	260	100yr	2740.00	6325.00	6333.41		6334.31	0.003820	8.24	483.73	158.18	0.67
reach_1	255	Flume Design	350.00	6324.75	6329.74		6330.02	0.002903	4.27	81.93	37.59	0.51
reach_1	255	5yr	593.00	6324.75	6330.56		6330.95	0.003787	5.05	117.49	51.99	0.59
reach_1	255	100yr	2740.00	6324.75	6333.42		6334.28	0.003508	8.04	493.62	158.23	0.65
reach_1	250	Flume Design	350.00	6324.50	6329.46	6329.14	6329.98	0.007256	5.77	60.66	35.47	0.78
reach_1	250	5yr	593.00	6324.50	6330.24	6329.81	6330.90	0.007299	6.51	91.08	45.00	0.81
reach_1	250	100yr	2740.00	6324.50	6333.19		6334.23	0.004783	8.86	445.56	157.11	0.75
reach_1	245	Flume Design	350.00	6324.50	6329.14	6329.14	6329.91	0.012851	7.03	49.82	33.25	1.01
reach_1	245	5yr	593.00	6324.50	6329.81	6329.81	6330.82	0.011973	8.06	73.55	37.96	1.02
reach_1	245	100yr	2740.00	6324.50	6332.77	6332.77	6334.17	0.007075	10.09	381.31	155.02	0.89
reach_1	225	Flume Design	350.00	6324.01	6327.85	6327.85	6328.77	0.011861	7.69	45.50	25.28	1.01
reach_1	225	5yr	593.00	6324.01	6328.85	6328.68	6329.85	0.009036	8.02	73.91	31.39	0.92
reach_1	225	100yr	2740.00	6324.01	6332.40	6332.40	6333.88	0.006684	10.16	357.49	153.06	0.88
reach_1	179	Flume Design	350.00	6323.92	6327.19	6327.19	6328.20	0.011346	8.04	43.51	21.92	1.01
reach_1	179	5yr	593.00	6323.92	6328.11	6328.11	6329.37	0.010641	8.99	65.97	26.73	1.01
reach_1	179	100yr	2740.00	6323.92	6331.81	6331.81	6333.31	0.006160	10.84	406.33	147.18	0.86
reach_1	100	Flume Design	350.00	6322.86	6326.18	6326.18	6327.09	0.011668	7.64	45.79	25.82	1.01
reach_1	100	5yr	593.00	6322.86	6327.05	6327.05	6328.10	0.011019	8.21	72.25	35.21	1.01
reach_1	100	100yr	2740.00	6322.86	6329.72	6329.72	6330.94	0.010235	8.87	310.23	133.51	1.01

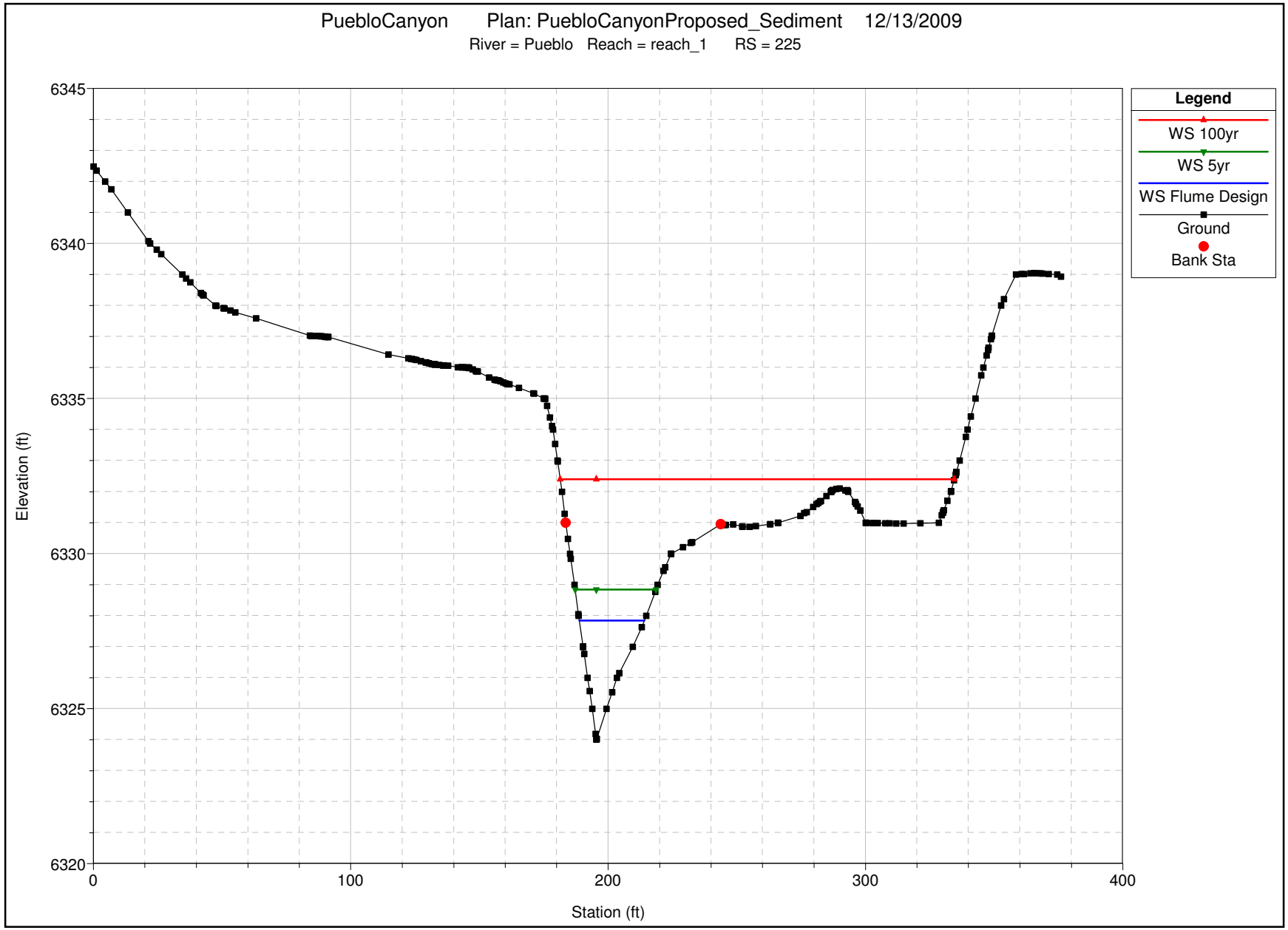
Proposed Conditions
With Sediment

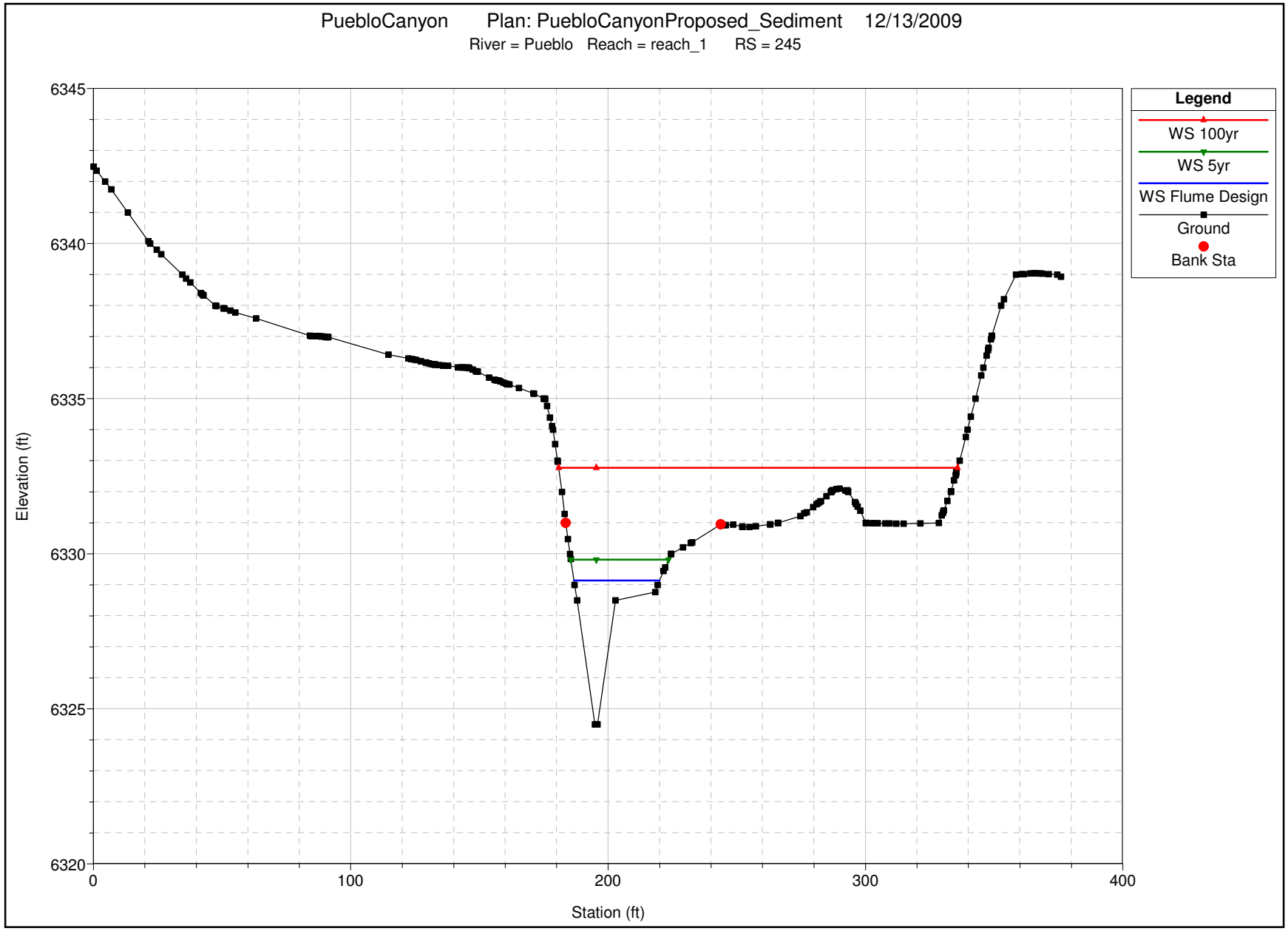
Starting Sediment Elevation 6339 at RS 612

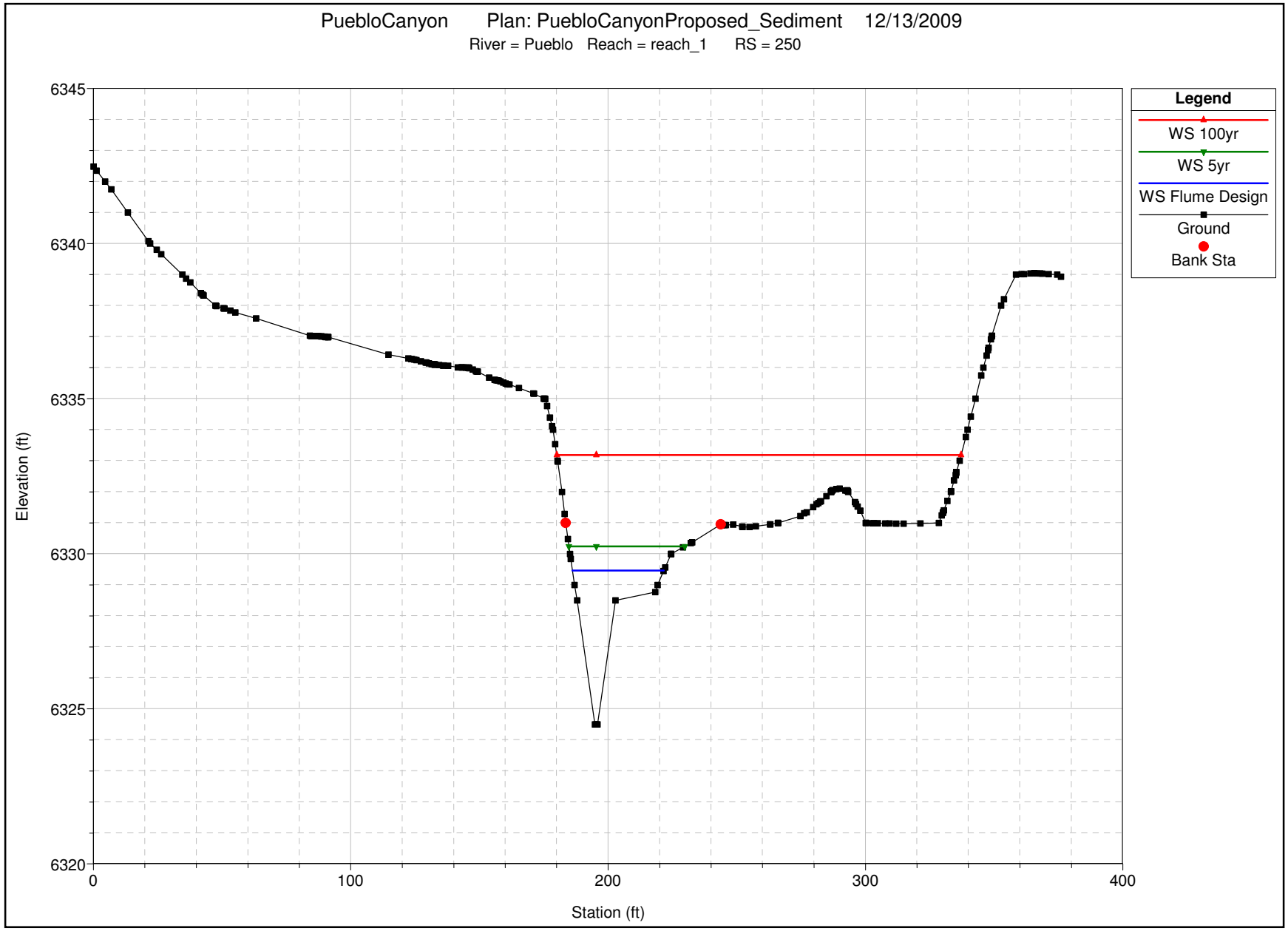
2527
2427
2327
2227
2127
reach_1
2027
1827
Pueblo
1627
1527
1427
1328
1048
851
751
578
320
280
100
179

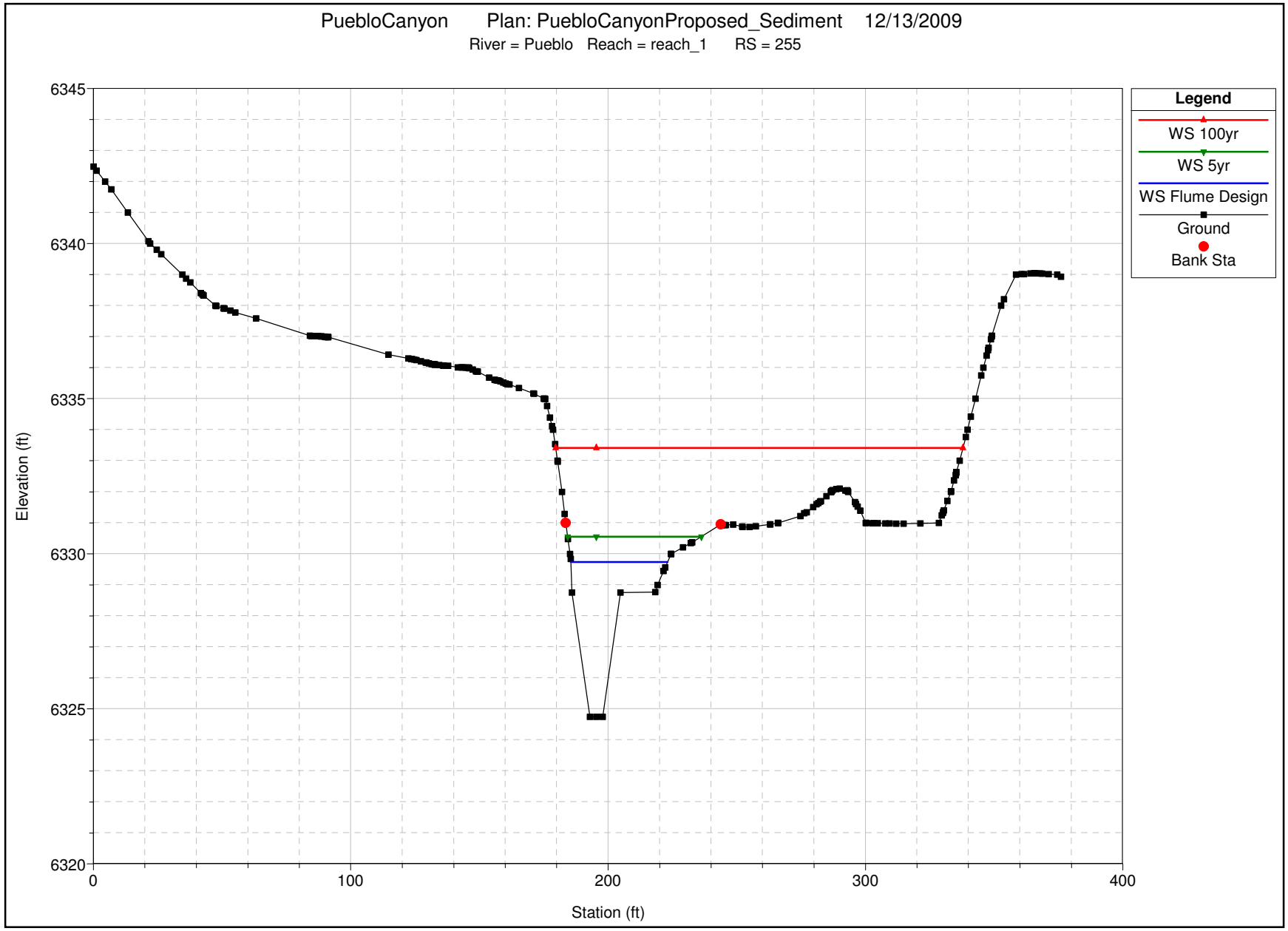

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 100
Elevation (ft)
6338
6336
6334
6332
6330
6328
6326
6324
6322
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

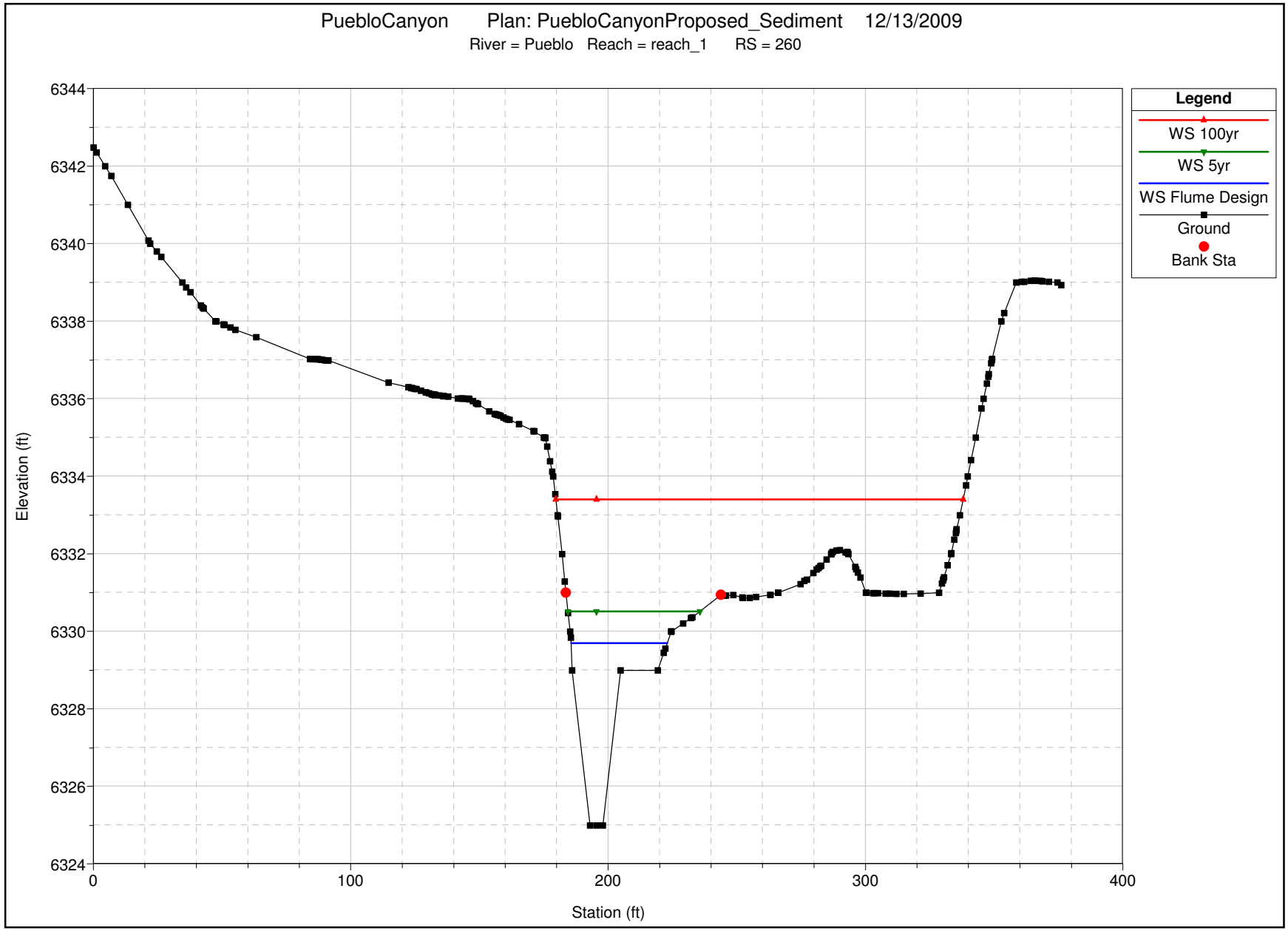

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 179
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
6322
0
50
100
150
200
250
300
350

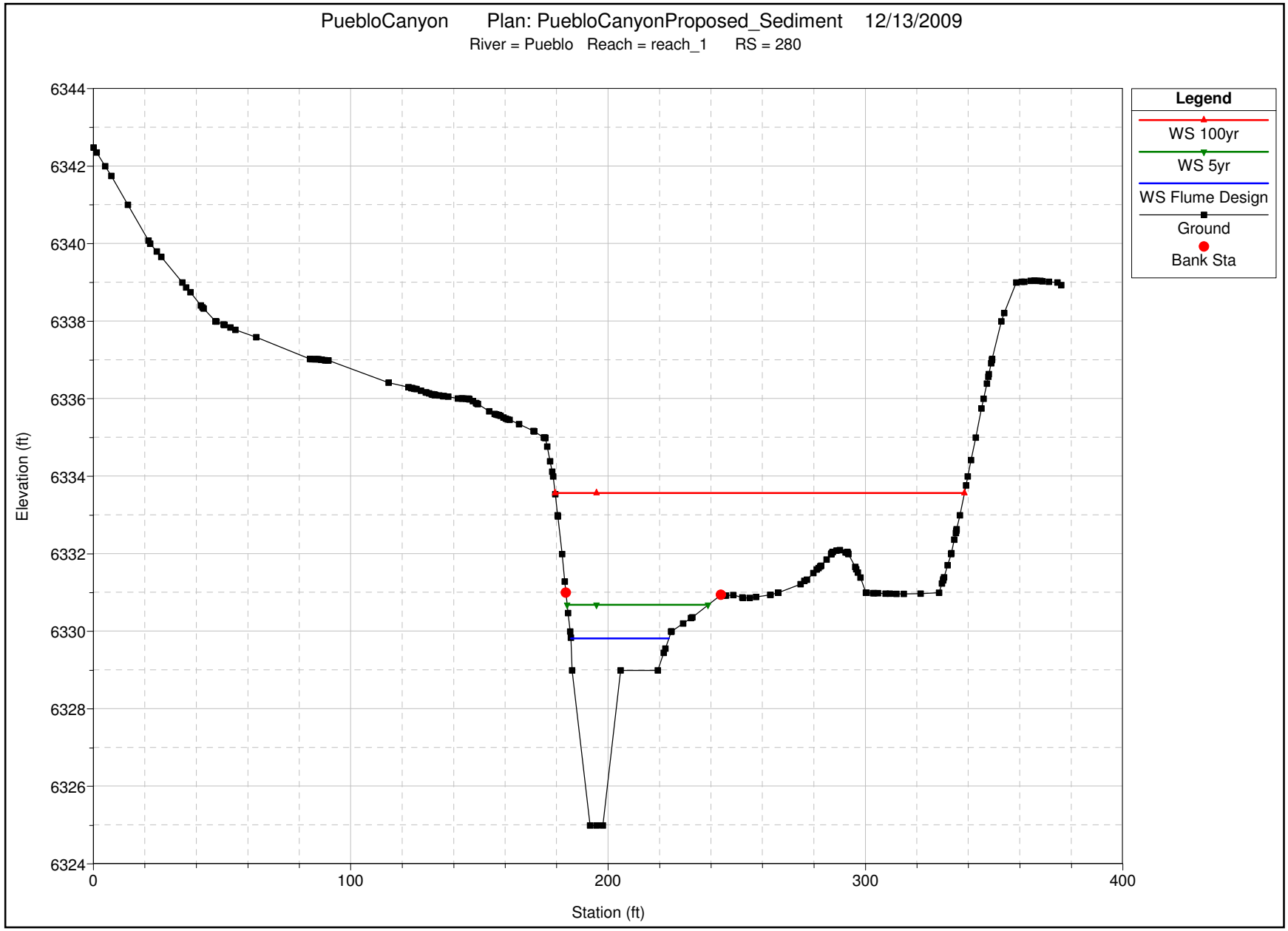

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 225
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400

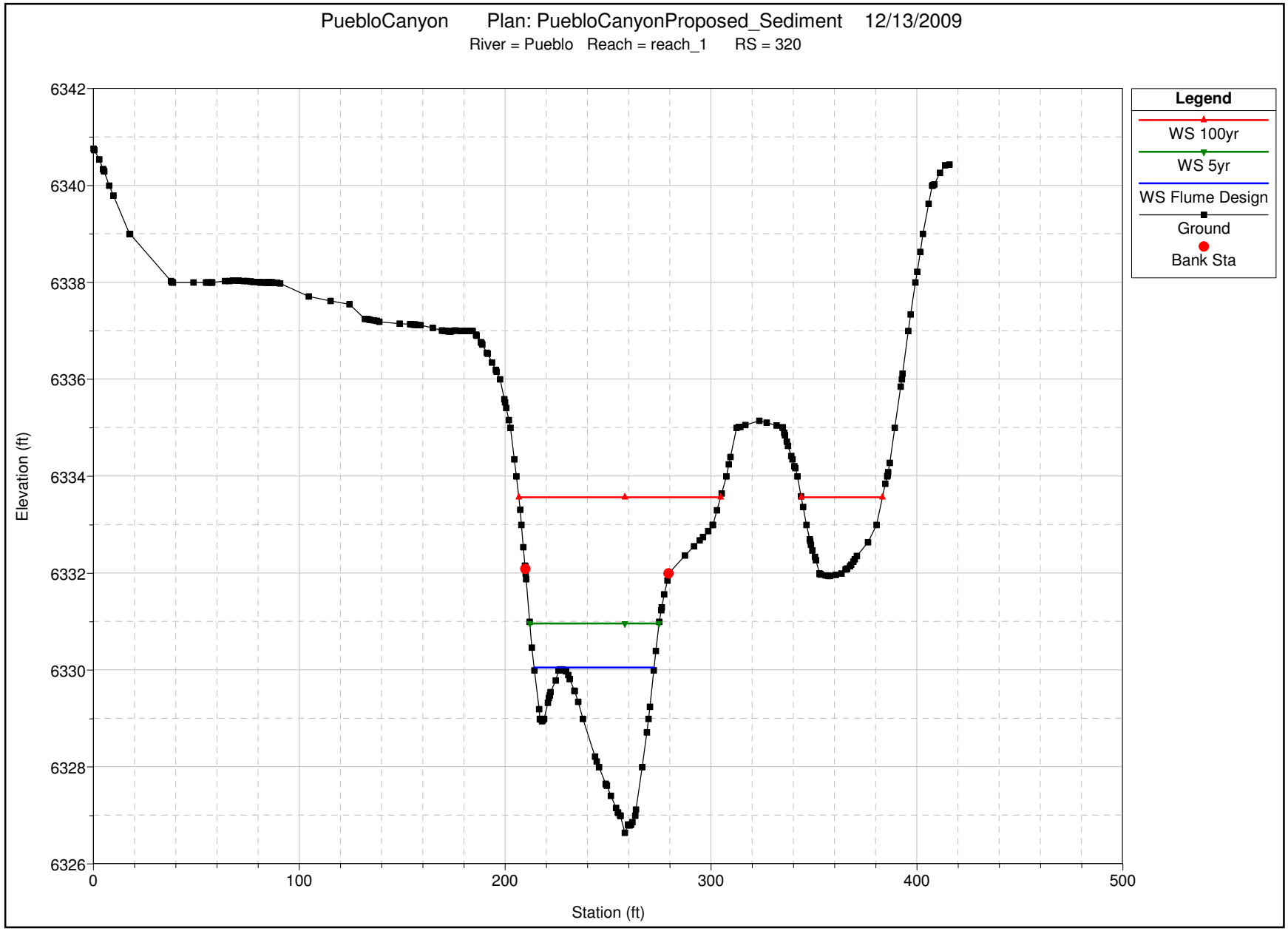

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 245
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 250
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 255
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400

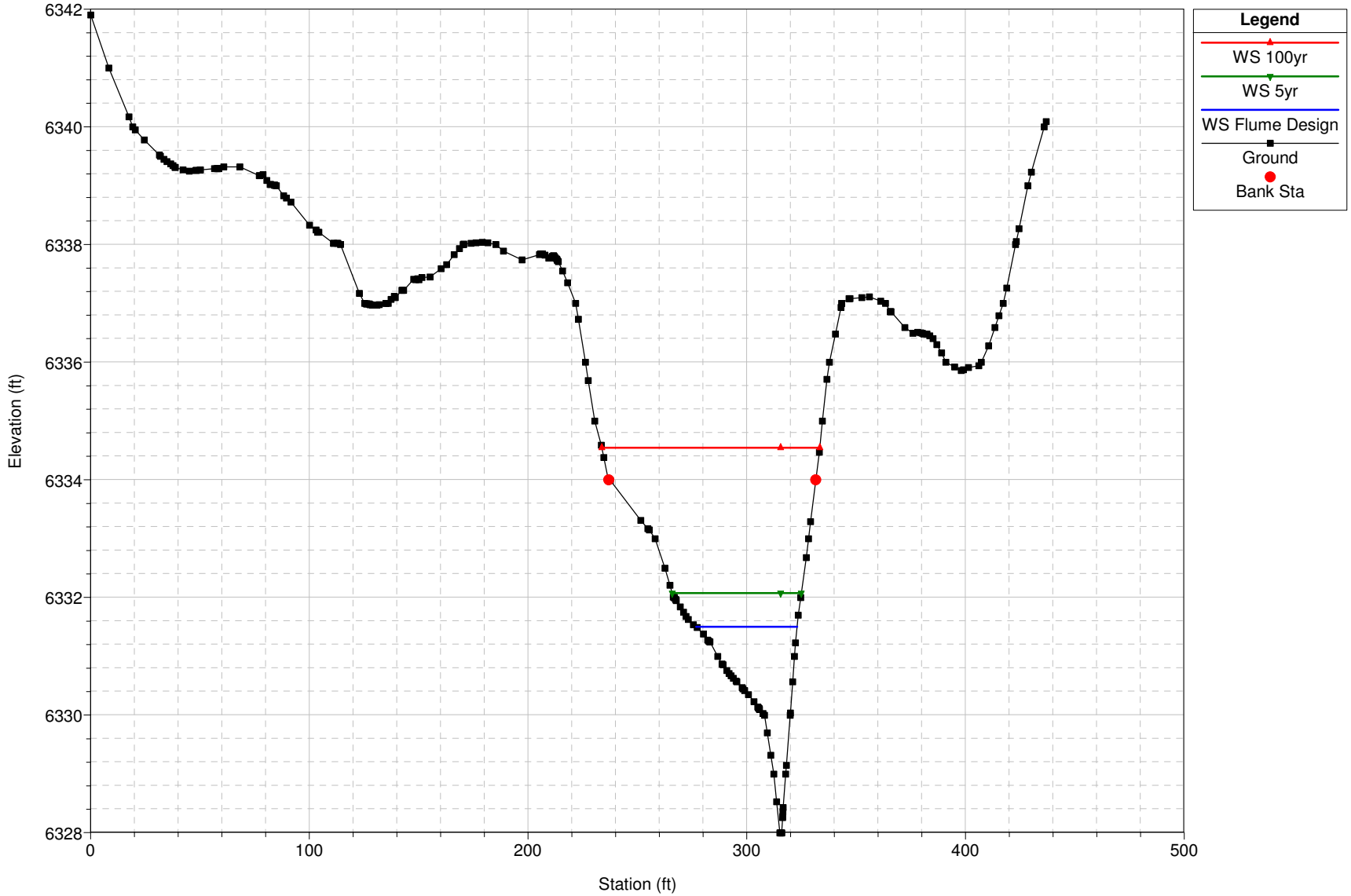

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 260
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6344
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
0
100
200
300
400

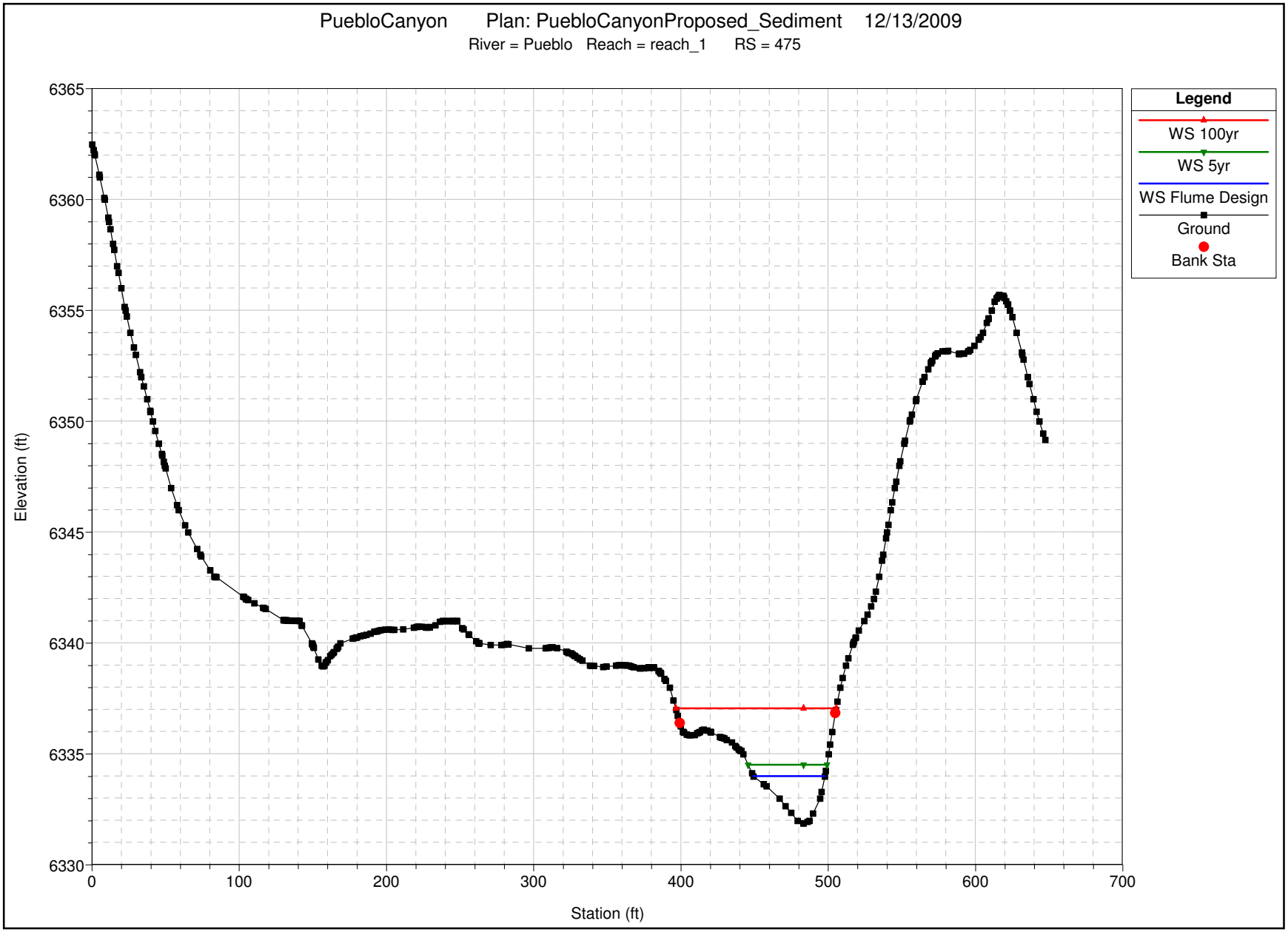

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 280
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6344
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
0
100
200
300
400


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 320
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6342
6340
6338
6336
6334
6332
6330
6328
6326
0
100
200
300
400
500

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

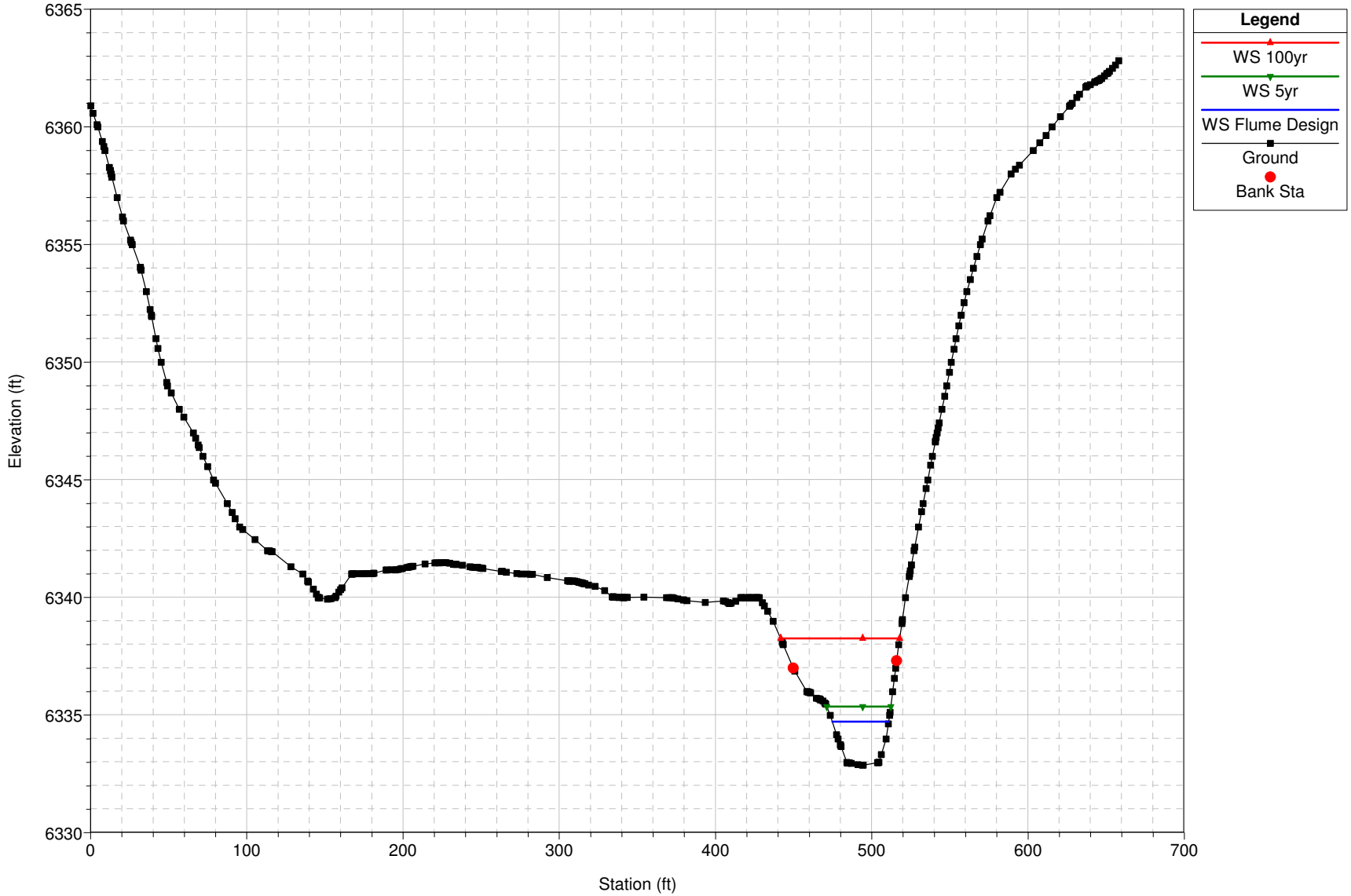
River = Pueblo Reach = reach_1 RS = 378




PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 475
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700

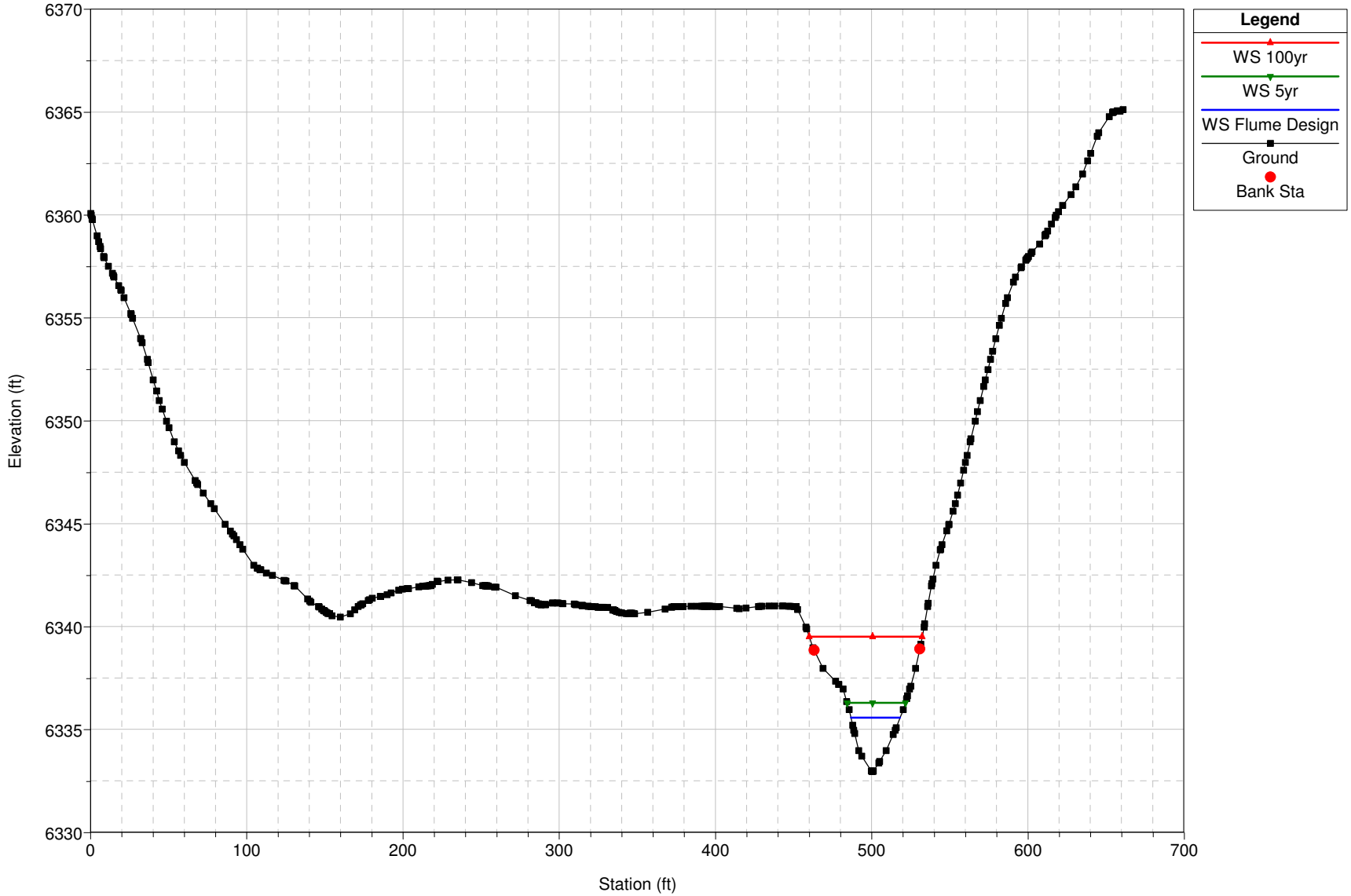
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

River = Pueblo Reach = reach_1 RS = 528



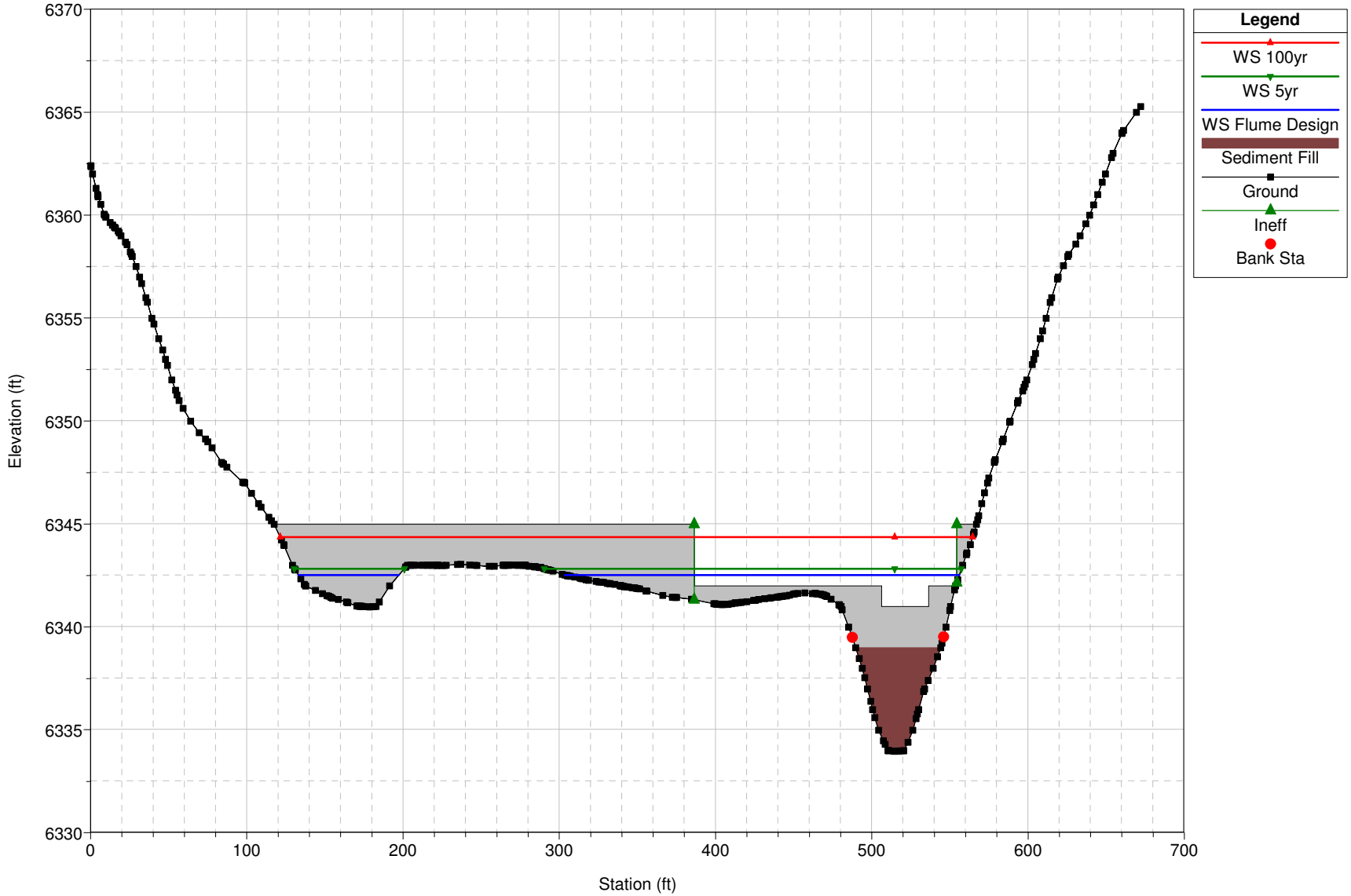
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

River = Pueblo Reach = reach_1 RS = 578



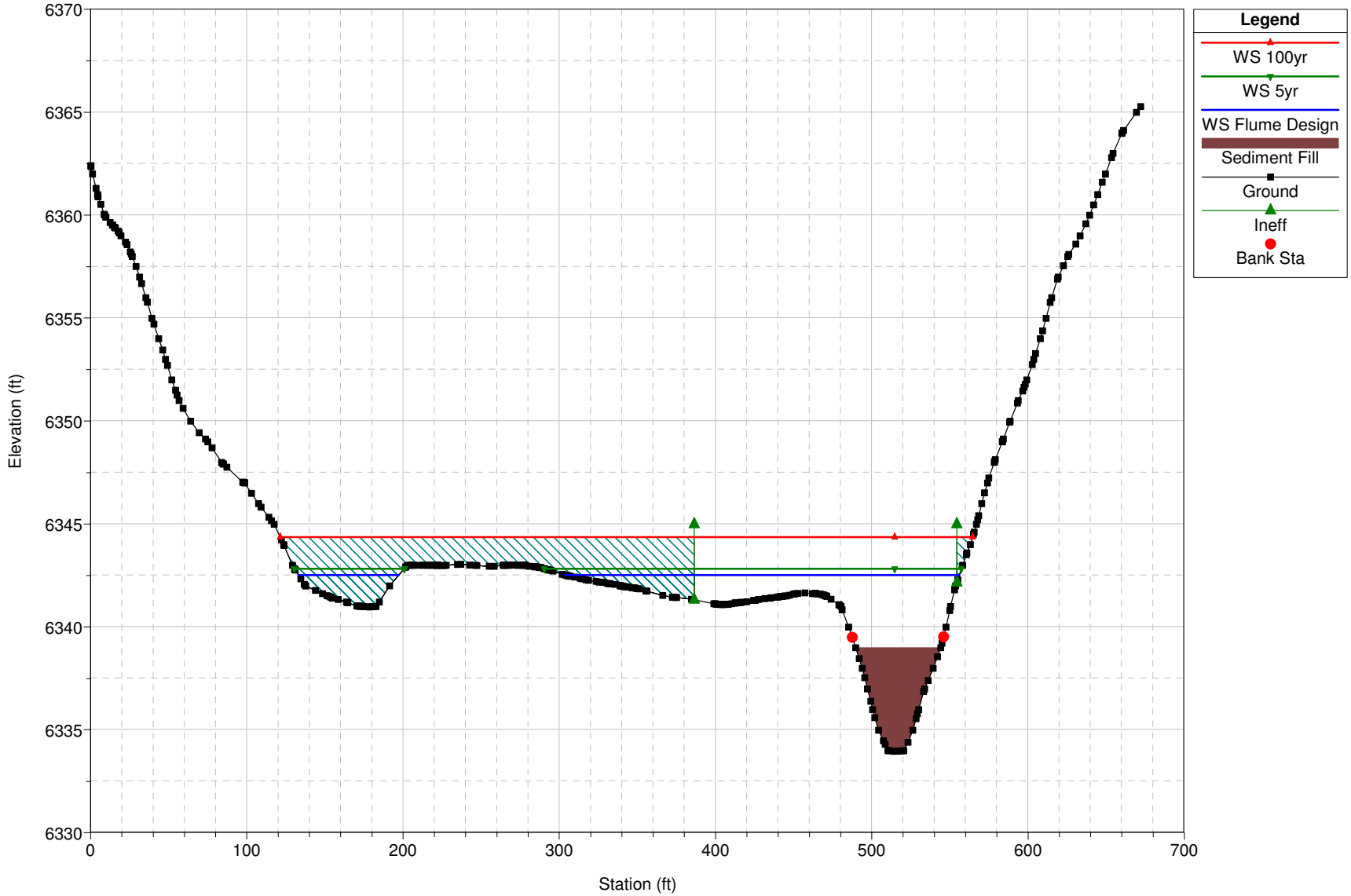
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

River = Pueblo Reach = reach_1 RS = 609 IS Pueblo Canyon Gabion Grade Control Structure



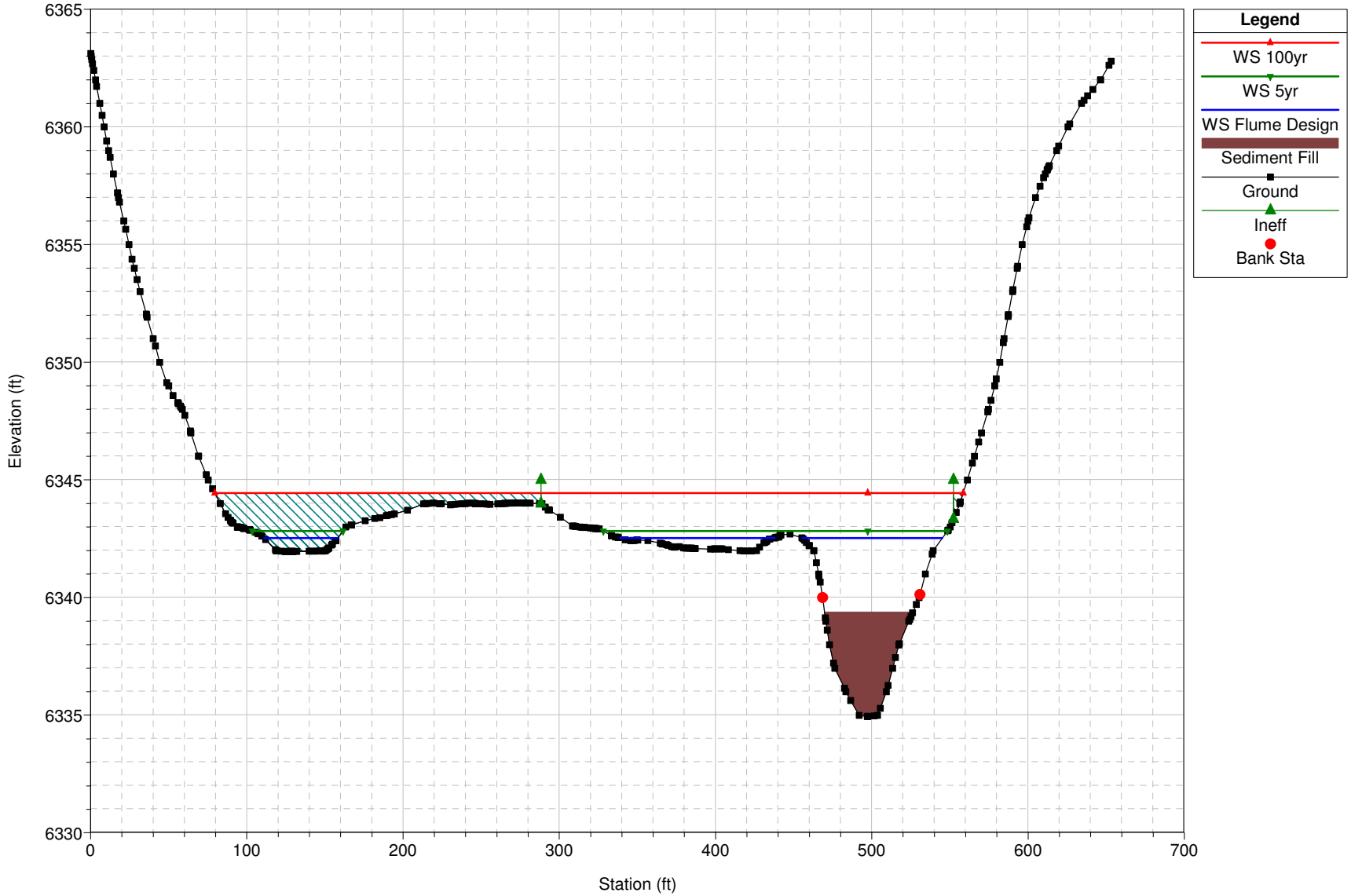
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

River = Pueblo Reach = reach_1 RS = 612 coordinate at station 525 interpolated from topo



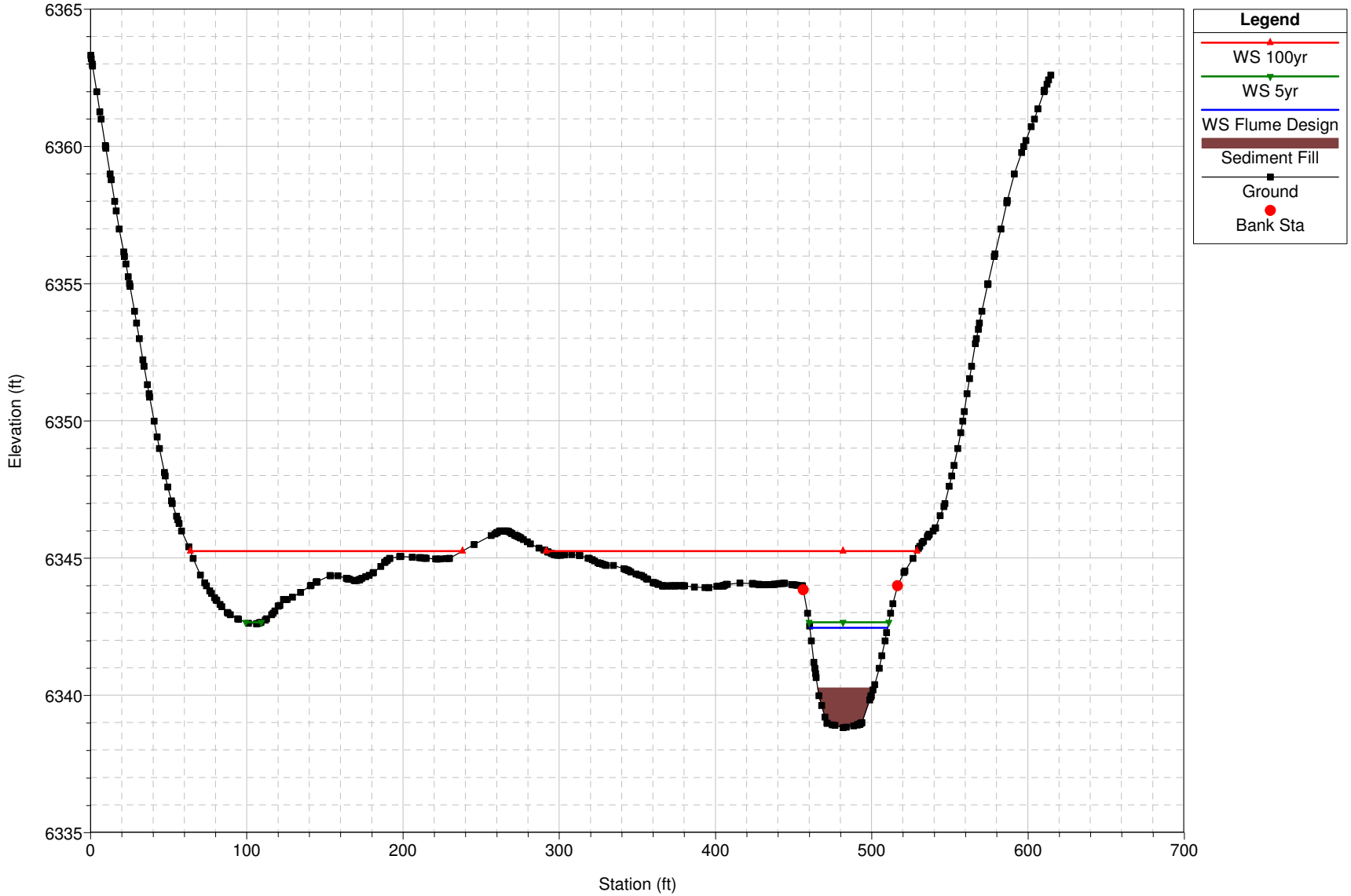
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

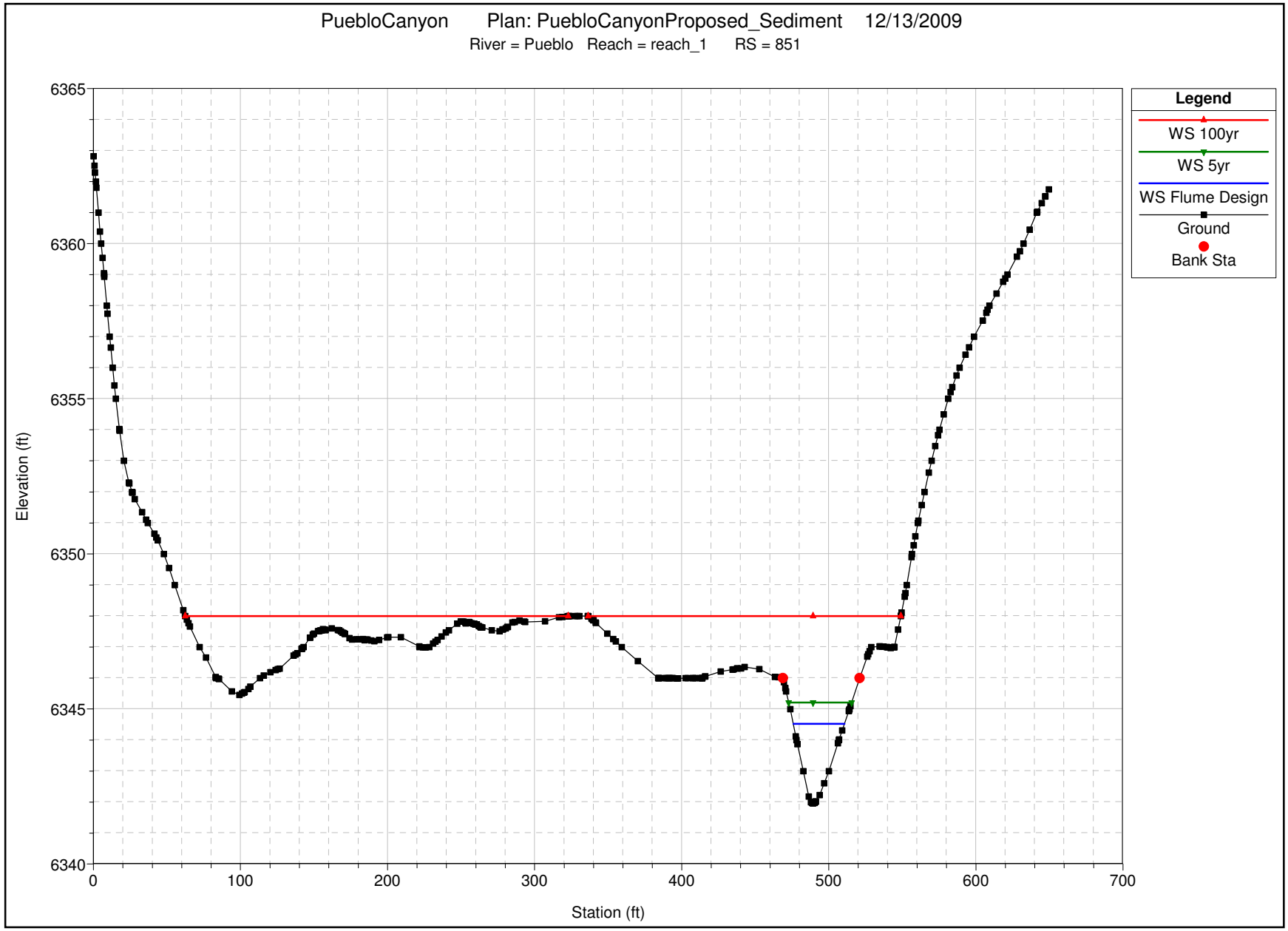
River = Pueblo Reach = reach_1 RS = 655

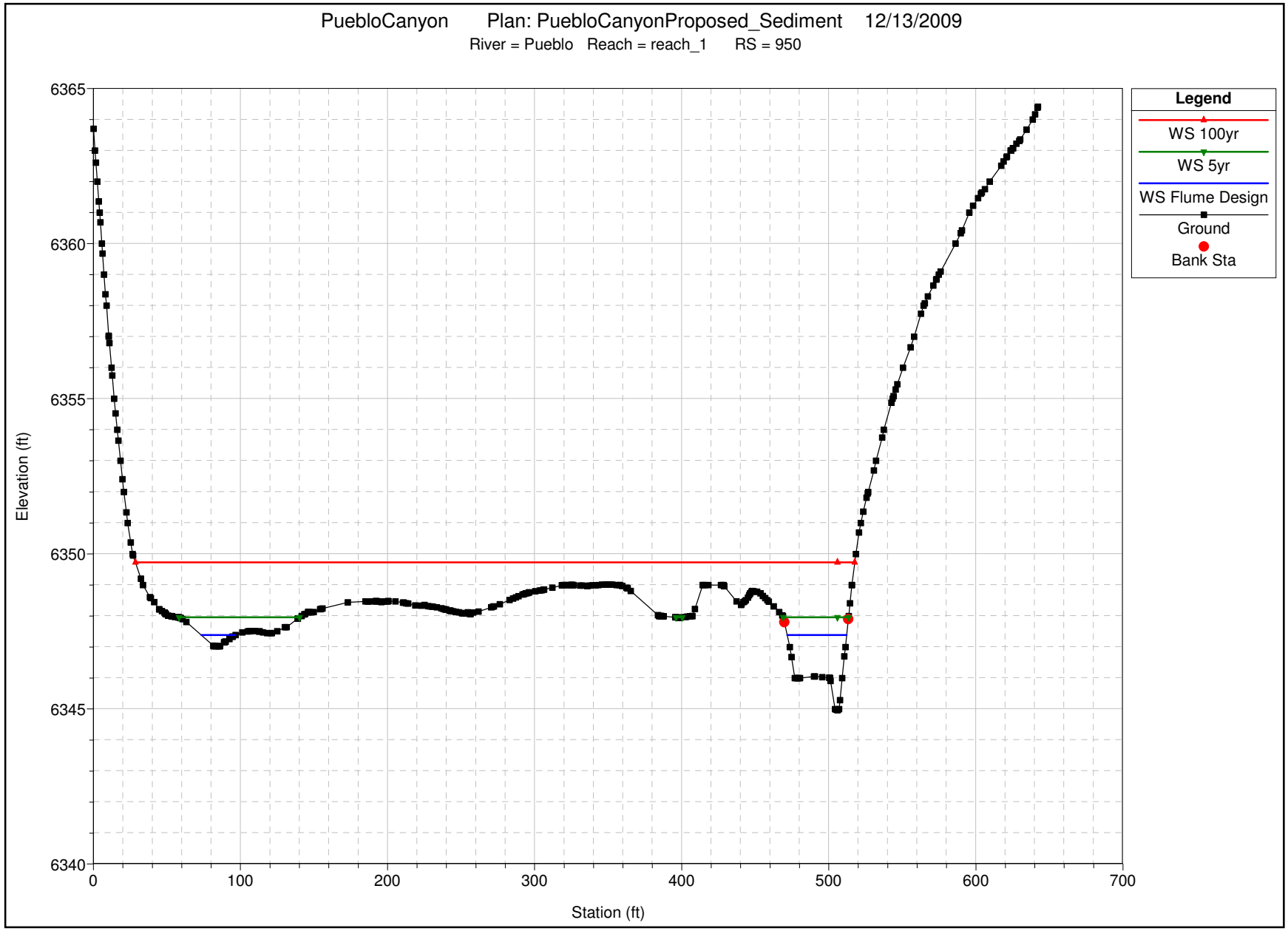


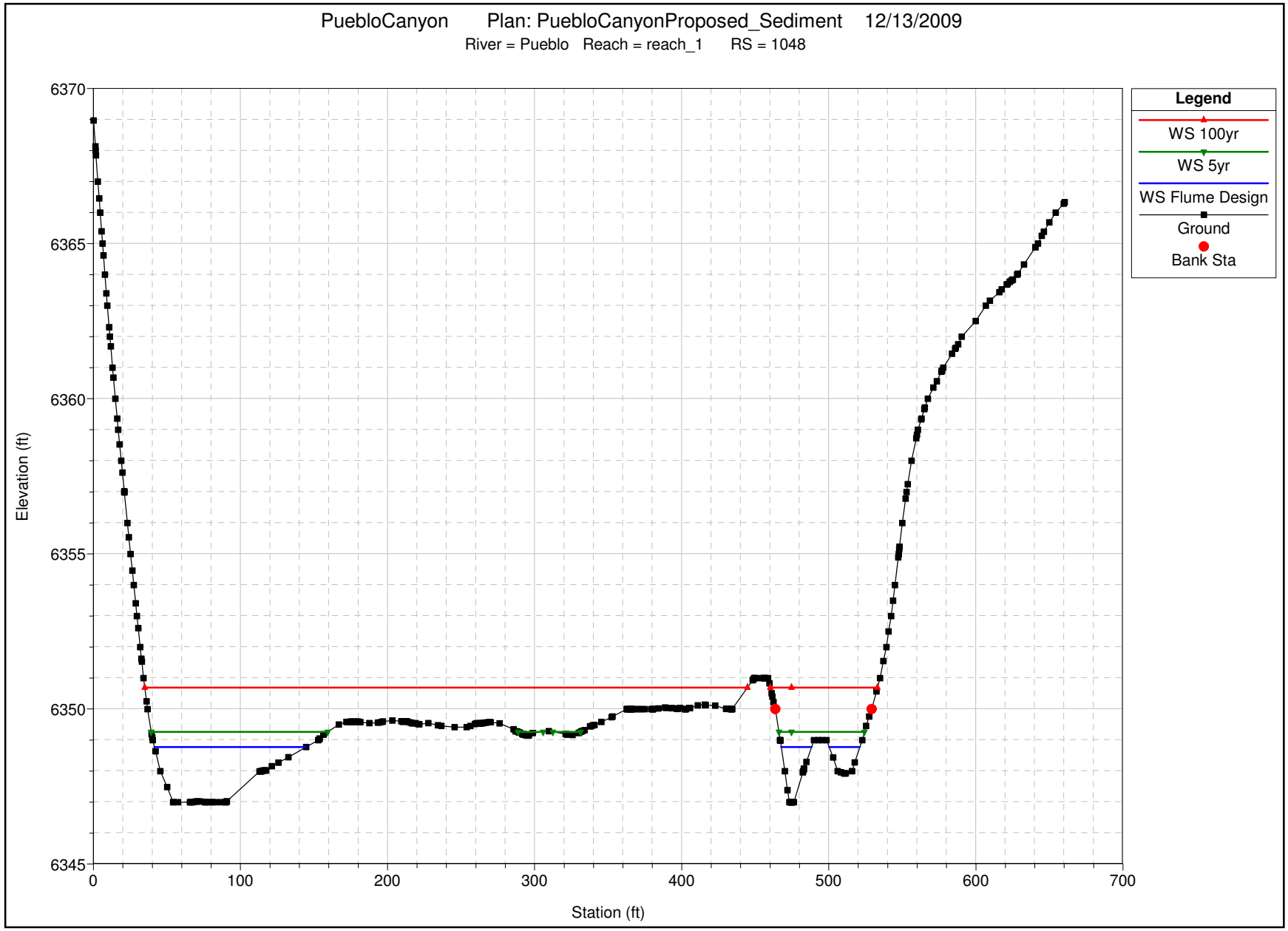
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

River = Pueblo Reach = reach_1 RS = 751 coordinate at station 471 interpolated from topo



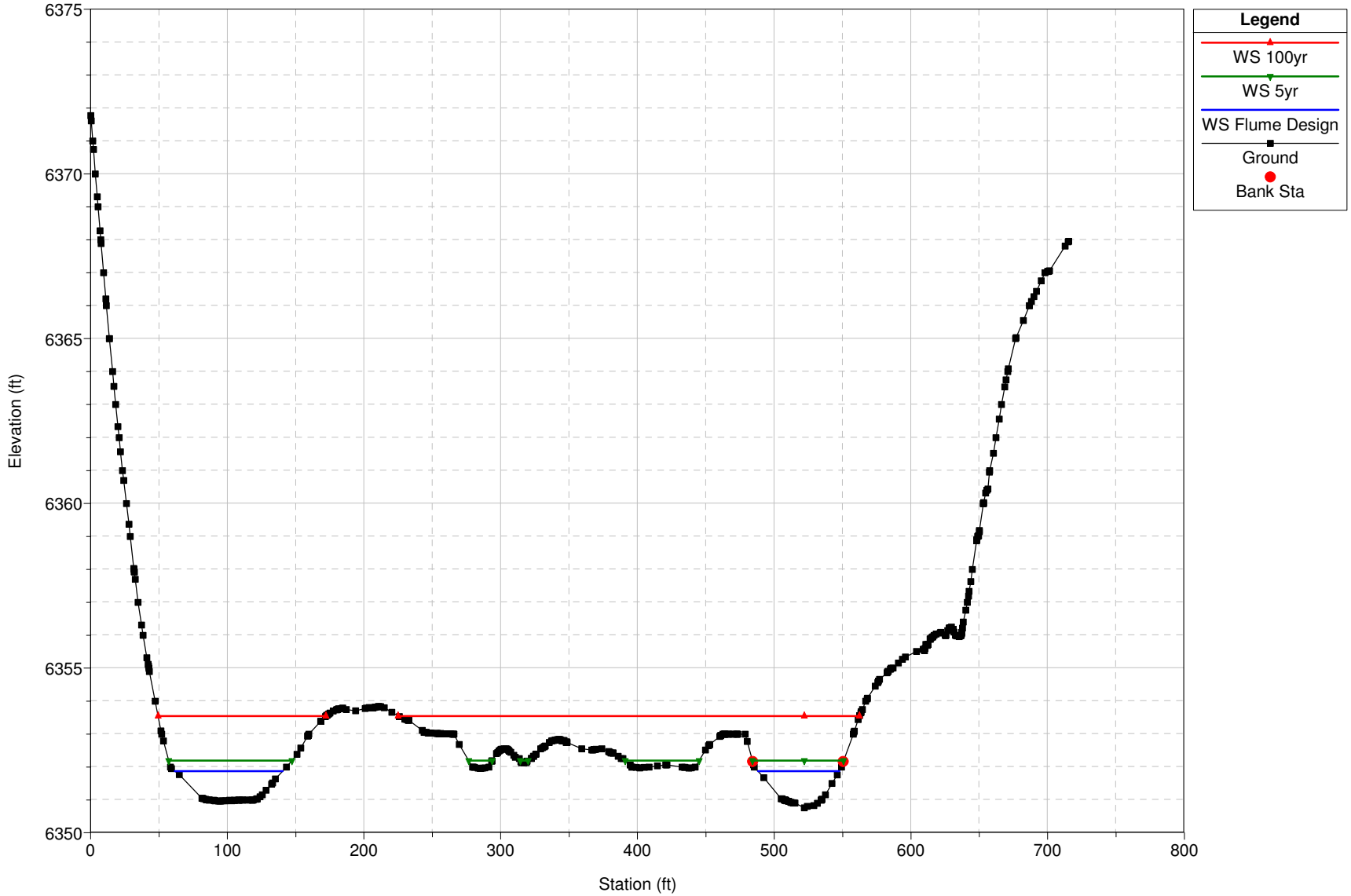

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 851
Elevation (ft)
6365
6360
6355
6350
6345
6340
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

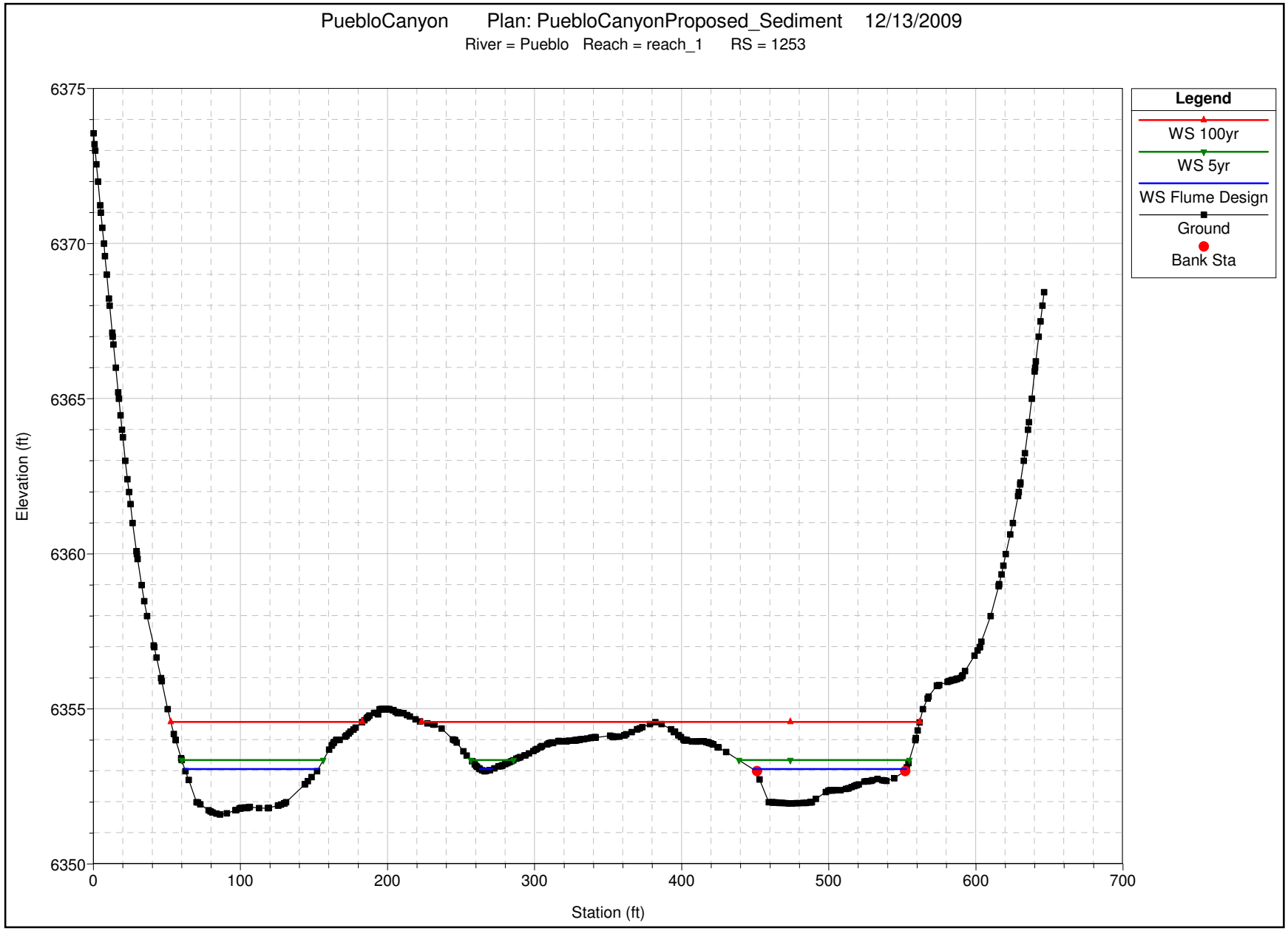

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 950
Elevation (ft)
6365
6360
6355
6350
6345
6340
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

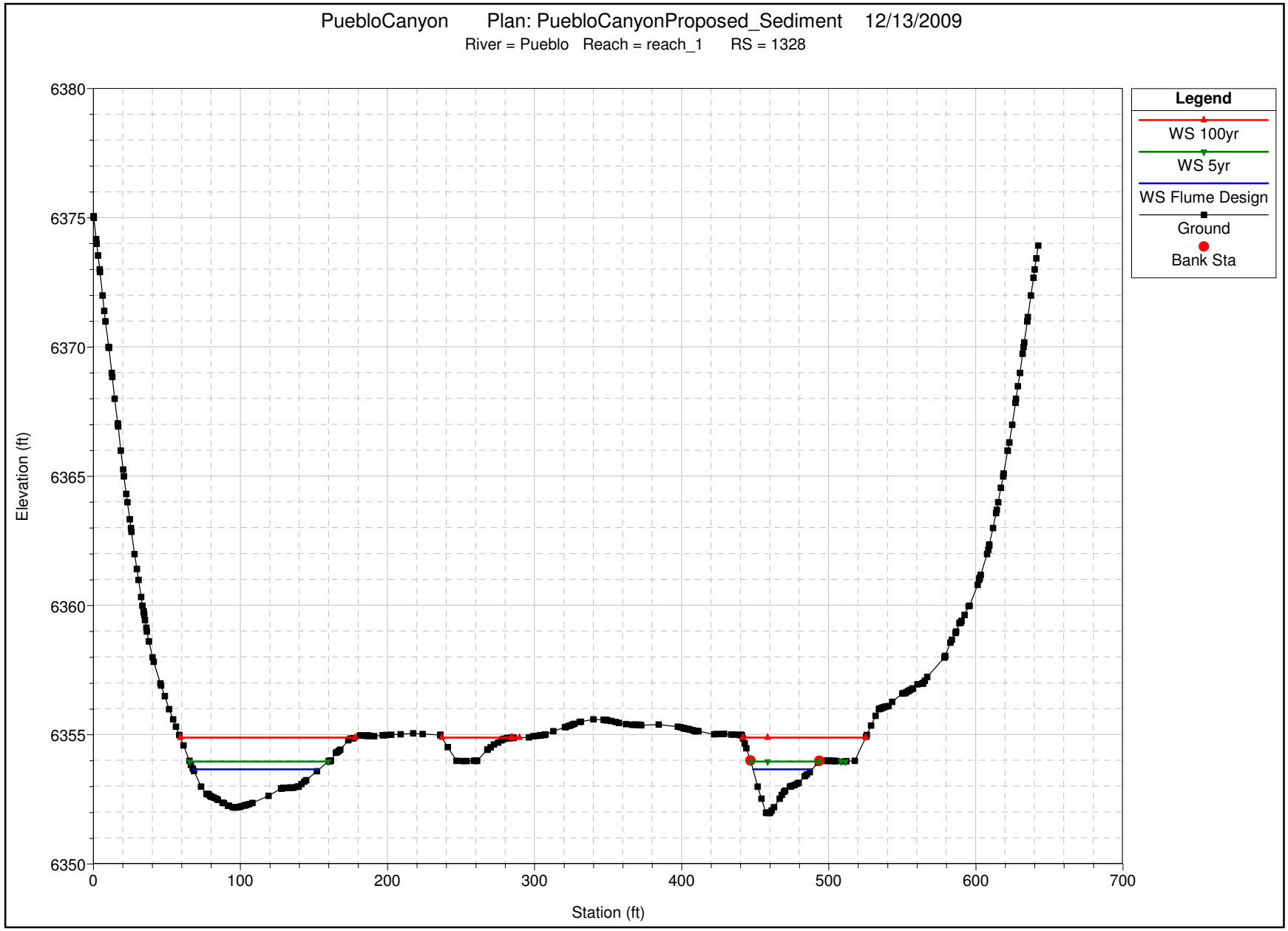

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 1048
Elevation (ft)
6370
6365
6360
6355
6350
6345
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

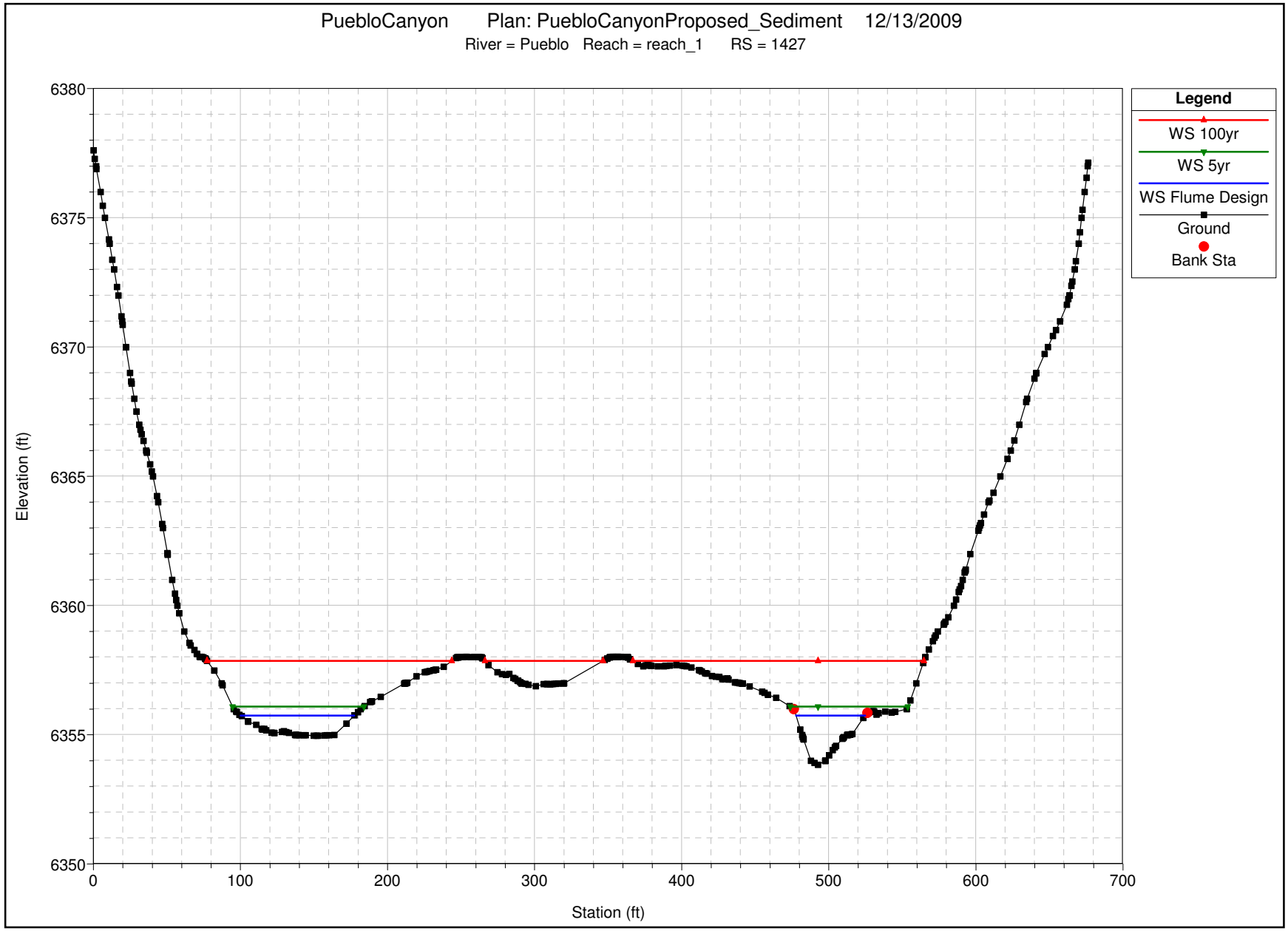
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

River = Pueblo Reach = reach_1 RS = 1149 coordinate at station 515 interpolated from topo



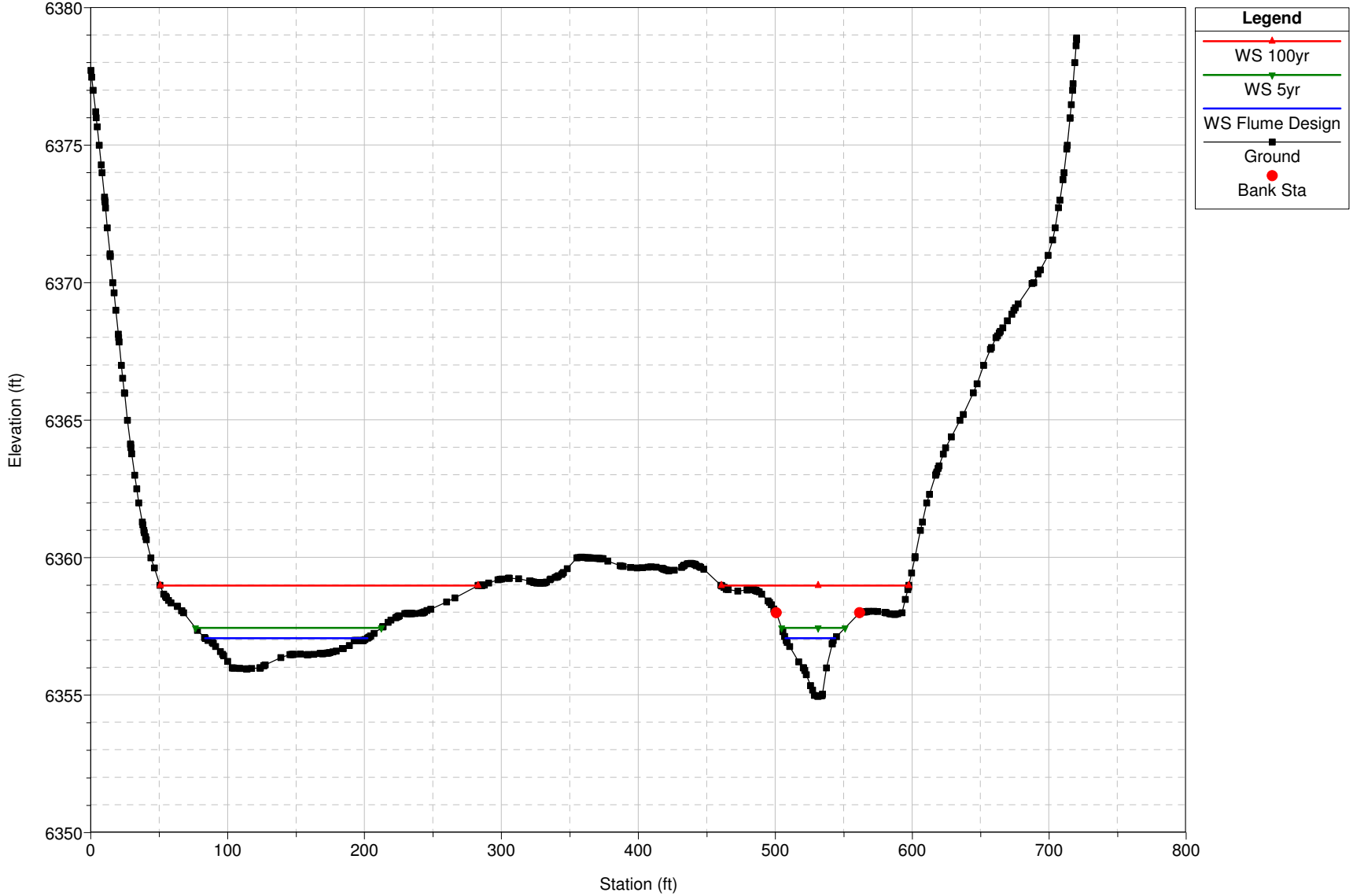

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 1253
Elevation (ft)
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

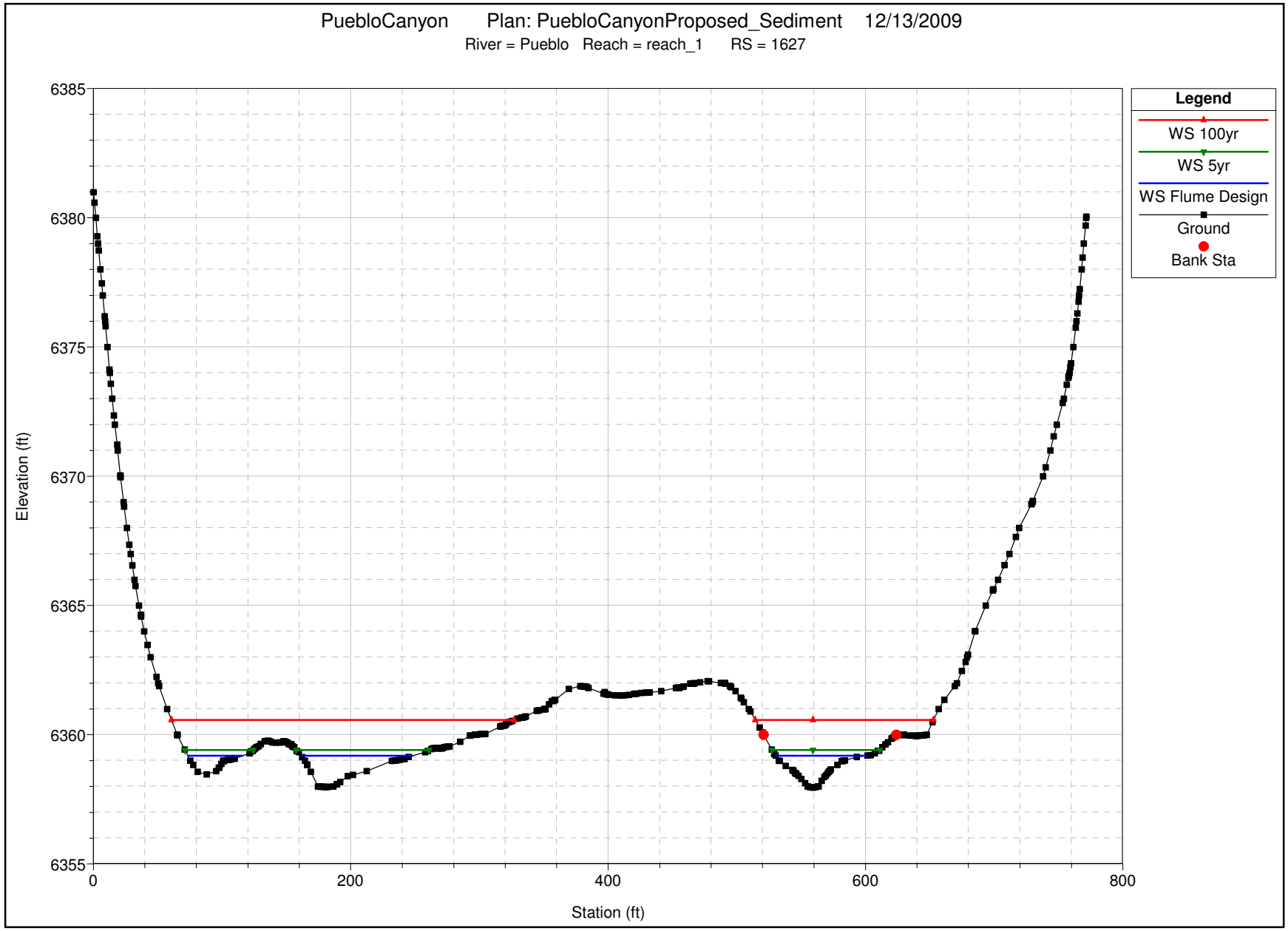

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 1328
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)

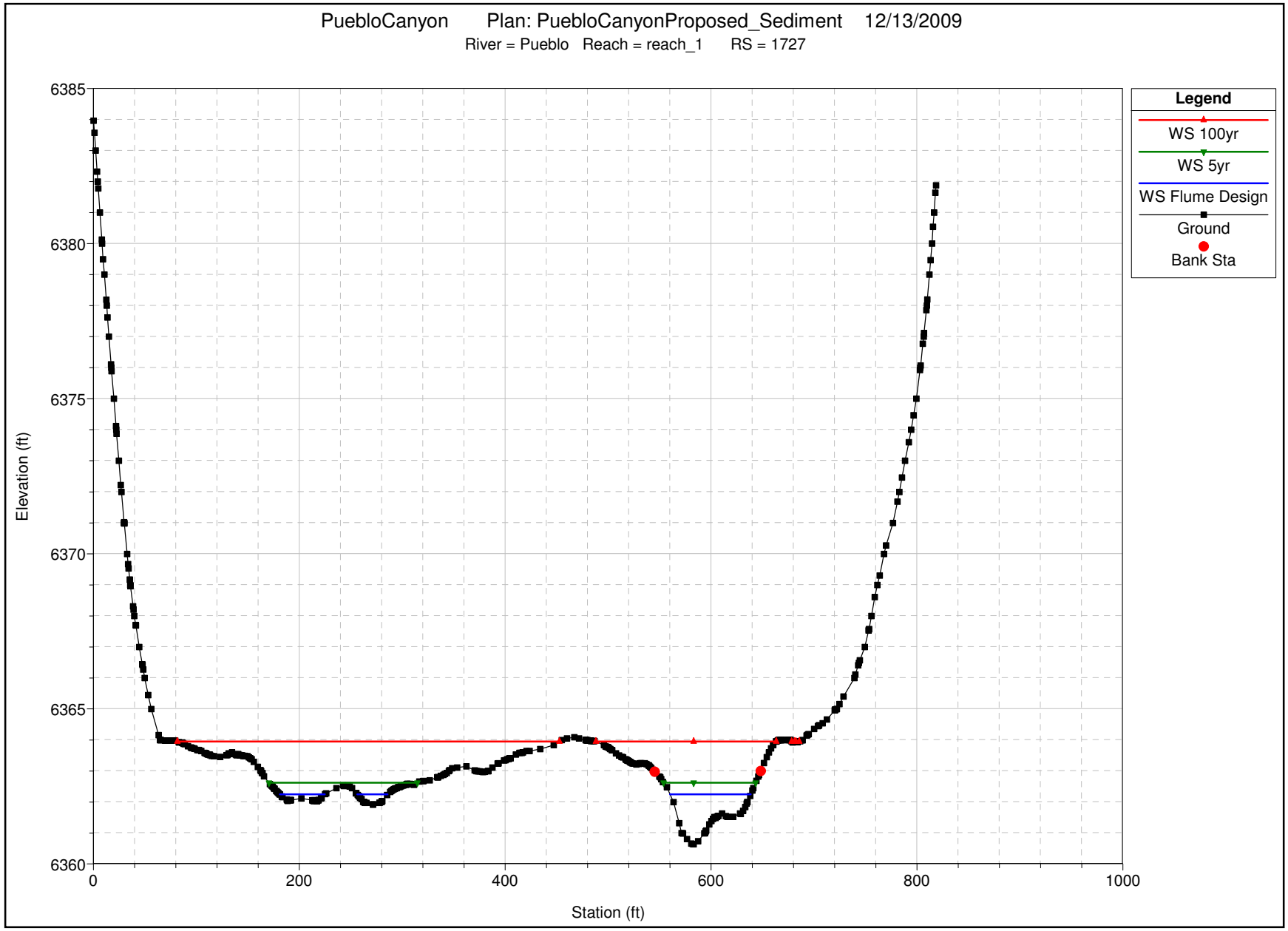

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 1427
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)

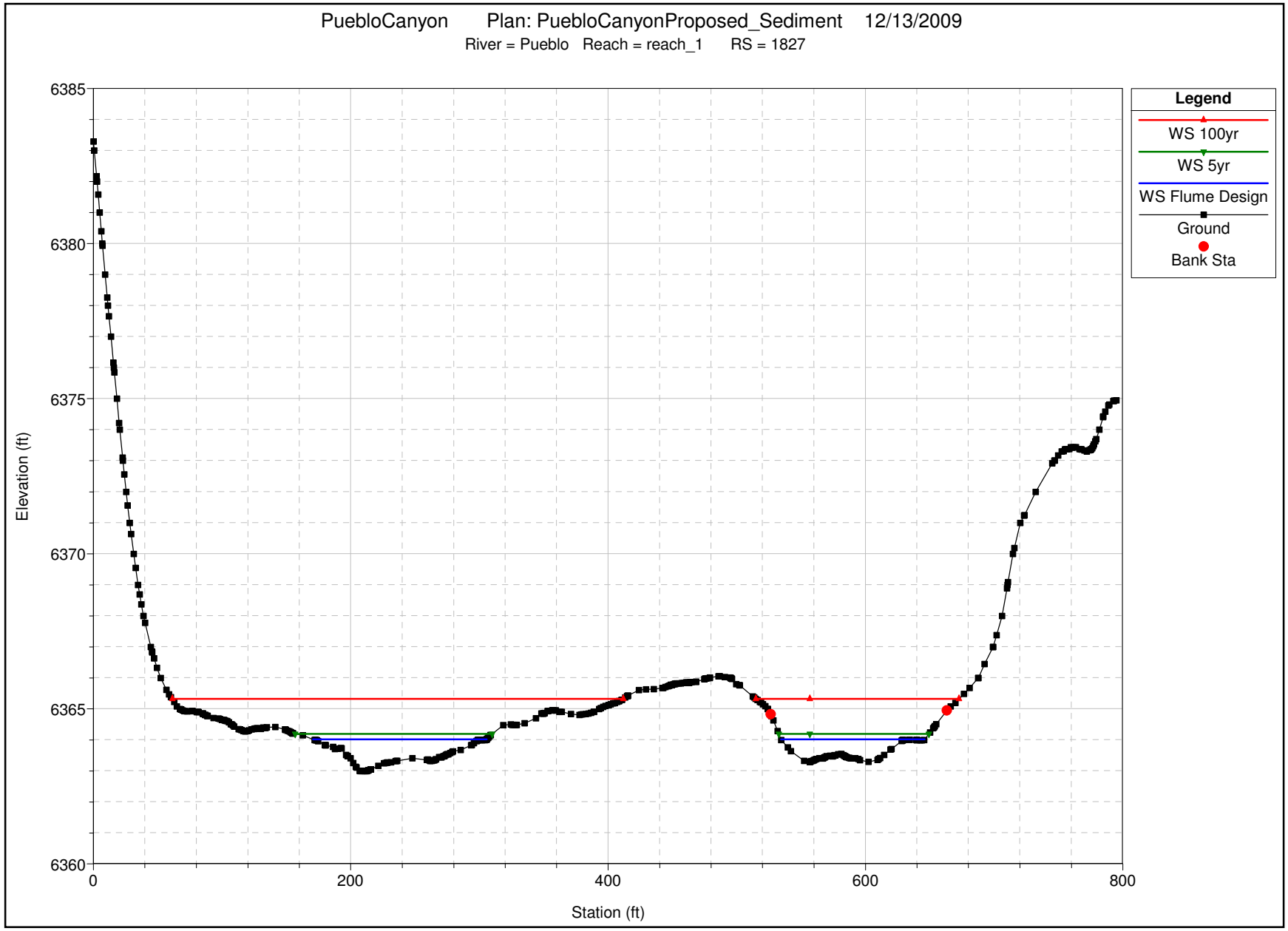
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

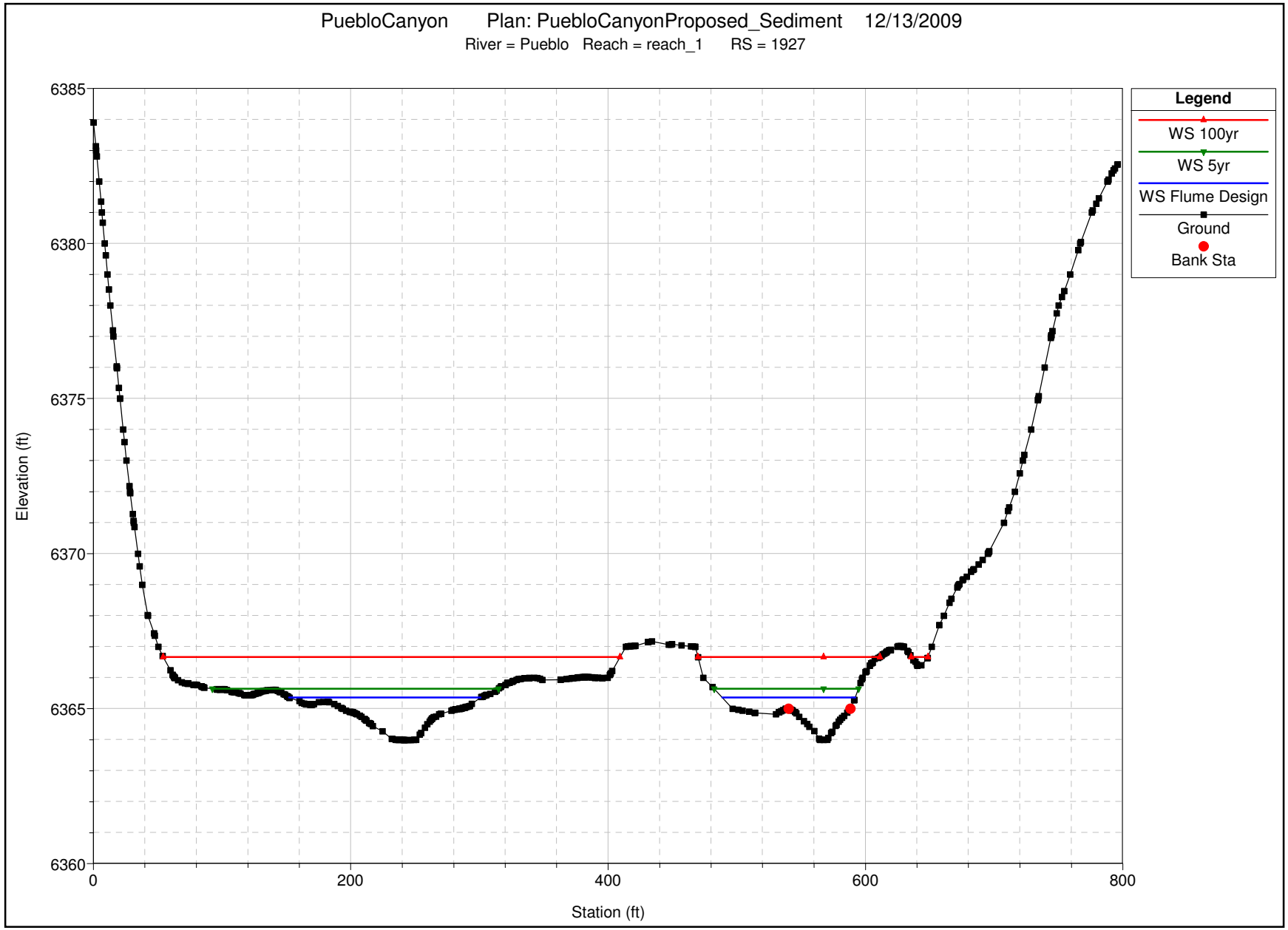
River = Pueblo Reach = reach_1 RS = 1527 coordinate at station 525 interpolated from topo




PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 1627
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
6355
0
200
400
600
800
Station (ft)

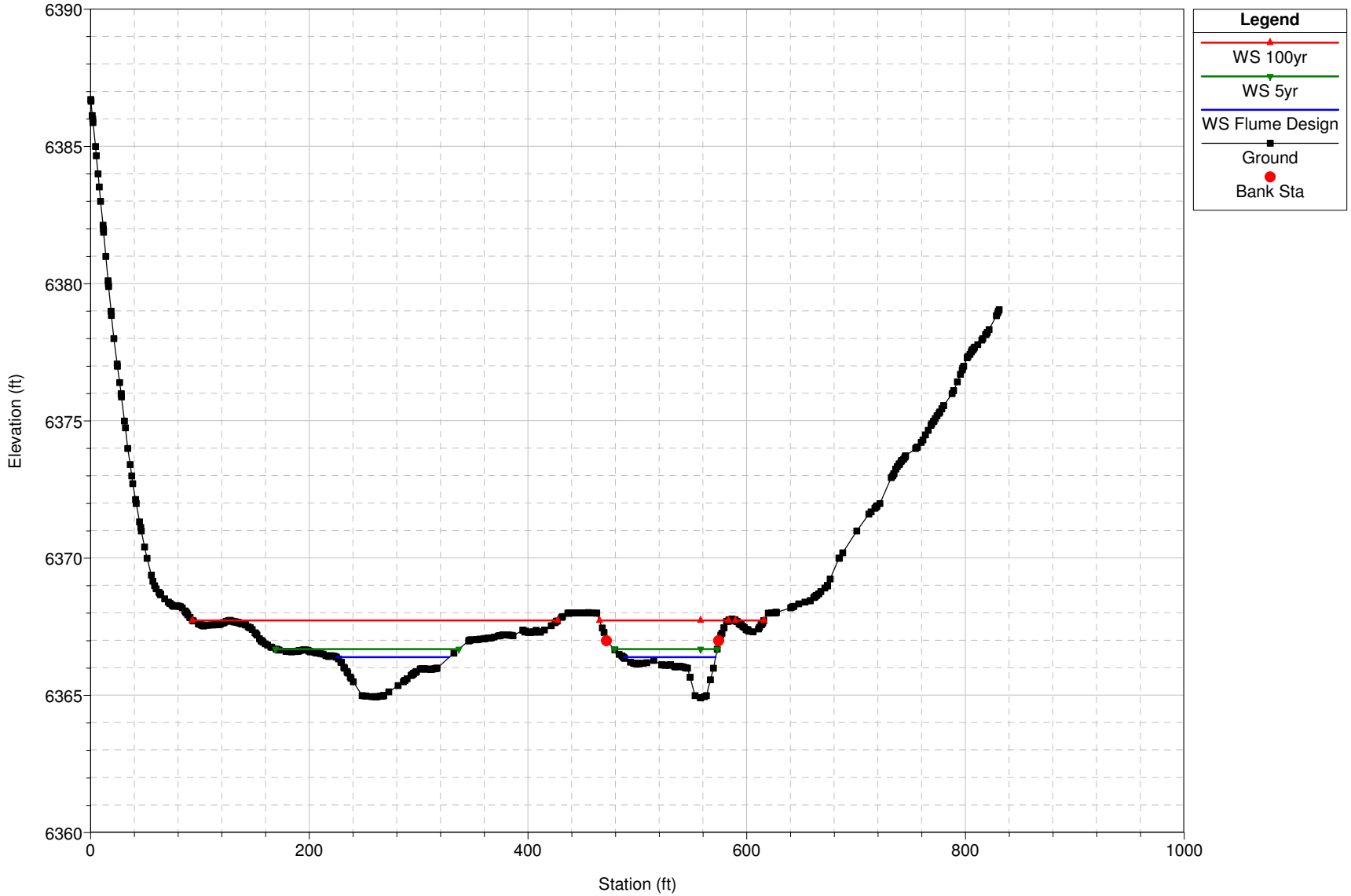

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 1727
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
1000
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 1827
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 1927
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

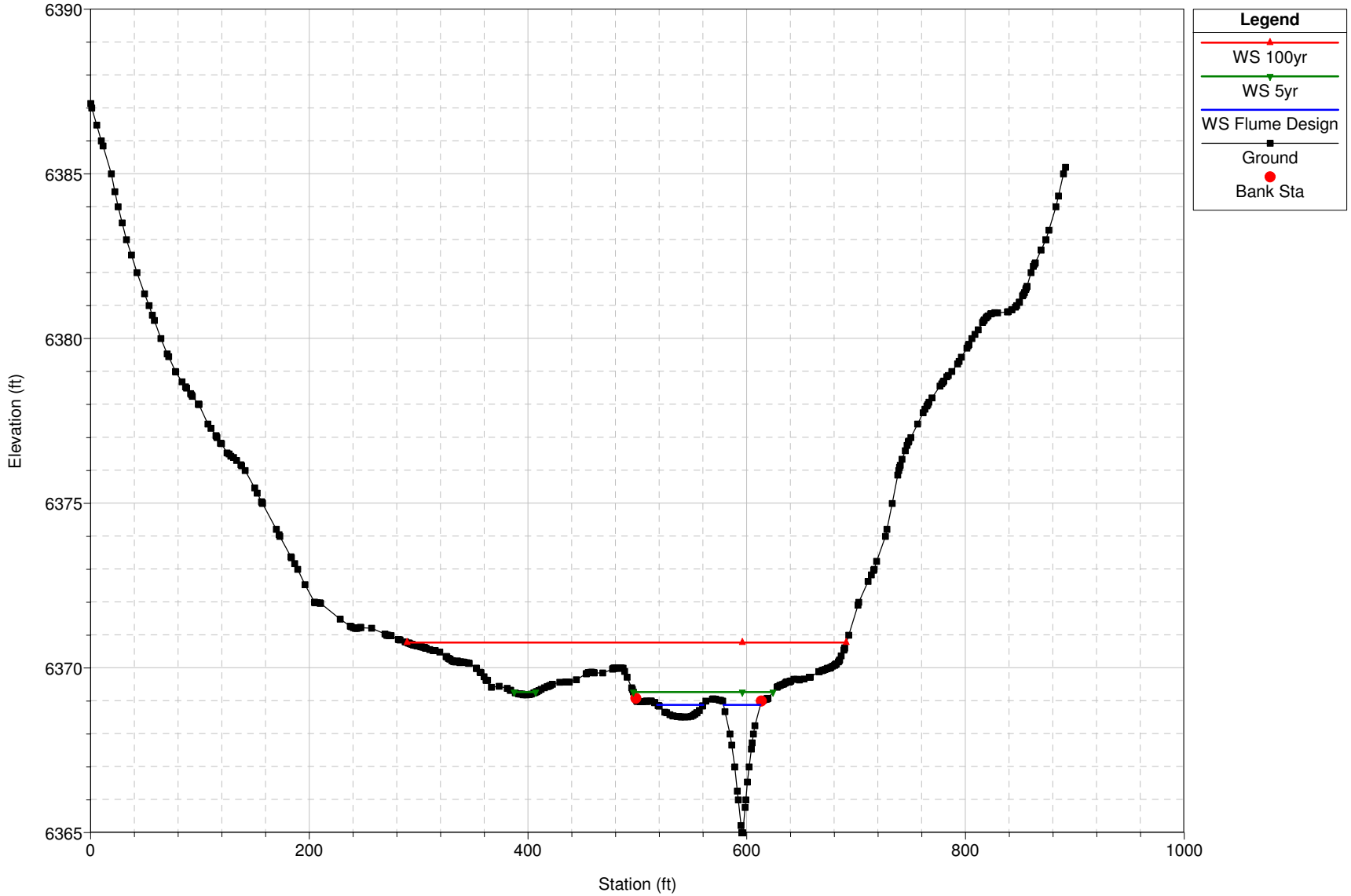
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

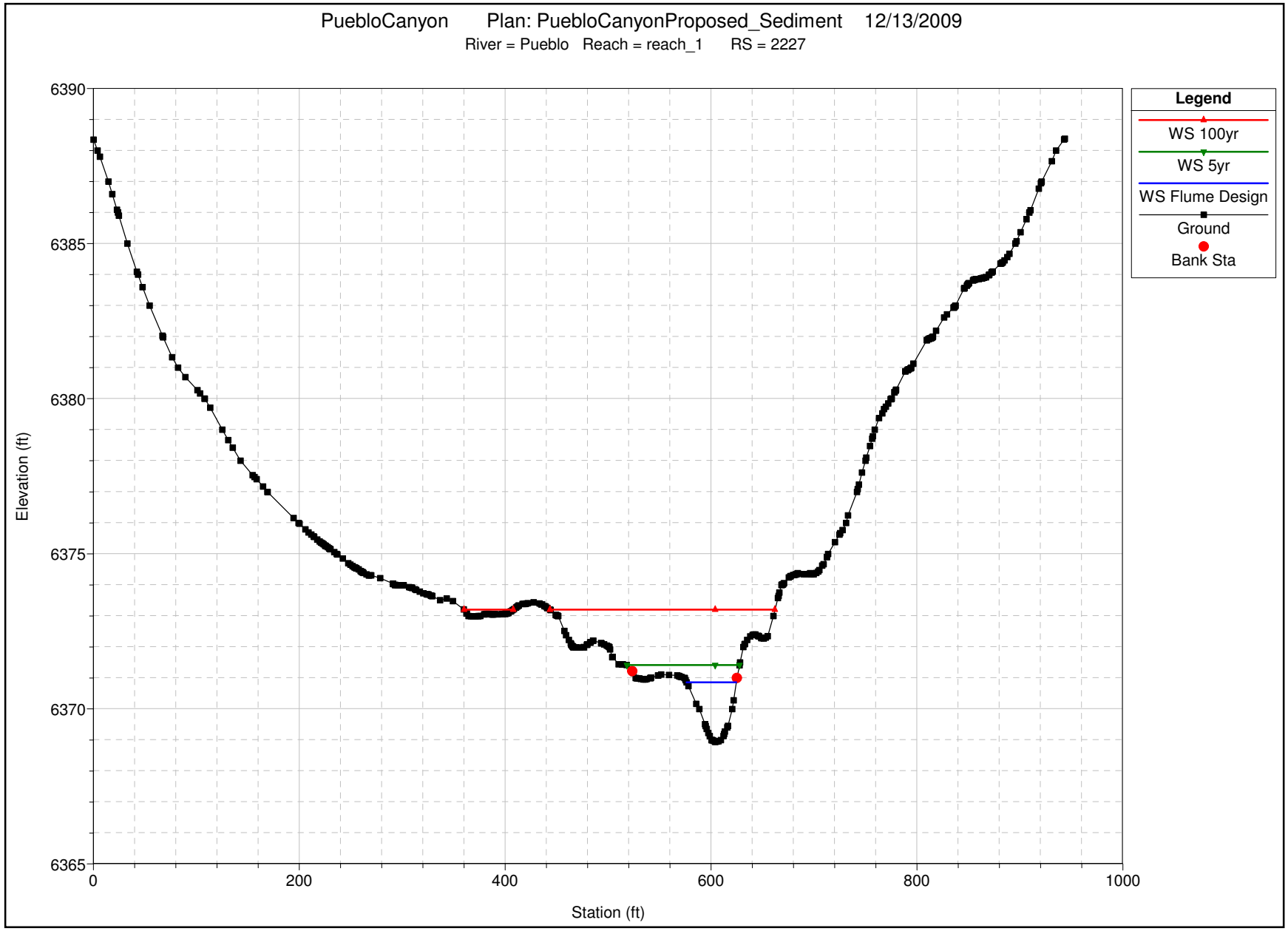
River = Pueblo Reach = reach_1 RS = 2027 coordinates at stations 491, 509, and 558 interpolated from topo

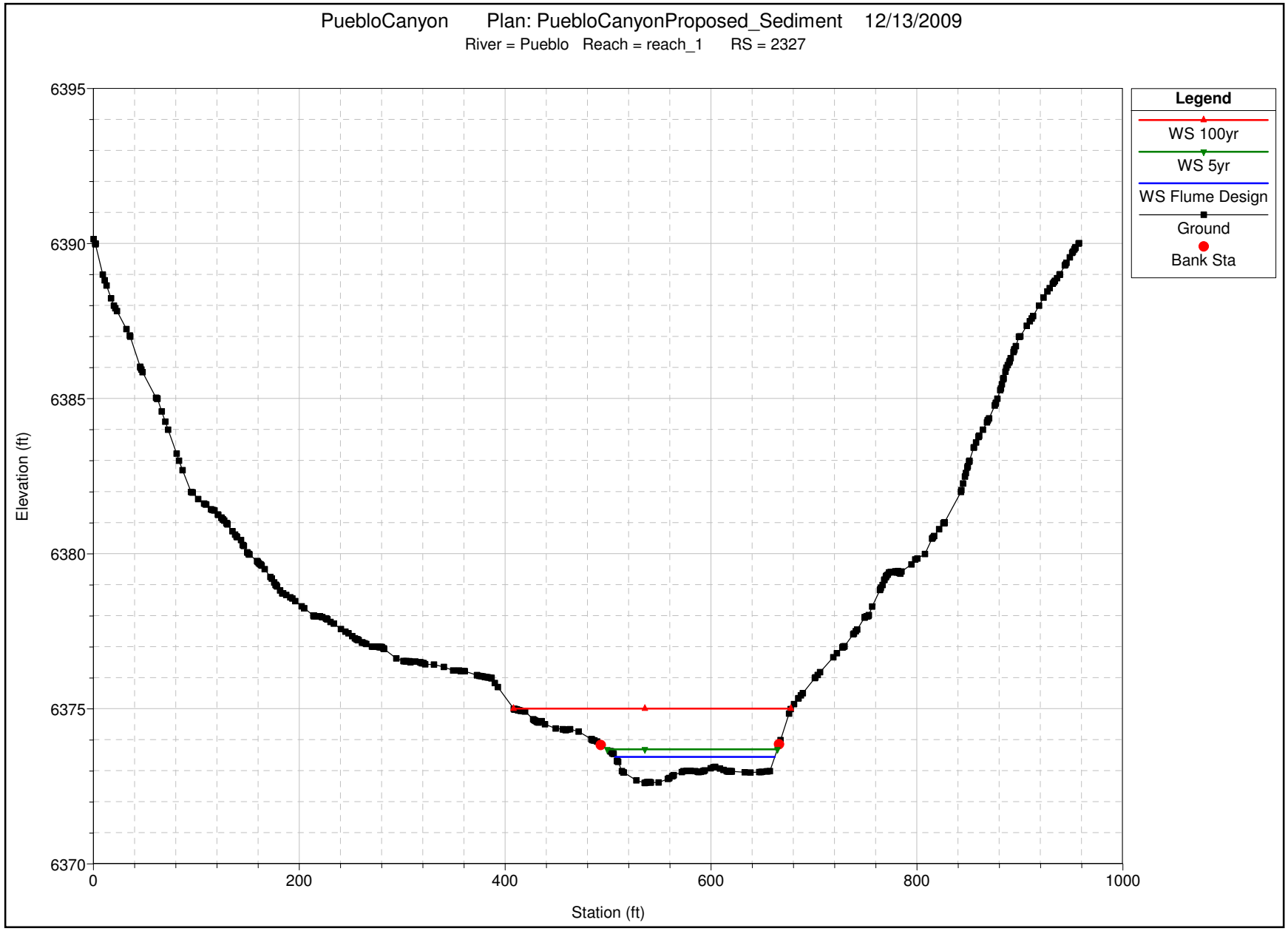


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

River = Pueblo Reach = reach_1 RS = 2127 coordinate at station 510 interpolated from topo

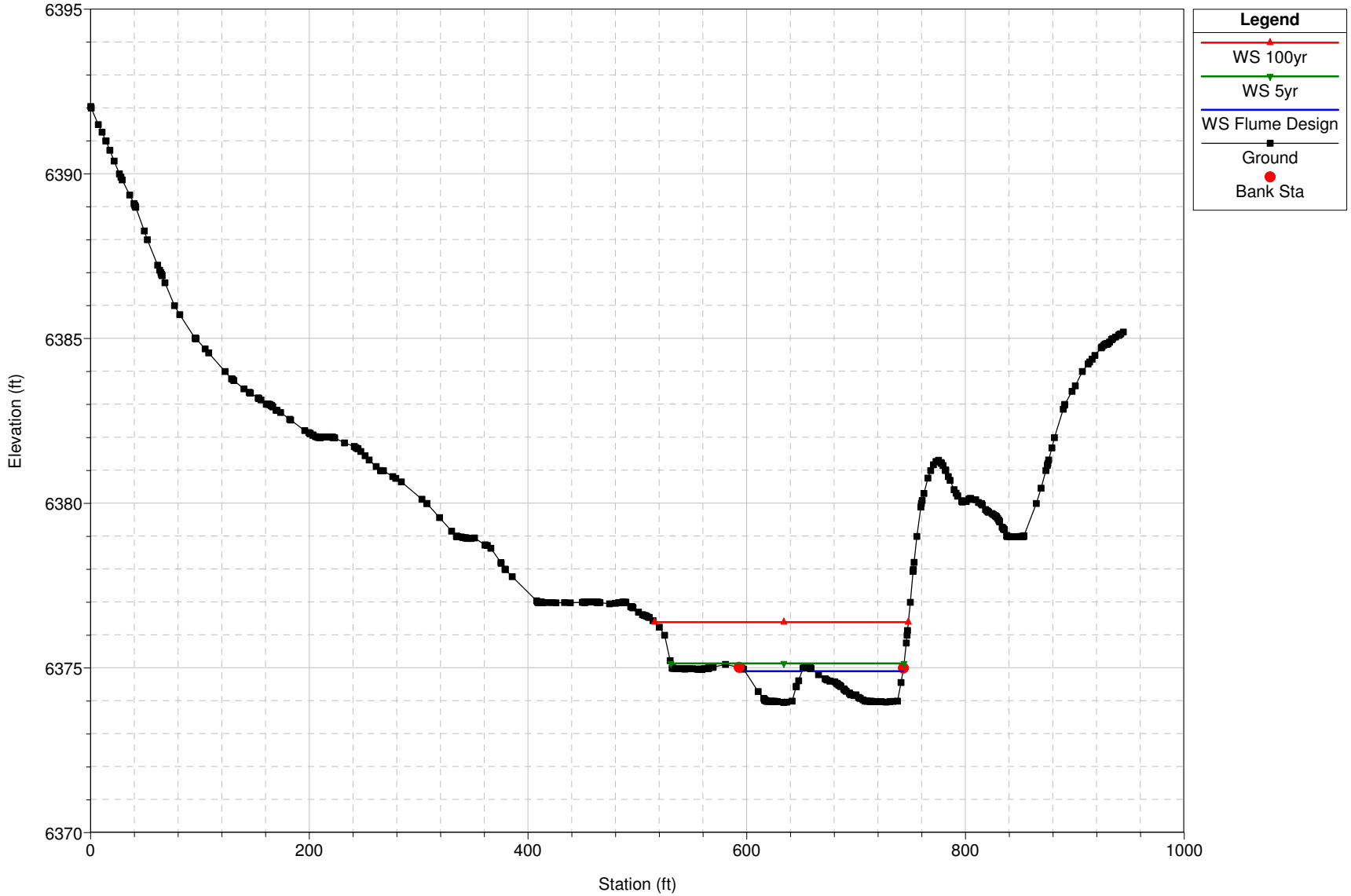


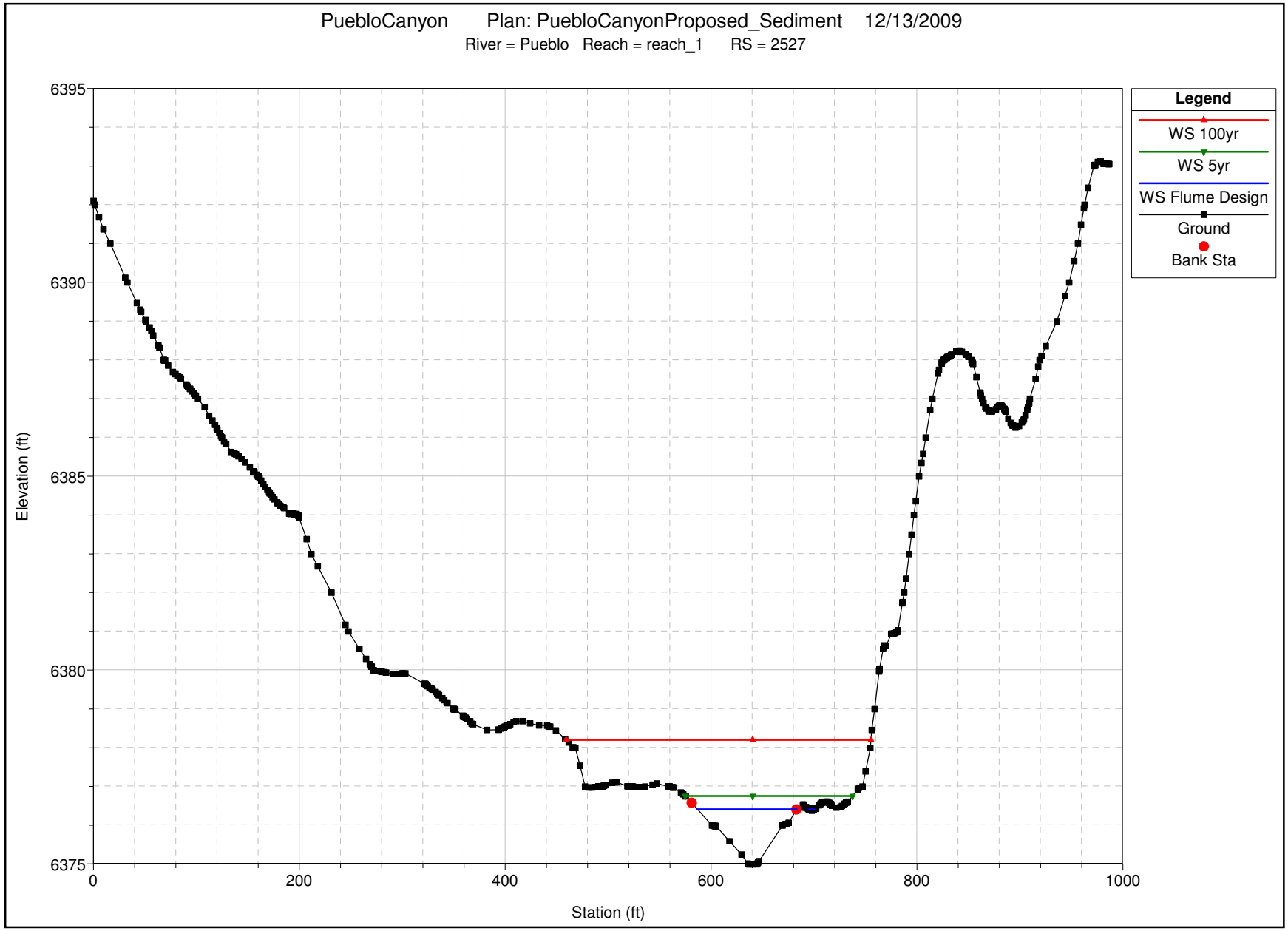

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 2227
Elevation (ft)
6390
6385
6380
6375
6370
6365
0
200
400
600
800
1000
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

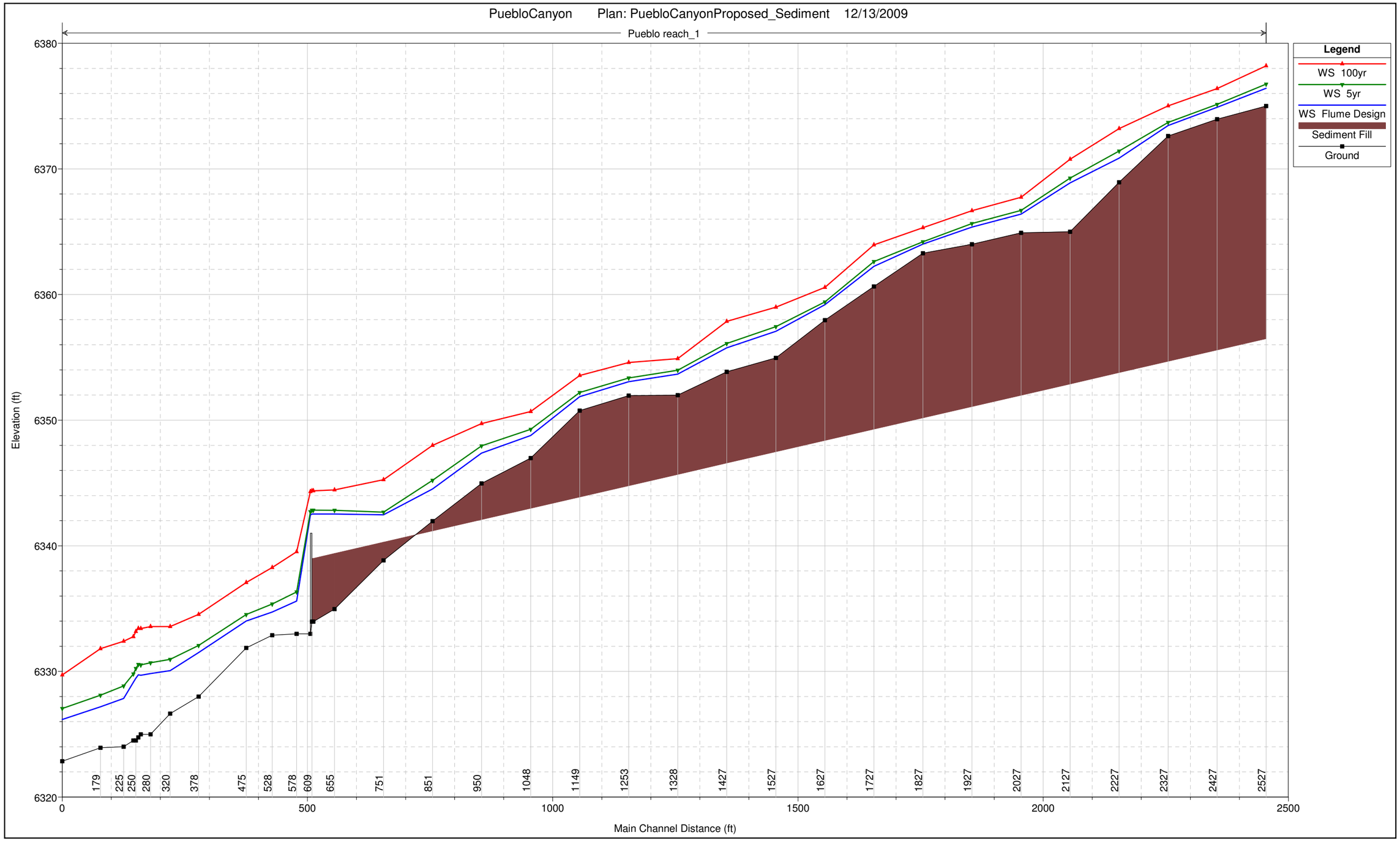

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 2327
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
6370
0
200
400
600
800
1000
Station (ft)

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009

River = Pueblo Reach = reach_1 RS = 2427 coordinate at station 745 interpolated from topo




PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
River = Pueblo Reach = reach_1 RS = 2527
Elevation (ft)
6395
6390
6385
6380
6375
0
200
400
600
800
1000
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
Pueblo reach_1
Legend
WS 100yr
WS 5yr
WS Flume Design
Sediment Fill
Ground
Elevation (ft)
6380
6370
6360
6350
6340
6330
6320
0
500
1000
1500
2000
2500
Main Channel Distance (ft)
179
225
250
280
320
378
475
528
578
609
655
751
851
950
1048
1149
1253
1328
1427
1527
1627
1727
1827
1927
2027
2127
2227
2327
2427
2527

HEC-RAS Plan: Pueblo_Prop_Sed River: Pueblo Reach: reach_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	2527	Flume Design	350.00	6375.00	6376.41	6376.41	6376.79	0.014787	4.93	71.09	100.15	1.01
reach_1	2527	5yr	593.00	6375.00	6376.76	6376.76	6377.22	0.011766	5.51	119.18	162.48	0.95
reach_1	2527	100yr	2740.00	6375.00	6378.21	6378.21	6379.13	0.008882	8.57	496.55	295.93	0.96
reach_1	2427	Flume Design	350.00	6373.96	6374.91	6374.85	6375.16	0.011953	4.05	86.33	133.12	0.89
reach_1	2427	5yr	593.00	6373.96	6375.14	6375.14	6375.51	0.013110	4.89	128.21	213.08	0.96
reach_1	2427	100yr	2740.00	6373.96	6376.40	6376.40	6377.34	0.010342	8.13	404.24	232.05	1.00
reach_1	2327	Flume Design	350.00	6372.62	6373.46	6373.46	6373.74	0.017161	4.25	82.30	155.07	1.03
reach_1	2327	5yr	593.00	6372.62	6373.70	6373.70	6374.07	0.014757	4.89	121.18	165.15	1.01
reach_1	2327	100yr	2740.00	6372.62	6375.02	6375.02	6375.90	0.009419	7.65	403.15	269.34	0.95
reach_1	2227	Flume Design	350.00	6368.94	6370.86	6370.86	6371.45	0.012625	6.17	56.69	48.30	1.00
reach_1	2227	5yr	593.00	6368.94	6371.42	6371.42	6371.92	0.012966	5.71	104.84	109.61	1.00
reach_1	2227	100yr	2740.00	6368.94	6373.21	6373.21	6374.28	0.007853	8.72	417.68	266.46	0.92
reach_1	2127	Flume Design	350.00	6365.00	6368.89	6368.89	6369.32	0.013838	5.27	66.38	76.10	0.99
reach_1	2127	5yr	593.00	6365.00	6369.27	6369.27	6369.75	0.014227	5.57	109.10	147.31	1.02
reach_1	2127	100yr	2740.00	6365.00	6370.78	6370.78	6371.58	0.008011	7.96	557.57	401.56	0.90
reach_1	2027	Flume Design	350.00	6364.92	6366.40	6366.22	6366.55	0.015775	3.85	124.17	187.31	0.97
reach_1	2027	5yr	593.00	6364.92	6366.70	6366.39	6366.94	0.015192	4.90	190.29	261.98	1.02
reach_1	2027	100yr	2740.00	6364.92	6367.74	6367.70	6368.60	0.017621	9.33	553.16	478.41	1.26
reach_1	1927	Flume Design	350.00	6364.00	6365.36		6365.55	0.010057	4.51	153.65	252.04	0.85
reach_1	1927	5yr	593.00	6364.00	6365.65		6365.91	0.010440	5.55	235.13	334.55	0.91
reach_1	1927	100yr	2740.00	6364.00	6366.67	6366.67	6367.30	0.013553	9.67	689.07	509.44	1.16
reach_1	1827	Flume Design	350.00	6363.29	6364.02	6363.96	6364.21	0.021802	4.24	119.11	246.51	1.12
reach_1	1827	5yr	593.00	6363.29	6364.20	6364.16	6364.50	0.023093	5.33	164.51	269.75	1.22
reach_1	1827	100yr	2740.00	6363.29	6365.32	6365.32	6365.95	0.013566	7.83	611.98	508.07	1.10
reach_1	1727	Flume Design	350.00	6360.64	6362.25	6362.25	6362.62	0.011858	4.94	81.94	151.73	0.93
reach_1	1727	5yr	593.00	6360.64	6362.63	6362.63	6363.03	0.010019	5.34	153.00	233.77	0.89
reach_1	1727	100yr	2740.00	6360.64	6363.95	6363.95	6364.69	0.009089	8.15	650.72	551.89	0.95
reach_1	1627	Flume Design	350.00	6357.96	6359.20	6359.20	6359.46	0.025264	5.16	106.50	200.24	1.25
reach_1	1627	5yr	593.00	6357.96	6359.41	6359.41	6359.78	0.026995	6.10	154.14	239.99	1.33
reach_1	1627	100yr	2740.00	6357.96	6360.57	6360.57	6361.32	0.016715	8.87	547.24	404.71	1.22
reach_1	1527	Flume Design	350.00	6354.96	6357.08	6357.08	6357.42	0.011859	5.69	113.30	155.04	0.96
reach_1	1527	5yr	593.00	6354.96	6357.45	6357.38	6357.80	0.012020	6.07	175.48	181.85	0.98
reach_1	1527	100yr	2740.00	6354.96	6358.99	6358.86	6359.72	0.011119	9.27	594.77	368.98	1.06
reach_1	1427	Flume Design	350.00	6353.85	6355.76	6355.76	6356.15	0.011470	5.56	94.77	124.22	0.94
reach_1	1427	5yr	593.00	6353.85	6356.10	6356.10	6356.61	0.011718	6.53	146.40	169.26	0.99
reach_1	1427	100yr	2740.00	6353.85	6357.86	6357.86	6358.74	0.008699	9.82	637.16	444.45	0.98
reach_1	1328	Flume Design	350.00	6351.99	6353.67	6353.49	6353.90	0.013291	5.03	112.05	125.84	0.97
reach_1	1328	5yr	593.00	6351.99	6353.98	6353.81	6354.33	0.015483	6.18	153.04	143.72	1.08
reach_1	1328	100yr	2740.00	6351.99	6354.90	6354.90	6356.88	0.039189	15.08	345.35	254.24	1.92
reach_1	1253	Flume Design	350.00	6351.96	6353.07		6353.16	0.005419	2.85	164.52	203.84	0.60
reach_1	1253	5yr	593.00	6351.96	6353.35		6353.50	0.005684	3.68	228.30	240.93	0.66
reach_1	1253	100yr	2740.00	6351.96	6354.59		6355.18	0.008161	7.59	653.60	468.81	0.90
reach_1	1149	Flume Design	350.00	6350.76	6351.87	6351.87	6352.22	0.020126	5.56	93.42	138.27	1.17
reach_1	1149	5yr	593.00	6350.76	6352.20	6352.20	6352.60	0.016441	6.12	154.87	233.79	1.11
reach_1	1149	100yr	2740.00	6350.76	6353.55	6353.55	6354.26	0.011123	9.09	648.39	460.08	1.06
reach_1	1048	Flume Design	350.00	6346.99	6348.78		6348.89	0.007019	3.53	152.35	144.85	0.70
reach_1	1048	5yr	593.00	6346.99	6349.27		6349.40	0.006115	3.84	234.02	214.18	0.68
reach_1	1048	100yr	2740.00	6346.99	6350.69		6351.10	0.007731	7.46	796.67	482.41	0.87
reach_1	950	Flume Design	350.00	6344.97	6347.39	6347.39	6348.00	0.011075	6.31	59.63	63.51	0.95
reach_1	950	5yr	593.00	6344.97	6347.96	6347.96	6348.64	0.008979	6.89	118.52	130.69	0.90
reach_1	950	100yr	2740.00	6344.97	6349.73	6349.73	6350.41	0.006199	9.01	787.97	488.93	0.84
reach_1	851	Flume Design	350.00	6341.96	6344.52	6344.52	6345.27	0.012005	6.91	50.64	34.79	1.01
reach_1	851	5yr	593.00	6341.96	6345.22	6345.22	6346.13	0.010992	7.66	77.45	42.70	1.00
reach_1	851	100yr	2740.00	6341.96	6348.00	6348.00	6348.92	0.004989	9.02	679.47	472.91	0.78
reach_1	751	Flume Design	350.00	6340.29	6342.48		6342.69	0.002413	3.70	94.68	49.83	0.47
reach_1	751	5yr	593.00	6340.29	6342.68		6343.17	0.005091	5.65	105.26	61.07	0.70
reach_1	751	100yr	2740.00	6340.29	6345.27	6345.27	6346.22	0.004605	8.68	612.95	411.31	0.74

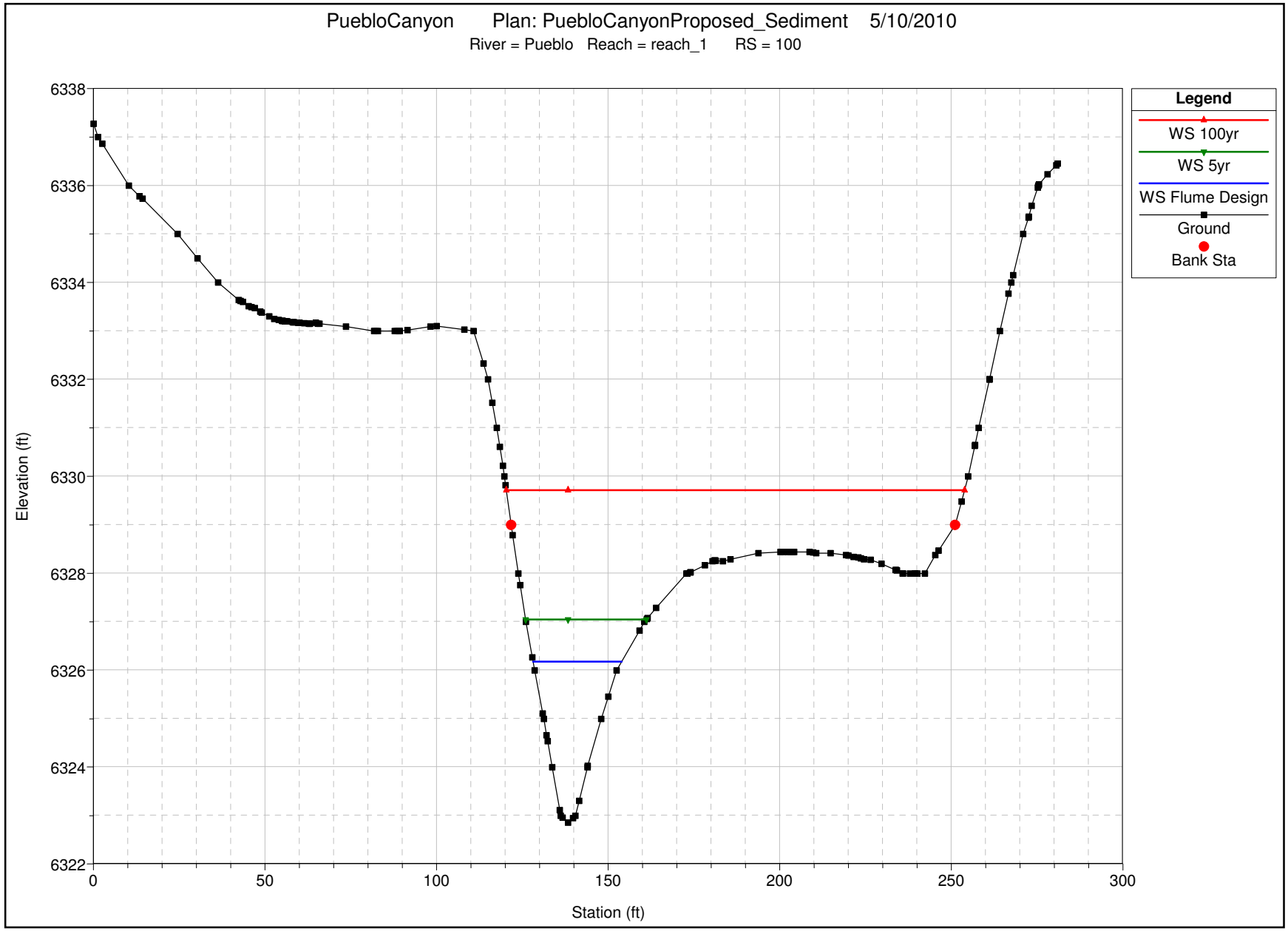
HEC-RAS Plan: Pueblo_Prop_Sed River: Pueblo Reach: reach_1 (Continued)

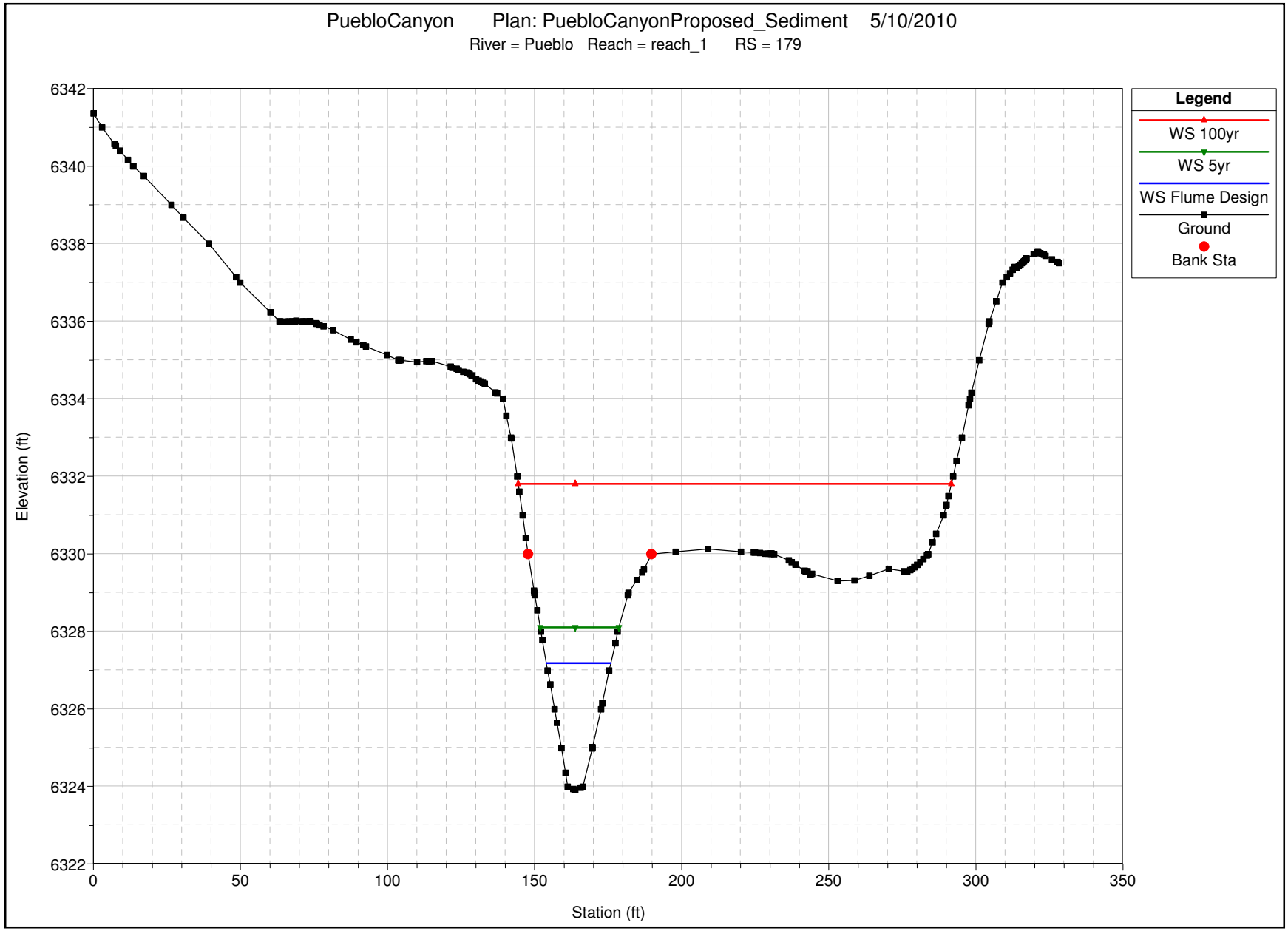
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	655	Flume Design	350.00	6339.39	6342.53	6340.43	6342.58	0.000273	1.74	249.89	235.86	0.17
reach_1	655	5yr	593.00	6339.39	6342.83	6340.85	6342.93	0.000546	2.62	312.18	278.22	0.25
reach_1	655	100yr	2740.00	6339.39	6344.45	6343.53	6344.99	0.002130	6.70	722.27	478.91	0.53
reach_1	612	Flume Design	350.00	6339.00	6342.53	6340.06	6342.56	0.000168	1.48	345.55	316.78	0.14
reach_1	612	5yr	593.00	6339.00	6342.84	6340.49	6342.90	0.000345	2.24	396.40	337.20	0.20
reach_1	612	100yr	2740.00	6339.00	6344.38	6342.98	6344.90	0.001901	6.60	655.05	443.10	0.50
reach_1	609		Inl Struct									
reach_1	578	Flume Design	350.00	6333.00	6335.60	6335.60	6336.40	0.011761	7.15	48.92	31.30	1.01
reach_1	578	5yr	593.00	6333.00	6336.33	6336.33	6337.33	0.010870	8.04	73.79	37.30	1.01
reach_1	578	100yr	2740.00	6333.00	6339.53	6339.53	6341.38	0.008599	10.90	252.92	72.26	1.00
reach_1	528	Flume Design	350.00	6332.88	6334.73	6334.73	6335.45	0.011980	6.81	51.42	36.12	1.01
reach_1	528	5yr	593.00	6332.88	6335.37	6335.37	6336.32	0.011135	7.81	75.95	40.98	1.01
reach_1	528	100yr	2740.00	6332.88	6338.27	6338.27	6340.13	0.008545	10.95	255.39	76.17	0.99
reach_1	475	Flume Design	350.00	6331.88	6334.02	6334.02	6334.61	0.012920	6.19	56.50	48.67	1.01
reach_1	475	5yr	593.00	6331.88	6334.53	6334.53	6335.33	0.011744	7.15	82.93	53.50	1.01
reach_1	475	100yr	2740.00	6331.88	6337.08	6337.08	6338.46	0.009557	9.44	291.17	109.03	1.00
reach_1	378	Flume Design	350.00	6328.00	6331.50	6331.50	6332.12	0.013055	6.30	55.54	46.10	1.01
reach_1	378	5yr	593.00	6328.00	6332.08	6332.08	6332.81	0.012022	6.89	86.08	58.99	1.00
reach_1	378	100yr	2740.00	6328.00	6334.55	6334.55	6336.04	0.009439	9.80	280.98	99.67	1.00
reach_1	320	Flume Design	350.00	6326.65	6330.06		6330.30	0.003662	3.93	89.01	58.23	0.56
reach_1	320	5yr	593.00	6326.65	6330.97		6331.23	0.002357	4.12	143.85	62.72	0.48
reach_1	320	100yr	2740.00	6326.65	6333.57		6334.59	0.003705	8.23	393.13	137.45	0.67
reach_1	280	Flume Design	350.00	6325.00	6329.83		6330.15	0.003582	4.54	77.16	38.09	0.56
reach_1	280	5yr	593.00	6325.00	6330.69		6331.09	0.004147	5.09	116.41	54.72	0.62
reach_1	280	100yr	2740.00	6325.00	6333.58		6334.39	0.003324	7.87	510.21	158.98	0.63
reach_1	260	Flume Design	350.00	6325.00	6329.70		6330.06	0.004311	4.83	72.40	37.36	0.61
reach_1	260	5yr	593.00	6325.00	6330.52		6330.99	0.004960	5.51	107.59	51.27	0.67
reach_1	260	100yr	2740.00	6325.00	6333.41		6334.31	0.003820	8.24	483.73	158.18	0.67
reach_1	255	Flume Design	350.00	6324.75	6329.74		6330.02	0.002903	4.27	81.93	37.59	0.51
reach_1	255	5yr	593.00	6324.75	6330.56		6330.95	0.003787	5.05	117.49	51.99	0.59
reach_1	255	100yr	2740.00	6324.75	6333.42		6334.28	0.003508	8.04	493.62	158.23	0.65
reach_1	250	Flume Design	350.00	6324.50	6329.46	6329.14	6329.98	0.007256	5.77	60.66	35.47	0.78
reach_1	250	5yr	593.00	6324.50	6330.24	6329.81	6330.90	0.007299	6.51	91.08	45.00	0.81
reach_1	250	100yr	2740.00	6324.50	6333.19		6334.23	0.004783	8.86	445.56	157.11	0.75
reach_1	245	Flume Design	350.00	6324.50	6329.14	6329.14	6329.91	0.012851	7.03	49.82	33.25	1.01
reach_1	245	5yr	593.00	6324.50	6329.81	6329.81	6330.82	0.011973	8.06	73.55	37.96	1.02
reach_1	245	100yr	2740.00	6324.50	6332.77	6332.77	6334.17	0.007075	10.09	381.31	155.02	0.89
reach_1	225	Flume Design	350.00	6324.01	6327.85	6327.85	6328.77	0.011861	7.69	45.50	25.28	1.01
reach_1	225	5yr	593.00	6324.01	6328.85	6328.68	6329.85	0.009036	8.02	73.91	31.39	0.92
reach_1	225	100yr	2740.00	6324.01	6332.40	6332.40	6333.88	0.006684	10.16	357.49	153.06	0.88
reach_1	179	Flume Design	350.00	6323.92	6327.19	6327.19	6328.20	0.011346	8.04	43.51	21.92	1.01
reach_1	179	5yr	593.00	6323.92	6328.11	6328.11	6329.37	0.010641	8.99	65.97	26.73	1.01
reach_1	179	100yr	2740.00	6323.92	6331.81	6331.81	6333.31	0.006160	10.84	406.33	147.18	0.86
reach_1	100	Flume Design	350.00	6322.86	6326.18	6326.18	6327.09	0.011668	7.64	45.79	25.82	1.01
reach_1	100	5yr	593.00	6322.86	6327.05	6327.05	6328.10	0.011019	8.21	72.25	35.21	1.01
reach_1	100	100yr	2740.00	6322.86	6329.72	6329.72	6330.94	0.010235	8.87	310.23	133.51	1.01

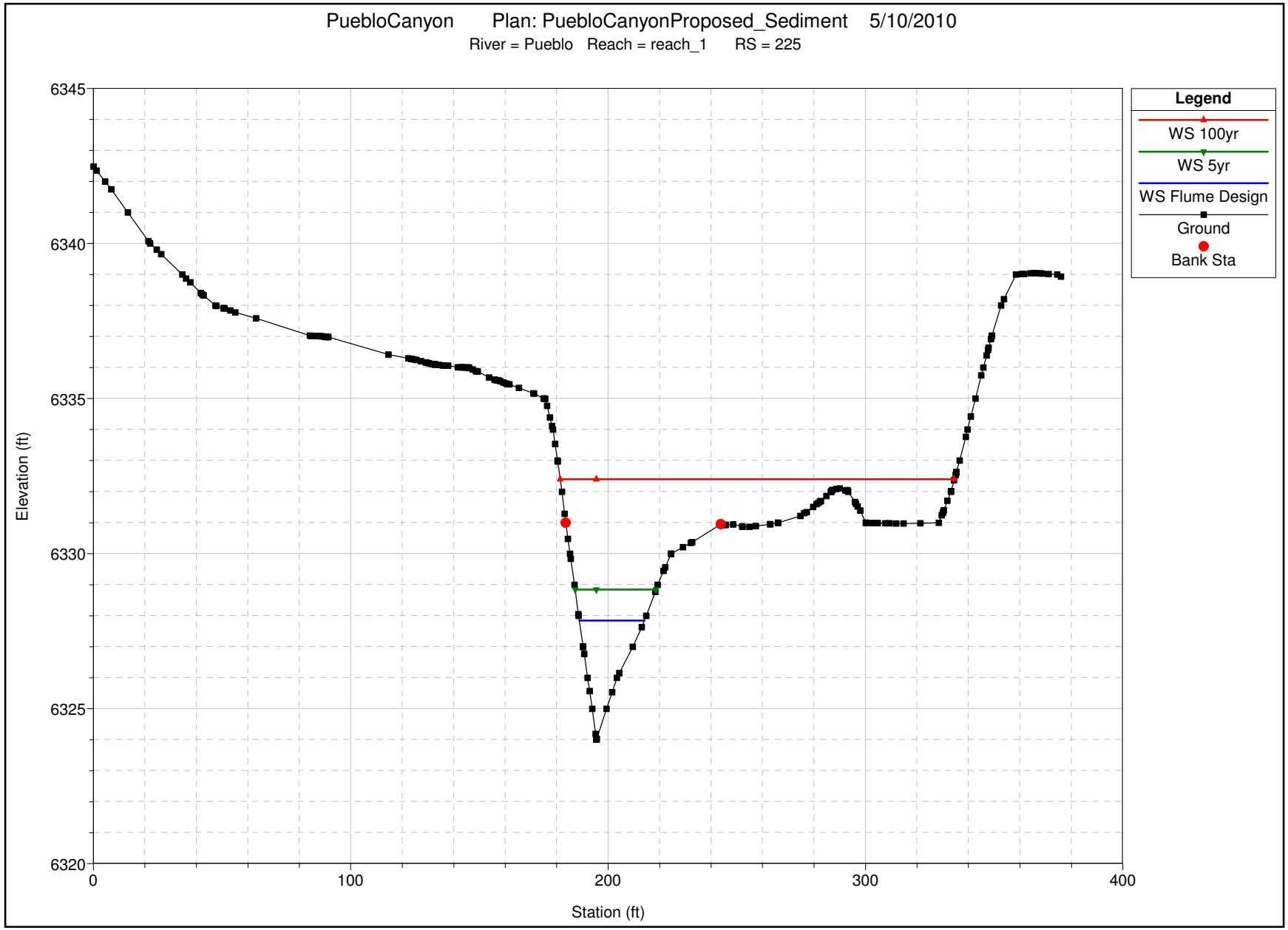
Proposed Conditions
With Sediment

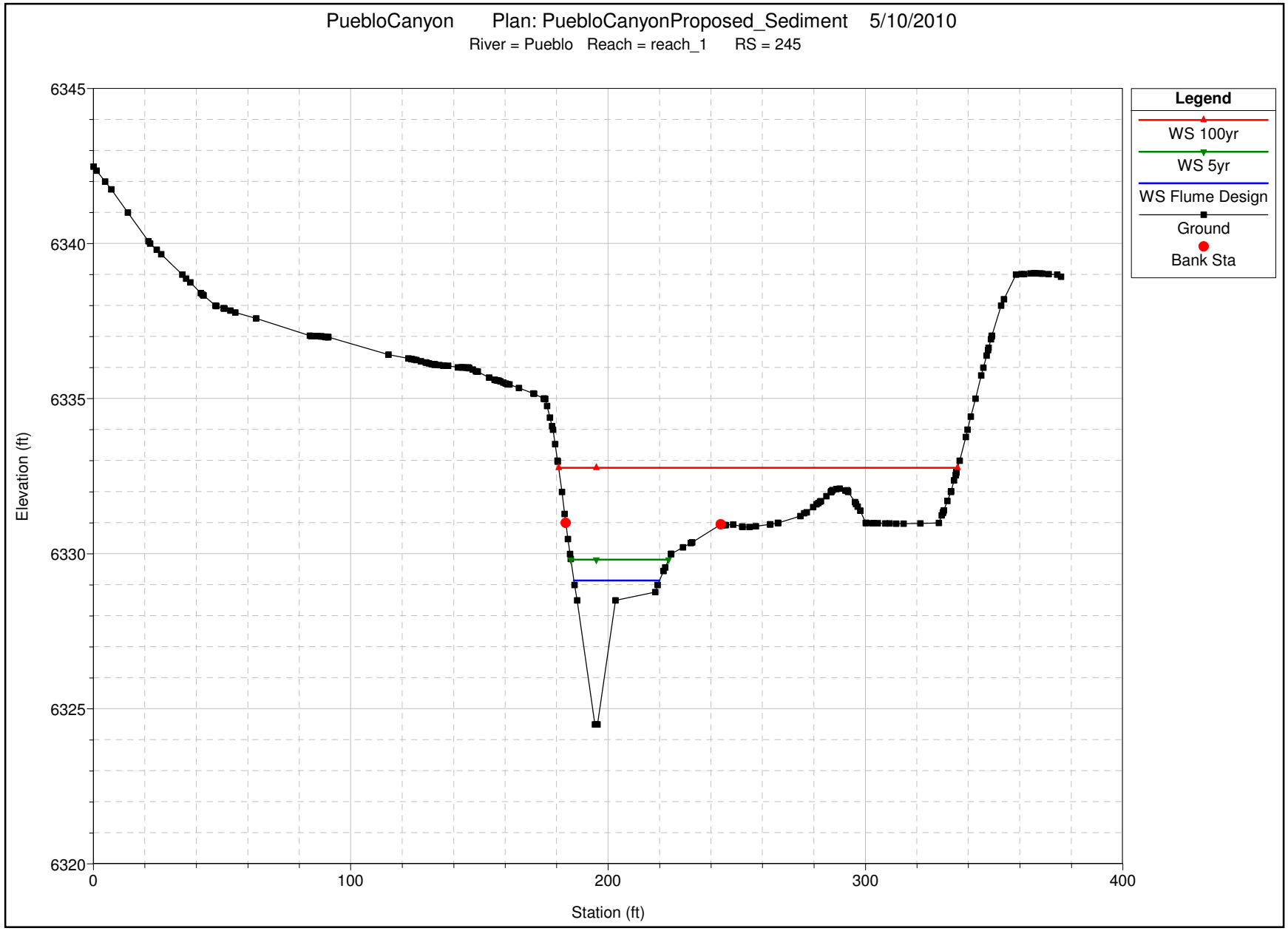
Starting Sediment Elevation 6341 at RS 612

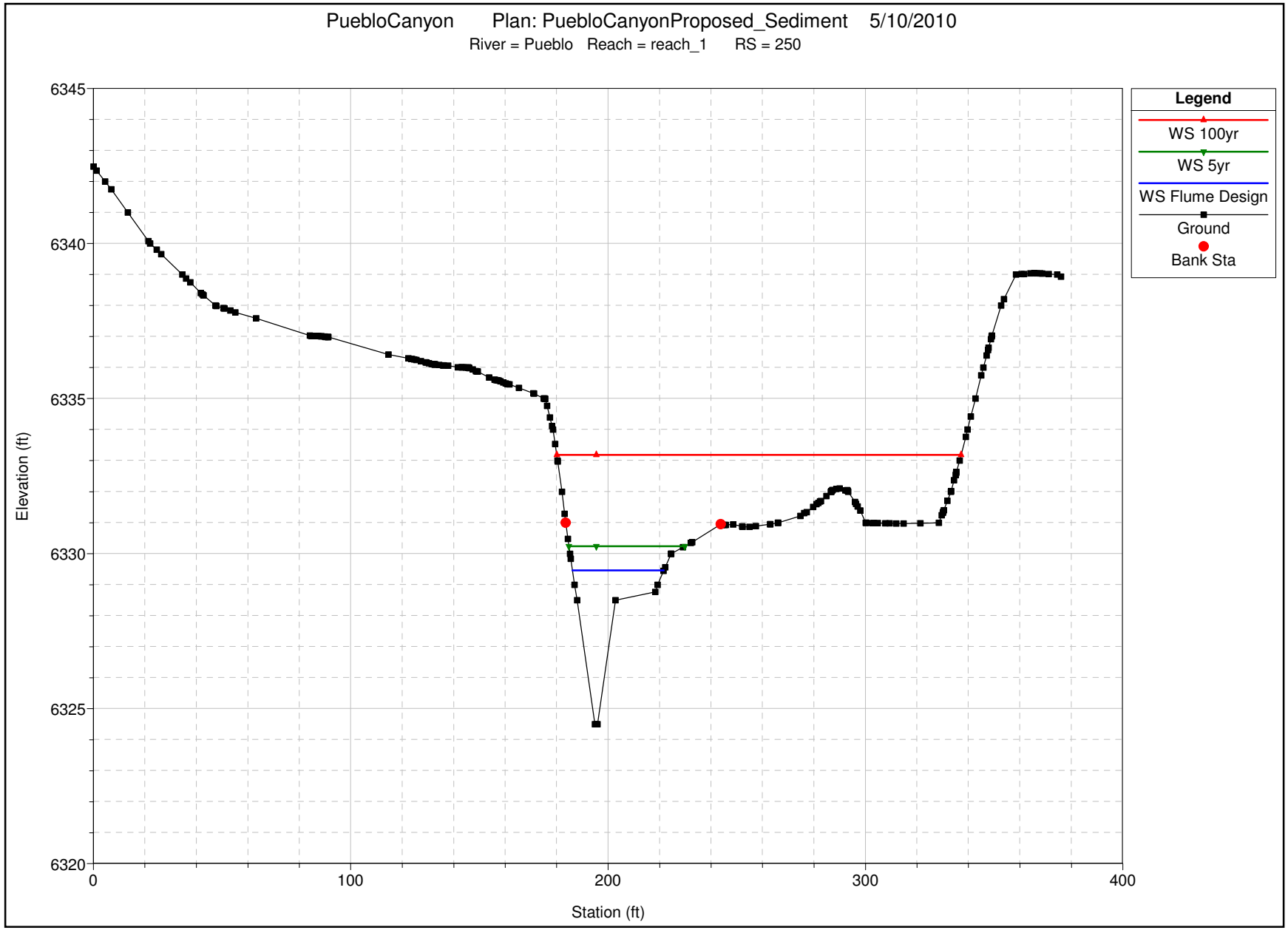
2527
2427
2327
2227
2127
reach_1
2027
1827
Pueblo
1627
1527
1427
1328
1048
851
751
578
320
280
100
179

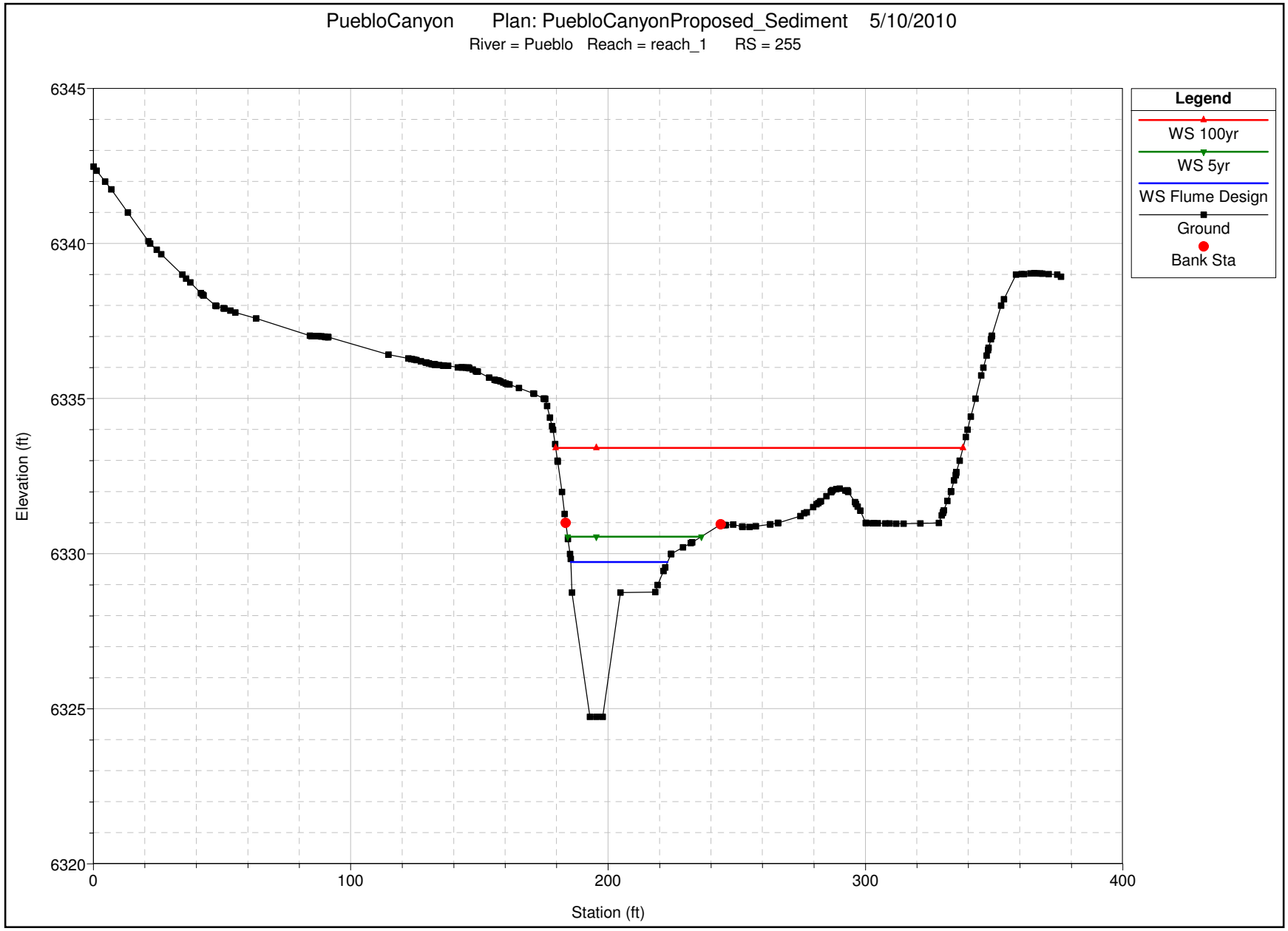

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 100
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6338
6336
6334
6332
6330
6328
6326
6324
6322
0
50
100
150
200
250
300

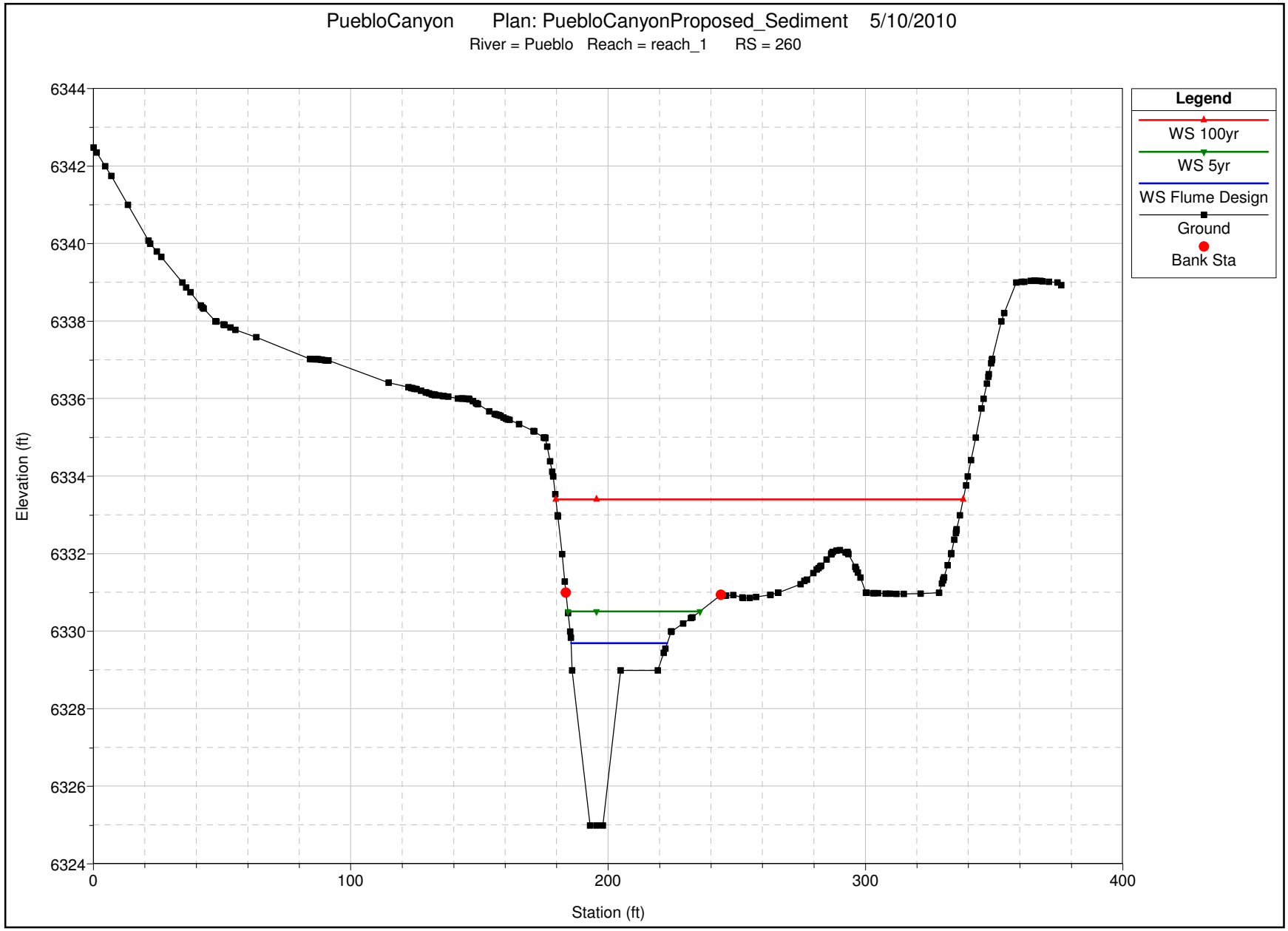

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 179
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
6322
0
50
100
150
200
250
300
350

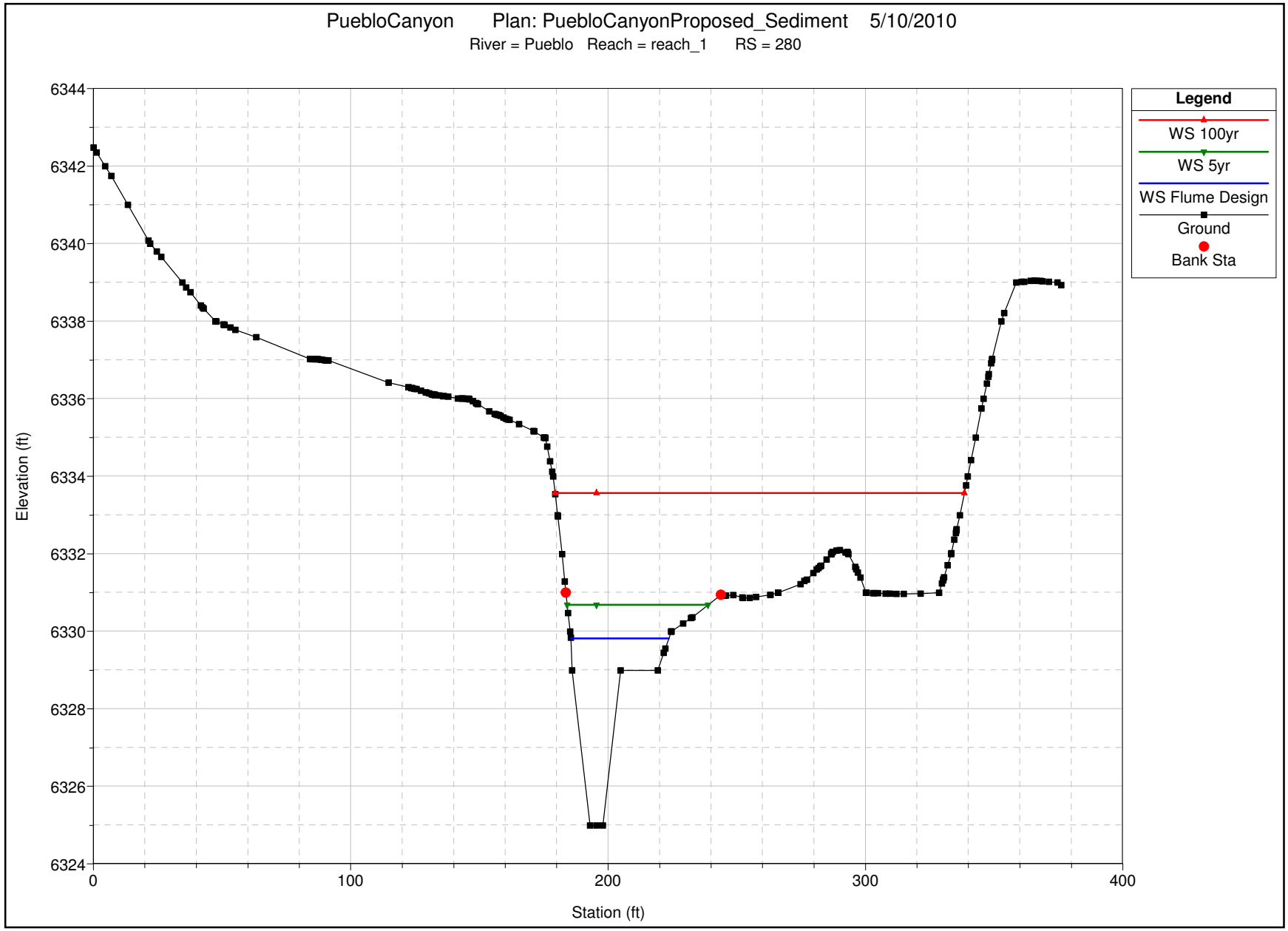

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 225
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400

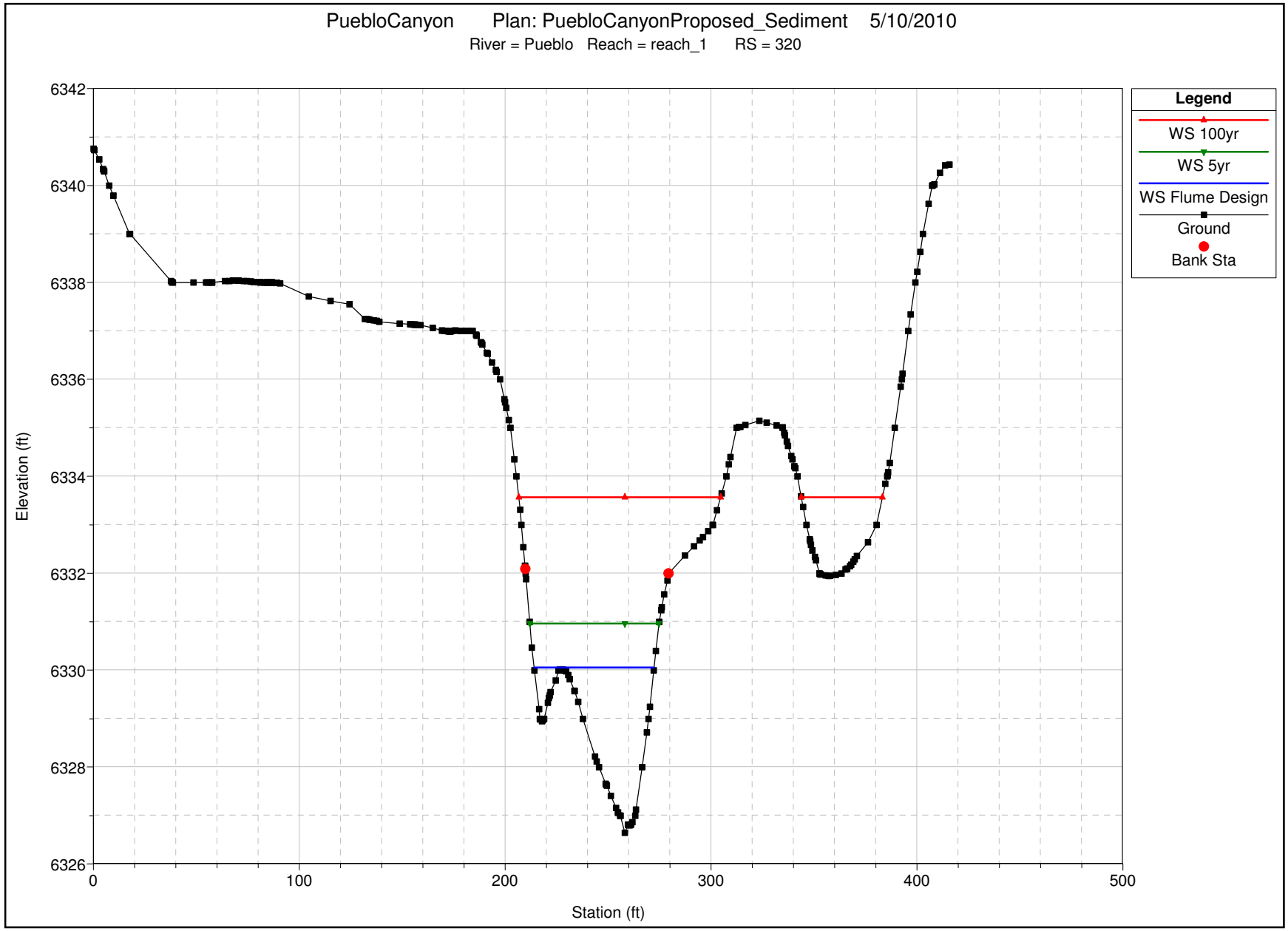

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 245
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400

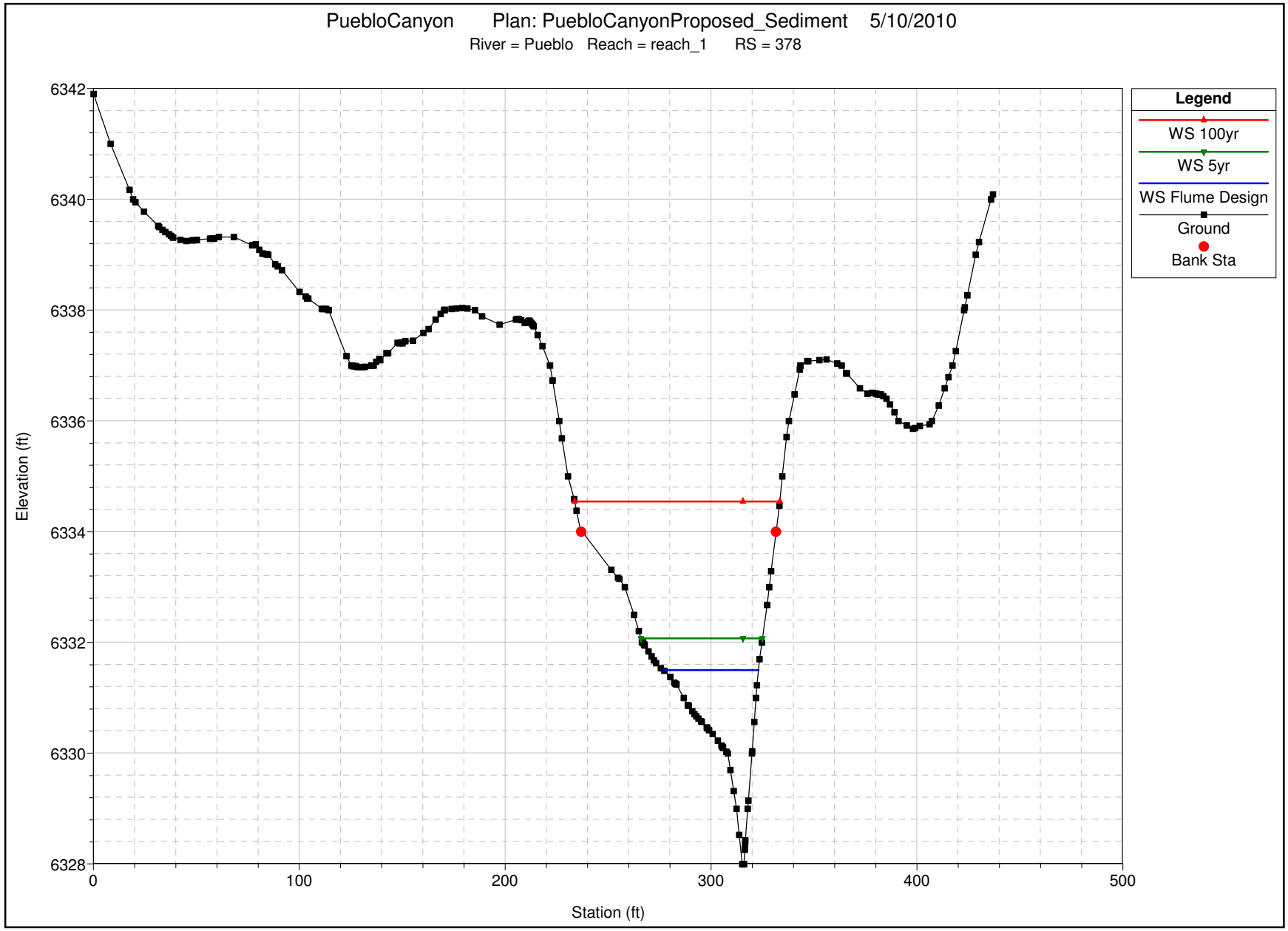

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 250
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 255
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6345
6340
6335
6330
6325
6320
0
100
200
300
400


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 260
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6344
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
0
100
200
300
400

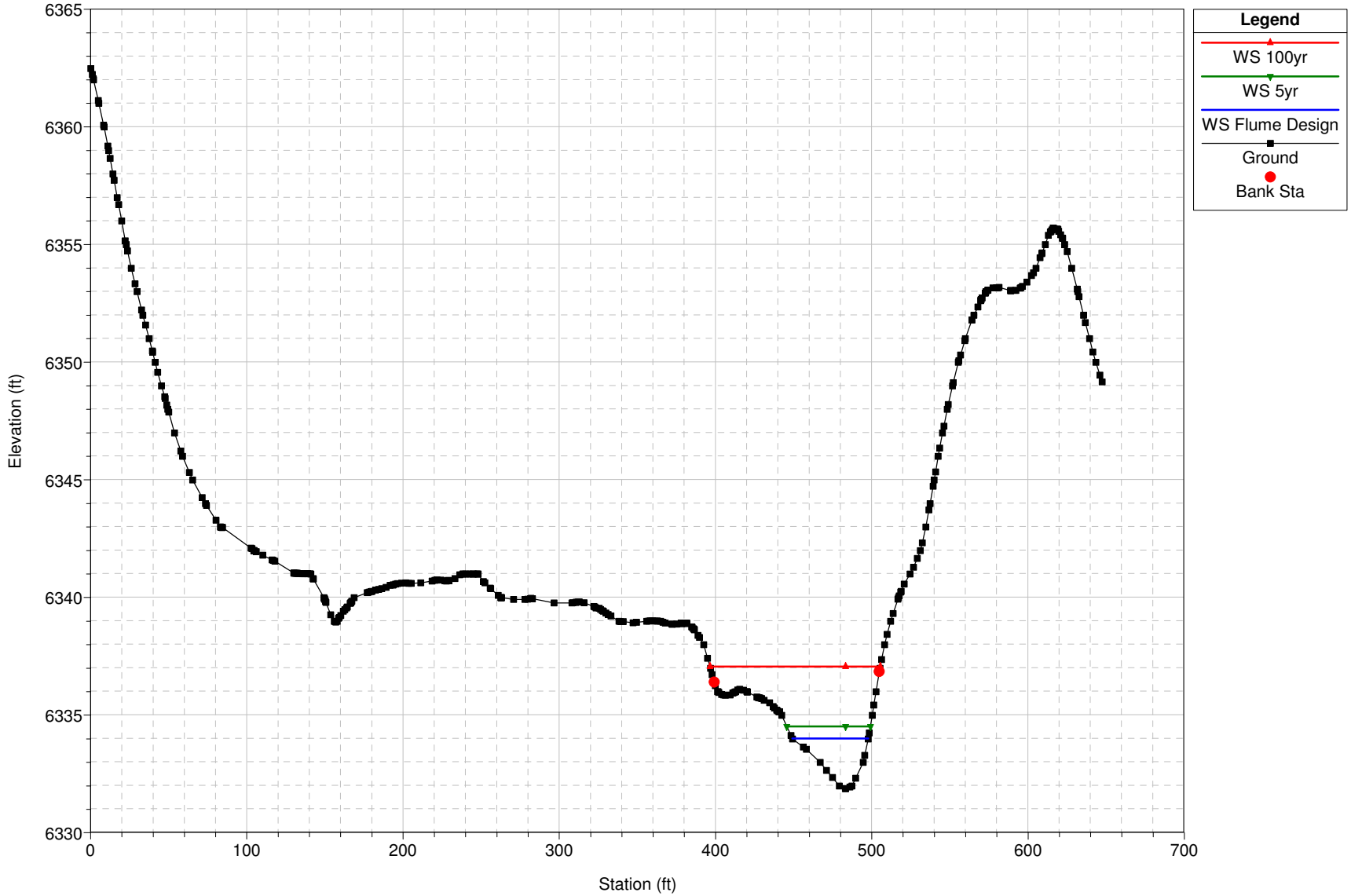

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 280
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6344
6342
6340
6338
6336
6334
6332
6330
6328
6326
6324
0
100
200
300
400

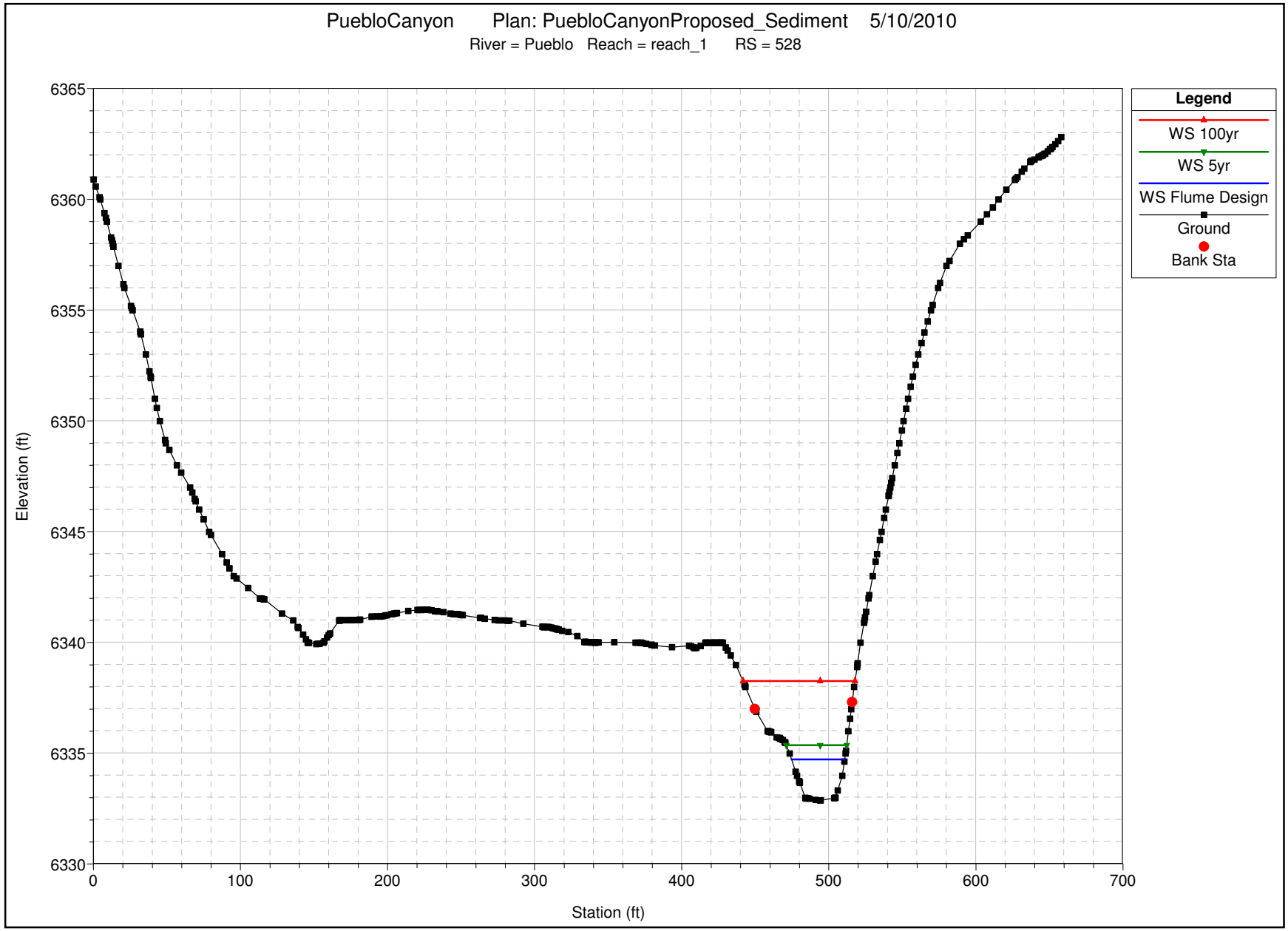

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 320
Elevation (ft)
6342
6340
6338
6336
6334
6332
6330
6328
6326
0
100
200
300
400
500
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

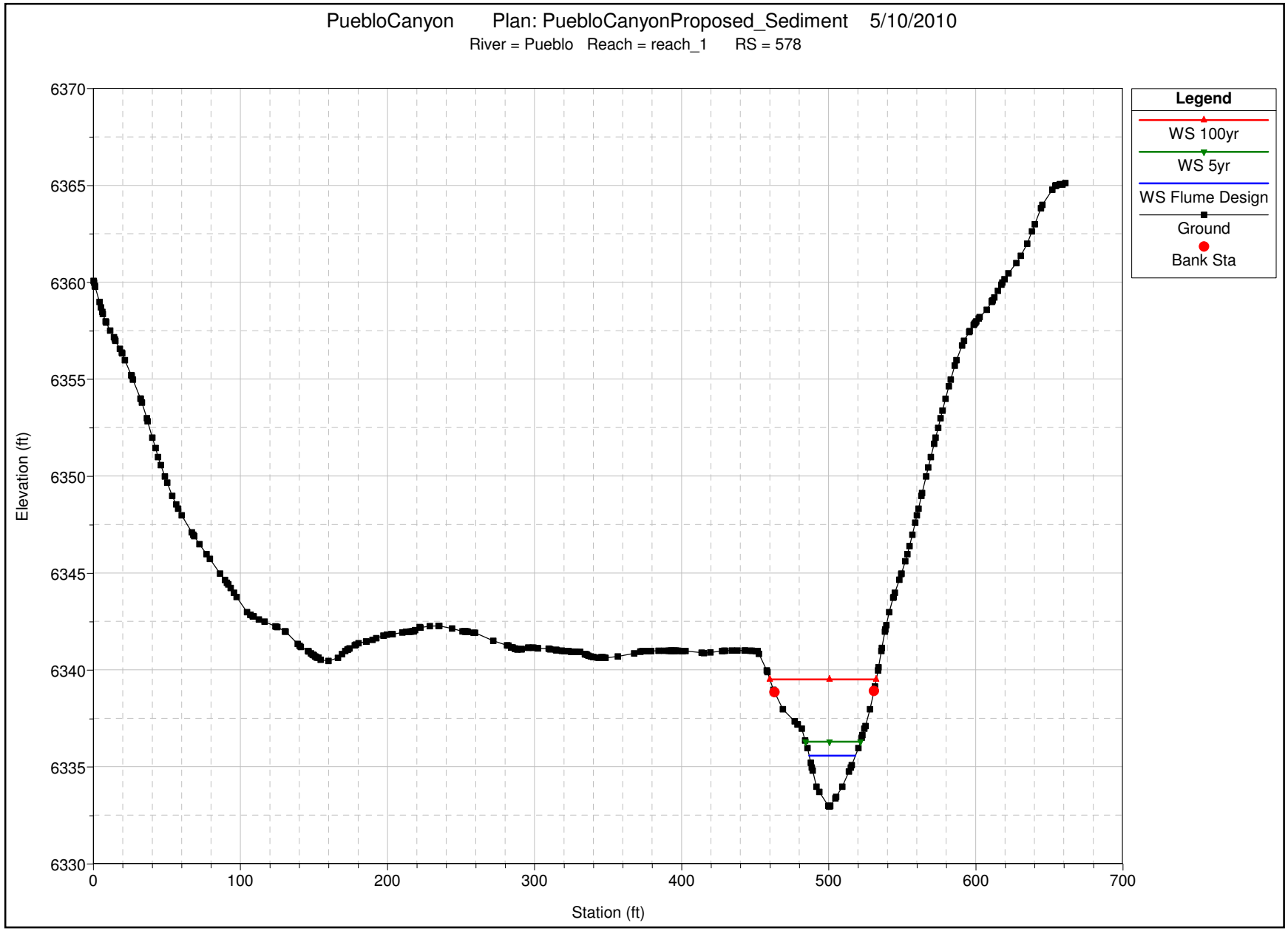

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 378
Elevation (ft)
6342
6340
6338
6336
6334
6332
6330
6328
0
100
200
300
400
500
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010

River = Pueblo Reach = reach_1 RS = 475

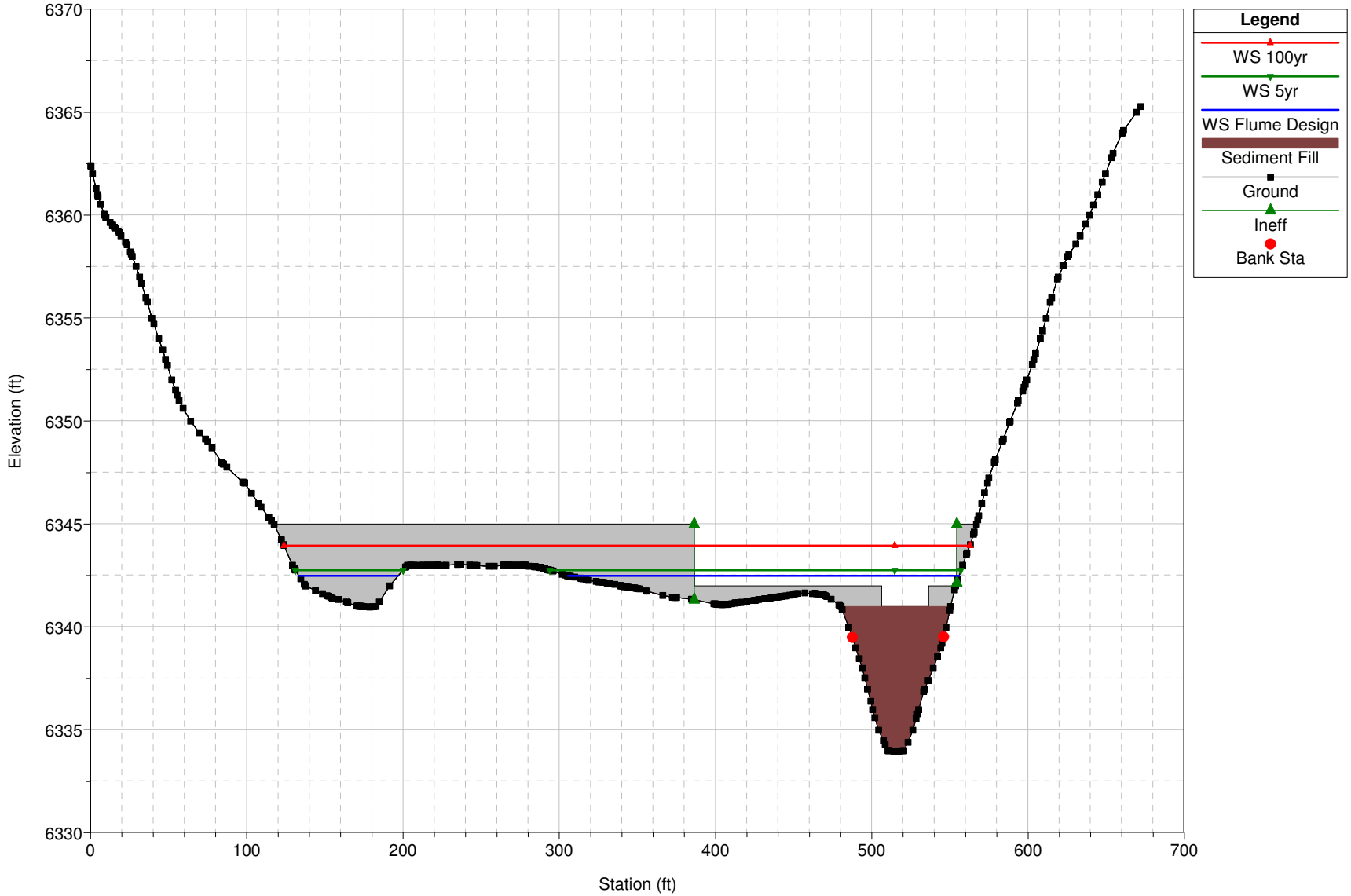



PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 528
Elevation (ft)
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 578
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6370
6365
6360
6355
6350
6345
6340
6335
6330
0
100
200
300
400
500
600
700
Station (ft)

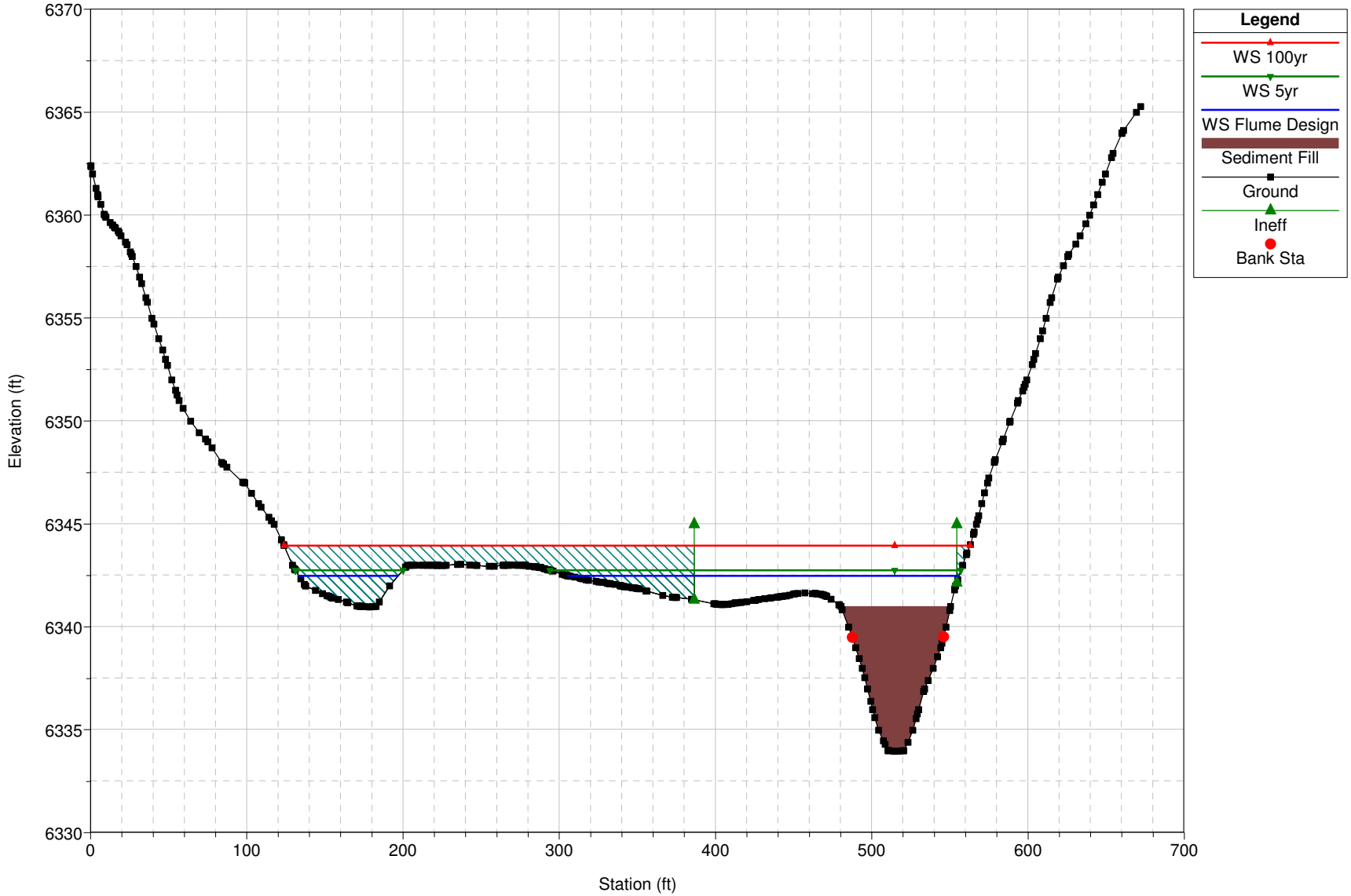
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010

River = Pueblo Reach = reach_1 RS = 609 IS Pueblo Canyon Gabion Grade Control Structure



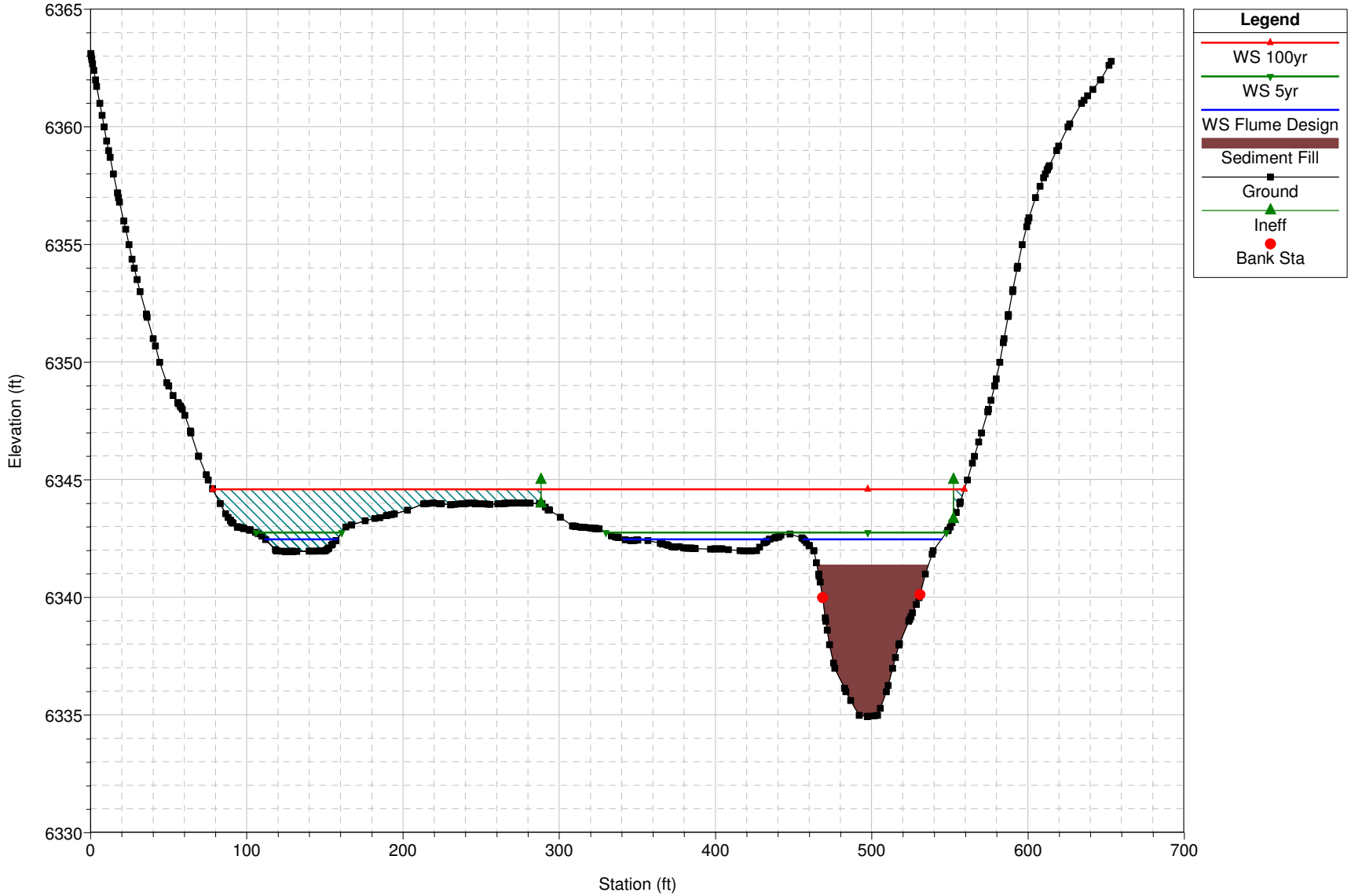
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010

River = Pueblo Reach = reach_1 RS = 612 coordinate at station 525 interpolated from topo



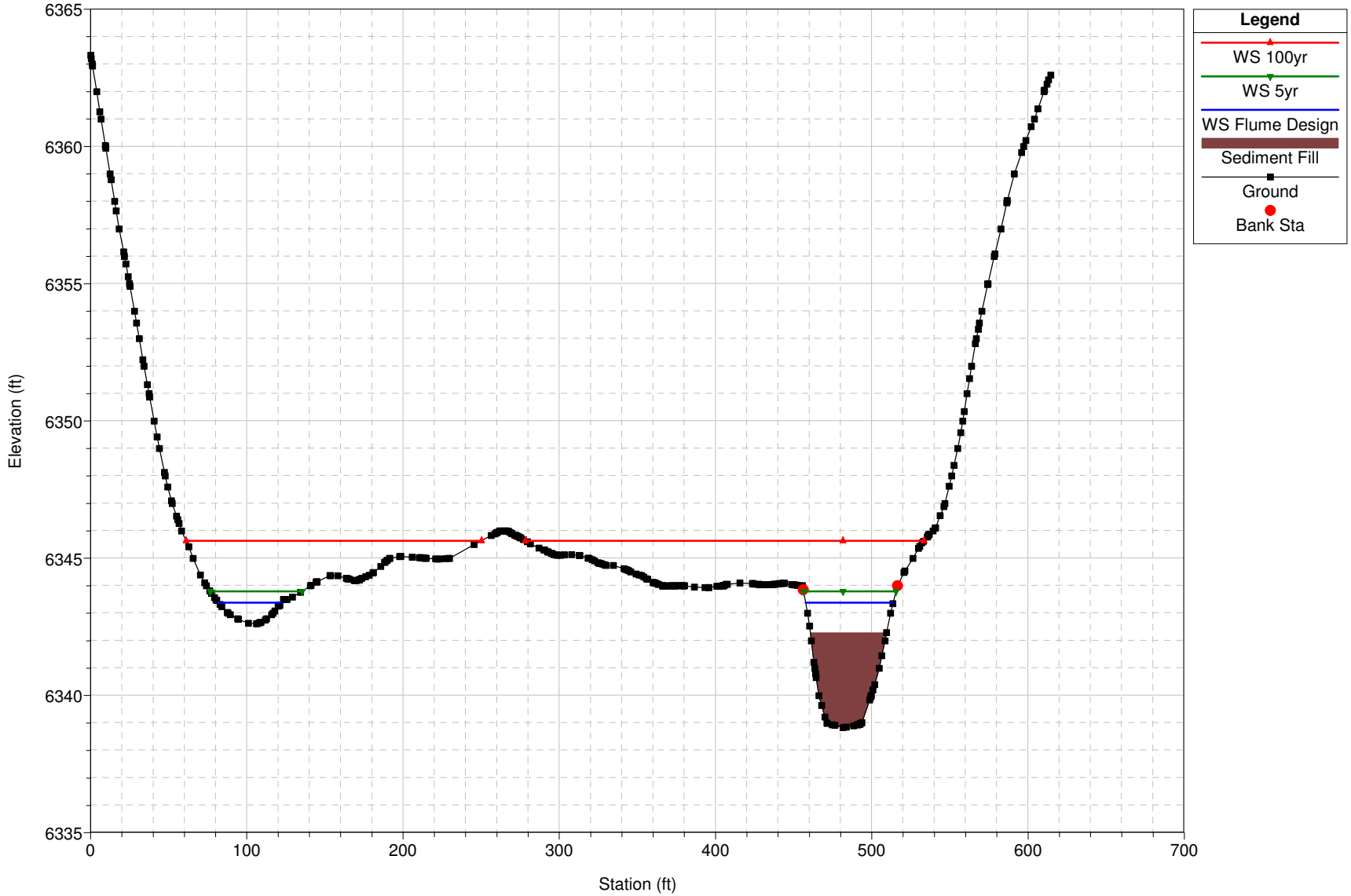
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010

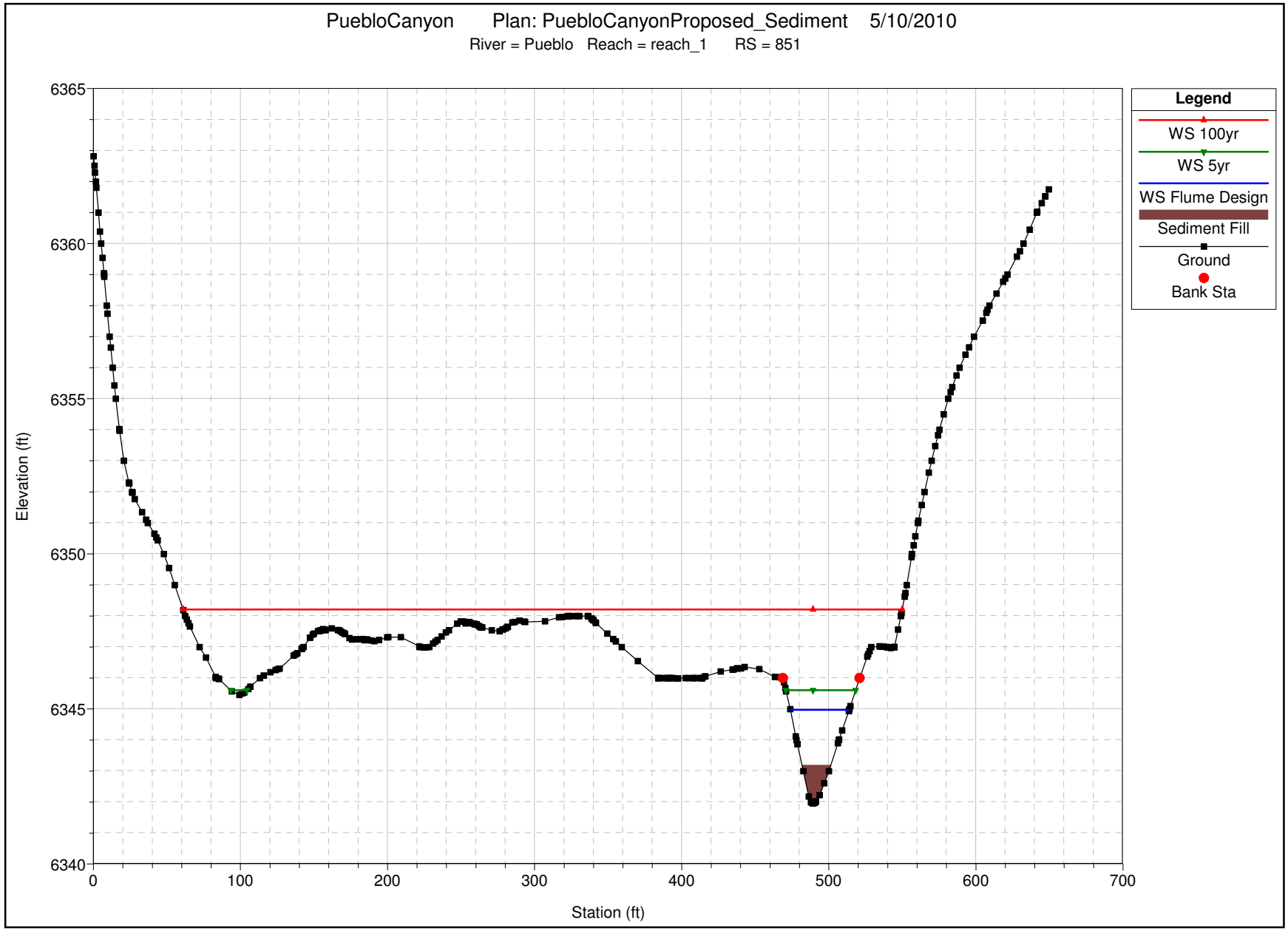
River = Pueblo Reach = reach_1 RS = 655

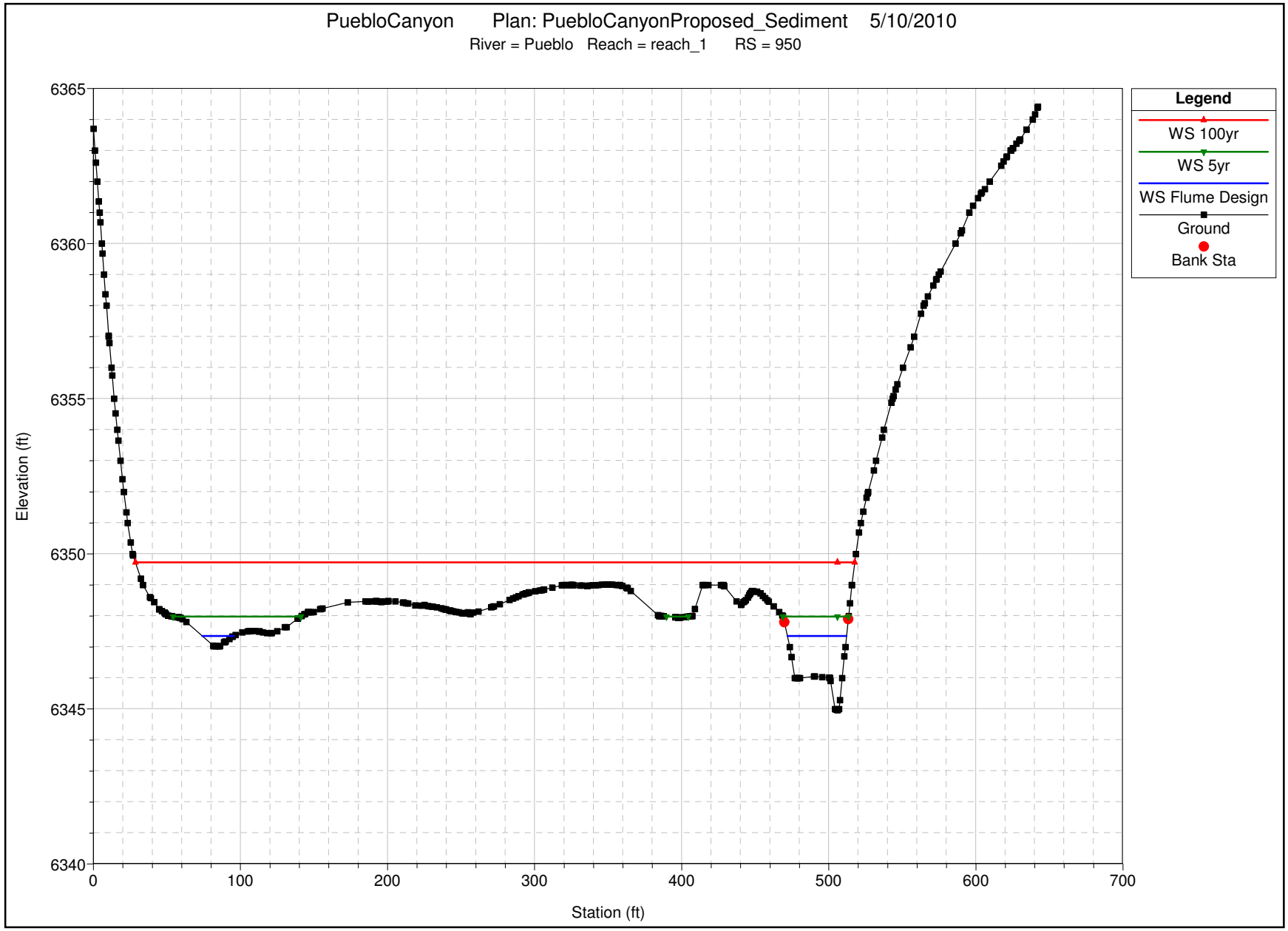


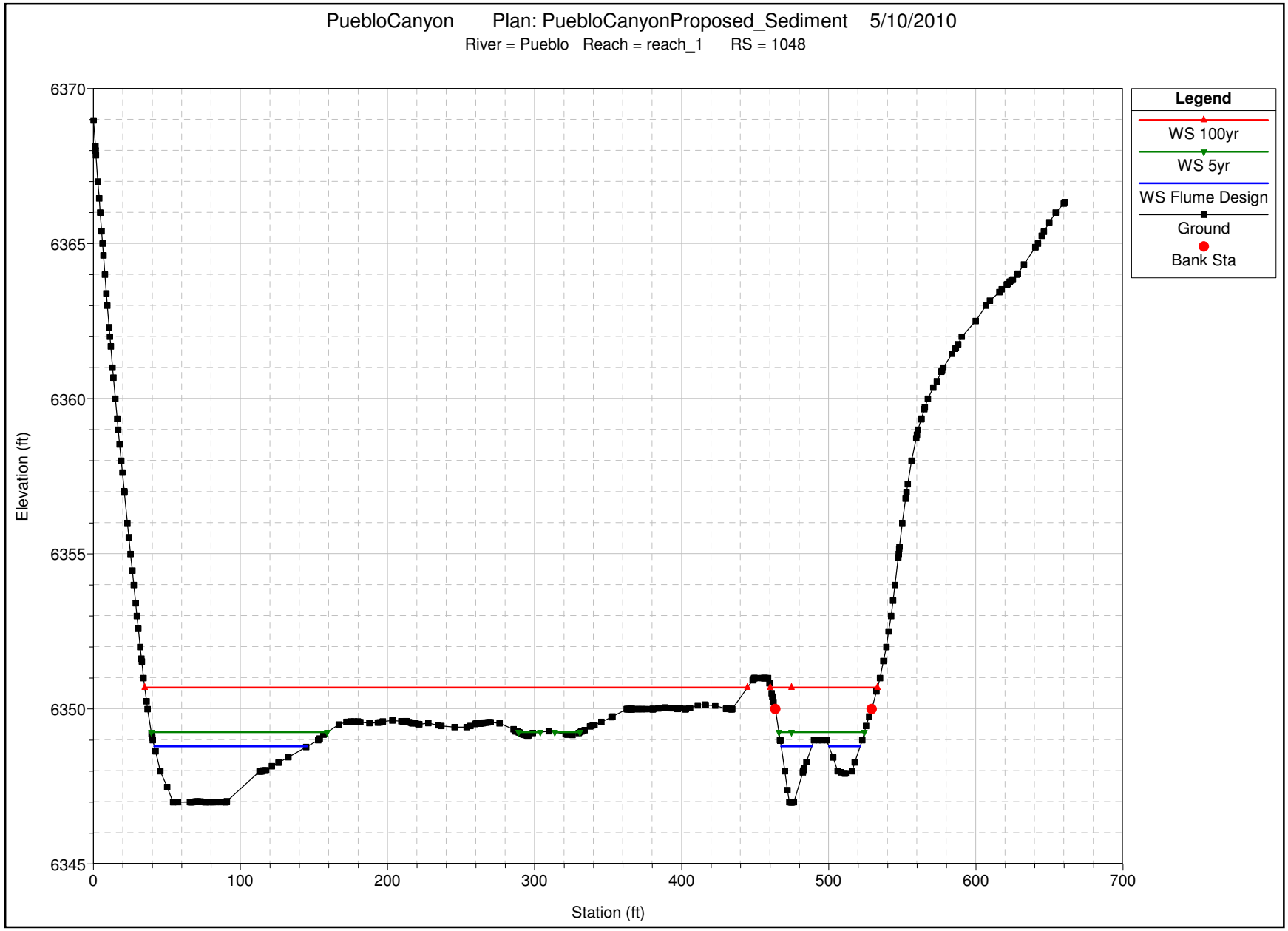
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010

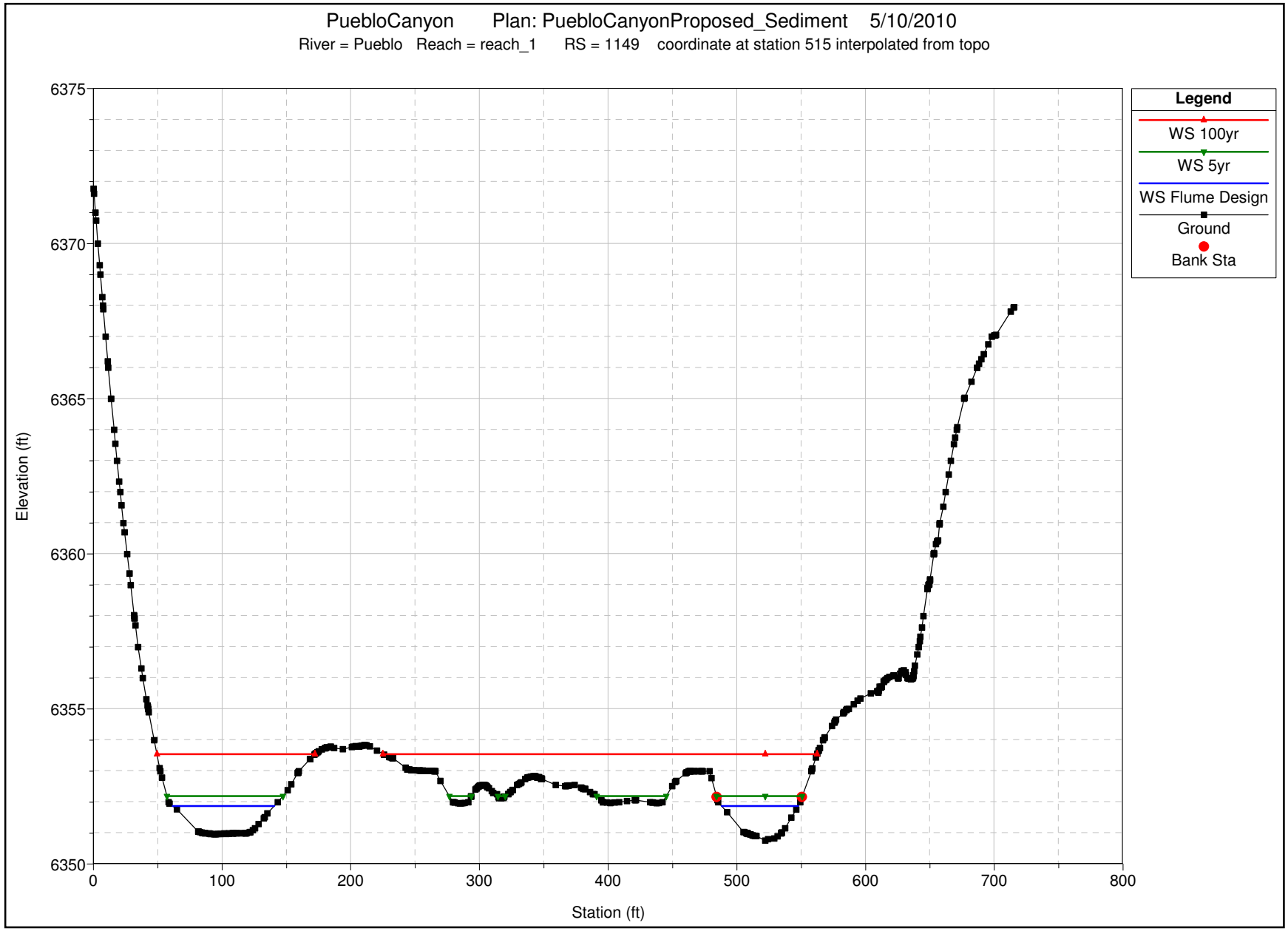
River = Pueblo Reach = reach_1 RS = 751 coordinate at station 471 interpolated from topo

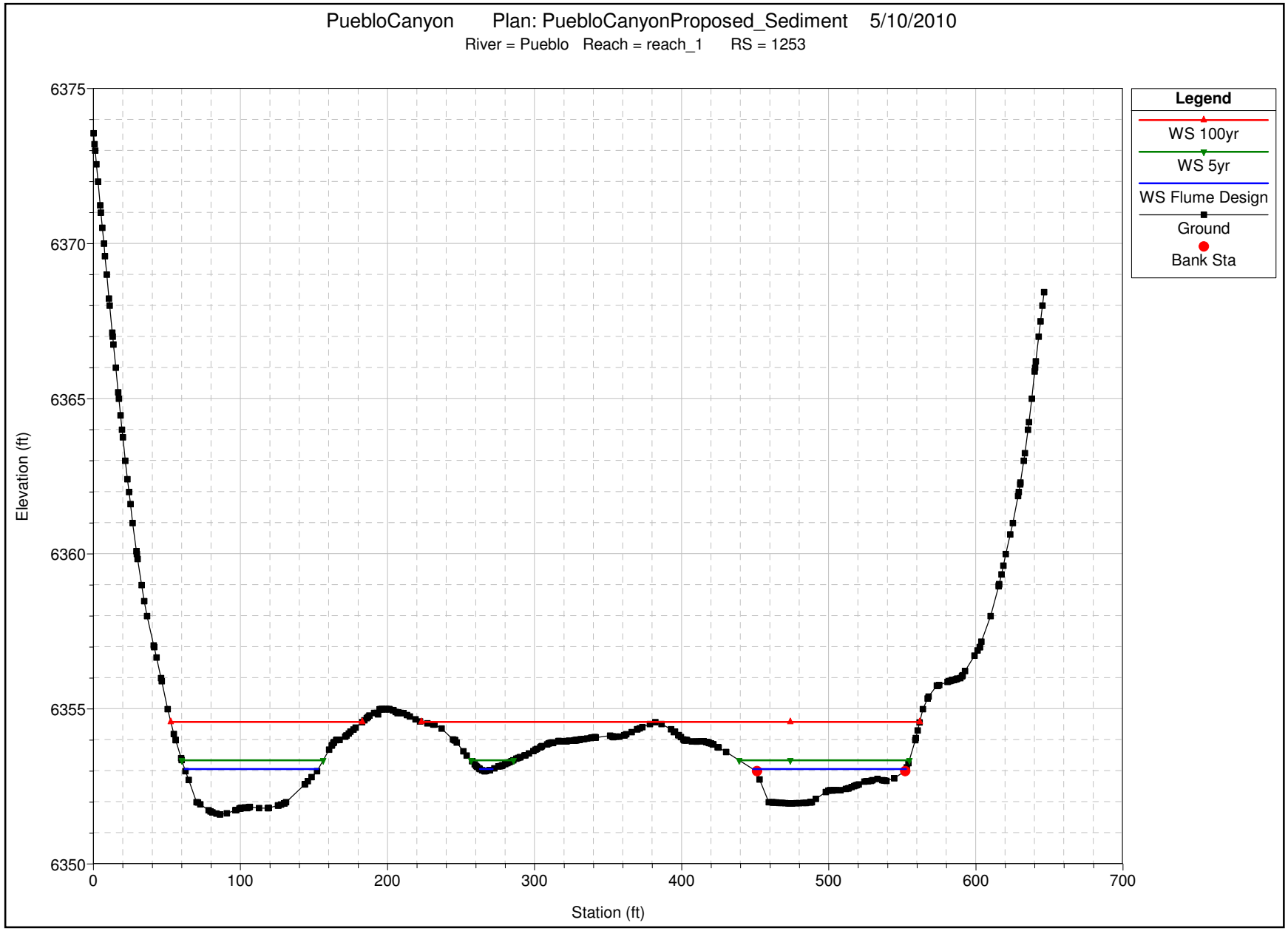


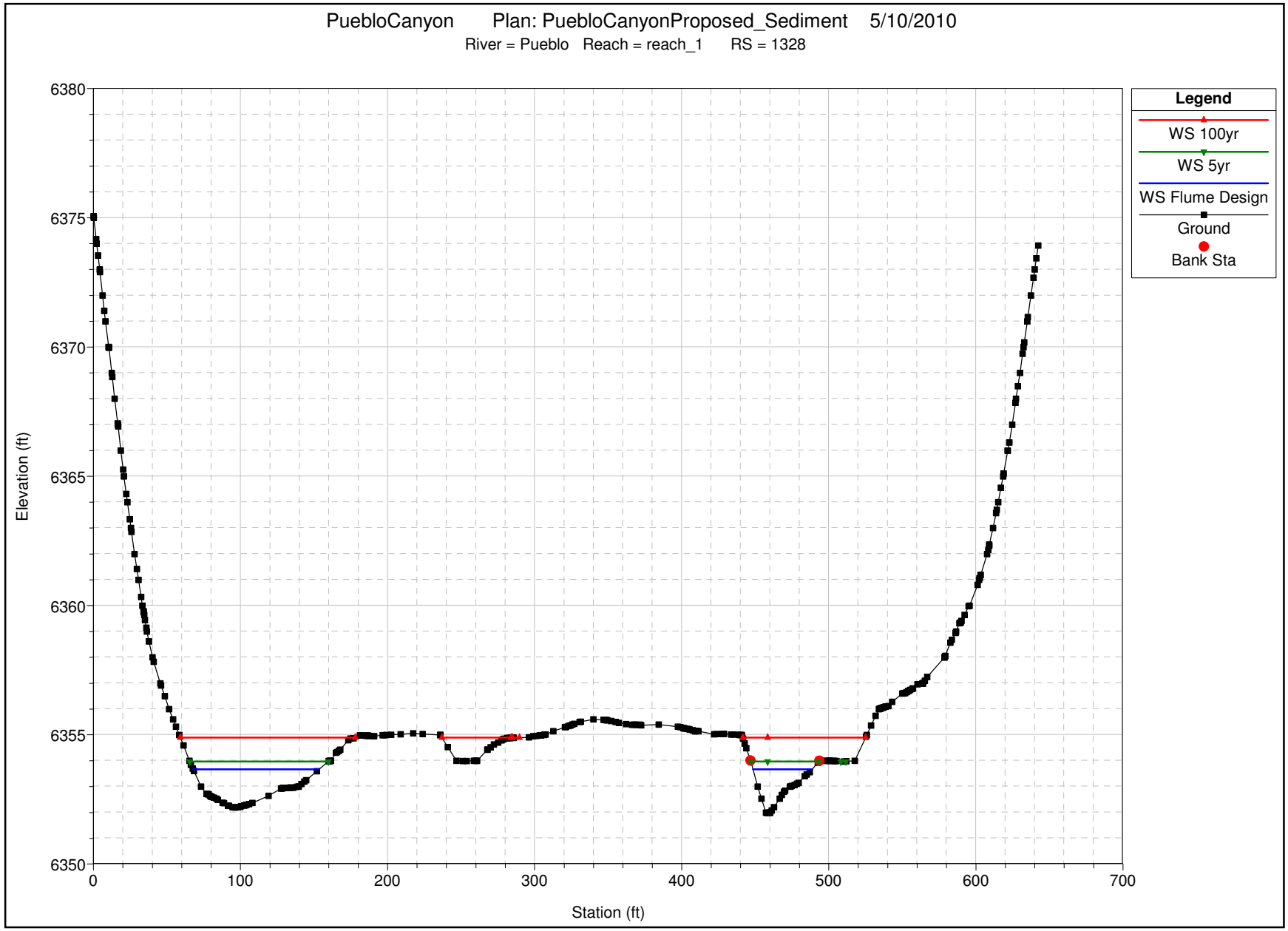

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 851
Elevation (ft)
6365
6360
6355
6350
6345
6340
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Sediment Fill
Ground
Bank Sta

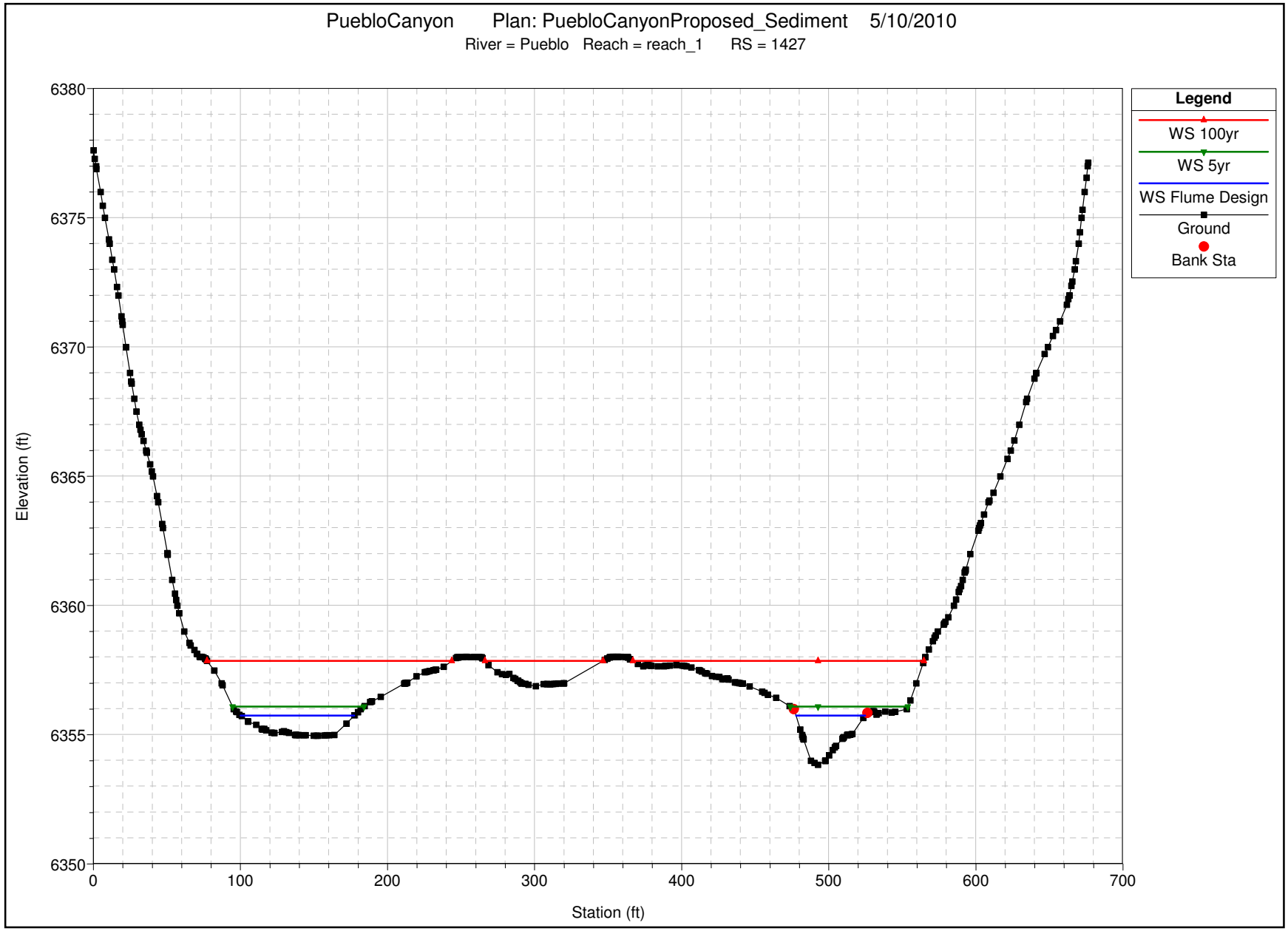

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 950
Elevation (ft)
6365
6360
6355
6350
6345
6340
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

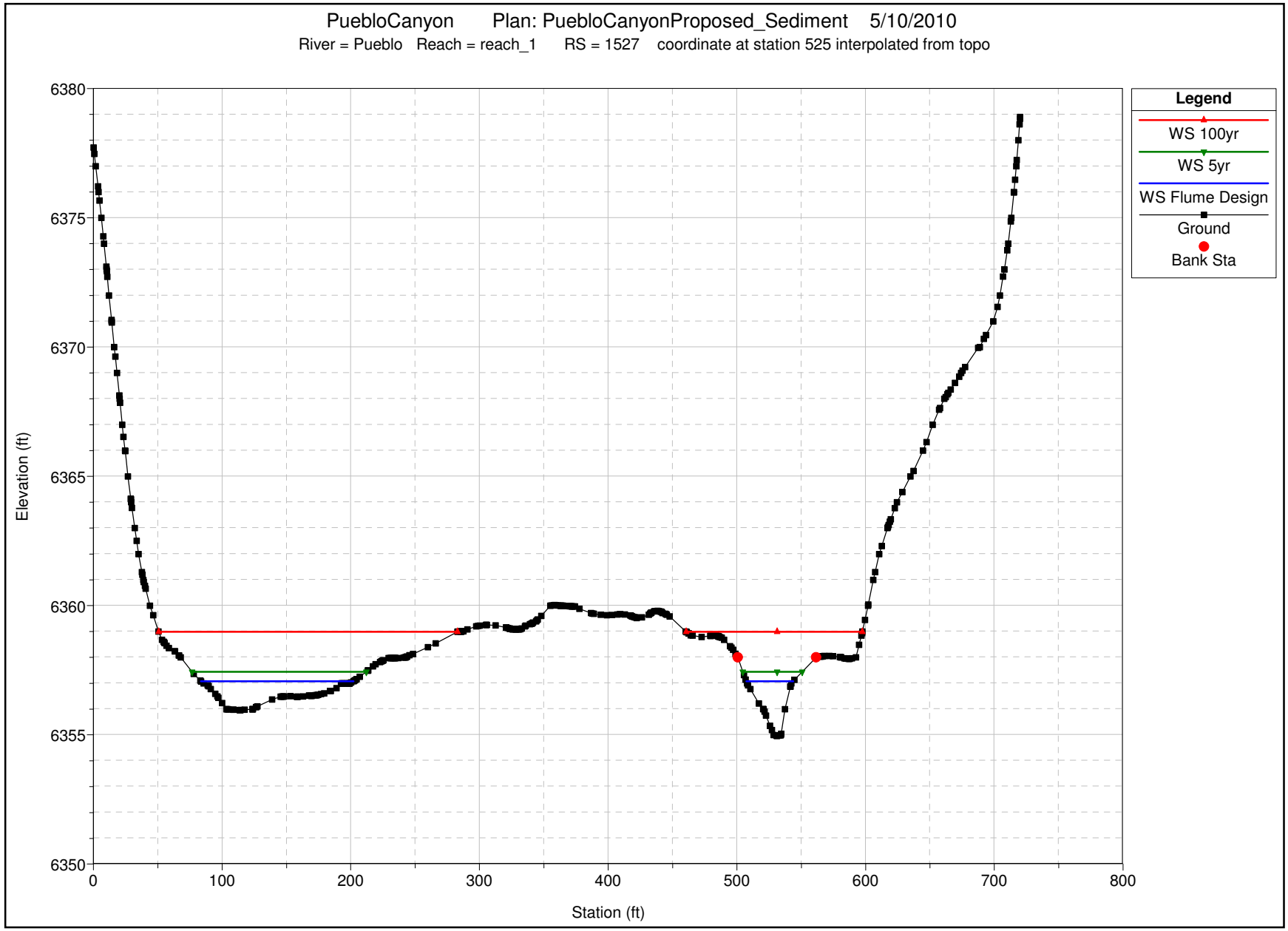

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1048
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6370
6365
6360
6355
6350
6345
0
100
200
300
400
500
600
700
Station (ft)

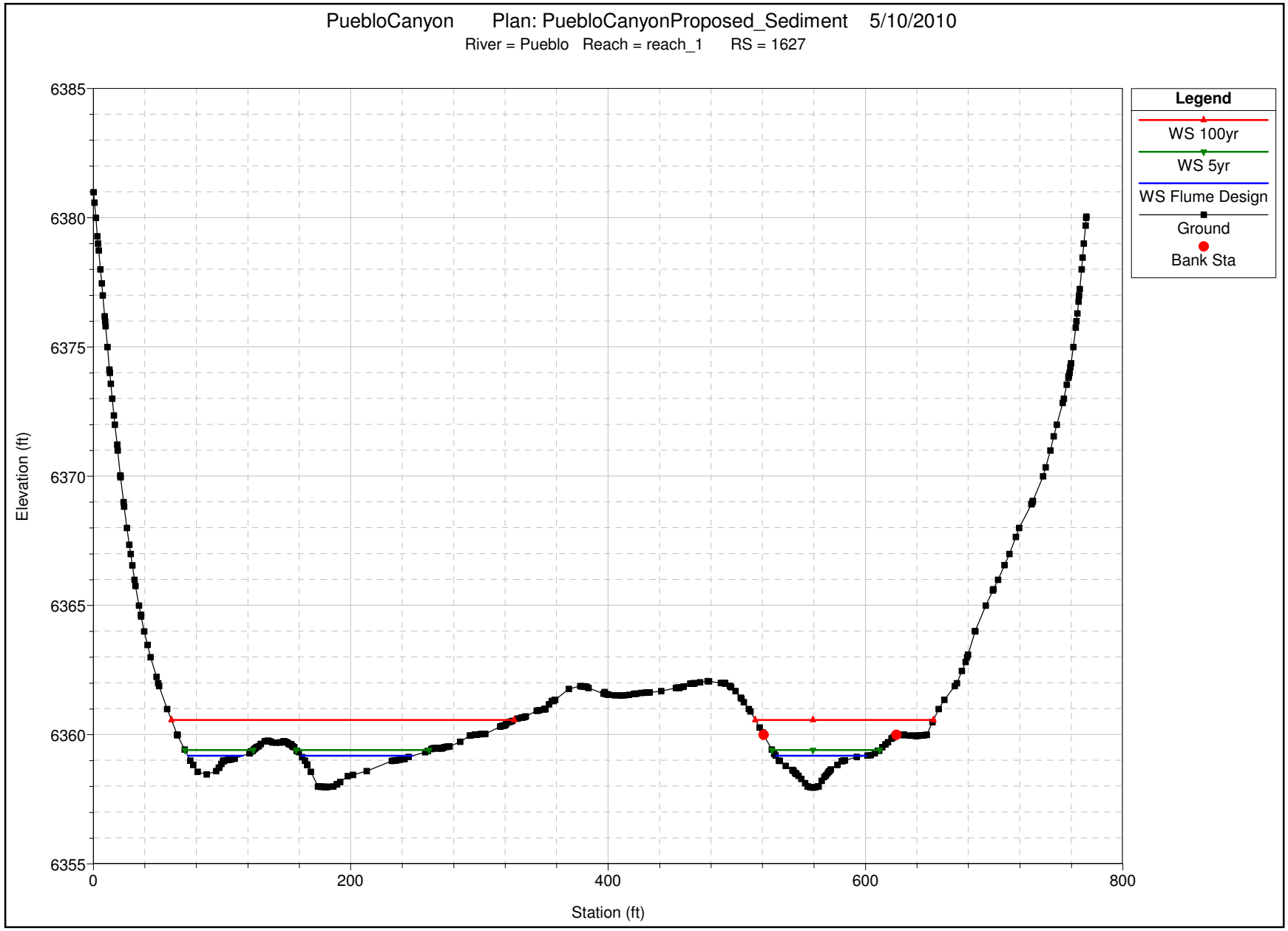

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1149 coordinate at station 515 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6375
6370
6365
6360
6355
6350
Station (ft)
0
100
200
300
400
500
600
700
800

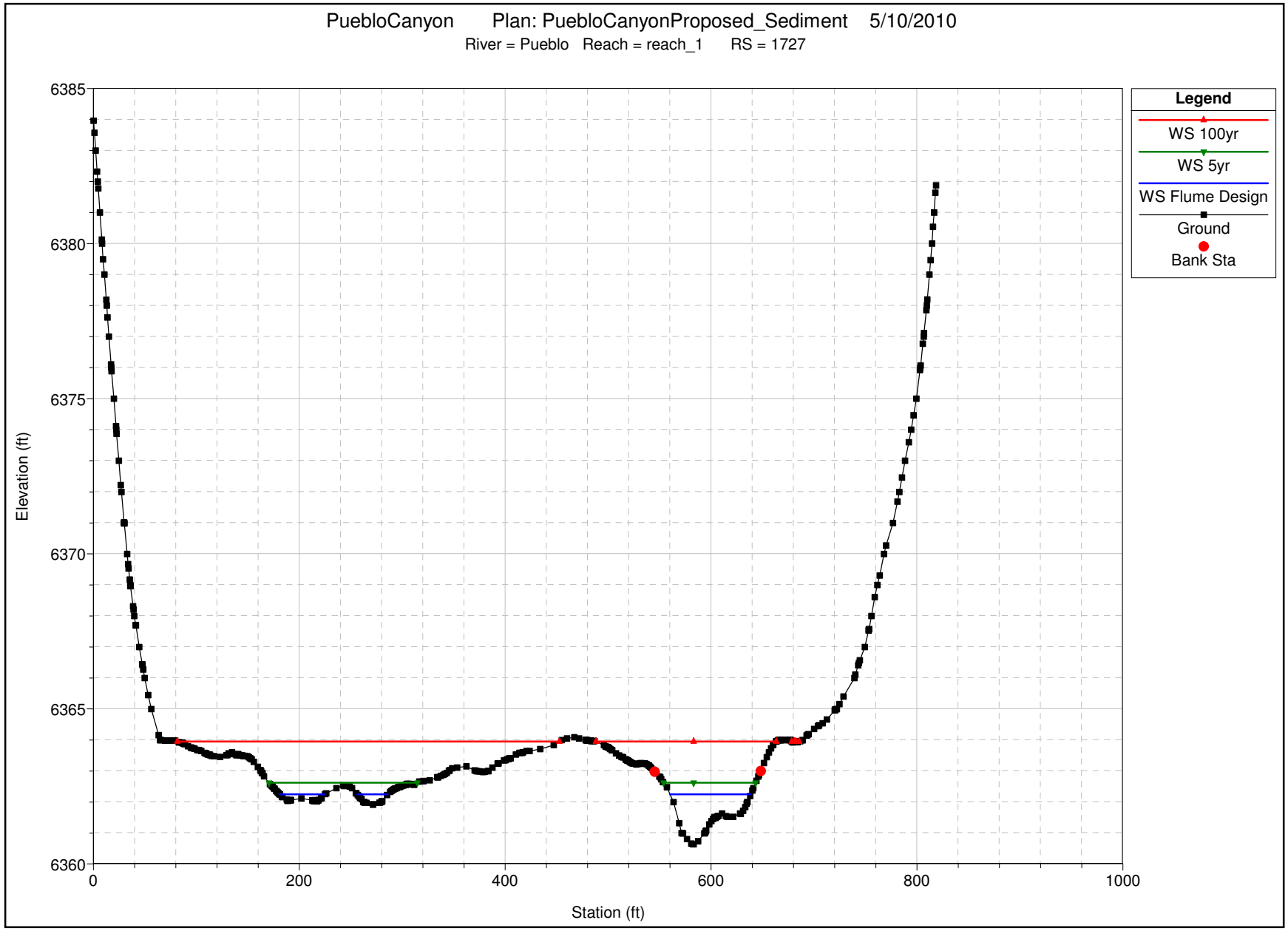

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1253
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)

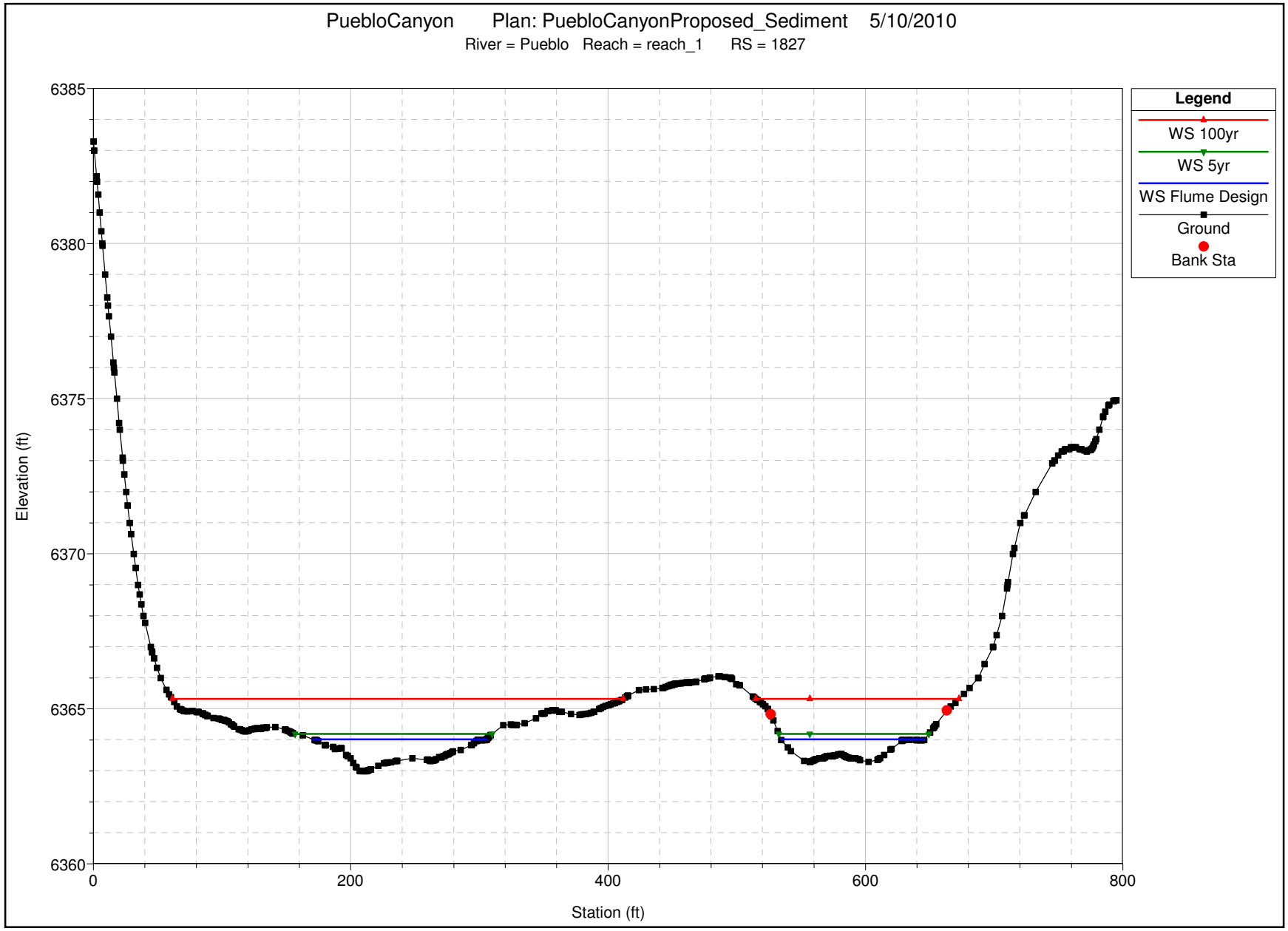

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1328
Elevation (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta

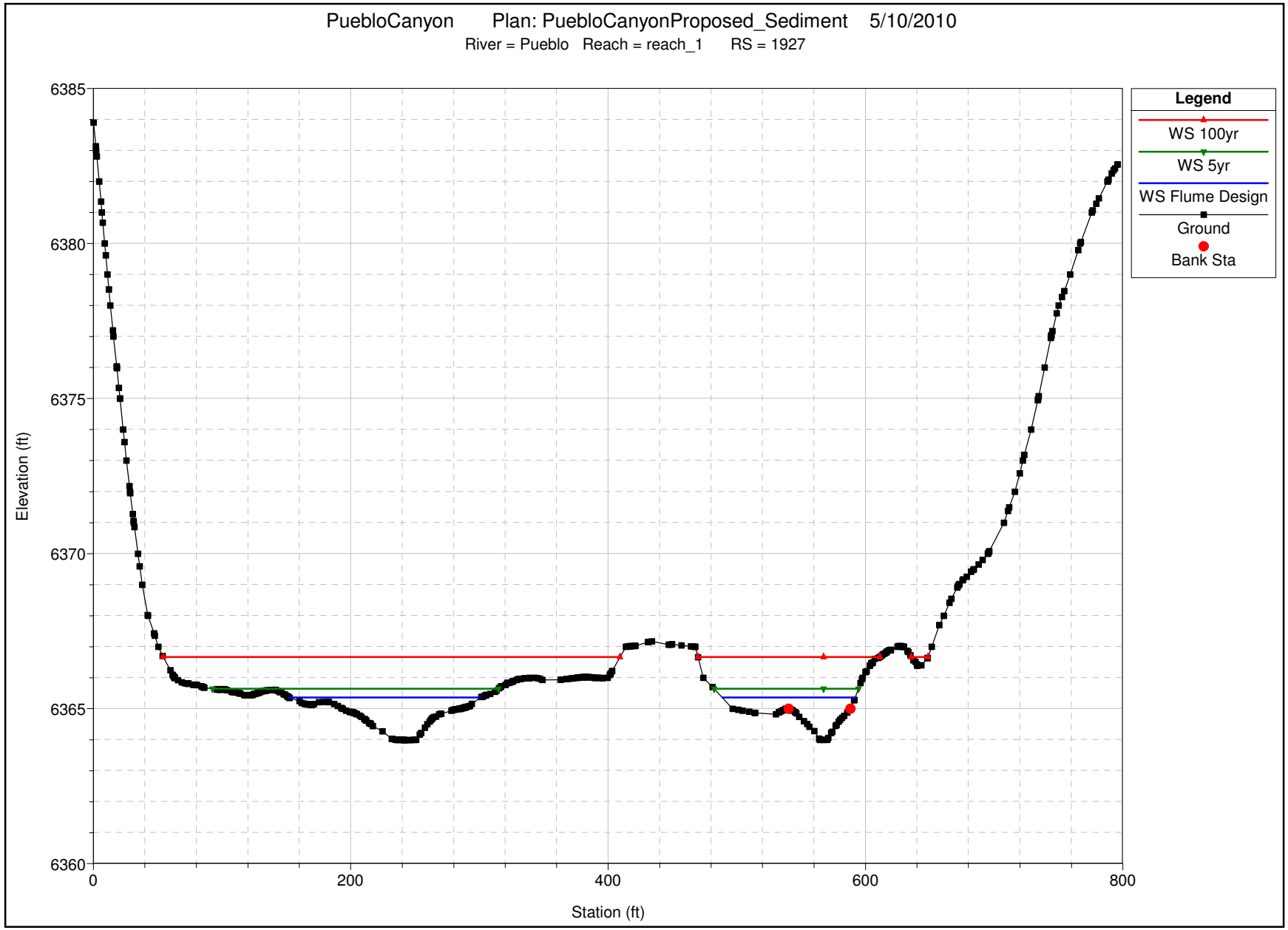

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1427
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1527 coordinate at station 525 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6380
6375
6370
6365
6360
6355
6350
0
100
200
300
400
500
600
700
800


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1627
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
6355
0
200
400
600
800
Station (ft)

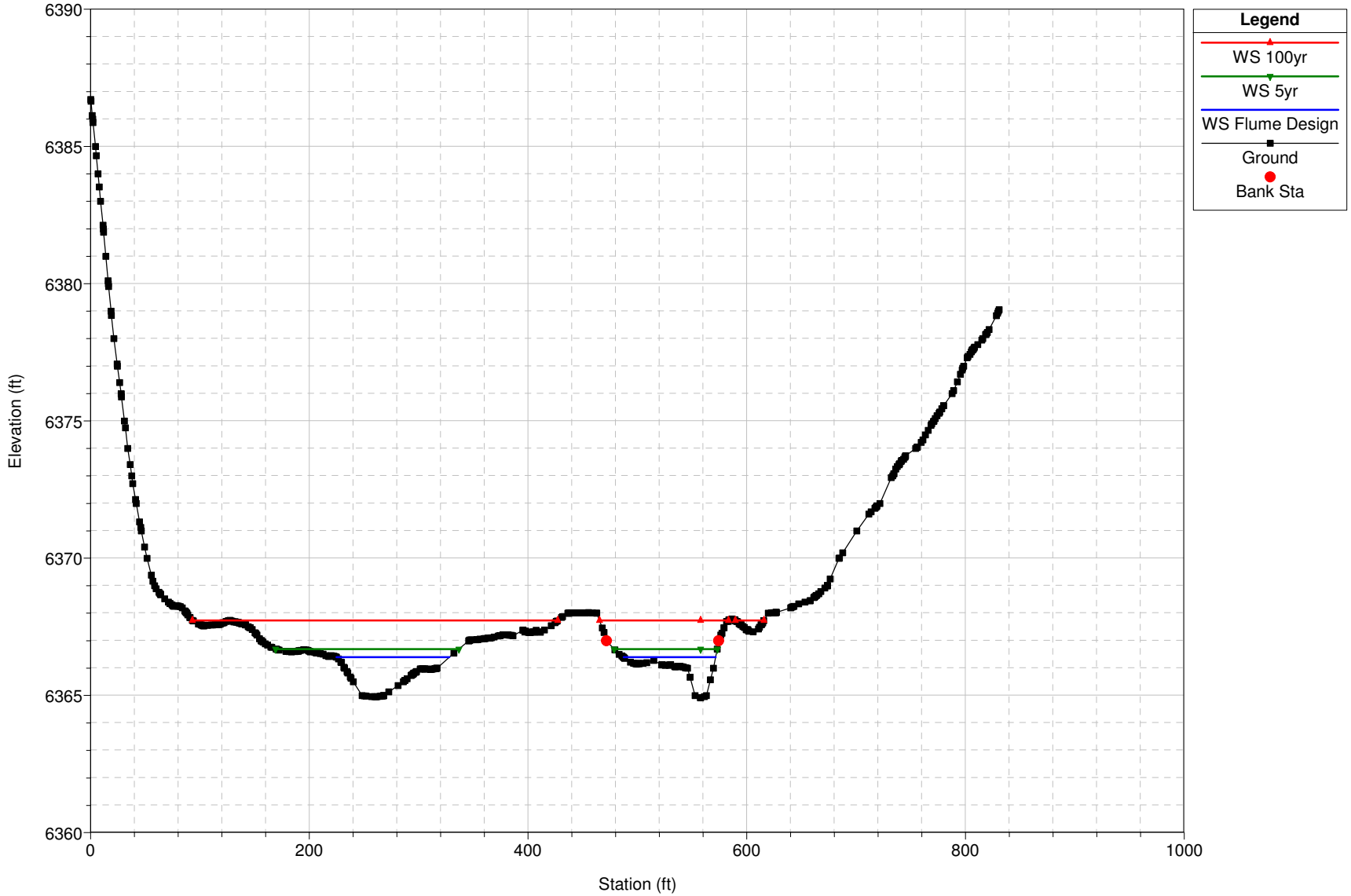

PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1727
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
1000
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1827
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 1927
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6385
6380
6375
6370
6365
6360
0
200
400
600
800
Station (ft)

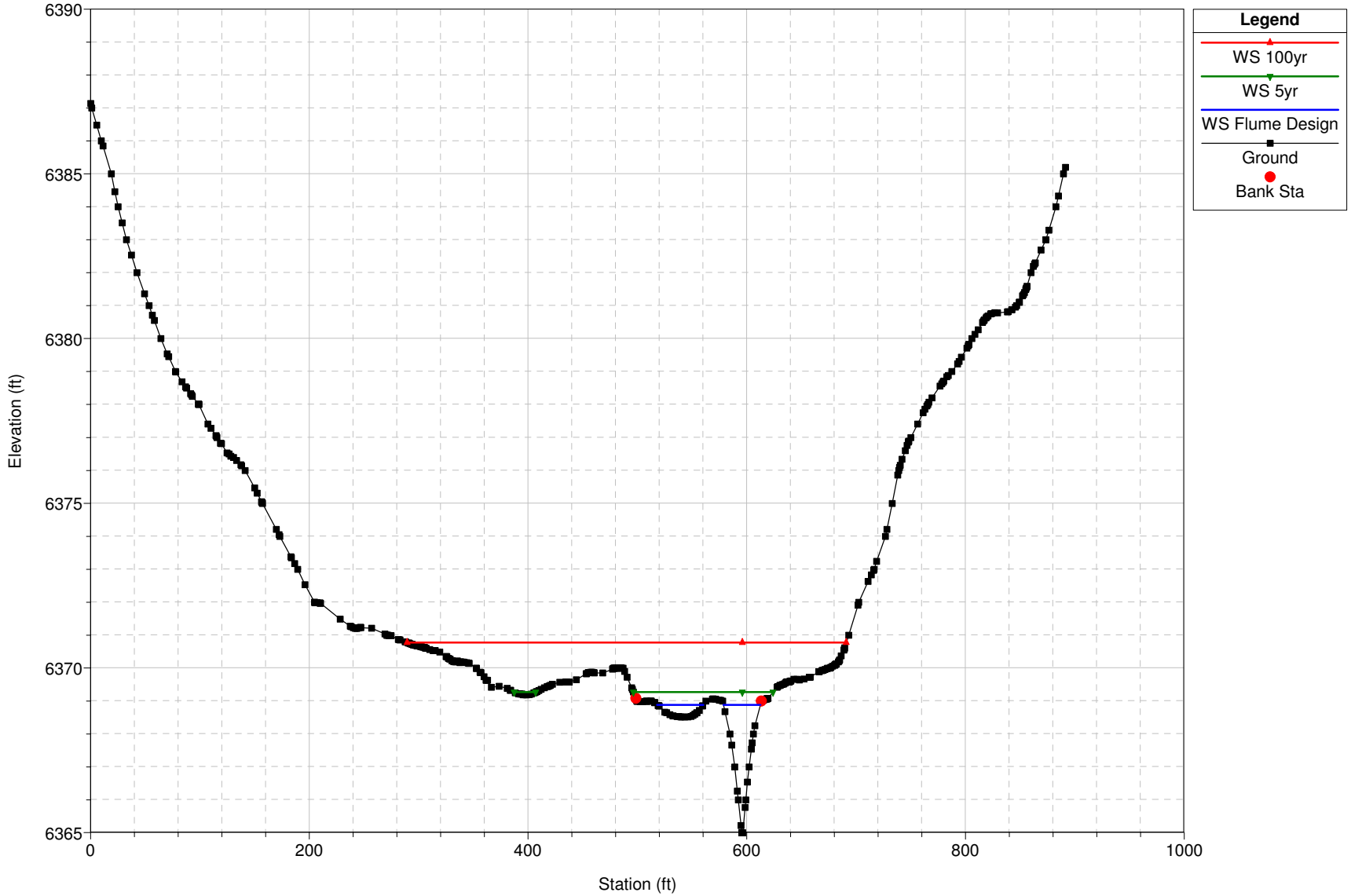
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010

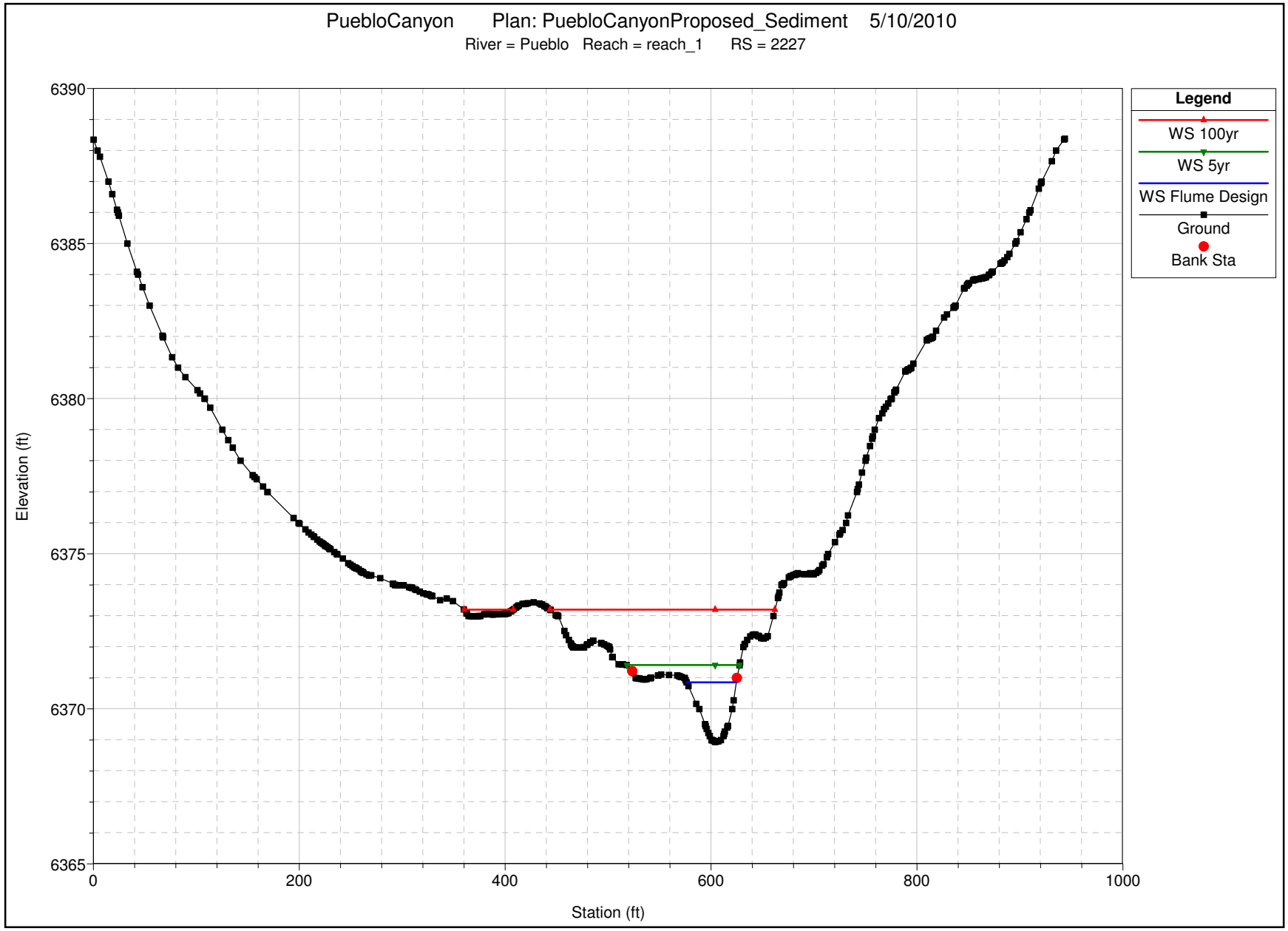
River = Pueblo Reach = reach_1 RS = 2027 coordinates at stations 491, 509, and 558 interpolated from topo

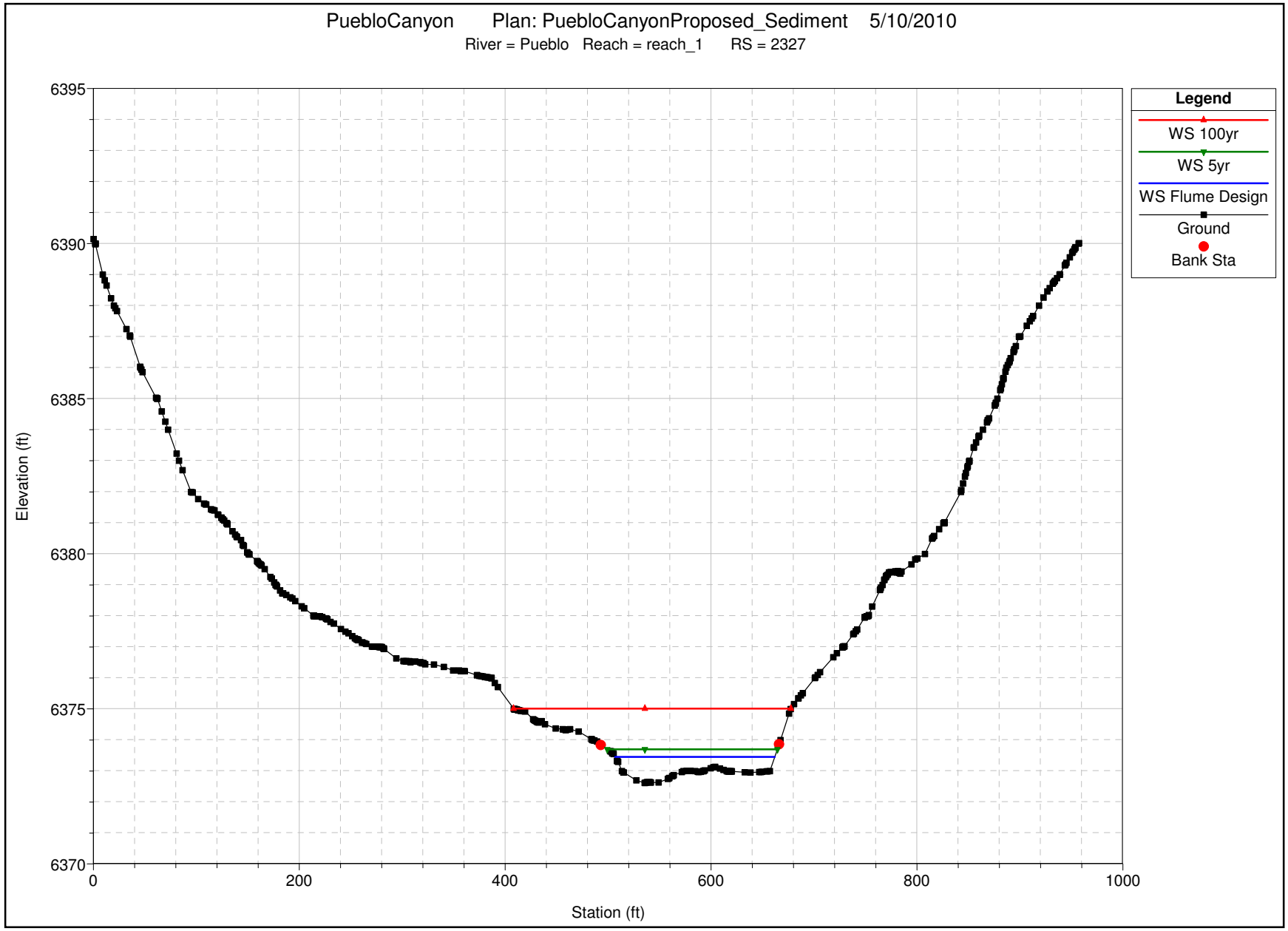


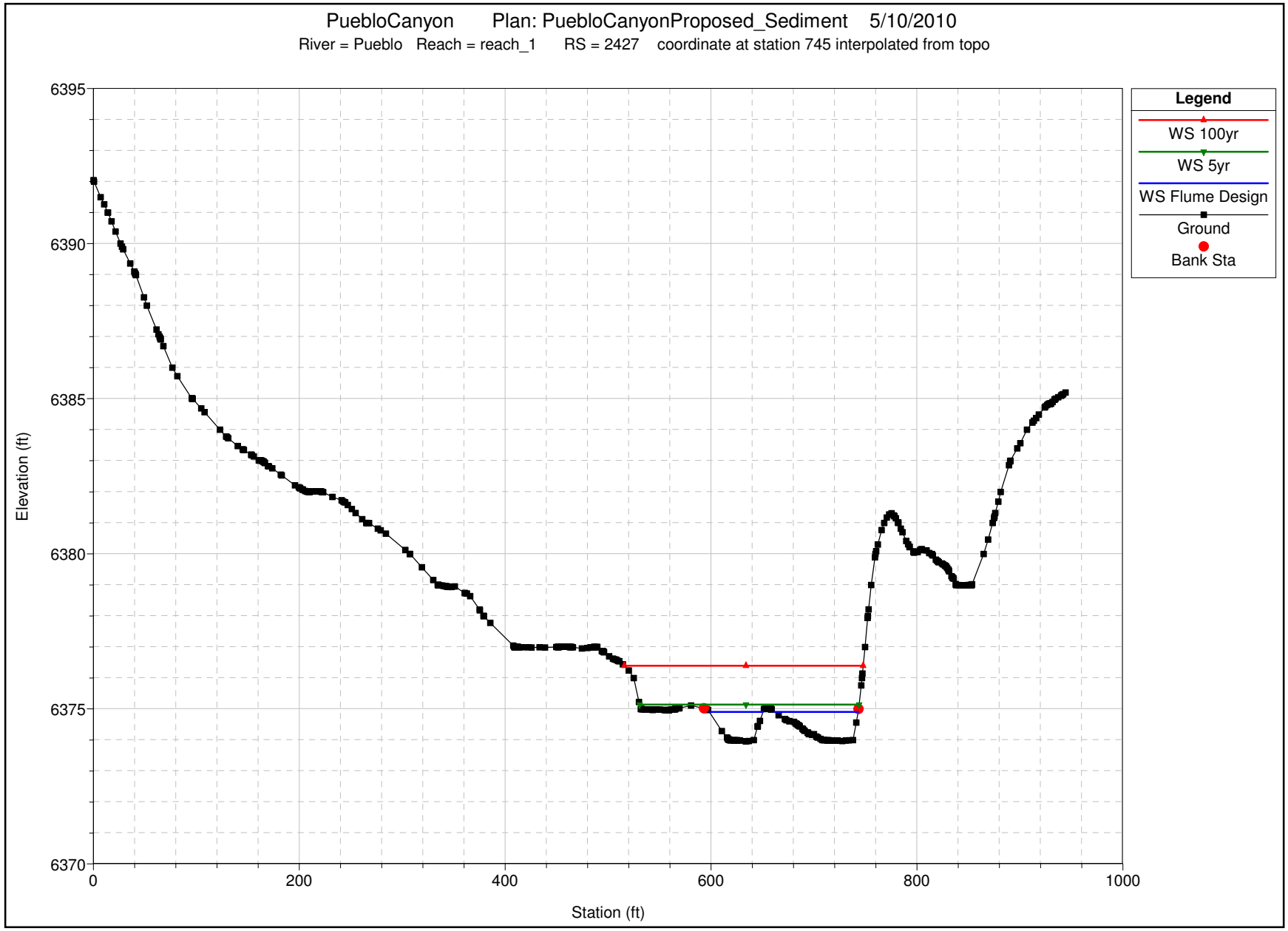
PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010

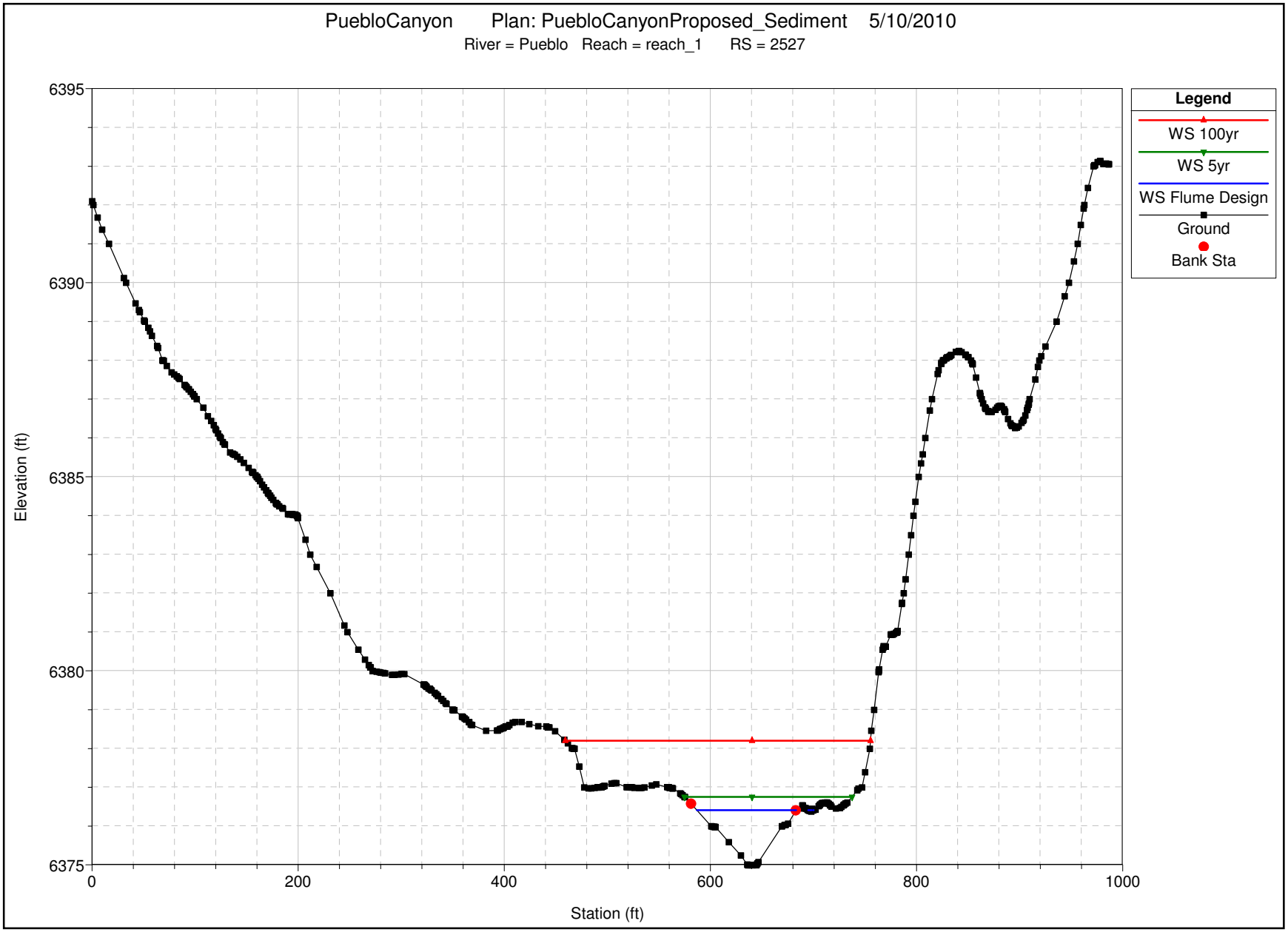
River = Pueblo Reach = reach_1 RS = 2127 coordinate at station 510 interpolated from topo

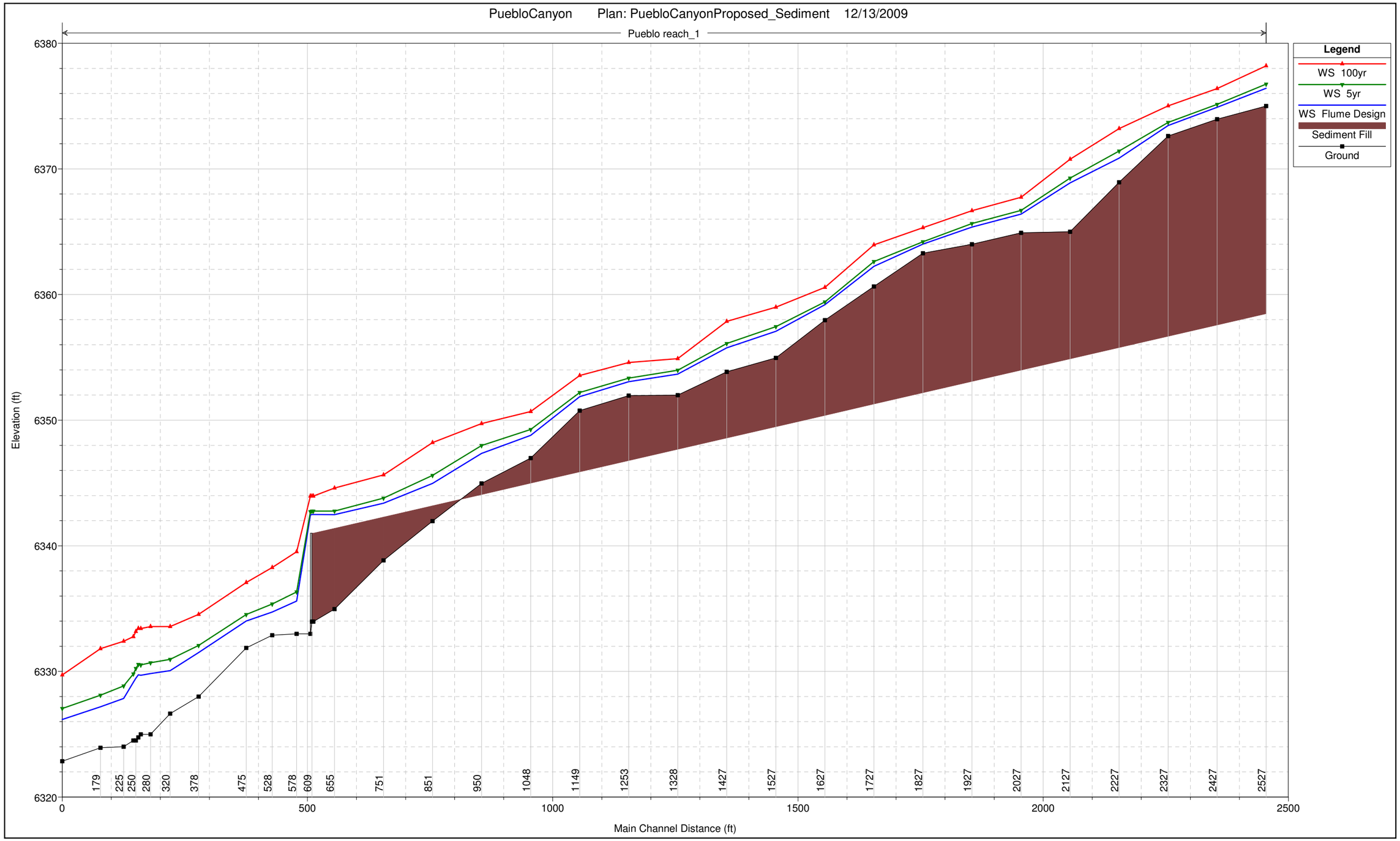



PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 2227
Elevation (ft)
6390
6385
6380
6375
6370
6365
0
200
400
600
800
1000
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 2327
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
6370
0
200
400
600
800
1000
Station (ft)


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 2427 coordinate at station 745 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
Station (ft)
6395
6390
6385
6380
6375
6370
0
200
400
600
800
1000


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 5/10/2010
River = Pueblo Reach = reach_1 RS = 2527
Legend
WS 100yr
WS 5yr
WS Flume Design
Ground
Bank Sta
Elevation (ft)
6395
6390
6385
6380
6375
Station (ft)
0
200
400
600
800
1000


PuebloCanyon Plan: PuebloCanyonProposed_Sediment 12/13/2009
Pueblo reach_1
Legend
WS 100yr
WS 5yr
WS Flume Design
Sediment Fill
Ground
Elevation (ft)
6380
6370
6360
6350
6340
6330
6320
0
500
1000
1500
2000
2500
Main Channel Distance (ft)
179
225
250
280
320
378
475
528
578
609
655
751
851
950
1048
1149
1253
1328
1427
1527
1627
1727
1827
1927
2027
2127
2227
2327
2427
2527

HEC-RAS Plan: Pueblo_Prop_Sed River: Pueblo Reach: reach_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	2527	Flume Design	350.00	6375.00	6376.41	6376.41	6376.79	0.014787	4.93	71.09	100.15	1.01
reach_1	2527	5yr	593.00	6375.00	6376.76	6376.76	6377.22	0.011766	5.51	119.18	162.48	0.95
reach_1	2527	100yr	2740.00	6375.00	6378.21	6378.21	6379.13	0.008882	8.57	496.55	295.93	0.96
reach_1	2427	Flume Design	350.00	6373.96	6374.91	6374.85	6375.16	0.011953	4.05	86.33	133.12	0.89
reach_1	2427	5yr	593.00	6373.96	6375.14	6375.14	6375.51	0.013110	4.89	128.21	213.08	0.96
reach_1	2427	100yr	2740.00	6373.96	6376.40	6376.40	6377.34	0.010342	8.13	404.24	232.05	1.00
reach_1	2327	Flume Design	350.00	6372.62	6373.46	6373.46	6373.74	0.017161	4.25	82.30	155.07	1.03
reach_1	2327	5yr	593.00	6372.62	6373.70	6373.70	6374.07	0.014757	4.89	121.18	165.15	1.01
reach_1	2327	100yr	2740.00	6372.62	6375.02	6375.02	6375.90	0.009419	7.65	403.15	269.34	0.95
reach_1	2227	Flume Design	350.00	6368.94	6370.86	6370.86	6371.45	0.012625	6.17	56.69	48.30	1.00
reach_1	2227	5yr	593.00	6368.94	6371.42	6371.42	6371.92	0.012966	5.71	104.84	109.61	1.00
reach_1	2227	100yr	2740.00	6368.94	6373.21	6373.21	6374.28	0.007853	8.72	417.68	266.46	0.92
reach_1	2127	Flume Design	350.00	6365.00	6368.89	6368.89	6369.32	0.013838	5.27	66.38	76.10	0.99
reach_1	2127	5yr	593.00	6365.00	6369.27	6369.27	6369.75	0.014227	5.57	109.10	147.31	1.02
reach_1	2127	100yr	2740.00	6365.00	6370.78	6370.78	6371.58	0.008011	7.96	557.57	401.56	0.90
reach_1	2027	Flume Design	350.00	6364.92	6366.40	6366.22	6366.55	0.015775	3.85	124.17	187.31	0.97
reach_1	2027	5yr	593.00	6364.92	6366.70	6366.39	6366.94	0.015192	4.90	190.29	261.98	1.02
reach_1	2027	100yr	2740.00	6364.92	6367.74	6367.70	6368.60	0.017621	9.33	553.16	478.41	1.26
reach_1	1927	Flume Design	350.00	6364.00	6365.36		6365.55	0.010057	4.51	153.65	252.04	0.85
reach_1	1927	5yr	593.00	6364.00	6365.65		6365.91	0.010440	5.55	235.13	334.55	0.91
reach_1	1927	100yr	2740.00	6364.00	6366.67	6366.67	6367.30	0.013553	9.67	689.07	509.44	1.16
reach_1	1827	Flume Design	350.00	6363.29	6364.02	6363.96	6364.21	0.021802	4.24	119.11	246.51	1.12
reach_1	1827	5yr	593.00	6363.29	6364.20	6364.16	6364.50	0.023093	5.33	164.51	269.75	1.22
reach_1	1827	100yr	2740.00	6363.29	6365.32	6365.32	6365.95	0.013566	7.83	611.98	508.07	1.10
reach_1	1727	Flume Design	350.00	6360.64	6362.25	6362.25	6362.62	0.011858	4.94	81.94	151.73	0.93
reach_1	1727	5yr	593.00	6360.64	6362.63	6362.63	6363.03	0.010019	5.34	153.00	233.77	0.89
reach_1	1727	100yr	2740.00	6360.64	6363.95	6363.95	6364.69	0.009089	8.15	650.72	551.89	0.95
reach_1	1627	Flume Design	350.00	6357.96	6359.20	6359.20	6359.46	0.025264	5.16	106.50	200.24	1.25
reach_1	1627	5yr	593.00	6357.96	6359.41	6359.41	6359.78	0.026995	6.10	154.14	239.99	1.33
reach_1	1627	100yr	2740.00	6357.96	6360.57	6360.57	6361.32	0.016715	8.87	547.24	404.71	1.22
reach_1	1527	Flume Design	350.00	6354.96	6357.08	6357.08	6357.42	0.011859	5.69	113.30	155.04	0.96
reach_1	1527	5yr	593.00	6354.96	6357.45	6357.38	6357.80	0.012127	6.09	174.86	181.62	0.98
reach_1	1527	100yr	2740.00	6354.96	6358.99	6358.86	6359.72	0.011119	9.27	594.77	368.98	1.06
reach_1	1427	Flume Design	350.00	6353.85	6355.76	6355.76	6356.15	0.011470	5.56	94.77	124.22	0.94
reach_1	1427	5yr	593.00	6353.85	6356.10	6356.10	6356.61	0.011718	6.53	146.40	169.26	0.99
reach_1	1427	100yr	2740.00	6353.85	6357.86	6357.86	6358.74	0.008699	9.82	637.16	444.45	0.98
reach_1	1328	Flume Design	350.00	6351.99	6353.67	6353.49	6353.90	0.013270	5.03	112.11	125.87	0.97
reach_1	1328	5yr	593.00	6351.99	6353.98	6353.81	6354.33	0.015444	6.18	153.19	144.18	1.08
reach_1	1328	100yr	2740.00	6351.99	6354.90	6354.90	6356.88	0.039189	15.08	345.35	254.24	1.92
reach_1	1253	Flume Design	350.00	6351.96	6353.07		6353.16	0.005441	2.85	164.32	203.69	0.61
reach_1	1253	5yr	593.00	6351.96	6353.35		6353.50	0.005718	3.68	227.83	240.70	0.66
reach_1	1253	100yr	2740.00	6351.96	6354.59		6355.18	0.008161	7.59	653.60	468.81	0.90
reach_1	1149	Flume Design	350.00	6350.76	6351.87	6351.87	6352.22	0.020126	5.56	93.42	138.27	1.17
reach_1	1149	5yr	593.00	6350.76	6352.20	6352.20	6352.60	0.016441	6.12	154.87	233.79	1.11
reach_1	1149	100yr	2740.00	6350.76	6353.55	6353.55	6354.26	0.011123	9.09	648.39	460.08	1.06
reach_1	1048	Flume Design	350.00	6346.99	6348.80		6348.90	0.006732	3.48	154.62	145.92	0.68
reach_1	1048	5yr	593.00	6346.99	6349.26		6349.39	0.006267	3.86	231.84	209.75	0.68
reach_1	1048	100yr	2740.00	6346.99	6350.69		6351.10	0.007731	7.46	796.67	482.41	0.87
reach_1	950	Flume Design	350.00	6344.97	6347.36	6347.36	6348.00	0.011849	6.46	57.82	61.69	0.98
reach_1	950	5yr	593.00	6344.97	6347.98	6347.98	6348.64	0.008523	6.77	122.11	146.17	0.88
reach_1	950	100yr	2740.00	6344.97	6349.73	6349.73	6350.41	0.006199	9.01	787.97	488.93	0.84
reach_1	851	Flume Design	350.00	6343.19	6344.97	6344.97	6345.65	0.012246	6.59	53.09	39.93	1.01
reach_1	851	5yr	593.00	6343.19	6345.61	6345.61	6346.44	0.010906	7.33	81.72	58.45	0.99
reach_1	851	100yr	2740.00	6343.19	6348.21	6348.21	6348.96	0.004443	8.45	769.82	488.81	0.73
reach_1	751	Flume Design	350.00	6342.29	6343.39	6343.39	6343.83	0.012217	5.55	77.97	96.32	0.97
reach_1	751	5yr	593.00	6342.29	6343.80	6343.80	6344.37	0.011180	6.43	121.88	118.15	0.97
reach_1	751	100yr	2740.00	6342.29	6345.64	6345.64	6346.42	0.006849	8.83	688.59	444.08	0.87

HEC-RAS Plan: Pueblo_Prop_Sed River: Pueblo Reach: reach_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	655	Flume Design	350.00	6341.39	6342.48	6342.37	6342.76	0.007202	4.47	112.88	227.48	0.75
reach_1	655	5yr	593.00	6341.39	6342.77	6342.74	6343.17	0.008342	5.61	170.36	272.75	0.84
reach_1	655	100yr	2740.00	6341.39	6344.60	6344.23	6345.23	0.005497	8.00	634.24	480.86	0.79
reach_1	612	Flume Design	350.00	6341.00	6342.49	6341.87	6342.57	0.001664	2.63	213.77	313.66	0.38
reach_1	612	5yr	593.00	6341.00	6342.76	6342.13	6342.91	0.002584	3.67	259.79	331.85	0.49
reach_1	612	100yr	2740.00	6341.00	6343.96	6343.69	6344.90	0.008789	9.57	460.35	438.93	0.98
reach_1	609		Inl Struct									
reach_1	578	Flume Design	350.00	6333.00	6335.60	6335.60	6336.40	0.011761	7.15	48.92	31.30	1.01
reach_1	578	5yr	593.00	6333.00	6336.33	6336.33	6337.33	0.010870	8.04	73.79	37.30	1.01
reach_1	578	100yr	2740.00	6333.00	6339.53	6339.53	6341.38	0.008599	10.90	252.92	72.26	1.00
reach_1	528	Flume Design	350.00	6332.88	6334.73	6334.73	6335.45	0.011980	6.81	51.42	36.12	1.01
reach_1	528	5yr	593.00	6332.88	6335.37	6335.37	6336.32	0.011135	7.81	75.95	40.98	1.01
reach_1	528	100yr	2740.00	6332.88	6338.27	6338.27	6340.13	0.008545	10.95	255.39	76.17	0.99
reach_1	475	Flume Design	350.00	6331.88	6334.02	6334.02	6334.61	0.012920	6.19	56.50	48.67	1.01
reach_1	475	5yr	593.00	6331.88	6334.53	6334.53	6335.33	0.011744	7.15	82.93	53.50	1.01
reach_1	475	100yr	2740.00	6331.88	6337.08	6337.08	6338.46	0.009557	9.44	291.17	109.03	1.00
reach_1	378	Flume Design	350.00	6328.00	6331.50	6331.50	6332.12	0.013055	6.30	55.54	46.10	1.01
reach_1	378	5yr	593.00	6328.00	6332.08	6332.08	6332.81	0.012022	6.89	86.08	58.99	1.00
reach_1	378	100yr	2740.00	6328.00	6334.55	6334.55	6336.04	0.009439	9.80	280.98	99.67	1.00
reach_1	320	Flume Design	350.00	6326.65	6330.06		6330.30	0.003662	3.93	89.01	58.23	0.56
reach_1	320	5yr	593.00	6326.65	6330.97		6331.23	0.002357	4.12	143.85	62.72	0.48
reach_1	320	100yr	2740.00	6326.65	6333.57		6334.59	0.003705	8.23	393.13	137.45	0.67
reach_1	280	Flume Design	350.00	6325.00	6329.83		6330.15	0.003582	4.54	77.16	38.09	0.56
reach_1	280	5yr	593.00	6325.00	6330.69		6331.09	0.004147	5.09	116.41	54.72	0.62
reach_1	280	100yr	2740.00	6325.00	6333.58		6334.39	0.003324	7.87	510.21	158.98	0.63
reach_1	260	Flume Design	350.00	6325.00	6329.70		6330.06	0.004311	4.83	72.40	37.36	0.61
reach_1	260	5yr	593.00	6325.00	6330.52		6330.99	0.004960	5.51	107.59	51.27	0.67
reach_1	260	100yr	2740.00	6325.00	6333.41		6334.31	0.003820	8.24	483.73	158.18	0.67
reach_1	255	Flume Design	350.00	6324.75	6329.74		6330.02	0.002903	4.27	81.93	37.59	0.51
reach_1	255	5yr	593.00	6324.75	6330.56		6330.95	0.003787	5.05	117.49	51.99	0.59
reach_1	255	100yr	2740.00	6324.75	6333.42		6334.28	0.003508	8.04	493.62	158.23	0.65
reach_1	250	Flume Design	350.00	6324.50	6329.46	6329.14	6329.98	0.007256	5.77	60.66	35.47	0.78
reach_1	250	5yr	593.00	6324.50	6330.24	6329.81	6330.90	0.007299	6.51	91.08	45.00	0.81
reach_1	250	100yr	2740.00	6324.50	6333.19		6334.23	0.004783	8.86	445.56	157.11	0.75
reach_1	245	Flume Design	350.00	6324.50	6329.14	6329.14	6329.91	0.012851	7.03	49.82	33.25	1.01
reach_1	245	5yr	593.00	6324.50	6329.81	6329.81	6330.82	0.011973	8.06	73.55	37.96	1.02
reach_1	245	100yr	2740.00	6324.50	6332.77	6332.77	6334.17	0.007075	10.09	381.31	155.02	0.89
reach_1	225	Flume Design	350.00	6324.01	6327.85	6327.85	6328.77	0.011861	7.69	45.50	25.28	1.01
reach_1	225	5yr	593.00	6324.01	6328.85	6328.68	6329.85	0.009036	8.02	73.91	31.39	0.92
reach_1	225	100yr	2740.00	6324.01	6332.40	6332.40	6333.88	0.006684	10.16	357.49	153.06	0.88
reach_1	179	Flume Design	350.00	6323.92	6327.19	6327.19	6328.20	0.011346	8.04	43.51	21.92	1.01
reach_1	179	5yr	593.00	6323.92	6328.11	6328.11	6329.37	0.010641	8.99	65.97	26.73	1.01
reach_1	179	100yr	2740.00	6323.92	6331.81	6331.81	6333.31	0.006160	10.84	406.33	147.18	0.86
reach_1	100	Flume Design	350.00	6322.86	6326.18	6326.18	6327.09	0.011668	7.64	45.79	25.82	1.01
reach_1	100	5yr	593.00	6322.86	6327.05	6327.05	6328.10	0.011019	8.21	72.25	35.21	1.01
reach_1	100	100yr	2740.00	6322.86	6329.72	6329.72	6330.94	0.010235	8.87	310.23	133.51	1.01

Appendix D

Photo Documentation

This appendix contains a series of photographs depicting the work progress on the Pueblo Canyon grade-control structure and associated stream gage E060.1. Photos are representative of the work performed and completed as of the dates noted. Although field work commenced October 26, 2010, photos were not allowed to be taken until November 14, 2009. These photos range from November 14, 2009, through final seeding on May 19, 2010.

November 14, 2009

Photo 1 Downstream of structure, looking east

Photo 2 Temporary access road, looking upgradient at structure location

Photo 3 Silt fence and rock check dam, downgradient of structure

Photo 4 Silt fence and rock check dam

November 14, 2009 (continued)

Photo 5 Assembly area

Photo 6 Assembly area

Photo 7 Gabion baskets

Photo 8 Gabion structure, looking downgradient at stilling-basin subgrade

Photo 9 Stream through temporary access road, diversion channel-right side of photo

Photo 10 Temporary access road

November 14, 2009 (continued)

Photo 11 Gabion stone stockpile

Photo 12 Gabion structure, looking north

Photo 13 Gabion structure subgrade, looking northwest

Photo 14 Gabion structure upstream, looking northeast at overflow weir subgrade and crest

Photo 15 Downstream, looking east

Photo 16 Gabion structure upstream, looking northeast at stilling basin and overflow weir

November 14, 2009 (continued)

Photo 17 Silt fence along channel, looking downstream of borrow area

Photo 18 Looking downstream of structure

Photo 19 Check dam and silt fence

Photo 20 Check dam

November 14, 2009 (continued)

Photo 21 Silt fence

Photo 22 Silt fence, downstream of structure around borrow area

Photo 23 Gabion structure, upstream looking east

November 21, 2009

Photo 1 Temporary access road upgradient of structure

Photo 2 Gabion stone stockpile

Photo 3 Gabion stone stockpile, looking upgradient

Photo 4 Gabion construction, looking north

November 21, 2009 (continued)

Photo 5 Gabion structure upstream, looking east at stilling basin and overflow weir

Photo 6 Structure construction, looking north

Photo 7 Gabion assembly

Photo 8 Structure looking north, gabion assembly

November 21, 2009 (continued)

Photo 9 Geotextile fabric on upstream face of structure

Photo 10 Geotextile fabric on upstream face of structure

Photo 11 Close-up view of gabion baskets

Photo 12 Close-up view of gabion baskets

Photo 13 Overflow basin/gabion bench, looking southwest

Photo 14 Looking upstream towards structure

November 23, 2009

Photo 1 Channel access to structure

Photo 2 Subgrade overflow weir gabion baskets

Photo 3 Overflow weir subgrade gabion baskets

Photo 4 Excavated area for stilling-basin gabion baskets

Photo 5 Stilling-basin gabion baskets, looking northwest

Photo 6 Structure construction, looking north

November 23, 2009 (continued)

Photo 7 Diversion channel downstream of structure

Photo 8 Diversion channel upstream of channel

Photo 9 Structure construction, looking north

November 28, 2009

Photo 1 Area to be excavated for southern portion of structure

Photo 2 Structure looking north, gabion-basket production

Photo 3 Area to be excavated for southern portion of structure

Photo 4 Structure looking northeast, gabion-basket production

Photo 5 Subgrade gabion baskets for gabion bench and stilling basin

Photo 6 Subgrade gabion baskets for gabion bench and stilling basin

November 28, 2009 (continued)

Photo 7 Gabion basket production area

Photo 8 Class A rip-rap stone stockpiles

Photo 9 Excavation of south half of stilling basin

Photo 10 Looking upstream from structure

Photo 11 Area to be excavated for southern portion of structure

December 3, 2009

Photo 1 Gabion structure looking south

Photo 2 Earthen berm construction

Photo 3 Gabion structure, looking south

Photo 4 Gabion structure, looking south from confinement gabion wall

Photo 5 Looking downstream at structure

Photo 6 Structure looking downstream

December 11, 2009

Photo 1 Grading of permanent access road

Photo 2 Grading of permanent access road

Photo 3 Grading of permanent access road

Photo 4 Grading of permanent access road

Photo 5 Grading of permanent access road

Photo 6 Structure, looking north from access road

December 11, 2009 (continued)

Photo 7 Earthen berm, looking north

Photo 8 Structure, looking upstream

Photo 9 Compacted earthen berm

Photo 10 Structure, looking upstream

Photo 11 Looking upstream at structure, gabion baskets in background

December 16, 2009

Photo 1 Structure, looking south from confinement gabions

Photo 2 Forms for concrete cap

Photo 3 Form for concrete cap

Photo 4 Concrete being delivered

December 16, 2009 (continued)

Photo 5 Concrete placement, low-flow and overflow weir

Photo 6 Concrete placement, low-flow and overflow weir

Photo 7 Concrete placement, low-flow and overflow weir

Photo 8 Concrete slump test

December 16, 2009 (continued)

Photo 9 Concrete placement, low-flow and overflow weir

Photo 10 Concrete placement, low-flow and overflow weir

December 17, 2009

Photo 1 Concrete cap finishing

Photo 2 Looking south, concrete cap placement

Photo 3 Placing Class A rip rap along upstream side of earthen berm

December 26, 2009

Photo 1 Concrete weir cap (low-flow and overflow weir)

Photo 2 Concrete weir cap

Photo 3 Class A rip-rap armoring of earthen berm, upstream face of berm

January 3, 2010

Photo 1 Structure, looking south

Photo 2 Looking downstream from structure

Photo 3 Low-flow weir, looking north

Photo 4 Standpipe buried by ice before extension

Photo 5 Earthen berm after rip-rap placement

Photo 6 Earthen berm

January 7, 2010

Photo 1 Structure with concrete cap

Photo 2 Structure, looking north from access road

January 11, 2010

Photo 1 Excavation for installation of Class B rip-rap armoring, downstream side of structure stilling basin

Photo 2 Excavation for installation of Class B rip-rap armoring, downstream side of structure stilling basin

January 14, 2010

Photo 1 Temporary access road looking downstream towards structure

Photo 2 Structure, looking north

Photo 3 South portion of structure, low-flow weir (foreground), overflow weir, confinement wall and gabion bench

Photo 4 Class B rip rap, downstream side of stilling basin

January 14, 2010 (continued)

Photo 5 Structure, looking south

Photo 6 Downgradient side of confinement wall and overflow weir, looking south

Photo 7 Stilling basin, downstream Class B rip rap armoring

Photo 8 Channel access road to flume

January 18, 2010

Photo 1 View from access road, looking northwest

Photo 2 Looking east at north overflow weir

Photo 3 View of structure from access road, looking northwest

Photo 4 Looking upstream of structure

January 18, 2010 (continued)

Photo 5 Downstream side of structure, looking southwest

Photo 6 Downstream side of structure, looking northwest

Photo 7 Overflow weir bench, overflow weir

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January 18, 2010 (continued)

Photo 9 Looking south from confinement wall

Photo 10 Riser pipe before extension

Photo 11 Looking downstream (structure in background)

February 1, 2010

Photo 1 Structure, looking upstream at stilling basin and riser-pipe outlet pipe

Photo 2 Downstream of structure, Class B rip rap for flume entrance

Photo 3 Groundwater intrusion in flume excavation

Photo 4 Excavation for concrete flume

February 1, 2010 (continued)

Photo 5 Form work for flume

Photo 6 Form work for flume

Photo 7 Form work for flume

Photo 8 Excavation for flume

Photo 9 Excavation for flume, groundwater intrusion

Photo 10 Excavation for flume, groundwater intrusion

February 1, 2010 (continued)

Photo 11 Excavation for flume, groundwater intrusion

Photo 12 Looking downgradient at flume

Photo 13 Headwall subgrade compaction

Photo 14 Headwall subgrade compaction

Photo 15 Headwall subgrade compaction

February 2, 2010

Photo 1 Flume headwall form work

Photo 2 Headwall subgrade compaction

Photo 3 Headwall subgrade compaction

Photo 4 Headwall subgrade compaction

Photo 5 Headwall form work

Photo 6 Headwall subgrade compaction

February 2, 2010 (continued)

Photo 7 Headwall subgrade compaction

Photo 8 Headwall subgrade compaction

Photo 9 Headwall form work

Photo 10 Headwall form work

February 5, 2010

Photo 1 Concrete testing for flume headwall concrete placement

Photo 2 Mode of transporting concrete to flume

Photo 3 Slump test

Photo 4 Preparing test cylinder

Photo 5 Concrete testing

Photo 6 Preparing concrete cylinders

February 5, 2010 (continued)

Photo 7 Flume headwall concrete placement

Photo 8 Flume headwall concrete placement

Photo 9 Flume headwall concrete placement

Photo 10 Flume headwall concrete placement

February 9, 2010

Photo 1 Excavation for flume subgrade

Photo 2 Excavation for flume subgrade

Photo 3 Flume headwalls

Photo 4 Flume subgrade compaction

Photo 5 Flume subgrade compaction

Photo 6 Flume subgrade compaction

February 10, 2010

Photo 1 Flume subgrade compaction

Photo 2 Flume subgrade compaction

Photo 3 Flume subgrade compaction

Photo 4 Flume subgrade compaction

Photo 5 Flume subgrade compaction

February 11, 2010

Photo 1 Wire mesh reinforcement for flume

Photo 2 Monitoring temperature of concrete for flume concrete placement

Photo 3 Flume concrete slump test

Photo 4 Flume concrete cylinder samples

Photo 5 Flume concrete cylinder samples for lab testing

Photo 6 Placing concrete flume

February 11, 2010 (continued)

Photo 7 Concrete placement and finishing of flume

Photo 8 Concrete finishing of flume

Photo 9 Concrete finishing of flume

Photo 10 Concrete finishing of flume

February 11, 2010 (continued)

Photo 11 Concrete finishing of flume

Photo 12 Concrete finishing of flume

Photo 13 Concrete finishing of flume

March 4, 2010

Photo 1 Channel access to flume downstream of structure

Photo 2 Flume diversion trench

Photo 3 Placing stilling well for gage

Photo 4 Working on flume rip-rap installation

March 5, 2010

Photo 1 Rip-rap placement

Photo 2 Stream gage stilling-well installation, compaction around well

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Photo 1 View of south downgradient slope being prepared for Class A rip-rap armoring installation

Photo 2 Structure, looking at south upgradient slope, being prepared for Class A rip-rap armoring installation

Photo 3 Working on Class B rip-rap installation upstream of flume

Photo 4 Installing Class A rip rap for flume

March 8, 2010 (continued)

Photo 5 Installing Class A rip rap

Photo 6 Preparing south downgradient slope for Class A rip-rap armoring

Photo 7 Downstream of structure, looking at gage station rip-rap installation

Photo 8 Final grading, upstream side of structure

Photo 9 Downstream of structure, looking south

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Photo 2 Preparing south slope, downstream of structure, for rip rap

Photo 3 Placing geotextile for south slope rip rap, downstream of structure

Photo 4 Preparing to place Class A rip-rap armoring on south slope downgradient of structure

Photo 5 Preparing to place Class A rip-rap armoring on south slope downgradient of structure

March 10, 2010

Photo 1 Structure, looking south

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Photo 3 Looking downgradient from structure

Photo 4 Class A rip-rap placement, south slope downgradient of structure

March 10, 2010 (continued)

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Photo 6 Looking south at south slope armoring

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Photo 8 Working on Class A rip-rap exit from flume

Photo 9 Working on Class A rip-rap entrance to flume

March 11, 2010

Photo 1 Placing Class A rip-rap armoring on south slope downgradient of structure

Photo 2 Placing rip-rap armoring on south slope downgradient of structure

Photo 3 Finalizing grade downstream of flume

Photo 4 Upstream side of low-flow weir

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Photo 1 Access road

Photo 2 Flume

Photo 3 Class B rip-rap work

Photo 4 Class A rip-rap armoring of south slope on upstream side of structure

March 12, 2010 (continued)

Photo 5 Grading and compacting area south of flume

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Photo 7 Class B (foreground) and Class A (background) rip-rap approach to flume

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Photo 1 Slope of flume

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Photo 3 Flume and stilling well

Photo 4 South access road

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Photo 2 Flume Class B rip-rap installation looking upstream from flume

Photo 3 Flume Class B rip-rap installation looking downstream from structure

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Photo 6 Final grading upstream of structure, newly planted willows on right side of photo

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Photo 2 Looking upstream from structure

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LA-UR-10-3300
June 2010
EP2010-0214

Completion Report for DP Canyon Grade-Control Structure and Gage Station E039.1

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

Los Alamos National Laboratory, operated by Los Alamos National Security, LLC, for the U.S. Department of Energy under Contract No. DE-AC52-06NA25396, has prepared this document pursuant to the Compliance Order on Consent, signed March 1, 2005. The Compliance Order on Consent contains requirements for the investigation and cleanup, including corrective action, of contamination at Los Alamos National Laboratory. The U.S. government has rights to use, reproduce, and distribute this document. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.

LA-UR-10-3300
EP2010-0214

Completion Report for DP Canyon Grade-Control Structure and Gage Station E039.1

June 2010

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EXECUTIVE SUMMARY

This report was prepared by Kellogg Brown and Root Services, Inc. (KBR), and Post, Buckley, Schuh, and Jernigan, Inc. (PBS&J), for the U.S. Department of Energy (DOE) Los Alamos Site Office, and Los Alamos National Laboratory (LANL or the Laboratory) to document and summarize the design, analysis, and construction of the Delta Prime (DP) Canyon grade-control structure and associated stream gage E039.1. This report addresses engineering and site exploration activities, deviations from the original design, permitting, and construction activities.

The Los Alamos and Pueblo watershed, including the canyons and their tributaries, encompasses several former and current technical areas of the Laboratory. In 2004, the Los Alamos and Pueblo Canyons Investigation Report presented investigations of the nature, extent, transport, and potential risk from chemicals of potential concern in the watershed. Following a notice of disapproval from the New Mexico Environment Department (NMED) in 2005, DOE and the University of California prepared a supplemental investigation report for Los Alamos and Pueblo Canyons. In 2007, NMED issued an approval with direction for this report, with requests that the Laboratory conduct actions to mitigate the transport of polychlorinated biphenyls (PCBs) in stormwater. The February 2008 Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons presented interim actions to mitigate PCB transport. NMED issued an approval with modifications to the interim measure work plan, resulting in a supplemental interim measure work plan. The DP Canyon grade-control structure was presented in the supplemental plan as an additional mitigation measure to reduce contaminant transport within the Los Alamos and Pueblo watershed.

The DP Canyon project consisted of (1) the construction of a grade-control structure that raises the level of the stream bed to induce channel aggradation (sediment deposition) upstream of the structure and (2) the relocation of the E039 stream gage and construction of a supercritical-flow flume to enhance water flow measurements at the new location. The goal of the grade-control structure is to partially fill the upstream channel, with the result of more frequent out-of-bank flooding, thereby increasing the potential for sediment deposition on adjacent floodplains, burying contaminated sediment deposits. The DP Canyon grade-control structure is located downcanyon from the former Solid Waste Management Unit 21-011(k) Outfall at Technical Area 21 and near the site of the former E039 gaging station at the east end of reach DP-2. The relocated and upgraded gage, E039.1, is located 62 ft downstream of the structure. In this location, the flume and gage can measure the efficiency of the grade-control structure.

Construction of the grade-control structure began October 26, 2009, and was completed January 26, 2010. A letter submitted to NMED on February 5, 2010, gave notice of the grade-control structure completion and requested an extension to the completion report submittal date. In a letter dated February 16, 2010, NMED approved the requested extension for the completion report to June 3, 2010. Stream gage E039.1 construction was completed February 27, 2010. Seeding of the entire area was delayed until May when the noise ordinance for the canyon was lifted. The site was seeded May 4, 2010.

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Appendix B Geotechnical Engineering Report (on CD included with this document)

Appendix C HEC-RAS Calculations (on CD included with this document)

Appendix D Photo Documentation

Acronyms and Abbreviations

2-D	two-dimensional
3-D	three-dimensional
CMP	corrugated metal pipe
CQC	contractor quality control
DOE	Department of Energy (U.S)
DP	Delta Prime (canyon)
EPA	Environmental Protection Agency (U.S.)
FFA	flood frequency analysis
KBR	Kellogg Brown and Root Services, Inc.
HDC	hydraulic design chart
HEC-FFA	Hydrologic Engineering Center Flood Frequency Analysis (U.S. Army Corps of Engineers statistical computer program)
HEC-RAS	Hydrologic Engineering Center River Analysis System (U.S. Army Corps of Engineers surface model)
IMWP	interim measure work plan
LANL	Los Alamos National Laboratory
LIDAR	light detection and ranging
NMED	New Mexico Environment Department
PBS&J	Post, Buckley, Schuh, and Jernigan, Inc.
PCB	polychlorinated biphenyls

PM	project manager
PVC	polyvinyl chloride
SDIC	Security, Disaster, Infrastructure Construction (USACE multiple-award task-order contract)
SIMWP	supplemental interim measure work plan
TA	technical area
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

1.0 PROJECT OBJECTIVES

The Los Alamos and Pueblo watershed, including the canyons and their tributaries, encompasses several former and current technical areas of Los Alamos National Laboratory (LANL or the Laboratory). The Los Alamos and Pueblo Canyons Investigation Report (LANL 2004, 087390) presented investigations of the nature, extent, transport, and potential risk from chemicals of potential concern in the watershed. Following a notice of disapproval from the New Mexico Environment Department (NMED) (2005, 088463), the Laboratory prepared a supplemental investigation report for Los Alamos and Pueblo Canyons (LANL 2005, 091818). NMED issued an approval with direction for this report (NMED 2007, 098284), with requests that actions be conducted to mitigate the transport of polychlorinated biphenyls (PCBs) in stormwater. The February 2008 Interim Measure Work Plan (IMWP) to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons (LANL 2008, 101714) presented interim actions to mitigate PCB transport. NMED issued an approval with modifications to the IMWP (NMED 2008, 103007), resulting in a supplemental IMWP (SIMWP) (LANL 2008, 105716; NMED 2009, 105014). The DP Canyon grade-control structure is an additional mitigation measure identified in the SIMWP to reduce contaminant transport within the Los Alamos and Pueblo watershed. Figure 1.0-1 shows sediment transport mitigation sites in Los Alamos and Pueblo Canyons, highlighting the DP Canyon grade-control structure and the stream gage E039.1.

The project consisted of the construction of a grade-control structure and relocation and upgrade of the E039 stream gage located within the Laboratory's Technical Area 71 (TA-71). The structure and associated stream gage are within Delta Prime (DP) Canyon and are referred to as the DP Canyon grade-control structure and stream gage E039.1, respectively. The DP Canyon grade-control structure is located downcanyon from the former 21-011(k) Outfall at TA 21 and near the site of the prior E039 gaging station at the east end of reach DP-2. The relocated stream gage, E039.1, is located approximately 62 ft downgradient of the structure as measured from the downstream end of the structure stilling basin to the upstream flume invert (see Figures 1.0-1, 1.0-2, and Appendix A).

The structure is part of remedial actions taken to reduce the migration of contaminated sediment into the lower reaches of DP and Los Alamos Canyons, where they could migrate off-site. Beneficial results of the grade control include the partial burial of upstream banks, reducing the potential for bank erosion, and the enhancement of floodplain deposition upstream of the structure.

The DP Canyon grade-control structure was designed to induce upstream aggradation (sediment deposition) that will fill the channel and partially bury the existing sediments in the floodplain. Aggradation within the channel upstream of the structure will reduce erosion of contaminated stream banks and overbank areas during significant storm events. Flood flows will more frequently spill into the overbank areas and, through deposition, bury existing contaminated floodplain deposits.

In order to simplify the design, reduce costs, and still provide a stable, safe structure, the structure was designed and constructed to ensure that it did not fall under New Mexico Safe Dams regulations. Under these rules and regulations, a structure is classified as a dam when the structure is more than 10 ft in height (measured from original channel elevation to the top of the low spillway) or is capable of impounding more than 10 acre-ft of water. The DP Canyon grade-control structure does not exceed either of these limitations. The design and final as-built height of the structure is 4 ft at the low-flow weir and 7 ft at the overflow weir as measured from the stream-channel elevation. Maximum impoundment at the low-flow weir is 0.05 acre-ft and at the overflow weir is 0.33 acre-ft.

The objective of relocating stream gage E039 downstream of the structure is to monitor the efficiency of the structure. To enhance the accuracy of water flow data, a concrete supercritical flume was constructed at the relocated stream-gage location.

2.0 DESIGN

2.1 General

2.1.1 Grade-Control Structure

The DP Canyon grade-control structure is composed of rock-filled gabion baskets with a 21-ft-wide low-flow weir centered perpendicular to the stream centerline. The low-flow weir was designed to carry storm runoff from a 5-yr storm event. A 54-ft-long overflow weir was constructed at 3 ft above the low-flow weir to accommodate a 100-yr storm event. The 100-yr flow was used to determine the upper-weir and confinement-wall dimensions and to calculate the energy dissipation stilling-basin dimensions (Figures 2.1-1 and 2.1-2, and Appendix A sheet C-400).

Since the gabion structure would be unsupported, it was designed to provide sufficient mass to prevent slippage and overturning. The design of the structure also provides for the raising of water surface elevations behind the structure during more frequent flood events (5-yr), such that the sediment deposition occurs immediately upstream of the structure and yet minimizes the backwater effects of the less frequent flood events (50- to 100-yr).

The structure design also includes buttress gabions upstream of the weir. The upstream buttress gabions protect the main gabion structure from flow that may contain boulders, trees, and other debris. The top of the grade-control structure was designed to direct flow onto the gabion benches below the top elevation. Downstream buttress gabions also provide energy dissipation of flows. With flows directed to the stilling-basin floor, energy will also be dissipated through the benches.

The upstream face of the structure was wrapped in a geotextile material to minimize the transport of fine sediments during the early stages of operation as well as to reduce the flow of water through the structure. The type of geotextile material was based on gradation analysis of the stream sediment. The material was buried by backfill, using streambed material to stabilize the geotextile and to add impermeability. In addition, a 3-in. concrete cap was applied to the low-flow and overflow weir crests to protect against potential damage from scouring and debris (Figure 2.1-3).

A perforated and slotted riser pipe was constructed approximately 25 ft upstream of the structure to assist in releasing water stored upstream (Figure 2.1-4). One side consists of removable wood boards placed in slots. The remaining riser pipe is a perforated corrugated metal pipe (CMP) to allow water to enter the pipe. This pipe is connected to an outfall pipe that goes through the gabion structure to the stilling basin. The top wood board is placed at the elevation of the low-flow weir or higher to ensure that maximum water surface elevations are achieved to induce sediment settling. After a storm event, the perforations on the pipe will allow dewatering behind the weir. However, if the rate of dewatering is not sufficient to meet standards or the perforations get plugged by debris, wood boards can be removed as needed to accelerate the dewatering process.

2.1.2 Stream Gage

The new stream gage, E039.1, was originally designed to be located within the grade-control structure. However, during construction the location was changed to provide more accurate measurements and to

better monitor the efficiency of the grade-control structure. The stream gage's concrete supercritical-flow flume design measures flow up to 350 cubic ft per second (cfs) (Figure 2.1-5). The determination of the stream-gage location, approximately 62 ft downstream of the grade-control structure stilling basin, was based on topographic conditions, on-site investigations, and stream geometry. The U.S. Geological Survey (USGS) publication "Techniques of Water Resources Investigations of United States Geological Survey," Chapter A14, Use of Flumes in Measuring Discharge (Kilpatrick and Schneider 1983, 109514), was used to develop a flume design to accommodate measuring equipment and instrumentation and measure flows up to 350 cfs. The final design, the result of the collaboration of design, construction, and environmental professionals, was subjected to a thorough review by Laboratory and U.S. Department of Energy (DOE) personnel. Design details and as-built information are contained in Appendix A, sheets C-06 through SG-03.

2.2 Site Selection/Exploration

2.2.1 Grade-Control Structure

The grade-control structure location was chosen to meet the overall project objectives and also provide an efficient and value-engineered structure. During the initial design process, adjustments were made to the structure to reduce the overall length by taking advantage of existing topography.

The general area in which the structure was to be constructed was determined primarily by U.S. Army Corps of Engineers (USACE), DOE, and Laboratory input to meet the principal objectives for the project. During the design process, more detailed topographic information was obtained and a geotechnical exploration was performed. The geotechnical exploration and subsequent report provided information on subsurface soil and bedrock conditions; groundwater conditions; structure support; lateral earth pressures; and earthwork recommendations (see Appendix B for the geotechnical engineering report).

The final site selection was based on a variety of additional factors including hydrologic/hydraulic effectiveness, existing topography, vegetation, on-site investigations, an existing historic trail, and value engineering. Two factors were considered as the primary focus.

- **Hydraulic Effectiveness**. During the modeling and design process, the positions of the structure longitudinally along the canyon and laterally within the canyon were evaluated. Factors such as turbulence of flow, erosion mitigation, sediment containment, and structural stability were considered. Upstream and downstream channel conditions played a significant role in the design based on the model analysis of the effectiveness of the proposed upstream channel aggradation.
- **Existing Topography**. Significant material excavation and fill were necessary to construct the grade-control structure. Personnel and equipment access during construction and operation were also considered. Once a preliminary structure design was complete, the gabion configuration was fitted into the existing topography of several of the preliminary locations that were identified by field surveys. Each potential site was then evaluated based on the amount of material to be excavated and filled, ease of access, and position in reference to significant contour changes in the canyon.

Once the final location was determined, an additional field visit was performed to ensure no other existing conditions were overlooked.

2.2.2 Stream Gage

Greater accuracy in flow measurements and sediment data were factors that contributed to the choice of a supercritical-flow flume design for the stream gage. The new stream gage measures flow up to 350 cfs. The flume has specific dimensions, is trapezoidal in shape, and requires a 5% channel slope and a straight approach and exit for proper operation. Distance from the structure was also an important consideration. Location of the gage station was driven by

- channel geometry and topographic conditions, so that the approach to and exit from the flume would be fairly straight and that minimal channel disturbance would be required to construct the flume, and
- a distance from the structure that would allow water exiting the structure to calm before entering the flume but would not be too far to prevent accurate sediment disposition measurements.

Appendix A provides as-built drawings of the grade-control structure and stream gage.

2.3 Hydrologic/Hydraulic Modeling

2.3.1 General

The DP Canyon watershed is within the semiarid higher-elevation mountains of New Mexico and contains an ephemeral stream system. The watershed includes areas of variable vegetation density, rock outcrops, and urbanization. Flood-flow frequency estimates for the structure locations were based on statistical analysis based on historical stream-gage information within the project area and the regional USGS regression formulas (USGS 2000, 109515) and the USACE statistical computer program Hydraulic Engineering Center Flood Frequency Analysis (HEC-FFA) (USACE 1992, 109512).

A hydrologic analysis was performed to provide design parameters for the proposed grade-control structure. The initial analysis, performed in August 2009, was based on stream-gage data, topographic information, a site visit, and the geomorphic and climatologic conditions of the project area. This initial analysis was used to develop the conceptual and preliminary construction plans. Additional light detection and ranging (LIDAR) survey data was obtained during the final phases of design. This provided a more detailed and accurate surface model than was previously available. The new LIDAR data and final design dimensions, which included changes to weir elevations and approach conditions, were used to run a second analysis with the HEC River Analysis System (HEC-RAS) model (USACE 2008, 109518) in December 2009. The results of the new model verified that the final design and as-built structure met the original project objectives. Results of the HEC-RAS analysis are included in Appendix C.

2.3.2 Flood Frequency Analysis Results

Table 2.3-1 presents the FFA results for the DP Canyon project site collected at DP Canyon gage station E038. The gage data at the site is statistically very short, having only 6 yr of records. In addition, the USGS regression formulas used, USGS Rural (USGS 2000, 109515), are based on regional analysis of gage data, which also is sparse and generally of short-record periods.

Stream gage E038 is located upstream of the DP Canyon grade-control structure. Therefore, the FFA results were modified to reflect the larger drainage basin at the project location (Table 2.3-1, column 3, FFA Extended to Project Site). The modification involved multiplying the results by the ratio of the drainage area at the project site to the drainage area at the gage location to the power of the drainage area factor as recommended by the USGS for this region (Waltemeyer 2008, 109516).

In review of the results, the FFA extended discharge-frequencies are higher for the more frequent events (2- to 10-yr floods) and becoming smaller for the more rare events (50- to 500-yr floods). This may be explained by the fact that this watershed has a large area that has become urbanized. The USGS regression equation generally accounts for rural or undeveloped areas and would miss the higher runoff from more frequent rainfall events that would not produce runoff in undeveloped semiarid conditions. The FFA results are based on just a few years of information that do not contain a rare-event flood and miss the higher end of the frequency range (higher flows). Since the geomorphic design for DP Canyon is based upon the more frequent lower flow, the FFA Extended to Project Site was adopted. The higher flows (50- to 100-yr) were used to ensure that the structure can safely pass these flows. To accommodate the uncertainty at the high flows, a safety factor was incorporated by raising the side walls of the structure above the design elevation required to contain the 100-yr flood.

2.3.3 Development of the HEC-RAS Hydraulic Models

To determine the hydraulic effects of the proposed structures, HEC-RAS models were developed. The HEC-RAS Version 4.0 models were initially constructed using shape (.shp) files provided by the Laboratory. The two-dimensional (2-D) data were then converted to 3-D data and geographic information system techniques were used for cross-section development. Existing conditions models were constructed and calibrated to the best extent, and water surface elevations for the 2-, 5-, 10-, 50-, and 100-yr peak-flood discharges were simulated and plotted. All subsequent models used these peak-flood discharges. This initial model was used to develop a base design and plan for the structure. Additional survey data were collected for the site. Based on the new data, new cross sections were prepared and the final, revised, and refined current model was developed.

A proposed conditions model (with grade control), without accumulated sedimentation behind the structure, was constructed, simulated, and plotted. The HEC-RAS in-line weir option was used to model the grade-control structure. Proposed conditions models, with sedimentation, were created to simulate the change in the streambed elevations due to anticipated long-term deposition of sediment upstream of the grade-control structures (described in section 2.4). These three conditions─existing, grade-control structure without sediment deposits, and grade-control structure with sediment deposits─were compared and analyzed. Cross-section layouts, profiles, cross sections, and tabular results for each model condition are included in Appendix C.

2.3.4 Grade-Control Structure Stilling-Basin Design

The stilling-basin length and end-sill height were determined using the USACE Hydraulic Design Chart (HDC) Number 623 (USACE 1959, 109511) based upon the 100-yr flood. HDC 623 develops empirical relationships between the design-critical depth of the approach flow to the height between the weir crest and the top of the end sill in order to size the length of the stilling basin as well as the height of the end sill.

For the empirical relationship of HDC 623 to be successful, the tailwater depth beyond the end sill is recommended to be between 1.25 to 1.67 times that of the approach flow-critical depth. For DP Canyon, the design discharge tailwater would need to be approximately 2½ to 3 ft above the top of the end sill. The HEC-RAS results showed the tailwater conditions were met.

2.3.5 Grade-Control Structure Low-Flow Weir Design

A low-flow rectangular weir was sized to induce the design volumes and location of deposition in the upstream area. The width and depth of the weir was estimated using regime equations (Copeland 1994,

109508) and assuming that the 5-yr discharge is a “channel forming” discharge; a common practice for arid to semiarid regions. The regime width and depth dimensions for the 5-yr flood were used as initial guides and adjusted to meet multiple objectives such as accommodating standard gabion sizes and physical site restrictions and minimizing the structure footprint. The weir was laterally placed where the natural thalweg of the stream is located. The height of the weir above the natural ground was determined by examining the design deposition slope (described in section 2.4) and adjusting it vertically to maximize deposition on the overbank sediments, safely pass the 100-yr flood above the weir, and still be a stable structure. The initial height of the low-flow weir is 1 ft above the existing ground. This height can be varied as described in section 2.5.

2.4 Sediment Deposition Profile Analysis

The profile of the anticipated sedimentation behind the grade-control structure was based upon examination of equilibrium slope analyses (Pemberton and Lara 1984, 109509) and engineering judgment to select an appropriate slope. The equilibrium slope is the theoretical slope that the stream would eventually reach. This slope is projected upstream, starting at the low-flow weir notch elevation, to determine the depths that would cover the contaminated sediments in the floodplain and the potential wetland extents. This deposition profile was used to adjust the cross-section geometry in the HEC-RAS models to determine the water surface elevations for the varied-frequency floods. The deposition profile predicts the water surface profiles for ultimate conditions.

2.5 Adaptive Management Features

2.5.1 Adjustable Weir Crest Height

Predictions of the sediment deposition in the upstream overbank areas can vary because of variations in the stream flow, changes in the sediment characteristics, varying equilibrium slopes, and other factors. To enhance operational flexibility, an additional vertical column of gabions was added to the structure, increasing the thickness of the upper weir foundation. The thicker foundation makes it possible to increase the low-flow weir crest by progressively adding gabions or gabion mattresses up to the crest of the 100-yr overflow. This gives opportunities to accelerate the deposition and to increase or decrease the sediment deposition elevations in the areas upstream of the structure. The initial design crest of the low-flow weir is 1 ft above the existing ground but can go as high as 7 ft. Any additional gabions also increase the structural integrity of the structure.

2.5.2 Adjustable Riser Pipe

When a flow event occurs, the structure causes an impoundment of the water and allows settling of the sediment. After the event has receded and the majority of the suspended sediment has settled, the standing water must be released downstream. A perforated and slotted riser pipe, placed approximately 25 ft upstream of the structure, assists in these functions. The upstream face consists of removable wood boards placed in slots, while the remainder of the riser pipe is perforated CMP (Figure 2.1-4). This pipe is connected to an outfall pipe that goes through the gabion structure out to the stilling basin. The height of the riser pipe is the same as the top of the overflow weir to allow for adjustments if the low-flow weir elevation is ever increased. Varying the elevation of the top board enables maximum retention of water behind the structure, inducing sediment settlement, or allows for accelerated dewatering.

2.6 Engineering

2.6.1 Grade-Control Structure

Since the gabion grade-control structure is unsupported and acts as a retaining structure, the gabion design required sufficient mass to prevent sliding and overturning. The design of the structure required raising the water surface elevations for the more frequent flood events (5-yr) such that significant sediment deposition will now occur immediately upstream of the structure, minimizing potential backwater effects of the rare flood events (50- to 100-yr) and ensuring the 100-yr flood does not overtop the structure.

The 5-yr flow was used to design a low-flow notch. The 100-yr flow was used to determine the dimensions of the rest of the structure (the overflow weir and confinement walls) and to calculate the energy dissipation (stilling) basin dimensions and end-sill heights. A 50-yr design was considered, but since the increase in design heights to contain the 100-yr event was small (0.5 ft or less); the design was based upon the 100-yr peak-flood event. This resulted in a minimal increase in cost as well as provided additional structural safety. Structural integrity of the grade-control structures, with and without saturated sediment against the upstream face, was evaluated by a licensed structural engineer.

The structure design included additional gabions upstream of the low-flow weir. The purpose of these gabions is to raise the flow of water approaching the weir for better efficiency; to prevent damage of the main gabion structure and weirs from flow that may contain large rocks, trees, and other debris; and to provide additional structural mass to prevent sliding and overturning. The lower and upper weirs direct flow into buttress gabions downstream. These gabions dissipate flow energy and also provide additional structural mass to prevent sliding and overturning.

The structure design is composed of gabions consisting of 6- to 9-in. -diameter rock enclosed in wire baskets. Whenever possible, standard 3-ft x 3-ft x 6-ft gabions were used. Structure dimensions and embedment elevations were conservatively adjusted to eliminate the need for nonstandard size gabions. See Appendix A for as-built drawings.

2.6.2 Stream Gage

The supercritical-flow flume is a concrete structure approximately 19 ft wide at the entrance, 15 ft wide at the exit, 15 ft in length, and 4 ft in depth. Several factors were considered in determining the flume location, including minimal disturbance to the downstream channel, overall design and construction costs, providing a straight channel for entrance and exit, and minimal influence on the accuracy of instrument readings. The flume was placed 62 ft downstream of the structure.

Class A rip-rap armoring was added upstream, downstream, and along the edges of the flume to prevent water from undermining the flume, to minimize potential accumulation of additional sediment between the gabion structure and flume, and to protect the stream channel from potential erosion. To maintain flow through the flume and provide accurate measurements, the Class A rip rap on the downstream is a minimum of 4 in. below the bottom of the flume. This elevation difference allows unimpeded flow from the flume.

Three polyvinyl chloride (PVC) pipes are embedded into the south wall of the flume at varying heights. The PVC pipes daylight into a CMP stilling well. As the water levels in the flume reach the pipe openings, the water is conveyed to the stilling well. Equipment used in measuring water flow and in sample collection is housed in and on top of the CMP. The height of the CMP was designed to keep the equipment above the water surface in the event of a 100-yr flow event. As-built drawings are provided in Appendix A. Equipment for collecting sampling and flow data was also installed at the stream gage E039.1.

2.7 Permitting

The Laboratory's Construction and Engineering group performed an internal review of the design model and the construction documents. To comply with Section 404/401 of the Clean Water Act, applications for Nationwide Permits 43 and 5 were filed with the NMED Surface Water Quality Bureau and the Albuquerque District of the USACE. Section 404 regulates discharges of dredged or filled material in waters of the United States. NMED certified the proposed discharges would not adversely affect water quality standards under Section 401. Local municipal permitting was not required for the proposed improvements.

An erosion control plan was prepared and followed to ensure the use of best management practices and ensure maximum protection of the environment during and after construction. Erosion and sediment control measures were in accordance with NMED Watershed Protection and U.S. Environmental Protection Agency Guidelines (EPA 2007, 109510) for stormwater pollution prevention. The protocols of the erosion control plan conform to Laboratory requirements. This plan was prepared under the direction of a certified professional in erosion and sediment control. The erosion control plan is provided in Appendix A, sheet C-304.

2.8 Design Improvements/Deviations

The design process was relatively fluid and adaptive to the existing site conditions and Laboratory requirements. The following were the key design changes in the project:

- A riser pipe was designed and installed upstream of the structure to facilitate sedimentation while providing a means for discharging retained water through the structure. The riser pipe is adjustable so that it remains functional as sedimentation accumulates behind the structure.
- The riser pipe elevation was increased from the height of the low-flow weir crest to match the height of the overflow weir crest, allowing for greater flexibility should the height of the structure increase.
- The structure was shifted to accommodate the existing topographic conditions and minimize potential impact to an existing historic trail.
- Gabion depths and configuration were adjusted in some areas where bedrock was encountered.
- A 3-in. concrete cap was added to the low-flow and overflow weirs to protect the gabions and reduce long-term maintenance.
- Class B rip rap was added downstream of the structure to ensure that flows exiting the stilling basin would not undermine the downstream side of the stilling-basin gabions.
- Existing bedrock found directly downstream of the structure was used as a substitute for a portion of the proposed rip rap.

Constructability reviews by the construction subcontractor where completed before the initiation of construction. Therefore, no significant modifications occurred during the construction process. As-built drawings of the improvements detail the minor deviations (Appendix A).

3.0 CONSTRUCTION

3.1 General

Under contract with the USACE, Omaha District, Security, Disaster, Infrastructure Construction (SDIC) multiple award task order contract, Kellogg Brown and Root Services, Inc. (KBR) performed general contractor services, delivering the project using the design-build method. Construction of the DP Canyon grade-control structure and stream gage E039.1 began on October 26, 2009. The grade-control structure was completed on January 26, 2010. The Class B rip-rap installation downstream of the structure and construction of the stream gage and associated Class A rip rap were completed on February 27, 2010. Seeding of the entire area was delayed until May when the noise ordinance for the canyon was lifted. The site was seeded May 4, 2010. Appendix D presents photo documentation of construction activities.

3.2 Safety and Health

With the guidance and approval of the Omaha District of the USACE, and the Laboratory, the design-build contractor implemented a specific project safety plan to ensure the project met safety and health goals. All work and reports were accomplished in accordance with the USACE Safety and Health Requirements Manual EM 385-1-1 and Laboratory requirements. An activity hazard analysis was conducted for each definable feature of work. Consideration was given to work tasks and steps; hazards, concerns, and potential accidents; controls, preventive measures, and bounding conditions; reference documents; and training and qualification requirements. As a result, there were no lost-time accidents or incidents during the entire project.

3.3 Quality Control

With the guidance and approval of the Omaha District of the USACE, the design-build contractor implemented a contractor quality control (CQC) plan to ensure the project met quality construction goals. The plan was compliant with ISO 9001:2000 international quality standards and met the quality control requirements of the contract. The project quality manager used the quality management system and CQC plan to ensure adherence to USACE SDIC requirements and standards.

The design-build contractor implemented the CQC as follows:

- Assigned ultimate responsibility for quality to the project manager (PM), who delegated responsibility to each level within the program organization, down to the individual craftsperson and worker. Each level was responsible for application and enforcement of policy within its respective area of authority.
- Provided a quality control supervisor who assisted the PM by administering the program and providing an independent analysis of the quality control program's results.
- Explained to each employee and subcontractor, through an orientation, the program, the individual's role in it, and his or her expected contribution. A primary goal of the quality improvement program was to promote a sense of pride in workmanship. Top management led this program and took a strong, active part in its implementation.
- Delegated to the quality control supervisor the necessary authority, such as stop-work authority, to make quality a viable program. This delegated authority for the quality function ensured that deficiencies were corrected.

4.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Copeland, R.R., September 1994. "Application of Channel Stability Methods – Case Studies," Technical Report HL-94-11, report prepared for the U.S. Army Corps of Engineers, Washington, D.C. (Copeland 1994, 109508)

EPA (U.S. Environmental Protection Agency), September 17, 2007. "Appendix A: SWPPP Template – Unauthorized States," Version 1.1, Washington, D.C. (EPA 2007, 109510)

Kilpatrick, F.A., and V.R. Schneider, 1983. "Techniques of Water-Resources Investigations of the United States Geological Survey, Chapter A14, Use of Flumes in Measuring Discharge," Book 3, Applications of Hydraulics, U.S. Geological Survey, Washington, D.C. (Kilpatrick and Schneider 1983, 109514)

LANL (Los Alamos National Laboratory), April 2004. "Los Alamos and Pueblo Canyons Investigation Report," Los Alamos National Laboratory document LA-UR-04-2714, Los Alamos, New Mexico. (LANL 2004, 087390)

LANL (Los Alamos National Laboratory), December 2005. "Los Alamos and Pueblo Canyons Supplemental Investigation Report," Los Alamos National Laboratory document LA-UR-05-9230, Los Alamos, New Mexico. (LANL 2005, 091818)

LANL (Los Alamos National Laboratory), February 2008. "Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," Los Alamos National Laboratory document LA-UR-08-1071, Los Alamos, New Mexico. (LANL 2008, 101714)

LANL (Los Alamos National Laboratory), October 2008. "Supplemental Interim Measures Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," Los Alamos National Laboratory document LA-UR-08-6588, Los Alamos, New Mexico. (LANL 2008, 105716)

NMED (New Mexico Environment Department), March 14, 2005. "Notice of Disapproval, Los Alamos and Pueblo Canyons Investigation Report," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and G.P. Nanos (LANL Director) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2005, 088463)

NMED (New Mexico Environment Department), August 30, 2007. "Approval with Direction, Los Alamos and Pueblo Canyons Supplemental Investigation Report," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2007, 098284)

NMED (New Mexico Environment Department), July 18, 2008. "Approval with Modifications, Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2008, 103007)

NMED (New Mexico Environment Department), February 20, 2009. "Approval with Modifications, Supplemental Interim Measure Work Plan (SIWP) to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 105014)

Pemberton, E.L., and J.M. Lara, January 1984. "Computing Degradation and Local Scour," Technical Guideline for Bureau of Reclamation, U.S. Department of the Interior, Denver, Colorado. (Pemberton and Lara 1984, 109509)

USACE (U.S. Army Corps of Engineers), May 1959. "Hydraulic Design Criteria, Artificial Channels – 600," excerpted from the *Corps of Engineers Hydraulic Design Criteria*, Washington, D.C. (USACE 1959, 109511)

USACE (U.S. Army Corps of Engineers), May 1992. "HEC-FFA Flood Frequency Analysis, User's Manual," Computer Program Documentation No. CPD-13, Washington, D.C. (USACE 1992, 109512)

USACE (U.S. Army Corps of Engineers), March 2008. "HEC-RAS River Analysis System, User's Manual," Version 4.0, Computer Program Documentation No. CPD-68, Washington, D.C. (USACE 2008, 109518)

USGS (U.S. Geological Survey), October 2000. "The National Flood-Frequency Program—Methods for Estimating Flood Magnitude and Frequency in Rural Areas in New Mexico, 2000," USGS Fact Sheet 055-00. (USGS 2000, 109515)

Waltemeyer, S.D., 2008. "Analysis of the Magnitude and Frequency of Peak Discharge and Maximum Observed Peak Discharge in New Mexico and Surrounding Areas," report prepared for the U.S. Department of the Interior and the U.S. Geological Survey in cooperation with the New Mexico Department of Transportation, Scientific Investigations Report 2008-5119, Washington, D.C. (Waltemeyer 2008, 109516)

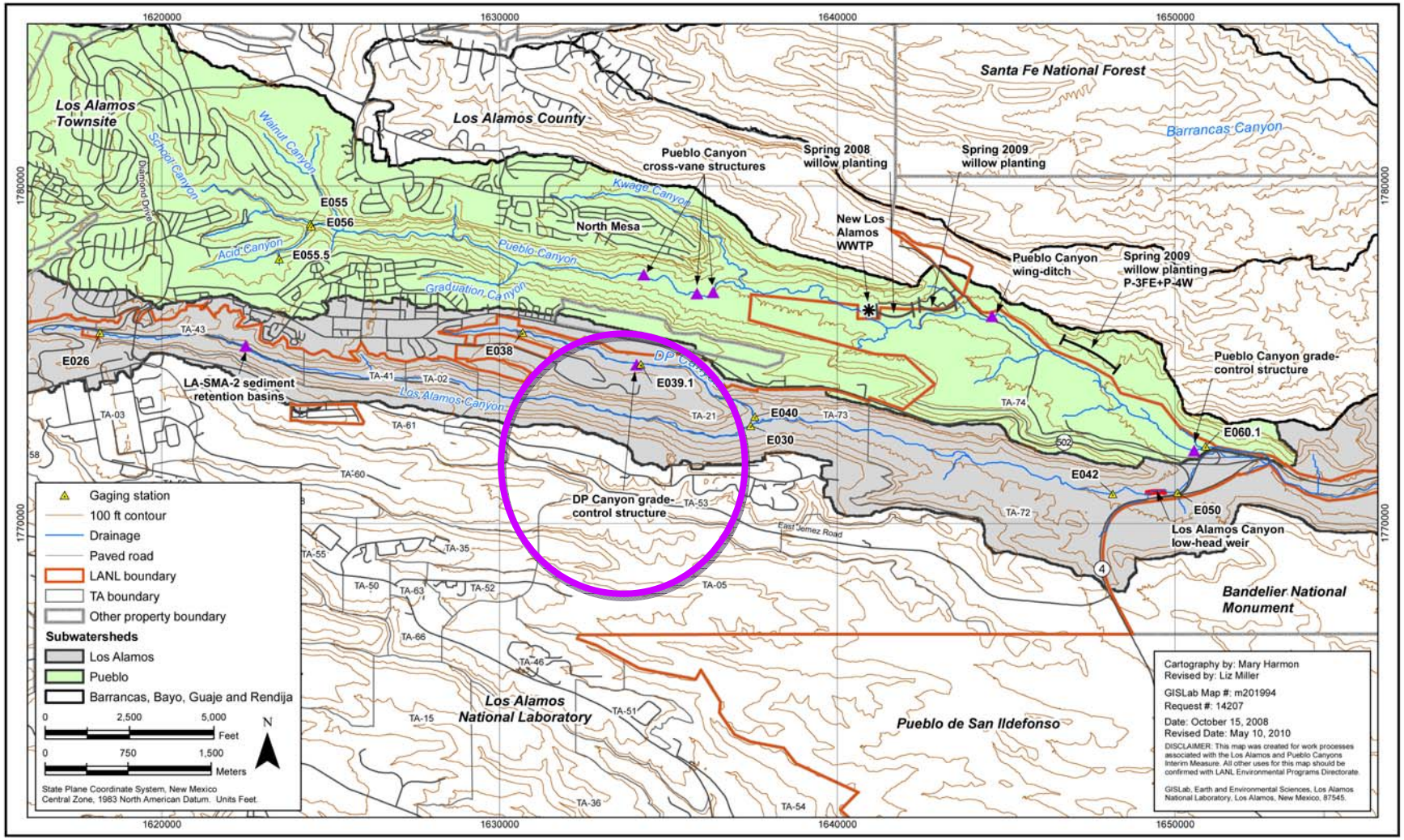

Figure 1.0-1 Sediment transport mitigation sites in Los Alamos and Pueblo Canyons, highlighting the site locations for the DP Canyon grade-control structure and stream gage E039.1

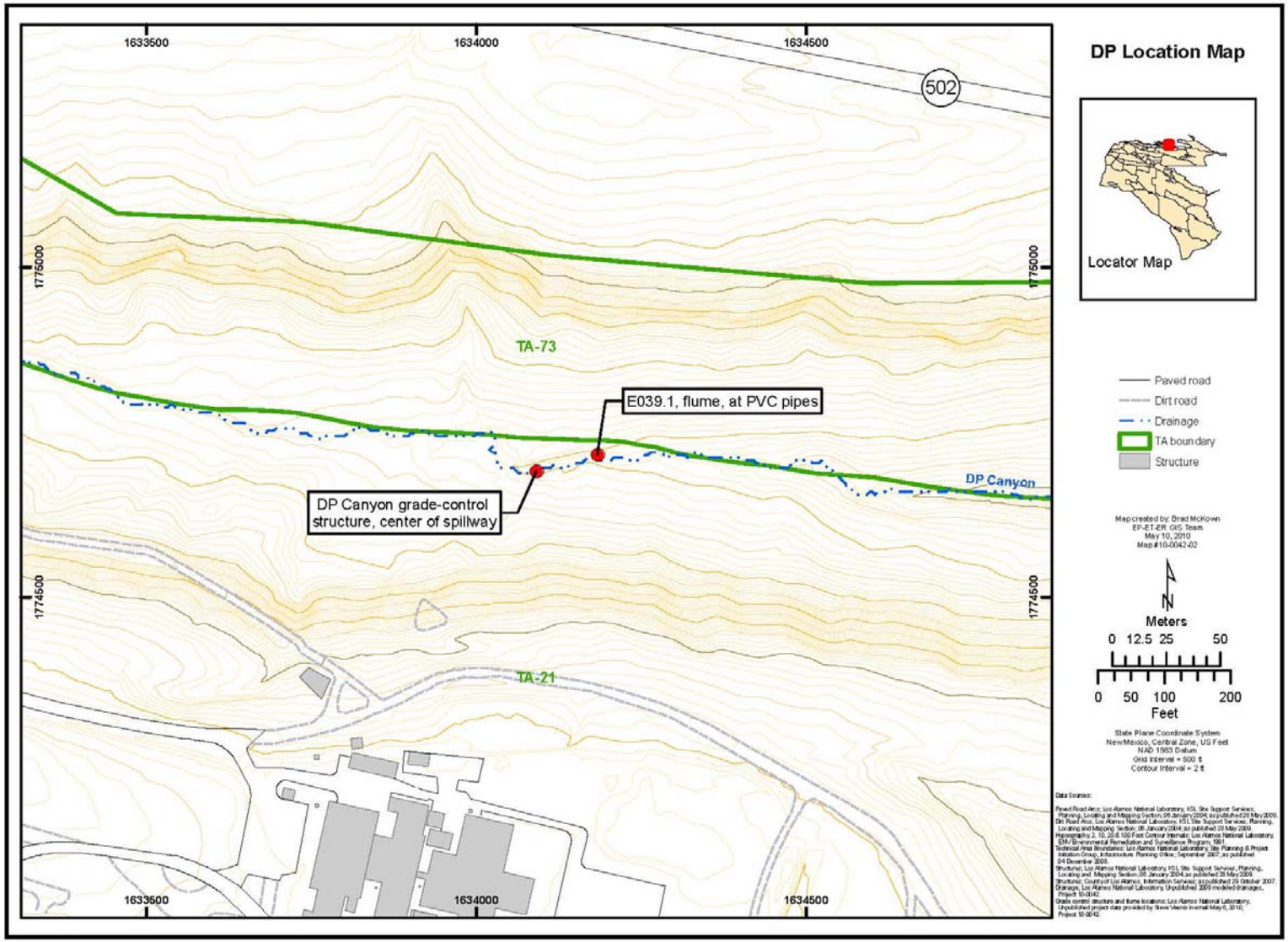

Figure 1.0-2 DP Canyon grade-control structure and stream gage E039.1 site locations

Figure 2.1-1 DP grade-control structure (looking north)

Figure 2.1-2 DP grade-control structure (looking east), low-flow and overflow weirs shown (riser pipe in foreground)

Figure 2.1-3 Concrete cap placement

Figure 2.1-4 Adjustable riser pipe extended in height to match overflow weir crest height, low-flow and overflow weirs in background

Figure 2.1-5 E039.1 supercritical-flow flume/stream gage

Table 2.3-1
DP Canyon Flood Frequencies

Percent Chance Exceedance	FFA at Gage E038 (cfs)[a]	FFA Extended to Project Site (cfs)[a,b]	USGS Rural (cfs)[c]
0.2 (500 yr)	372	523	998
1 (100 yr)	333	465	601
2 (50 yr)	316	438	468
10 (10 yr)	274	374	226
20 (5 yr)	253	343	149
50 (2 yr)	218	289	68

Note: Equations used for determining basin discharges were based on the following references:

[a] USACE (U.S. Army Corps of Engineers), May 1992. "HEC-FFA Flood Frequency Analysis, User's Manual," Computer Program Documentation No. CPD-13, Washington, D.C. (USACE 1992, 109512).

[b] Waltemeyer, S.D., 2008. "Analysis of the Magnitude and Frequency of Peak Discharge and Maximum Observed Peak Discharge in New Mexico and Surrounding Areas," report prepared for the U.S. Department of the Interior and the U.S. Geological Survey in cooperation with the New Mexico Department of Transportation, Scientific Investigations Report 2008-5119, Washington, D.C. (Waltemeyer 2008, 109516).

[c] USGS (U.S. Geological Survey), October 2000. "The National Flood-Frequency Program—Methods for Estimating Flood Magnitude and Frequency in Rural Areas in New Mexico, 2000," USGS Fact Sheet 055-00. (USGS 2000, 109515)

Appendix A

As-Built Drawings

CONSTRUCTION PLANS FOR:

LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURE

FOR DP CANYON
LOS ALAMOS, NEW MEXICO

INDEX OF DRAWINGS

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~~C-102 OVERALL SITE PLAN WITH AERIAL~~
~~C-103 ENLARGED SITE PLAN~~
~~C-104 EROSION CONTROL PLAN~~

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DP CANYON
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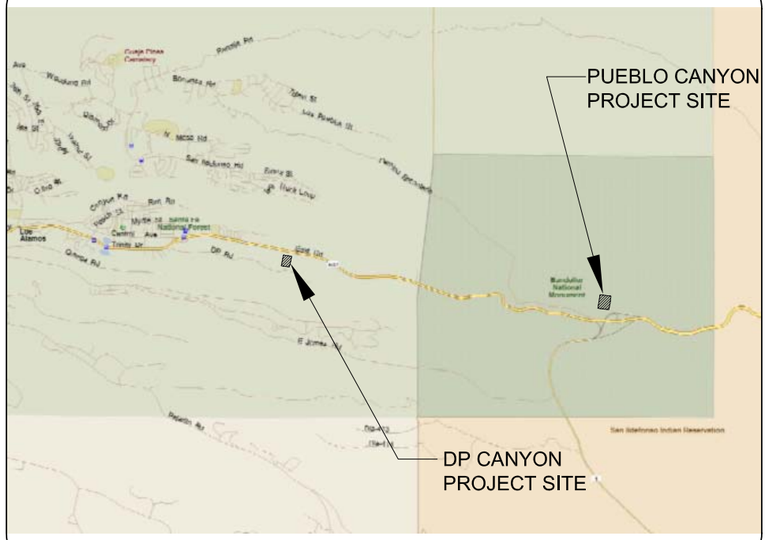
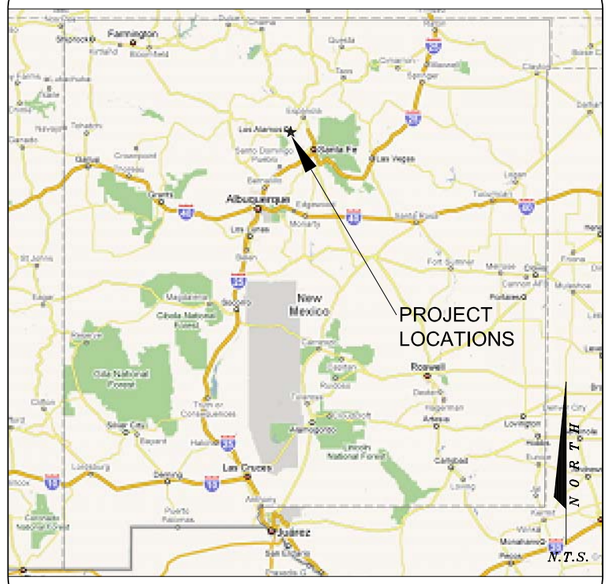
C-501 GENERAL DETAILS
C-502 S.W.P.P.P. DETAILS
C-503 S.W.P.P.P. DETAILS
C-504 S.W.P.P.P. DETAILS

LOCATION MAP



VICINITY MAP



DRAWINGS REVISED TO INCORPORATE CONTRACTOR AS-BUILT INFORMATION. REVISIONS ARE INDICATED AS REVISION 1 WHERE APPLICABLE. 1

PREPARED FOR:
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REVISIONS

LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURE

JOB NO.100005632

DATE: 10/13/2009 SHT. 1 OF 12

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Drawing Name: \\SARFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-000 - COVER.dwg May 24, 2010 - 10:31am

GENERAL CONSTRUCTION NOTES

1. ALL ELEVATIONS REFER TO THE NORTH AMERICAN DATUM (1983).

2. LOCATIONS, ELEVATIONS, AND DIMENSIONS OF EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES ARE SHOWN ACCORDING TO THE BEST INFORMATION AVAILABLE AT THE TIME OF PREPARATION OF THESE PLANS. THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS, AND DIMENSIONS OF ALL EXISTING UTILITIES, STRUCTURES AND OTHER FEATURES AFFECTING THIS WORK PRIOR TO CONSTRUCTION.

3. THE CONTRACTOR SHALL CHECK PLANS FOR CONFLICTS AND DISCREPANCIES PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL NOTIFY THE OWNER'S ENGINEER OF ANY CONFLICT BEFORE PERFORMING ANY WORK IN THE AFFECTED AREA.

4. THE CONTRACTOR SHALL EXERCISE EXTREME CAUTION IN AREAS OF BURIED UTILITIES AND SHALL PROVIDE AT LEAST 48 HOURS NOTICE TO THE VARIOUS UTILITY COMPANIES IN ORDER TO PERMIT MARKING THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES IN ADVANCE OF CONSTRUCTION.

5. ANY WELLS DISCOVERED DURING EXCAVATION, EARTHMOVING OR CONSTRUCTION MUST BE REPORTED TO THE APPROPRIATE GOVERNMENTAL AGENCY OFFICE WITHIN 24 HOURS OF DISCOVERY.

6. IT IS THE CONTRACTOR'S RESPONSIBILITY TO BECOME FAMILIAR WITH THE PERMIT AND INSPECTION REQUIREMENTS OF THE VARIOUS GOVERNMENTAL AGENCIES. THE CONTRACTOR SHALL SCHEDULE INSPECTIONS ACCORDING TO AGENCY INSTRUCTION.

7. ALL SPECIFICATIONS AND DOCUMENTS REFERRED TO SHALL BE OF LATEST REVISIONS AND/OR LATEST EDITION.

8. ALL WORK PERFORMED SHALL COMPLY WITH THE REGULATIONS AND ORDINANCES OF THE GOVERNMENTAL AGENCIES HAVING JURISDICTION OVER THE WORK.

9. CONTRACTOR SHALL SUBMIT FOR APPROVAL TO THE OWNER'S ENGINEER SHOP DRAWINGS ON ALL PRECAST AND MANUFACTURED ITEMS PRIOR TO ORDERING MATERIALS. FAILURE TO OBTAIN APPROVAL BEFORE INSTALLATION MAY RESULT IN REMOVAL AND REPLACEMENT AT CONTRACTOR'S EXPENSE.

10. AT LEAST 3 WORKING DAYS PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL NOTIFY THE OWNER AND APPROPRIATE AGENCIES. NOTIFICATION SHALL INCLUDE THE CONTRACTOR'S NAME, STARTING DATE, PROJECTED SCHEDULE, AND OTHER INFORMATION AS REQUIRED. ANY WORK PERFORMED PRIOR TO NOTIFYING THE OWNER OR WITHOUT AGENCY INSPECTOR PRESENT MAY BE SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.

11. ALL DISTURBED AREAS WITHIN PUBLIC RIGHT-OF-WAY ARE TO BE RESTORED TO ORIGINAL CONDITION OR BETTER.

12. THE CONTRACTOR IS RESPONSIBLE FOR THE REPAIR AND/OR REPLACEMENT OF ALL PROPERTY, ABOVE AND BELOW GROUND, AFFECTED BY THIS WORK. ALL PROPERTY SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN EXISTING CONDITIONS BEFORE CONSTRUCTION COMMENCED UNLESS SPECIFICALLY EXEMPTED BY THE PLANS. ADDITIONAL COSTS ARE INCIDENTAL TO OTHER CONSTRUCTION.

13. ALL DISTURBED AREAS ASSOCIATED WITH CONSTRUCTION, WHICH ARE NOT TO BE SODDED, ARE TO BE SEEDED AND MULCHED TO THE NEW MEXICO DEPARTMENT OF TRANSPORTATION STANDARDS AND MAINTAINED UNTIL A SATISFACTORY STAND OF GRASS ACCEPTABLE TO THE OWNER HAS BEEN OBTAINED. ANY WASHOUTS, REGRADING, RESEEDING, GRASSING, AND OTHER EROSION WORK REQUIRED, WILL BE PERFORMED BY THE CONTRACTOR/SUBCONTRACTOR UNTIL THE SYSTEM IS ACCEPTED FOR MAINTENANCE BY THE OWNER.

15. AS-BUILT DRAWINGS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RECORDING INFORMATION ON A SET OF THE APPROVED PLANS CONCURRENTLY WITH CONSTRUCTION PROGRESS. WITHIN TWO (2) WEEKS FOLLOWING FINAL INSPECTION THE CONTRACTOR SHALL SUBMIT ONE (1) SET OF AS-BUILT DRAWINGS TO THE ENGINEER. THE FINAL RECORD DRAWINGS SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS:

A. DRAWINGS TO BE LEGIBLY MARKED TO RECORD ACTUAL CONSTRUCTION.
B. DRAWINGS SHALL SHOW ACTUAL LOCATION OF ALL UNDERGROUND WORK.
C. DRAWINGS SHALL CLEARLY SHOW ALL FIELD CHANGES OF DIMENSION AND DETAIL INCLUDING CHANGES MADE BY FIELD ORDER OR BY CHANGE ORDER.
D. DRAWINGS SHALL CLEARLY SHOW ALL DETAILS NOT ON ORIGINAL CONTRACT DRAWINGS BUT CONSTRUCTED IN THE FIELD. ALL EQUIPMENT AND PIPING RELOCATION SHALL BE CLEARLY SHOWN.
E. LOCATIONS OF ALL FEATURES SHALL BE SHOWN.
F. DRAWINGS TO BE SIGNED AND SEALED BY A LICENSED SURVEYOR.

16. ALL CONCRETE STRUCTURES SHALL BE MADE OF 3000 PSI CONCRETE PER DOT STANDARD SPECIFICATIONS UNLESS OTHERWISE NOTED ON THE PLANS.

SITE CLEARING PREPARATION NOTES

1. THE CONTRACTOR IS TO PREPARE THE SITE PRIOR TO BEGINNING INFRASTRUCTURE CONSTRUCTION IN ACCORDANCE WITH SOILS TESTING REPORT.

2. CONTRACTOR SHALL CLEAR AND GRUB ONLY THOSE PORTIONS OF THE SITE NECESSARY FOR CONSTRUCTION. DISTURBED AREAS WILL BE SEEDED, MULCHED, OR PLANTED WITH OTHER APPROVED LANDSCAPE MATERIAL IMMEDIATELY FOLLOWING CONSTRUCTION.

3. THE TOP 4" TO 6" OF GROUND REMOVED DURING CLEARING AND GRUBBING SHALL BE STOCKPILED AT A SITE DESIGNATED BY THE OWNER TO BE USED FOR LANDSCAPING PURPOSES, UNLESS OTHERWISE DIRECTED BY THE OWNER.

4. ALL CONSTRUCTION DEBRIS AND OTHER WASTE MATERIAL SHALL BE DISPOSED OF OFF-SITE IN ACCORDANCE WITH APPLICABLE REGULATIONS.

5. CONTRACTOR TO OBTAIN ALL NECESSARY PERMITS AND APPROVALS PRIOR TO BEGINNING WORK.

6. THE LOCATION OF ALL EXISTING UTILITIES SHOWN ON THE PLANS HAVE BEEN DETERMINED FROM THE BEST INFORMATION AVAILABLE AND ARE GIVEN FOR THE CONVENIENCE OF THE CONTRACTOR/SUBCONTRACTOR. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR ACCURACY PRIOR TO THE START OF ANY CONSTRUCTION ACTIVITY. IT SHALL BE THE CONTRACTOR'S/SUBCONTRACTOR'S RESPONSIBILITY TO NOTIFY THE VARIOUS UTILITIES AND TO MAKE THE NECESSARY ARRANGEMENTS FOR ANY RELOCATIONS OF THESE UTILITIES WITH THE OWNER OF THE UTILITY. THE CONTRACTOR/SUBCONTRACTOR SHALL EXERCISE CAUTION WHEN CROSSING ANY UNDERGROUND UTILITY, WHETHER SHOWN ON THE PLANS OR LOCATED BY THE UTILITY COMPANY. ALL UTILITIES WHICH INTERFACE WITH THE PROPOSED CONSTRUCTION SHALL BE RELOCATED BY THE RESPECTIVE UTILITY COMPANIES AND THE CONTRACTOR/SUBCONTRACTOR SHALL COOPERATE WITH THE UTILITY COMPANIES DURING RELOCATION OPERATIONS. ANY DELAY OR INCONVENIENCE CAUSED TO THE CONTRACTOR/SUBCONTRACTOR BY THE VARIOUS UTILITIES SHALL BE INCIDENTAL TO THE CONTRACT AND NO EXTRA COMPENSATION WILL BE ALLOWED.

7. ALTHOUGH NOT ANTICIPATED, THE LOCATION OF ANY EXISTING UNDERGROUND UTILITY LINES, WELLS OR OTHER BURIED PIPING OR STRUCTURES ASSOCIATED WITH PAST SITE USE WITHIN THE CONSTRUCTION AREA SHOULD BE ESTABLISHED PRIOR TO CONSTRUCTION. PROVISIONS SHOULD THEN BE MADE TO RELOCATE ANY INTERFERING UTILITY LINES WITHIN THE CONSTRUCTION AREA TO APPROPRIATE LOCATIONS. IN THIS REGARD, IT SHOULD BE NOTED THAT IF ABANDONED UNDERGROUND PIPES ARE NOT PROPERLY REMOVED OR PLUGGED, THEY MAY SERVE AS CONDUITS FOR SUBSURFACE EROSION, WHICH SUBSEQUENTLY MAY RESULT IN EXCESSIVE SETTLEMENTS.

8. SITE CLEARING, GRUBBING AND DEMOLITION SHALL INCLUDE THE REMOVAL OF TREES, GROUND BRUSH, ORGANIC SOILS, ROOT MATS, EXISTING STRUCTURES, PAVEMENT, UTILITIES OR OTHER DELETERIOUS MATERIALS ENCOUNTERED. CLEARING AND GRUBBING SHALL BE REVIEWED BY THE OWNER'S REPRESENTATIVE PRIOR TO BEGINNING CONSTRUCTION AT THE SITE. AS A MINIMUM, THE CLEARING OPERATIONS SHALL EXTEND AT LEAST 5 FEET BEYOND THE BUILDING PERIMETERS. ANY EXCAVATIONS OR CAVITIES FORMED BY THE REMOVAL OF ORGANIC MATERIAL, GROUND BRUSH OR STUMPS SHOULD BE FILLED WITH CLEAN, COMPACTED STRUCTURAL FILL.

GRADING AND EROSION CONTROL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING EXCAVATIONS AGAINST COLLAPSE AND WILL PROVIDE BRACING SHEETING OR SHORING AS NECESSARY. TRENCHES SHALL BE KEPT DRY WHILE PIPE AND APPURTENANCES ARE BEING PLACED. DEWATERING SHALL BE USED AS REQUIRED.

2. CONTRACTOR IS TO PROVIDE EROSION CONTROL BARRIERS (HAY BALES OR SILTATION CURTAIN) TO PREVENT SILTATION OF ADJACENT PROPERTY, STREETS, STORM SEWERS, WATERWAYS, AND EXISTING WETLANDS PER THE CONSTRUCTION DRAWINGS. IN ADDITION, CONTRACTOR SHALL CONSTRUCT A TEMPORARY CONSTRUCTION EXIT (SEE DETAILS) IN AREAS WHERE CONSTRUCTION RELATED TRAFFIC IS TO ENTER AND EXIT THE SITE. IF, IN THE OPINION OF THE OWNER'S REPRESENTATIVE OR GOVERNMENTAL AGENCY THAT EXCESSIVE QUANTITIES OF EARTH ARE TRANSPORTED OFF-SITE EITHER BY NATURAL DRAINAGE OR BY VEHICULAR TRAFFIC, THE CONTRACTOR IS TO REMOVE SAID EARTH TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE AND/OR GOVERNING OFFICIALS. SEE SWPPP NARRATIVE FOR ADDITIONAL INFORMATION.

3. IF WIND EROSION BECOMES SIGNIFICANT DURING CONSTRUCTION, THE CONTRACTOR SHALL STABILIZE THE AFFECTED AREA USING SPRINKLING, IRRIGATION, OR OTHER ACCEPTABLE METHODS.

4. THERE IS TO BE NO DISCHARGE (I.E. PUMPING, SHEET FLOW, SWALE, DITCH, ETC.) INTO EXISTING DITCHES OR CANALS WITHOUT THE USE OF SETTLING PONDS. IF THE CONTRACTOR DESIRES TO DISCHARGE INTO THE EXISTING DITCHES OR CANALS A SETTLING POND PLAN PREPARED BY THE CONTRACTOR MUST BE SUBMITTED TO AND APPROVED BY THE OWNER'S REPRESENTATIVE AND APPROPRIATE GOVERNMENTAL AGENCY PRIOR TO CONSTRUCTION.

GRADING AND EROSION CONTROL NOTES (CONT'D)

5. ANY VEGETATION FROM CLEARING/GRUBBING SHALL BE DISPOSED OF OFF-SITE.

6. SITE CONDITIONS
   A. DP CANYON. SURFACE SOILS CONSIST OF SILTY SANDS (SM) TO A DEPTH OF ABOUT 3 TO 4 FEET, VOLCANIC TUFF BEDROCK WAS ENCOUNTERED BELOW THE SILTY SAND AND EXTENDED DOWN TO THE DEPTH OF BORING TERMINATION (APPROXIMATE 15 FEET). TUFF BEDROCK VARIED FROM NON-WELDED TO STRONGLY WELDED.

   B. PUEBLO CANYON. SURFACE AND SUBSURFACE SOILS CONSIST OF WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM), POORLY GRADED SAND WITH GRAVEL (SP), SILTY SAND (SM), AND SANDY SILT (ML) TO THE FULL DEPTH OF EXPLORATION (SEE SOILS REPORT)

7. IT IS ANTICIPATED THAT SHALLOW EXCAVATIONS IN SOME AREAS FOR THE PROPOSED CONSTRUCTION CAN BE ACCOMPLISHED WITH CONVENTIONAL EARTHMOVING EQUIPMENT. HOWEVER, VERY HARD BEDROCK MATERIALS, AND AUGER REFUSAL MATERIALS WERE ENCOUNTERED AT DEPTHS RANGING BETWEEN 2 AND 3 FEET BELOW EXISTING GROUND SURFACE. BASED UPON THE BORING AND TEST PIT DATA, THIS CONDITION APPEARS TO BE ASSOCIATED WITH THE DP CANYON SITE. DIFFICULT EXCAVATION TECHNIQUES MAY BE REQUIRED IN THIS AREA DEPENDING ON THE FINAL EXCAVATION DEPTHS. CONTRACTOR SHOULD REVIEW THE DATA AND INFORMATION CONTAINED IN THE GEOTECHNICAL REPORT TO DETERMINE THE APPROPRIATE EQUIPMENT REQUIRED TO ADVANCE THE EXCAVATIONS TO CONSTRUCTION DEPTHS.

8. SUBGRADE PREPARATION: EXPOSED AREAS WHICH WILL RECEIVE FILL OF THE INITIAL COURSE OF THE GABION STRUCTURE, ONCE PROPERLY CLEARED, SHOULD BE SCARIFIED TO A MINIMUM DEPTH OF 10 INCHES, CONDITIONED TO NEAR OPTIMUM MOISTURE CONTENT, AND COMPACTED.

9. FILL MATERIALS AND PLACEMENT: GENERALLY, CLEAN ON-SITE SOILS OR APPROVED IMPORTED MATERIALS MAY BE USED AS FILL MATERIAL (IF APPLICABLE) FOR THE SITE. THE FILL MATERIALS SHOULD CONFORM TO THE FOLLOWING:

GRADATION	PERCENT FINER BY WEIGHT ASTM C136)
6"	100
3"	70-100
NO. 4 SIEVE	50-100
NO. 200 SIEVE	35(MAX)
● LIQUID LIMIT	30 (MAX)
● PLASTICITY INDEX	12 (MAX)

FILL LIFTS SHOULD NOT EXCEED 10 INCHES LOOSE THICKNESS. IMPORTED SOILS SHOULD BE COMPACTED WITHIN A MOISTURE RANGE OF OPTIMUM 3 PERCENT ABOVE OPTIMUM IF THE MATERIALS HAVE A PI OF 5 OR MORE. ON-SITE SOILS AND IMPORT SOILS THAT HAVE A PI OF LESS THAN 5 SHOULD BE COMPACTED WITHIN A MOISTURE RANGE OF ±3 PERCENT OF OPTIMUM MOISTURE CONTENT.

10. DISTURBED AREAS, NOT DESIGNATED TO RECEIVE OTHER PERMANENT COVER, SHALL BE SEEDED IN ACCORDANCE WITH SECTION 632.2 OF THE NEW MEXICO DEPARTMENT OF TRANSPORTATION (NMDOT) STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES.

11. PROVIDE TEMPORARY TRAFFIC CONTROL DEVICES, AT PUEBLO CANYON, IN ACCORDANCE WITH NMDOT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES SECTION 702.

12. CONTRACTOR SHALL SUBMIT NPDES NOTICE OF INTENT (N.O.I.) A MINIMUM OF 7 DAYS PRIOR TO BEGINNING WORK.

13. CONTRACTOR SHALL SUBMIT NPDES NOTICE OF TERMINATION (N.O.T.) WITHIN 30 DAYS OF CONSTRUCTION COMPLETION.

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	GENERAL NOTES
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS: 1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-001

User Name: 22190
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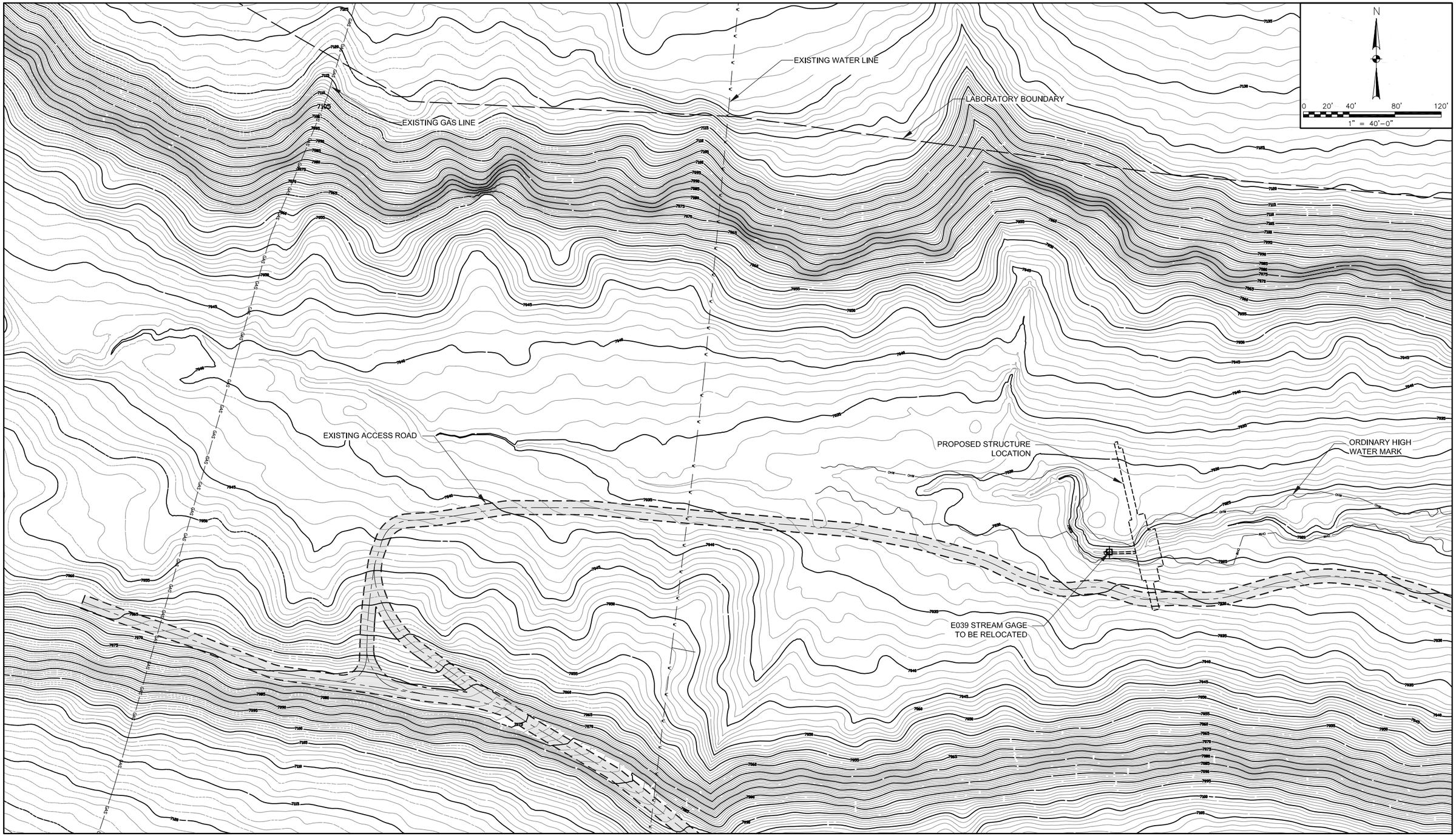

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	DP CANYON EXISTING CONDITIONS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-301

User Name: 22180
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May 05, 2010 - 6:49pm

DISTURBED AREAS	
STRUCTURE	0.293 ACRES
LAYDOWN AREA	0.039 ACRES
TOTAL	0.332 ACRES
FILL WIITHIN OHWM	
OHWM IMPACT	0.013 ACRES

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	DP CANYON OVERALL SITE PLAN WITH AERIAL

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-302

User Name: 22190
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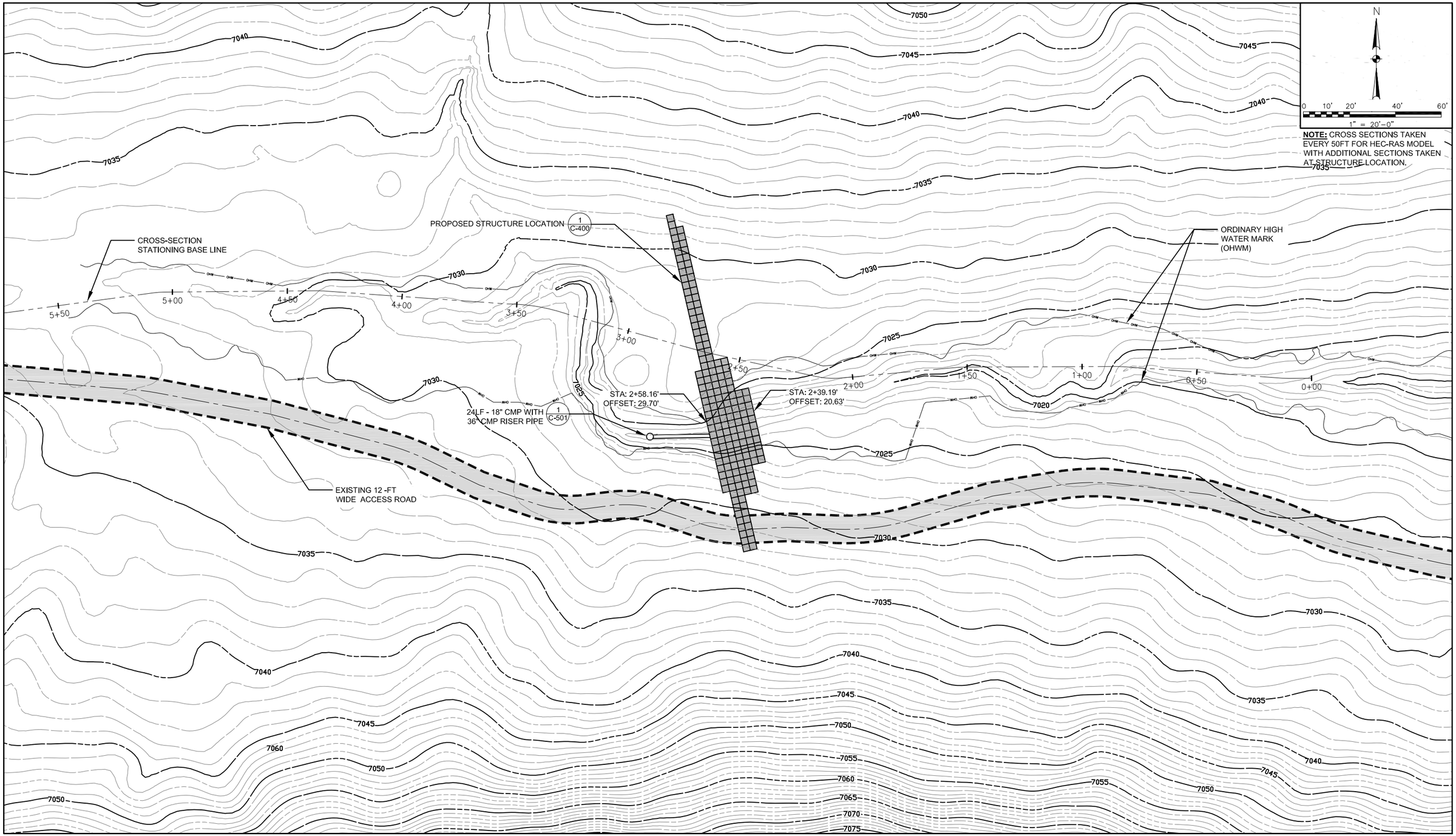

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	DP CANYON ENLARGED SITE PLAN

ORIGINAL DATE: 08/24/09
REVISIONS:
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JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
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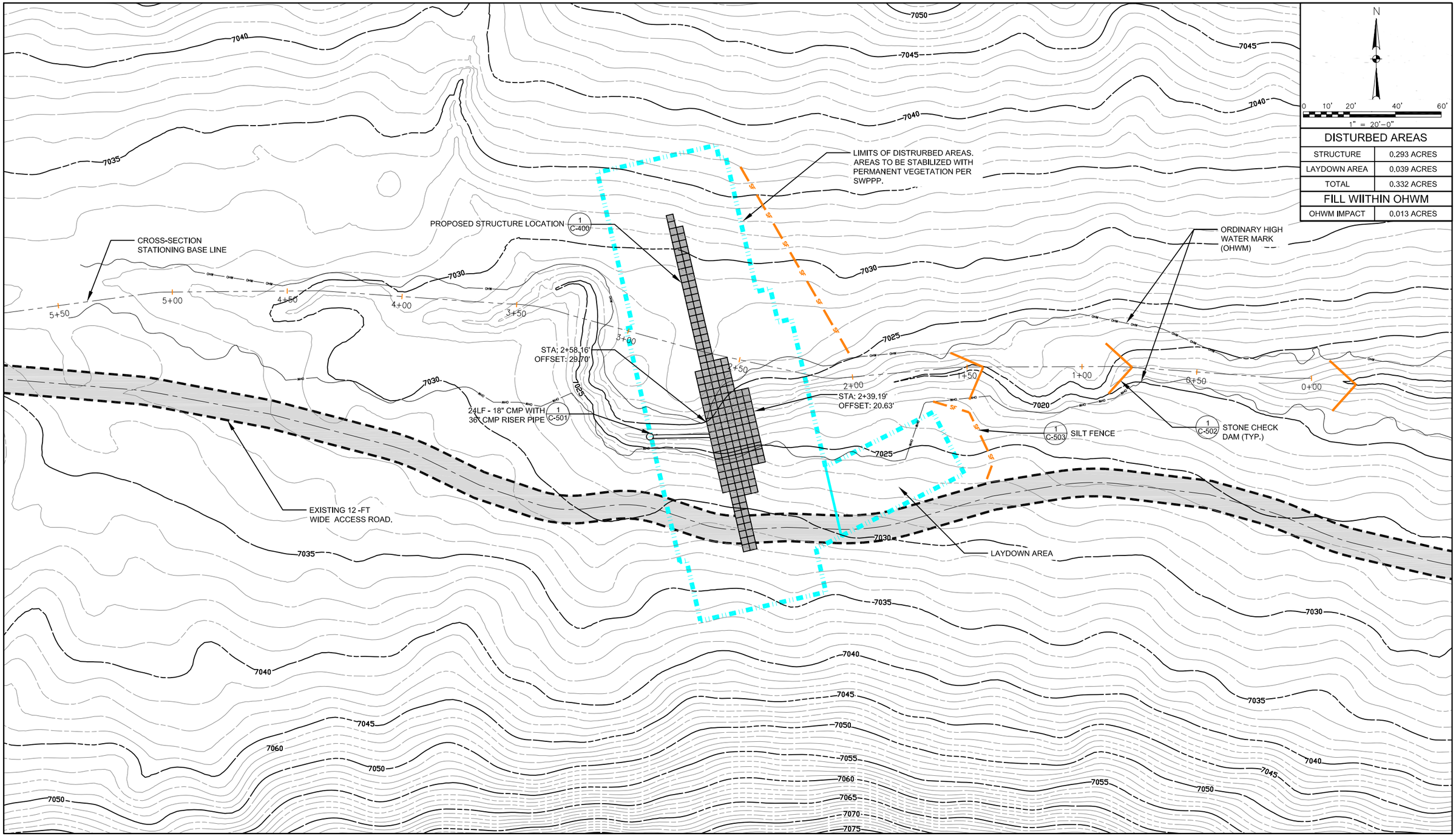

DISTURBED AREAS	
STRUCTURE	0.293 ACRES
LAYDOWN AREA	0.039 ACRES
TOTAL	0.332 ACRES
FILL WIITHIN OHWM	
OHWM IMPACT	0.013 ACRES

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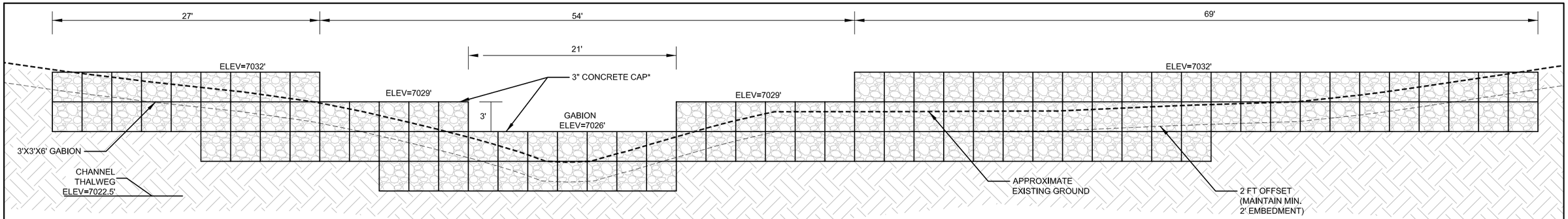
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	DP CANYON EROSION CONTROL PLAN

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

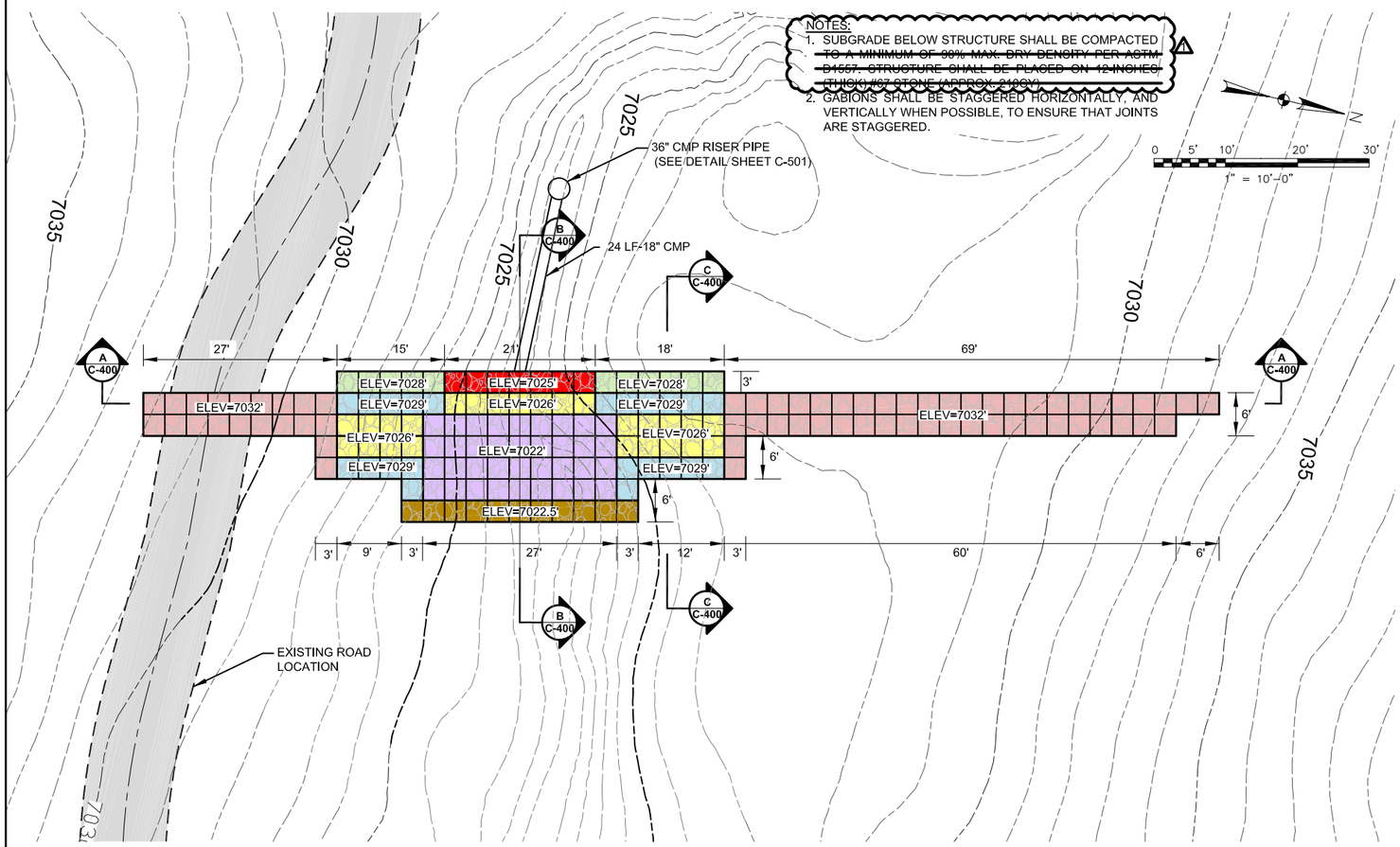
JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-304

User Name: 22190
Drawing Name: \\SAFFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-304 - DP CANYON EROSION CONTROL PLAN.dwg May 06, 2010 - 8:58am

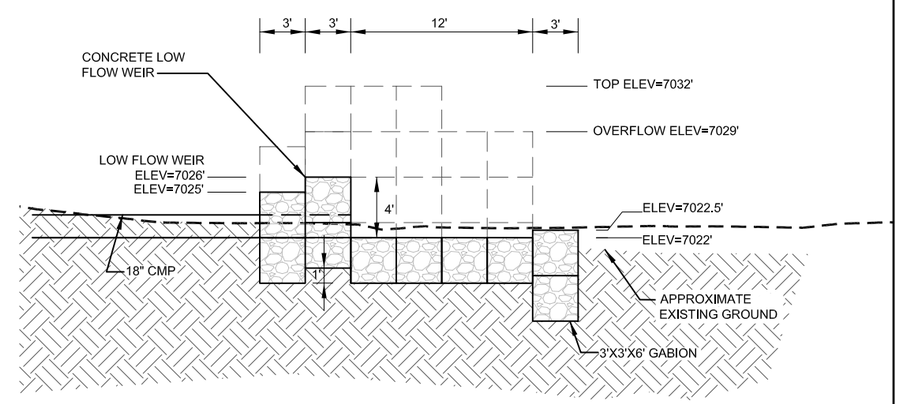


* CAP LOW FLOW AND OVERFLOW WEIR WITH MIN. 4,000 PSI CONCRETE, EMBEDDED 5" INTO TOP GABION. PROVIDE ¾" CHAMFER AT EDGES AND INTEGRAL COLORS - CLIFFSIDE BROWN #6804 (OR APPROVED EQUAL) PER MANUFACTURER'S INSTRUCTIONS.

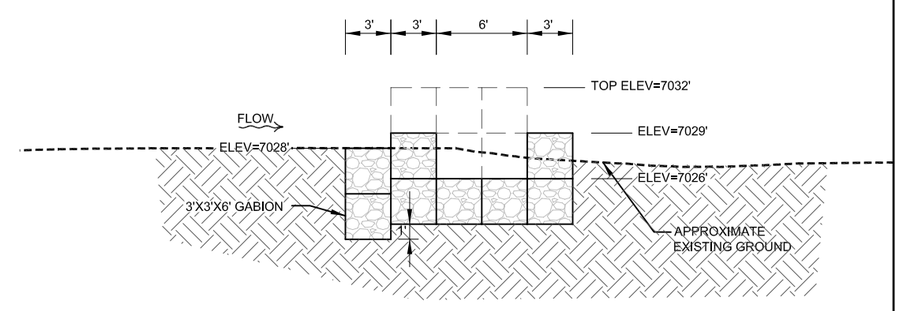
A C-400 | C-400 DP CANYON GABION CROSS SECTION A-A
SCALE: 1" = 5'



1 C-400 | C-400 DP CANYON GABION PLAN VIEW
SCALE: 1" = 10'



B C-400 | C-400 PROFILE SECTION B-B
SCALE: N.T.S.



C C-400 | C-400 PROFILE SECTION C-C
SCALE: N.T.S.

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	DP CANYON CROSS SECTIONS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
2
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12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-400

User Name: 22190
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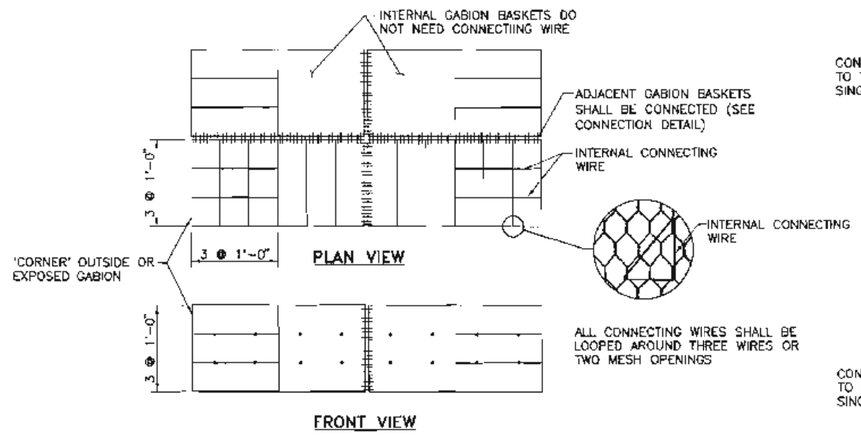
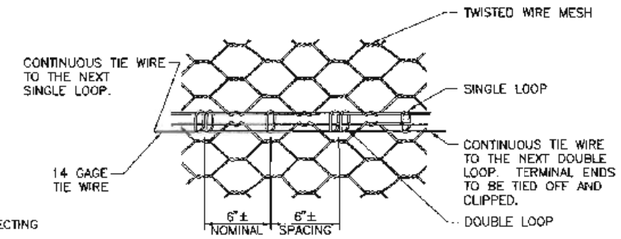
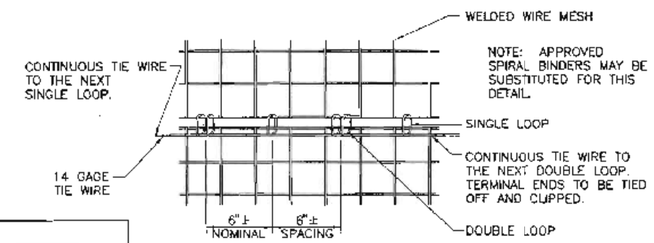


DETAILS OF 9 GAGE INTERNAL CONNECTING WIRES



(FOR USE W/ TWISTED MESH)

STANDARD JOINT CONNECTION DETAIL



(FOR USE W/ WELDED WIRE MESH)

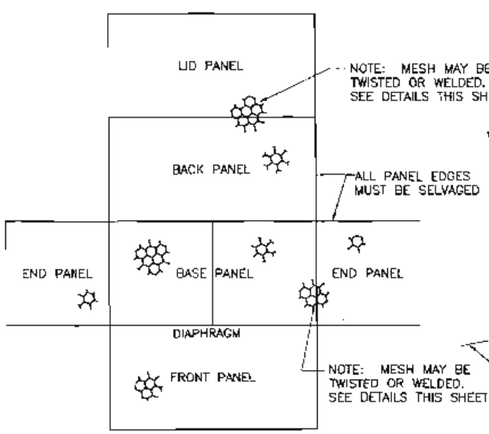
STANDARD JOINT CONNECTION DETAIL

GENERAL NOTES

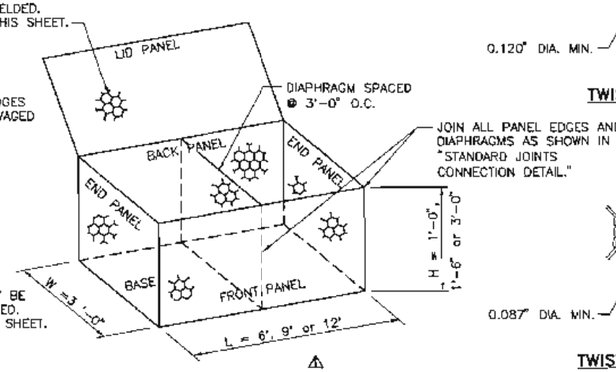
1. INTERNAL CONNECTING WIRES ARE TO BE INSTALLED ACROSS WIDTH OF INTERIOR GABIONS AND ACROSS WIDTH AND LENGTH OF END GABIONS.
2. INTERNAL CONNECTING WIRE, LACING WIRE AND GABION MESH SHALL BE GALVANIZED.
3. INTERNAL CONNECTING WIRES ARE REQUIRED ON ALL GABIONS 3'-0" HIGH AND ON ALL GABIONS 1'-6" HIGH WHEN USED TO BUILD VERTICAL STRUCTURES.
4. PREFORMED STIFFENERS (11 GAGE OR 9 GAGE) ARE AN ACCEPTABLE ALTERNATIVE TO INTERNAL CONNECTING WIRES. INSTALL THEM AS RECOMMENDED BY THE MANUFACTURER OR AS DIRECTED BY THE PROJECT MANAGER AT $\frac{1}{3}$ POINTS.
5. PLACE ROCK IN THE END GABION CELL FIRST, AND CONTINUE BY FILLING INTERIOR GABION CELLS.
6. FOR GABION DIMENSIONS, REFER TO THE TABLE "STANDARD GABION SIZES."
7. A JOINT CONNECTION MUST BE MADE WHERE ANY PANEL EDGE MEETS ANOTHER PANEL. THIS INCLUDES ADJACENT GABION BASKETS, INDIVIDUAL PANELS WITHIN A BASKET, DIAPHRAGM EDGES ETC. ALL JOINT CONNECTIONS SHALL BE MADE USING STANDARD TIE WIRE.
8. ALTERNATE JOINT CONNECTION PROCEDURES MAY BE USED PROVIDED THAT THE COMPLETED JOINT WILL DEVELOP A TENSILE STRENGTH OF NOT LESS THAN 1400 POUNDS PER FOOT. IF ALTERNATE JOINT CONNECTION PROCEDURES ARE USED THE CONTRACTOR SHALL SUBMIT TO THE PROJECT MANAGER CERTIFIED TEST REPORTS DEMONSTRATING THE ALTERNATE JOINT CONNECTIONS WILL MEET THE MINIMUM TENSILE STRENGTH REQUIREMENTS.

STANDARD REVETMENT MATTRESS SIZES				
LENGTH	WIDTH	HEIGHT	NUMBER OF CELLS	VOLUME CUBIC YARDS
FEET				
9'-0"	6'-0"	0'-6"	3	1.00
12'-0"	6'-0"	0'-6"	4	1.33
9'-0"	6'-0"	0'-9"	3	1.50
12'-0"	6'-0"	0'-9"	4	2.00

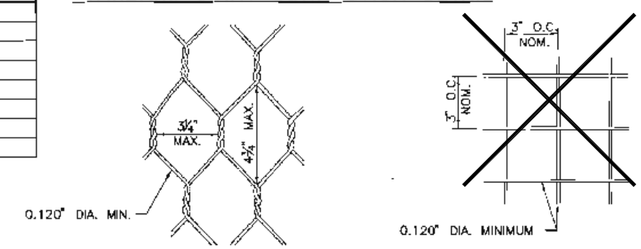
STANDARD GABION SIZES				
LENGTH	WIDTH	HEIGHT	NUMBER OF CELLS	VOLUME CUBIC YARDS
FEET				
6'-0"	3'-0"	3'-0"	2	2.00
9'-0"	3'-0"	3'-0"	3	3.00
12'-0"	3'-0"	3'-0"	4	4.00
6'-0"	3'-0"	1'-6"	2	1.00
9'-0"	3'-0"	1'-6"	3	1.50
12'-0"	3'-0"	1'-6"	4	2.00
6'-0"	3'-0"	1'-0"	2	0.66
9'-0"	3'-0"	1'-0"	3	1.00
12'-0"	3'-0"	1'-0"	4	1.33



TYPICAL FLAT LAYOUT OF GABION BASKET

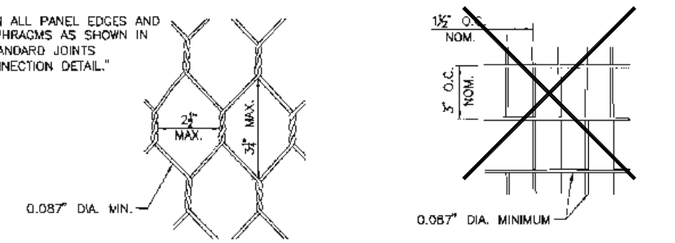


TYPICAL ASSEMBLED GABION BASKET



TWISTED MESH GABION

WELDED MESH GABION



TWISTED MESH MATTRESS

WELDED MESH MATTRESS

TYPICAL ACCEPTABLE MESH STYLES

SERIAL 602-05-2/2 SHEET 2 OF 2 MUST ACCOMPANY THIS SHEET.

NO.	DATE	REV. BY	DESCRIPTION
1	01/16/08	YML	CORRECTED L = 6', 9' or 12'

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO
DEPARTMENT OF TRANSPORTATION
STANDARD DRAWING

GABION
BASKET DETAILS

APPROVED Ray M. Trujillo 3-5-08
DESIGN ENGINEER DATE

DESIGNED BY TM DRAWN BY SKL CHECKED BY YML

602-05-1/2 SHEET 1 of 2

1 GABION BASKET DETAIL (NMDOT)
C-103 C-303 C-500 SCALE: NTS

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232
Ph. (941) 378-0272
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5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

KBR

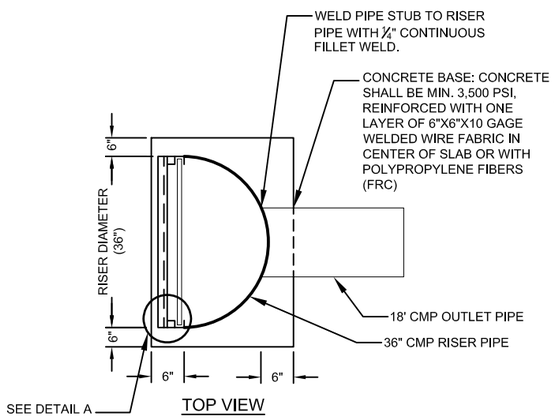
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	GENERAL DETAILS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

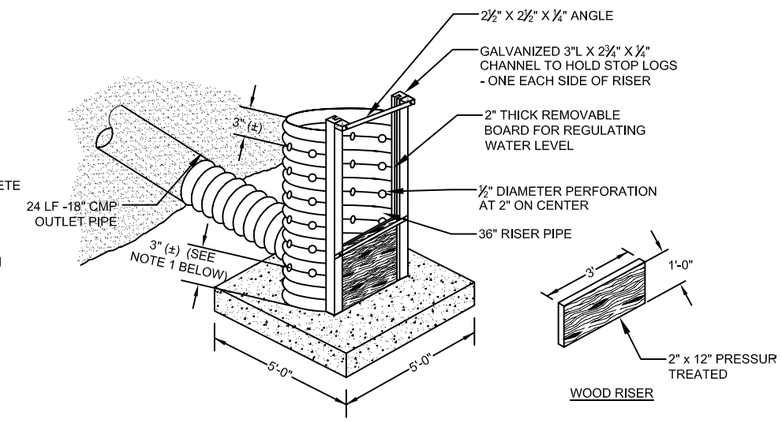
JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-500

User Name: 23190
Drawing Name: \\SAPFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-500 - C-501 - GENERAL DETAILS.dwg May 06, 2010 - 9:05am

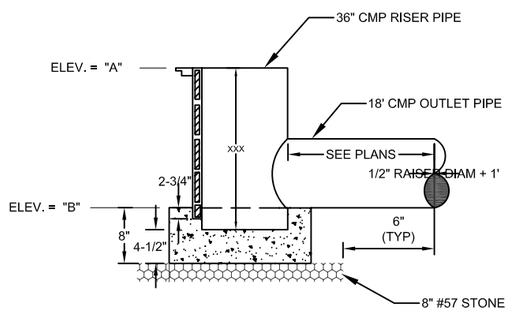
NOTE: ALL APPURTENANCES SHALL BE GALVANIZED, OR PAINTED WITH NOT LESS THAN TWO COATS OF ZINC OXIDE PAINT.



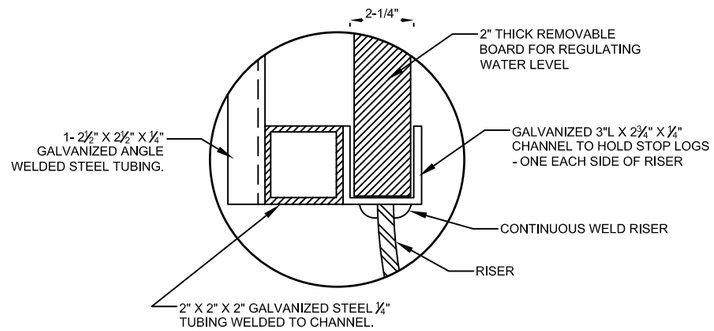
TOP VIEW



ISOMETRIC VIEW



CROSS SECTION OF RISER



DETAIL A

	DP CANYON	PUEBLO CANYON
ELEV "A"	~~7026.0'~~ 7029'	~~6341.0'~~ 6343'
ELEV "B"	7022.5'	6335.5'

NOTES:
1. AT PUEBLO CANYON PERFORATIONS SHALL NOT EXTEND BELOW ELEV. 6339'.
2. CMP SHALL BE FULLY COATED.

1
C-200 C-501 C-400

RISER PIPE DETAILS

SCALE: NTS

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232
Ph. (941) 378-0272
Post Buckley Schuh & Jernigan, Inc., d/b/a PBS&J
5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

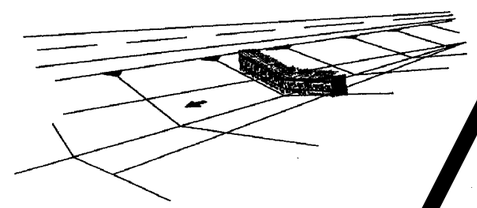
KBR

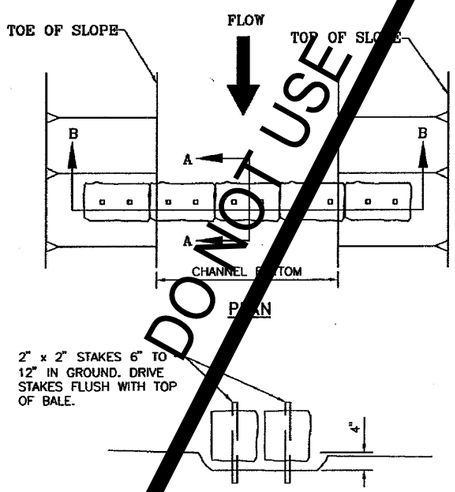
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	GENERAL DETAILS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 08/24/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
2
3
4
5
6
7
8
9
10
11
12

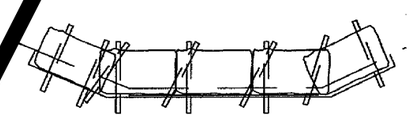
JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-501

User Name: 22190
Drawing Name: \\SARFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-500 - C-501 - GENERAL DETAILS.dwg May 06, 2010 - 9:06am



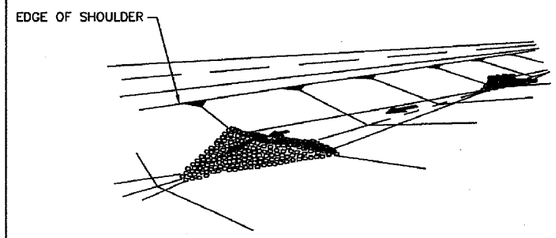


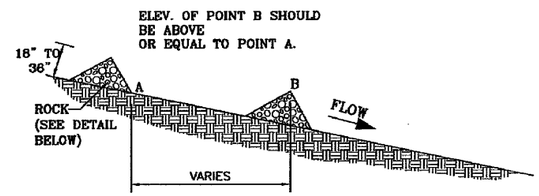
SECTION A–A

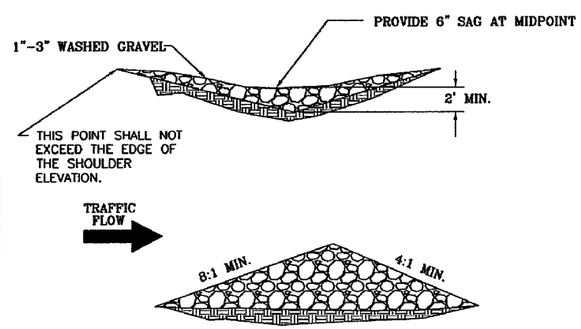


SECTION B–B

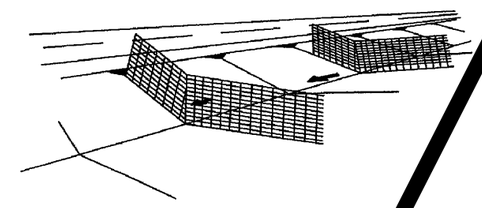
TYPE III
(STRAW BALE)

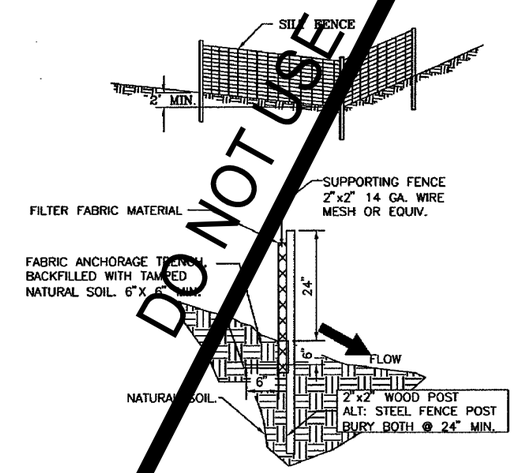






TYPE II
STONE DAM





TYPE I SILT FENCE

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO
DEPARTMENT OF TRANSPORTATION
STANDARD DRAWING

TEMPORARY EROSION & SEDIMENT CONTROL MEASURES
CHECK DAMS

APPROVED Raymunda VanHoose 11/29/06
DESIGN ENGINEER DATE

DESIGNED BY___ DRAWN BY ___ CHECKED BY ___

603–01–2/7 SHEET 2 OF 7

DO NOT USE

DO NOT USE

1 CHECK DAM DETAILS (NMDOT)
C-104 C-304 | C-502 SCALE: NTS

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232
Ph. (941) 378–0272
Post Buckley Schuh & Jernigan, Inc,. d/b/a PBS&J
5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

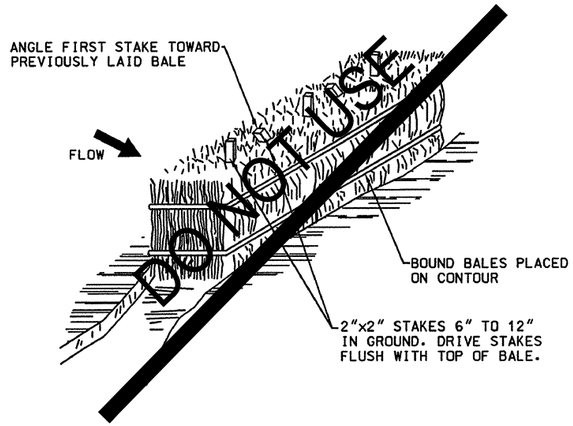
KBR

CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	S.W.P.P.P. DETAILS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

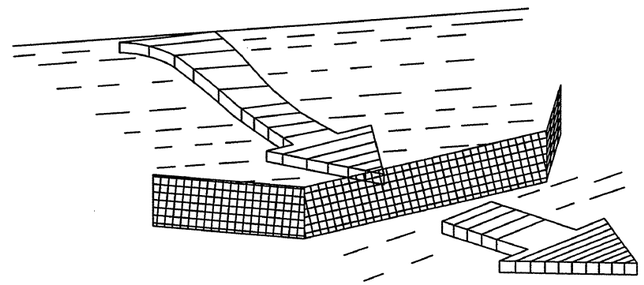
ORIGINAL DATE: 08/24/09
REVISIONS:
1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___ 11 ___ 12 ___

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-502

User Name: 22190
Drawing Name: \\SARFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-502 – C-504 – EROSION CONTROL DETAILS.dwg May 06, 2010 – 9:14am



TYPE II
STRAW BALE OPTION



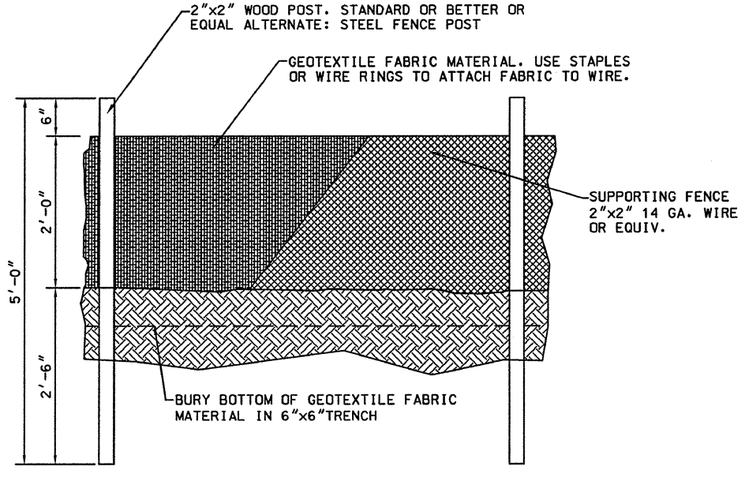
TYPE I
SILT FENCE

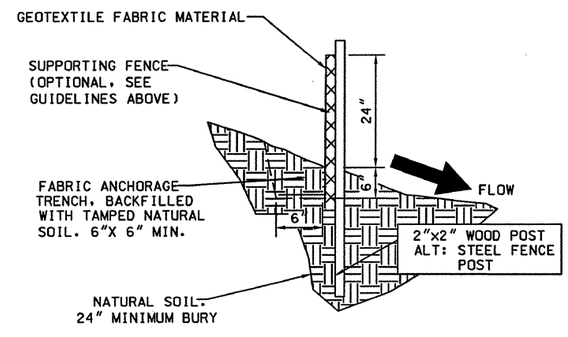
NOTES: SILT FENCE AND CHECK DAM

THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE POST SPACING FOR SILT FENCES TO MINIMIZE MAINTENANCE.

1. POST SPACING SHALL BE 4 FT. MAXIMUM WITHOUT SUPPORTING FENCE, 10 FT. MAXIMUM WITH SUPPORTING FENCE.
2. POSTS FOR 4 FT. MAXIMUM POST SPACING SHALL BE 2 INCH SQUARE NOMINAL SIZE OR HEAVIER WOOD POSTS, OR STANDARD "T" OR "U" SECTION STEEL POSTS WEIGHING NOT LESS THAN 2 LBS. PER. LINEAR FOOT.

   POSTS FOR 10 FT. MAXIMUM POST SPACING SHALL BE 4 INCH SQUARE NOMINAL SIZE OR HEAVIER WOOD POSTS, OR STEEL POSTS AS SPECIFIED ABOVE.
3. SUPPORTING FENCE SHALL BE WIRE MESH (14 GA. MIN., 1 INCH MAX. MESH OPENINGS), SNOW FENCE, PLASTIC FENCE OR APPROVED.
4. SUPPORTING FENCE SHALL BE FASTENED SECURELY TO POSTS WITH STAPLES OR WIRE TIES. GEOTEXTILE FABRIC SHALL BE FASTENED SECURELY TO SUPPORTING FENCE WITH WIRE TIES SPACED AT 2 FT. CENTERS ALONG THE TOP AND MID-SECTION. WHEN A SUPPORTING FENCE IS NOT USED, GEOTEXTILE FABRIC SHALL BE SECURELY FASTENED TO POSTS WITH STAPLES OR WIRE TIES.
5. ~~WHEN SILT FENCE IS USED FOR CHECK DAMS INSTALLED IN DITCHES, A SUPPORTING FENCE SHALL BE PROVIDED, WITH MAXIMUM POST SPACING OF 10 FT.~~
6. ~~STANDARD "T" OR "U" SECTION STEEL POSTS SHALL NOT BE USED WITHIN THE CONSTRUCTION CLEAR ZONE RECOVERY AREA.~~
7. ~~STRAW BALES ARE NOT INTENDED FOR USE ON NEW MEXICO DEPARTMENT OF TRANSPORTATION PROJECTS.~~





1 T.E.S.C.M. SILT FENCE (NMDOT)

C-104 C-503 C-304 SCALE: NTS

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO DEPARTMENT OF TRANSPORTATION STANDARD DRAWING

TEMPORARY EROSION & SEDIMENT CONTROL MEASURES SILT FENCE

APPROVED Raymundo Von Hoven 11/29/09
DESIGN ENGINEER DATE

DESIGNED BY___ DRAWN BY___ CHECKED BY___

603-01-3/7

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232
Ph. (941) 378-0272
Post Buckley Schuh & Jernigan, Inc,. d/b/a PBS&J
5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

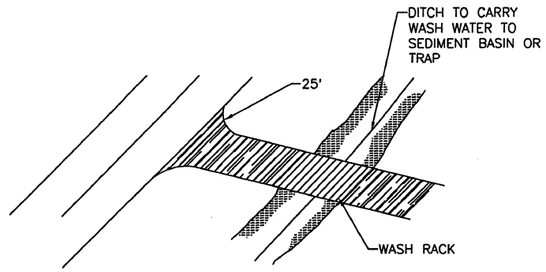
KBR

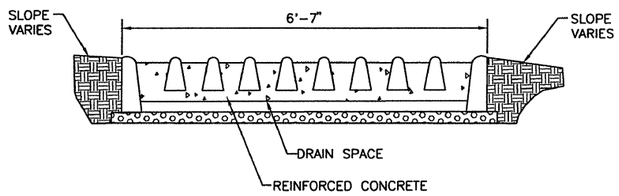
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	S.W.P.P.P. DETAILS

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

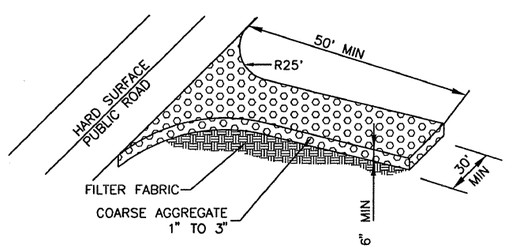
JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-503

User Name: 23190
Drawing Name: \\SAFESD1\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-502 - C-504 - EROSION CONTROL DETAILS.dwg May 06, 2010 - 9:16am

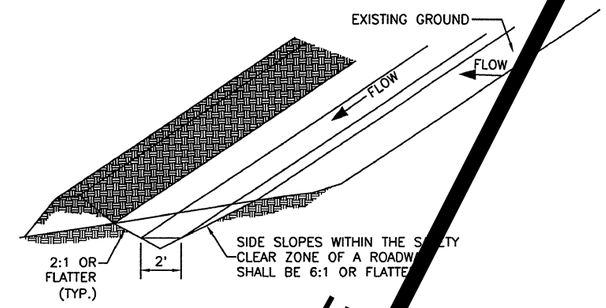




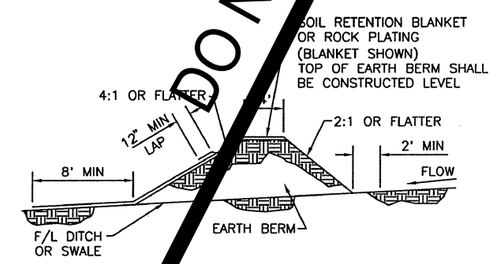
WASH RACK



OFFSITE TRACKING PREVENTION



TYPICAL SWALE CONFIGURATION



FILTER FABRIC DIVERSION DIKE

DO NOT USE

DIVERSION DIKE

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO DEPARTMENT OF TRANSPORTATION STANDARD DRAWING

T.E.S.C.M. OFFSITE TRACKING PREVENTION & DIVERSION DIKE

APPROVED Raymundo Van Hoven 11/24/09
DESIGN ENGINEER DATE

DESIGNED BY___ DRAWN BY ___ CHECKED BY ___

603-01-7/7 SHEET 7 OF 7

1 T.E.S.C.M. OFFSITE TRACKING PREVENTION (NMDOT)
C-104 | C-504 SCALE: NTS

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5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	S.W.P.P.P. DETAILS

ORIGINAL DATE: 08/24/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 10/13/2009
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-504

User Name: 22190
Drawing Name: \\SAFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-502 - C-504 - EROSION CONTROL DETAILS.dwg May 06, 2010 - 9:18am

CONSTRUCTION PLANS FOR:

LOS ALAMOS NATIONAL LABORATORY STREAM GAGE

FOR DP CANYON
LOS ALAMOS, NEW MEXICO

INDEX OF DRAWINGS

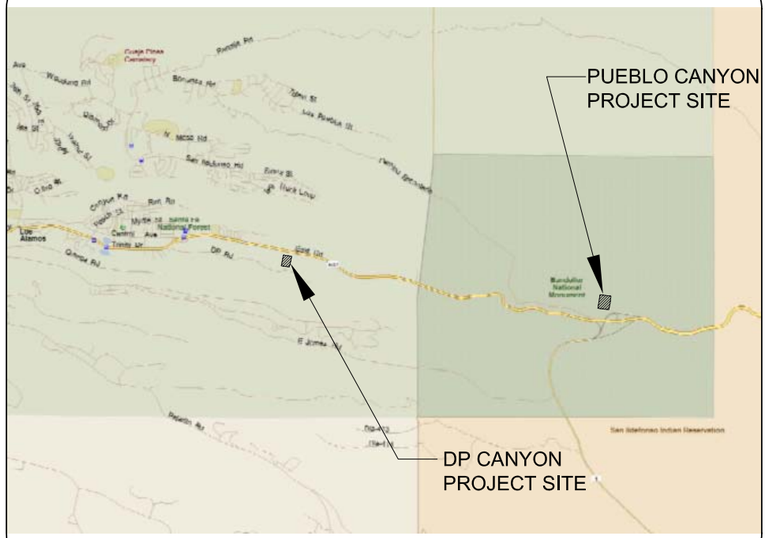
C-00 COVER SHEET

~~PUEBLO CANYON~~ (NOT INCLUDED)
~~C-01 OVERALL SITE/GRADING PLAN~~
~~C-02 SITE/GRADING ENLARGED PLAN~~
~~C-03 SITE/GRADING ENLARGED PLAN~~
~~C-04 STREAM GAGE PLAN AND PROFILE~~
~~C-05 STREAM GAGE TEMPORARY DIVERSION PLAN~~

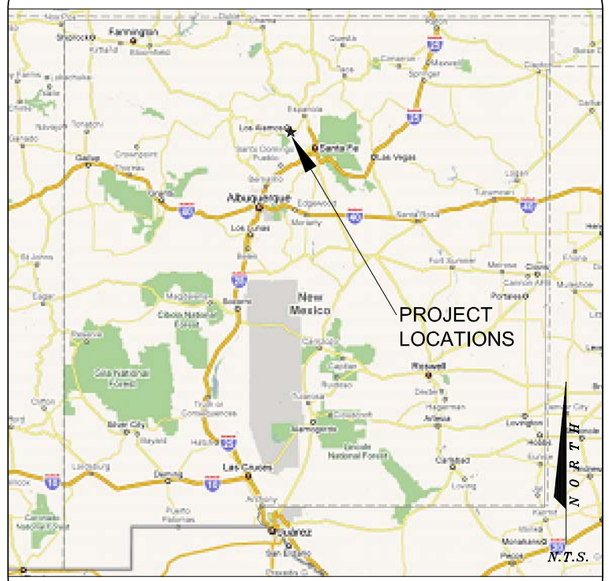
DP CANYON
C-06 OVERALL SITE/GRADING PLAN
C-07 SITE/GRADING ENLARGED PLAN
C-08 STREAM GAGE PLAN AND PROFILE
C-09 STREAM GAGE TEMPORARY DIVERSION PLAN

DETAILS
C-10 RIP RAP AND CHECK DAM DETAILS
SG-01 STREAM GAGE DETAILS
SG-02 STREAM GAGE DETAILS
SG-03 STREAM GAGE DETAILS

LOCATION MAP



VICINITY MAP



DRAWINGS REVISED TO INCORPORATE CONTRACTOR AS-BUILT INFORMATION. REVISIONS ARE INDICATED AS REVISION 1 WHERE APPLICABLE. 1

PREPARED FOR:
LOS ALAMOS NATIONAL LABORATORY
P.O. BOX 1663
LOS ALAMOS, NM 87545

PREPARED BY:

PBS&J
CONSULTING ENGINEERS
101 ARTHUR ANDERSEN PARKWAY, SUITE 260
SARASOTA, FLORIDA 34232
(941) 378-0272 (VOICE)
(941) 371-0297 (FAX)

KBR
GOVERNMENT AND INFRASTRUCTURE
2451 CRYSTAL DRIVE
ARLINGTON, VIRGINIA 22202
(703) 526-7500

DATE:	SHEETS	BY:
05/05/2010	C-06, C-07, C-09 C-10, SG-01 TO SG-03	JVC

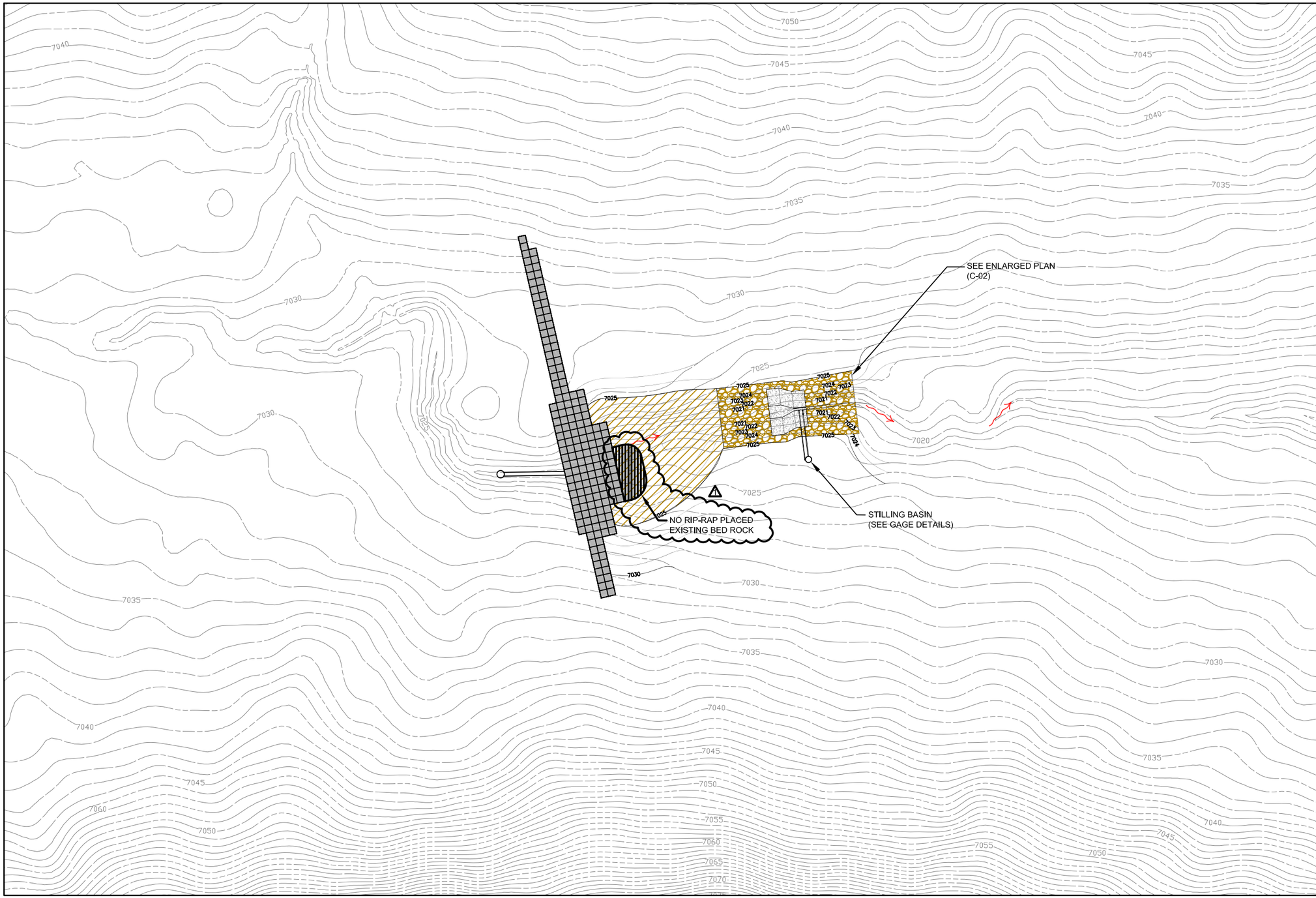
REVISIONS

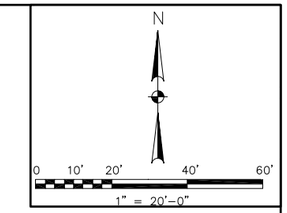
LOS ALAMOS NATIONAL LABORATORY STREAM GAGE

JOB NO. 100005632

DATE: 12/22/2009 SHT. 1 OF 9

User Name: 22190
Drawing Name: \\SAKFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-000 - COVER Gages.dwg May 24, 2010 - 10:23am





NOTES:

1. REFERENCE N.M.D.O.T. STANDARD SPECIFICATIONS FOR HIGHWAY & BRIDGE CONSTRUCTION SECTION 602.
2. ALL DISTURBED AREAS, NOT RECEIVING RIP-RAP, SHALL BE STABILIZED WITH PERMANENT VEGETATION. SEE GRADE CONTROL STRUCTURE DRAWINGS & SPECIFICATIONS.
3. ALL FILL SLOPES SHALL BE PLACED IN 6"-10" LIFTS AND COMPACTED TO MIN. 95% MAX DRY DENSITY PER ASTM D1557.

LEGEND

- 7020 — EXISTING CONTOUR LINE
- 7025 — PROPOSED CONTOUR LINE
- RIP-RAP (CLASS "A"-SEE NOTE 1)
- RIP-RAP (CLASS "B"-SEE NOTE 1)
- INDICATES DIRECTION OF SURFACE RUNOFF

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Sarasota, Florida 34232
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FBPR Certificate of Authorization No.: 24

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	DP CANYON STREAM GAGE OVERALL SITE/GRADING PLAN
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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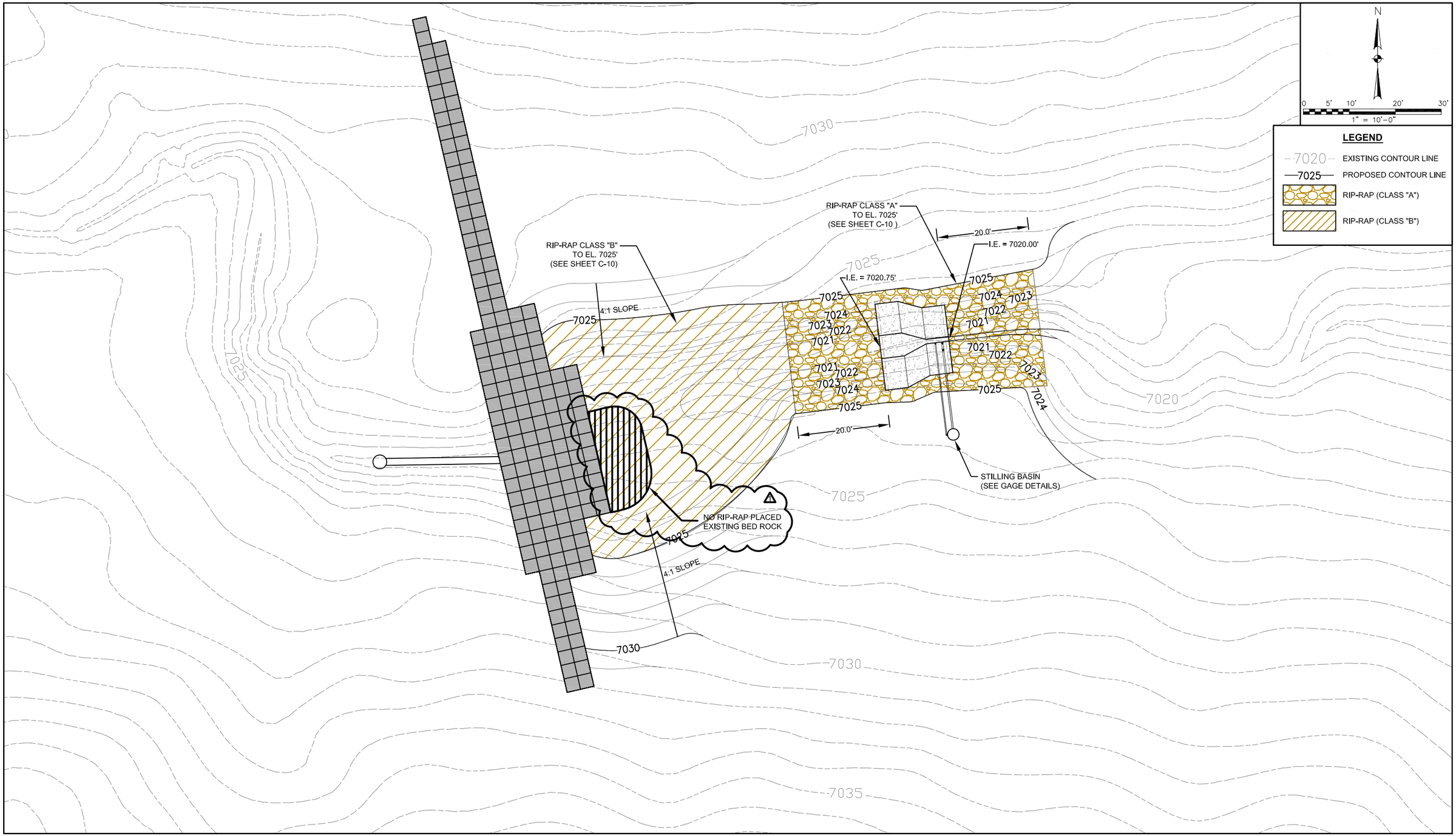
JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-06

User Name: 22190
Drawing Name: \\SAFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-06 - C-08 -DP-STREAM GAGE DETAILS.dwg
May 06, 2010 - 9:54am



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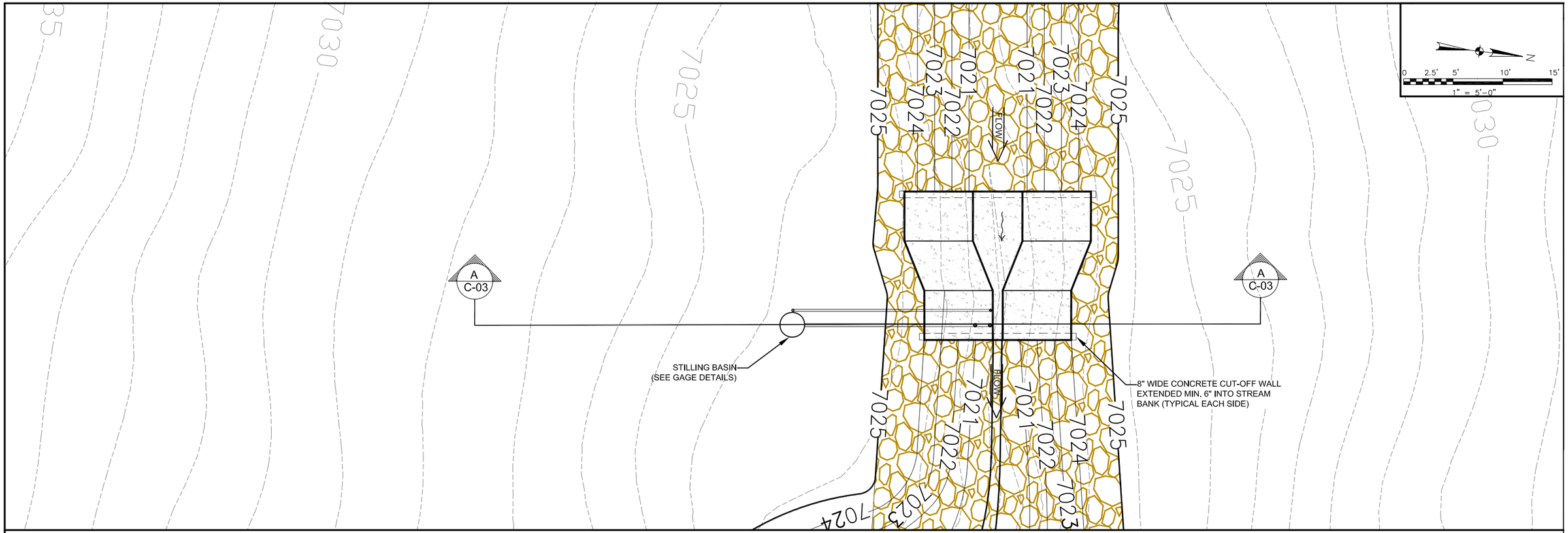
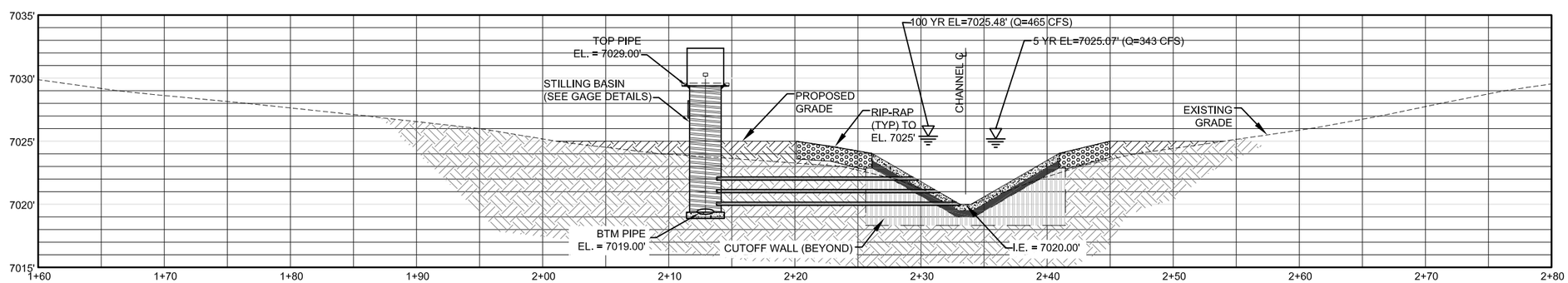
JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-07

User Name: 22190
Drawing Name: \\SAFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-08 - DP-STREAM GAGE DETAILS.dwg May 06, 2010 - 9:55am





A C-03 | C-03 CROSS SECTION A-A
SCALE: 1"=5'

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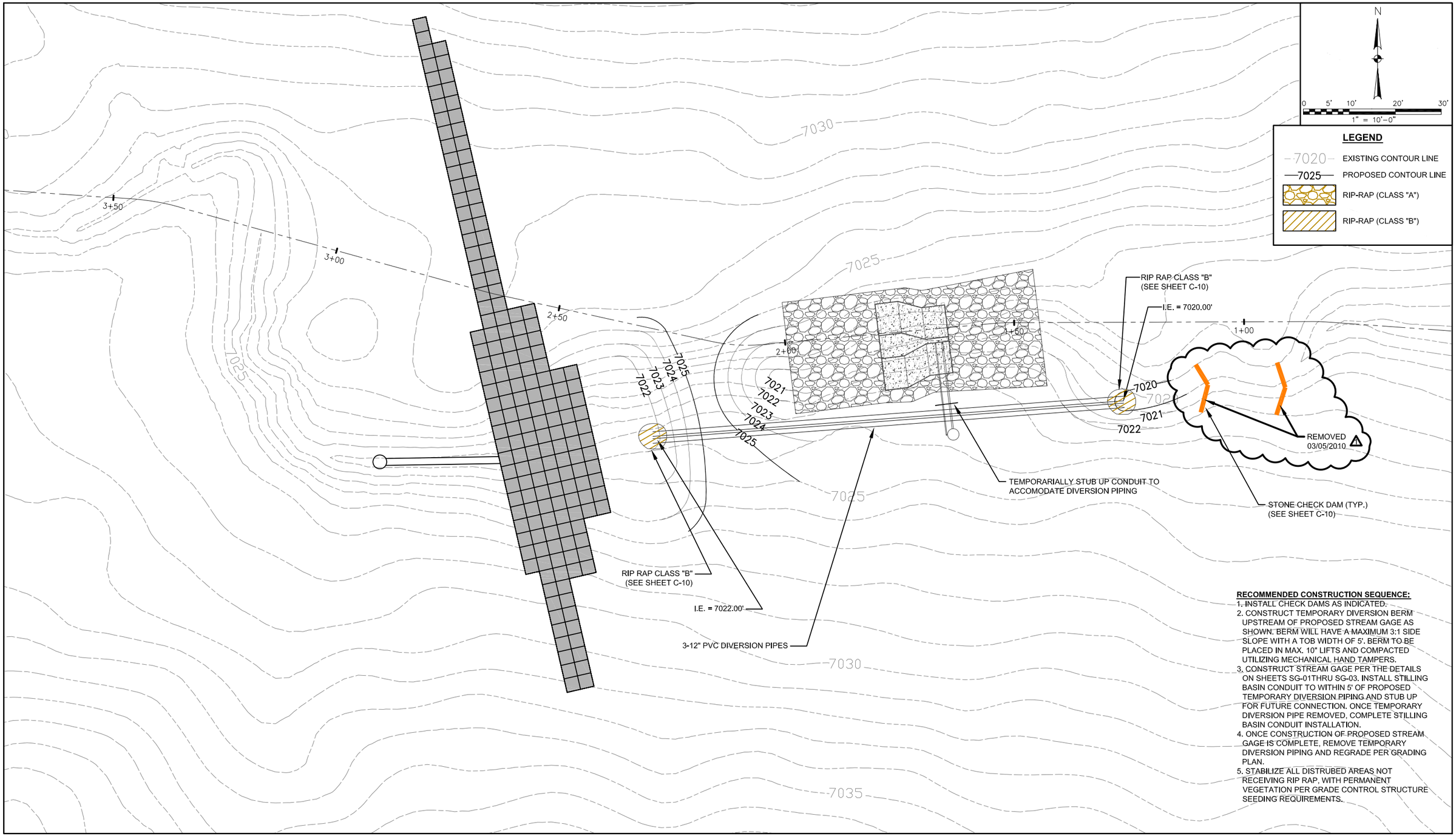
CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	DP CANYON STREAM GAGE PLAN AND PROFILE

ORIGINAL DATE: 12/22/09
REVISIONS:
1 2 3 4 5 6 7 8 9 10 11 12

JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-08

User Name: 22190
Drawing Name: \\SARFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-05 - C-08 -DP-STREAM GAGE DETAILS.dwg May 06, 2010 - 9:56am



RECOMMENDED CONSTRUCTION SEQUENCE:

1. INSTALL CHECK DAMS AS INDICATED.
2. CONSTRUCT TEMPORARY DIVERSION BERM UPSTREAM OF PROPOSED STREAM GAGE AS SHOWN. BERM WILL HAVE A MAXIMUM 3:1 SIDE SLOPE WITH A TOB WIDTH OF 5'. BERM TO BE PLACED IN MAX. 10" LIFTS AND COMPACTED UTILIZING MECHANICAL HAND TAMPERS.
3. CONSTRUCT STREAM GAGE PER THE DETAILS ON SHEETS SG-01THRU SG-03. INSTALL STILLING BASIN CONDUIT TO WITHIN 5' OF PROPOSED TEMPORARY DIVERSION PIPING AND STUB UP FOR FUTURE CONNECTION. ONCE TEMPORARY DIVERSION PIPE REMOVED, COMPLETE STILLING BASIN CONDUIT INSTALLATION.
4. ONCE CONSTRUCTION OF PROPOSED STREAM GAGE IS COMPLETE, REMOVE TEMPORARY DIVERSION PIPING AND REGRADE PER GRADING PLAN.
5. STABILIZE ALL DISTRUBED AREAS NOT RECEIVING RIP RAP, WITH PERMANENT VEGETATION PER GRADE CONTROL STRUCTURE SEEDING REQUIREMENTS.

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	DP CANYON STREAM GAGE TEMPORARY DIVERSION AND EROSION CONTROL PLAN

ORIGINAL DATE: 12/22/09
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1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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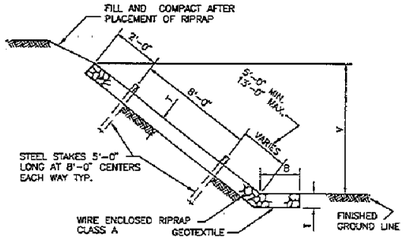
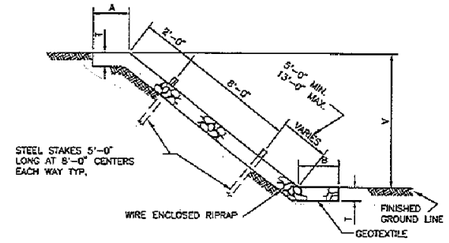
JOB NO. 100005632
DATE 01/05/2010
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-09

User Name: 22190
Drawing Name: \\SAFRS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\C-09 -DP-STREAM GAGE-TEMPORARY DIVERSION.dwg May 06, 2010 - 9:58am



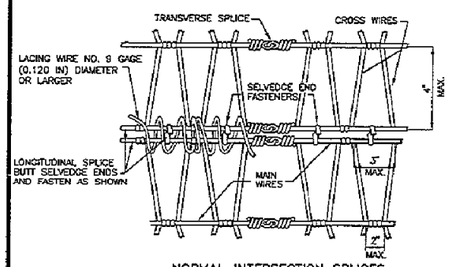
SECTION TYPE 1

QUANTITIES PER LINEAR FOOT	
SLOPE	RIPRAP CU. YARDS
1.5 : 1	$\frac{T}{27}(B + 1.803V + 0.303T)$
1.75 : 1	$\frac{T}{27}(B + 2.016V + 0.266T)$
2 : 1	$\frac{T}{27}(B + 2.236V + 0.236T)$
3 : 1	$\frac{T}{27}(B + 3.162V + 0.162T)$
4 : 1	$\frac{T}{27}(B + 4.123V + 0.123T)$

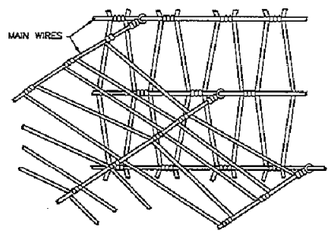


SECTION TYPE 2

QUANTITIES PER LINEAR FOOT	
SLOPE	RIPRAP CU. YARDS
1 : 1	$\frac{T}{27}(A + B + 1.414V)$
1.5 : 1	$\frac{T}{27}(A + B + 1.803V)$
1.75 : 1	$\frac{T}{27}(A + B + 2.016V)$
2 : 1	$\frac{T}{27}(A + B + 2.236V)$
3 : 1	$\frac{T}{27}(A + B + 3.162V)$
4 : 1	$\frac{T}{27}(A + B + 4.123V)$

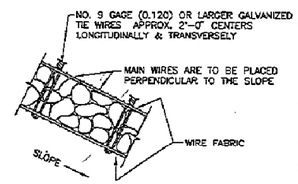


NORMAL INTERSECTION SPLICES



SKEWED INTERSECTION SPLICE

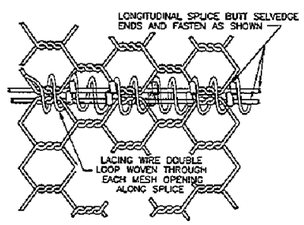
"W" MESH



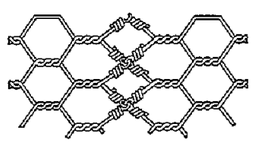
TYPICAL SECTION

GENERAL NOTES

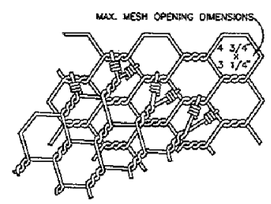
1. WIRE FABRIC FOR RIP RAP SHALL BE "W" OR HEXAGONAL MESH AND MEET THE REQUIREMENTS LISTED IN SECTION 602 OF THE STANDARD SPECIFICATIONS.
2. STEEL STAKES MAY BE RAILROAD RAILS WEIGHING NOT LESS THAN 30 LBS. PER YARD, 4" NOMINAL DIAMETER STANDARD STRENGTH GALVANIZED STEEL PIPE, OR L4"x4" x3/8" STEEL ANGLES. STEEL STAKES SHALL PROJECT 4" ABOVE TOP OF RIPRAP. STEEL STAKES ARE CONSIDERED INCIDENTAL TO THE COMPLETION OF THE WORK AND NO DIRECT MEASUREMENT OR PAYMENT WILL BE MADE THEREFOR.
3. IF LENGTH OF SLOPE IS 15 FEET OR LESS, ONLY ONE ROW OF STEEL STAKES 2 FEET FROM THE TOP EDGE OF RIPRAP WILL BE REQUIRED UNLESS OTHERWISE NOTED ON PLANS.
4. FOR DIMENSIONS A,B,V,&T SEE BRIDGE OR ROADWAY PLANS.
5. T=12" UNLESS OTHERWISE SHOWN ON PLANS. T= 18" AT BRIDGES.
6. FASTENERS FOR SPLICES AND/OR SELVEDGE END CONNECTORS MAY BE WIRE TIES, INTERLOCKING WIRE CLIPS, HOG RINGS, OR LACING WIRE. ONLY FASTENERS WHICH APPEAR ON THE DEPARTMENT'S "APPROVED PRODUCT LISTING" MAY BE USED.
7. LACING SHALL BE CONTINUOUS AS FAR AS IS PRACTICAL AND SHALL PASS THROUGH EACH MESH OPENING.
8. WHERE SPLICING IS NECESSARY, AN OVERLAP OF LACING OF AT LEAST 1 FOOT SHALL BE PROVIDED.



NORMAL INTERSECTION SPLICE



TRANSVERSE SPLICE



SKEWED INTERSECTION SPLICE

HEXAGONAL MESH

NO.	DATE	REV. BY	DESCRIPTION

REVISIONS (OR CHANGE NOTICES)

NEW MEXICO
DEPARTMENT OF TRANSPORTATION
STANDARD DRAWING

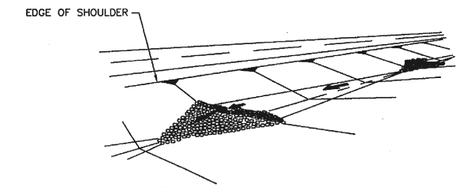
WIRE ENCLOSED RIPRAP
CLASS A

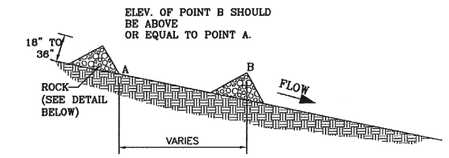
APPROVED DESIGN ENGINEER 11-27-09 DATE

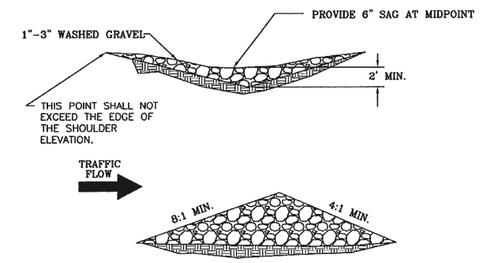
DESIGNED BY___ DRAWN BY ___ CHECKED BY ___

602-01-1/1

A C-10 | C-10 CLASS A RIP RAP DETAIL
SCALE: NTS

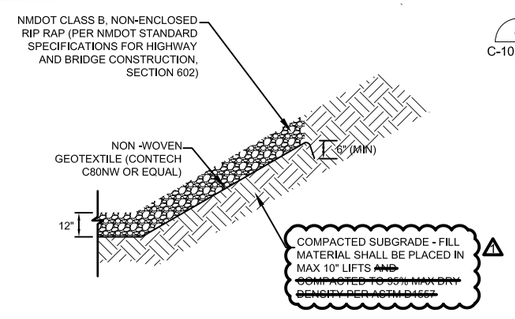






TYPE II
STONE DAM

C C-10 | C-10 CHECK DAM DETAIL (NMDOT)
SCALE: NTS



B C-10 | C-10 CLASS B RIP RAP DETAIL
SCALE: NTS

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	RIP RAP AND CHECK DAM DETAILS

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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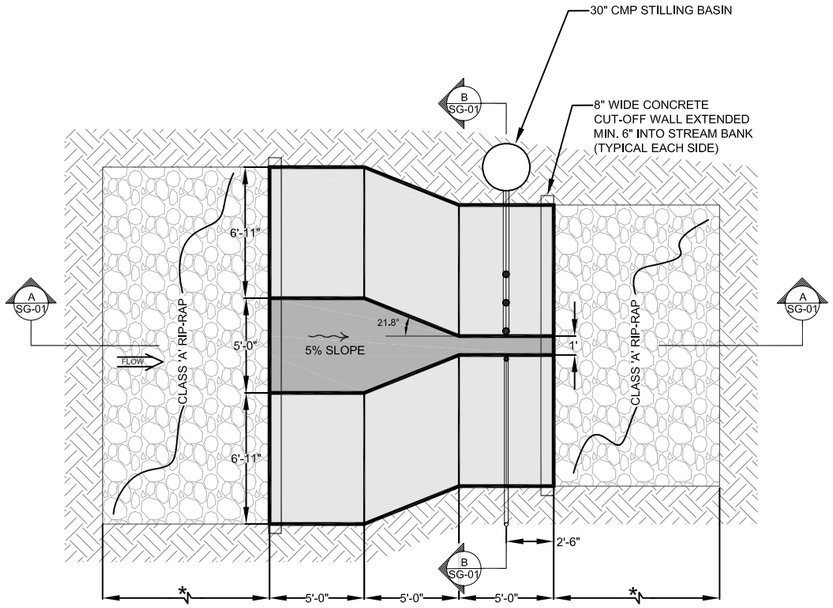
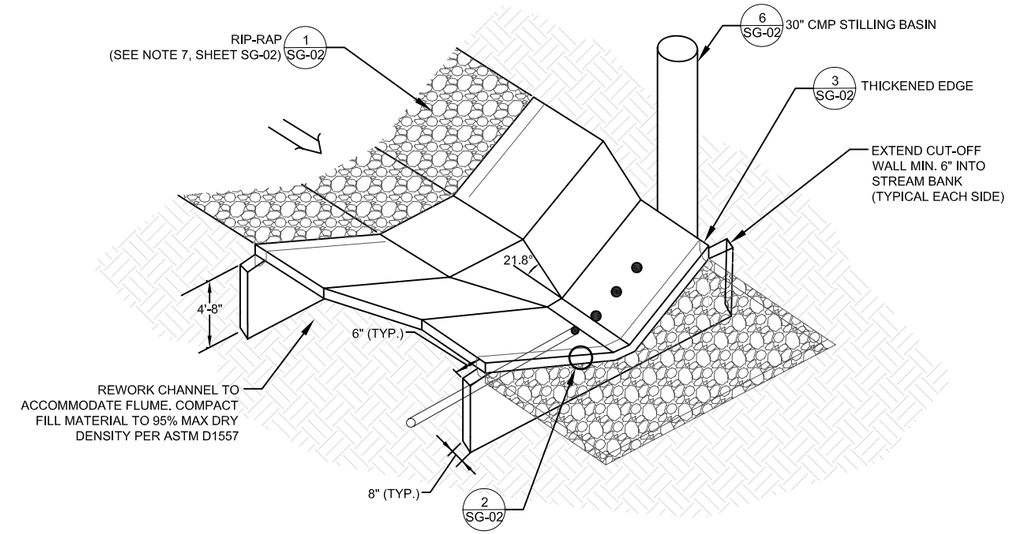
JOB NO. 100005632
DATE 12/22/09
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET C-10

User Name: 22190
Drawing Name: \\SAFFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\SC-01-03 AND C-10 DETAILS.dwg
May 06, 2010 - 10:02am

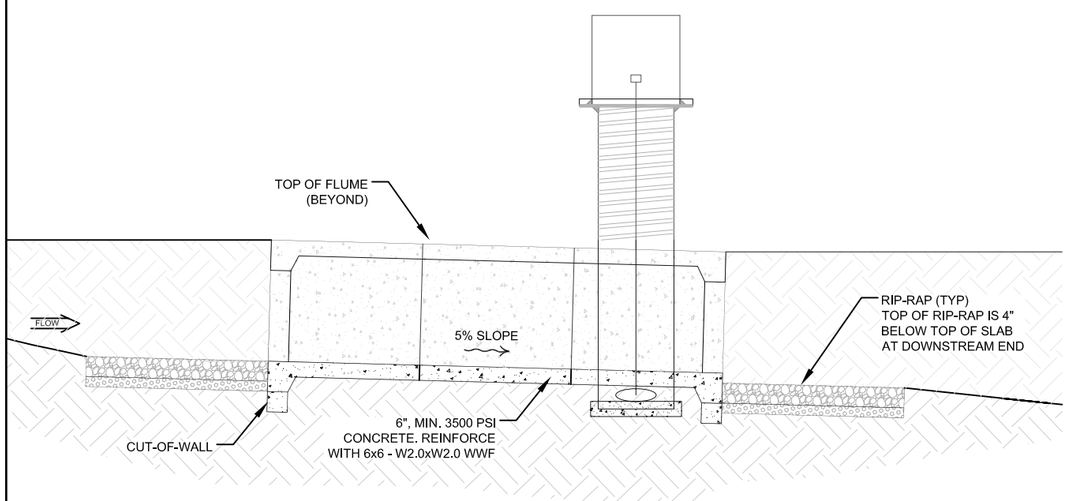


* RIP-RAP DIMENSIONS SHALL BE DETERMINED BASED ON LOCATION AND DESIGN CONDITIONS

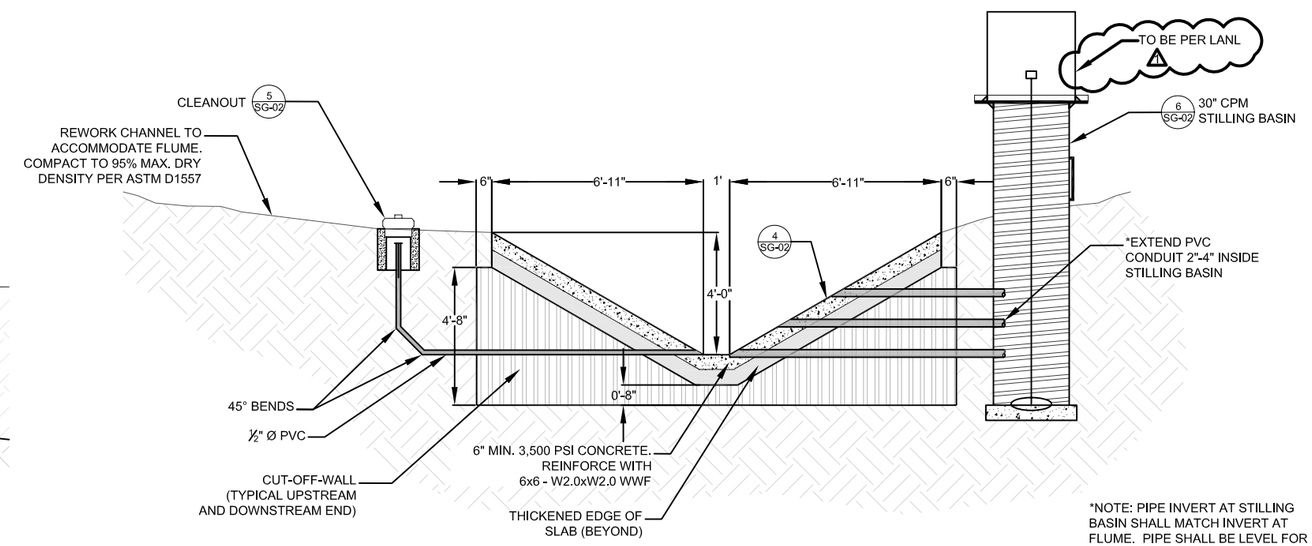
1 STREAM GAGE FLUME (PLAN VIEW)
SG-01 SCALE: N.T.S.



2 STREAM GAGE FLUME (ISOMETRIC VIEW)
SG-01 SCALE: NTS



A STREAM GAGE (SECTION THRU ℄)
SG-01 SG-01 SCALE: NTS



*NOTE: PIPE INVERT AT STILLING BASIN SHALL MATCH INVERT AT FLUME. PIPE SHALL BE LEVEL FOR ENTIRE LENGTH

B STREAM GAGE (SECTION B-B)
SG-01 SG-01 SCALE: NTS

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NM	LOS ALAMOS NATIONAL LABORATORY GRADE CONTROL STRUCTURES	STANDARD STREAM GAGE DETAILS (SHEET 1 OF 3)

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
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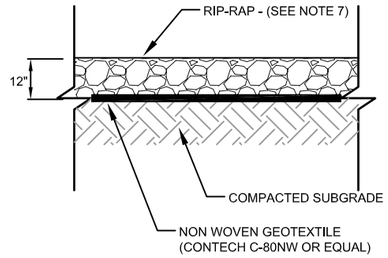
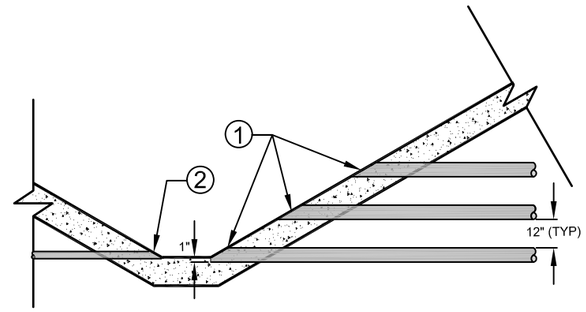
JOB NO. 100005632
DATE 12/22/09
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET SG-01

User Name: 22190
Drawing Name: \\SAFRS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\SG-01-03 AND C-10 DETAILS.dwg
May 06, 2010 - 10:02am



1 RIP-RAP
SG-01 | SG-02 SCALE: NTS



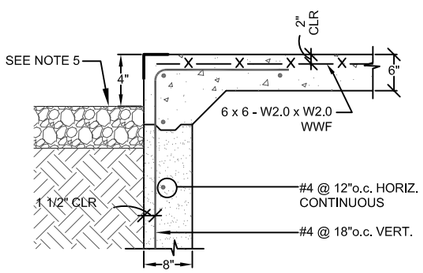
① 3-INCH Ø SCHEDULE 40 PVC. TRIM PIPE FLUSH WITH TOP OF SLAB. LOWER PIPE INVERT SHALL BE 1-INCH BELOW FLUME INVERT.

② ½-INCH Ø SCHEDULE 40 PVC. TRIM FLUSH WITH TOP OF SLAB. INVERT APPROX. ½-INCH ABOVE TOP OF SLAB.

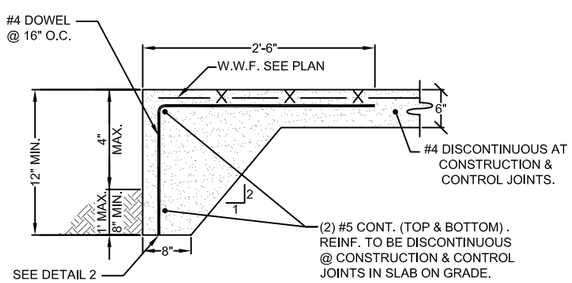
4 SECTION VIEW OF GAS PURGE STAGE MANOMETER CONDUIT & PIPE INTAKE
SG-01 | SG-02 SCALE: NTS

NOTES:

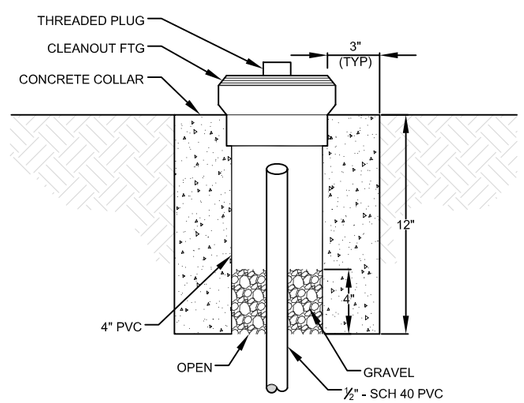
1. THE LENGTH OF STILLING WELL WILL BE DETERMINED DURING THE CONSTRUCTION OF THE STREAM GAGE.
2. METAL ENCLOSURE TO BE INSTALLED AS AN OPTION AT OWNER'S DIRECTION.
3. AS AN OPTION TO THE METAL ENCLOSURE INSTALL 3' x 3' x ¼" (t) METAL COVER PLATE. COVER PLATE SHALL BE PROVIDED WITH TWO HINGES AND A LOCKABLE HASP.
4. EXACT LOCATION OF ACCESS DOOR TO BE DETERMINED IN THE FIELD BY OWNER.
5. RIP-RAP SHALL BE FLUSH WITH TOP OF SLAB AT UPSTREAM END OF FLUME.
6. STILLING BASIN AND PIPE INTAKE SYSTEM MAY BE LOCATED EITHER SIDE OF FLUME. LOCATION TO BE DETERMINED BY OWNER ON A SITE SPECIFIC BASIS.
7. RIP-RAP SHALL BE DURABLE ROCKS OR ROUGH QUARRY STONE WITH NO MORE THAN 60% WEAR PER AASHTO T96. MINIMUM 70 TO 80 PERCENT OF STONE SHALL BE NO LESS THAN 4-INCHES AND NO MORE THAN 8-INCHES IN THE SMALLEST DIMENSION. RIP RAP SHALL BE CLASS A PER NMDOT STD. 602.



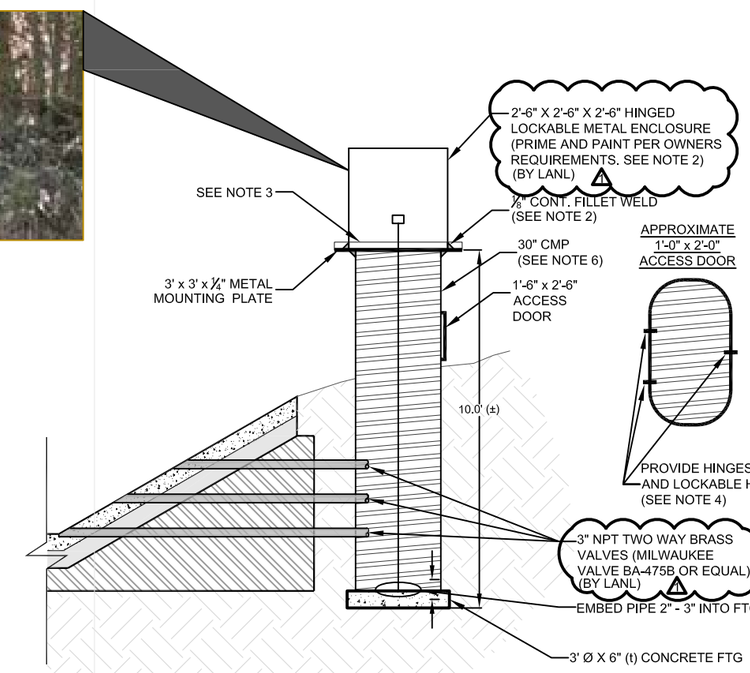
2 REBAR DETAIL
SG-01 | SG-02 SCALE: NTS



3 TYPICAL THICKENED EDGE
SG-01 | SG-02 SCALE: NTS



5 CLEANOUT DETAIL - GAS PURGE - STAGE MANOMETER CONDUIT
SG-01 | SG-02 SCALE: NTS



6 STILLING BASIN DETAIL
SG-01 | SG-02 SCALE: NTS

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CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	STANDARD STREAM GAGE DETAILS
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	(SHEET 2 OF 3)

ORIGINAL DATE: 12/22/09
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CHECKED IMT
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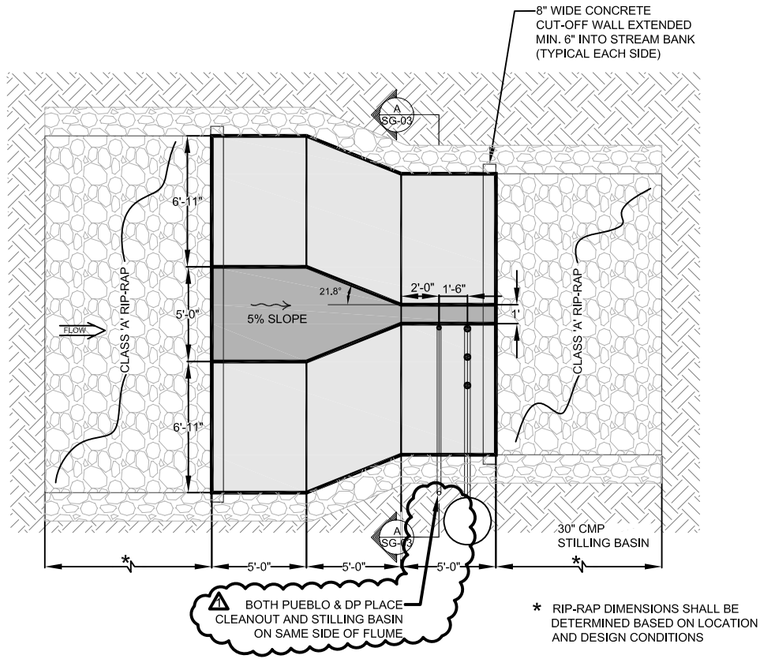
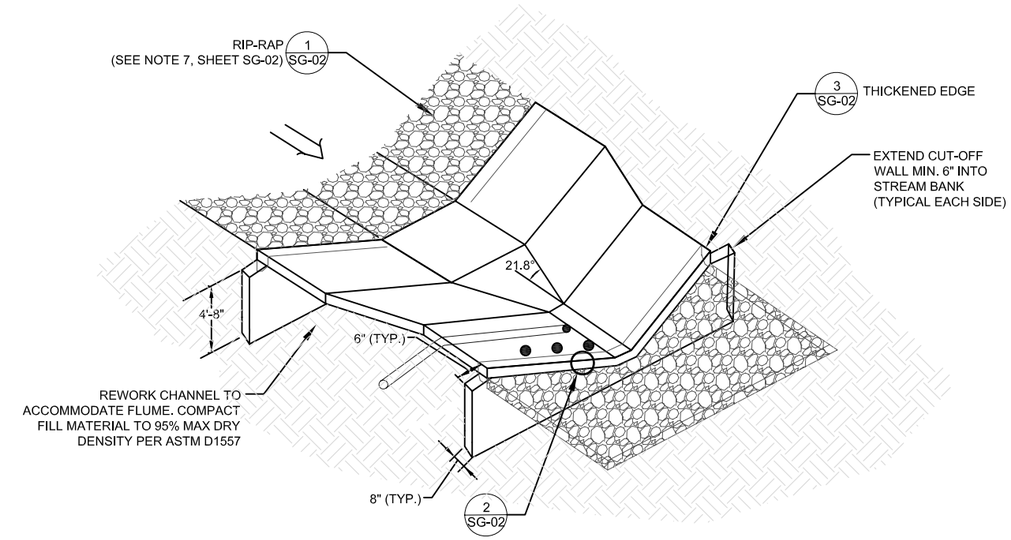
SHEET SG-02

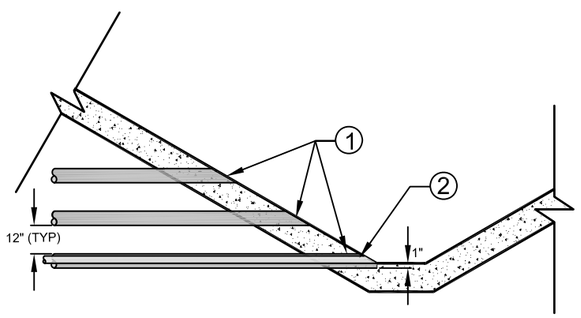
User Name: 22190
Drawing Name: \\SAFS01\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\SG-01-03 AND C-10 DETAILS.dwg
May 06, 2010 - 10:03am



1 STREAM GAGE FLUME (PLAN VIEW)
SG-03 SCALE: N.T.S.



2 STREAM GAGE FLUME (ISOMETRIC VIEW)
SG-03 SCALE: NTS

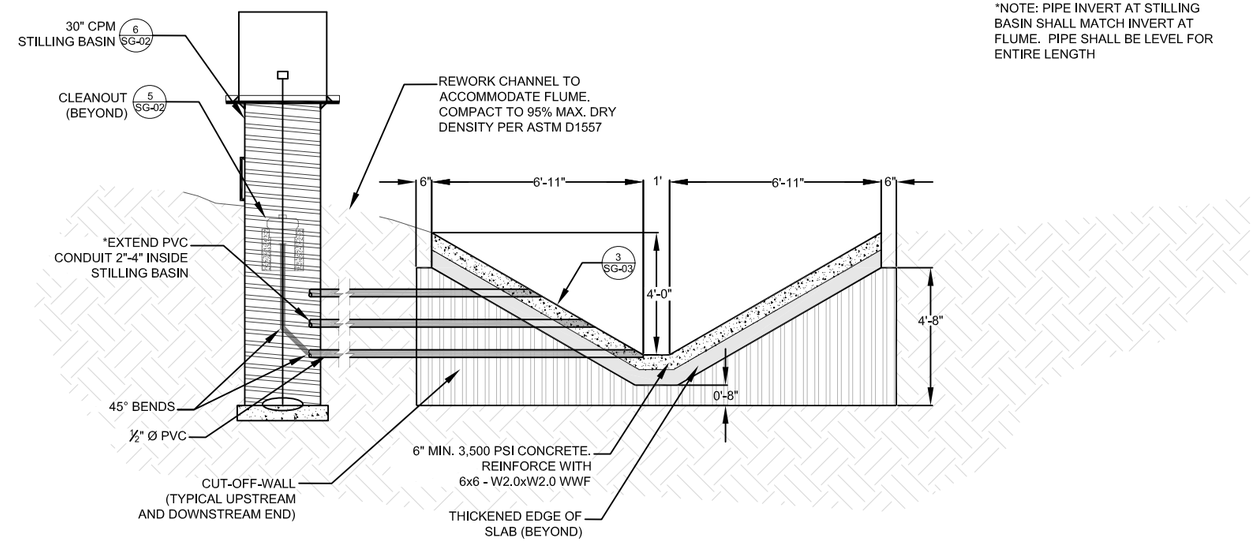


1 3-INCH Ø SCHEDULE 40 PVC. TRIM PIPE FLUSH WITH TOP OF SLAB. LOWER PIPE INVERT SHALL BE 1-INCH BELOW FLUME INVERT.

2 ½-INCH Ø SCHEDULE 40 PVC. TRIM FLUSH WITH TOP OF SLAB. INVERT APPROX. ½-INCH ABOVE TOP OF SLAB. (SEE PLAN VIEW)

3 SECTION VIEW OF GAS PURGE STAGE MANOMETER CONDUIT & PIPE INTAKE
SG-03 SG-03 SCALE: NTS

*NOTE: PIPE INVERT AT STILLING BASIN SHALL MATCH INVERT AT FLUME. PIPE SHALL BE LEVEL FOR ENTIRE LENGTH



A STREAM GAGE (SECTION B-B)
SG-03 SG-03 SCALE: NTS

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232
Ph. (941) 378-0272
Post Buckley Schuh & Jernigan, Inc., d/b/a PBS&J
5300 West Cypress Street, Suite 200, Tampa, Fl 33607
FBPR Certificate of Authorization No.: 24

KBR

CLIENT	PROJECT	TASK
LOS ALAMOS NATIONAL LABORATORY	LOS ALAMOS NATIONAL LABORATORY	STANDARD STREAM GAGE DETAILS (OPTION)
LOS ALAMOS, NM	GRADE CONTROL STRUCTURES	(SHEET 3 OF 3)

ORIGINAL DATE: 12/22/09
REVISIONS:
1 INCORPORATED CONTRACTOR AS-BUILT INFO 05/05/2010
2
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JOB NO. 100005632
DATE 12/22/09
DESIGNED DTW
PE RMP
CHECKED IMT
QC MS
SHEET SG-03

User Name: 22190
Drawing Name: \\SAFESO1\COMMON\100005632 Los Alamos\Record Drawings\DP & Pueblo Canyon\SG-01-03 AND C-10 DETAILS.dwg
May 06, 2010 - 10:04am

Appendix B

Geotechnical Engineering Report
(on CD included with this document)

GEOTECHNICAL ENGINEERING REPORT

SEDIMENT GRADE CONTROL STRUCTURES
DP AND PUEBLO CANYONS
LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

TERRACON PROJECT NO. 66095039
August 31, 2009

Prepared for:

PBS&J
101Arthur Andersen Parkway, Suite 260
Sarasota, Florida 43232

Attn: Mr. R. Michael Peel, P.E.
Senior Project Manager

Prepared by:

TERRACON CONSULTANTS, INC.
4905 Hawkins NE
Albuquerque, New Mexico 87109
Phone: (505) 797-4287
Fax: (505) 797-4288

Terracon

August 31, 2009

PBS&J
101 Arthur Andersen Parkway, Suite 260
Sarasota, Florida 34232

Attn: Mr. R. Michael Peel, P.E
Senior Project Manager

Re: Geotechnical Engineering Report
Sediment Grade Control Structures
DP and Pueblo Canyons
Los Alamos National Laboratory
Los Alamos County, New Mexico
Terracon Project No. 66095039

Dear Mr. Peel:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering exploration for the proposed sediment grade control structures in Los Alamos, New Mexico. This study was performed in general accordance with our revised Proposal No. P6609-0061 dated April 16, 2009.

The results of our engineering study, including the Area Map, Exploration Location Diagrams, laboratory test results, Logs of Borings and Test Pits, and the geotechnical recommendations needed to aid in the design and construction of the structures and other earth connected phases of this project are attached.

We appreciate being of service to you in the geotechnical engineering phase of this project, and are prepared to assist you during the construction phases as well. If you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact us.

Sincerely,

TERRACON CONSULTANTS, INC.

Meagan J. Duneman, E.I.
Staff Engineer

Michael E. Anderson, P.E.
Principal

MICHAEL E. ANDERSON
NEW MEXICO
12132
PROFESSIONAL ENGINEER

Copies to: Addressee (3 hard copies, 1-email)

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GEOTECHNICAL ENGINEERING REPORT
SEDIMENT GRADE CONTROL STRUCTURES
DP AND PUEBLO CANYONS
LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

TERRACON PROJECT NO. 66095039
August 31, 2009

INTRODUCTION

This report contains the results of our geotechnical engineering exploration for the proposed sediment grade control structures in Los Alamos, New Mexico. The location of the two sites with respect to the surrounding roads and general topography is shown on the Area Map, Figure A1 in Appendix A.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil/bedrock conditions,
- groundwater conditions,
- structure support,
- lateral earth pressures,
- earthwork.

The recommendations contained in this report are based upon results of field and laboratory testing, engineering analyses, experience with similar soil/bedrock conditions and structures, and our understanding of the proposed project.

PROPOSED CONSTRUCTION

Based on the provided information, we understand that the project will consist of the construction of sediment grade control structures at the Pueblo Canyon and DP Canyon sites. The structure at each site will consist of a gabion drop structure comprised of 3 feet wide, 3 feet long, and 6 feet deep units. The gabions will be embedded one course below the ground surface to prevent scouring and undermining the structures, along with providing stability. In addition, the upstream side will be wrapped in a geotextile filter fabric to minimize transport of fine sediments during early stages of use. The maximum height of the gabion drop structures will range from about 9 to 12 feet. The gabion drop structures will be designed to resist potential hydrostatic/flood loads and to resist overturning and sliding.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is

concerned about the potential for such contamination or pollution, other studies should be undertaken.

SITE OBSERVATIONS

During the site visits performed as part of the Kick-off meeting on August 11, 2009, it appeared that relatively shallow volcanic tuff bedrock was exposed within portions of the channel within the drainage at each proposed structure location.

Based upon our observations at the Pueblo Canyon site, the bedrock exposed at this location was weakly welded and "soft". In some cases several feet of alluvium is situated above the suspected bedrock. Accessibility to this site was fairly remote due to existing vegetation and trees and the lack of an access road to this area.

Based upon our visual observations, the bedrock exposed at the DP site was more strongly welded and harder than the Pueblo Canyon site. Existing piezometers had been installed in this area to observe shallow water conditions during storm events. It is our understanding that information associated with the installation of these piezometers indicates that bedrock is about 3 to 5 feet below existing site grade. Accessibility to this site was relatively good, via an unpaved and/or gravel surfaced road.

SITE EXPLORATION

The scope of the services performed for this project included site reconnaissance by a Terracon representative, a subsurface exploration program, laboratory testing and engineering analyses.

Field Exploration: A total of five (5) explorations were performed on August 19, 2009. The location, depths, and type of exploration are summarized in the following:

Location	Type of Exploration	Depth of Exploration (ft.)
DP Canyon – South Side	Boring (B-01)	15-1/2
DP Canyon - North Side	Test Pit (TP-01)	5-1/2*
Pueblo Canyon – Floodplain	Test Pit (TP-02)	9-1/2
Pueblo Canyon – Drainage	Test Pit (TP-03)	9-1/2
Pueblo Canyon – Channel	Test Pit (TP-04)	11

*Test pit refusal encountered

The approximate locations of the explorations are shown on the Exploration Location Diagrams, Figure A2a and A2b in Appendix A. The boring was advanced with a truck-mounted drilling rig, utilizing 7-½ inch outside-diameter hollow-stem augers. The test pits were performed with a rubber-tired backhoe using a 24-inch bucket.

The explorations were located in the field based upon the site plan prepared by PBS&J and measurements from existing site features. The accuracy of exploration locations should only be assumed to the level implied by the methods used to determine each.

Lithologic logs of the explorations were recorded by the Terracon representative during the drilling/excavation operations. At selected intervals within the boring, samples of the subsurface materials were taken by driving standard split-spoon or ring-barrel samplers. In addition, bulk disturbed samples were obtained at selected intervals in the test pits.

Penetration resistance measurements performed in the boring were obtained by driving the split-spoon and ring-barrel into the subsurface materials with a 140-pound hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency, relative density or hardness of the materials encountered.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the boring performed at the DP Canyon site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

In addition to obtaining penetration resistance measurements, bedrock core drilling operations were performed in the boring at the DP Canyon site, coring operations were performed. The bedrock was cored using NX coring methods. A minimum 10-foot core sample was obtained. Rock Quality Designation (RQD) was recorded for each 5-foot core run.

Groundwater conditions were evaluated in the explorations at the time of site exploration, and immediately upon completion of drilling/excavating.

Laboratory Testing: Samples retrieved during the field exploration were taken to the laboratory for observation by the project geotechnical engineer and were classified in general accordance with the Unified Soil Classification System and Rock Descriptions in Appendix C. At that time, an applicable laboratory testing program was formulated to determine the engineering properties of the subsurface materials and the field descriptions were confirmed or modified as necessary. Boring and Test Pit Logs were prepared and are presented in Appendix A.

Laboratory tests were conducted on selected soil and bedrock samples and are presented in Appendix B and on the Logs of Boring and Test Pits. The test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with applicable accepted standards.

Selected soil and/or bedrock samples were tested for the following engineering properties:

- Water Content
- Unconfined Compressive Strength
- Soluble Sulfates
- Resistivity
- Percent Fines/Gradation
- Plasticity Index
- Dry Density
- pH

SITE CONDITIONS

DP Canyon: The proposed site is located within an existing drainage north of DP Road and the TSTA Building. The site is undeveloped, with the exception of an unpaved and/or gravel surfaced access road that parallels the existing drainage. Existing piezometers were observed directly west of the project site. A gauge station and equipment shelters were observed directly south of the proposed site. Vegetation consisted of a sparse to heavy growth of native brush and grasses. The site generally slopes down to the east, along the existing drainage.

Pueblo Canyon: The proposed site is located within an existing drainage northwest of State Highway 502 and 4. The site is undeveloped. An unpaved and/or gravel surfaced road that parallels the existing drainage and gauge station are located upstream from the project site. In addition, a New Mexico Department of Transportation maintenance patrol yard is located northwest of the project site. Vegetation consisted of a sparse to heavy growth of native brush and grasses. The site generally slopes down to the south and southeast, along the existing drainage.

SUBSURFACE CONDITIONS

DP Canyon: As presented on the Log of Boring and Log of Test Pit, the surface soils consisted of silty sand (SM) to a depth of about 2 to 3 feet below existing site grade. Volcanic tuff bedrock was encountered below the silty sand and extended down to the full depth of exploration. Test pit excavation refusal was encountered in Test Pit TP-01at a depth of about 5-1/2 feet below existing site grade. The tuff bedrock varied from non-welded to strongly welded.

Pueblo Canyon: As presented on the Logs of Test Pits, the surface and subsurface soils consisted of well graded sand with silt and gravel (SW-SM), poorly graded sand with gravel (SP), silty sand (SM), and sandy silt (ML) to the full depth of exploration. Auger refusal was not encountered in the test pits.

Field and Laboratory Test Results: Correlation to field penetration test results indicates that the tuff bedrock varies from medium heard to very hard in hardness.

Laboratory test results indicate that the sands and silts are non-plastic in plasticity. Based upon our experience with similar soil conditions and our observations performed during drilling/excavation, it is our opinion that the sand soils will likely exhibit low to moderate compressibility under anticipated loads. Furthermore, it is our opinion that the sand soils will likely exhibit low to moderate potential for hydro-compaction when elevated in moisture content.

Results of the unconfined compressive strength testing performed on the tuff bedrock at a depth of about six feet below existing site grade, indicated a value of 112,032 pounds per square foot (778 pounds per square inch).

Results of the chemical laboratory testing, performed on two subsurface samples obtained within each site indicate that the soluble sulfate concentrations are about 17 mg/kg, the pH values range between 6.8 to 7.1, and the resistivities range between 10,900 to 27,400 ohms-cm.

Groundwater Conditions: Groundwater was not encountered in the explorations at the time of field exploration. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors.

Fluctuations in groundwater levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells, and periodic measurement of groundwater levels over a sufficient period of time. The possibility of groundwater fluctuations will need to be considered when developing design and construction plans for the project.

ENGINEERING ANALYSES AND RECOMMENDATIONS

Geotechnical Considerations: The sites appear suitable for the proposed construction. However, medium hard to very hard volcanic tuff bedrock was encountered at depths of about 2 to 3 feet below existing site grade at the DP Canyon site. Test pit excavation refusal was encountered at a depth of about 5-1/2 feet below existing site grade. Difficult excavation techniques may be required in this area depending on the final excavation depths. A qualified contractor should review the data and information contained in this report to determine the appropriate equipment required to advance the excavations to construction depths. It should be noted that a limited number of explorations were performed at both sites; therefore, the subsurface conditions encountered during construction could vary form those encountered as part of this study.

In addition, potentially compressible soils at shallow depths which show low to moderate tendency for compressibility at in-situ moisture contents and low to moderate tendency for hydro-compaction when elevated in moisture content will require particular attention in the design and construction.

Based on the geotechnical analyses, subsurface information and laboratory results, it is our opinion that the proposed structures can be supported on the existing soils or tuff bedrock at the sites.

Design and construction recommendations for structure support and other earth connected phases of the project are outlined below.

Structure Support: Based upon the boring and test pit information, and our experience with similar soil and bedrock conditions, the allowable bearing pressure of the sands is anticipated to be on the order of about 2,000 pounds per square foot (psf). A conservative allowable bearing pressure for the tuff bedrock is anticipated to be on the order of about 3,500 psf.

Total settlement of the structure designed to the maximum bearing pressure is estimated to be on the order of one to 2 inches. Due to the potential for unstable or very loose subgrade soils or seasonal groundwater at the base of the structures, a 12-inch gravel or rock layer may be required below the structures to provide a stable working/construction platform.

Foundation excavations and engineered fill placement should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Lateral Earth Pressures: The recommended equivalent fluid pressures for unrestrained foundation elements when using on-site soils as backfill are:

Active:

- Sand Soils ..... 35 psf/ft

Passive:

- Sand Soils ..... 390 psf/ft

Coefficient of base friction:

- Sand Soils 0.40*

*The coefficient of base friction should be reduced to 0.35 when used in conjunction with passive pressure.

Where the design includes restrained elements, the following equivalent fluid pressure is recommended:

At Rest:

- Sand Soils ..... 55 psf/ft

The above lateral earth pressures and coefficient do not include any factor of safety. Additional recommendations may be necessary if such conditions are to be included in the design.

Fill against the structures should be compacted to densities specified in the Earthwork section of this report. Compaction of each lift adjacent to structures should be accomplished with hand-operated tampers or other lightweight compactors. Overcompaction may cause higher lateral earth pressures which could result in movements.

Geotextile Filter Fabric: We recommend that a non-woven geotextile fabric be used to prevent the migration of fines from entering the Gabion structure. The fabric specified should be compatible with the on-site soils and meet minimum strength, permittivity, and flow rate requirements.

Earthwork:

- **General Considerations:** The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations and slabs are contingent upon following the recommendations outlined in this section.

  Earthwork on the project should be observed and evaluated by Terracon Consultants, Inc. The evaluation of earthwork should include observation and testing

of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

- **Site Preparation:** Strip and remove the existing vegetation, debris, and other deleterious materials from proposed structure areas. Exposed surfaces should be free of mounds and depressions, which could prevent uniform compaction.

  Stripped materials consisting of vegetation and organic materials should be wasted from the site, or used to revegetate landscaped areas or exposed slopes after completion of grading operations.

  If fill is placed in areas of the site where existing slopes are steeper than 5:1 (horizontal: vertical), the area should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be wide enough to accommodate compaction and earth moving equipment and to allow placement of horizontal lifts of fills.

  It is anticipated that shallow excavations in some areas for the proposed construction can be accomplished with conventional earthmoving equipment. However, very hard bedrock materials, and auger refusal materials were encountered at depths ranging between 2 and 3 feet below existing ground surface. Based upon the boring and test pit data, this condition appears to be associated with the DP Canyon site. Difficult excavation techniques may be required in this area depending on the final excavation depths. A qualified contractor should review the data and information contained in this report to determine the appropriate equipment required to advance the excavations to construction depths. It should be noted that a limited number of explorations were performed at both sites; therefore, the subsurface conditions encountered during construction could vary form those encountered as part of this study.

  Groundwater was not encountered to depths of about 5-1/2 to 11 feet below existing site grades. However, depending upon the season during construction, groundwater could be encountered at the project sites. Therefore, groundwater control measures could be required depending on the construction excavation depths.

  Based upon the subsurface conditions determined from the geotechnical exploration, it is our opinion that the shallow subgrade soils exposed during construction are anticipated to be relatively stable; however, groundwater could be encountered during construction. The stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unstable conditions develop, workability may be improved by scarifying and drying. Overexcavation of wet zones and replacement with granular materials may be necessary. Use of cement or geotextiles could also be considered as a stabilization technique. Laboratory

evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction. Lightweight excavation equipment may be required to reduce subgrade pumping.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

- **Subgrade Preparation:** Exposed areas which will receive fill of the initial course of the gabion structure, once properly cleared, should be scarified to a minimum depth of 10 inches, conditioned to near optimum moisture content, and compacted.

- **Fill Materials and Placement:** Generally, clean on-site soils or approved imported materials may be used as fill material (if applicable) for the site. The fill materials should conform to the following:

Gradation	Percent finer by weight (ASTM C136)
6"	100
3"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	35 (max)
• Liquid Limit	30 (max)
• Plasticity Index	12 (max)

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed 10 inches loose thickness. Recommended compaction criteria for engineered fill materials are as follows:

Material	Minimum Percent (ASTM D1557)
Scarified subgrade soils	90
Miscellaneous backfill (non-structural areas)	85

Imported soils should be compacted within a moisture range of optimum to 3 percent above optimum if the materials have a PI of 5 or more. On-site soils and import soils that have a PI of less than 5 should be compacted within a moisture range of +/-3 percent of optimum moisture content.

- **Excavation and Trench Construction:** Excavations into the on-site materials will likely encounter caving soils and possibly groundwater, depending upon the final depth of excavation. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

  The soils or bedrock to be penetrated by the proposed excavations may vary significantly across the site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

  As a safety measure, it is recommended that all vehicles and soil piles be kept to a minimum lateral distance from the crest of the slope equal to no less than the slope height. The exposed slope face should be protected against the elements.

  The contractor should retain a geotechnical engineer to monitor the soils/bedrock exposed in all excavations and provide engineering services for slopes. This will provide an opportunity to monitor the soil types encountered and to modify the excavation slopes as necessary. It also offers an opportunity to verify the stability of the excavation slopes during construction.

Additional Design and Construction Considerations:

- **Exterior Slab Design and Construction:** Exterior slabs-on-grade, exterior architectural features, and utilities founded on, or in fill/backfill or undisturbed soils may experience some movement due to the volume change of the backfill. To reduce the potential for damage caused by movement, we recommend:

  - using granular fill
  - minimizing moisture increases in the backfill/undisturbed soils
  - controlling moisture-density during placement of backfill
  - using designs which allow vertical movement between the exterior features and adjoining structural elements
  - placing effective control joints on relatively close centers

- **Corrosion Protection:** Results of the chemical laboratory testing, performed on two subsurface samples obtained within each site indicate that the soluble sulfate concentrations are about 17 mg/kg, the pH values range between 6.8 to 7.1, and the resistivities range between 10,900 to 27,400 ohms-cm.

Results of the chemical laboratory test results indicate that the soils tested have a mild potential for corrosion of concrete and a mild potential for corrosion of ferrous metals.

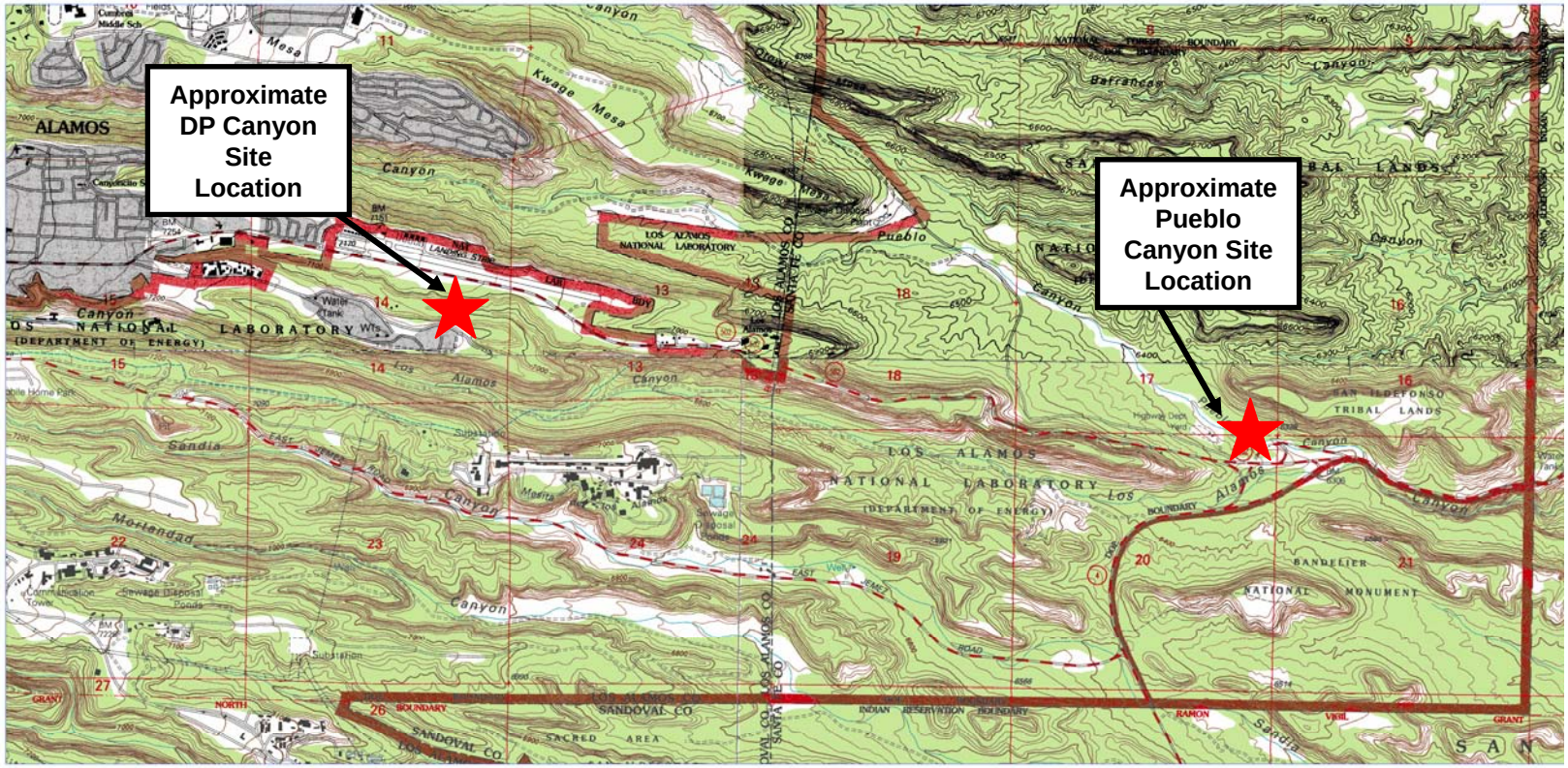
GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.



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1000 0 2000 4000 6000 8000 10,000 Feet

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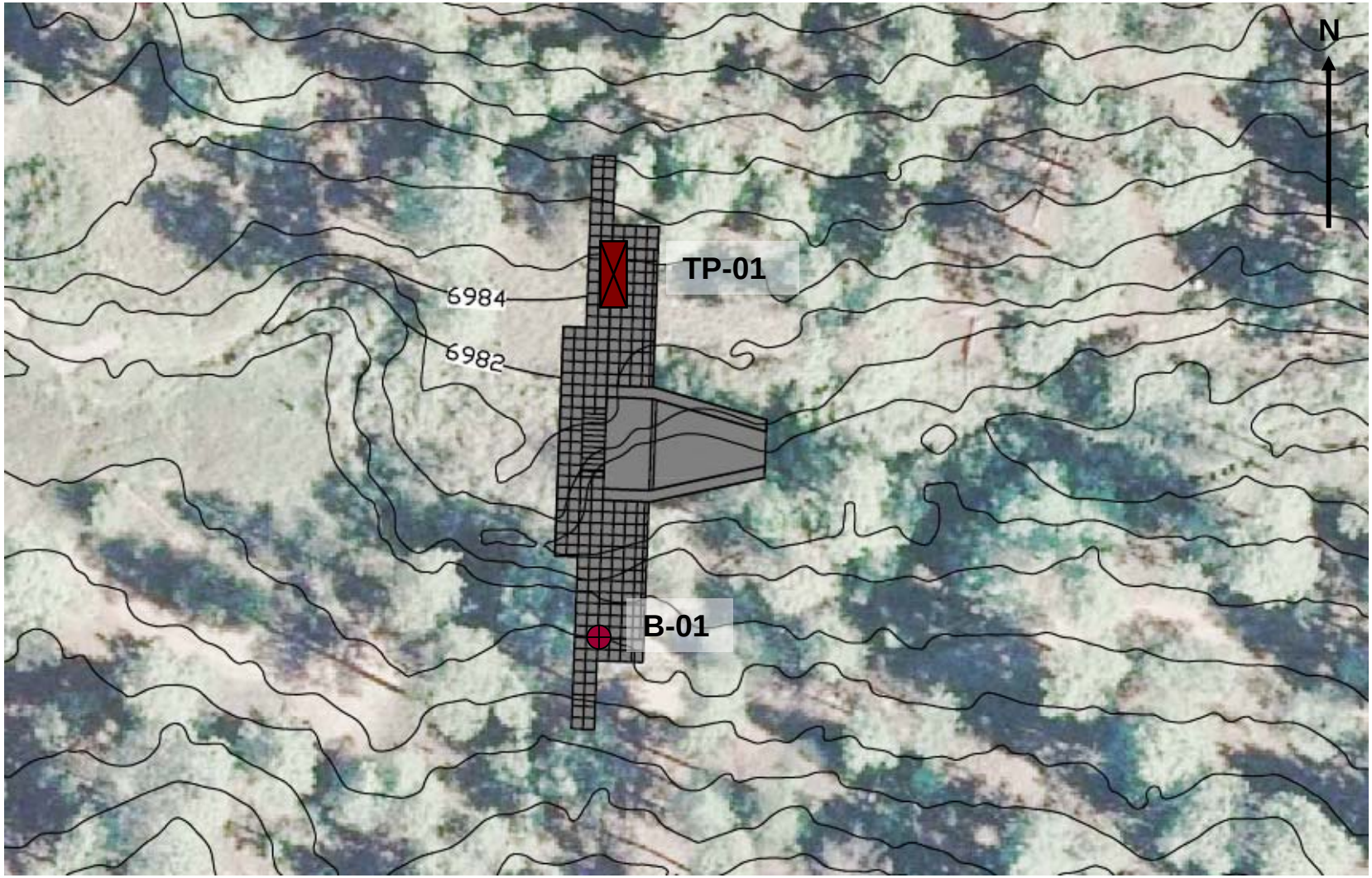
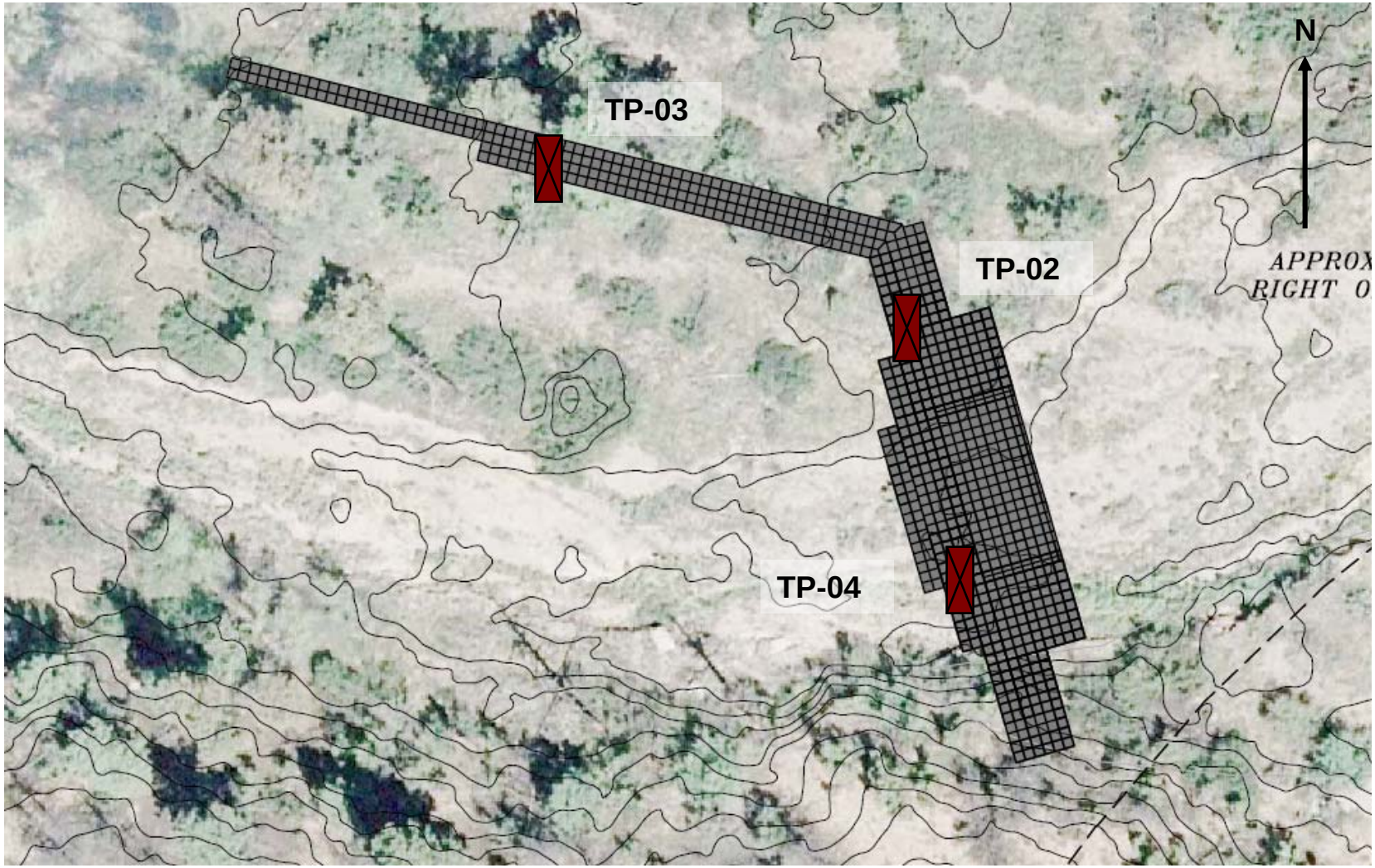
Source: USGS 7.5-Minute Topographic Maps "Puye", "Frijoles", "White Rock", and "Guaje Mountain", New Mexico, United States, dated 2002

Project Mngr: MJD	Project No. 66095039	Terracon Consulting Engineers and Scientists 4905 Hawkins St. NE Albuquerque, New Mexico 87109 Phone: 505.797.4287 Fax 505.797.4288	**AREA MAP**	FIG. No.
Drawn By:	Scale: As Shown		Sediment Grade Control Structures Pueblo Canyon Los Alamos County, New Mexico	A1
Checked By: MEA	File No.			
Approved By: MEA	Date: 8/2009			



Project Mngr: MJD	Project No. 66095039	Terracon Consulting Engineers and Scientists 4905 Hawkins St. NE Albuquerque, New Mexico 87109 Phone: 505.797.4287 Fax 505.797.4288	**EXPLORATION LOCATION DIAGRAM**	FIG. No.
Drawn By:	Scale: NTS		Sediment Grade Control Structures DP Canyon Los Alamos County, New Mexico	A2a
Checked By: MEA	File No.			
Approved By: MEA	Date: 8/2009			



Project Mngr: MJD	Project No. 66095039	Terracon Consulting Engineers and Scientists 4905 Hawkins St. NE Albuquerque, New Mexico 87109 Phone: 505.797.4287 Fax 505.797.4288	**EXPLORATION LOCATION DIAGRAM**	FIG. No.
Drawn By:	Scale: NTS		Sediment Grade Control Structures Pueblo Canyon Los Alamos County, New Mexico	A2b
Checked By: MEA	File No.			
Approved By: MEA	Date: 8/2009			

B-01

5.5 to 15.5 Feet

Project Mngr: MJD	Project No. 66095039	Terracon Consulting Engineers and Scientists 4905 Hawkins St. NE Albuquerque, New Mexico 87109 Phone: 505.797.4287 Fax 505.797.4288	**ROCK CORE PHOTOGRAPH**	FIG. No.
Drawn By:	Scale: NTS		Sediment Grade Control Structures Pueblo Canyon Los Alamos County, New Mexico	A3
Checked By: MEA	File No.			
Approved By: MEA	Date: 8/2009			

LOG OF BORING NO. B-01

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	SILTY SAND; trace gravel, brown									
2										
	VOLCANIC TUFF BEDROCK; grey, medium hard to very hard, slightly to very fractured, non- to strongly welded			1	RS	6	50	6	91	
				2	SS	14	50/0.4	5		
		5								
				3	C	100%	RQD 67%		101	112032
		10								
				4	C	95%	RQD 80%			
		15								
15.5										
	Boring Terminated at 15.5 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WD	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG	CME-75	FOREMAN	MJD
APPROVED	MEA	JOB #	66095039

LOG OF TEST PIT NO. TP-01

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	SILTY SAND; trace gravel, brown		SM	1	GRAB			4		
3										
	VOLCANIC TUFF BEDROCK; grey, non- to weakly welded			2	GRAB			2		
		5								
5.5										
	Test Pit Excavation Refusal at 5.5 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WE	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG		FOREMAN	MJD
APPROVED	MEA	JOB #	66095039

LOG OF TEST PIT NO. TP-02

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	WELL-GRADED SAND with SILT and GRAVEL; brown		SW SM	1	GRAB			2		
			SW SM	2	GRAB			4		
		5								
	6									
	SILTY SAND; trace gravel, brown		SM	3	GRAB			10		
	9.5									
	Test Pit Terminated at 9.5 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WE	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG		FOREMAN	MJD
APPROVED	MEA	JOB #	66095039

LOG OF TEST PIT NO. TP-03

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	SILTY SAND; trace gravel, brown									
2										
	POORLY GRADED SAND with GRAVEL; brown		SP	1	GRAB			4		
		5								
			SP	2	GRAB			9		
7										
	SILTY SAND; trace gravel, brown									
			SM	3	GRAB			5		
9.5										
	Test Pit Terminated at 9.5 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WE	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG		FOREMAN	MJD
APPROVED	MEA	JOB #	66095039

LOG OF TEST PIT NO. TP-04

CLIENT **PBS&J**

SITE **DP Canyon and Pueblo Canyon Los Alamos County, NM**

PROJECT **Sediment Grade Control Structures**

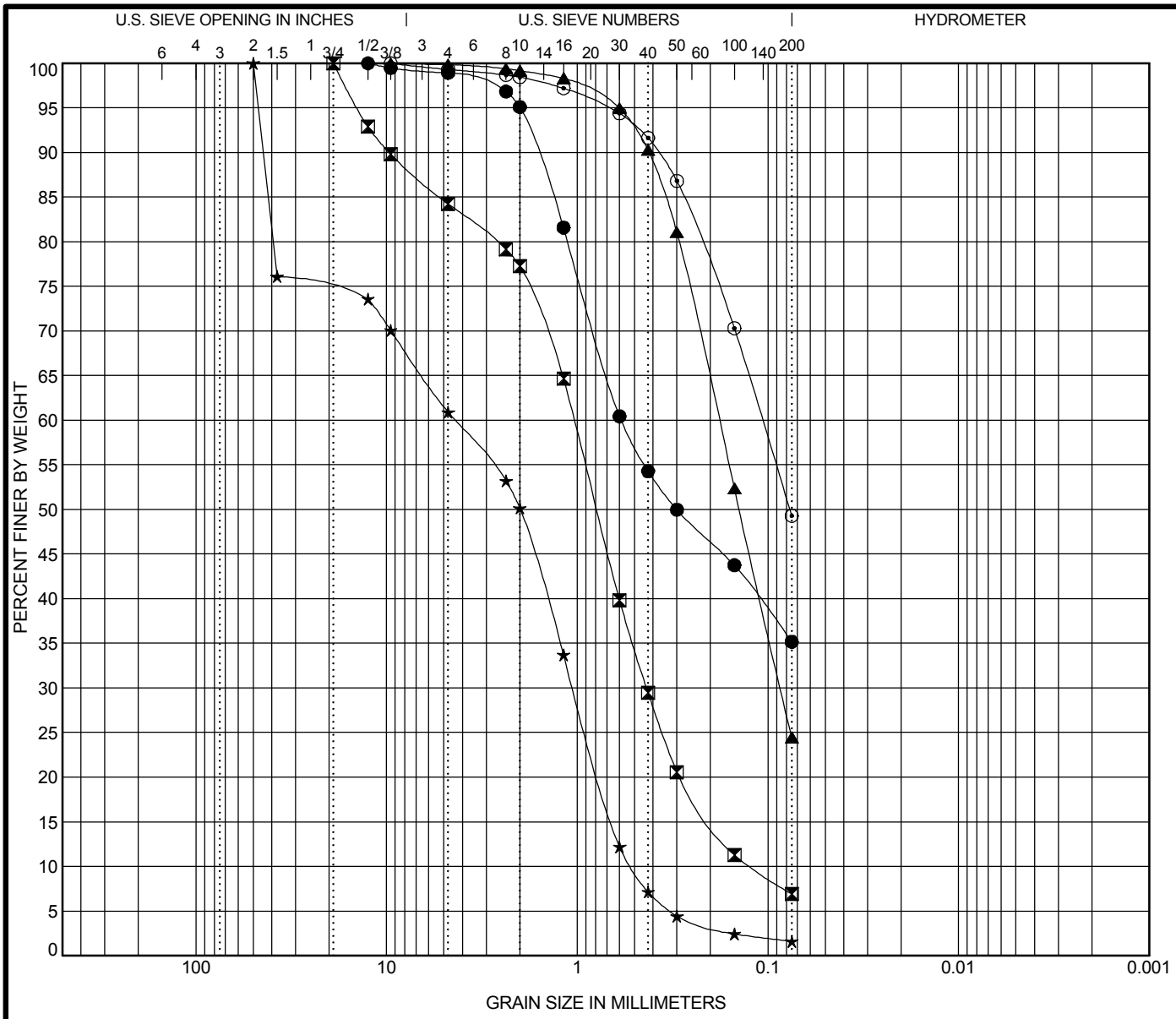
GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	SILTY SAND; trace gravel, brown		SM	1	GRAB			11		
			SM	2	GRAB			13		
			SM	3	GRAB			21		
		5								
			SM	4	GRAB			29		
	9 **SANDY SILT**; trace gravel, brown	10	ML	5	GRAB			26		
	11 Test Pit Terminated at 11 Feet.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

WATER LEVEL OBSERVATIONS, ft			
WL	NE	WE	
WL			
WL			

Terracon

BORING STARTED	8-19-09		
BORING COMPLETED	8-19-09		
RIG		FOREMAN	MJD
APPROVED	MEA	JOB #	66095039



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	TP-01	0.0ft	SILTY SAND(SM)	NP	NP	NP		
⊠	TP-02	4.0ft	WELL-GRADED SAND with SILT and GRAVEL(SW-SM)	NP	NP	NP	1.47	8.46
▲	TP-02	7.0ft	SILTY SAND(SM)	NP	NP	NP		
★	TP-03	2.0ft	POORLY GRADED SAND with GRAVEL(SP)	NP	NP	NP	0.49	8.47
⊙	TP-03	8.0ft	SILTY SAND(SM)	NP	NP	NP		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-01	0.0ft	12.5	0.585			1.1	63.8	35.2	
⊠	TP-02	4.0ft	19	1.039	0.433	0.123	15.8	77.3	6.9	
▲	TP-02	7.0ft	9.5	0.18	0.086		0.2	75.4	24.5	
★	TP-03	2.0ft	50	4.376	1.05	0.517	39.1	59.3	1.6	
⊙	TP-03	8.0ft	9.5	0.107			0.7	50.0	49.3	

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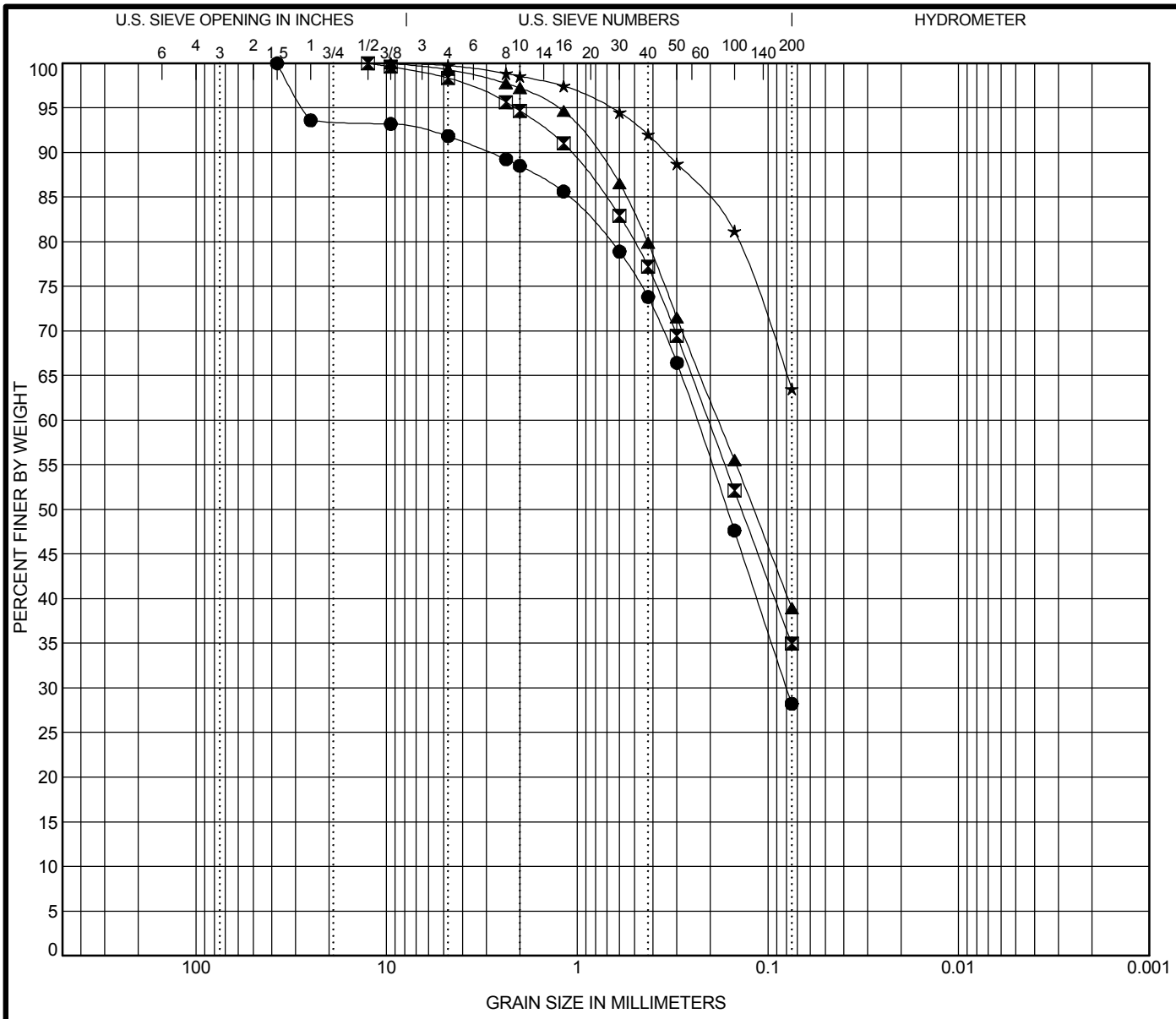
GRAIN SIZE DISTRIBUTION

Project: Sediment Grade Control Structures
Site: DP Canyon and Pueblo Canyon Los Alamos County, NM
Job #: 66095039
Date: 8-31-09

TC_GRAIN_SIZE 66095039.GPJ TERRACON.GDT 8/31/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**TP-04**	**0.0ft**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
⊠	**TP-04**	**2.0ft**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
▲	**TP-04**	**4.0ft**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
★	**TP-04**	**10.0ft**	**SANDY SILT(ML)**	**NP**	**NP**	**NP**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-04**	**0.0ft**	**37.5**	**0.237**	**0.08**		**8.2**	**63.6**	**28.2**	
⊠	**TP-04**	**2.0ft**	**12.5**	**0.205**			**1.6**	**63.4**	**35.0**	
▲	**TP-04**	**4.0ft**	**9.5**	**0.182**			**0.7**	**60.3**	**39.0**	
★	**TP-04**	**10.0ft**	**9.5**				**0.2**	**36.2**	**63.5**	

Terracon

GRAIN SIZE DISTRIBUTION

Project: Sediment Grade Control Structures
Site: DP Canyon and Pueblo Canyon Los Alamos County, NM
Job #: 66095039
Date: 8-31-09

TC GRAIN SIZE 66095039.GPJ TERRACON.GDT 8/31/09

Borehole	Depth ft	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	USCS Class-ification	Water Content (%)	Dry Unit Weight (pcf)	Satur-ation (%)	Void Ratio
B-01	2.0							6	91.1		
B-01	4.0							5			
B-01	6.0								101.5		
TP-01	0.0	NP	NP	NP	12.5	35	SM	4			
TP-01	3.0							2			
TP-02	0.0							2			
TP-02	4.0	NP	NP	NP	19	7	SW-SM	4			
TP-02	7.0	NP	NP	NP	9.5	24	SM	10			
TP-03	2.0	NP	NP	NP	50	2	SP	4			
TP-03	6.0							9			
TP-03	8.0	NP	NP	NP	9.5	49	SM	5			
TP-04	0.0	NP	NP	NP	37.5	28	SM	11			
TP-04	2.0	NP	NP	NP	12.5	35	SM	13			
TP-04	4.0	NP	NP	NP	9.5	39	SM	21			
TP-04	8.0							29			
TP-04	10.0	NP	NP	NP	9.5	64	ML	26			

Terracon

SUMMARY OF LABORATORY RESULTS

Project: Sediment Grade Control Structures
Site: DP Canyon and Pueblo Canyon Los Alamos County, NM
Job #: 66095039
Date: 8-31-09

HALL
ENVIRONMENTAL
ANALYSIS
LABORATORY

COVER LETTER

Friday, August 28, 2009

Michael Anderson
Terracon
4905 Hawkins, NE
Albuquerque, NM 87109

TEL: (505) 797-4287
FAX (505) 797-4288

RE: Sediment Grade Control Structures

Order No.: 0908325

Dear Michael Anderson:

Hall Environmental Analysis Laboratory, Inc. received 2 sample(s) on 8/20/2009 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. Below is a list of our accreditations. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites.

Reporting limits are determined by EPA methodology. No determination of compounds below these (denoted by the ND or < sign) has been made.

Please don't hesitate to contact HEAL for any additional information or clarifications.

Sincerely,

Andy Freeman, Laboratory Manager

NM Lab # NM9425
AZ license # AZ0682
ORELAP Lab # NM100001
Texas Lab# T104704424-08-TX

ACCREDITED IN ACCORDANCE WITH nelac

4901 Hawkins NE ■ Suite D ■ Albuquerque, NM 87109
505.345.3975 ■ Fax 505.345.4107
www.hallenvironmental.com

Hall Environmental Analysis Laboratory, Inc.

Date: *28-Aug-09*

CLIENT: Terracon
Lab Order: 0908325
Project: Sediment Grade Control Structures
Lab ID: 0908325-01

Client Sample ID: TP-01 @ 0-3'
Collection Date: 8/19/2009 12:00:00 PM
Date Received: 8/20/2009
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **TAF**
Sulfate	17	7.5		mg/Kg	5	8/21/2009 12:11:30 PM
SM4500-H+B: PH						Analyst: **KMS**
pH	7.11	0.1		pH Units	1	8/26/2009
RESISTIVITY						Analyst: **TAF**
Resistivity	10900	1.00		Ohms * cm	1	8/24/2009

Qualifiers:

*	Value exceeds Maximum Contaminant Level	B	Analyte detected in the associated Method Blank
E	Estimated value	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	MCL	Maximum Contaminant Level
ND	Not Detected at the Reporting Limit	RL	Reporting Limit
S	Spike recovery outside accepted recovery limits		

Hall Environmental Analysis Laboratory, Inc.

Date: *28-Aug-09*

CLIENT: Terracon
Lab Order: 0908325
Project: Sediment Grade Control Structures
Lab ID: 0908325-02

Client Sample ID: TP-02 @ 0-2'
Collection Date: 8/19/2009 3:00:00 PM
Date Received: 8/20/2009
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **TAF**
Sulfate	17	7.5		mg/Kg	5	8/22/2009 1:05:36 PM
SM4500-H+B: PH						Analyst: **KMS**
pH	6.86	0.1		pH Units	1	8/26/2009
RESISTIVITY						Analyst: **TAF**
Resistivity	27400	1.00		Ohms * cm	1	8/24/2009

Qualifiers:

*	Value exceeds Maximum Contaminant Level	B	Analyte detected in the associated Method Blank
E	Estimated value	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	MCL	Maximum Contaminant Level
ND	Not Detected at the Reporting Limit	RL	Reporting Limit
S	Spike recovery outside accepted recovery limits		

QA/QC SUMMARY REPORT

Client: Terracon
Project: Sediment Grade Control Structures

Work Order: 0908325

Analyte	Result	Units	PQL	SPK Va	SPK ref	%Rec	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Method: EPA Method 300.0: Anions											
Sample ID: 0908325-01AMSD		*MSD*				Batch ID:	**19935**	Analysis Date:		8/21/2009 12:46:20 PM	
Sulfate	42.63	mg/Kg	7.5	30	17.16	84.9	66.7	119	3.28	20	
Sample ID: MB-19935		*MBLK*				Batch ID:	**19935**	Analysis Date:		8/21/2009 11:36:41 AM	
Sulfate	ND	mg/Kg	1.5								
Sample ID: LCS-19935		*LCS*				Batch ID:	**19935**	Analysis Date:		8/21/2009 11:54:05 AM	
Sulfate	29.63	mg/Kg	1.5	30	0	98.8	90	110			
Sample ID: 0908325-01AMS		*MS*				Batch ID:	**19935**	Analysis Date:		8/21/2009 12:28:55 PM	
Sulfate	41.25	mg/Kg	7.5	30	17.16	80.3	66.7	119			

Qualifiers:

E	Estimated value	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
R	RPD outside accepted recovery limits	S	Spike recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Sample Receipt Checklist

Client Name **TER-ALB**

Date Received: **8/20/2009**

Work Order Number **0908325**

Received by: TLS

Sample ID labels checked by: TS
Initials

Checklist completed by: 18 8/20/09
Signature Date

Matrix:

Carrier name: Client drop-off

Shipping container/cooler in good condition?	Yes ☐	No ☐	Not Present ☑	
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☐	Not Shipped ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	N/A ☑	
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☑	No ☐		
Water - VOA vials have zero headspace?	No VOA vials submitted ☑	Yes ☐	No ☐	Number of preserved bottles checked for pH:
Water - Preservation labels on bottle and cap match?	Yes ☐	No ☐	N/A ☑	
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑	*<2 >12 unless noted below.*
Container/Temp Blank temperature?	**22.1°**	*<6° C Acceptable* If given sufficient time to cool.		

COMMENTS:

Client contacted _____ Date contacted: _____ Person contacted _____

Contacted by: _____ Regarding: _____

Comments: _____

Corrective Action _____

Chain-of-Custody Record

Client: Terracon

Mailing Address: 4905 Hawkins NE
ABQ, NM 87109

Phone #: (505) 797-4287

email or Fax#: mjdunneman@terracon.com

QA/QC Package:
☒ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other _____

☐ EDD (Type) _____

Turn-Around Time:
☒ Standard ☐ Rush _____

Project Name: Sediment Grade Control Structures

Project #: 66095039

Project Manager: Mike Anderson

Sampler: MJD

On Ice: ☐ Yes ☒ No

Sample Temperature: 02.1

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 0908305	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH Method 8015B (Gas/Diesel)	TPH (Method 418.1)	EDB (Method 504.1)	8310 (PNA or PAH)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	pH	Resistivity			Air Bubbles (Y or N)
8/19/09	12:00p	soil	TP-01 @ 0-3'	1/8oz	—	1								✓				✓	✓			
8/19/09	3:00p	soil	TP-02 @ 0-2'	1/8oz	—	2								✓				✓	✓			

Date:	Time:	Relinquished by:	Received by:	Date	Time
8/20/09	9:30a	Meagan Dunneman	[signature]	8/20/09	9:30
Date:	Time:	Relinquished by:	Received by: [signature]	Date	Time

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 3" O.D. ring samplers (RS) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per foot," and is not considered equivalent to the "Standard Penetration"or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 -15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
> 50	> 99	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

Terracon

GENERAL NOTES
Description of Rock Properties

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding and Foliation Spacing in Rock[a]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

Rock Quality Designator (RQD)[b]		Joint Openness Descriptors	
RQD, as a percentage	Diagnostic description	Openness	Descriptor
Exceeding 90	Excellent	No Visible Separation	Tight
90 – 75	Good	Less than 1/32 in.	Slightly Open
75 – 50	Fair	1/32 to 1/8 in.	Moderately Open
50 – 25	Poor	1/8 to 3/8 in.	Open
Less than 25	Very poor	3/8 in. to 0.1 ft.	Moderately Wide
		Greater than 0.1 ft.	Wide

a. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.
b. RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976.
U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			$PI < 4$ or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit - not dried			Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit - not dried			Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

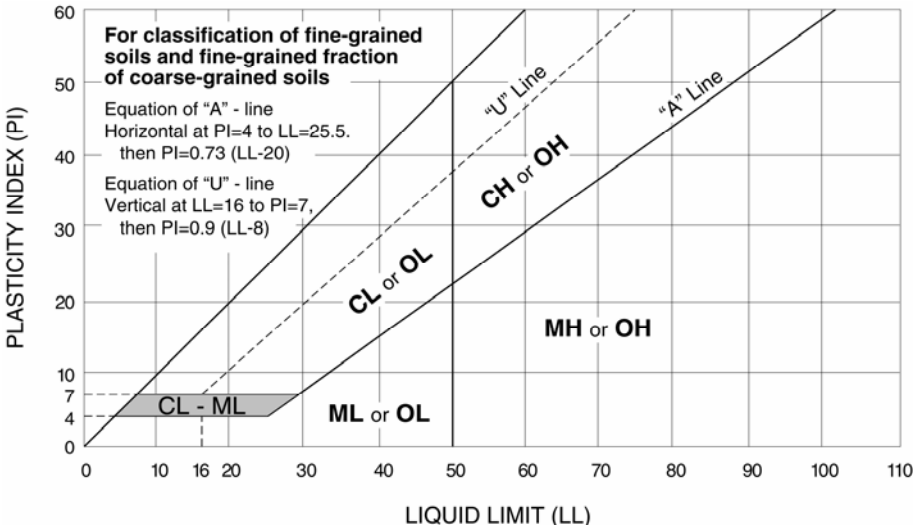
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

Appendix C

HEC-RAS Calculations
(on CD included with this document)

Los Alamos National Laboratory
DP Canyon Grade Control Structure
HEC-RAS Revised Modeling Narrative
December 21, 2009

General Project Description

The project consists of the construction of a grade stabilization structure within the Department of Energy's Los Alamos National Laboratory (LANL) in the vicinity of Los Alamos, New Mexico. LANL consists of representatives from DOE and LANS. LANS is Los Alamos National Security, LLC., the M&O contractor for DOE at the LANL. The structure is located within DP Canyon and referred to as the DP Canyon grade control structures. The approximate location of the proposed DP Canyon grade control structure is located down canyon from the outfall at Technical Area 21 and near the site of the current E039 gauging station at the east end of reach DP-2.

The proposed structure is part of remedial actions taken to reduce the migration of contaminated sediment. A beneficial result of the grade control is the expansion and enhancement of wetland areas upstream of the structure.

Development of the HEC-RAS Hydraulic Model

To determine the hydraulic effects of the proposed structure, a HEC-RAS model was developed. The HEC-RAS (Version 4.0) model was constructed using the most recent topographic data and GIS techniques for cross section development. An existing conditions model was constructed, calibrated to the best extent, and the water surface elevations for the 2-, 5-, 10-, 50-, and 100-year peak flood discharges were simulated and plotted. All subsequent models utilized these peak flood discharges. A proposed conditions model (with grade control), without accumulated sedimentation behind the structure, was constructed, simulated and plotted. The HEC-RAS In-line weir option was used to model the grade control structure. A proposed condition model, with sedimentation, was created to simulate the change in the streambed elevations due to anticipated long term deposition of sediment upstream of the grade control structure. These 3 conditions, existing, grade control structure without sediment deposits, and grade control structure with sediment deposits, were compared and analyzed. Results of the HEC-RAS hydraulic modeling analysis for the DP Canyon structure is available immediately following in this Appendix.

The HEC-RAS model for the stream system was revised in December 2009 to reflect new topographic survey information which was made available, as well as changes in the design of the grade control structure for the stream and the addition of a flume just downstream of the grade control structure. Below is a brief description of the methodology and assumptions used in preparing the revised HEC-RAS models for DP Canyon.

DP Canyon

1. Existing Conditions

- Cross sections of the channel were taken from RS 0 (approx. 2600' downstream of proposed Gabion Grade Control Structure) to RS 1250.
- Cross section coordinates were taken perpendicular to the centerline of the stream from new topographic survey using AutoCAD Civil 3D.
- Sign convention of the cross sections is left to right looking downstream with the zero station on an assumed survey baseline.
- By iteratively running the HEC-RAS model, the Left Bank and Right Bank stations were set so that the 50-year water surface was at or just above the bank elevations.
- Manning's n values of 0.03 for the channel and 0.07 for left overbank (LOB) and right overbank (ROB) were selected.
- Contraction and expansion coefficients of 0.1 and 0.3, respectively, were assumed.
- Flow data used was as follows (see original project design report for background information):

2-year	289 cfs
5-year	343 cfs
10-year	374 cfs
50-year	438 cfs
100-year	465 cfs

In addition, a flow of 350 cfs was analyzed for design of the flume in proposed conditions.

2. Proposed Conditions

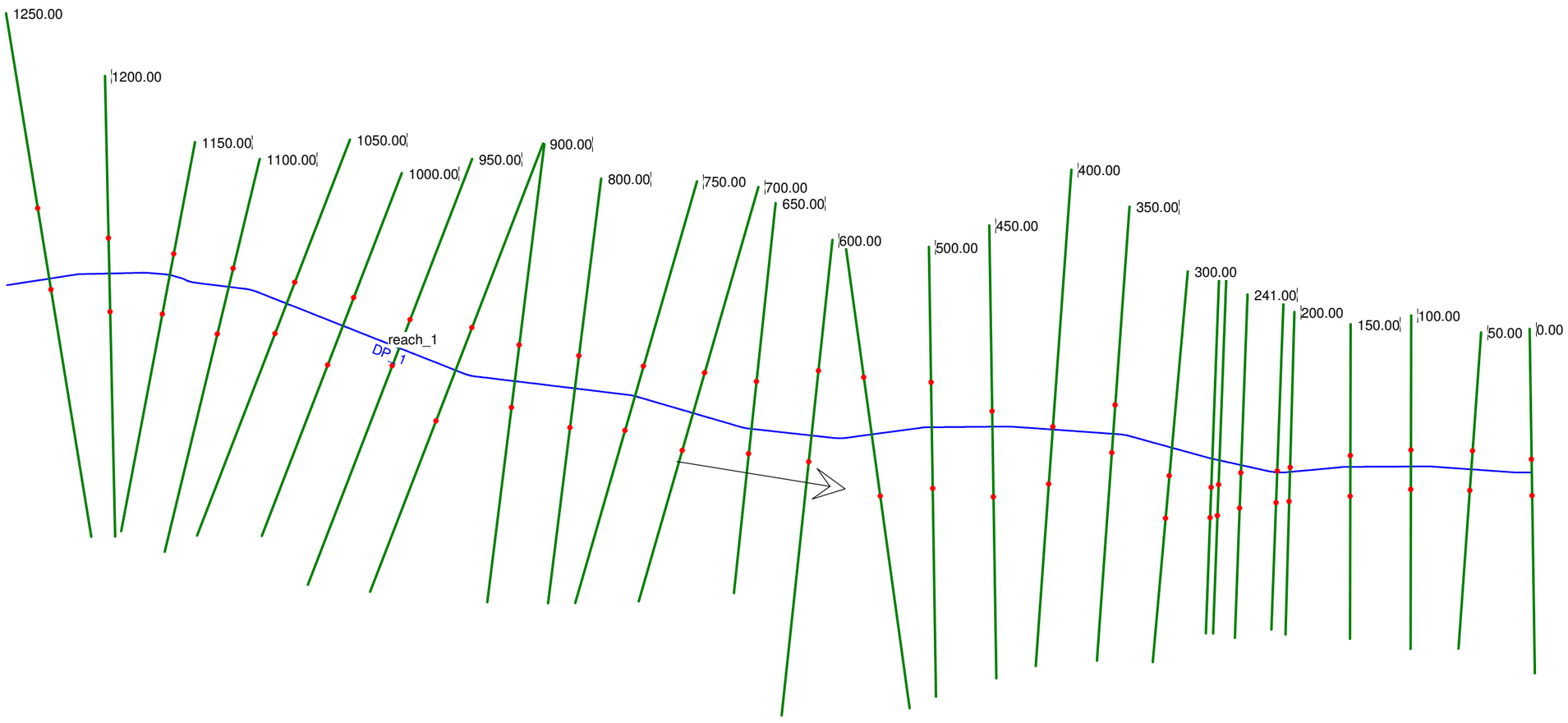
- Existing Conditions model cross sections between RS 200 and RS 100 were revised to define a proposed 5' to 1' bottom width flume from RS 180 to RS 165, with 20' transitions from RS 200 to RS 180 upstream of the flume and from RS 165 to RS 145 downstream of the flume.
- A Gabion Grade Control Structure was added at RS 259, with the following characteristics:
    - Station and elevation coordinates defined to match the plans (21' low flow weir at crest el. 7026; 54' weir at crest el. 7029; top of weir at el. 7032).
    - Distance = 0.3' to upstream section at RS 259.30.
    - Width = 3.0.
    - Weir Coefficient – 3.0.
- Ineffective flow areas upstream of the Gabion Grade Control Structure were assumed to direct flow to the structure:
    - At RS 265.39: Station 150 Left; Station 210 Left
    - At RS 259.30: Station 157 Left; Station 213 Right

3. Proposed Conditions with Sediment

- Proposed Conditions model was revised to analyze the effects of a sediment fill slope of 0.9% (as in the original HEC-RAS analysis) from RS 259.30 just upstream of the proposed Gabion Grade Control Structure.
- The sediment analysis profile used a starting sediment elevation near the Gabion Grade Control Structure equal to the low flow weir elevation of 7026 as in the original analysis. The sediment intersected the channel bottom approx. 110' upstream of the structure.

DP Canyon

Existing Conditions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500.00
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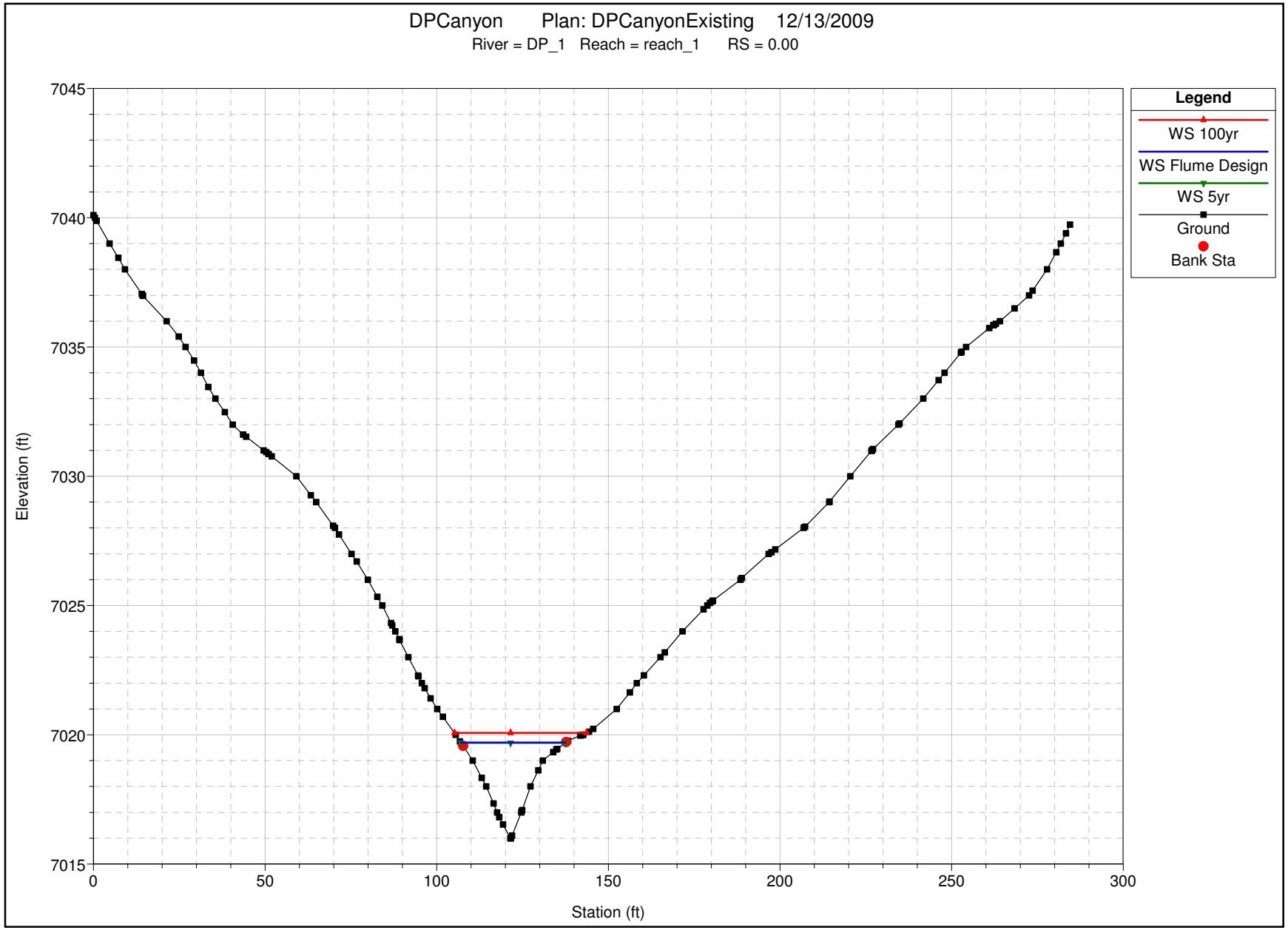
50.00
0.00
reach_1
DP_1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WS Flume Design
WS 5yr
Ground
Bank Sta
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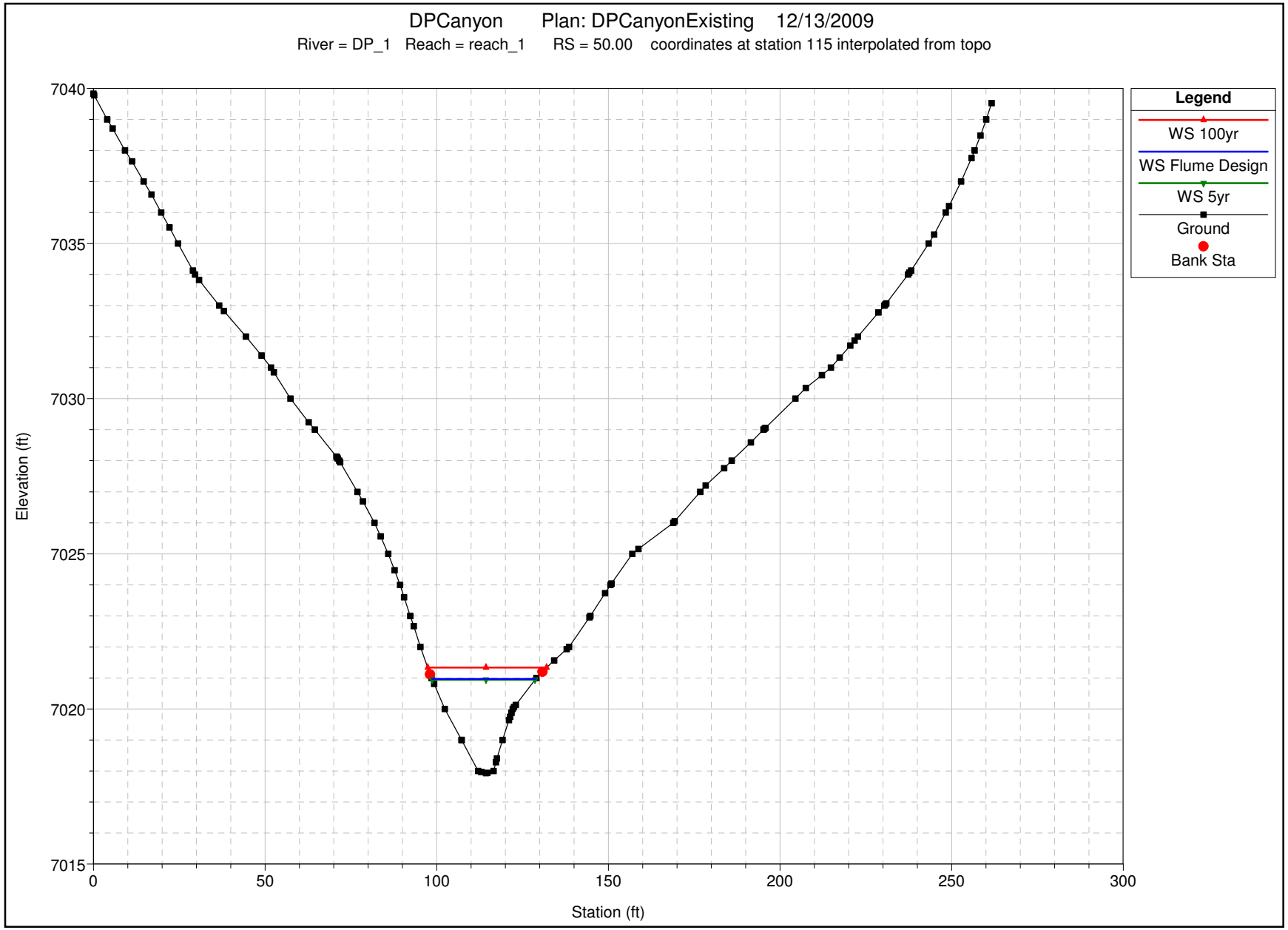
7035
7030
7025
7020
7015
0
50
100
150
200
250
300
Station (ft)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WS Flume Design
WS 5yr
Ground
Bank Sta
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Station (ft)
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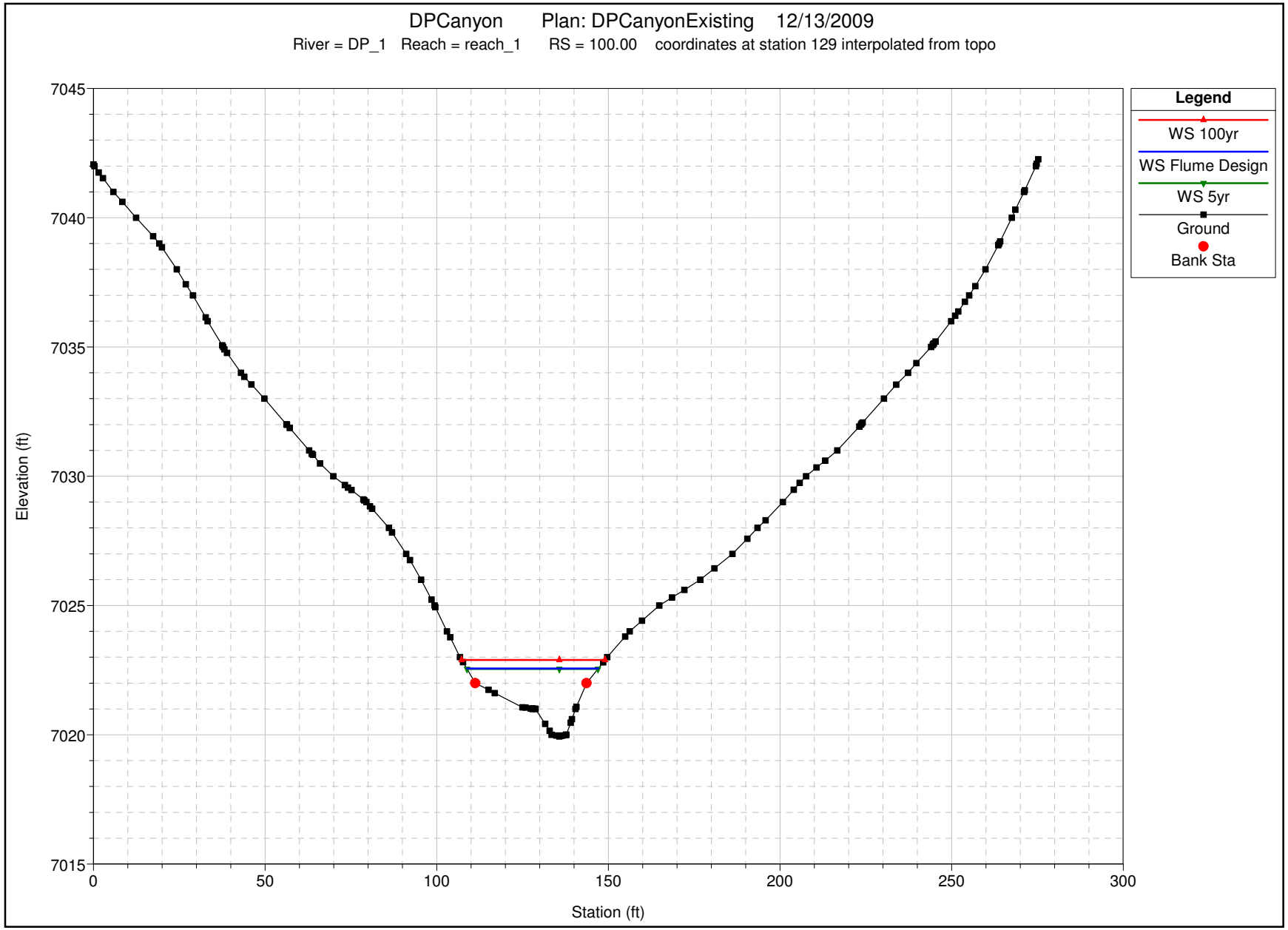
7025
7020
7015
0
50
100
150
200
250
300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WS Flume Design
WS 5yr
Ground
Bank Sta
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7020
7015
Station (ft)
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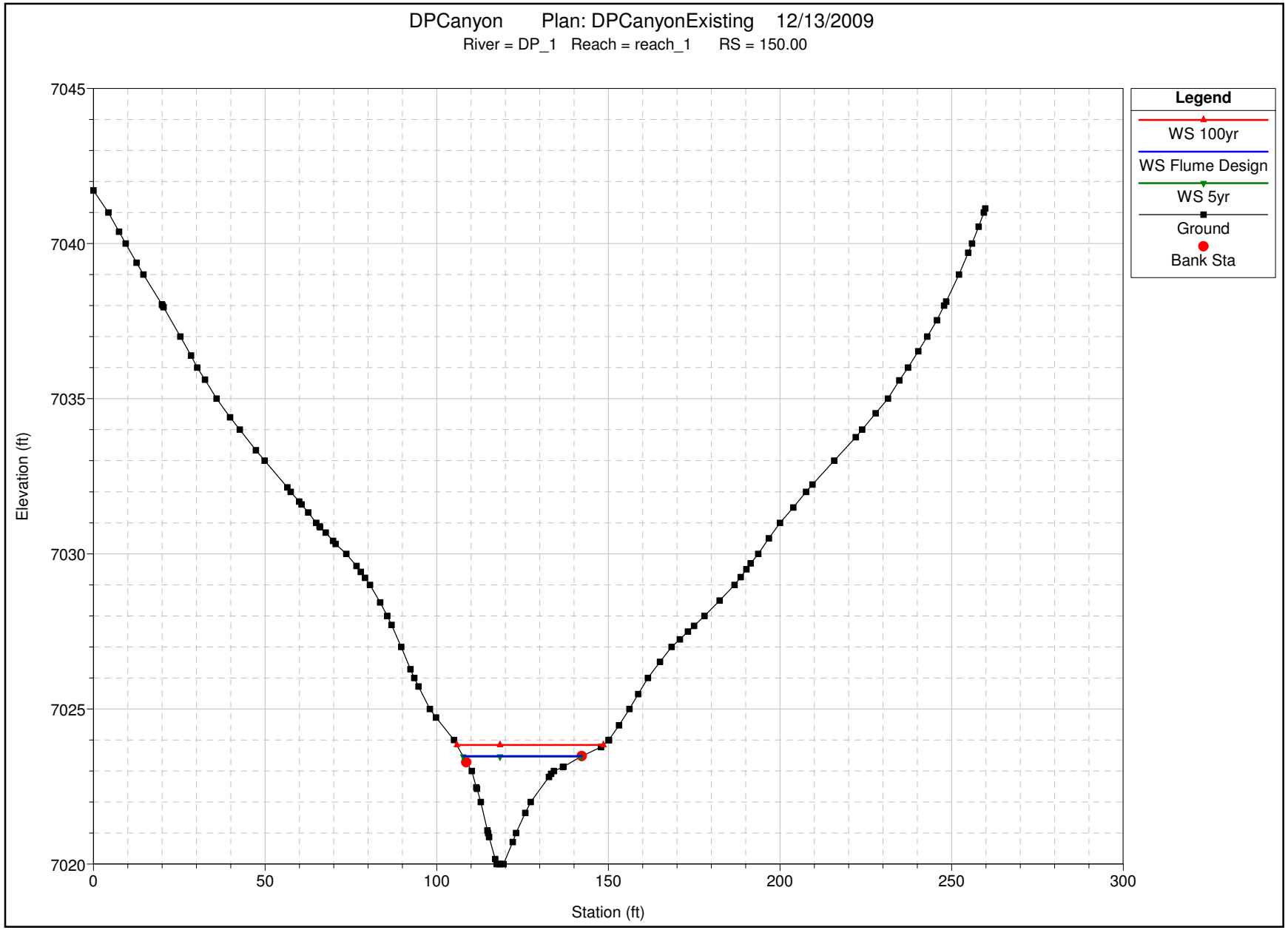
50
100
150
200
250
300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WS 5yr
Ground
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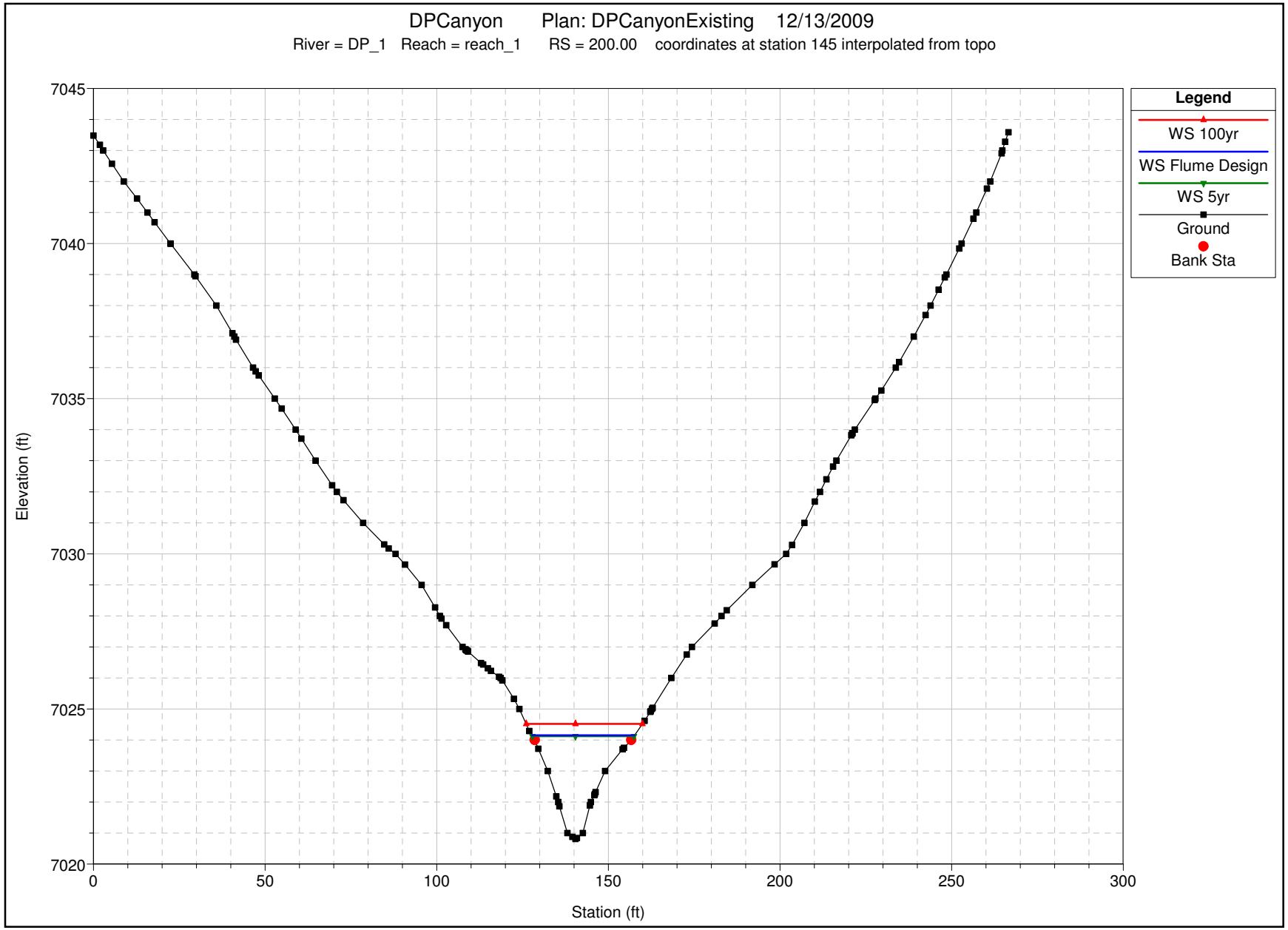
150
200
250
300
Station (ft)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WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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7040
7035
7030
7025
7020
0
50
100
150
200
250
300

DPCanyon Plan: DPCanyonExisting 12/13/2009

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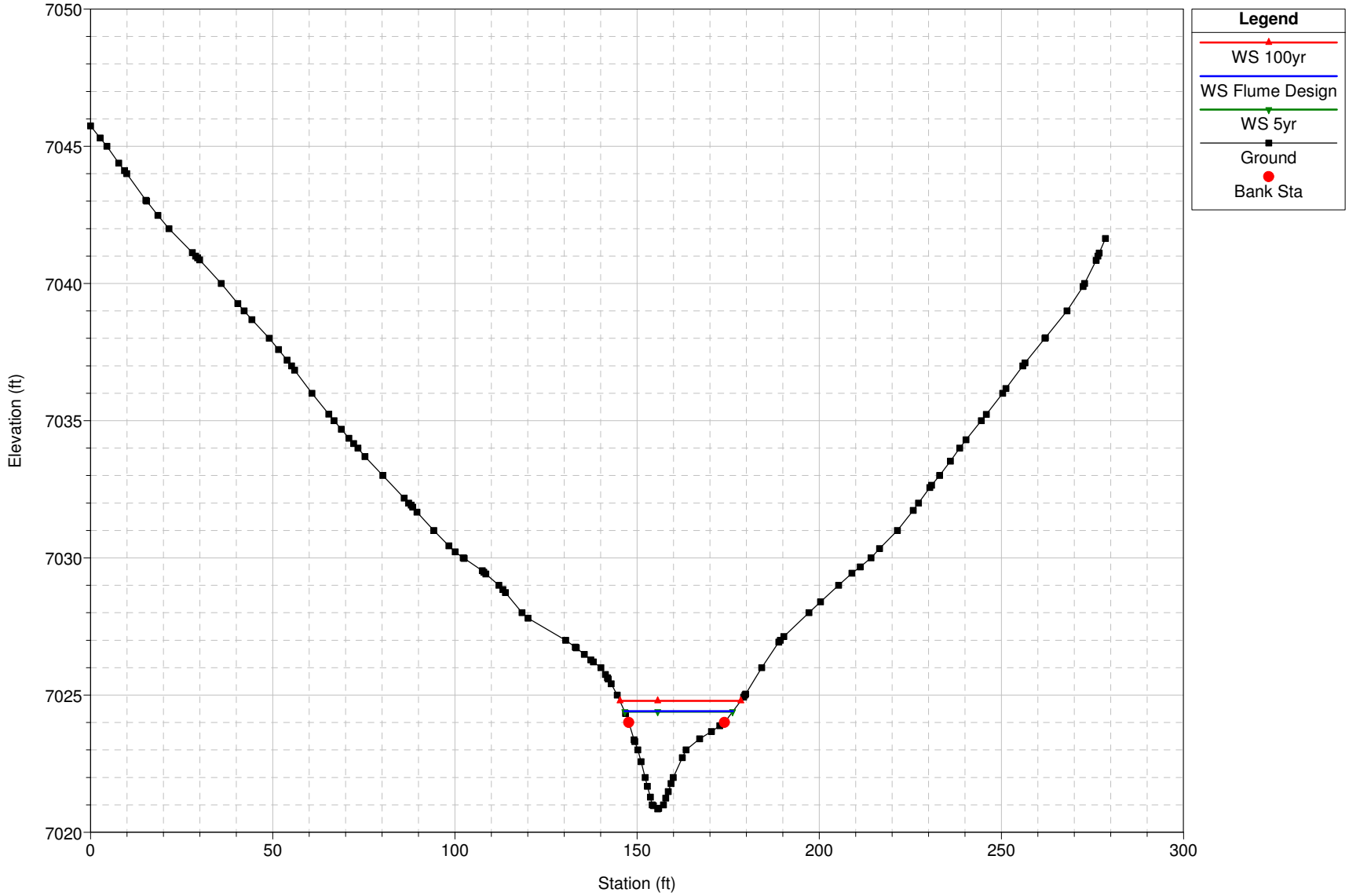

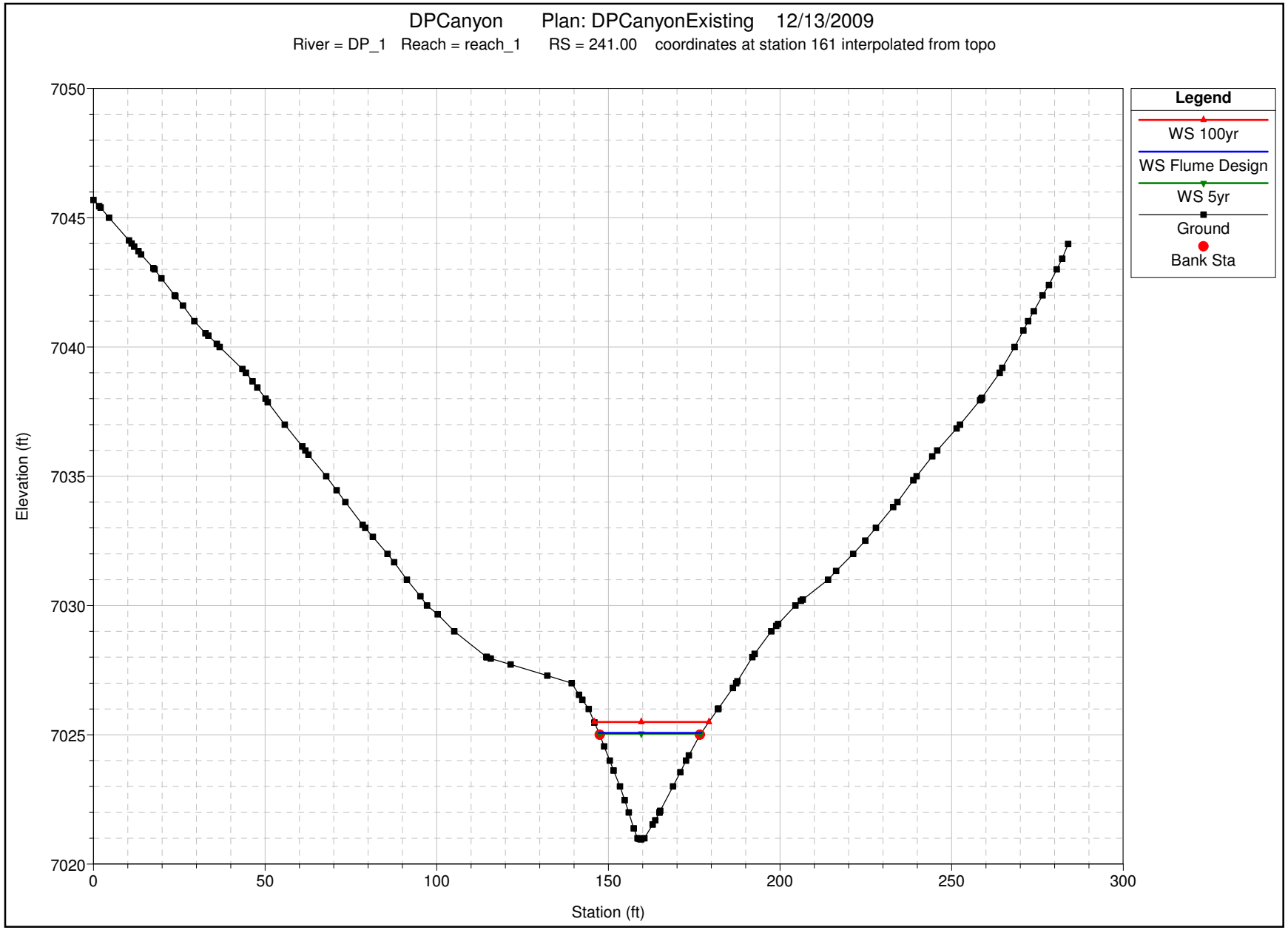
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WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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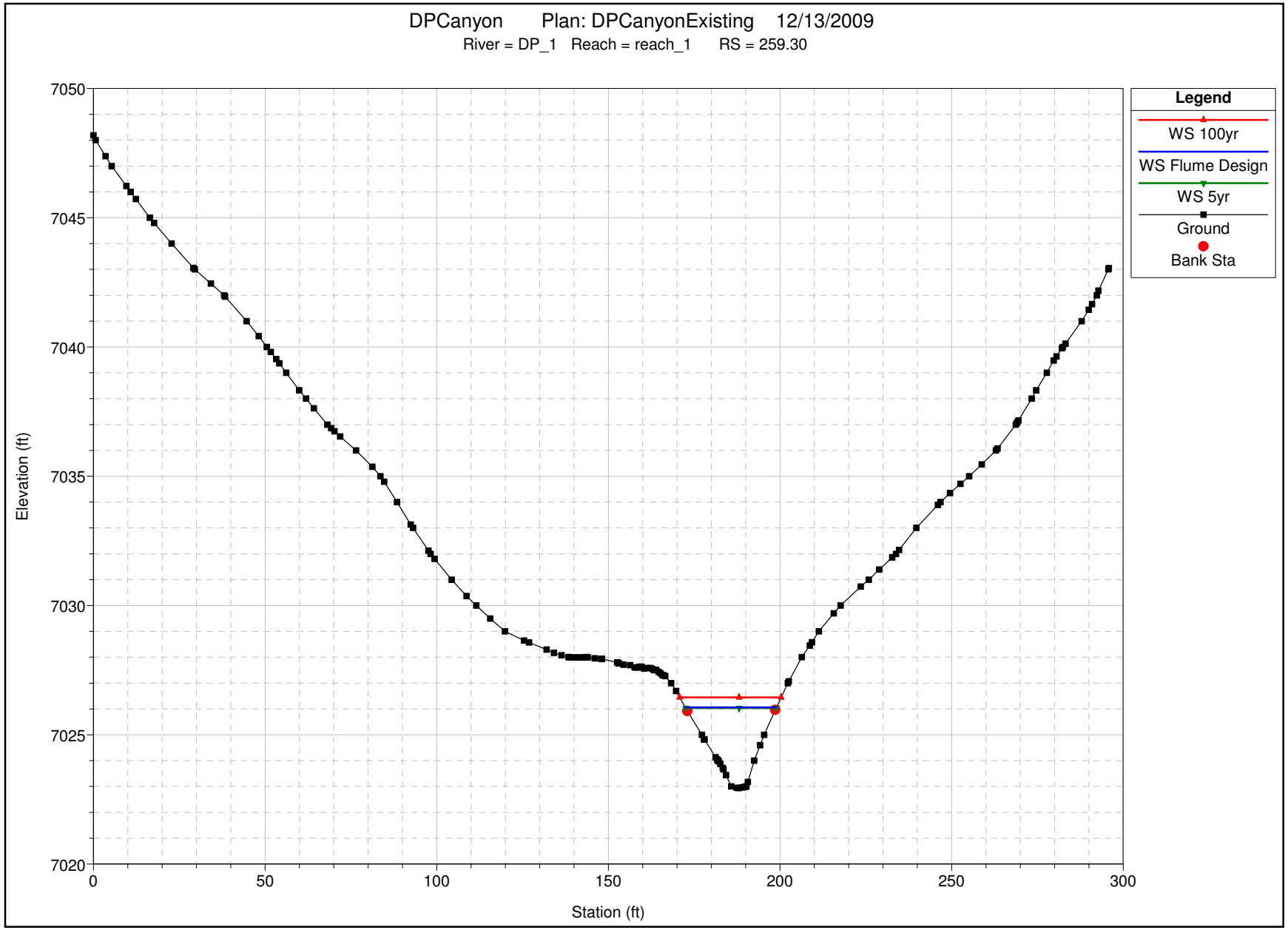
100
150
200
250
300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Legend
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WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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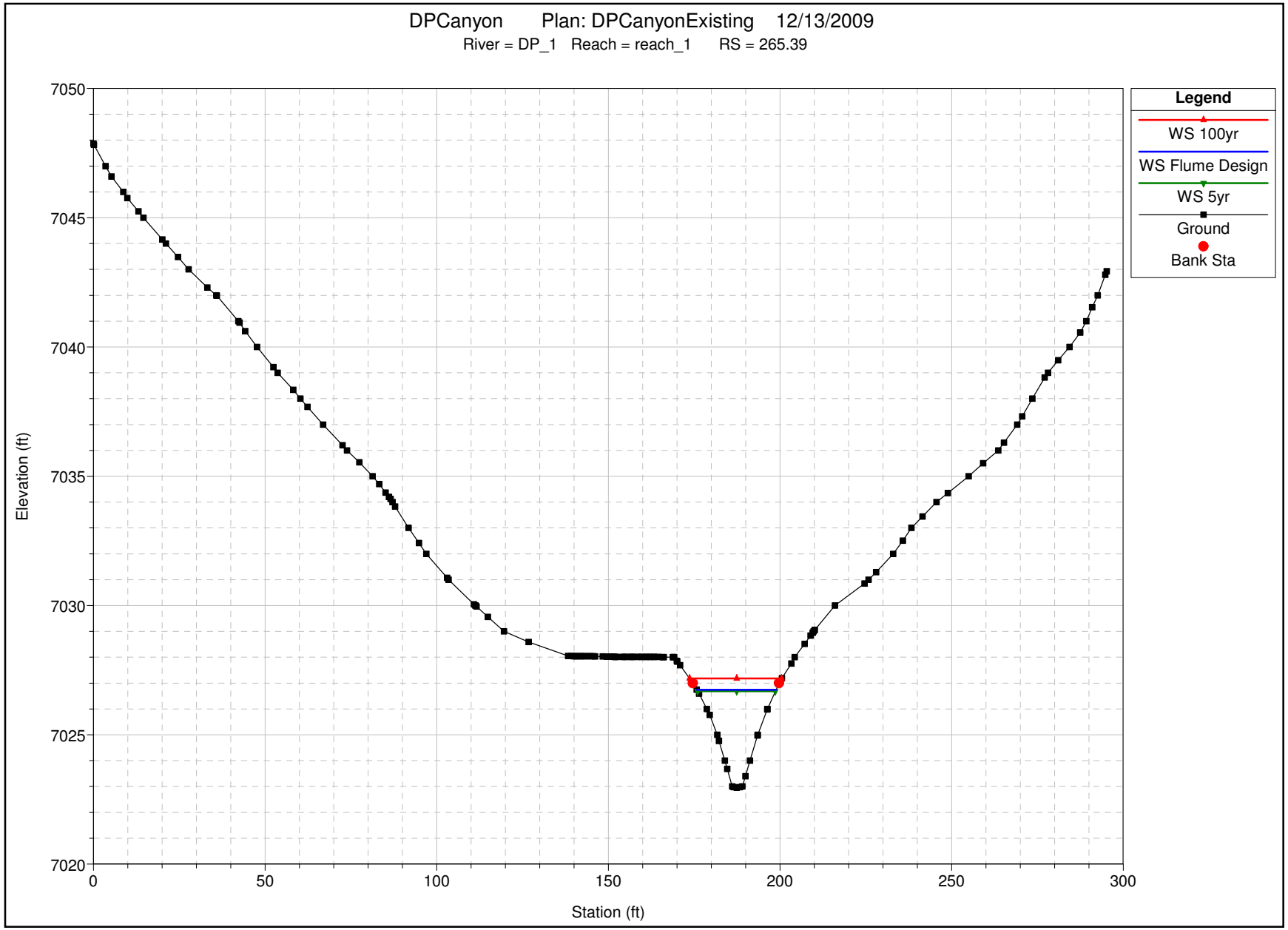
7020
0
50
100
150
200
250
300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Legend
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WS Flume Design
WS 5yr
Ground
Bank Sta
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Station (ft)
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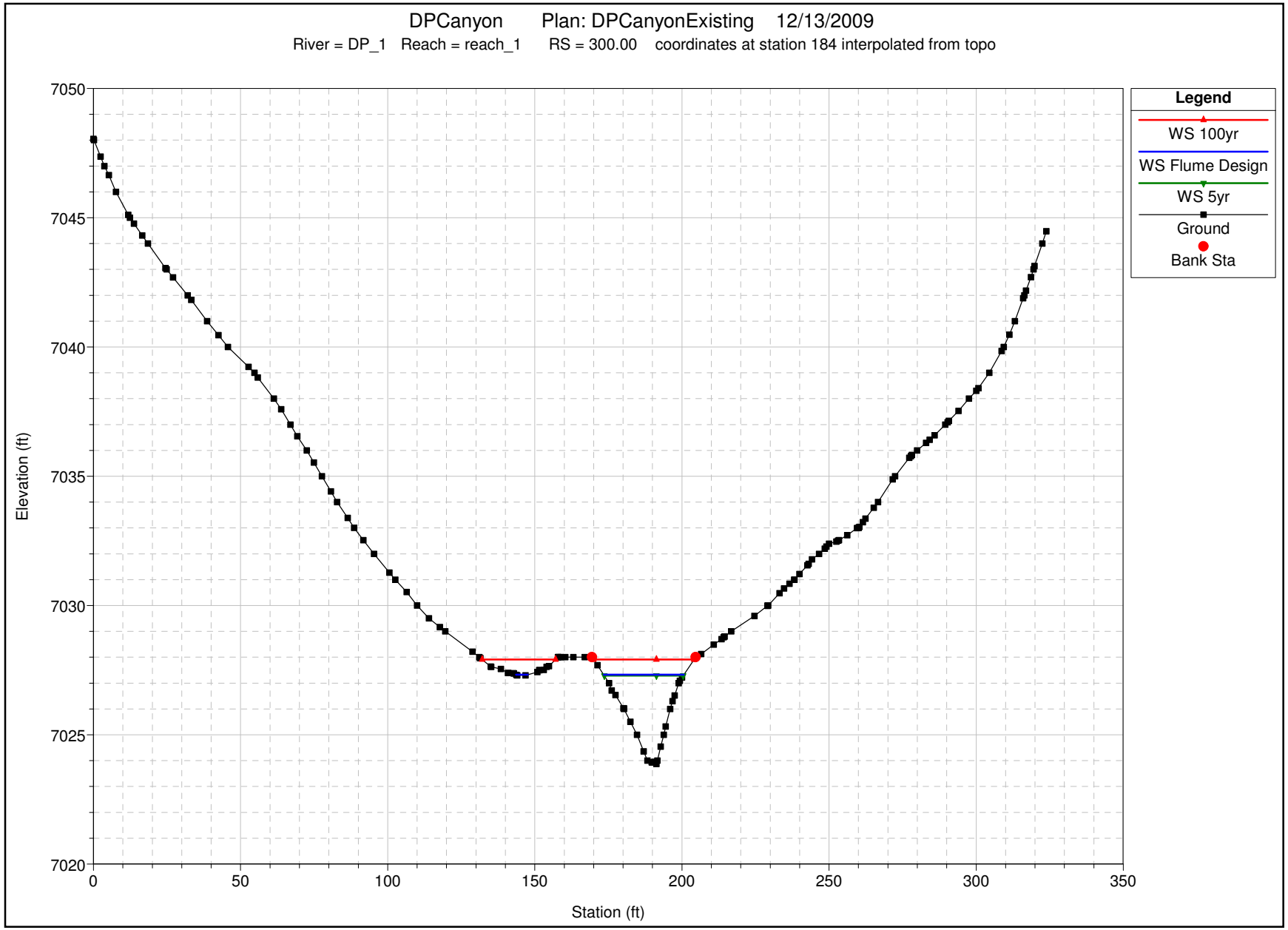
100
150
200
250
300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Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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7040
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7030
7025
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100
150
200
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300
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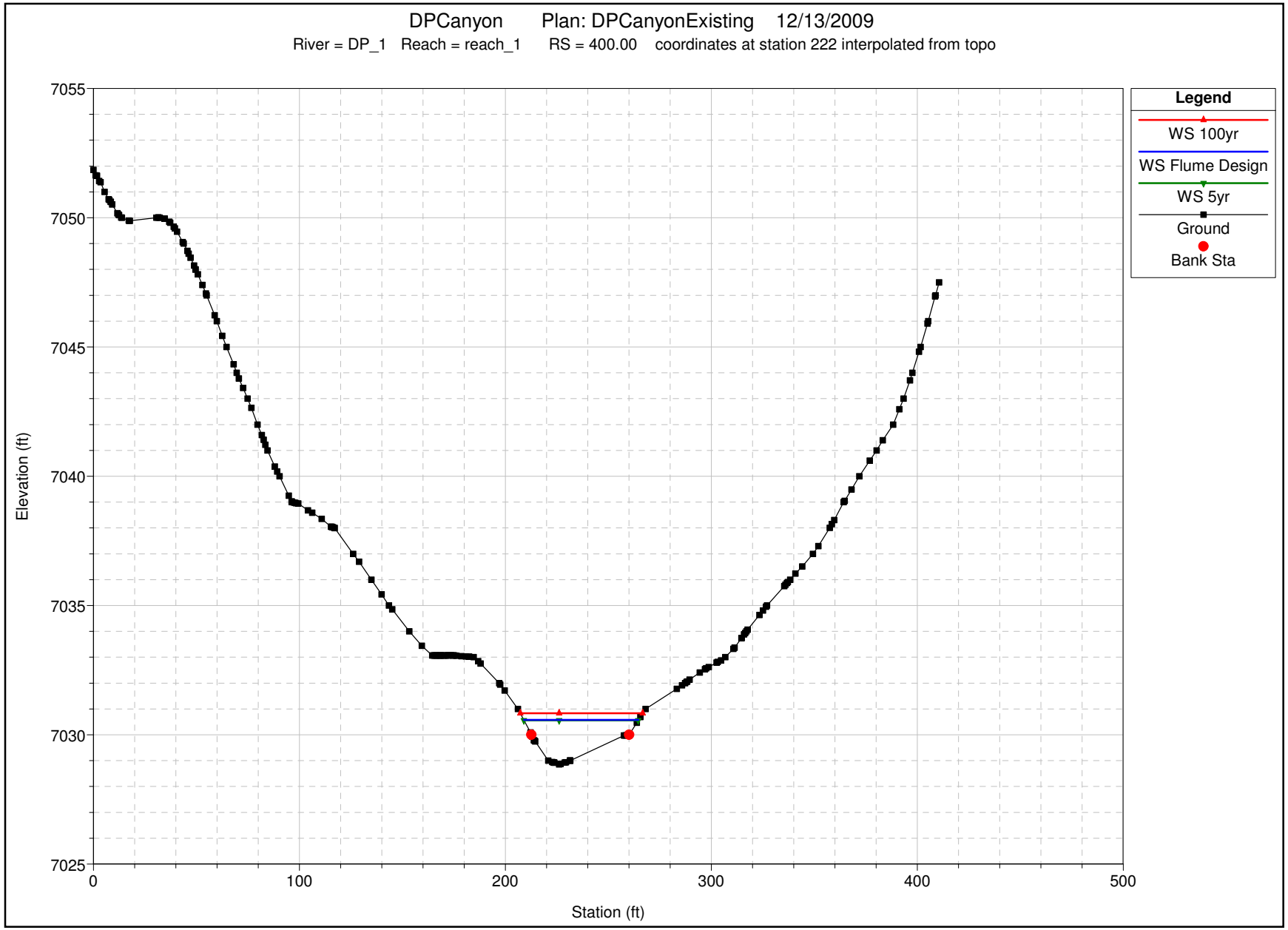
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Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
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7045
7040
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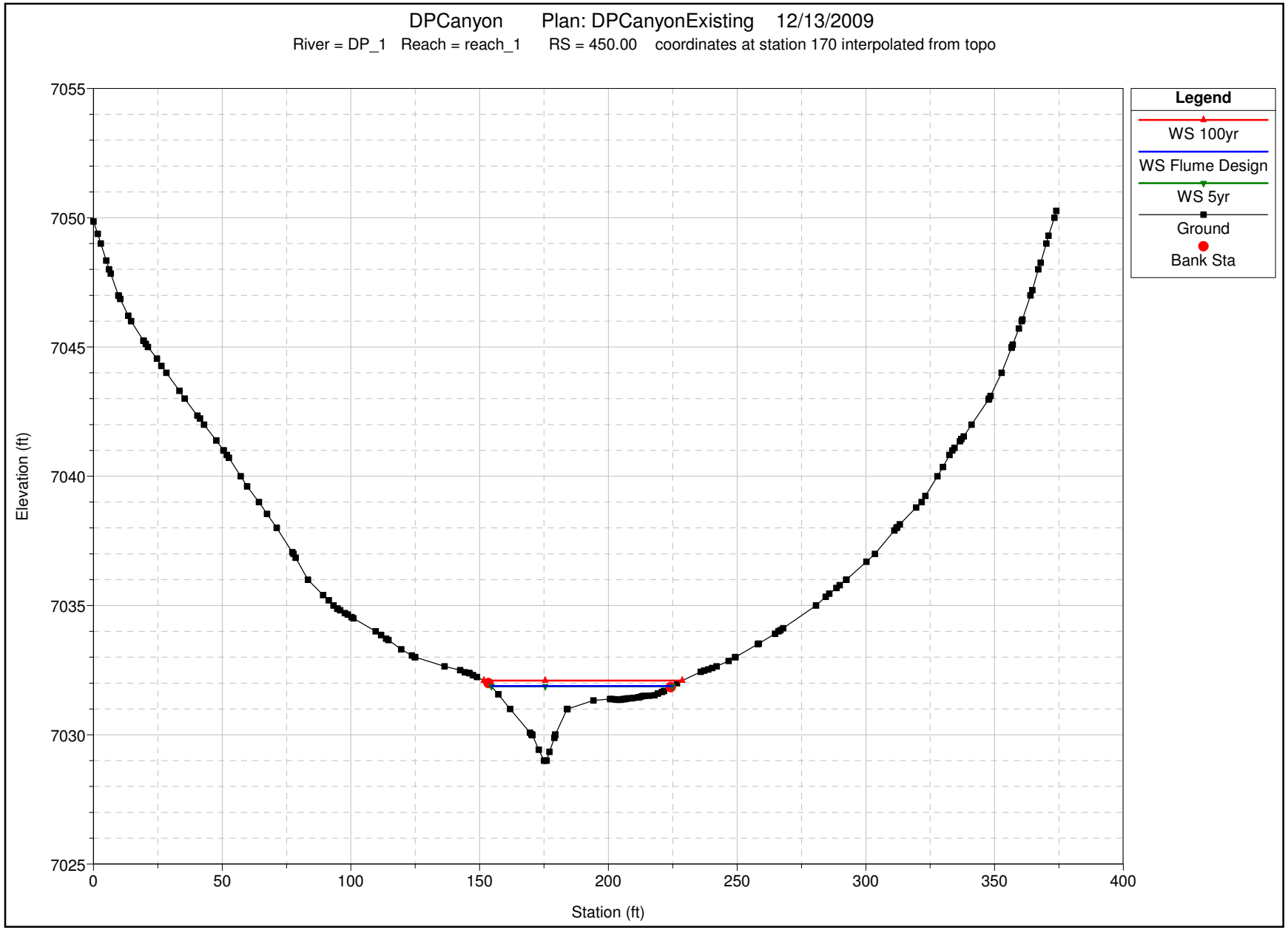
7030
7025
0
100
200
300
400
500
Station (ft)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Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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7045
7040
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7030
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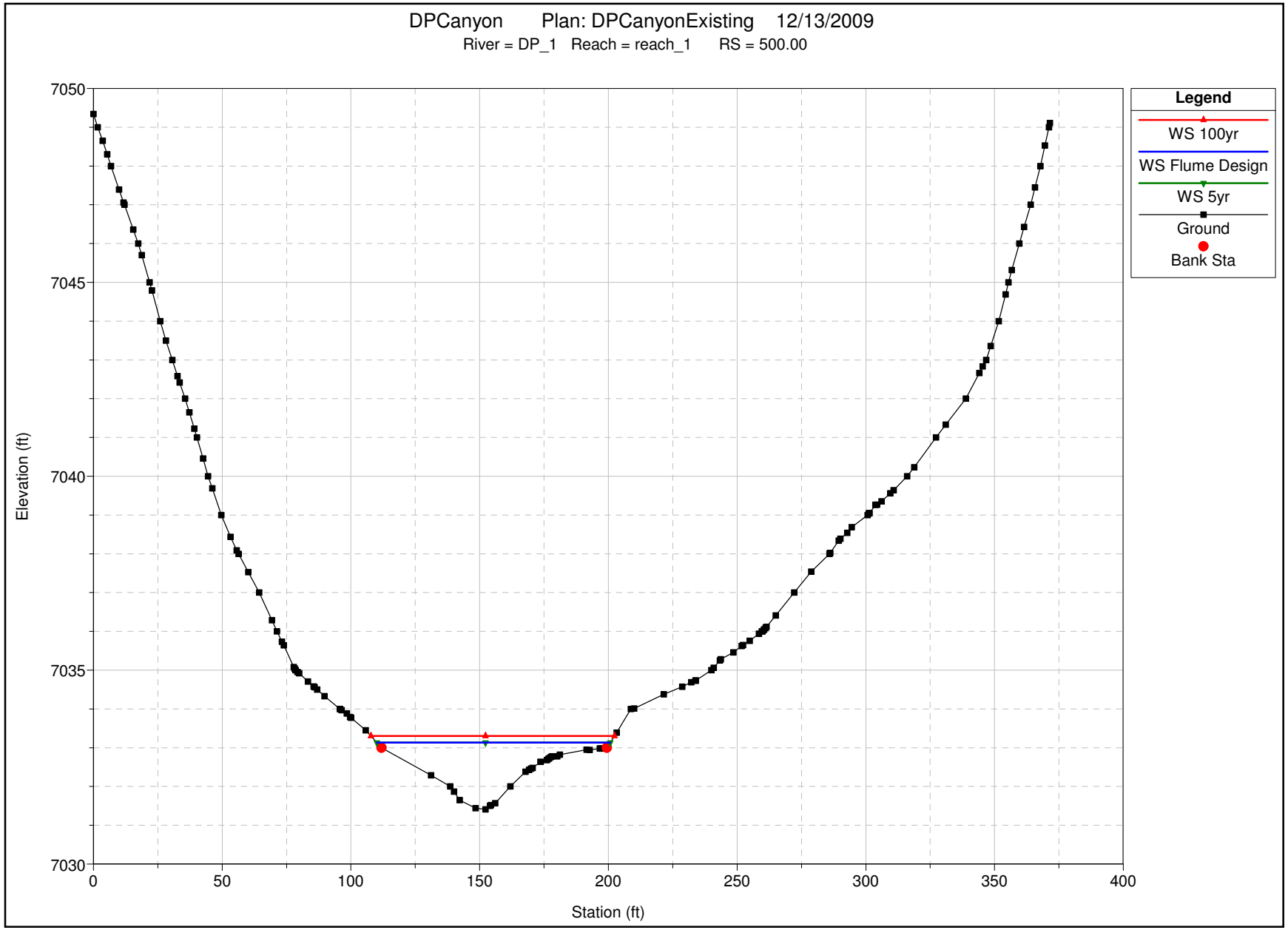
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Legend
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WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
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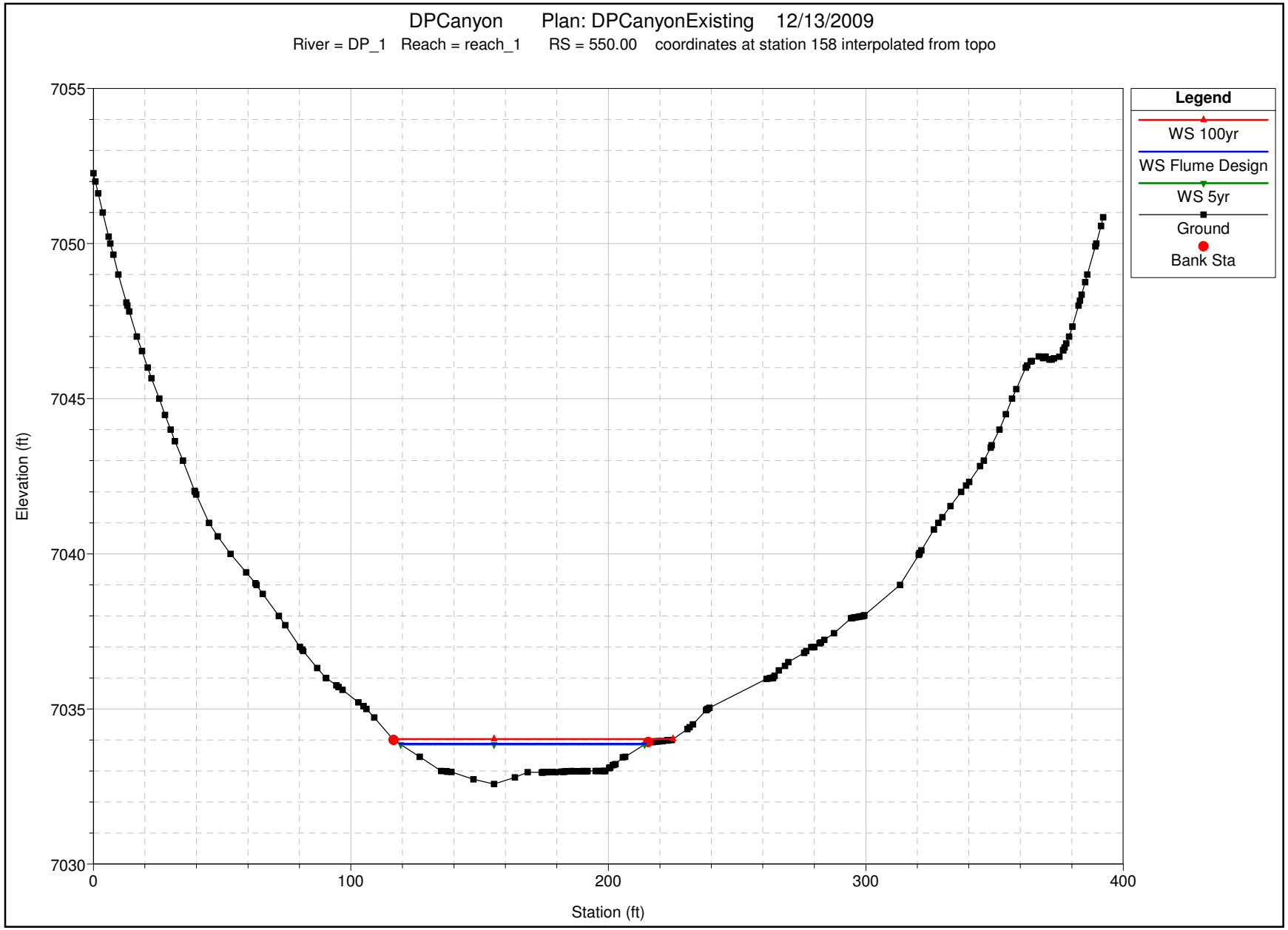
100
150
200
250
300
350
400
Station (ft)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Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
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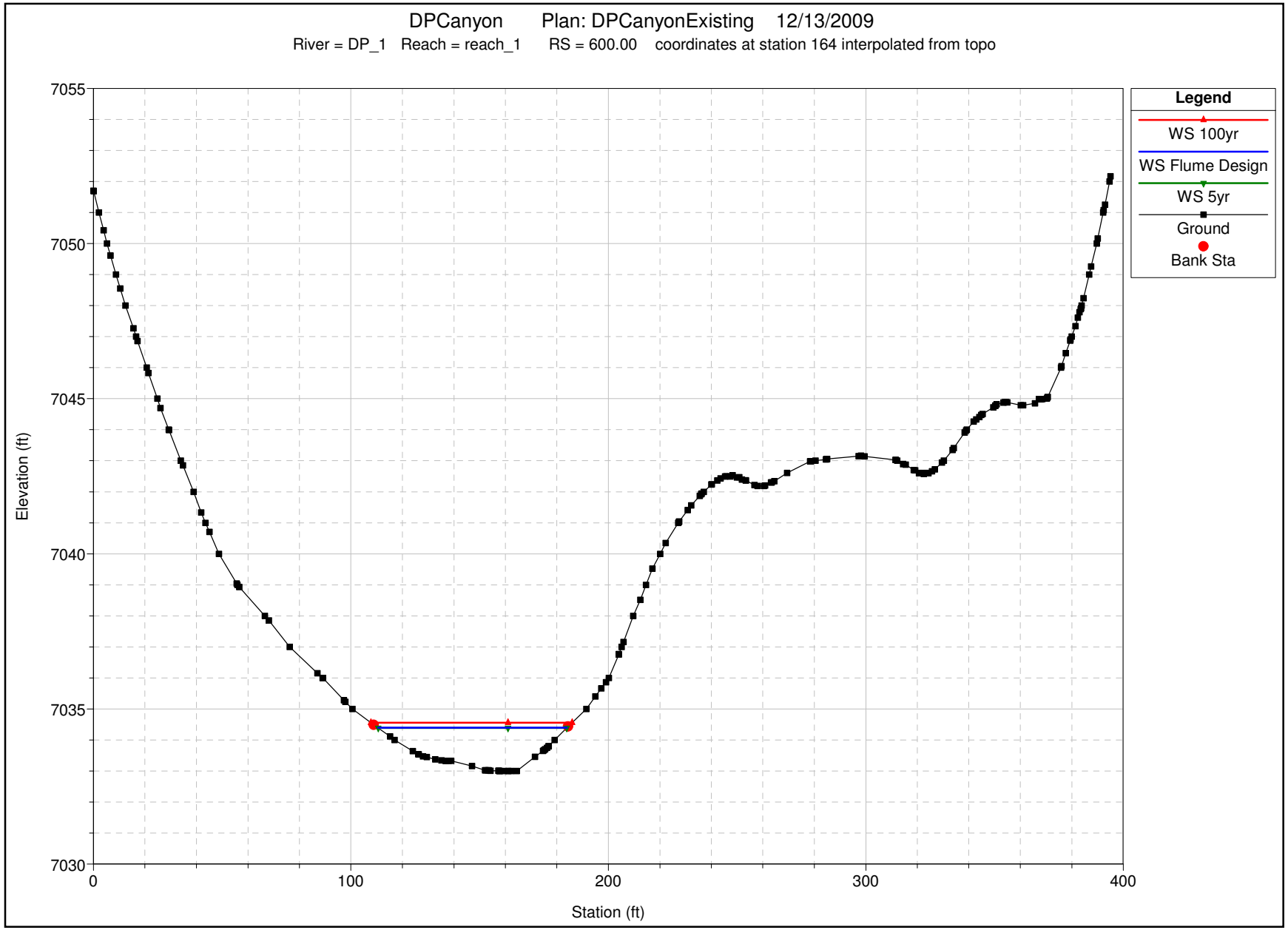
7045
7040
7035
7030
0
100
200
300
400
Station (ft)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Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
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7045
7040
7035
7030
Station (ft)
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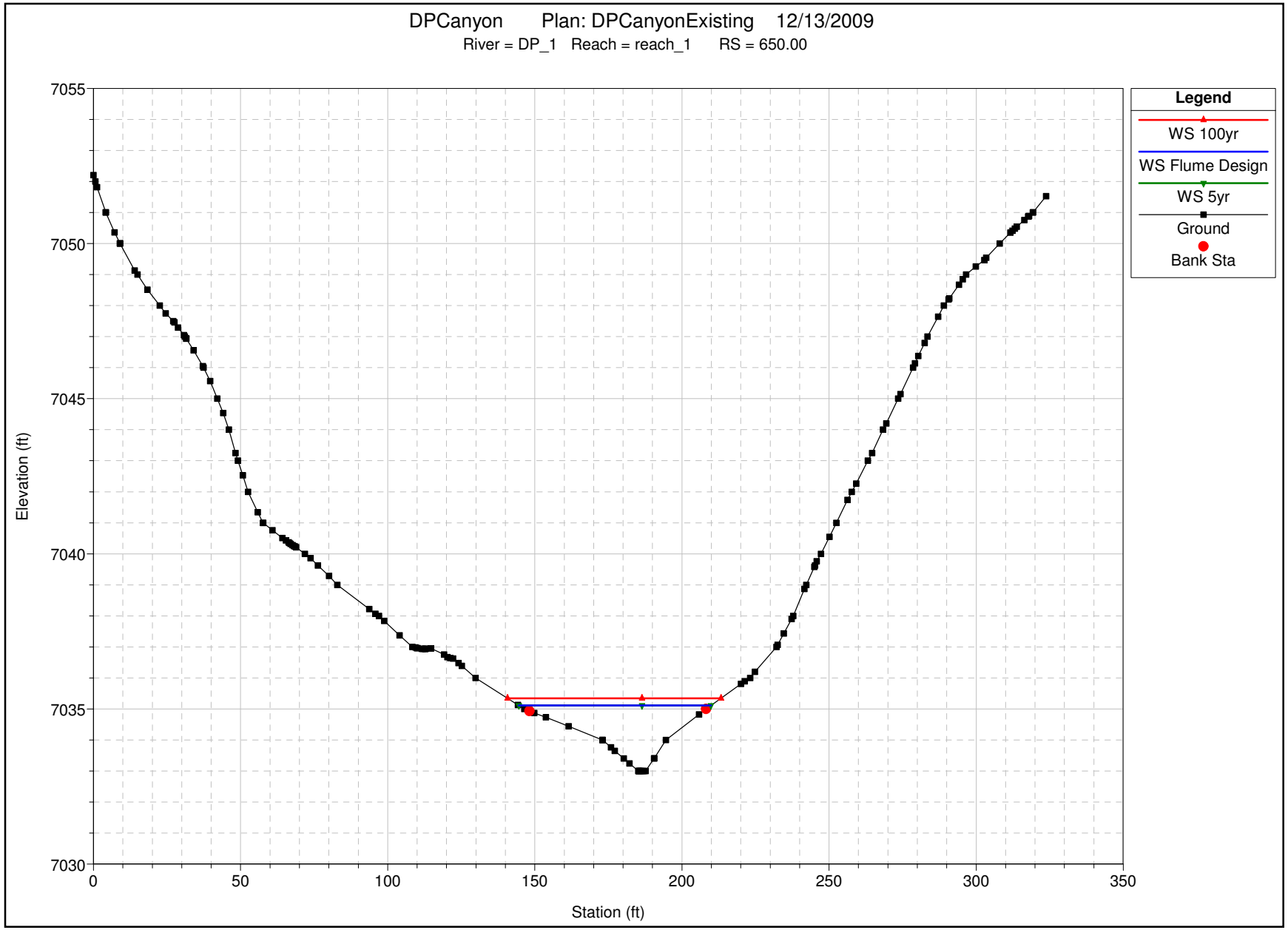
100
200
300
400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Legend
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WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
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7040
7035
7030
Station (ft)
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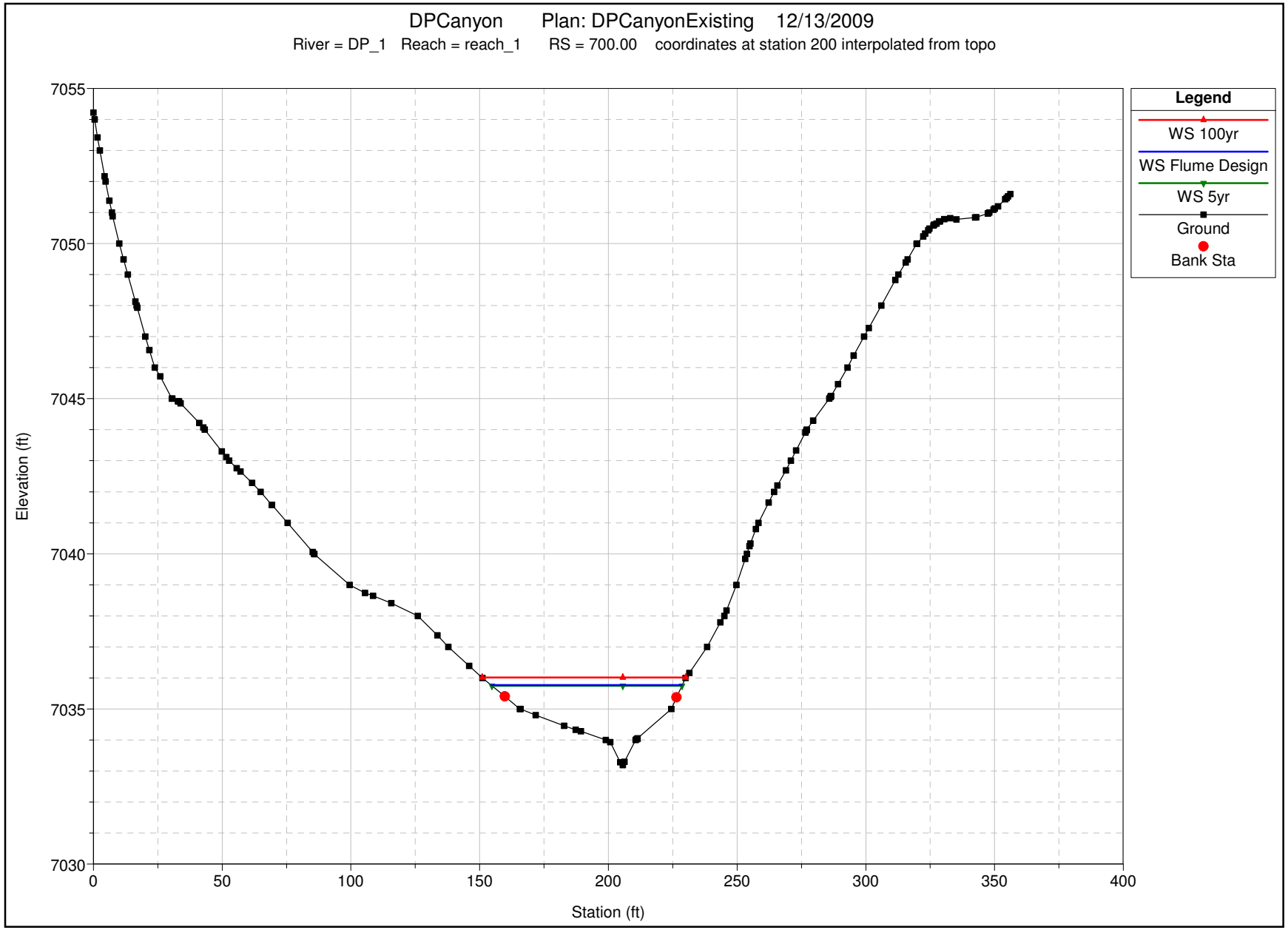
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Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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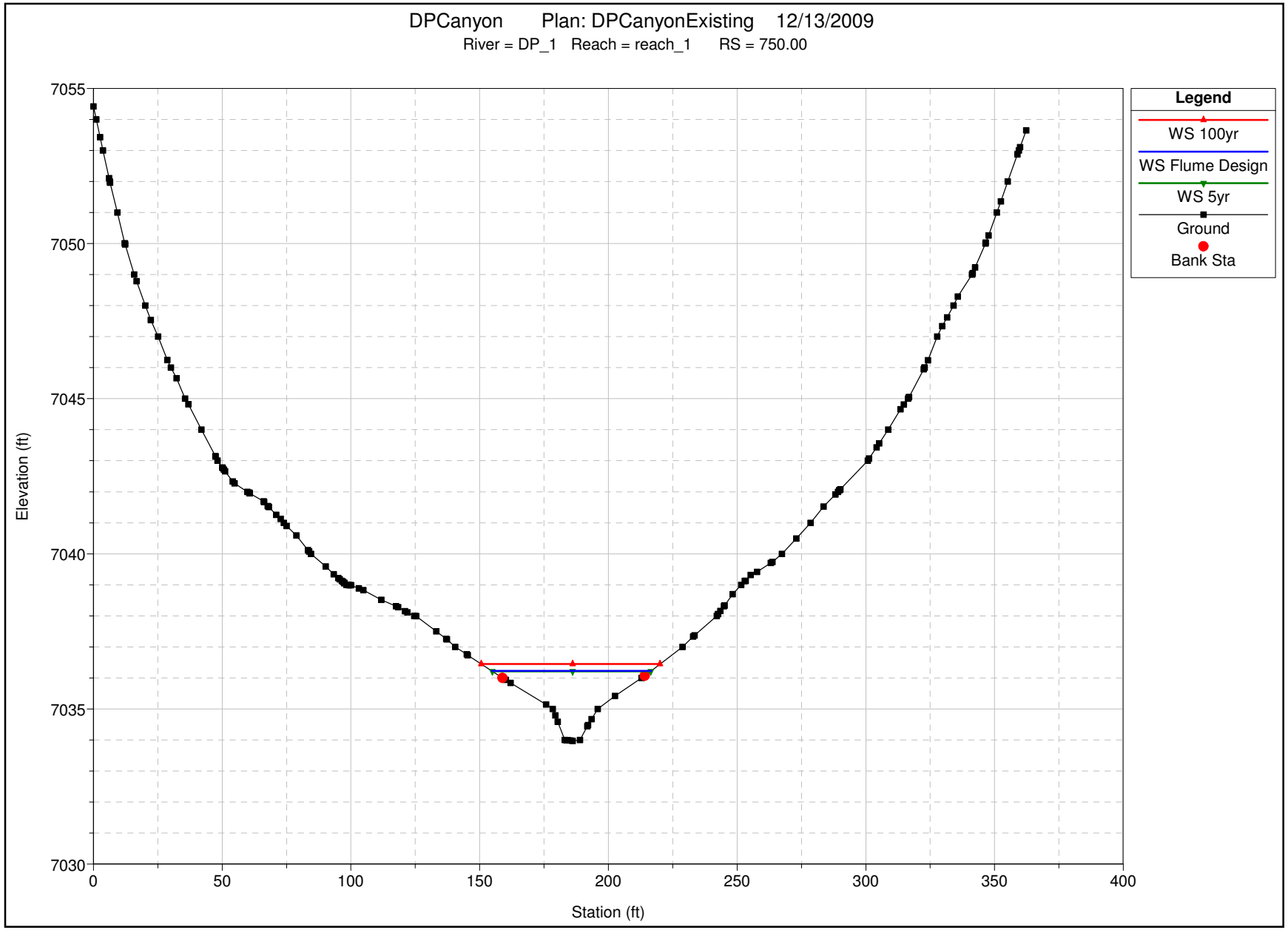
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WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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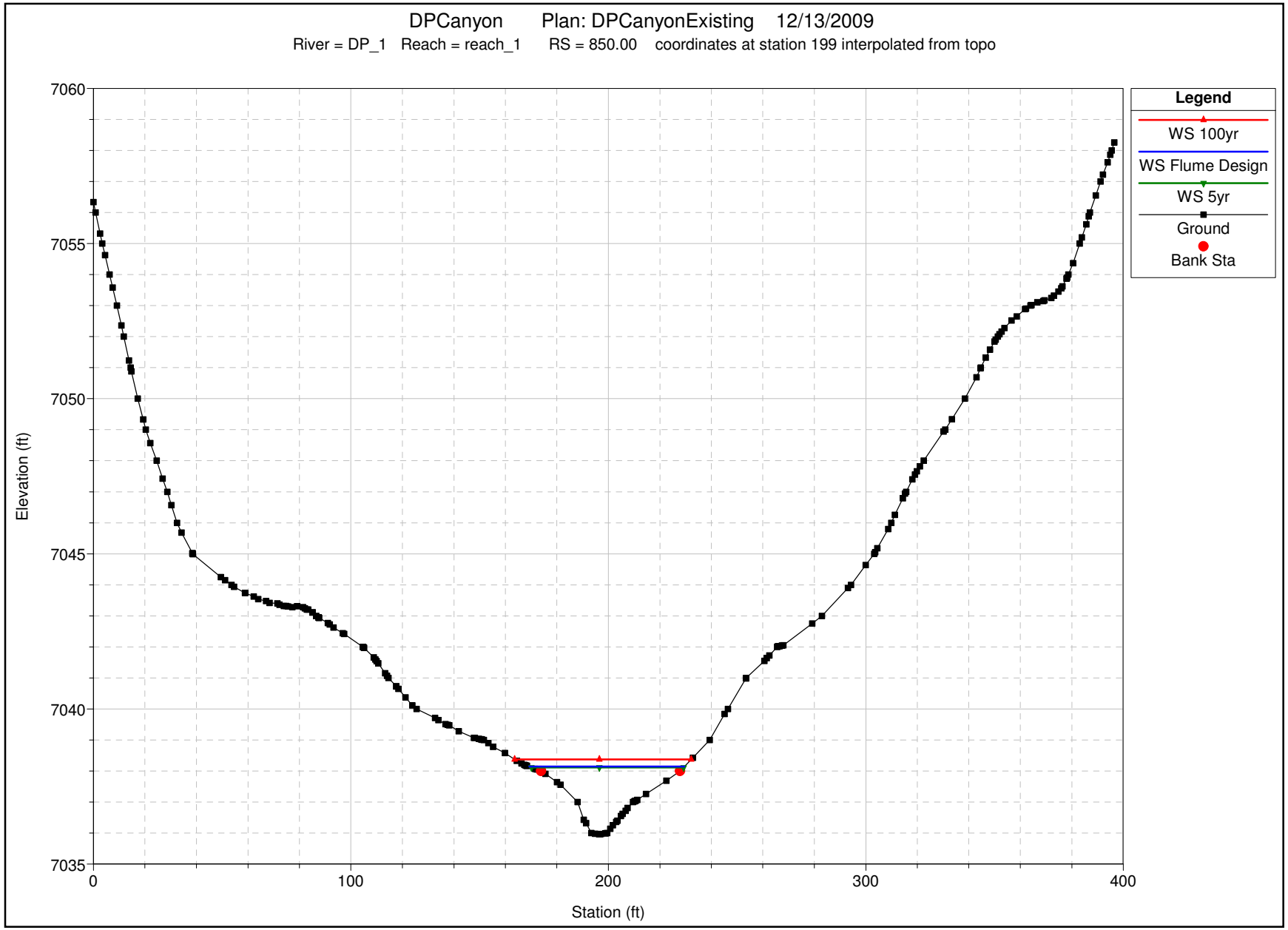
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Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
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7050
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7040
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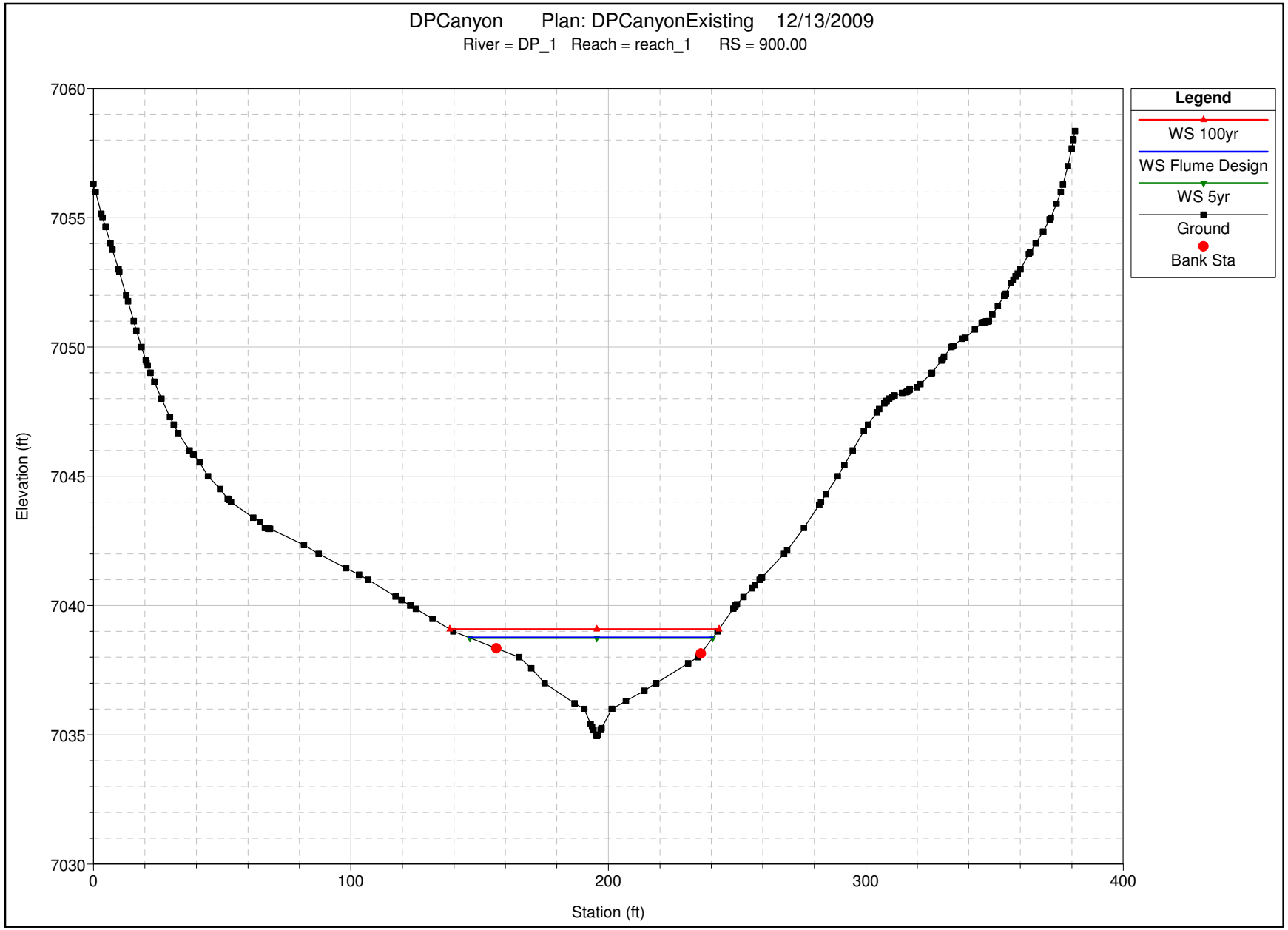
0
100
200
300
400
Station (ft)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WS Flume Design
WS 5yr
Ground
Bank Sta
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Station (ft)
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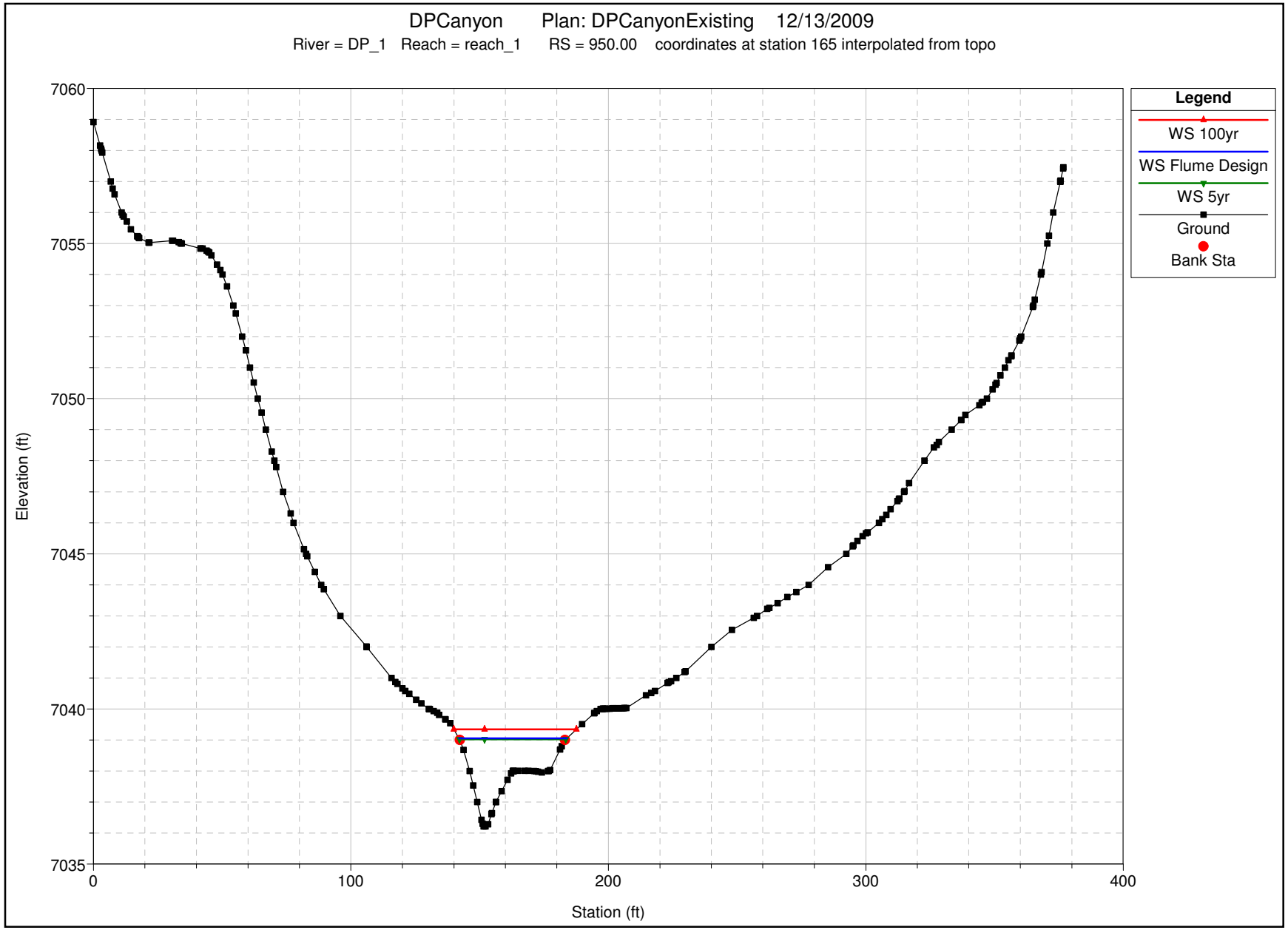
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WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
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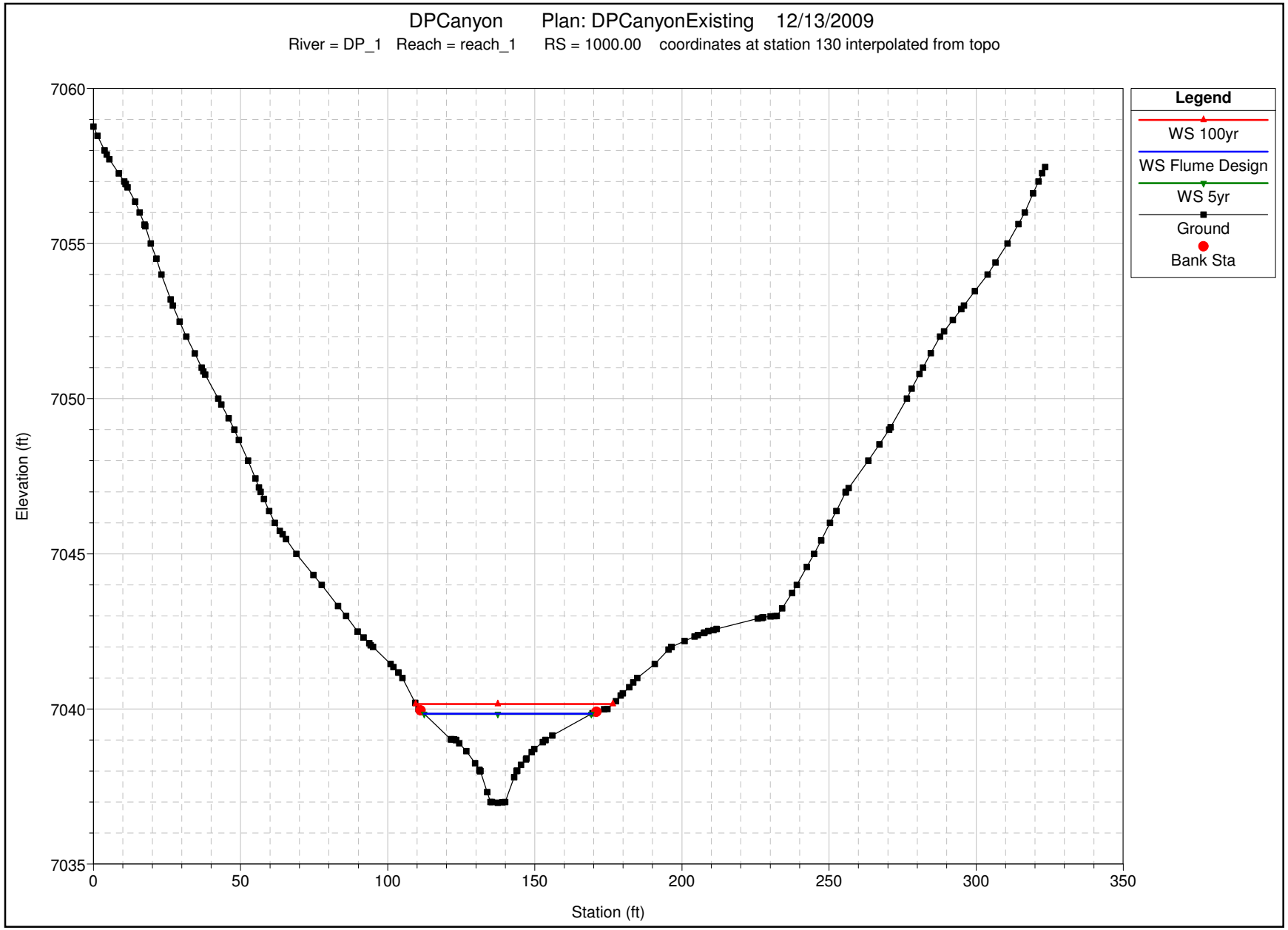
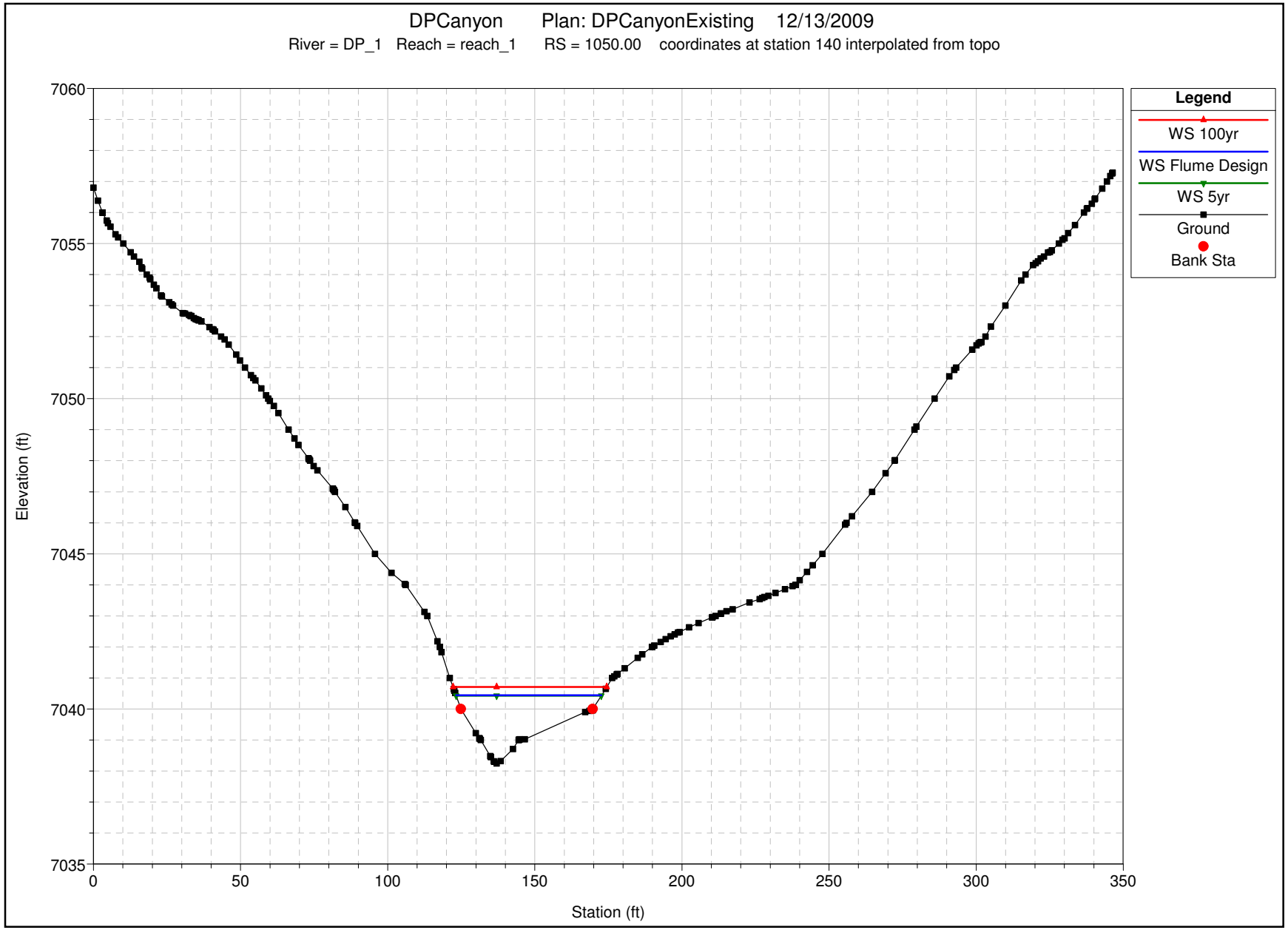
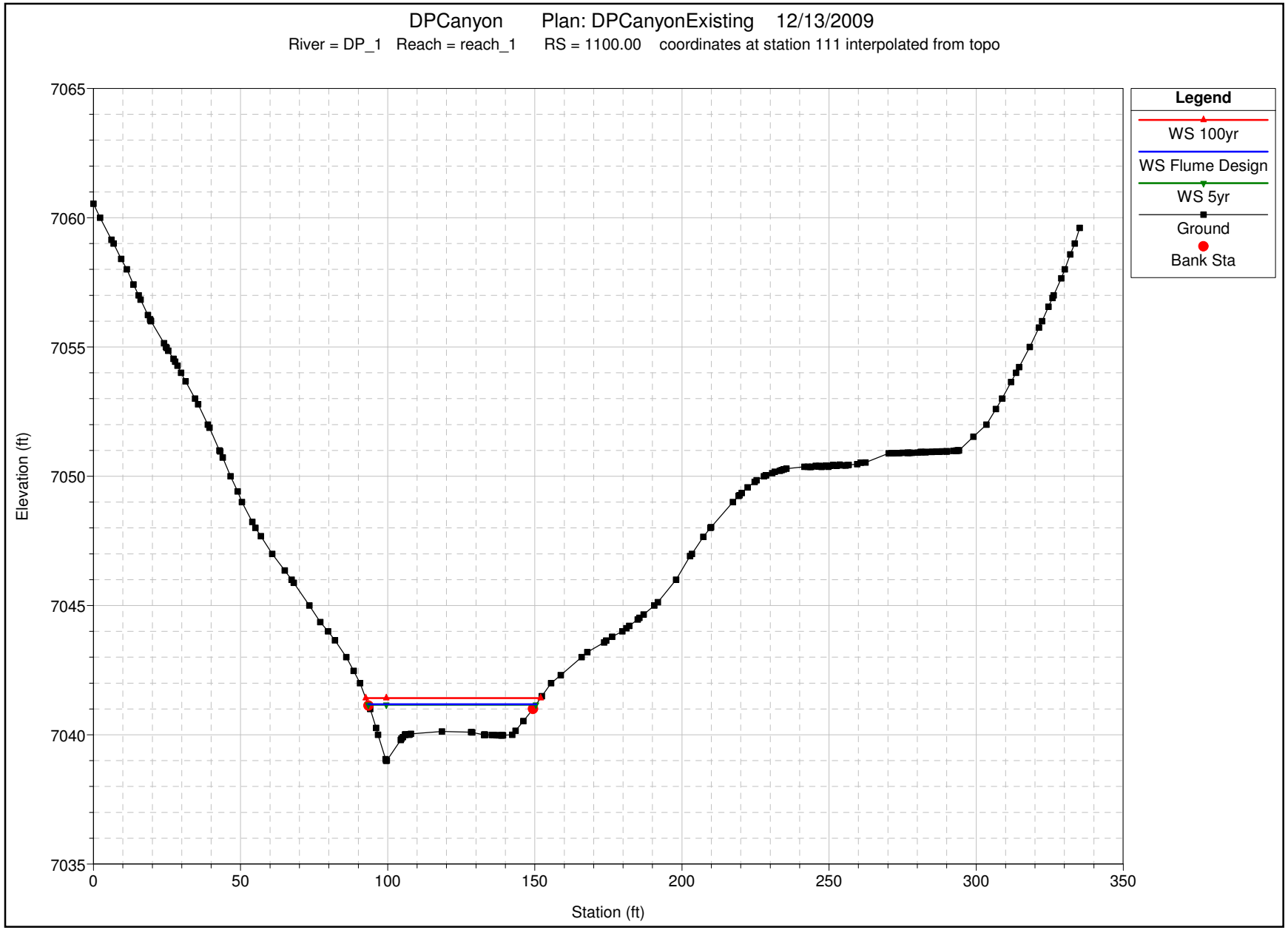
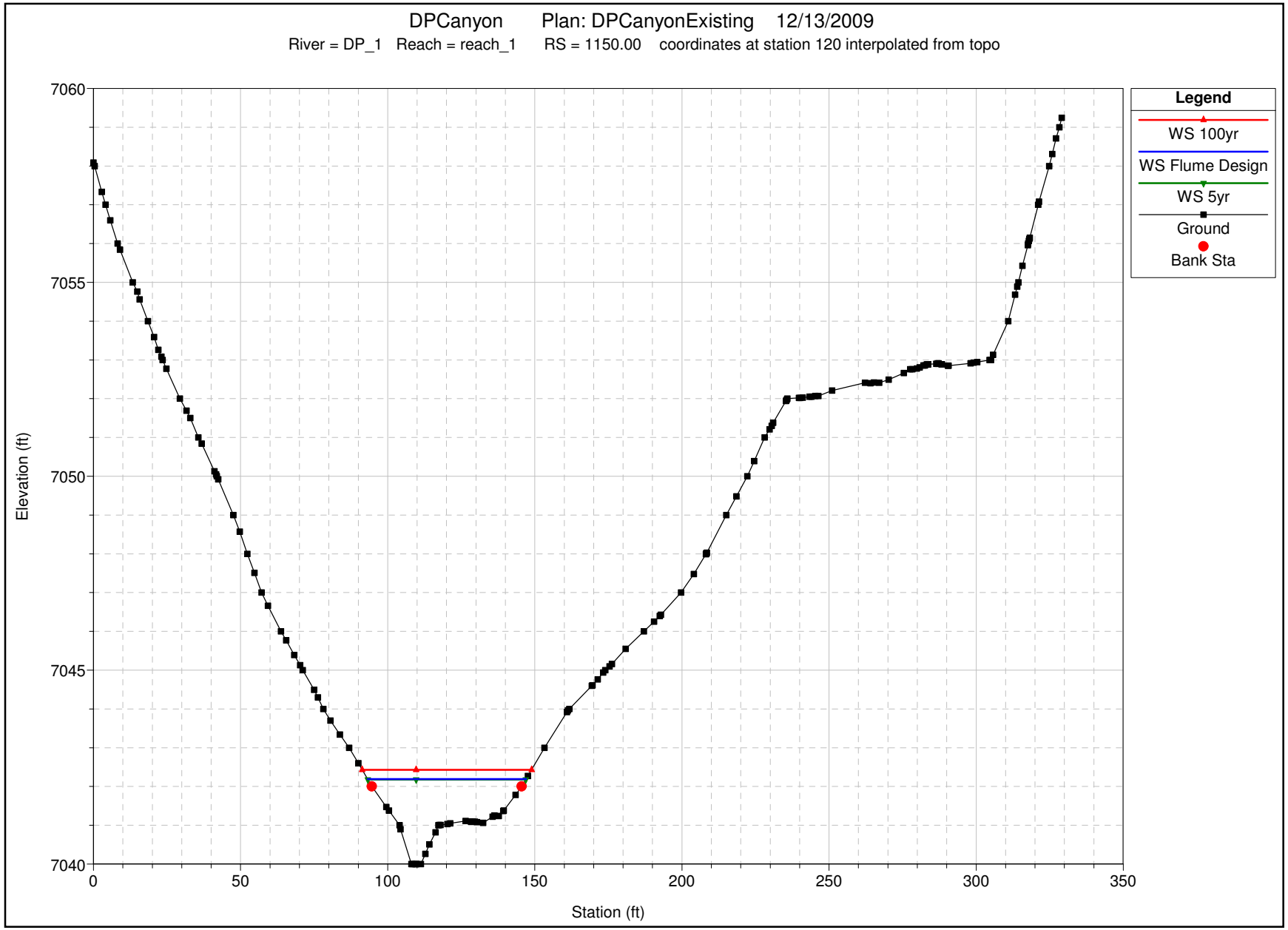
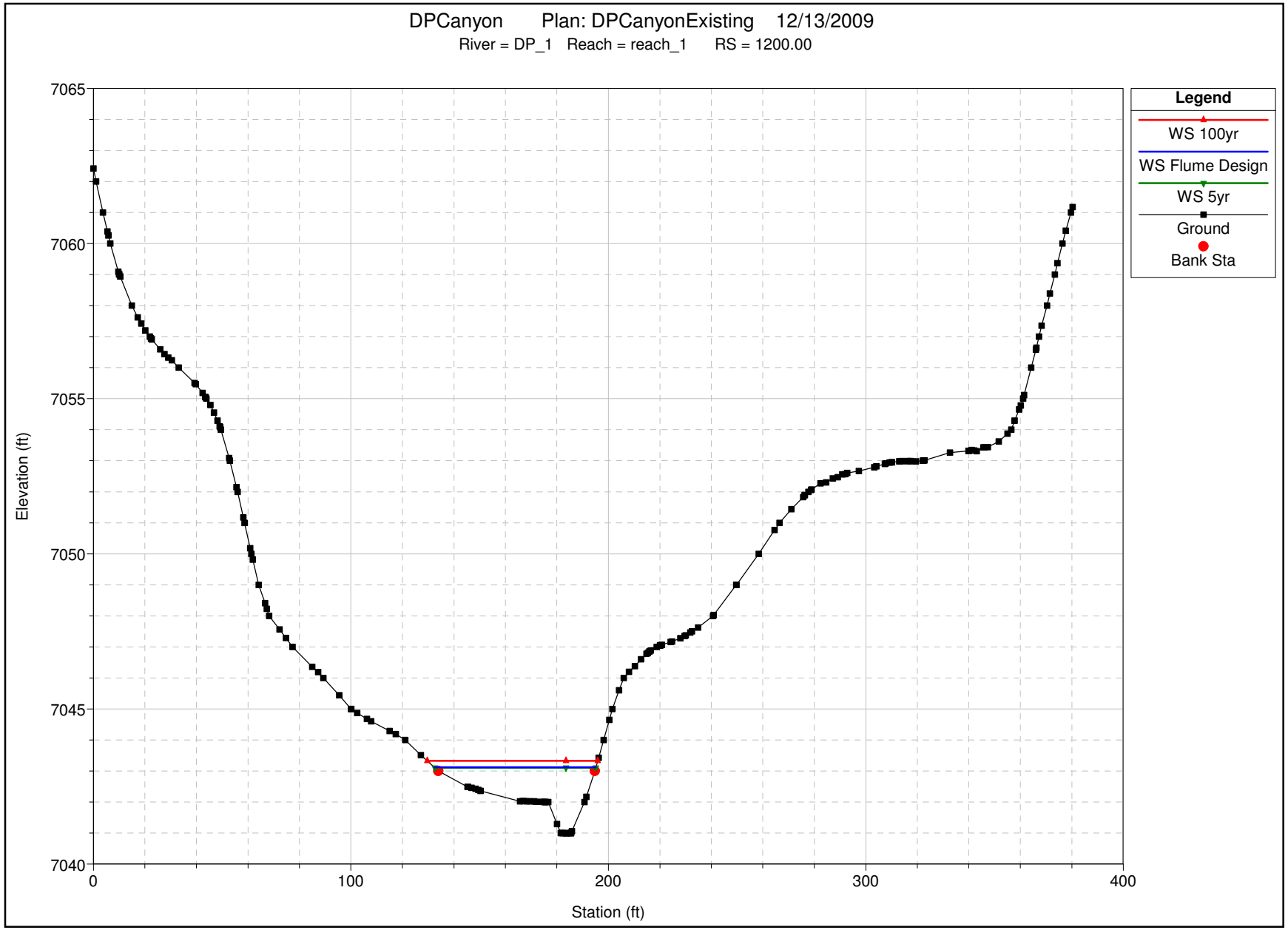
7055
7050
7045
7040
7035
0
100
200
300
400
Station (ft)

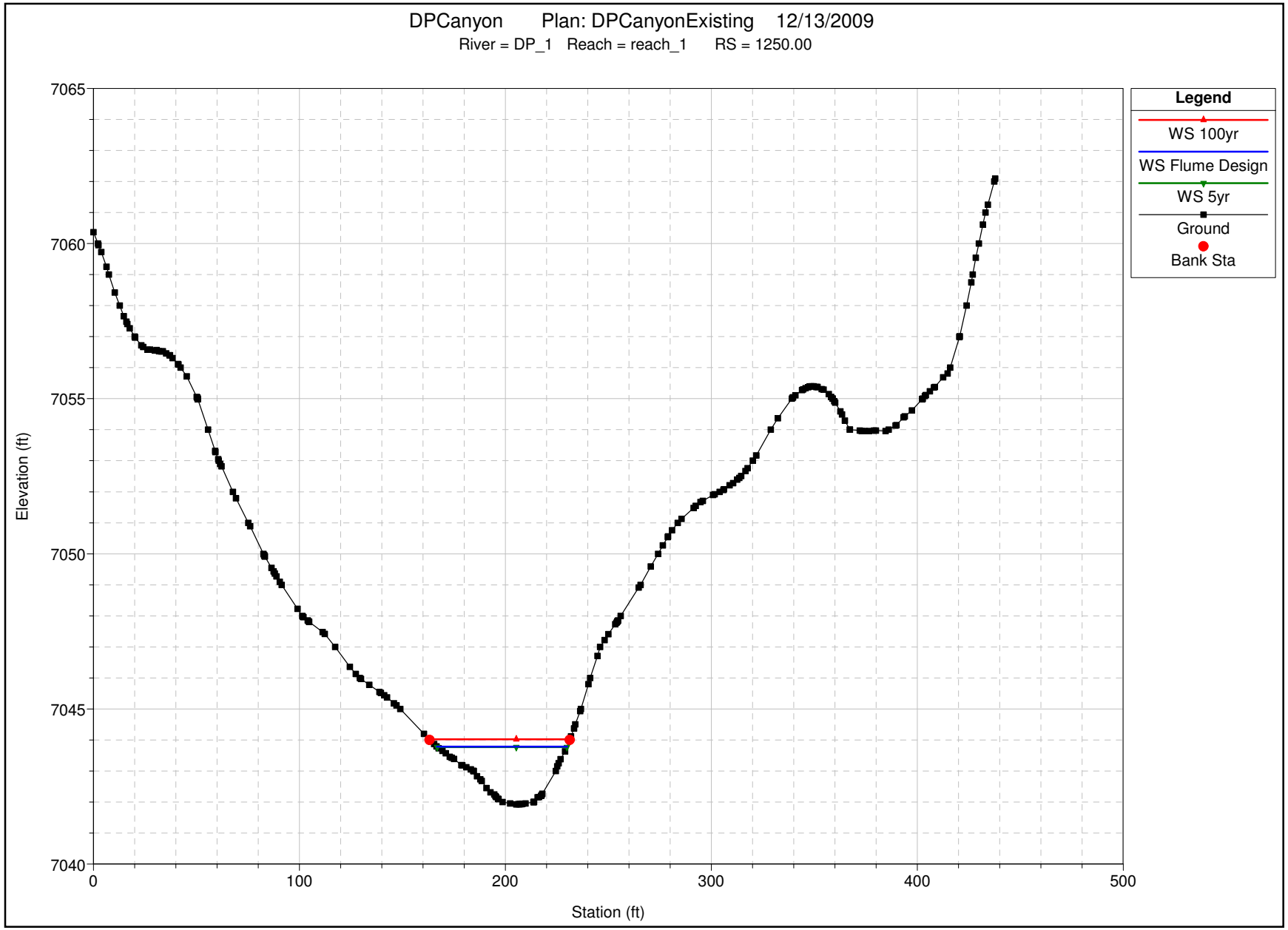

DPCanyon Plan: DPCanyonExisting 12/13/2009
River = DP_1 Reach = reach_1 RS = 1000.00 coordinates at station 130 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7060
7055
7050
7045
7040
7035
0
50
100
150
200
250
300
350

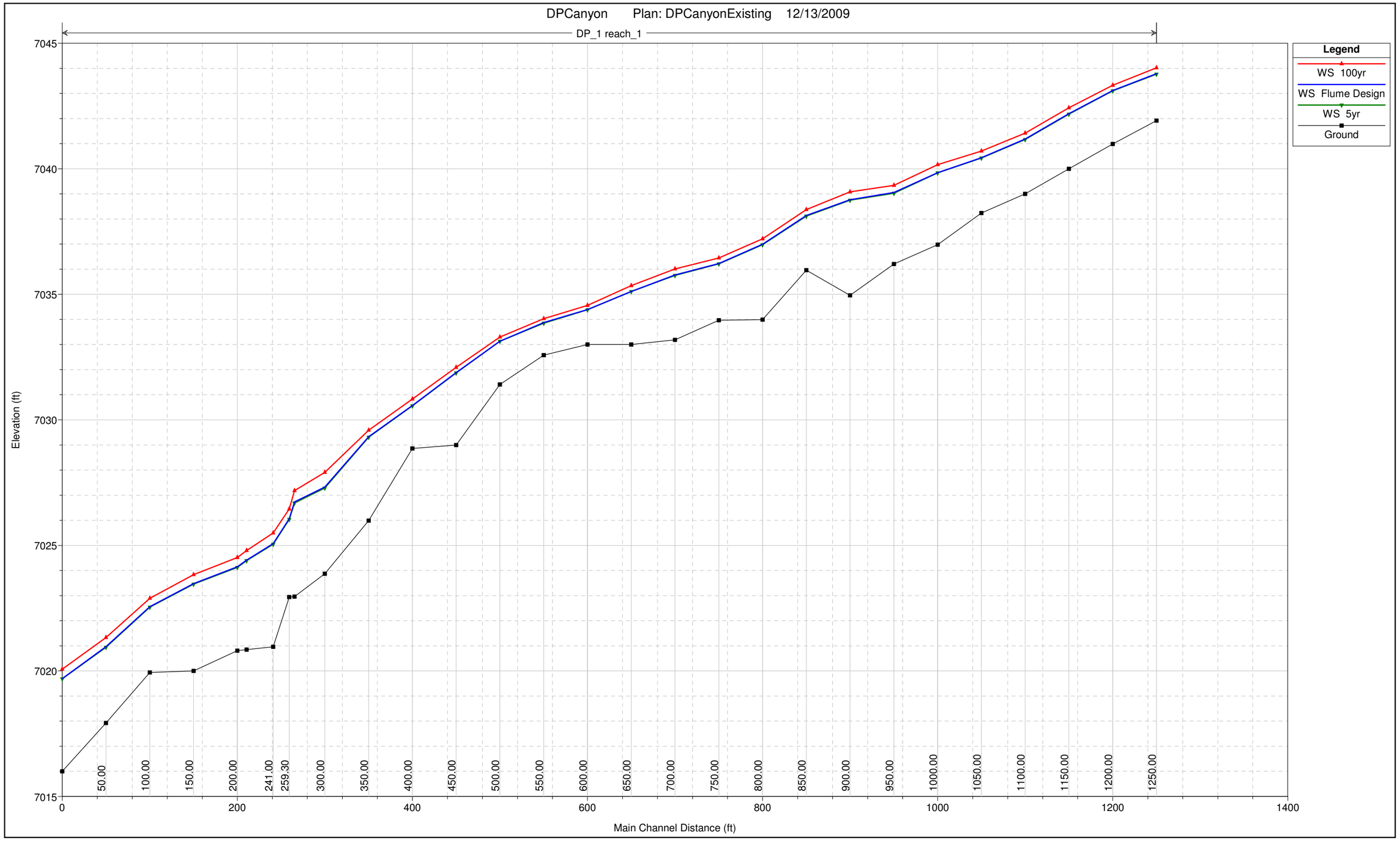

DPCanyon Plan: DPCanyonExisting 12/13/2009
River = DP_1 Reach = reach_1 RS = 1050.00 coordinates at station 140 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7060
7055
7050
7045
7040
7035
0
50
100
150
200
250
300
350


DPCanyon Plan: DPCanyonExisting 12/13/2009
River = DP_1 Reach = reach_1 RS = 1100.00 coordinates at station 111 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7065
7060
7055
7050
7045
7040
7035
0
50
100
150
200
250
300
350
Station (ft)


DPCanyon Plan: DPCanyonExisting 12/13/2009
River = DP_1 Reach = reach_1 RS = 1150.00 coordinates at station 120 interpolated from topo
Elevation (ft)
7060
7055
7050
7045
7040
0
50
100
150
200
250
300
350
Station (ft)
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta


DPCanyon Plan: DPCanyonExisting 12/13/2009
River = DP_1 Reach = reach_1 RS = 1200.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7065
7060
7055
7050
7045
7040
0
100
200
300
400
Station (ft)


DPCanyon Plan: DPCanyonExisting 12/13/2009
River = DP_1 Reach = reach_1 RS = 1250.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7065
7060
7055
7050
7045
7040
0
100
200
300
400
500
Station (ft)


DPCanyon Plan: DPCanyonExisting 12/13/2009
DP_1 reach_1
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Elevation (ft)
7045
7040
7035
7030
7025
7020
7015
0
200
400
600
800
1000
1200
1400
Main Channel Distance (ft)
50.00
100.00
150.00
200.00
241.00
259.30
300.00
350.00
400.00
450.00
500.00
550.00
600.00
650.00
700.00
750.00
800.00
850.00
900.00
950.00
1000.00
1050.00
1100.00
1150.00
1200.00
1250.00

HEC-RAS Plan: DPCanyonExist River: DP_1 Reach: reach_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	1250.00	2yr	289.00	7041.92	7043.65		7043.99	0.008261	4.62	62.49	59.86	0.80
reach_1	1250.00	5yr	343.00	7041.92	7043.77		7044.15	0.008636	4.92	69.76	63.01	0.82
reach_1	1250.00	Flume Design	350.00	7041.92	7043.79		7044.17	0.008677	4.95	70.65	63.33	0.83
reach_1	1250.00	10yr	374.00	7041.92	7043.83		7044.23	0.008768	5.07	73.77	64.37	0.83
reach_1	1250.00	50yr	438.00	7041.92	7043.98		7044.41	0.008637	5.27	83.04	67.50	0.84
reach_1	1250.00	100yr	465.00	7041.92	7044.02		7044.47	0.008741	5.40	86.06	68.50	0.85
reach_1	1200.00	2yr	289.00	7040.99	7042.99	7042.99	7043.44	0.014129	5.40	53.48	60.48	1.01
reach_1	1200.00	5yr	343.00	7040.99	7043.10	7043.10	7043.60	0.013331	5.68	60.51	62.50	1.00
reach_1	1200.00	Flume Design	350.00	7040.99	7043.12	7043.12	7043.62	0.013241	5.71	61.40	62.74	1.00
reach_1	1200.00	10yr	374.00	7040.99	7043.17	7043.17	7043.69	0.012970	5.83	64.39	63.54	1.00
reach_1	1200.00	50yr	438.00	7040.99	7043.27	7043.27	7043.87	0.012918	6.20	71.21	65.32	1.01
reach_1	1200.00	100yr	465.00	7040.99	7043.33	7043.33	7043.94	0.012512	6.29	74.75	66.22	1.00
reach_1	1150.00	2yr	289.00	7040.00	7042.05	7042.05	7042.56	0.013940	5.76	50.15	51.64	1.02
reach_1	1150.00	5yr	343.00	7040.00	7042.18	7042.18	7042.74	0.012964	6.04	57.01	53.65	1.01
reach_1	1150.00	Flume Design	350.00	7040.00	7042.19	7042.19	7042.77	0.012922	6.08	57.80	53.88	1.01
reach_1	1150.00	10yr	374.00	7040.00	7042.24	7042.24	7042.84	0.012896	6.24	60.32	54.60	1.01
reach_1	1150.00	50yr	438.00	7040.00	7042.39	7042.39	7043.04	0.011883	6.48	68.56	56.87	0.99
reach_1	1150.00	100yr	465.00	7040.00	7042.43	7042.43	7043.12	0.012014	6.66	71.05	57.53	1.00
reach_1	1100.00	2yr	289.00	7039.00	7041.04	7040.98	7041.47	0.011341	5.23	55.29	55.79	0.92
reach_1	1100.00	5yr	343.00	7039.00	7041.17	7041.11	7041.64	0.010929	5.52	62.21	57.03	0.92
reach_1	1100.00	Flume Design	350.00	7039.00	7041.19	7041.12	7041.66	0.010768	5.54	63.27	57.20	0.92
reach_1	1100.00	10yr	374.00	7039.00	7041.22	7041.17	7041.73	0.011022	5.73	65.43	57.56	0.93
reach_1	1100.00	50yr	438.00	7039.00	7041.36	7041.29	7041.92	0.010480	6.01	73.30	58.83	0.93
reach_1	1100.00	100yr	465.00	7039.00	7041.42	7041.34	7042.00	0.010049	6.08	77.11	59.44	0.92
reach_1	1050.00	2yr	289.00	7038.24	7040.29	7040.29	7040.85	0.013147	5.96	48.89	47.92	1.01
reach_1	1050.00	5yr	343.00	7038.24	7040.43	7040.43	7041.04	0.012534	6.29	55.37	49.32	1.01
reach_1	1050.00	Flume Design	350.00	7038.24	7040.44	7040.44	7041.07	0.012585	6.35	56.02	49.46	1.01
reach_1	1050.00	10yr	374.00	7038.24	7040.51	7040.51	7041.15	0.011898	6.41	59.55	50.20	0.99
reach_1	1050.00	50yr	438.00	7038.24	7040.66	7040.66	7041.36	0.011415	6.74	66.94	51.76	0.99
reach_1	1050.00	100yr	465.00	7038.24	7040.71	7040.71	7041.44	0.011471	6.91	69.53	52.27	1.00
reach_1	1000.00	2yr	289.00	7036.98	7039.65	7039.52	7040.06	0.009685	5.16	56.04	51.07	0.87
reach_1	1000.00	5yr	343.00	7036.98	7039.84		7040.25	0.008951	5.17	66.34	56.80	0.84
reach_1	1000.00	Flume Design	350.00	7036.98	7039.85		7040.27	0.009136	5.23	66.87	57.08	0.85
reach_1	1000.00	10yr	374.00	7036.98	7039.93		7040.35	0.008767	5.22	71.67	60.19	0.84
reach_1	1000.00	50yr	438.00	7036.98	7040.09		7040.54	0.007880	5.37	82.08	65.81	0.81
reach_1	1000.00	100yr	465.00	7036.98	7040.16		7040.62	0.007517	5.43	86.69	67.00	0.80
reach_1	950.00	2yr	289.00	7036.21	7038.88	7038.88	7039.48	0.013033	6.22	46.43	39.57	1.01
reach_1	950.00	5yr	343.00	7036.21	7039.02	7039.02	7039.69	0.012942	6.57	52.23	41.31	1.02
reach_1	950.00	Flume Design	350.00	7036.21	7039.05	7039.05	7039.72	0.012465	6.55	53.49	41.91	1.01
reach_1	950.00	10yr	374.00	7036.21	7039.11	7039.11	7039.81	0.012312	6.70	55.96	43.07	1.01
reach_1	950.00	50yr	438.00	7036.21	7039.27	7039.27	7040.04	0.011602	7.01	63.20	46.31	1.00
reach_1	950.00	100yr	465.00	7036.21	7039.34	7039.34	7040.13	0.011393	7.14	66.20	47.59	1.00
reach_1	900.00	2yr	289.00	7034.96	7038.58		7038.65	0.000951	2.16	135.31	88.81	0.29
reach_1	900.00	5yr	343.00	7034.96	7038.75		7038.83	0.000973	2.32	150.69	94.34	0.30
reach_1	900.00	Flume Design	350.00	7034.96	7038.77		7038.85	0.000980	2.35	152.45	94.95	0.30
reach_1	900.00	10yr	374.00	7034.96	7038.84		7038.93	0.000989	2.42	159.11	97.23	0.31
reach_1	900.00	50yr	438.00	7034.96	7039.01		7039.12	0.001004	2.58	177.06	102.99	0.31
reach_1	900.00	100yr	465.00	7034.96	7039.08		7039.19	0.001013	2.65	184.31	104.63	0.32
reach_1	850.00	2yr	289.00	7035.96	7038.00	7038.00	7038.49	0.013856	5.63	51.36	53.94	1.02
reach_1	850.00	5yr	343.00	7035.96	7038.12	7038.12	7038.66	0.013245	5.94	58.00	59.12	1.01
reach_1	850.00	Flume Design	350.00	7035.96	7038.14	7038.14	7038.69	0.012747	5.92	59.52	60.19	1.00
reach_1	850.00	10yr	374.00	7035.96	7038.20	7038.20	7038.76	0.012373	6.02	62.85	62.62	0.99
reach_1	850.00	50yr	438.00	7035.96	7038.32	7038.32	7038.94	0.012059	6.36	70.76	66.81	0.99
reach_1	850.00	100yr	465.00	7035.96	7038.38	7038.38	7039.02	0.011673	6.45	74.69	68.57	0.99
reach_1	800.00	2yr	289.00	7033.99	7036.84	7036.84	7037.33	0.013914	5.61	51.47	54.11	1.01
reach_1	800.00	5yr	343.00	7033.99	7036.98	7036.98	7037.50	0.013651	5.77	59.40	59.07	1.01
reach_1	800.00	Flume Design	350.00	7033.99	7036.99	7036.99	7037.52	0.013735	5.81	60.21	59.56	1.02
reach_1	800.00	10yr	374.00	7033.99	7037.04	7037.04	7037.59	0.013655	5.95	62.89	60.91	1.02
reach_1	800.00	50yr	438.00	7033.99	7037.16	7037.16	7037.76	0.013031	6.25	70.45	64.49	1.02
reach_1	800.00	100yr	465.00	7033.99	7037.21	7037.21	7037.84	0.012724	6.35	73.79	66.00	1.01
reach_1	750.00	2yr	289.00	7033.97	7036.08	7036.08	7036.57	0.014323	5.63	51.38	56.74	1.03
reach_1	750.00	5yr	343.00	7033.97	7036.22	7036.22	7036.74	0.012692	5.81	59.54	61.47	0.99
reach_1	750.00	Flume Design	350.00	7033.97	7036.23	7036.23	7036.76	0.012682	5.86	60.36	61.93	0.99
reach_1	750.00	10yr	374.00	7033.97	7036.27	7036.27	7036.83	0.012871	6.04	62.77	63.25	1.01
reach_1	750.00	50yr	438.00	7033.97	7036.40	7036.40	7037.02	0.011944	6.29	71.77	67.94	0.99
reach_1	750.00	100yr	465.00	7033.97	7036.45	7036.45	7037.09	0.012025	6.45	74.69	69.40	1.00

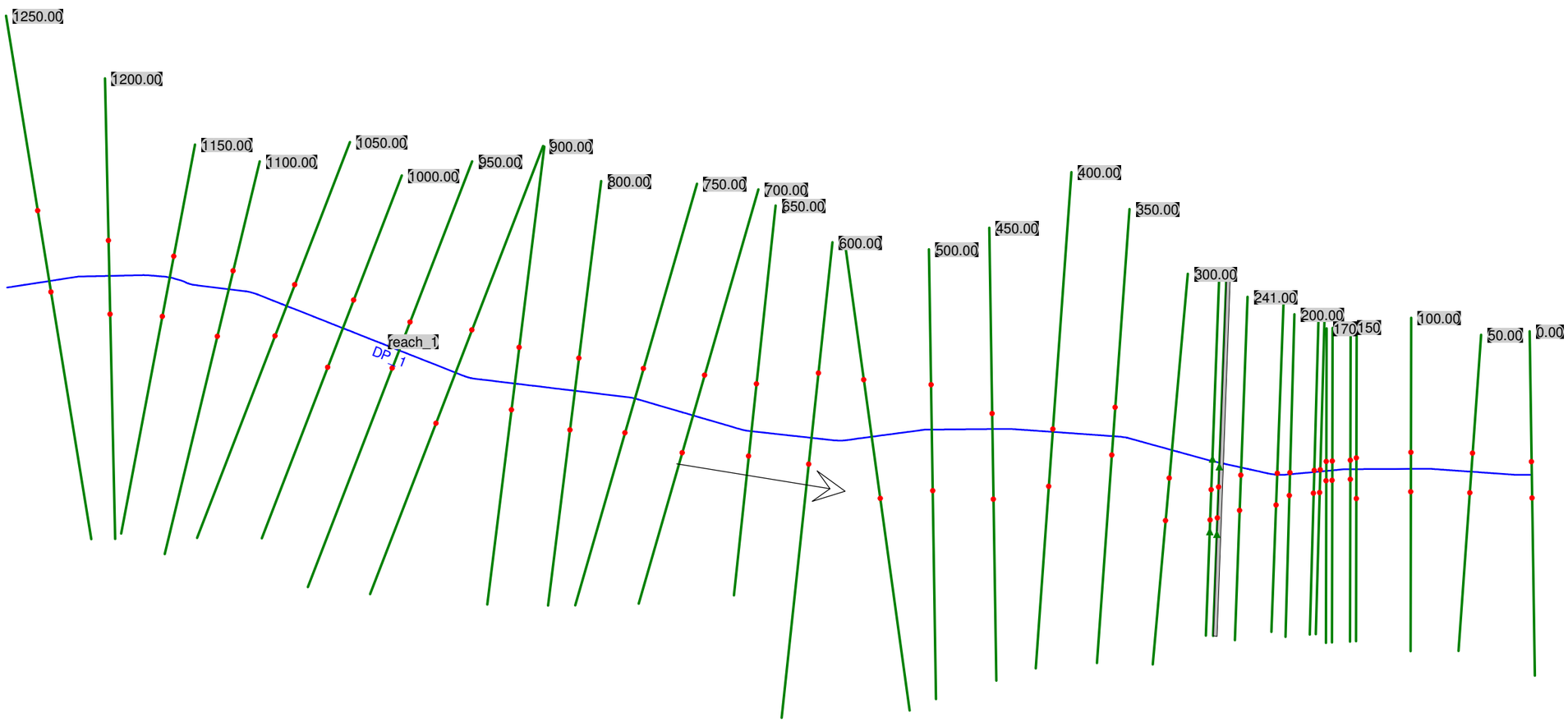
HEC-RAS Plan: DPCanyonExist River: DP_1 Reach: reach_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	700.00	2yr	289.00	7033.19	7035.63		7035.83	0.004146	3.60	80.79	71.38	0.58
reach_1	700.00	5yr	343.00	7033.19	7035.75		7035.98	0.004203	3.87	89.79	73.87	0.59
reach_1	700.00	Flume Design	350.00	7033.19	7035.77		7036.01	0.004156	3.89	91.31	74.28	0.59
reach_1	700.00	10yr	374.00	7033.19	7035.82		7036.07	0.004205	4.00	95.00	75.27	0.60
reach_1	700.00	50yr	438.00	7033.19	7035.96		7036.24	0.004164	4.25	105.86	78.12	0.60
reach_1	700.00	100yr	465.00	7033.19	7036.01		7036.31	0.004218	4.37	109.74	79.13	0.61
reach_1	650.00	2yr	289.00	7033.00	7034.99	7034.99	7035.45	0.014405	5.46	52.92	61.31	1.02
reach_1	650.00	5yr	343.00	7033.00	7035.11	7035.11	7035.61	0.013119	5.68	60.78	65.25	1.00
reach_1	650.00	Flume Design	350.00	7033.00	7035.12	7035.12	7035.63	0.013440	5.77	61.10	65.40	1.01
reach_1	650.00	10yr	374.00	7033.00	7035.17	7035.17	7035.70	0.012739	5.83	64.92	67.19	0.99
reach_1	650.00	50yr	438.00	7033.00	7035.29	7035.29	7035.87	0.012509	6.17	72.59	70.66	1.00
reach_1	650.00	100yr	465.00	7033.00	7035.35	7035.35	7035.94	0.011901	6.22	76.93	72.55	0.99
reach_1	600.00	2yr	289.00	7033.00	7034.29	7034.24	7034.65	0.012015	4.85	59.54	70.36	0.93
reach_1	600.00	5yr	343.00	7033.00	7034.38	7034.35	7034.80	0.012329	5.16	66.52	73.18	0.95
reach_1	600.00	Flume Design	350.00	7033.00	7034.39	7034.36	7034.82	0.012528	5.22	67.09	73.41	0.96
reach_1	600.00	10yr	374.00	7033.00	7034.43	7034.41	7034.88	0.012780	5.36	69.80	74.47	0.98
reach_1	600.00	50yr	438.00	7033.00	7034.52	7034.51	7035.03	0.013274	5.74	76.34	76.98	1.01
reach_1	600.00	100yr	465.00	7033.00	7034.56	7034.56	7035.09	0.012979	5.84	79.75	78.24	1.00
reach_1	550.00	2yr	289.00	7032.58	7033.78	7033.70	7034.06	0.010764	4.22	68.49	91.97	0.86
reach_1	550.00	5yr	343.00	7032.58	7033.85	7033.79	7034.18	0.011527	4.56	75.23	94.71	0.90
reach_1	550.00	Flume Design	350.00	7032.58	7033.88		7034.19	0.011122	4.53	77.23	95.50	0.89
reach_1	550.00	10yr	374.00	7032.58	7033.91		7034.24	0.011310	4.65	80.37	96.74	0.90
reach_1	550.00	50yr	438.00	7032.58	7033.99	7033.94	7034.37	0.011460	4.93	89.05	106.91	0.92
reach_1	550.00	100yr	465.00	7032.58	7034.03	7033.98	7034.42	0.011336	5.03	92.96	108.81	0.92
reach_1	500.00	2yr	289.00	7031.41	7033.04	7033.04	7033.40	0.015974	4.85	59.66	88.36	1.03
reach_1	500.00	5yr	343.00	7031.41	7033.13	7033.13	7033.53	0.014453	5.03	68.31	90.62	1.01
reach_1	500.00	Flume Design	350.00	7031.41	7033.13	7033.13	7033.54	0.014986	5.13	68.40	90.65	1.02
reach_1	500.00	10yr	374.00	7031.41	7033.17	7033.17	7033.60	0.014560	5.22	71.92	91.55	1.02
reach_1	500.00	50yr	438.00	7031.41	7033.27	7033.27	7033.73	0.013837	5.48	80.69	93.76	1.01
reach_1	500.00	100yr	465.00	7031.41	7033.30	7033.30	7033.79	0.013810	5.61	83.87	94.55	1.02
reach_1	450.00	2yr	289.00	7029.00	7031.76	7031.76	7032.19	0.014963	5.26	54.91	67.34	1.03
reach_1	450.00	5yr	343.00	7029.00	7031.87	7031.87	7032.34	0.014306	5.49	62.54	70.29	1.02
reach_1	450.00	Flume Design	350.00	7029.00	7031.88	7031.88	7032.36	0.014342	5.53	63.29	70.54	1.02
reach_1	450.00	10yr	374.00	7029.00	7031.94	7031.94	7032.42	0.013610	5.58	67.15	71.81	1.01
reach_1	450.00	50yr	438.00	7029.00	7032.04	7032.04	7032.58	0.013371	5.89	74.69	74.92	1.01
reach_1	450.00	100yr	465.00	7029.00	7032.09	7032.09	7032.64	0.012772	5.95	78.73	77.06	1.00
reach_1	400.00	2yr	289.00	7028.86	7030.43	7030.43	7030.95	0.012945	5.80	50.96	53.59	1.00
reach_1	400.00	5yr	343.00	7028.86	7030.56	7030.56	7031.14	0.012298	6.11	58.01	55.50	0.99
reach_1	400.00	Flume Design	350.00	7028.86	7030.57	7030.57	7031.16	0.012382	6.17	58.66	55.67	1.00
reach_1	400.00	10yr	374.00	7028.86	7030.63	7030.63	7031.24	0.011977	6.27	62.01	56.57	0.99
reach_1	400.00	50yr	438.00	7028.86	7030.77	7030.77	7031.44	0.011645	6.62	69.65	58.54	0.99
reach_1	400.00	100yr	465.00	7028.86	7030.83	7030.83	7031.52	0.011233	6.70	73.45	59.49	0.98
reach_1	350.00	2yr	289.00	7025.99	7029.15	7029.15	7029.71	0.011545	5.99	50.40	63.70	0.96
reach_1	350.00	5yr	343.00	7025.99	7029.31	7029.31	7029.90	0.010456	6.20	61.29	69.96	0.93
reach_1	350.00	Flume Design	350.00	7025.99	7029.33	7029.33	7029.92	0.010353	6.23	62.66	70.66	0.93
reach_1	350.00	10yr	374.00	7025.99	7029.39	7029.39	7030.00	0.010194	6.35	66.84	72.15	0.93
reach_1	350.00	50yr	438.00	7025.99	7029.53	7029.53	7030.20	0.009996	6.69	77.24	75.72	0.93
reach_1	350.00	100yr	465.00	7025.99	7029.59	7029.59	7030.28	0.009885	6.81	81.69	77.36	0.93
reach_1	300.00	2yr	289.00	7023.87	7027.04	7027.04	7027.87	0.011782	7.29	39.63	24.07	1.00
reach_1	300.00	5yr	343.00	7023.87	7027.29	7027.29	7028.16	0.011739	7.48	45.86	26.81	1.01
reach_1	300.00	Flume Design	350.00	7023.87	7027.33	7027.33	7028.19	0.011604	7.47	46.96	31.22	1.00
reach_1	300.00	10yr	374.00	7023.87	7027.46	7027.46	7028.30	0.011062	7.40	51.60	39.95	0.98
reach_1	300.00	50yr	438.00	7023.87	7027.76	7027.76	7028.56	0.009769	7.21	66.38	54.45	0.93
reach_1	300.00	100yr	465.00	7023.87	7027.91	7027.85	7028.66	0.008926	7.01	74.67	59.10	0.90
reach_1	265.39	2yr	289.00	7022.96	7026.43	7026.43	7027.34	0.011713	7.66	37.71	20.76	1.00
reach_1	265.39	5yr	343.00	7022.96	7026.69	7026.69	7027.66	0.011638	7.92	43.33	22.65	1.01
reach_1	265.39	Flume Design	350.00	7022.96	7026.74	7026.74	7027.70	0.011406	7.89	44.39	22.99	1.00
reach_1	265.39	10yr	374.00	7022.96	7026.84	7026.84	7027.83	0.011459	8.00	46.74	23.79	1.01
reach_1	265.39	50yr	438.00	7022.96	7027.09	7027.09	7028.15	0.011069	8.26	53.06	26.01	1.00
reach_1	265.39	100yr	465.00	7022.96	7027.18	7027.18	7028.28	0.010848	8.41	55.45	26.88	1.00
reach_1	259.30	2yr	289.00	7022.94	7025.84	7025.84	7026.65	0.011841	7.24	39.94	24.84	1.01
reach_1	259.30	5yr	343.00	7022.94	7026.04	7026.04	7026.94	0.011696	7.63	45.01	26.34	1.01
reach_1	259.30	Flume Design	350.00	7022.94	7026.06	7026.06	7026.98	0.011640	7.68	45.65	26.53	1.01
reach_1	259.30	10yr	374.00	7022.94	7026.15	7026.15	7027.10	0.011334	7.82	47.98	27.21	1.01
reach_1	259.30	50yr	438.00	7022.94	7026.36	7026.36	7027.41	0.010765	8.20	54.05	28.89	1.00

HEC-RAS Plan: DPCanyonExist River: DP_1 Reach: reach_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	259.30	100yr	465.00	7022.94	7026.45	7026.45	7027.53	0.010581	8.35	56.58	29.57	1.00
reach_1	241.00	2yr	289.00	7020.96	7024.82		7025.22	0.004217	5.05	57.24	27.96	0.62
reach_1	241.00	5yr	343.00	7020.96	7025.05		7025.50	0.004406	5.38	63.71	29.58	0.64
reach_1	241.00	Flume Design	350.00	7020.96	7025.07		7025.53	0.004398	5.43	64.54	29.82	0.64
reach_1	241.00	10yr	374.00	7020.96	7025.17		7025.65	0.004347	5.55	67.49	30.66	0.64
reach_1	241.00	50yr	438.00	7020.96	7025.41		7025.95	0.004307	5.90	74.94	32.67	0.65
reach_1	241.00	100yr	465.00	7020.96	7025.50		7026.06	0.004323	6.04	77.89	33.44	0.66
reach_1	210.58	2yr	289.00	7020.85	7024.20	7024.20	7024.97	0.012013	7.08	40.95	27.91	1.00
reach_1	210.58	5yr	343.00	7020.85	7024.39	7024.39	7025.25	0.011304	7.44	46.64	29.58	0.99
reach_1	210.58	Flume Design	350.00	7020.85	7024.42	7024.42	7025.29	0.011255	7.49	47.34	29.79	0.99
reach_1	210.58	10yr	374.00	7020.85	7024.49	7024.49	7025.41	0.011303	7.70	49.41	30.41	1.00
reach_1	210.58	50yr	438.00	7020.85	7024.70	7024.70	7025.70	0.010766	8.08	55.98	32.30	0.99
reach_1	210.58	100yr	465.00	7020.85	7024.79	7024.79	7025.82	0.010342	8.17	59.21	33.20	0.98
reach_1	200.00	2yr	289.00	7020.81	7023.94	7023.94	7024.70	0.012076	7.00	41.31	27.48	1.01
reach_1	200.00	5yr	343.00	7020.81	7024.12	7024.12	7024.97	0.011961	7.40	46.45	29.60	1.02
reach_1	200.00	Flume Design	350.00	7020.81	7024.15	7024.15	7025.01	0.011844	7.44	47.19	29.89	1.01
reach_1	200.00	10yr	374.00	7020.81	7024.23	7024.23	7025.12	0.011509	7.57	49.70	30.83	1.01
reach_1	200.00	50yr	438.00	7020.81	7024.45	7024.45	7025.41	0.010638	7.87	56.68	33.15	0.99
reach_1	200.00	100yr	465.00	7020.81	7024.52	7024.52	7025.53	0.010677	8.07	58.99	33.86	1.00
reach_1	150.00	2yr	289.00	7020.00	7023.25	7023.25	7023.97	0.012321	6.81	42.47	29.88	1.01
reach_1	150.00	5yr	343.00	7020.00	7023.46	7023.46	7024.22	0.012340	6.99	49.15	34.22	1.01
reach_1	150.00	Flume Design	350.00	7020.00	7023.48	7023.48	7024.25	0.012511	7.05	49.71	34.55	1.02
reach_1	150.00	10yr	374.00	7020.00	7023.56	7023.56	7024.35	0.011879	7.13	52.71	36.60	1.01
reach_1	150.00	50yr	438.00	7020.00	7023.76	7023.76	7024.61	0.010929	7.40	60.39	41.40	0.98
reach_1	150.00	100yr	465.00	7020.00	7023.84	7023.84	7024.71	0.010667	7.52	63.59	42.66	0.98
reach_1	100.00	2yr	289.00	7019.94	7022.38	7022.38	7023.05	0.012225	6.61	44.37	36.37	1.00
reach_1	100.00	5yr	343.00	7019.94	7022.54	7022.54	7023.29	0.011581	6.96	50.63	38.14	1.00
reach_1	100.00	Flume Design	350.00	7019.94	7022.56	7022.56	7023.32	0.011559	7.01	51.35	38.34	1.00
reach_1	100.00	10yr	374.00	7019.94	7022.65	7022.65	7023.42	0.011005	7.09	54.63	39.23	0.98
reach_1	100.00	50yr	438.00	7019.94	7022.82	7022.82	7023.68	0.010803	7.50	61.33	40.98	0.99
reach_1	100.00	100yr	465.00	7019.94	7022.89	7022.89	7023.78	0.010536	7.62	64.52	41.79	0.98
reach_1	50.00	2yr	289.00	7017.93	7020.72	7020.72	7021.48	0.012098	7.01	41.20	27.51	1.01
reach_1	50.00	5yr	343.00	7017.93	7020.94	7020.94	7021.75	0.011790	7.21	47.58	29.92	1.01
reach_1	50.00	Flume Design	350.00	7017.93	7020.97	7020.97	7021.78	0.011730	7.23	48.43	30.23	1.01
reach_1	50.00	10yr	374.00	7017.93	7021.06	7021.06	7021.89	0.011605	7.29	51.29	31.33	1.00
reach_1	50.00	50yr	438.00	7017.93	7021.27	7021.27	7022.16	0.011301	7.58	57.87	33.76	1.00
reach_1	50.00	100yr	465.00	7017.93	7021.33	7021.33	7022.26	0.011271	7.75	60.12	34.61	1.01
reach_1	0.00	2yr	289.00	7016.00	7019.45	7019.45	7020.23	0.012106	7.06	40.94	26.82	1.01
reach_1	0.00	5yr	343.00	7016.00	7019.69	7019.69	7020.49	0.011807	7.21	47.61	30.35	1.00
reach_1	0.00	Flume Design	350.00	7016.00	7019.70	7019.70	7020.53	0.012068	7.31	47.95	30.52	1.02
reach_1	0.00	10yr	374.00	7016.00	7019.78	7019.78	7020.64	0.011704	7.41	50.60	31.92	1.01
reach_1	0.00	50yr	438.00	7016.00	7019.98	7019.98	7020.91	0.011108	7.77	57.25	36.33	1.00
reach_1	0.00	100yr	465.00	7016.00	7020.07	7020.07	7021.02	0.010622	7.85	60.75	38.48	0.99

Proposed Conditions


1250.00
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1150.00
1100.00
1050.00
1000.00
950.00
900.00
800.00
750.00
700.00
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600.00
500.00
450.00
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300.00
241.00
200.00
170
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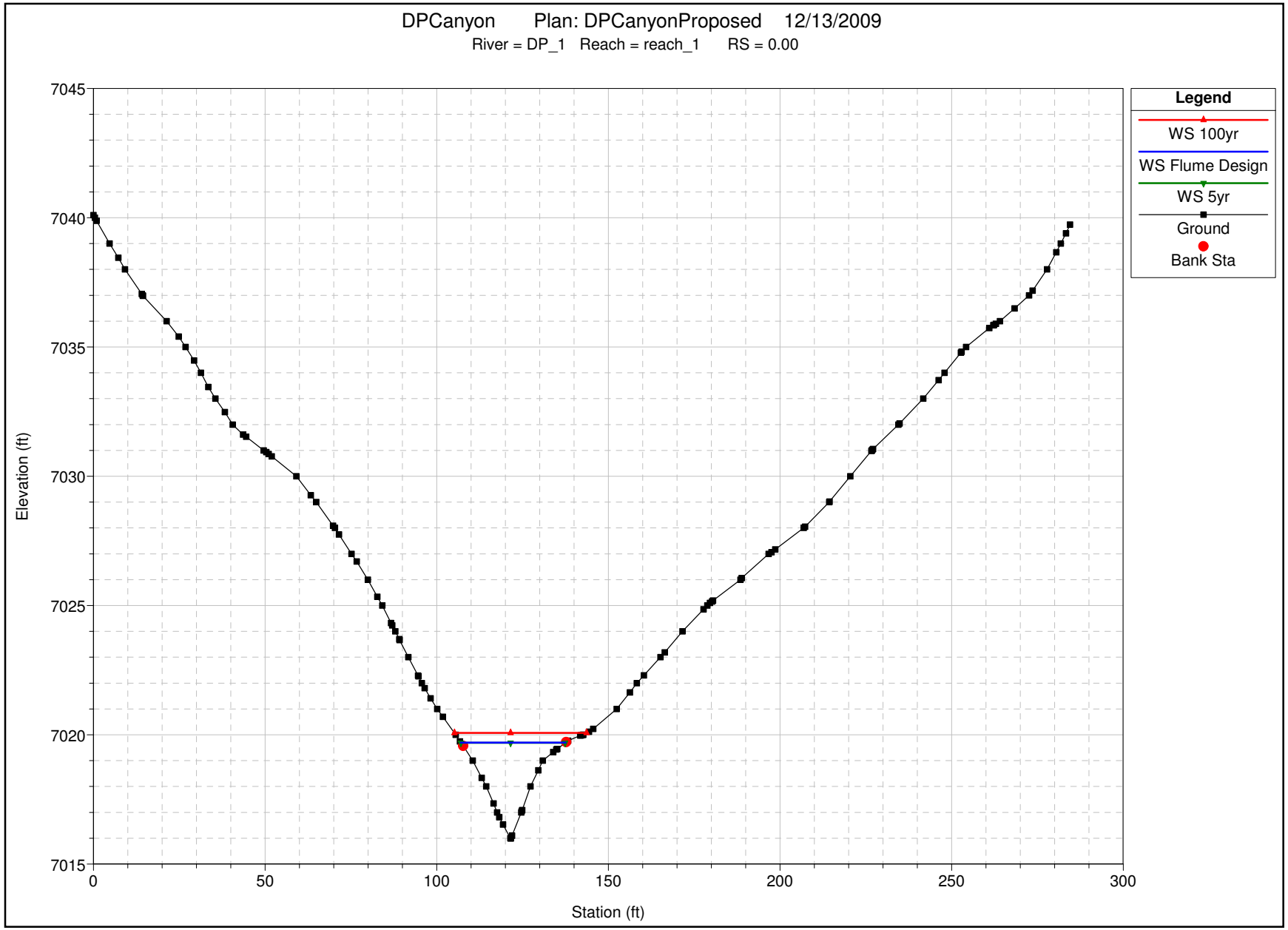
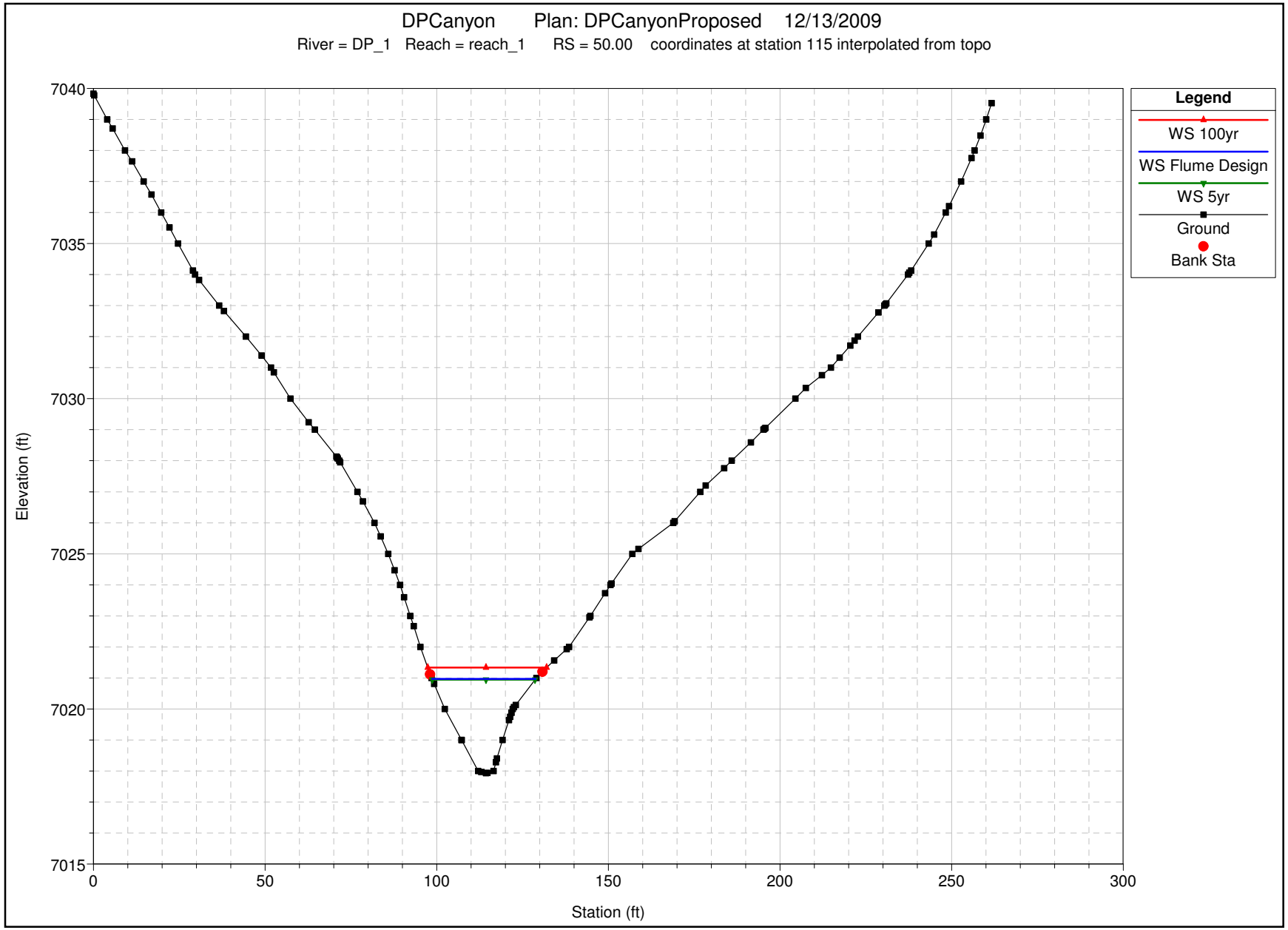
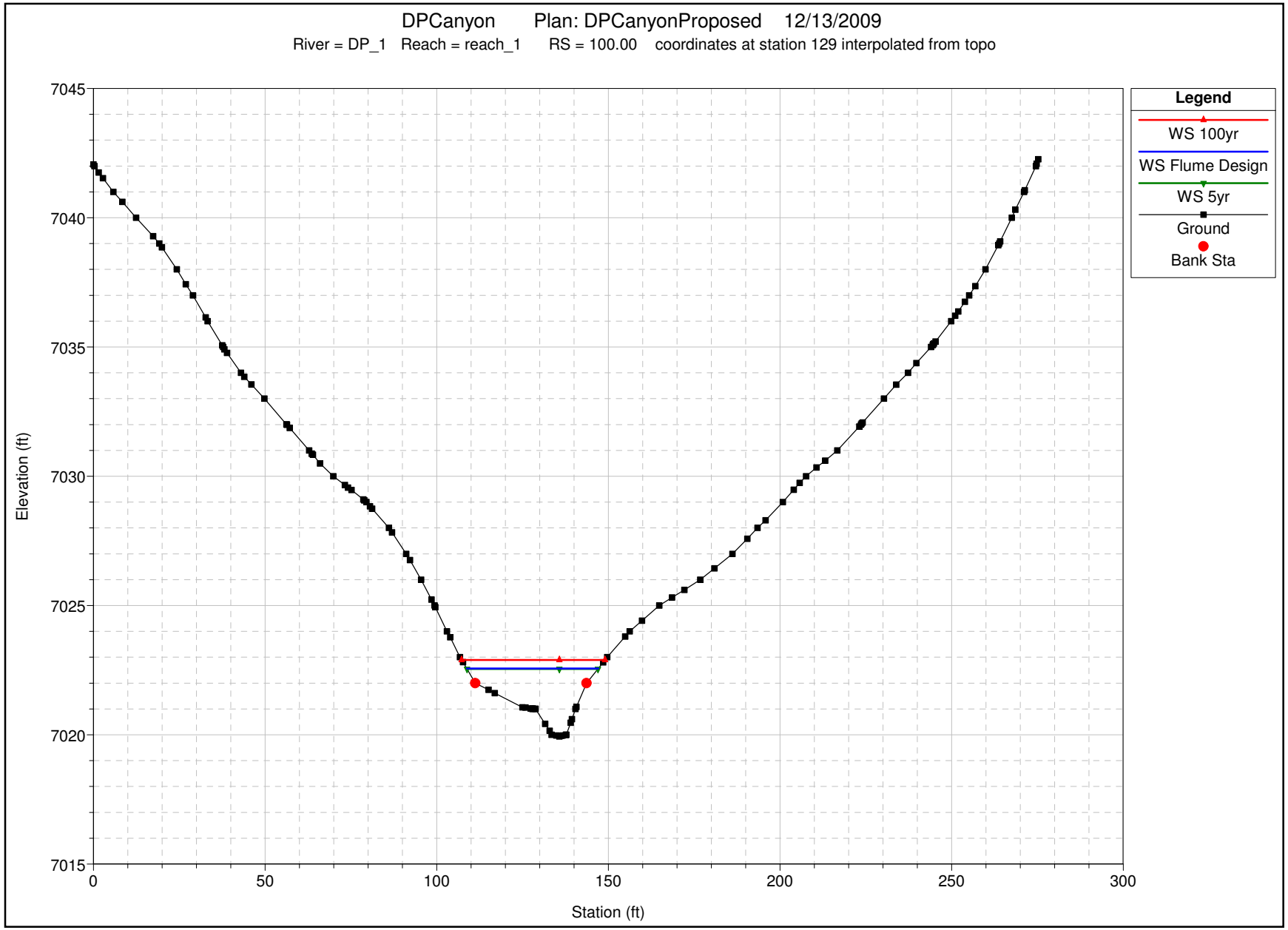
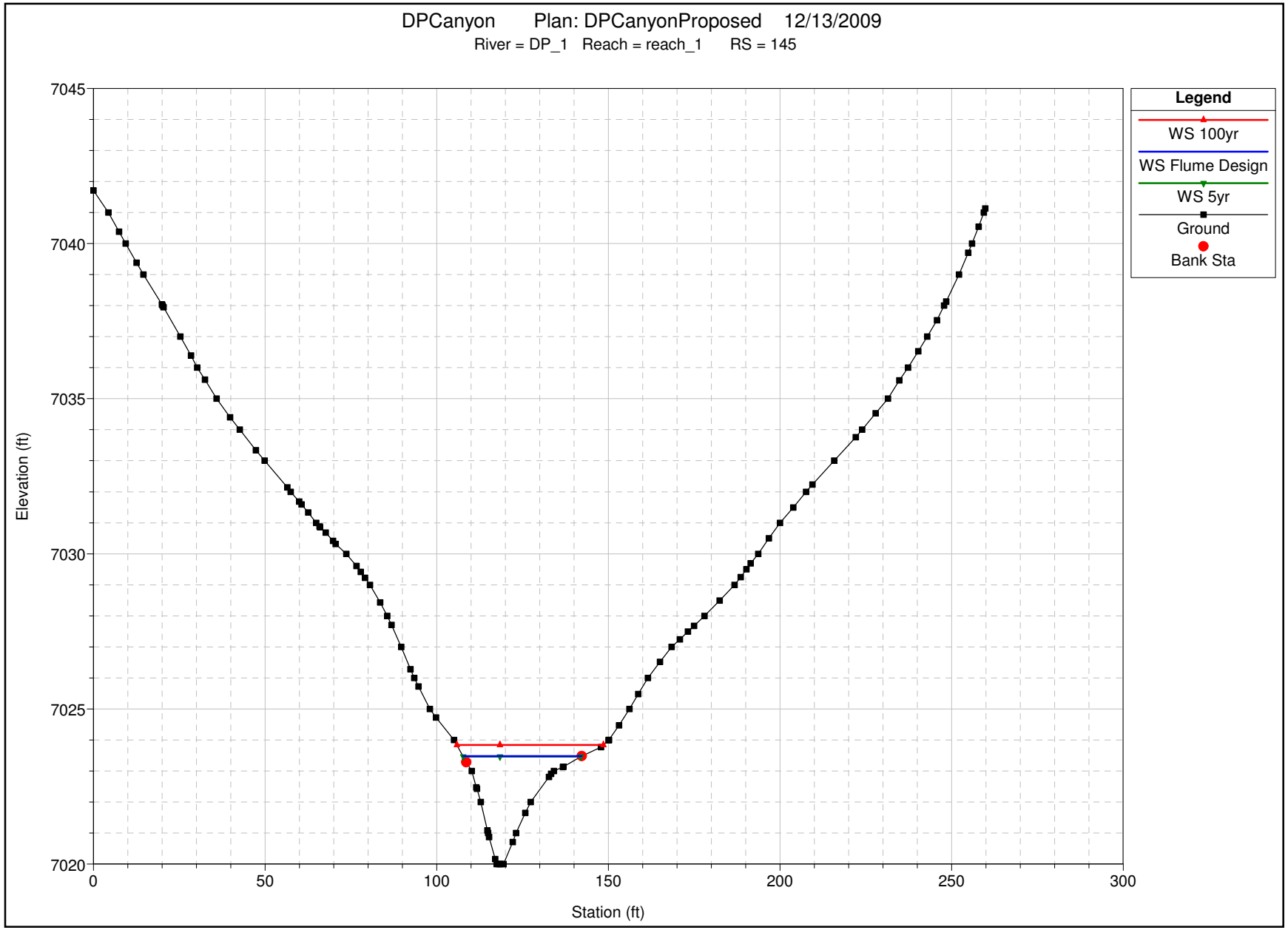
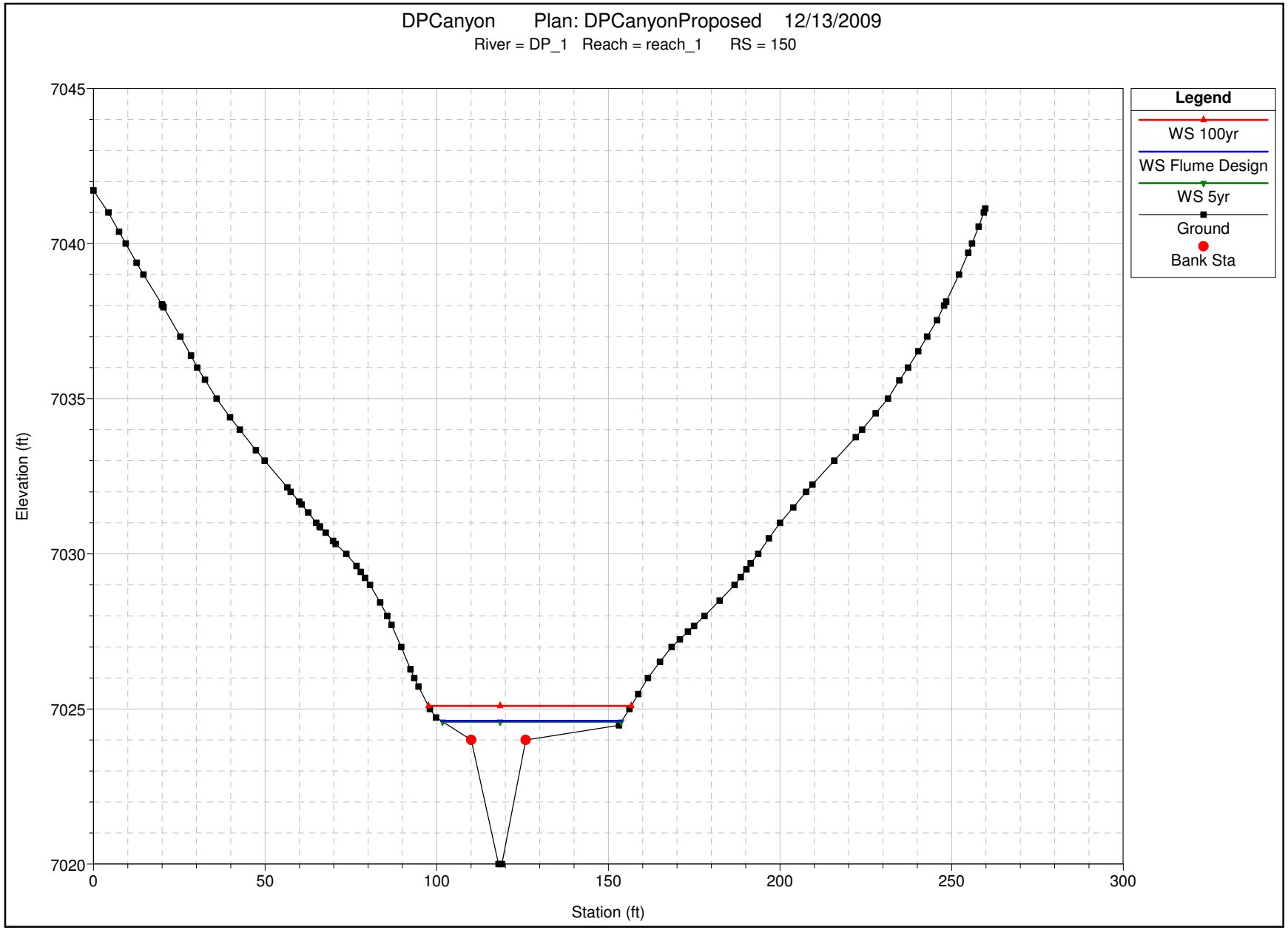
100.00
50.00
0.00
reach_1
DP_1

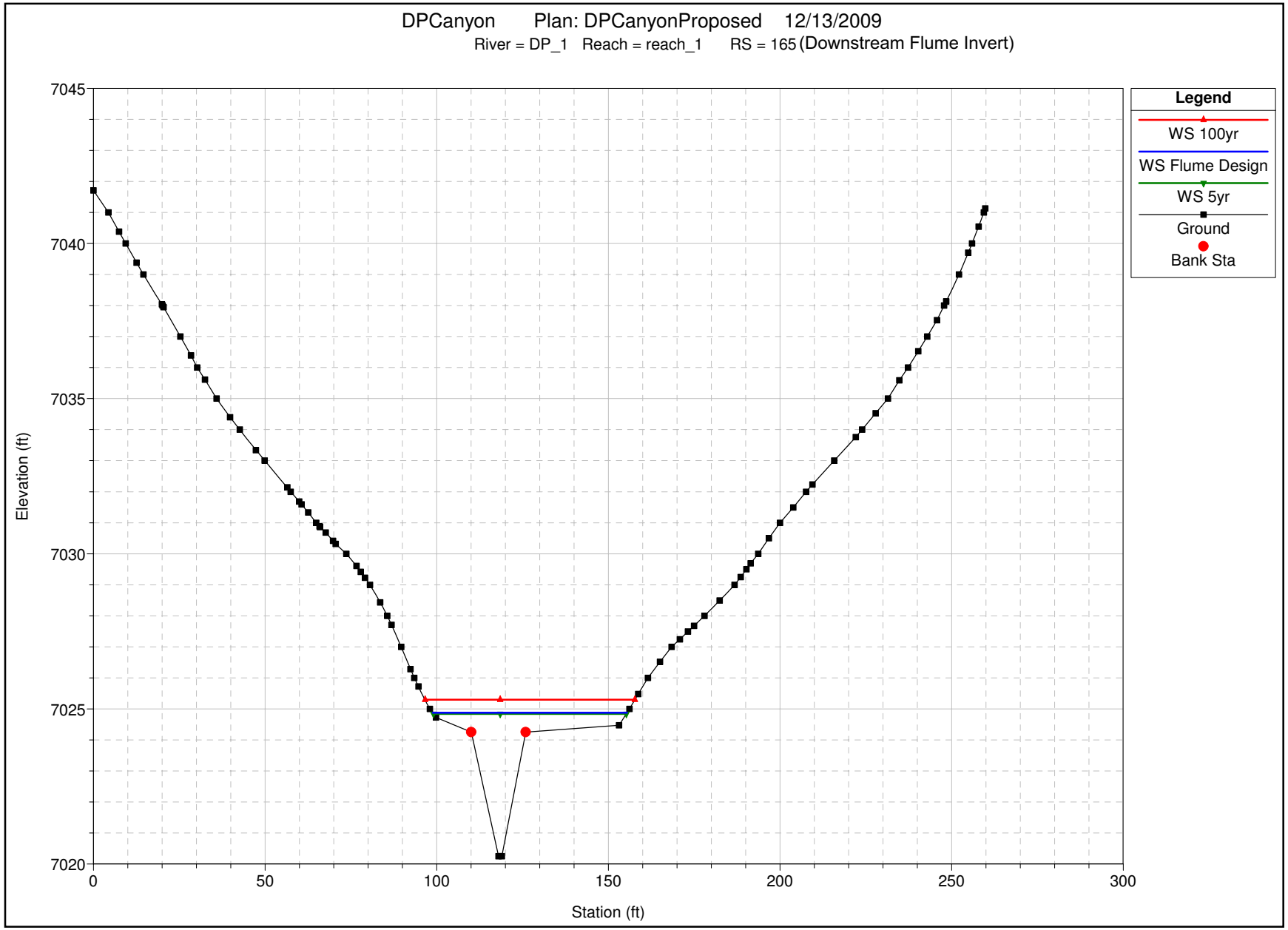

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 0.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
7015
0
50
100
150
200
250
300
Station (ft)

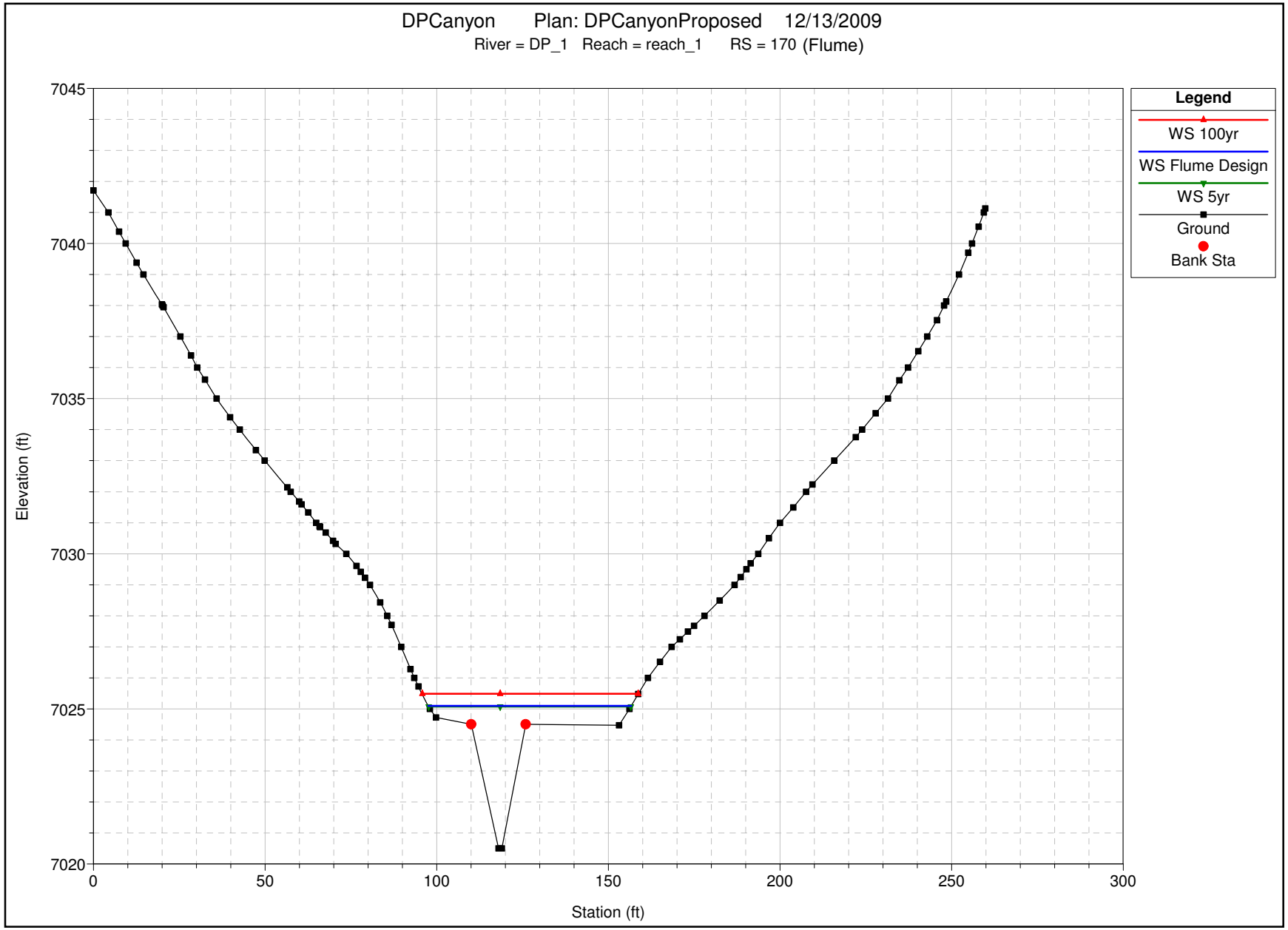

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 50.00 coordinates at station 115 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7040
7035
7030
7025
7020
7015
0
50
100
150
200
250
300

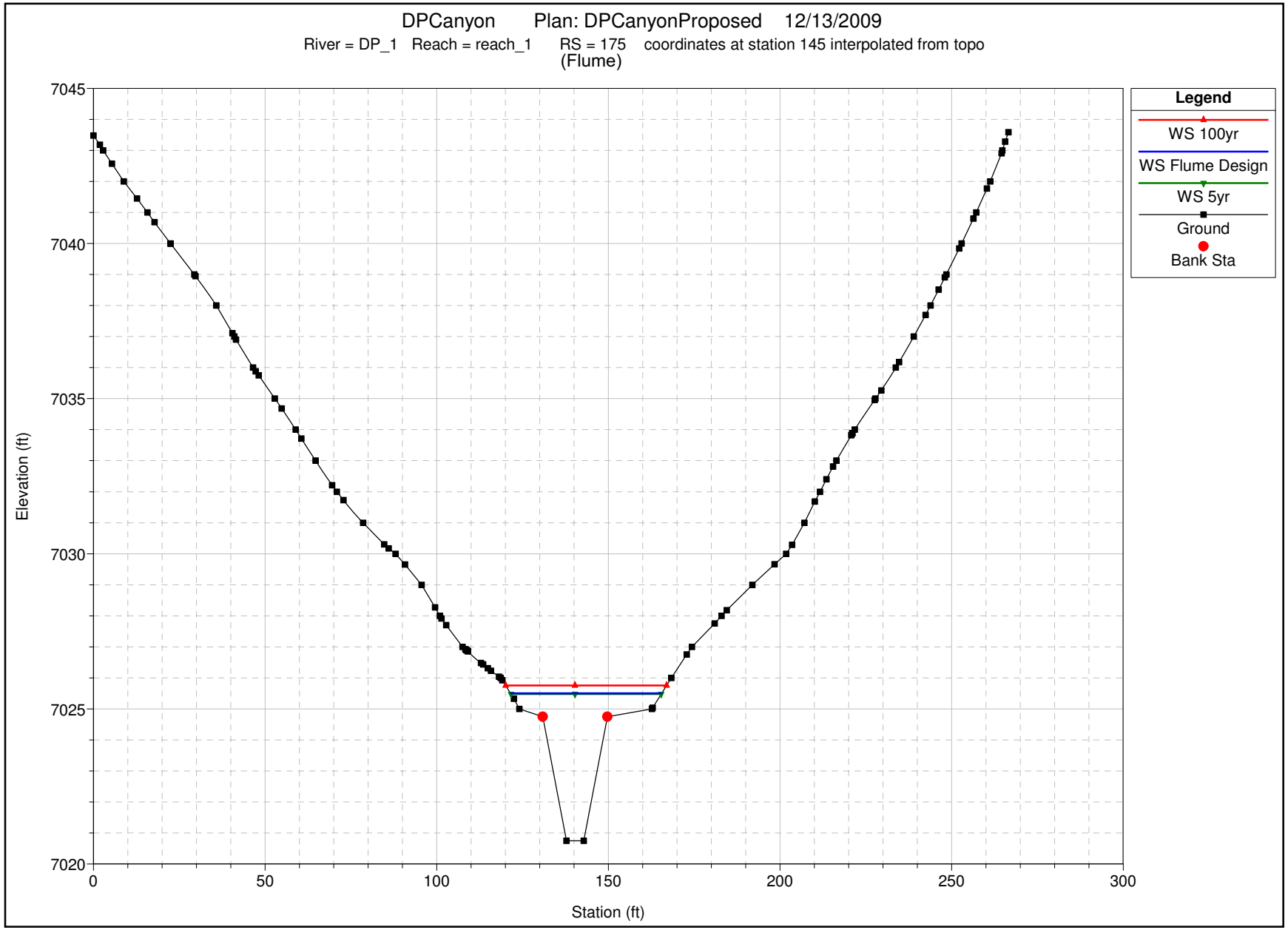

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 100.00 coordinates at station 129 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
7015
Station (ft)
0
50
100
150
200
250
300

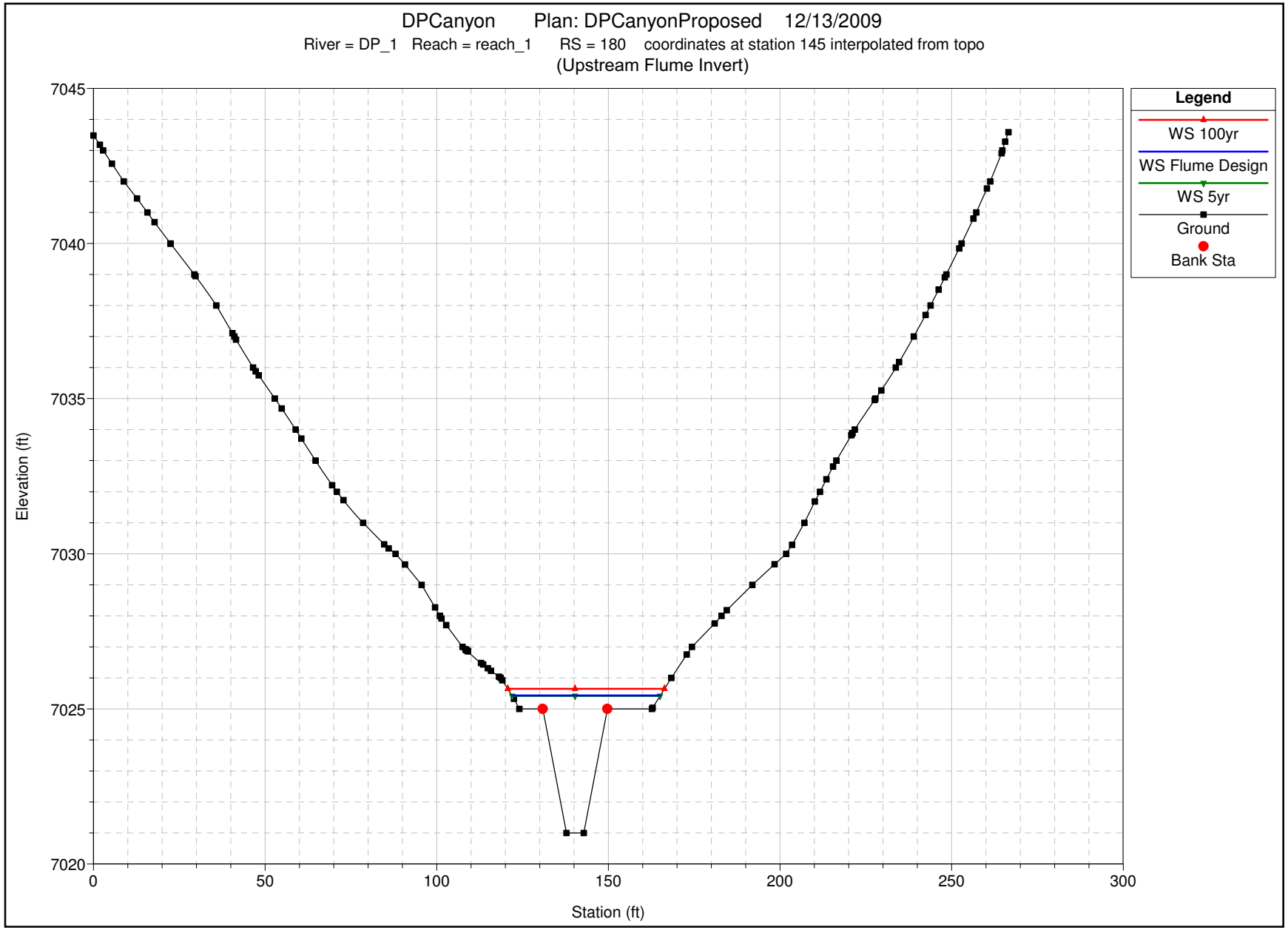

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 145
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
Station (ft)
0
50
100
150
200
250
300

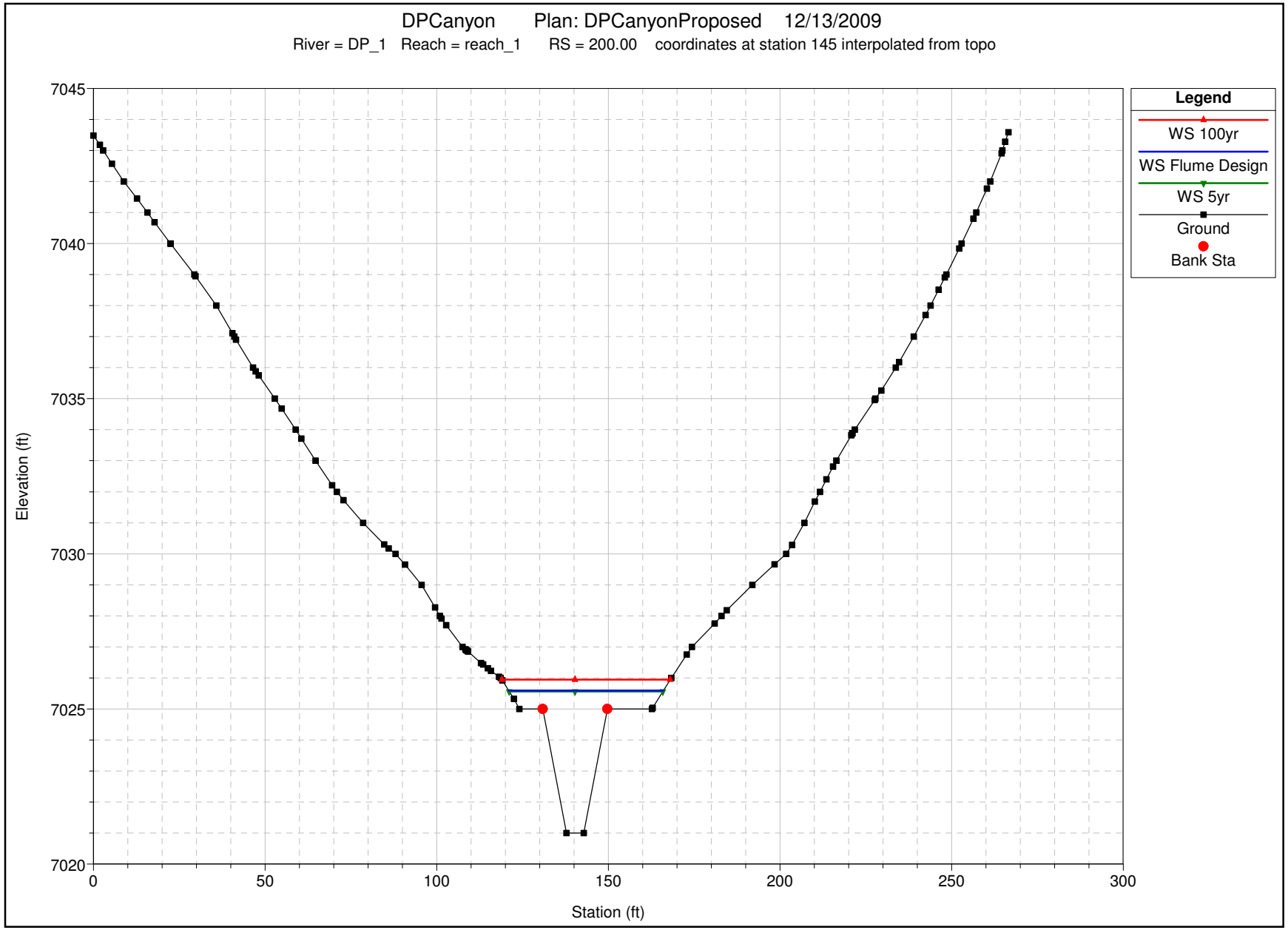

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 150
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300
Station (ft)

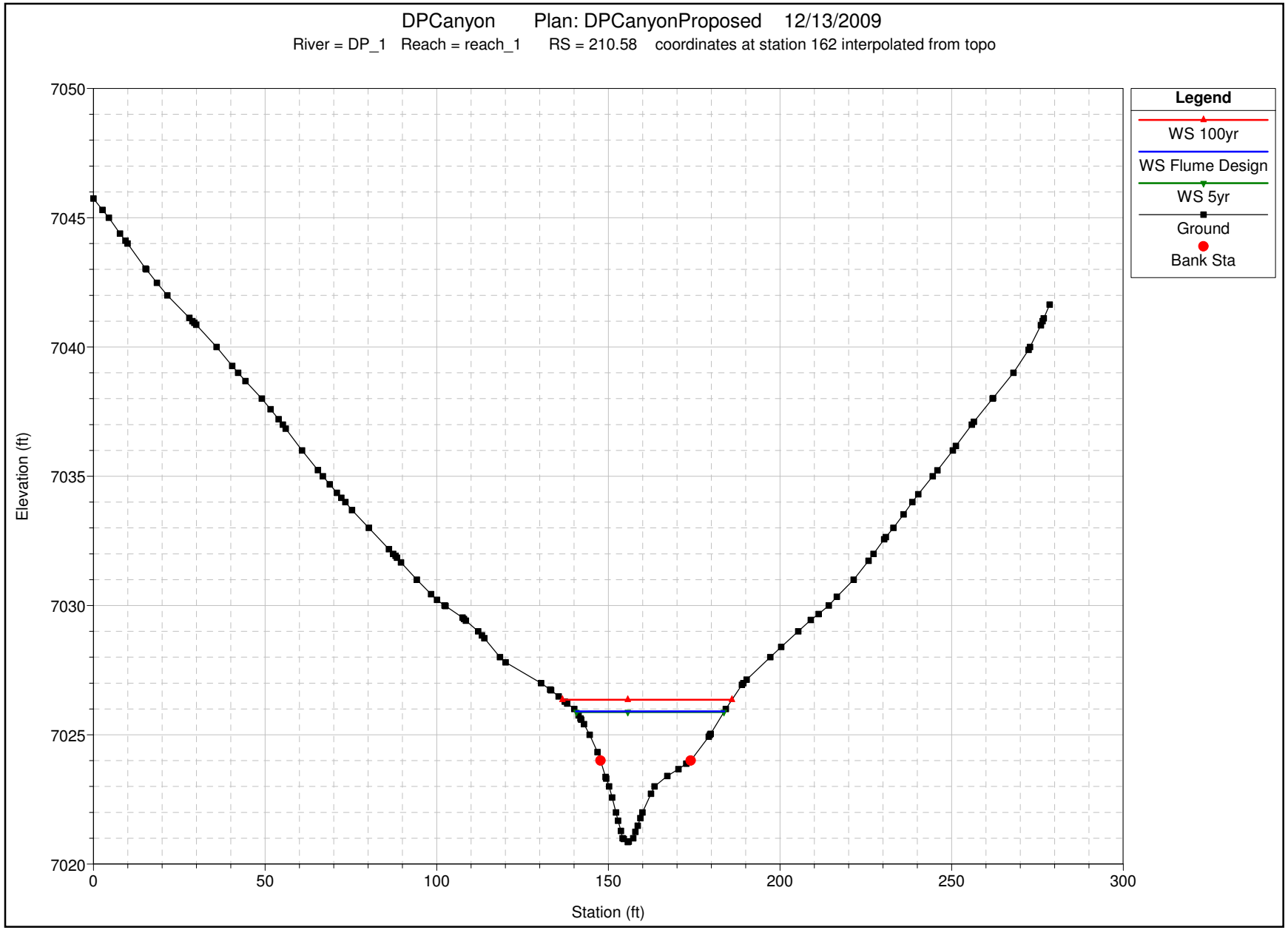

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 165 (Downstream Flume Invert)
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

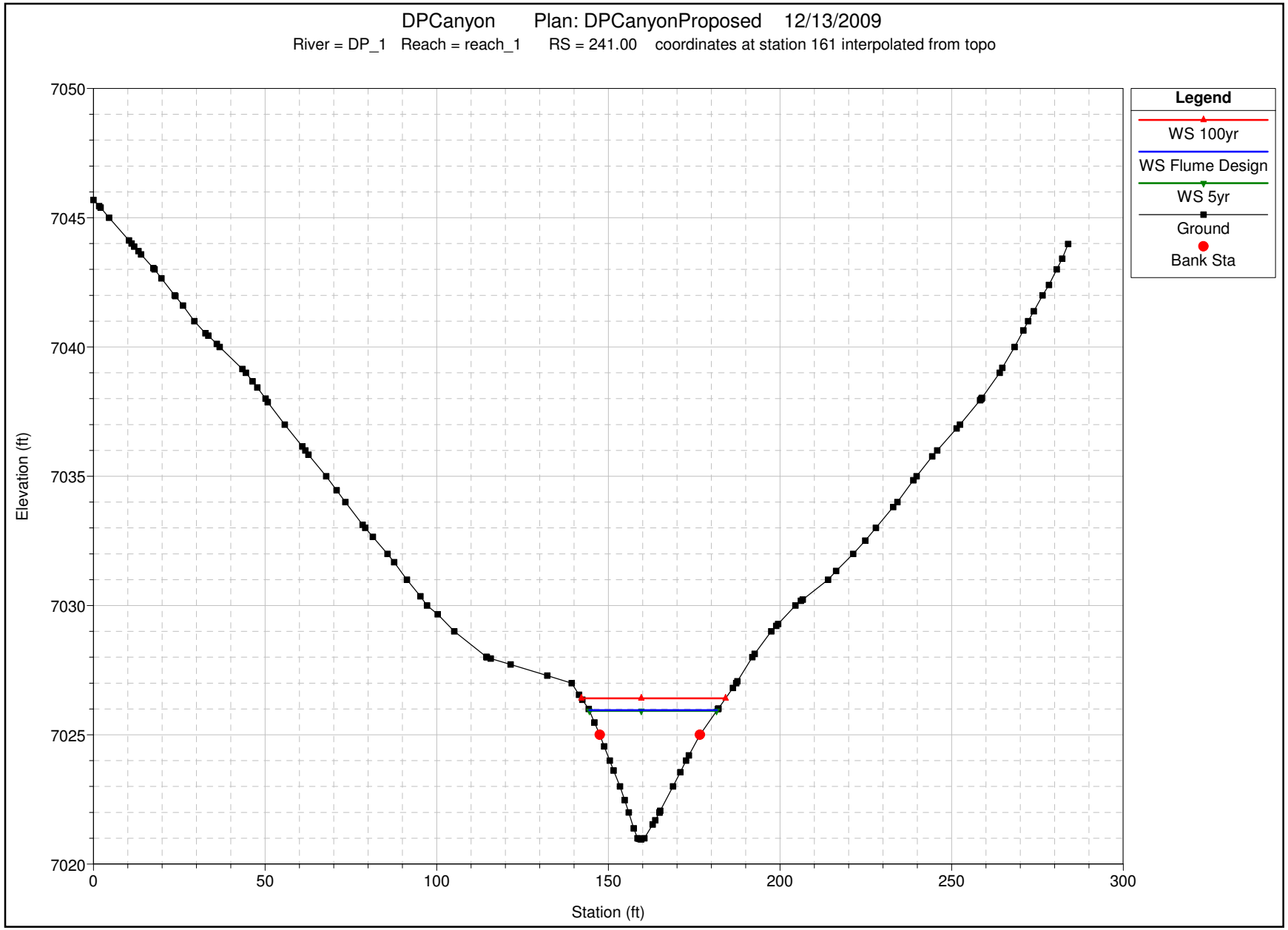

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 170 (Flume)
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

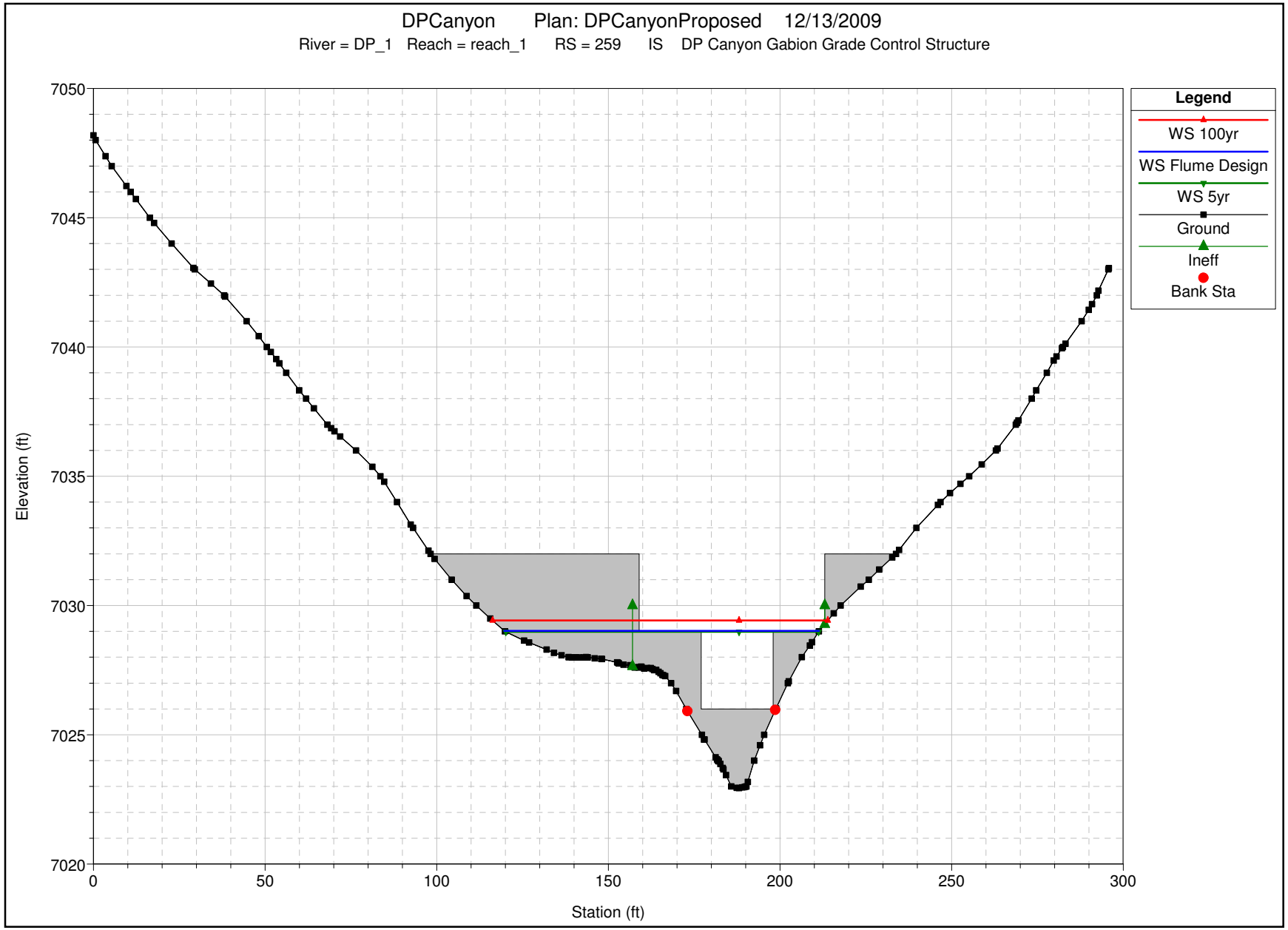

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 175 coordinates at station 145 interpolated from topo
(Flume)
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

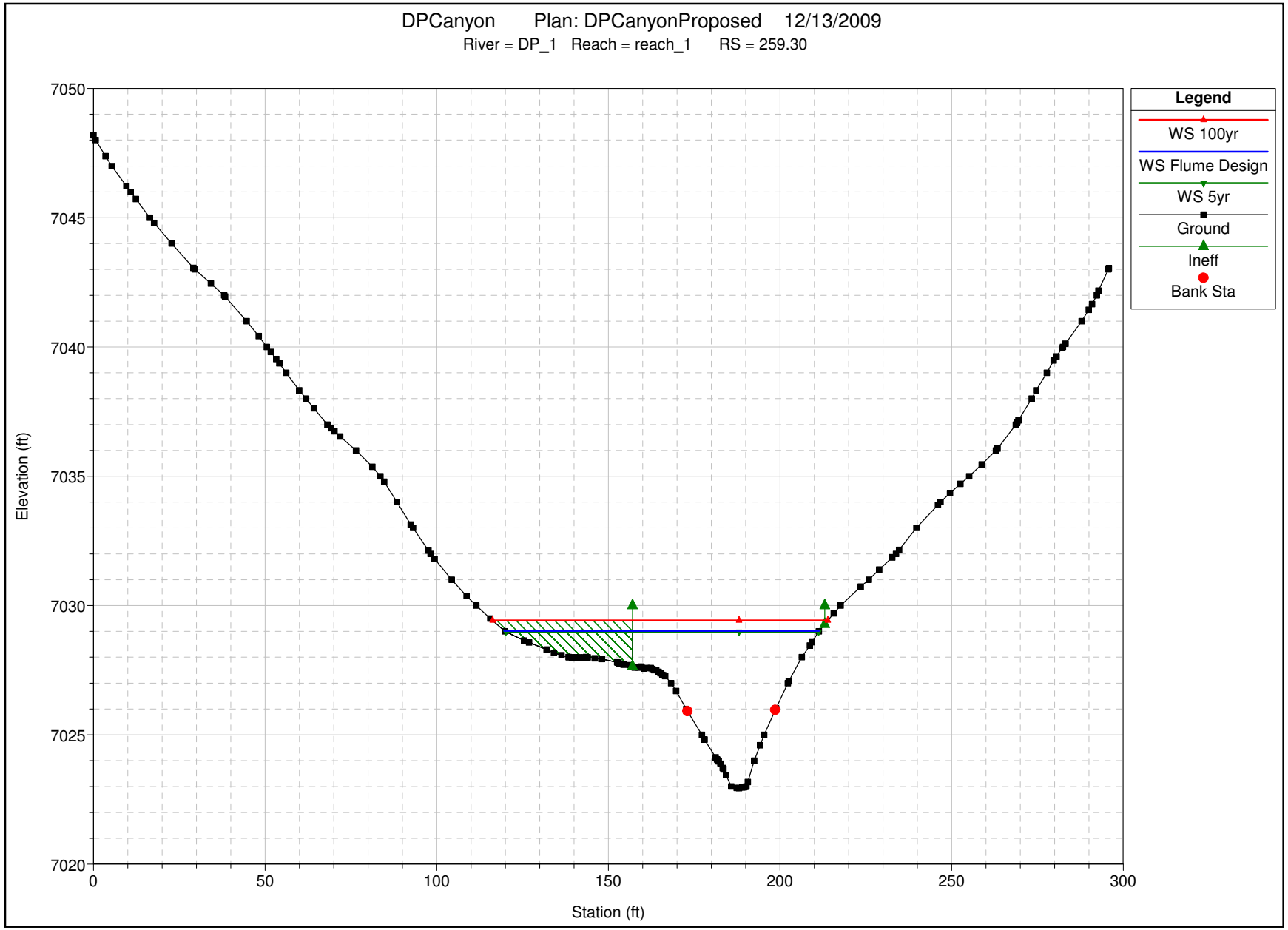

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 180 coordinates at station 145 interpolated from topo
(Upstream Flume Invert)
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
Station (ft)
0
50
100
150
200
250
300

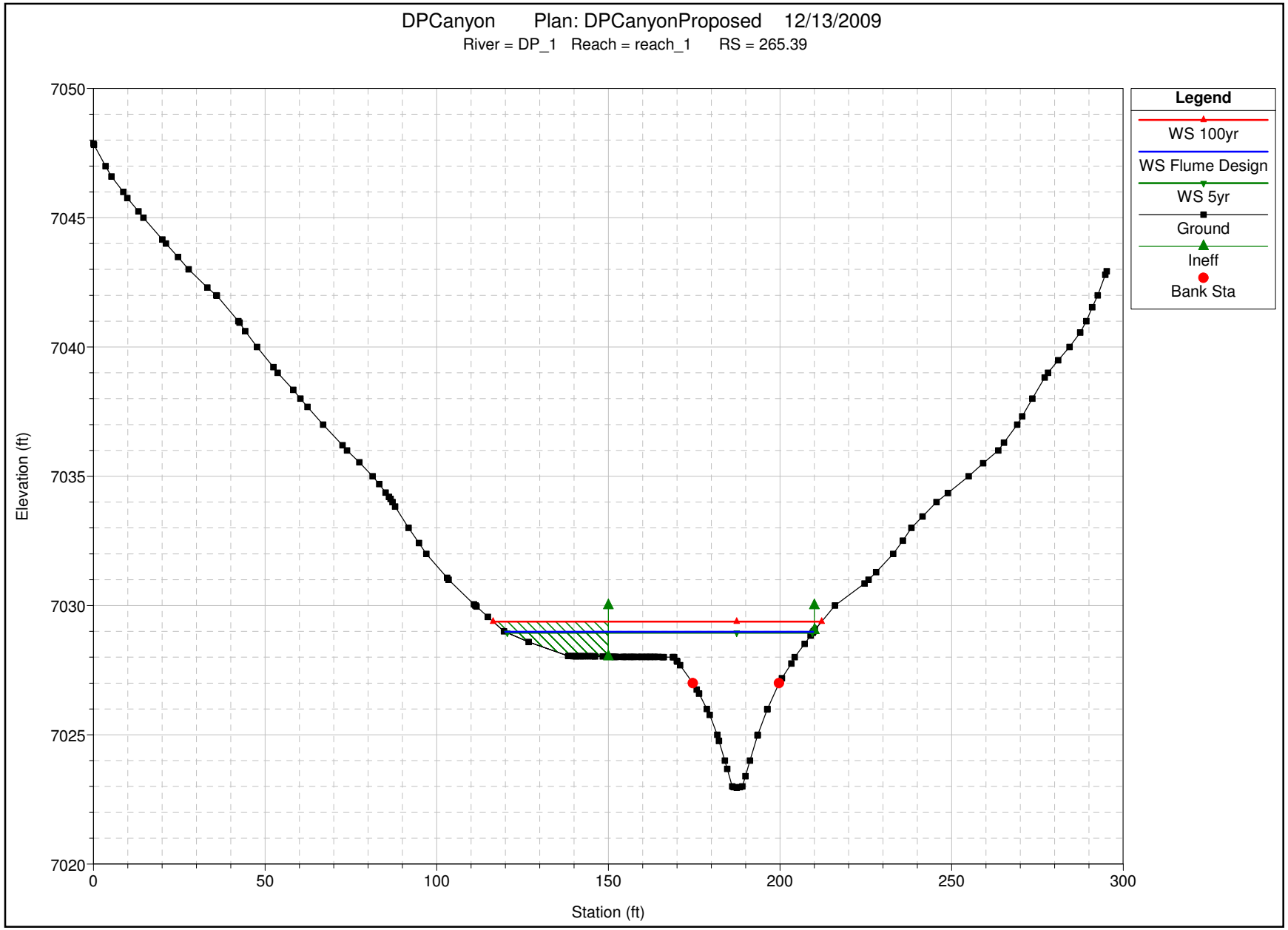

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 200.00 coordinates at station 145 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

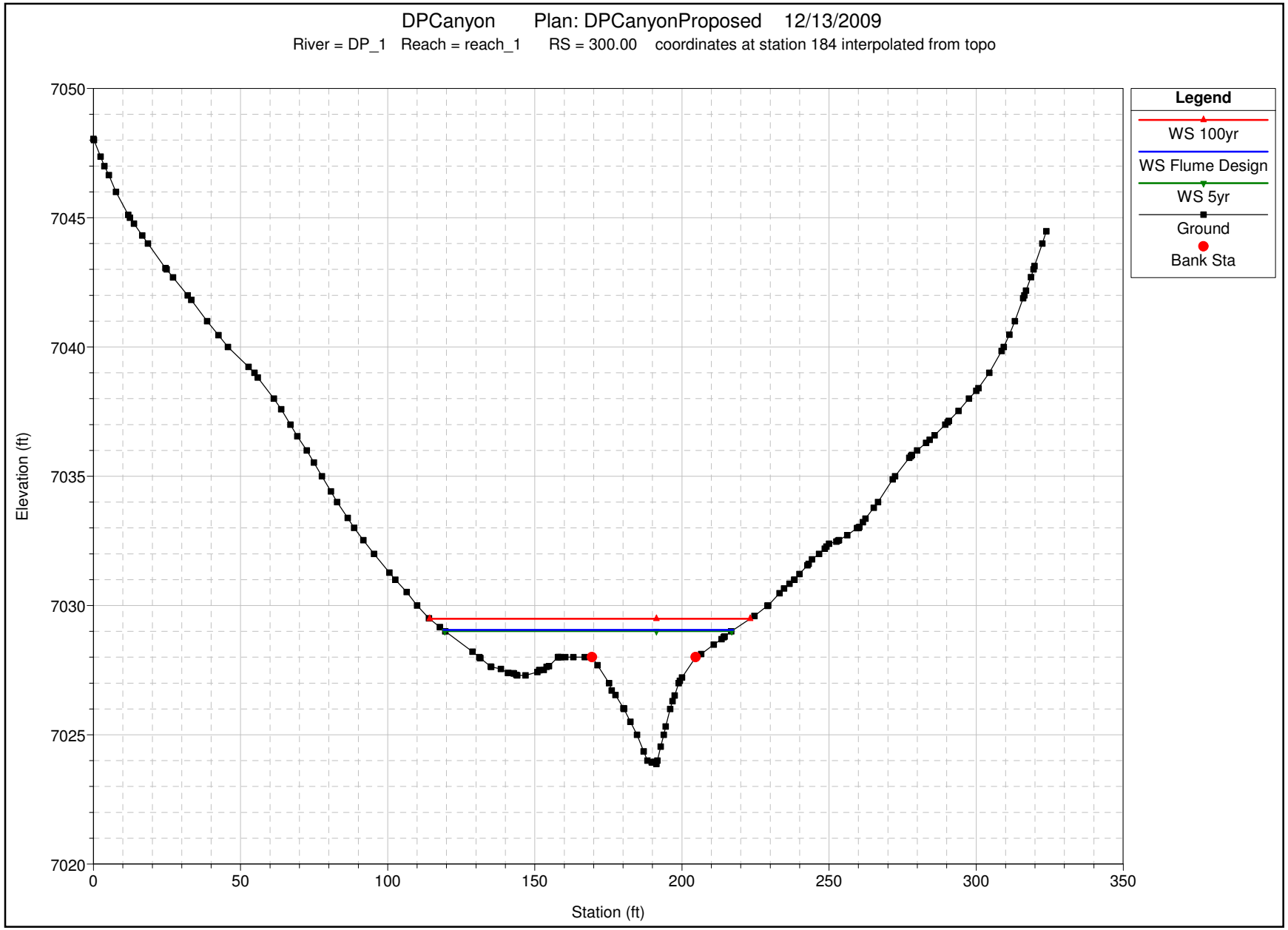

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 210.58 coordinates at station 162 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

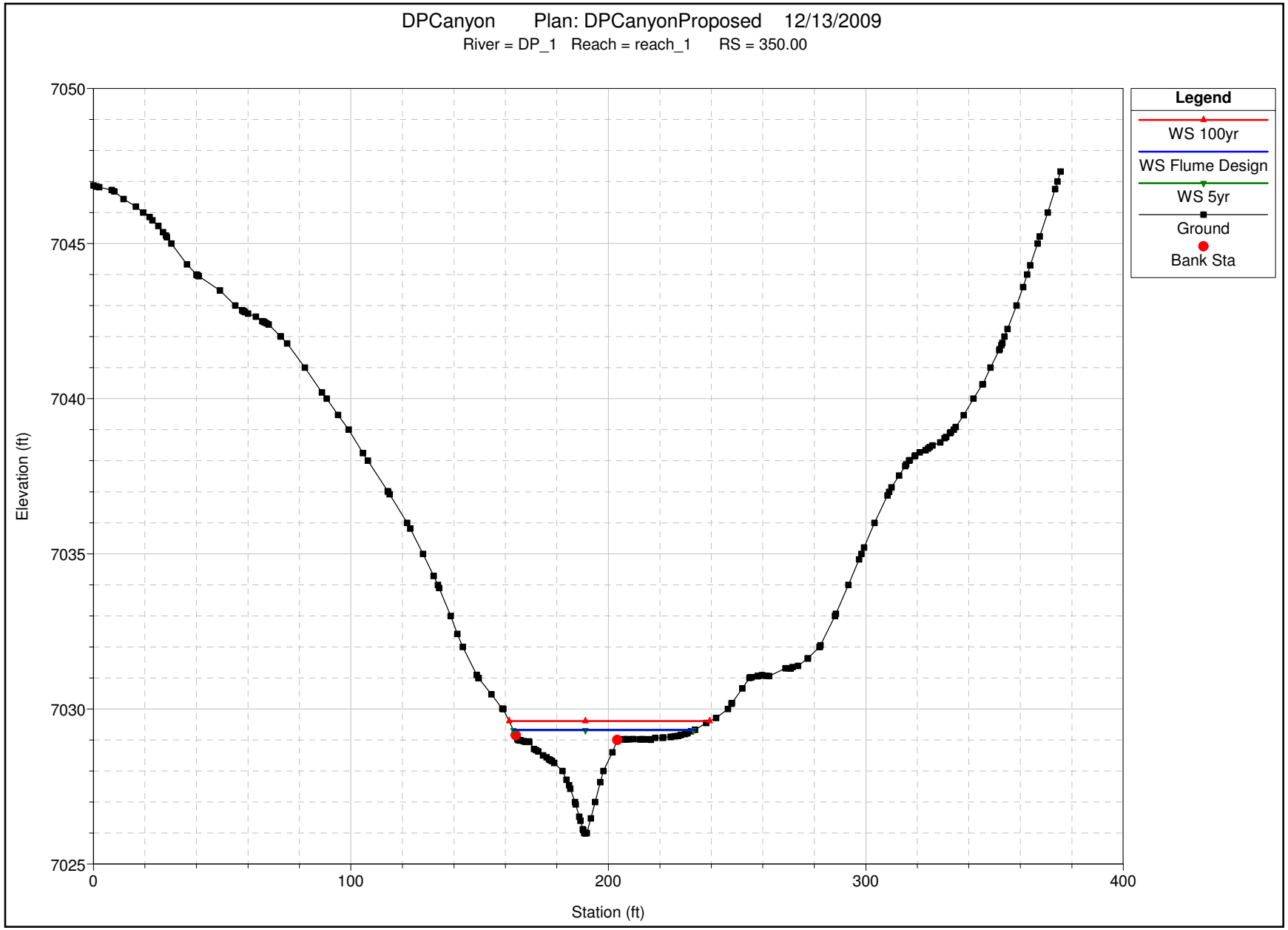

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 241.00 coordinates at station 161 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

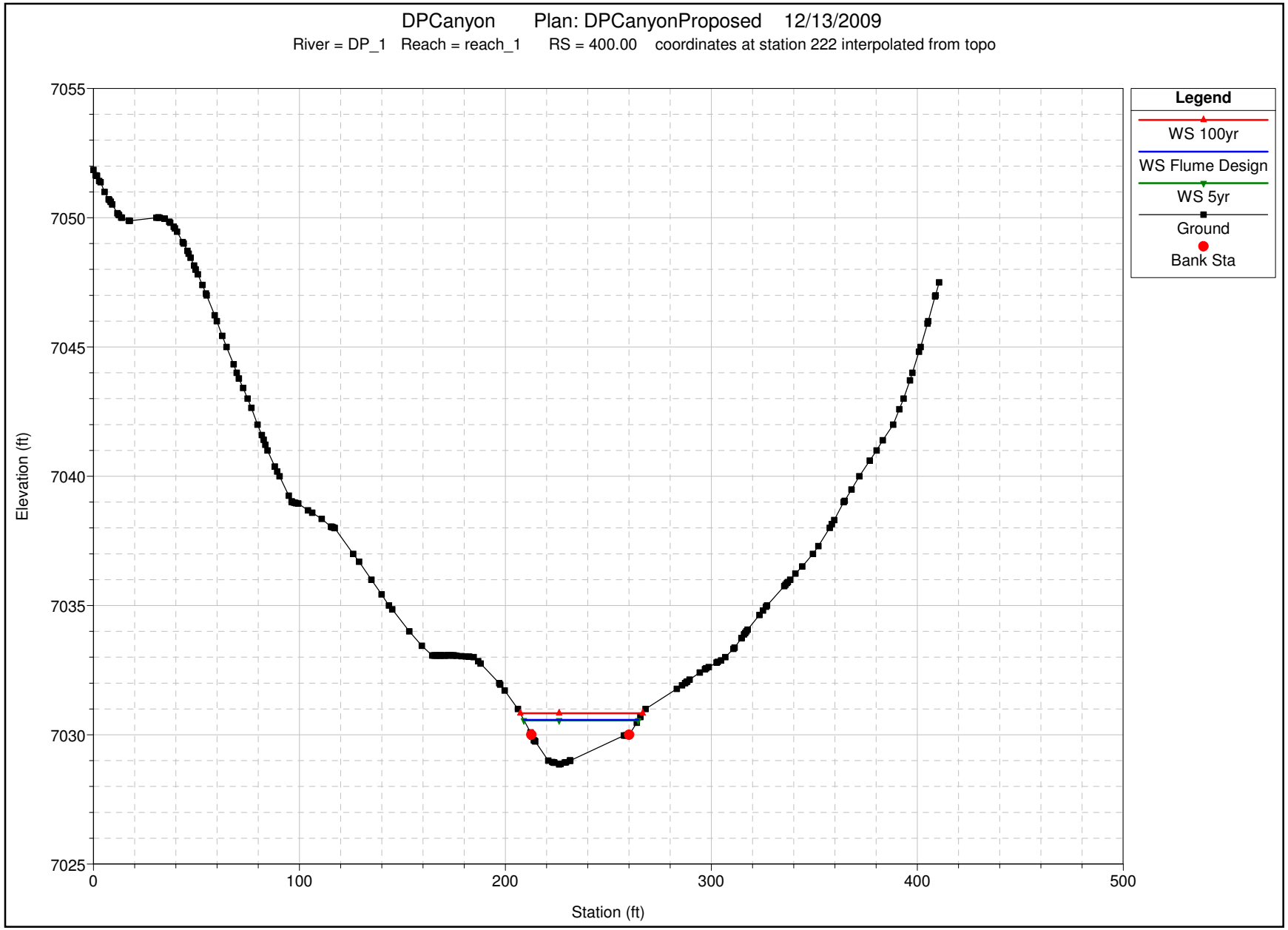

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 259 IS DP Canyon Gabion Grade Control Structure
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

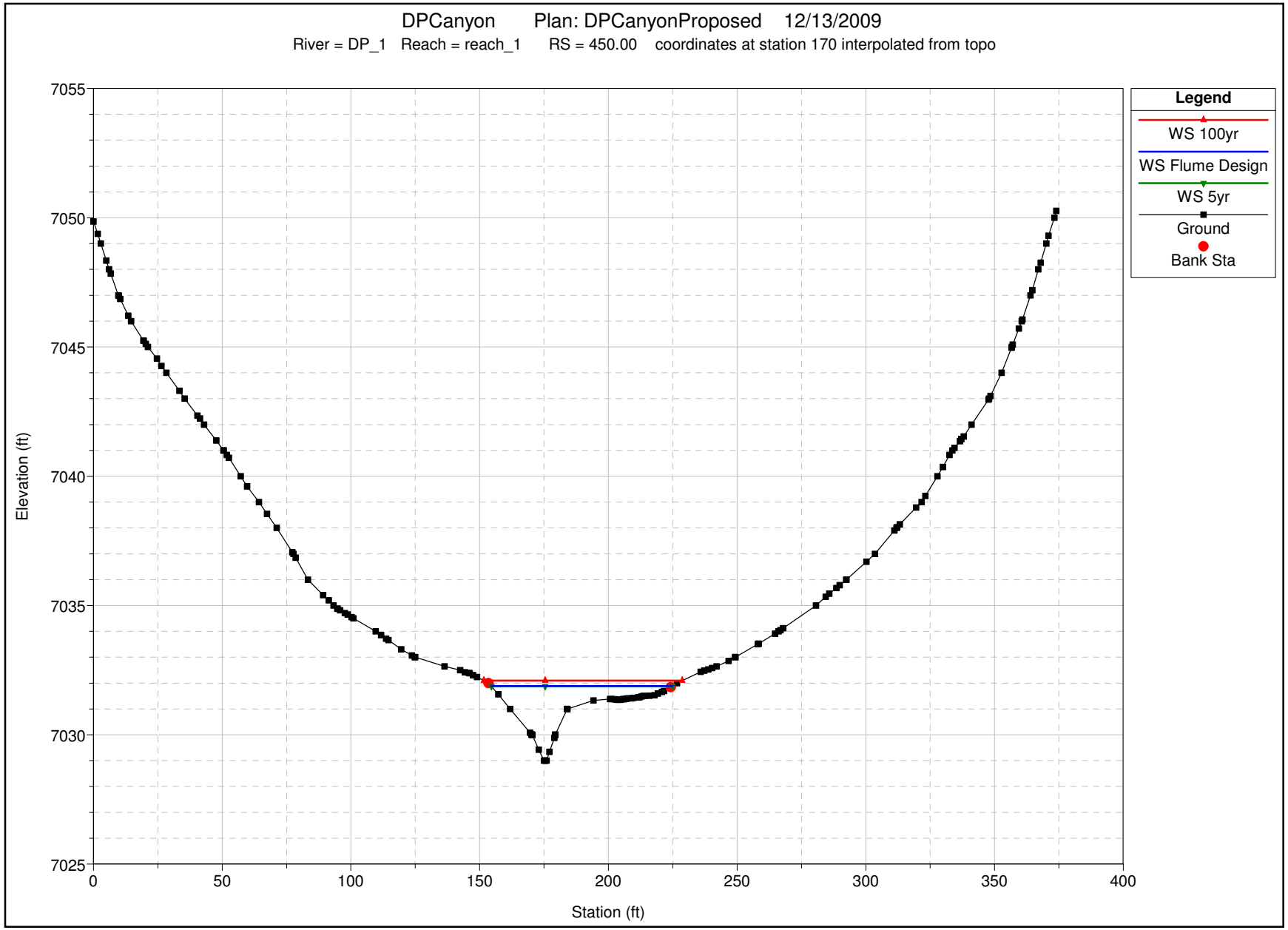

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 259.30
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

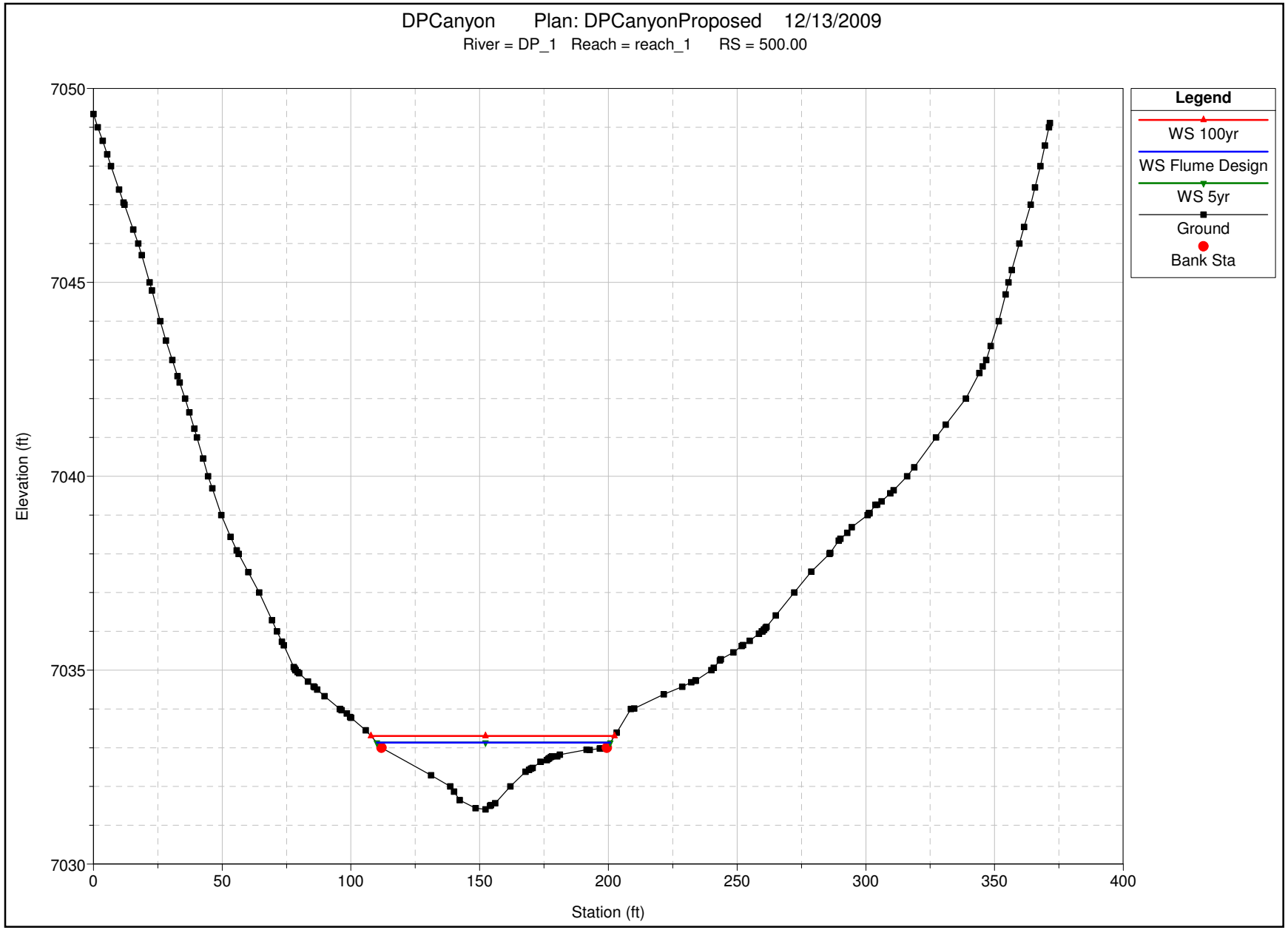

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 265.39
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Ineff
Bank Sta
Elevation (ft)
7050
7045
7040
7035
7030
7025
7020
Station (ft)
0
50
100
150
200
250
300

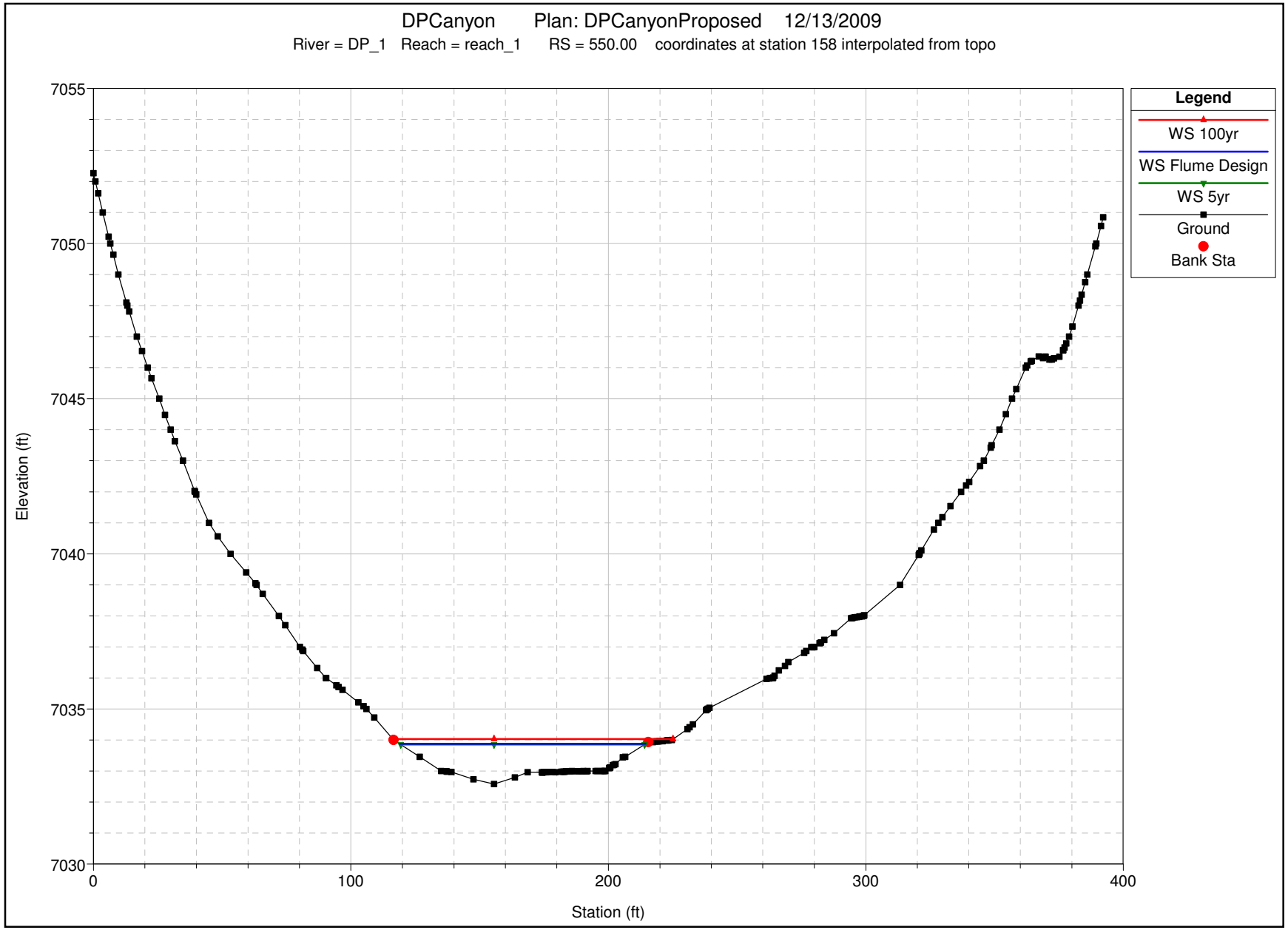

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 300.00 coordinates at station 184 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300
350

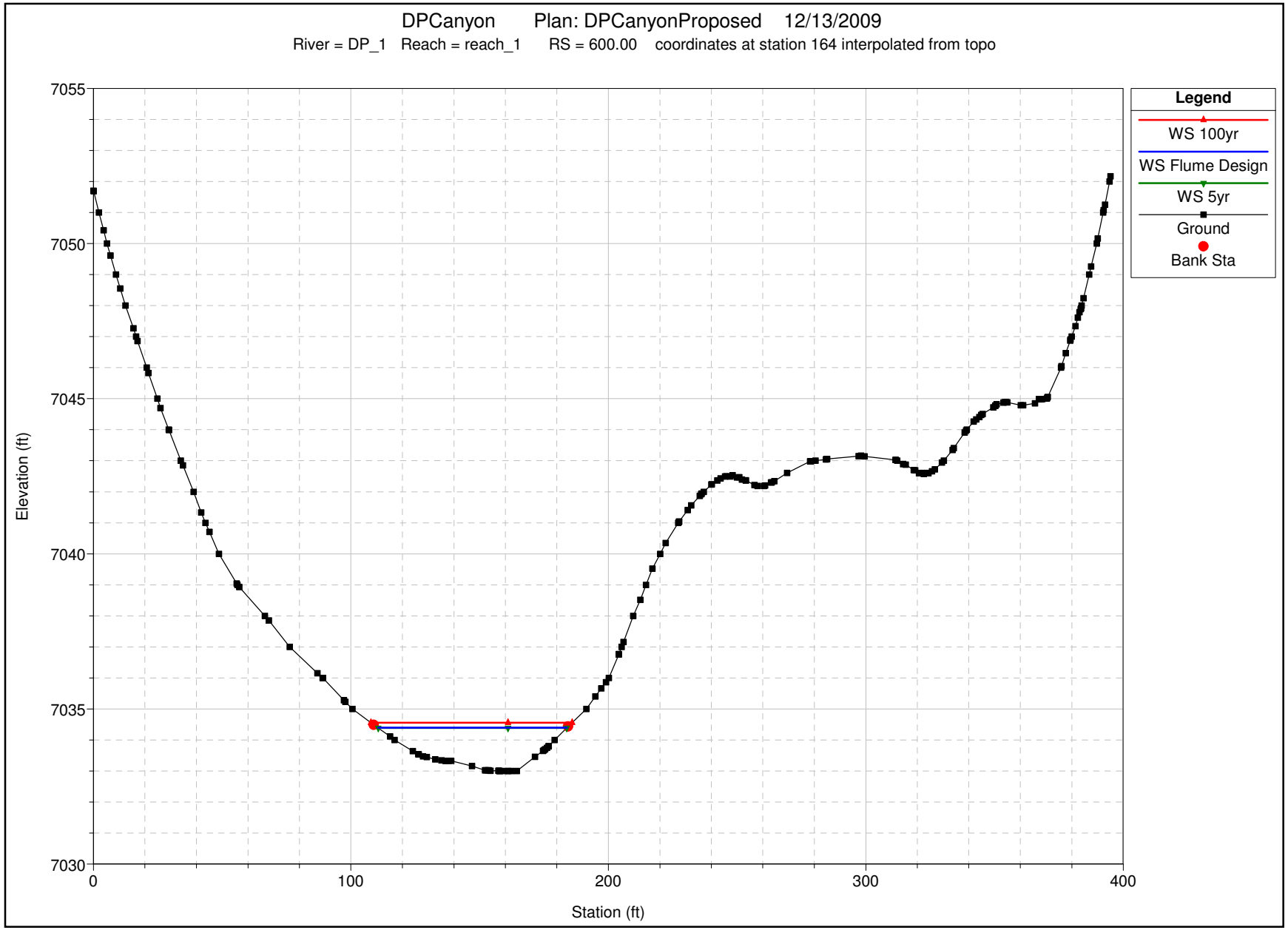

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 350.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7050
7045
7040
7035
7030
7025
Station (ft)
0
100
200
300
400

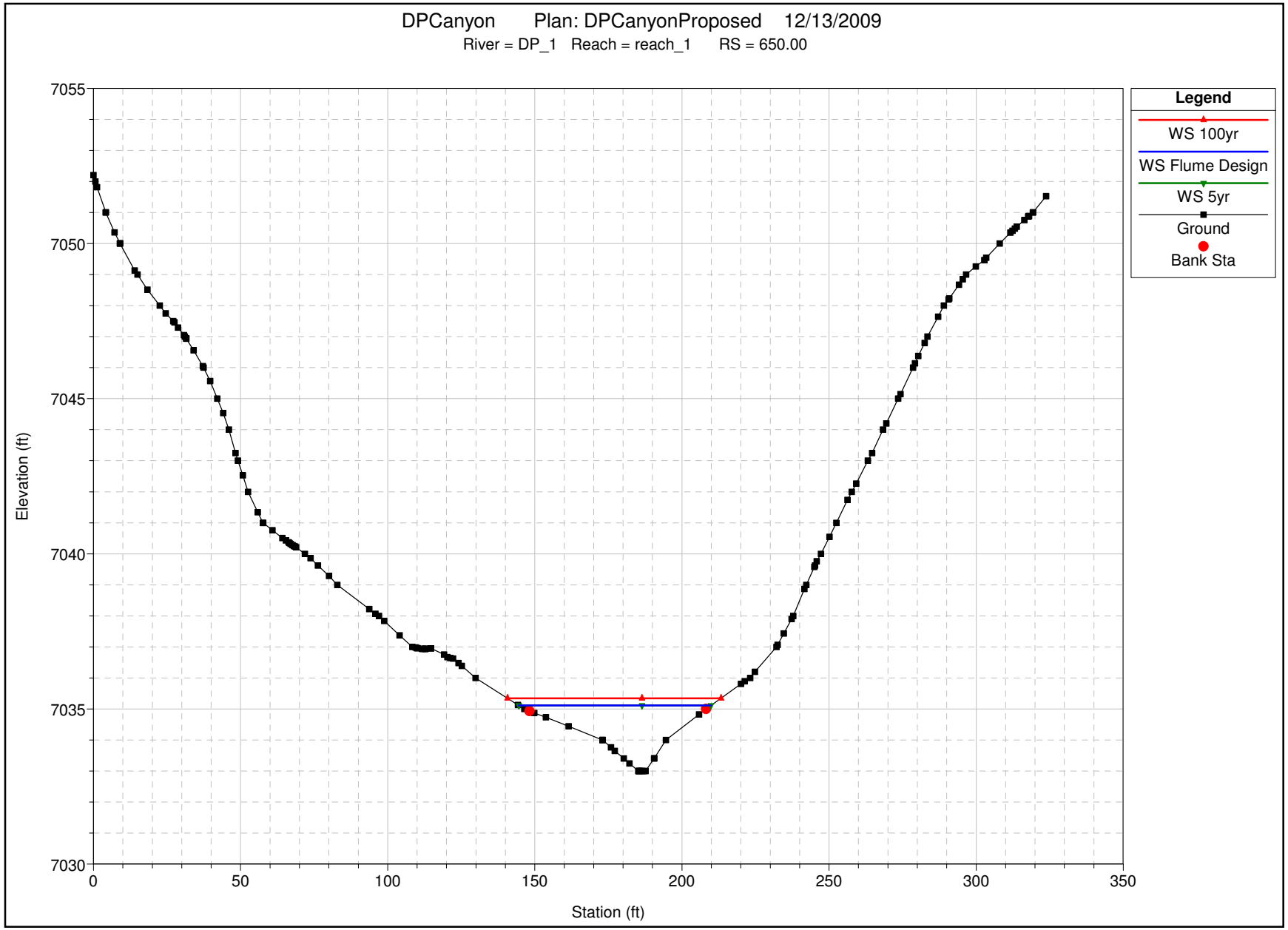

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 400.00 coordinates at station 222 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
7050
7045
7040
7035
7030
7025
0
100
200
300
400
500
Station (ft)

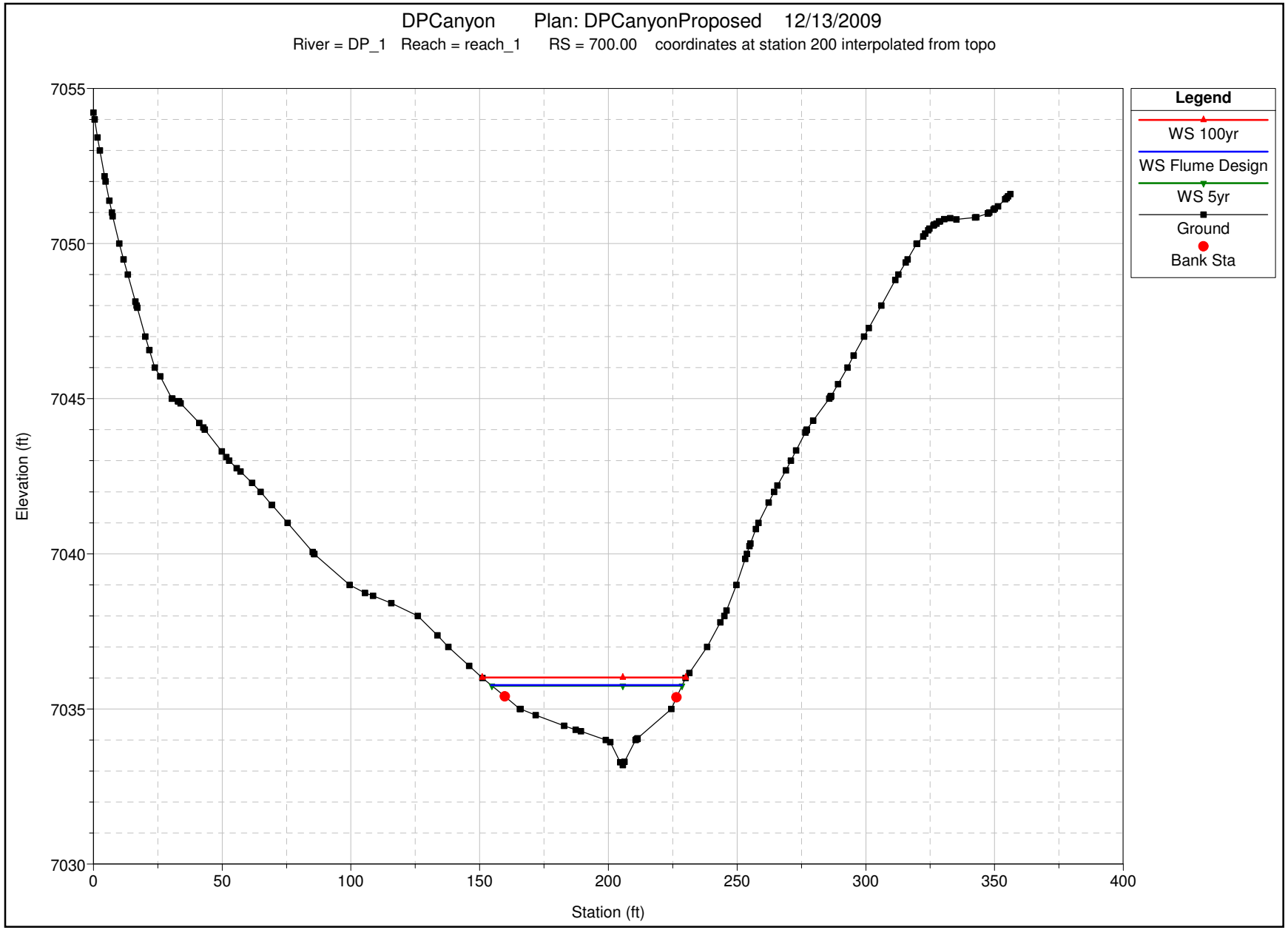

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 450.00 coordinates at station 170 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7055
7050
7045
7040
7035
7030
7025
0
50
100
150
200
250
300
350
400

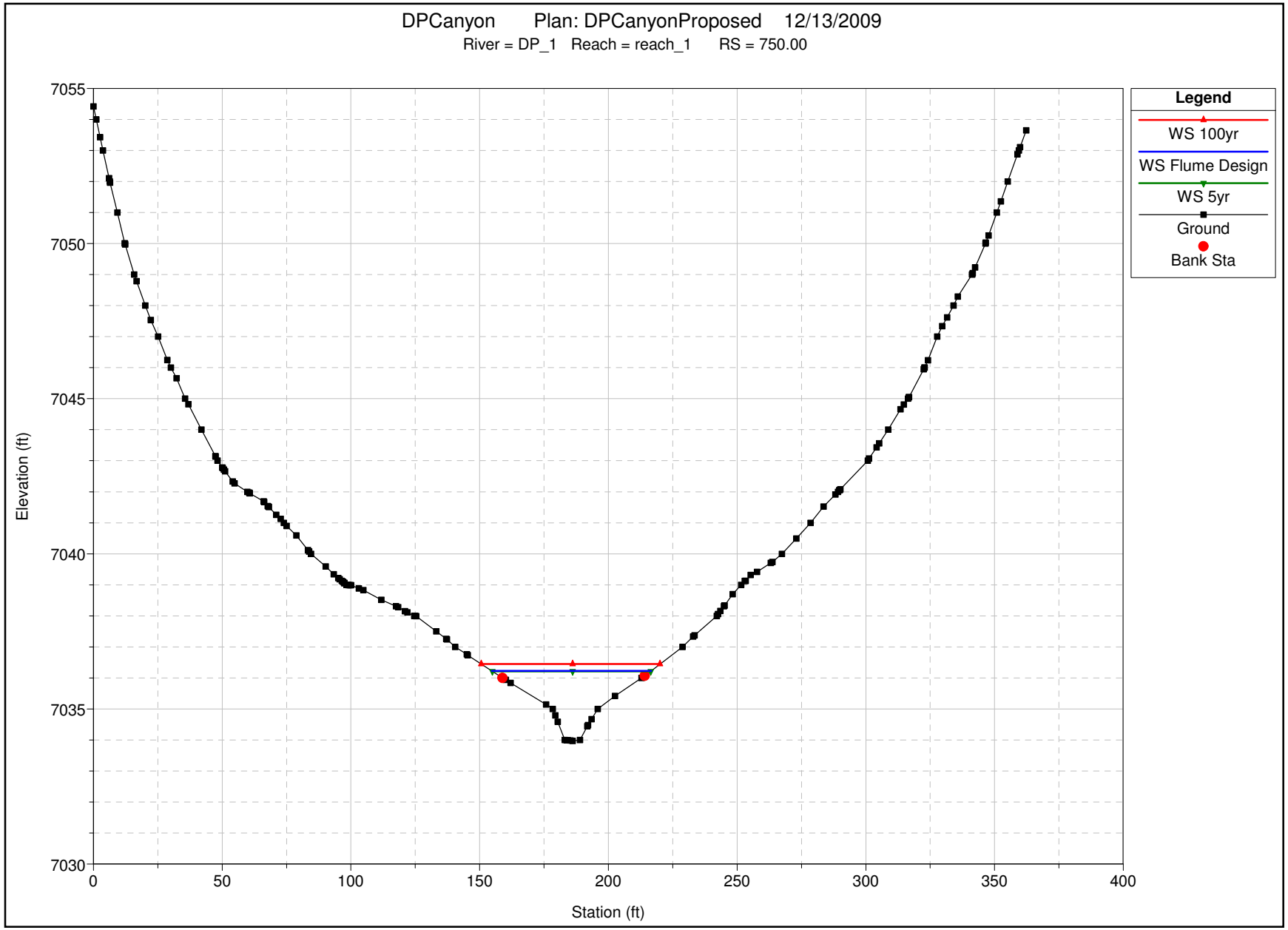

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 500.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7050
7045
7040
7035
7030
Station (ft)
0
50
100
150
200
250
300
350
400

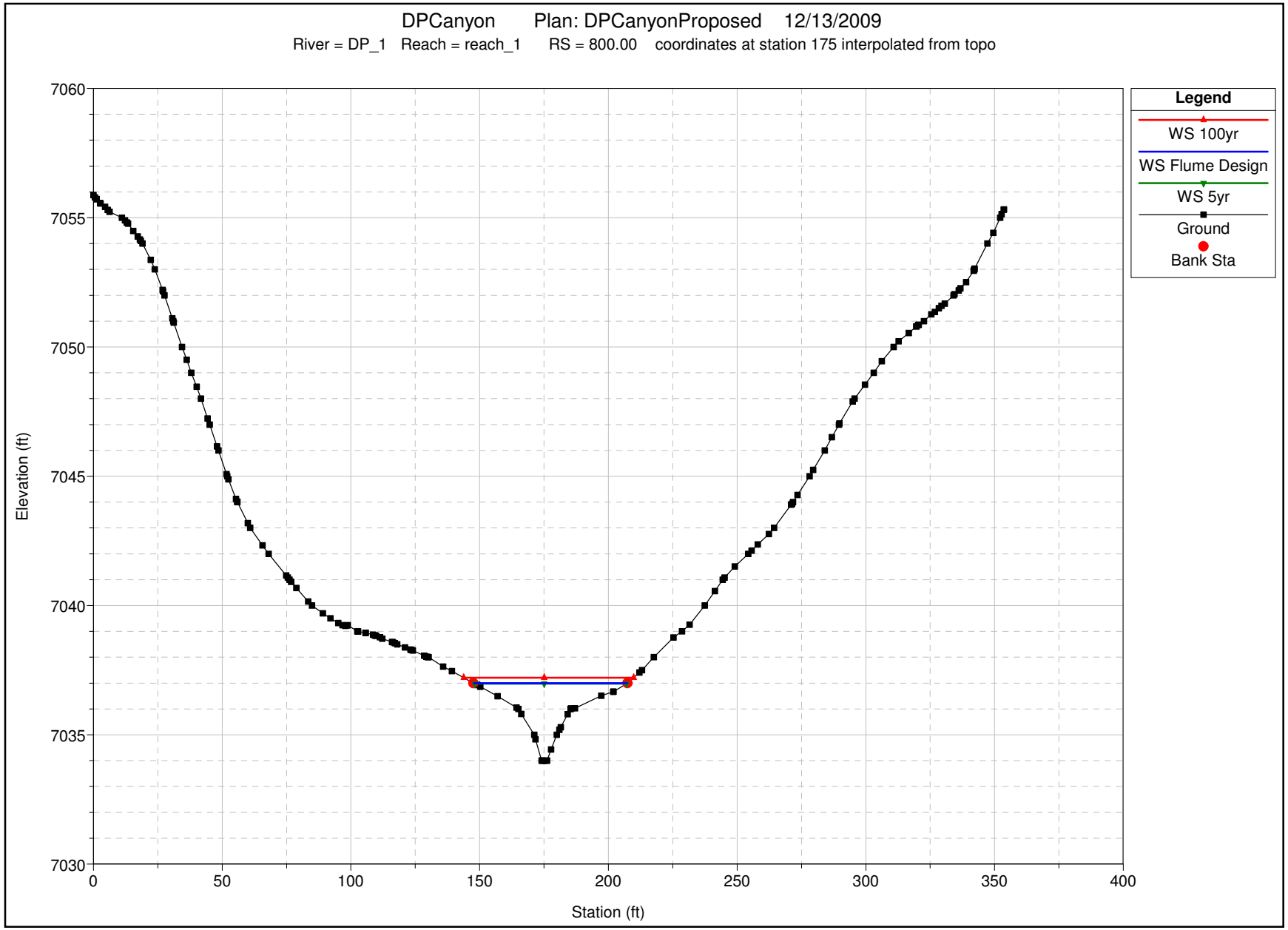

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 550.00 coordinates at station 158 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
7050
7045
7040
7035
7030
Station (ft)
0
100
200
300
400

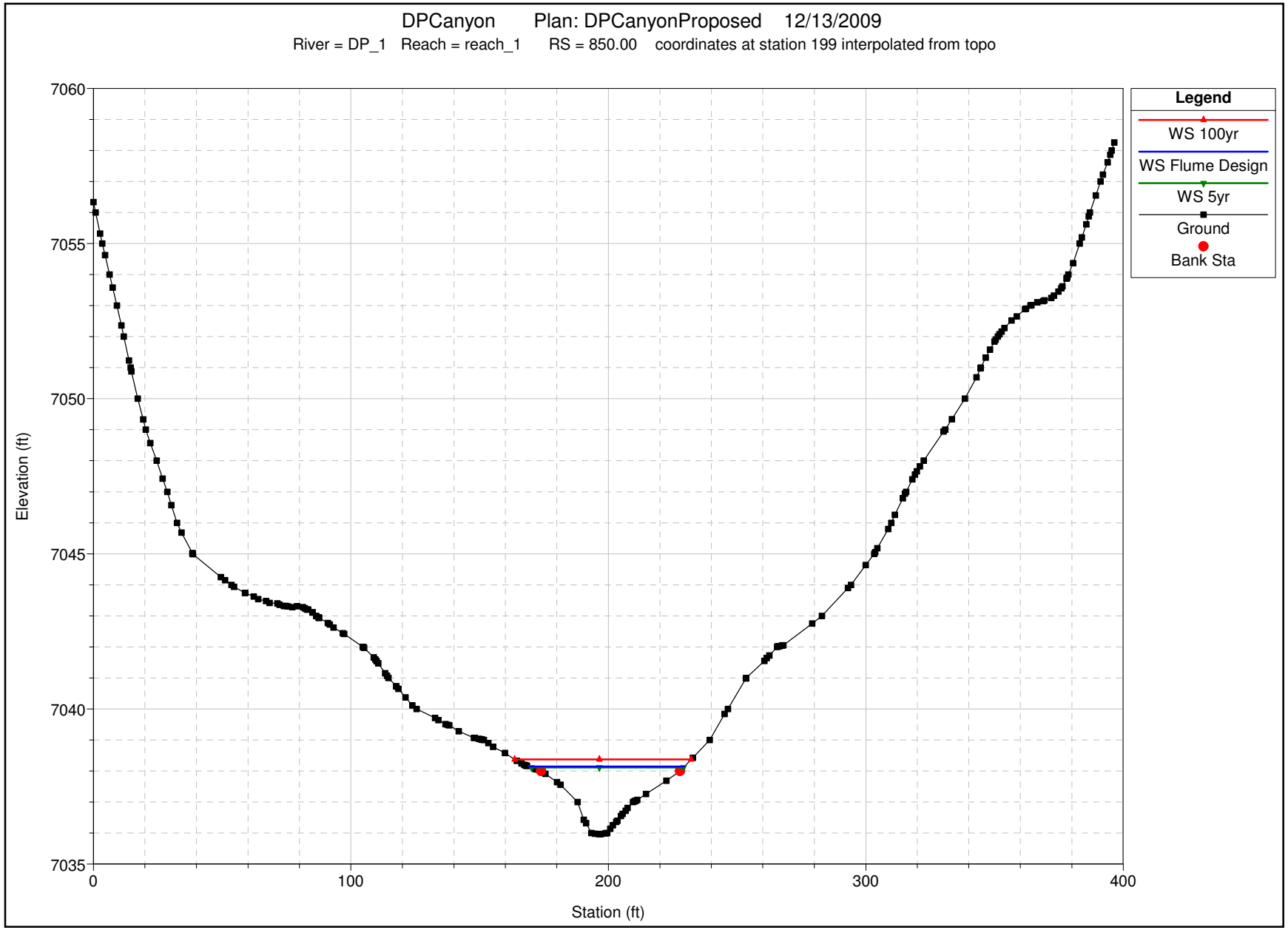

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 600.00 coordinates at station 164 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7055
7050
7045
7040
7035
7030
0
100
200
300
400

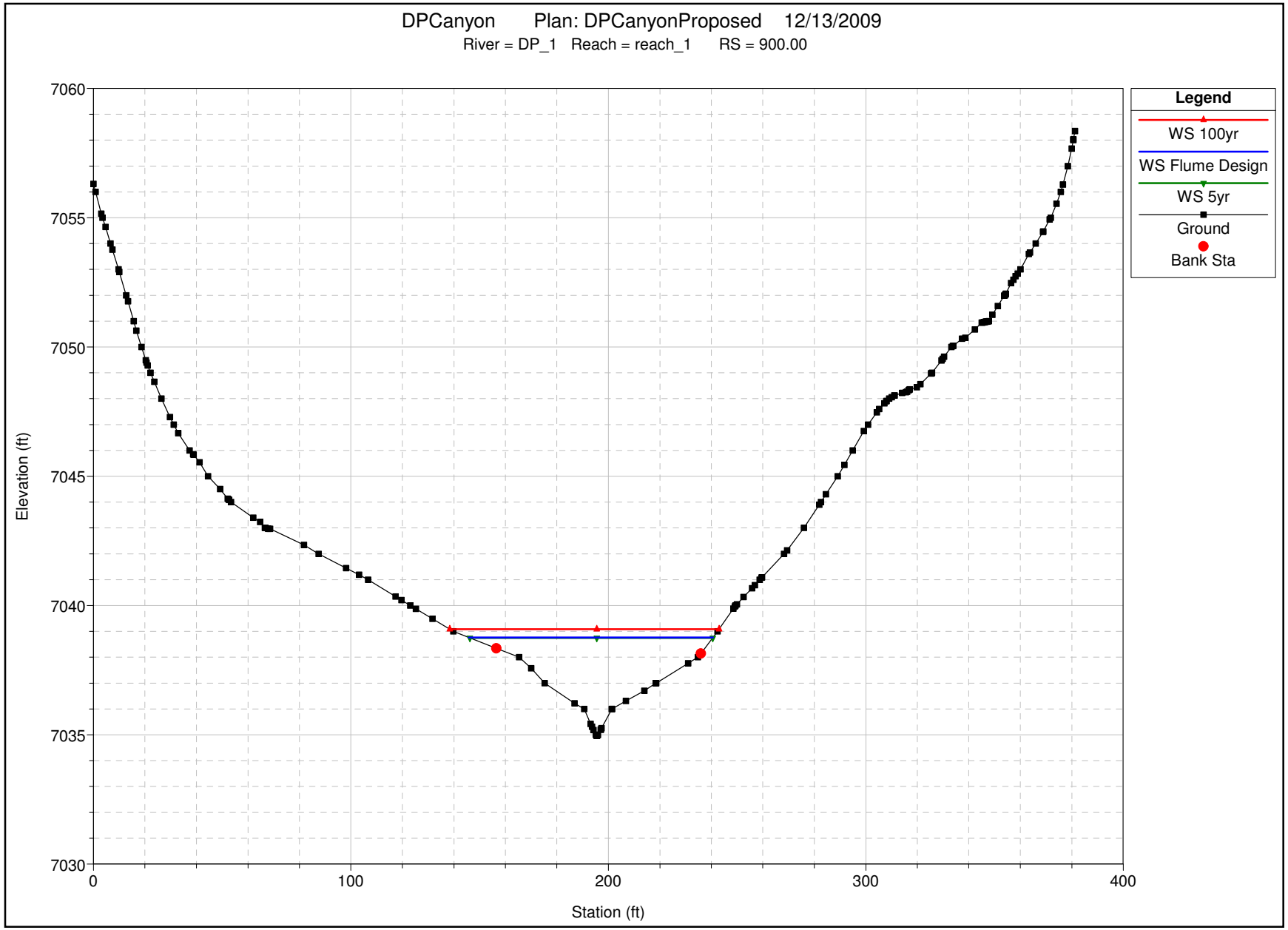

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 650.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7055
7050
7045
7040
7035
7030
0
50
100
150
200
250
300
350

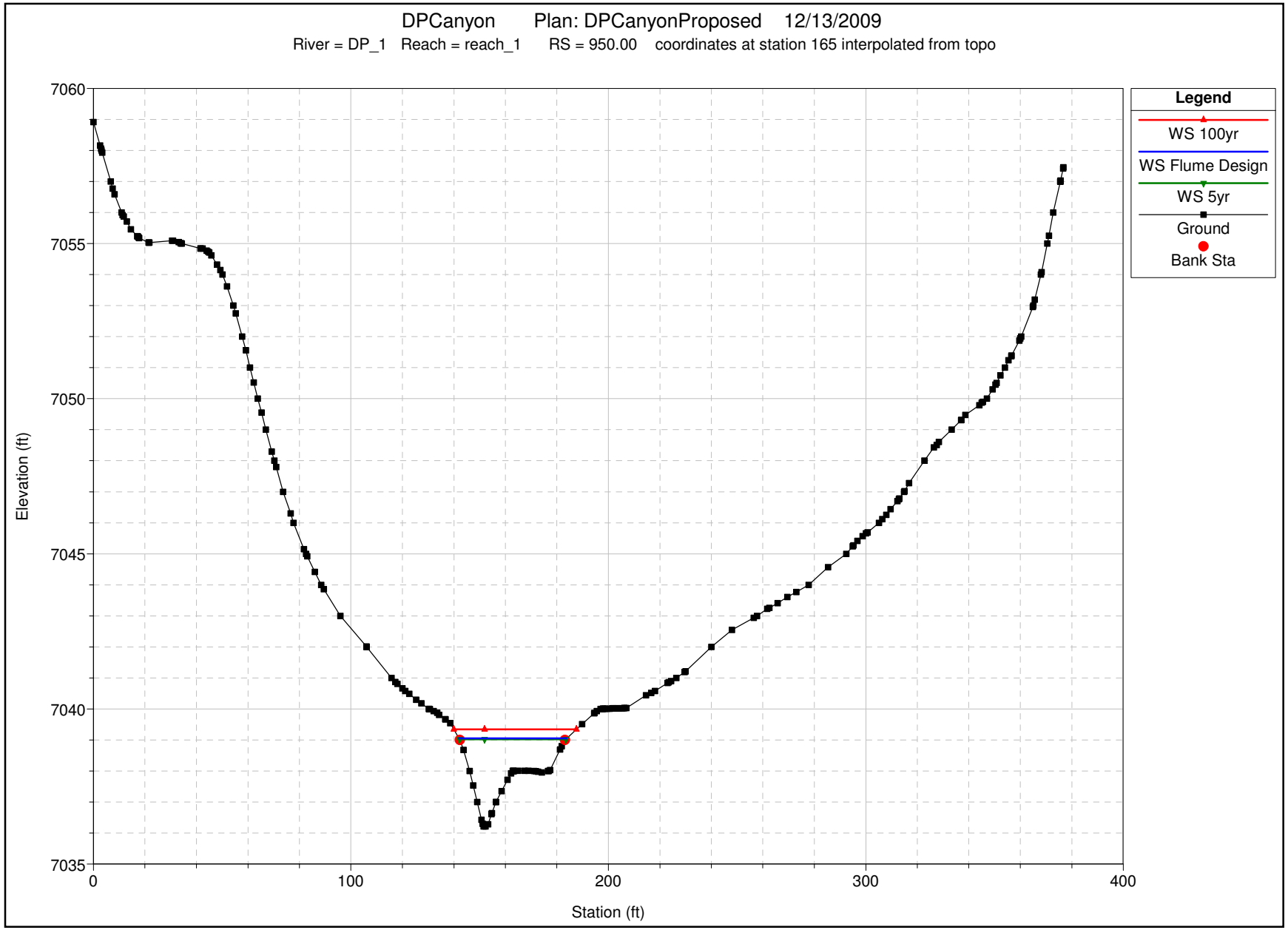

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 700.00 coordinates at station 200 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7055
7050
7045
7040
7035
7030
0
50
100
150
200
250
300
350
400

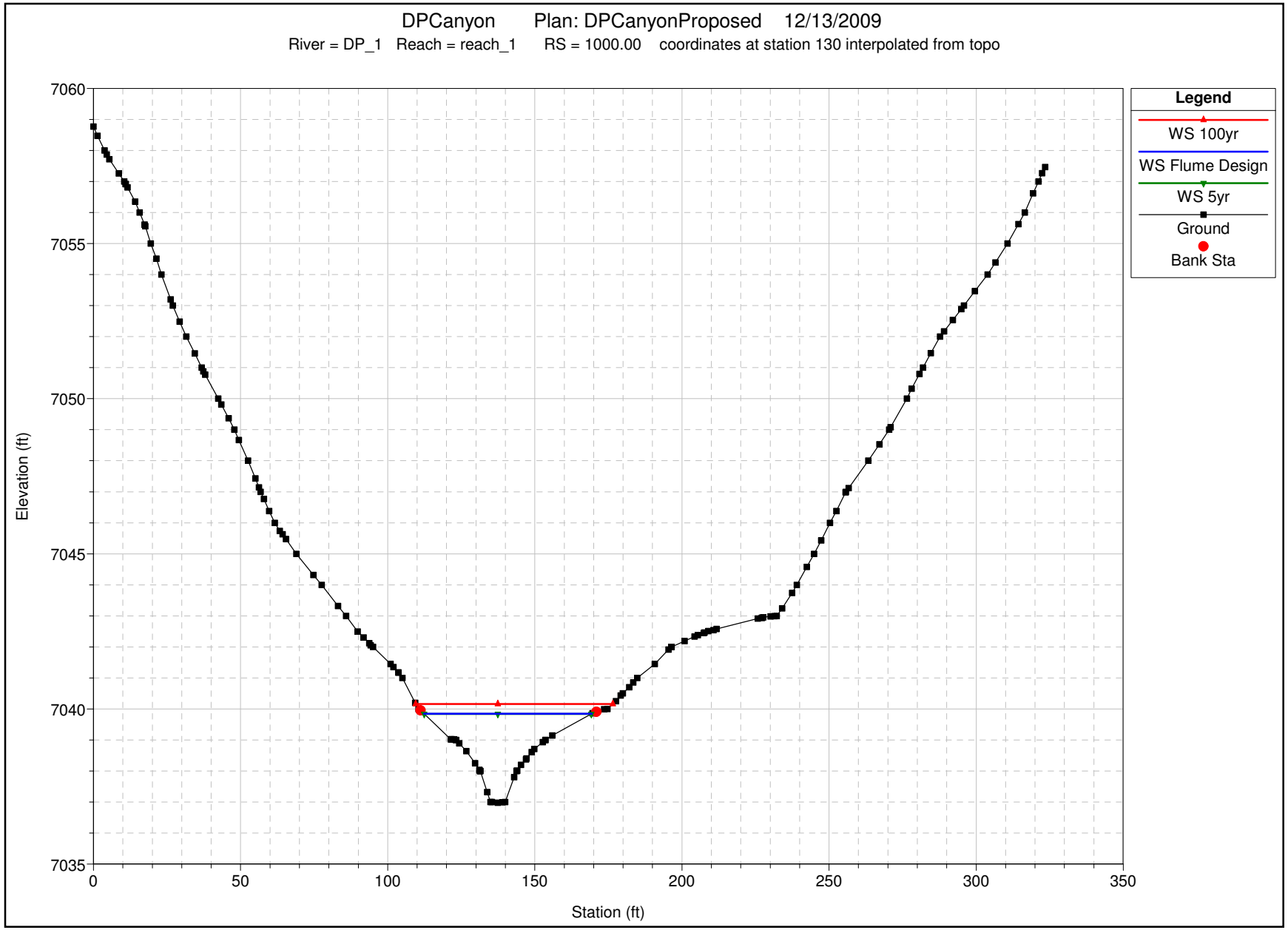

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 750.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
7050
7045
7040
7035
7030
Station (ft)
0
50
100
150
200
250
300
350
400

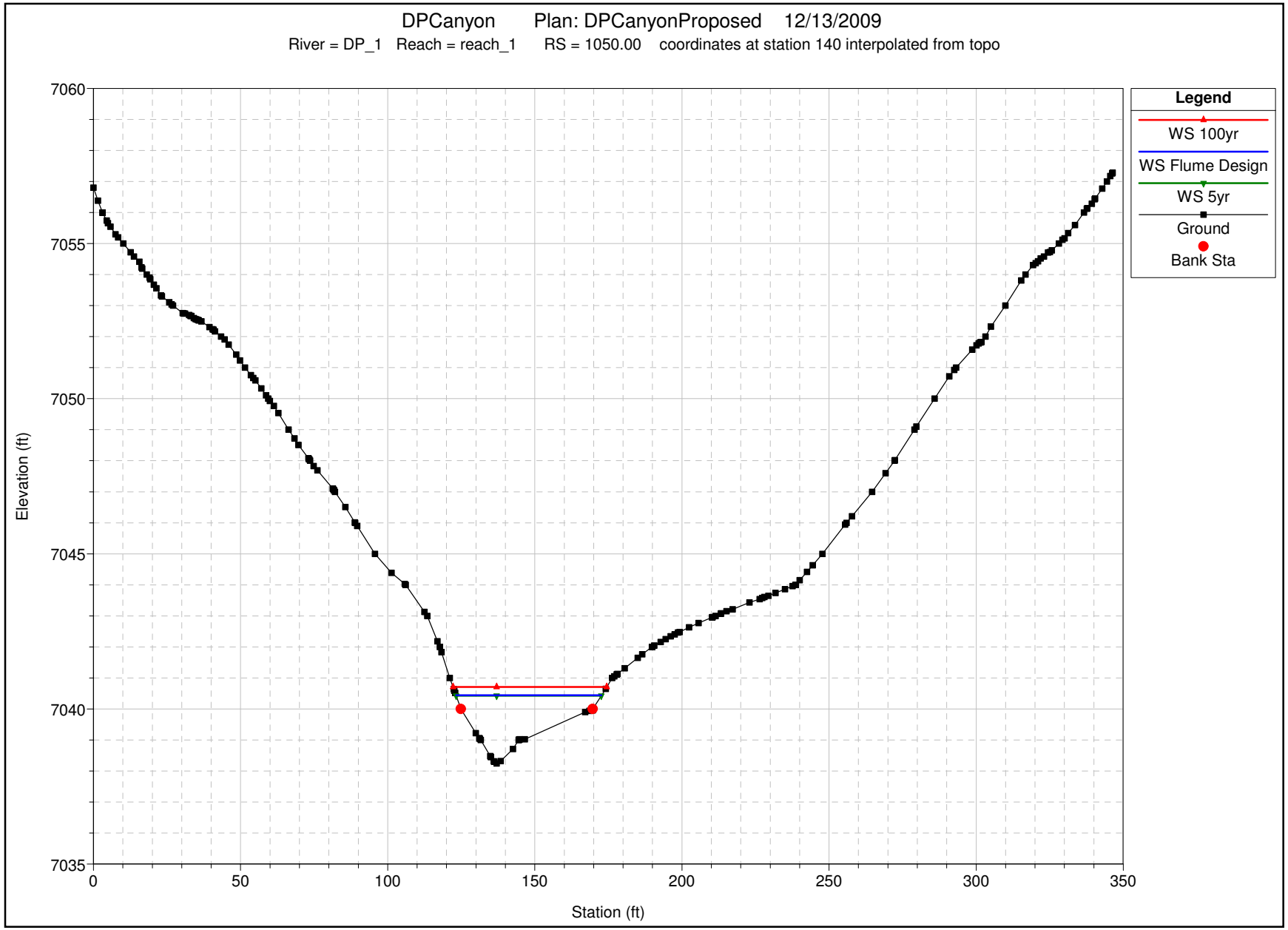

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 800.00 coordinates at station 175 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7060
7055
7050
7045
7040
7035
7030
0
50
100
150
200
250
300
350
400

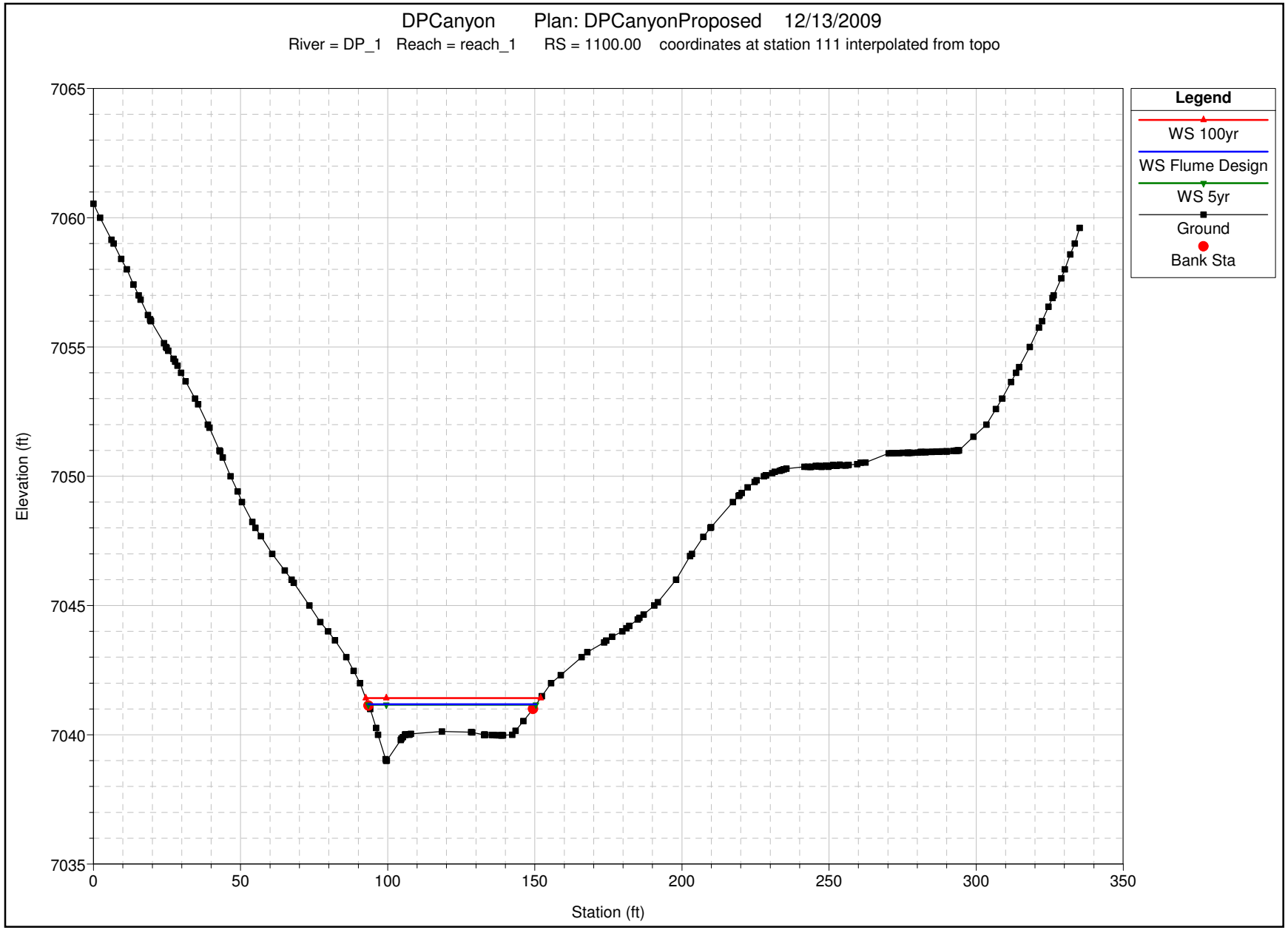

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 850.00 coordinates at station 199 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7060
7055
7050
7045
7040
7035
0
100
200
300
400
Station (ft)

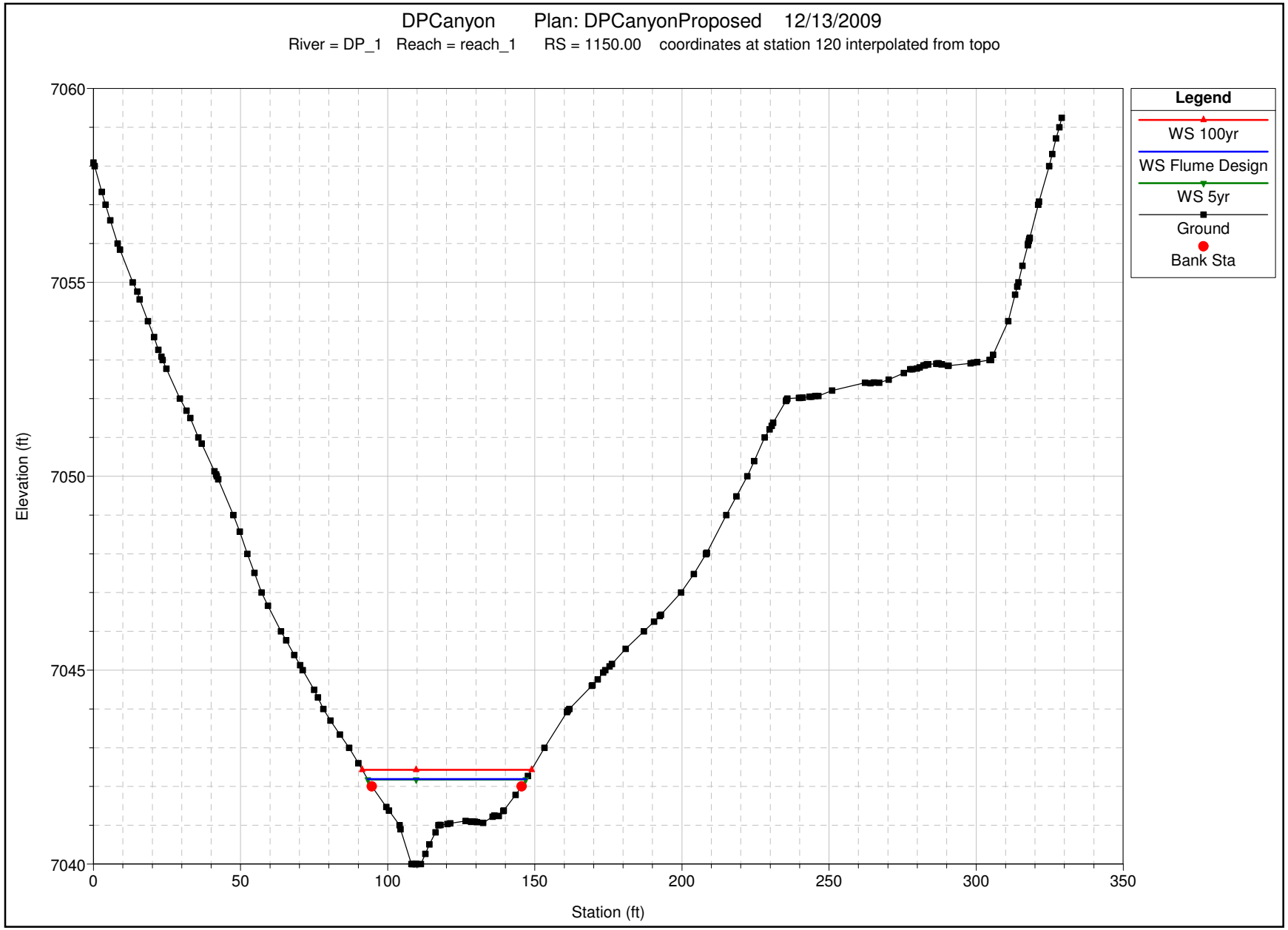

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 900.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7060
7055
7050
7045
7040
7035
7030
0
100
200
300
400
Station (ft)

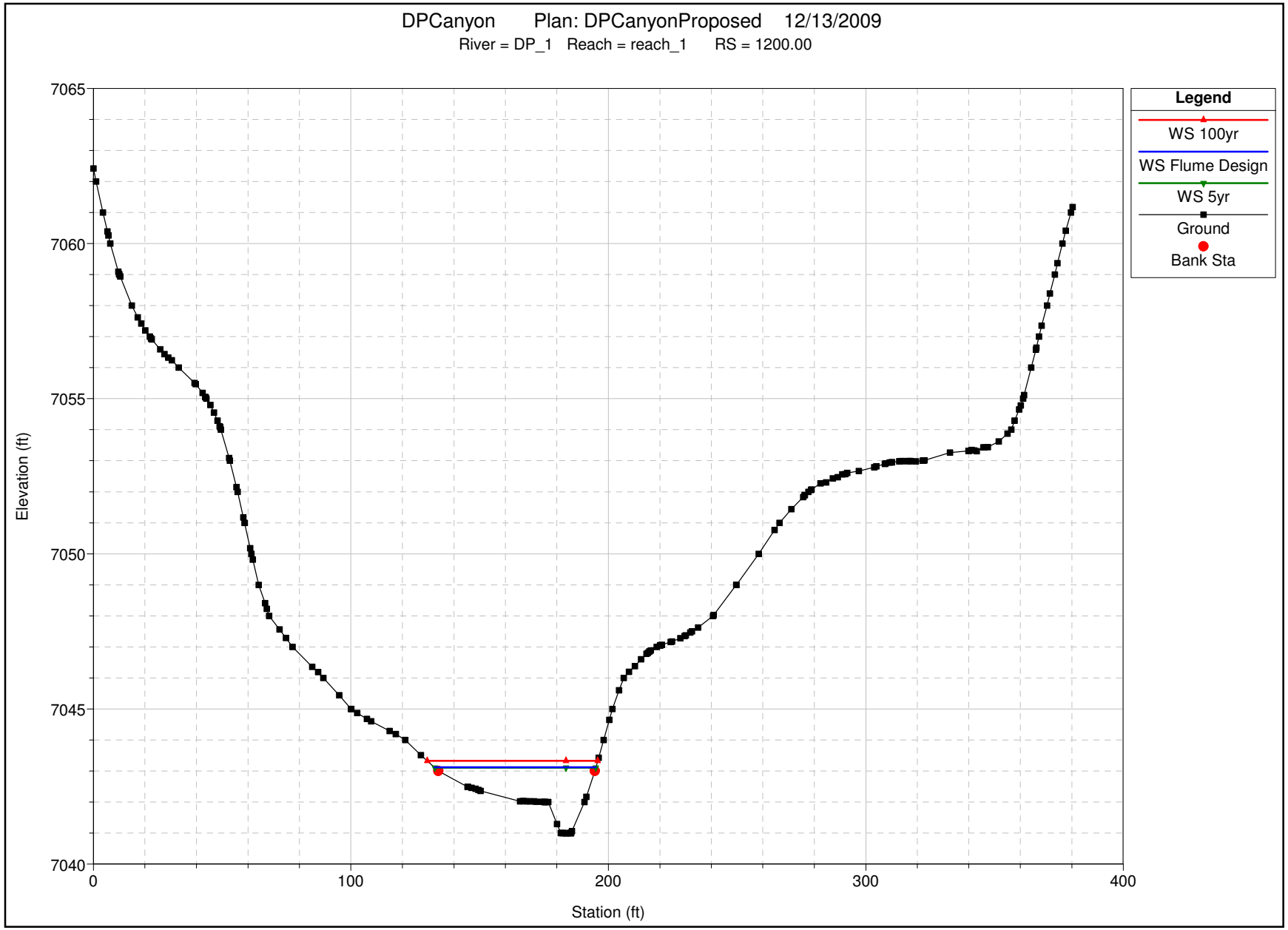

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 950.00 coordinates at station 165 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7060
7055
7050
7045
7040
7035
0
100
200
300
400
Station (ft)

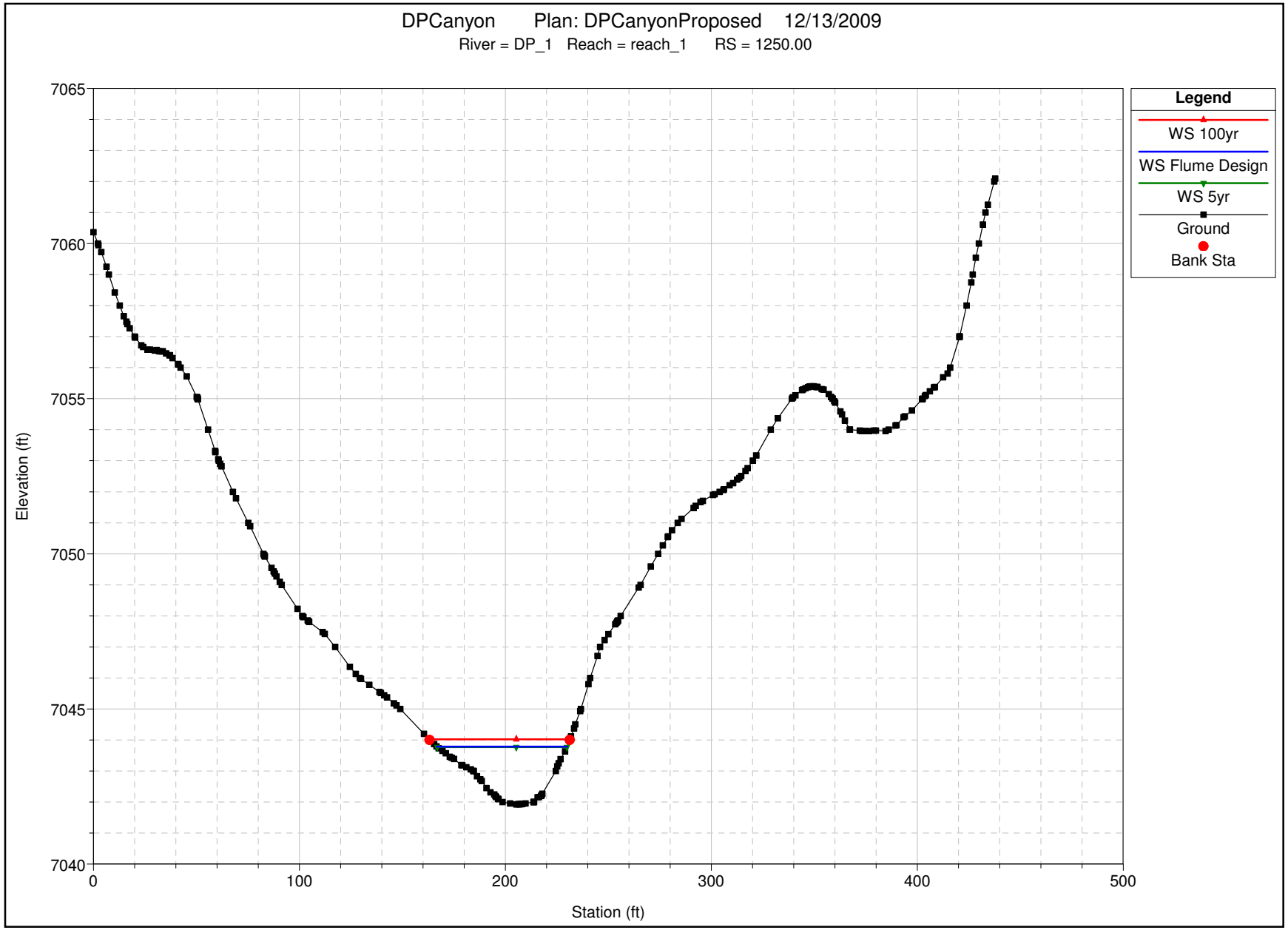

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 1000.00 coordinates at station 130 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7060
7055
7050
7045
7040
7035
0
50
100
150
200
250
300
350

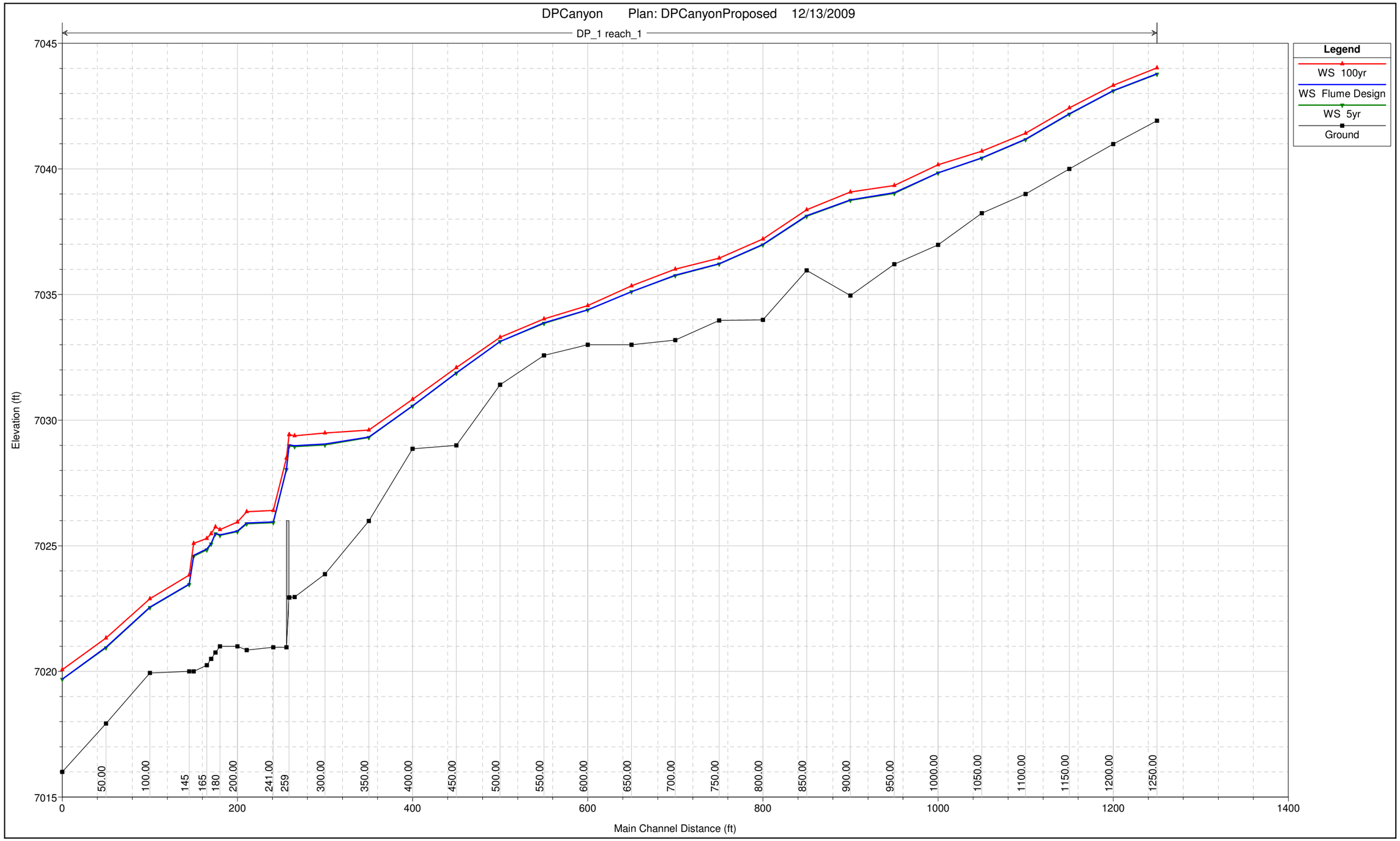

DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 1050.00 coordinates at station 140 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7060
7055
7050
7045
7040
7035
0
50
100
150
200
250
300
350
Station (ft)


DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 1100.00 coordinates at station 111 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7065
7060
7055
7050
7045
7040
7035
0
50
100
150
200
250
300
350


DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 1150.00 coordinates at station 120 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7060
7055
7050
7045
7040
Station (ft)
0
50
100
150
200
250
300
350


DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 1200.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7065
7060
7055
7050
7045
7040
0
100
200
300
400
Station (ft)


DPCanyon Plan: DPCanyonProposed 12/13/2009
River = DP_1 Reach = reach_1 RS = 1250.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7065
7060
7055
7050
7045
7040
0
100
200
300
400
500
Station (ft)


DPCanyon Plan: DPCanyonProposed 12/13/2009
DP_1 reach_1
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Elevation (ft)
7045
7040
7035
7030
7025
7020
7015
0
200
400
600
800
1000
1200
1400
Main Channel Distance (ft)
50.00
100.00
145
165
180
200.00
241.00
259
300.00
350.00
400.00
450.00
500.00
550.00
600.00
650.00
700.00
750.00
800.00
850.00
900.00
950.00
1000.00
1050.00
1100.00
1150.00
1200.00
1250.00

HEC-RAS Plan: DPCanyonProp River: DP_1 Reach: reach_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	1250.00	5yr	343.00	7041.92	7043.77		7044.15	0.008636	4.92	69.76	63.01	0.82
reach_1	1250.00	Flume Design	350.00	7041.92	7043.79		7044.17	0.008677	4.95	70.65	63.33	0.83
reach_1	1250.00	100yr	465.00	7041.92	7044.02		7044.47	0.008741	5.40	86.06	68.50	0.85
reach_1	1200.00	5yr	343.00	7040.99	7043.10	7043.10	7043.60	0.013331	5.68	60.51	62.50	1.00
reach_1	1200.00	Flume Design	350.00	7040.99	7043.12	7043.12	7043.62	0.013241	5.71	61.40	62.74	1.00
reach_1	1200.00	100yr	465.00	7040.99	7043.33	7043.33	7043.94	0.012512	6.29	74.75	66.22	1.00
reach_1	1150.00	5yr	343.00	7040.00	7042.18	7042.18	7042.74	0.012964	6.04	57.01	53.65	1.01
reach_1	1150.00	Flume Design	350.00	7040.00	7042.19	7042.19	7042.77	0.012922	6.08	57.80	53.88	1.01
reach_1	1150.00	100yr	465.00	7040.00	7042.43	7042.43	7043.12	0.012014	6.66	71.05	57.53	1.00
reach_1	1100.00	5yr	343.00	7039.00	7041.17	7041.11	7041.64	0.010929	5.52	62.21	57.03	0.92
reach_1	1100.00	Flume Design	350.00	7039.00	7041.19	7041.12	7041.66	0.010768	5.54	63.27	57.20	0.92
reach_1	1100.00	100yr	465.00	7039.00	7041.42	7041.34	7042.00	0.010049	6.08	77.11	59.44	0.92
reach_1	1050.00	5yr	343.00	7038.24	7040.43	7040.43	7041.04	0.012534	6.29	55.37	49.32	1.01
reach_1	1050.00	Flume Design	350.00	7038.24	7040.44	7040.44	7041.07	0.012585	6.35	56.02	49.46	1.01
reach_1	1050.00	100yr	465.00	7038.24	7040.71	7040.71	7041.44	0.011471	6.91	69.53	52.27	1.00
reach_1	1000.00	5yr	343.00	7036.98	7039.84		7040.25	0.008951	5.17	66.34	56.80	0.84
reach_1	1000.00	Flume Design	350.00	7036.98	7039.85		7040.27	0.009136	5.23	66.87	57.08	0.85
reach_1	1000.00	100yr	465.00	7036.98	7040.16		7040.62	0.007517	5.43	86.69	67.00	0.80
reach_1	950.00	5yr	343.00	7036.21	7039.02	7039.02	7039.69	0.012942	6.57	52.23	41.31	1.02
reach_1	950.00	Flume Design	350.00	7036.21	7039.05	7039.05	7039.72	0.012465	6.55	53.49	41.91	1.01
reach_1	950.00	100yr	465.00	7036.21	7039.34	7039.34	7040.13	0.011393	7.14	66.20	47.59	1.00
reach_1	900.00	5yr	343.00	7034.96	7038.75		7038.83	0.000973	2.32	150.69	94.34	0.30
reach_1	900.00	Flume Design	350.00	7034.96	7038.77		7038.85	0.000980	2.35	152.45	94.95	0.30
reach_1	900.00	100yr	465.00	7034.96	7039.08		7039.19	0.001013	2.65	184.31	104.63	0.32
reach_1	850.00	5yr	343.00	7035.96	7038.12	7038.12	7038.66	0.013245	5.94	58.00	59.12	1.01
reach_1	850.00	Flume Design	350.00	7035.96	7038.14	7038.14	7038.69	0.012747	5.92	59.52	60.19	1.00
reach_1	850.00	100yr	465.00	7035.96	7038.38	7038.38	7039.02	0.011673	6.45	74.69	68.57	0.99
reach_1	800.00	5yr	343.00	7033.99	7036.98	7036.98	7037.50	0.013651	5.77	59.40	59.07	1.01
reach_1	800.00	Flume Design	350.00	7033.99	7036.99	7036.99	7037.52	0.013735	5.81	60.21	59.56	1.02
reach_1	800.00	100yr	465.00	7033.99	7037.21	7037.21	7037.84	0.012724	6.35	73.79	66.00	1.01
reach_1	750.00	5yr	343.00	7033.97	7036.22	7036.22	7036.74	0.012692	5.81	59.54	61.47	0.99
reach_1	750.00	Flume Design	350.00	7033.97	7036.23	7036.23	7036.76	0.012682	5.86	60.36	61.93	0.99
reach_1	750.00	100yr	465.00	7033.97	7036.45	7036.45	7037.09	0.012025	6.45	74.69	69.40	1.00
reach_1	700.00	5yr	343.00	7033.19	7035.75		7035.98	0.004203	3.87	89.79	73.87	0.59
reach_1	700.00	Flume Design	350.00	7033.19	7035.77		7036.01	0.004156	3.89	91.31	74.28	0.59
reach_1	700.00	100yr	465.00	7033.19	7036.01		7036.31	0.004218	4.37	109.74	79.13	0.61
reach_1	650.00	5yr	343.00	7033.00	7035.11	7035.11	7035.61	0.013119	5.68	60.78	65.25	1.00
reach_1	650.00	Flume Design	350.00	7033.00	7035.12	7035.12	7035.63	0.013440	5.77	61.10	65.40	1.01
reach_1	650.00	100yr	465.00	7033.00	7035.35	7035.35	7035.94	0.011901	6.22	76.93	72.55	0.99
reach_1	600.00	5yr	343.00	7033.00	7034.38	7034.35	7034.80	0.012329	5.16	66.52	73.18	0.95
reach_1	600.00	Flume Design	350.00	7033.00	7034.39	7034.36	7034.82	0.012528	5.22	67.09	73.41	0.96
reach_1	600.00	100yr	465.00	7033.00	7034.56	7034.56	7035.09	0.012979	5.84	79.75	78.24	1.00
reach_1	550.00	5yr	343.00	7032.58	7033.85	7033.79	7034.18	0.011527	4.56	75.23	94.71	0.90
reach_1	550.00	Flume Design	350.00	7032.58	7033.88		7034.19	0.011122	4.53	77.23	95.50	0.89
reach_1	550.00	100yr	465.00	7032.58	7034.03	7033.98	7034.42	0.011336	5.03	92.96	108.81	0.92
reach_1	500.00	5yr	343.00	7031.41	7033.13	7033.13	7033.53	0.014453	5.03	68.31	90.62	1.01
reach_1	500.00	Flume Design	350.00	7031.41	7033.13	7033.13	7033.54	0.014986	5.13	68.40	90.65	1.02
reach_1	500.00	100yr	465.00	7031.41	7033.30	7033.30	7033.79	0.013810	5.61	83.87	94.55	1.02
reach_1	450.00	5yr	343.00	7029.00	7031.87	7031.87	7032.34	0.014306	5.49	62.54	70.29	1.02
reach_1	450.00	Flume Design	350.00	7029.00	7031.88	7031.88	7032.36	0.014342	5.53	63.29	70.54	1.02
reach_1	450.00	100yr	465.00	7029.00	7032.09	7032.09	7032.64	0.012772	5.95	78.73	77.06	1.00
reach_1	400.00	5yr	343.00	7028.86	7030.56	7030.56	7031.14	0.012298	6.11	58.01	55.50	0.99
reach_1	400.00	Flume Design	350.00	7028.86	7030.57	7030.57	7031.16	0.012382	6.17	58.66	55.67	1.00
reach_1	400.00	100yr	465.00	7028.86	7030.83	7030.83	7031.52	0.011233	6.70	73.45	59.49	0.98
reach_1	350.00	5yr	343.00	7025.99	7029.31	7029.31	7029.90	0.010523	6.21	61.12	69.87	0.93
reach_1	350.00	Flume Design	350.00	7025.99	7029.33	7029.33	7029.92	0.010405	6.24	62.52	70.60	0.93
reach_1	350.00	100yr	465.00	7025.99	7029.61	7029.61	7030.28	0.009500	6.73	83.09	77.90	0.92

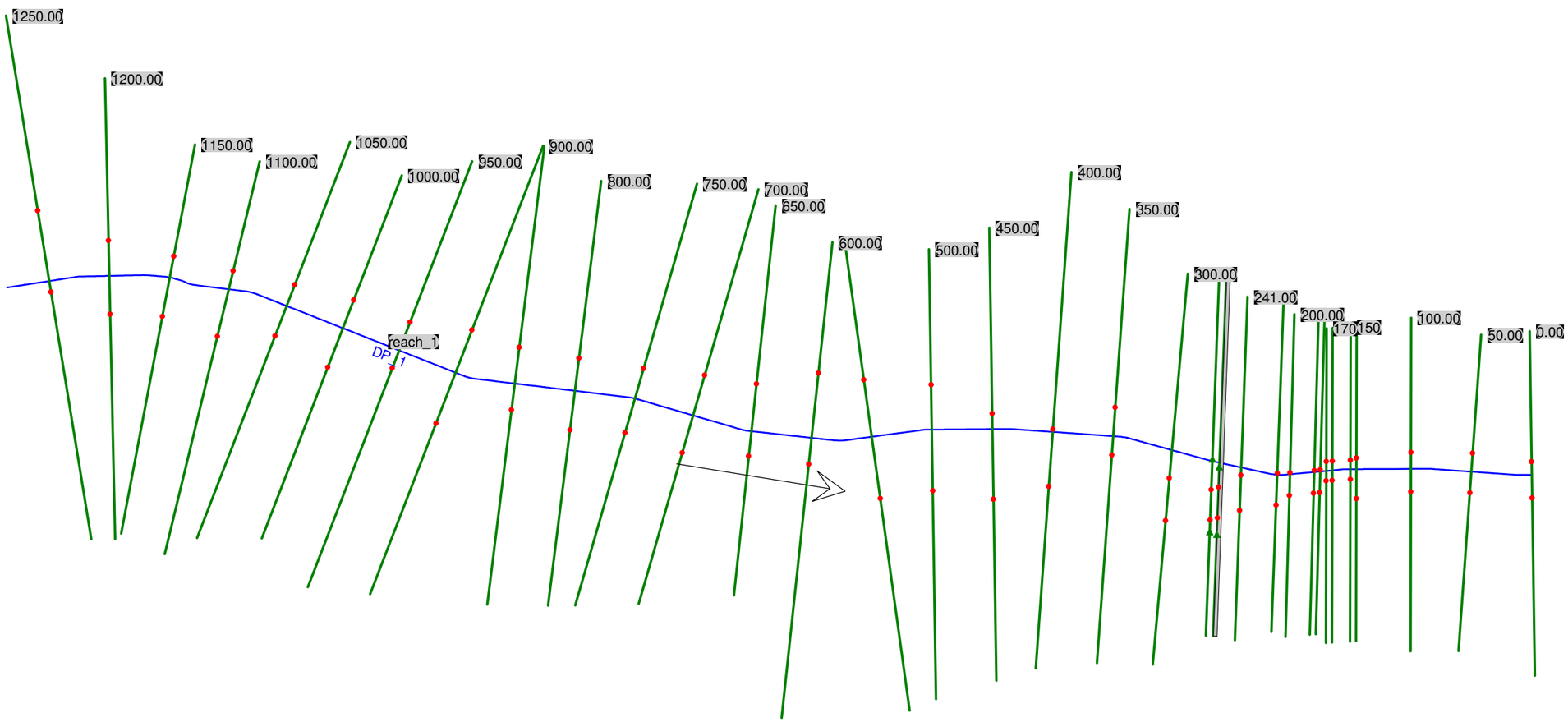
HEC-RAS Plan: DPCanyonProp River: DP_1 Reach: reach_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	300.00	5yr	343.00	7023.87	7029.02		7029.13	0.000855	2.91	167.16	97.56	0.30
reach_1	300.00	Flume Design	350.00	7023.87	7029.05		7029.17	0.000846	2.92	170.99	98.51	0.30
reach_1	300.00	100yr	465.00	7023.87	7029.49		7029.63	0.000872	3.25	216.23	108.96	0.31
reach_1	265.39	5yr	343.00	7022.96	7028.95	7026.73	7029.10	0.000735	3.24	134.51	88.93	0.29
reach_1	265.39	Flume Design	350.00	7022.96	7028.98	7026.74	7029.14	0.000738	3.27	136.72	89.79	0.29
reach_1	265.39	100yr	465.00	7022.96	7029.38	7027.21	7029.59	0.000900	3.84	160.56	95.75	0.32
reach_1	259.30	5yr	343.00	7022.94	7028.98	7026.08	7029.08	0.000374	2.63	166.86	91.07	0.21
reach_1	259.30	Flume Design	350.00	7022.94	7029.02	7026.09	7029.12	0.000378	2.66	168.91	91.73	0.22
reach_1	259.30	100yr	465.00	7022.94	7029.42	7026.49	7029.57	0.000490	3.20	191.34	97.66	0.25
reach_1	259		Inl Struct									
reach_1	241.00	5yr	343.00	7020.96	7025.92		7026.15	0.001415	3.82	92.93	37.02	0.39
reach_1	241.00	Flume Design	350.00	7020.96	7025.95		7026.18	0.001423	3.86	94.09	37.28	0.39
reach_1	241.00	100yr	465.00	7020.96	7026.41		7026.71	0.001571	4.44	112.06	42.00	0.42
reach_1	210.58	5yr	343.00	7020.85	7025.88		7026.11	0.001366	3.90	100.42	42.96	0.38
reach_1	210.58	Flume Design	350.00	7020.85	7025.91		7026.14	0.001376	3.94	101.75	43.26	0.38
reach_1	210.58	100yr	465.00	7020.85	7026.36		7026.66	0.001539	4.54	122.48	49.40	0.42
reach_1	200.00	5yr	343.00	7021.00	7025.57		7026.06	0.003395	5.71	71.25	44.75	0.57
reach_1	200.00	Flume Design	350.00	7021.00	7025.59		7026.09	0.003430	5.77	72.37	45.03	0.58
reach_1	200.00	100yr	465.00	7021.00	7025.94		7026.60	0.004011	6.70	88.96	49.08	0.63
reach_1	180	5yr	343.00	7021.00	7025.42		7025.98	0.004096	6.06	64.63	43.02	0.62
reach_1	180	Flume Design	350.00	7021.00	7025.44		7026.01	0.004156	6.14	65.51	43.26	0.63
reach_1	180	100yr	465.00	7021.00	7025.65		7026.49	0.005676	7.50	74.78	45.64	0.74
reach_1	175	5yr	343.00	7020.75	7025.48		7025.92	0.002864	5.42	74.61	43.76	0.53
reach_1	175	Flume Design	350.00	7020.75	7025.50		7025.96	0.002908	5.49	75.58	44.01	0.53
reach_1	175	100yr	465.00	7020.75	7025.75		7026.41	0.003874	6.66	87.00	46.89	0.62
reach_1	170	5yr	343.00	7020.50	7025.07	7025.07	7025.87	0.007028	7.43	64.89	58.86	0.80
reach_1	170	Flume Design	350.00	7020.50	7025.10	7025.10	7025.90	0.007011	7.47	66.47	59.13	0.80
reach_1	170	100yr	465.00	7020.50	7025.48	7025.48	7026.37	0.006940	8.11	89.92	62.91	0.81
reach_1	165	5yr	343.00	7020.25	7024.84	7024.84	7025.68	0.007230	7.57	60.12	56.19	0.81
reach_1	165	Flume Design	350.00	7020.25	7024.87	7024.87	7025.72	0.007153	7.59	61.99	56.59	0.81
reach_1	165	100yr	465.00	7020.25	7025.29	7025.29	7026.21	0.006820	8.15	86.82	61.05	0.81
reach_1	150	5yr	343.00	7020.00	7024.59	7024.59	7025.49	0.007582	7.74	54.93	52.02	0.83
reach_1	150	Flume Design	350.00	7020.00	7024.62	7024.62	7025.52	0.007495	7.76	56.77	52.73	0.83
reach_1	150	100yr	465.00	7020.00	7025.10	7025.10	7026.04	0.006741	8.19	83.58	59.10	0.80
reach_1	145	5yr	343.00	7020.00	7023.46	7023.46	7024.22	0.012340	6.99	49.15	34.22	1.01
reach_1	145	Flume Design	350.00	7020.00	7023.48	7023.48	7024.25	0.012511	7.05	49.71	34.55	1.02
reach_1	145	100yr	465.00	7020.00	7023.84	7023.84	7024.71	0.010667	7.52	63.59	42.66	0.98
reach_1	100.00	5yr	343.00	7019.94	7022.54	7022.54	7023.29	0.011581	6.96	50.63	38.14	1.00
reach_1	100.00	Flume Design	350.00	7019.94	7022.56	7022.56	7023.32	0.011559	7.01	51.35	38.34	1.00
reach_1	100.00	100yr	465.00	7019.94	7022.89	7022.89	7023.78	0.010536	7.62	64.52	41.79	0.98
reach_1	50.00	5yr	343.00	7017.93	7020.94	7020.94	7021.75	0.011790	7.21	47.58	29.92	1.01
reach_1	50.00	Flume Design	350.00	7017.93	7020.97	7020.97	7021.78	0.011730	7.23	48.43	30.23	1.01
reach_1	50.00	100yr	465.00	7017.93	7021.33	7021.33	7022.26	0.011271	7.75	60.12	34.61	1.01
reach_1	0.00	5yr	343.00	7016.00	7019.69	7019.69	7020.49	0.011807	7.21	47.61	30.35	1.00
reach_1	0.00	Flume Design	350.00	7016.00	7019.70	7019.70	7020.53	0.012068	7.31	47.95	30.52	1.02
reach_1	0.00	100yr	465.00	7016.00	7020.07	7020.07	7021.02	0.010622	7.85	60.75	38.48	0.99

HEC-RAS Plan: DPCanyonProp_Sed River: DP_1 Reach: reach_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	1250.00	5yr	343.00	7041.92	7043.77		7044.15	0.008636	4.92	69.76	63.01	0.82
reach_1	1250.00	Flume Design	350.00	7041.92	7043.79		7044.17	0.008677	4.95	70.65	63.33	0.83
reach_1	1250.00	100yr	465.00	7041.92	7044.02		7044.47	0.008741	5.40	86.06	68.50	0.85
reach_1	1200.00	5yr	343.00	7040.99	7043.10	7043.10	7043.60	0.013331	5.68	60.51	62.50	1.00
reach_1	1200.00	Flume Design	350.00	7040.99	7043.12	7043.12	7043.62	0.013241	5.71	61.40	62.74	1.00
reach_1	1200.00	100yr	465.00	7040.99	7043.33	7043.33	7043.94	0.012512	6.29	74.75	66.22	1.00
reach_1	1150.00	5yr	343.00	7040.00	7042.18	7042.18	7042.74	0.012964	6.04	57.01	53.65	1.01
reach_1	1150.00	Flume Design	350.00	7040.00	7042.19	7042.19	7042.77	0.012922	6.08	57.80	53.88	1.01
reach_1	1150.00	100yr	465.00	7040.00	7042.43	7042.43	7043.12	0.012014	6.66	71.05	57.53	1.00
reach_1	1100.00	5yr	343.00	7039.00	7041.17	7041.11	7041.64	0.010929	5.52	62.21	57.03	0.92
reach_1	1100.00	Flume Design	350.00	7039.00	7041.19	7041.12	7041.66	0.010768	5.54	63.27	57.20	0.92
reach_1	1100.00	100yr	465.00	7039.00	7041.42	7041.34	7042.00	0.010049	6.08	77.11	59.44	0.92
reach_1	1050.00	5yr	343.00	7038.24	7040.43	7040.43	7041.04	0.012534	6.29	55.37	49.32	1.01
reach_1	1050.00	Flume Design	350.00	7038.24	7040.44	7040.44	7041.07	0.012585	6.35	56.02	49.46	1.01
reach_1	1050.00	100yr	465.00	7038.24	7040.71	7040.71	7041.44	0.011471	6.91	69.53	52.27	1.00
reach_1	1000.00	5yr	343.00	7036.98	7039.84		7040.25	0.008951	5.17	66.34	56.80	0.84
reach_1	1000.00	Flume Design	350.00	7036.98	7039.85		7040.27	0.009136	5.23	66.87	57.08	0.85
reach_1	1000.00	100yr	465.00	7036.98	7040.16		7040.62	0.007517	5.43	86.69	67.00	0.80
reach_1	950.00	5yr	343.00	7036.21	7039.02	7039.02	7039.69	0.012942	6.57	52.23	41.31	1.02
reach_1	950.00	Flume Design	350.00	7036.21	7039.05	7039.05	7039.72	0.012465	6.55	53.49	41.91	1.01
reach_1	950.00	100yr	465.00	7036.21	7039.34	7039.34	7040.13	0.011393	7.14	66.20	47.59	1.00
reach_1	900.00	5yr	343.00	7034.96	7038.75		7038.83	0.000973	2.32	150.69	94.34	0.30
reach_1	900.00	Flume Design	350.00	7034.96	7038.77		7038.85	0.000980	2.35	152.45	94.95	0.30
reach_1	900.00	100yr	465.00	7034.96	7039.08		7039.19	0.001013	2.65	184.31	104.63	0.32
reach_1	850.00	5yr	343.00	7035.96	7038.12	7038.12	7038.66	0.013245	5.94	58.00	59.12	1.01
reach_1	850.00	Flume Design	350.00	7035.96	7038.14	7038.14	7038.69	0.012747	5.92	59.52	60.19	1.00
reach_1	850.00	100yr	465.00	7035.96	7038.38	7038.38	7039.02	0.011673	6.45	74.69	68.57	0.99
reach_1	800.00	5yr	343.00	7033.99	7036.98	7036.98	7037.50	0.013651	5.77	59.40	59.07	1.01
reach_1	800.00	Flume Design	350.00	7033.99	7036.99	7036.99	7037.52	0.013735	5.81	60.21	59.56	1.02
reach_1	800.00	100yr	465.00	7033.99	7037.21	7037.21	7037.84	0.012724	6.35	73.79	66.00	1.01
reach_1	750.00	5yr	343.00	7033.97	7036.22	7036.22	7036.74	0.012692	5.81	59.54	61.47	0.99
reach_1	750.00	Flume Design	350.00	7033.97	7036.23	7036.23	7036.76	0.012682	5.86	60.36	61.93	0.99
reach_1	750.00	100yr	465.00	7033.97	7036.45	7036.45	7037.09	0.012025	6.45	74.69	69.40	1.00
reach_1	700.00	5yr	343.00	7033.19	7035.75		7035.98	0.004203	3.87	89.79	73.87	0.59
reach_1	700.00	Flume Design	350.00	7033.19	7035.77		7036.01	0.004156	3.89	91.31	74.28	0.59
reach_1	700.00	100yr	465.00	7033.19	7036.01		7036.31	0.004218	4.37	109.74	79.13	0.61
reach_1	650.00	5yr	343.00	7033.00	7035.11	7035.11	7035.61	0.013119	5.68	60.78	65.25	1.00
reach_1	650.00	Flume Design	350.00	7033.00	7035.12	7035.12	7035.63	0.013440	5.77	61.10	65.40	1.01
reach_1	650.00	100yr	465.00	7033.00	7035.35	7035.35	7035.94	0.011901	6.22	76.93	72.55	0.99
reach_1	600.00	5yr	343.00	7033.00	7034.38	7034.35	7034.80	0.012329	5.16	66.52	73.18	0.95
reach_1	600.00	Flume Design	350.00	7033.00	7034.39	7034.36	7034.82	0.012528	5.22	67.09	73.41	0.96
reach_1	600.00	100yr	465.00	7033.00	7034.56	7034.56	7035.09	0.012979	5.84	79.75	78.24	1.00
reach_1	550.00	5yr	343.00	7032.58	7033.85	7033.79	7034.18	0.011527	4.56	75.23	94.71	0.90
reach_1	550.00	Flume Design	350.00	7032.58	7033.88		7034.19	0.011122	4.53	77.23	95.50	0.89
reach_1	550.00	100yr	465.00	7032.58	7034.03	7033.98	7034.42	0.011336	5.03	92.96	108.81	0.92
reach_1	500.00	5yr	343.00	7031.41	7033.13	7033.13	7033.53	0.014453	5.03	68.31	90.62	1.01
reach_1	500.00	Flume Design	350.00	7031.41	7033.13	7033.13	7033.54	0.014986	5.13	68.40	90.65	1.02
reach_1	500.00	100yr	465.00	7031.41	7033.30	7033.30	7033.79	0.013810	5.61	83.87	94.55	1.02
reach_1	450.00	5yr	343.00	7029.00	7031.87	7031.87	7032.34	0.014306	5.49	62.54	70.29	1.02
reach_1	450.00	Flume Design	350.00	7029.00	7031.88	7031.88	7032.36	0.014342	5.53	63.29	70.54	1.02
reach_1	450.00	100yr	465.00	7029.00	7032.09	7032.09	7032.64	0.012772	5.95	78.73	77.06	1.00
reach_1	400.00	5yr	343.00	7028.86	7030.56	7030.56	7031.14	0.012298	6.11	58.01	55.50	0.99
reach_1	400.00	Flume Design	350.00	7028.86	7030.57	7030.57	7031.16	0.012382	6.17	58.66	55.67	1.00
reach_1	400.00	100yr	465.00	7028.86	7030.83	7030.83	7031.52	0.011233	6.70	73.45	59.49	0.98
reach_1	350.00	5yr	343.00	7026.82	7029.38	7029.38	7029.96	0.010425	6.19	63.14	71.95	0.93
reach_1	350.00	Flume Design	350.00	7026.82	7029.41	7029.41	7029.99	0.010168	6.19	64.94	72.58	0.92
reach_1	350.00	100yr	465.00	7026.82	7029.67	7029.67	7030.34	0.009639	6.75	84.57	79.65	0.92

Proposed Conditions
With Sediment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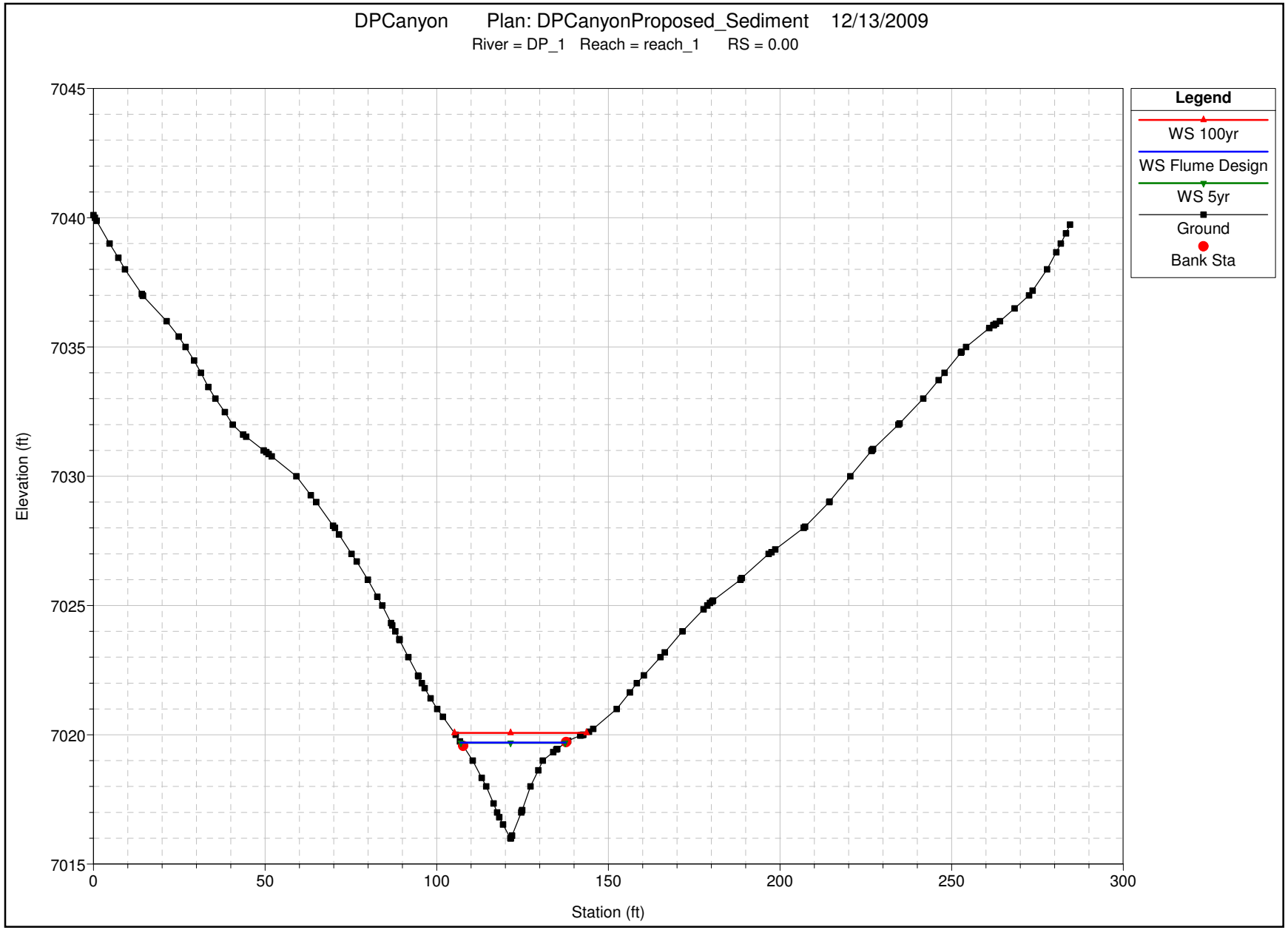
reach_1
DP_1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WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
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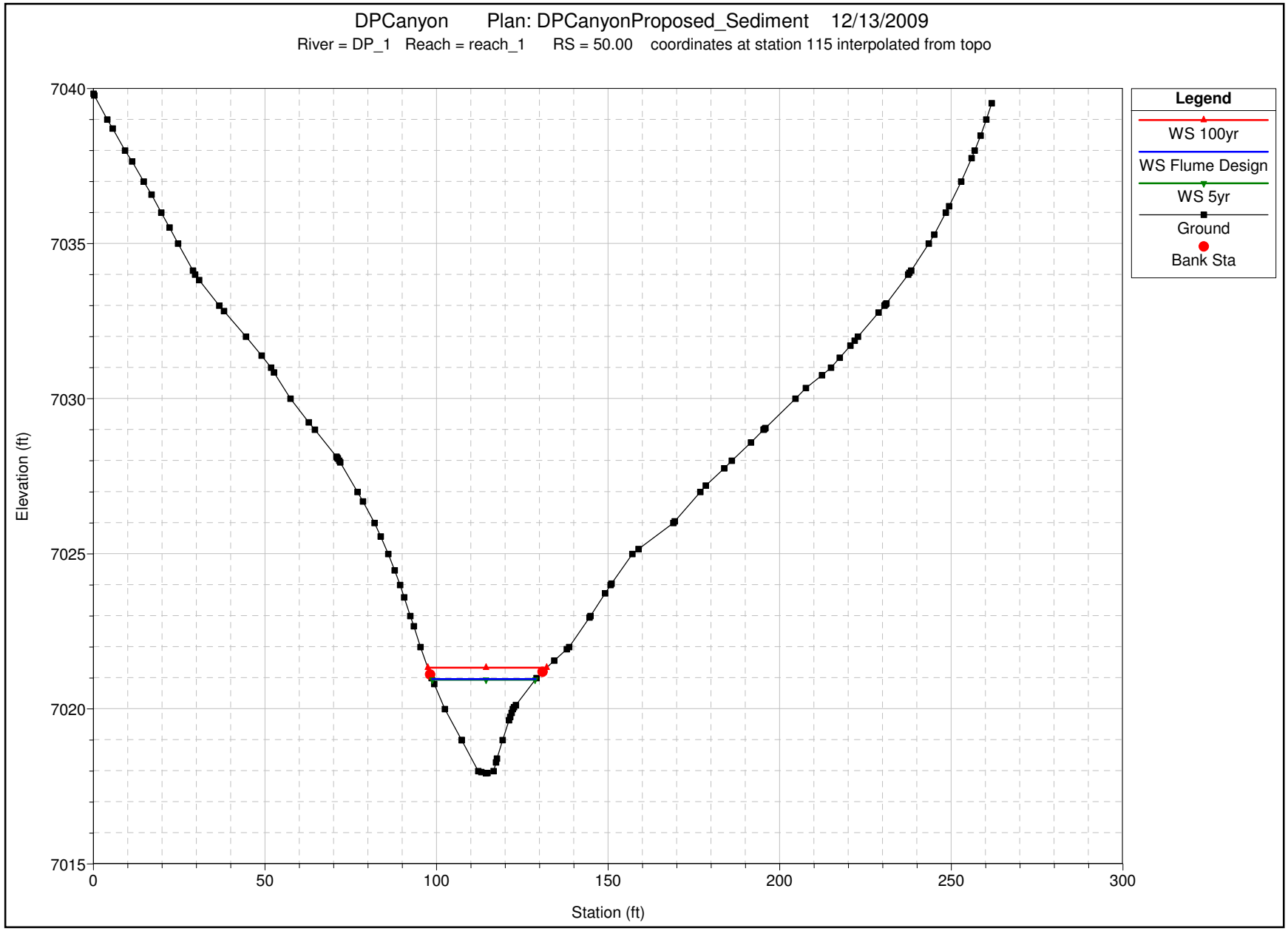
7035
7030
7025
7020
7015
0
50
100
150
200
250
300
Station (ft)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WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
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7030
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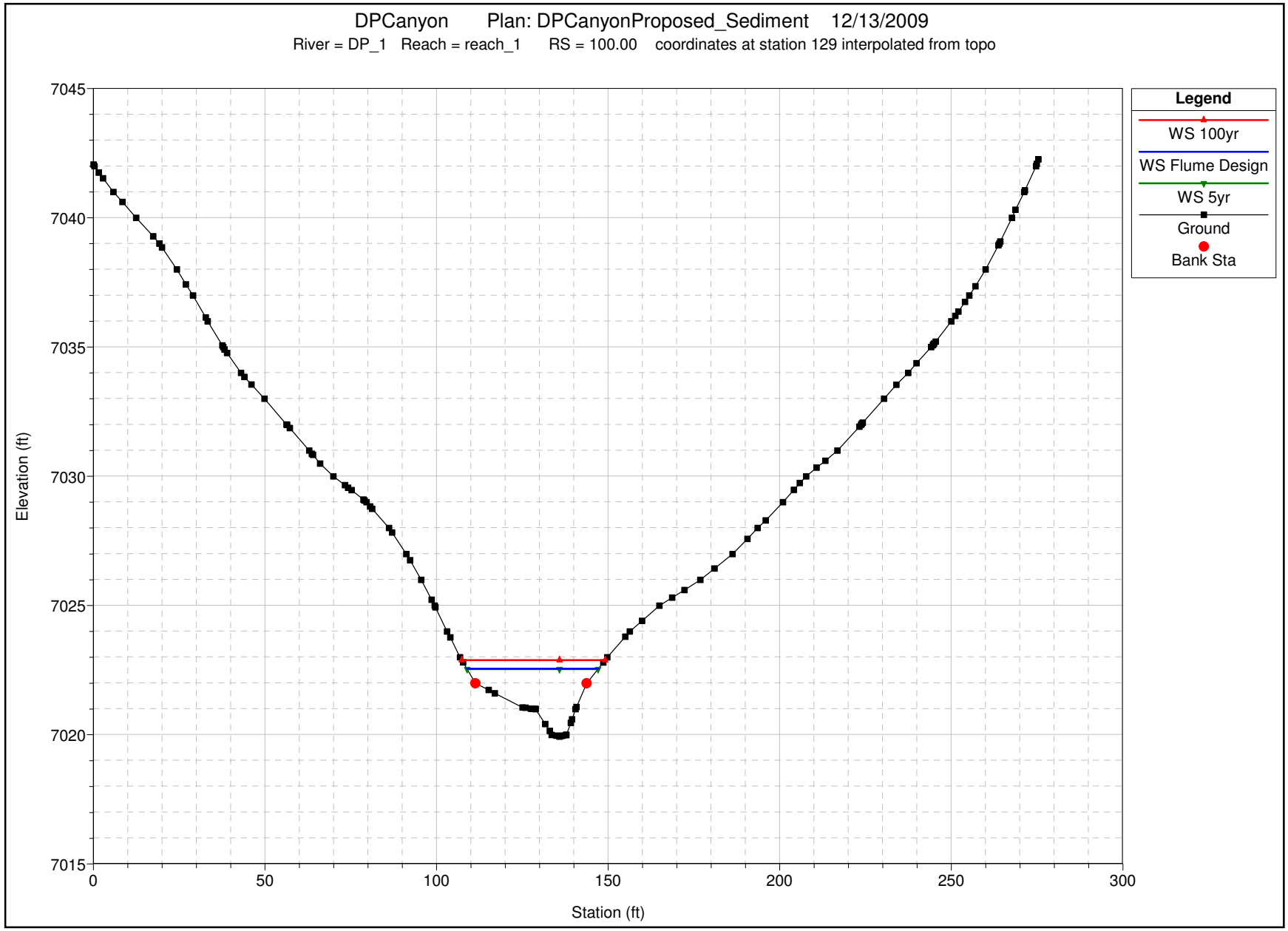
150
200
250
300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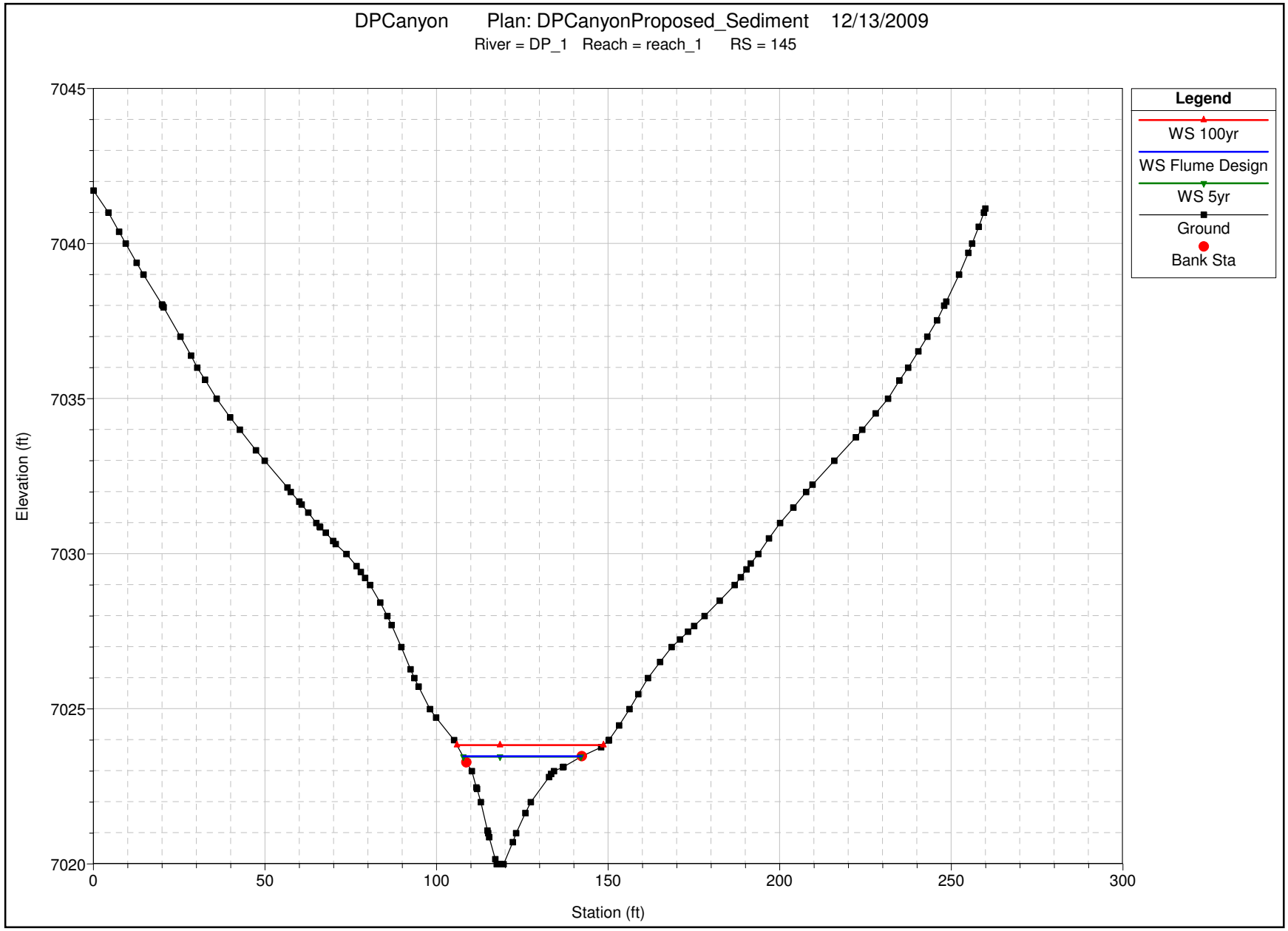
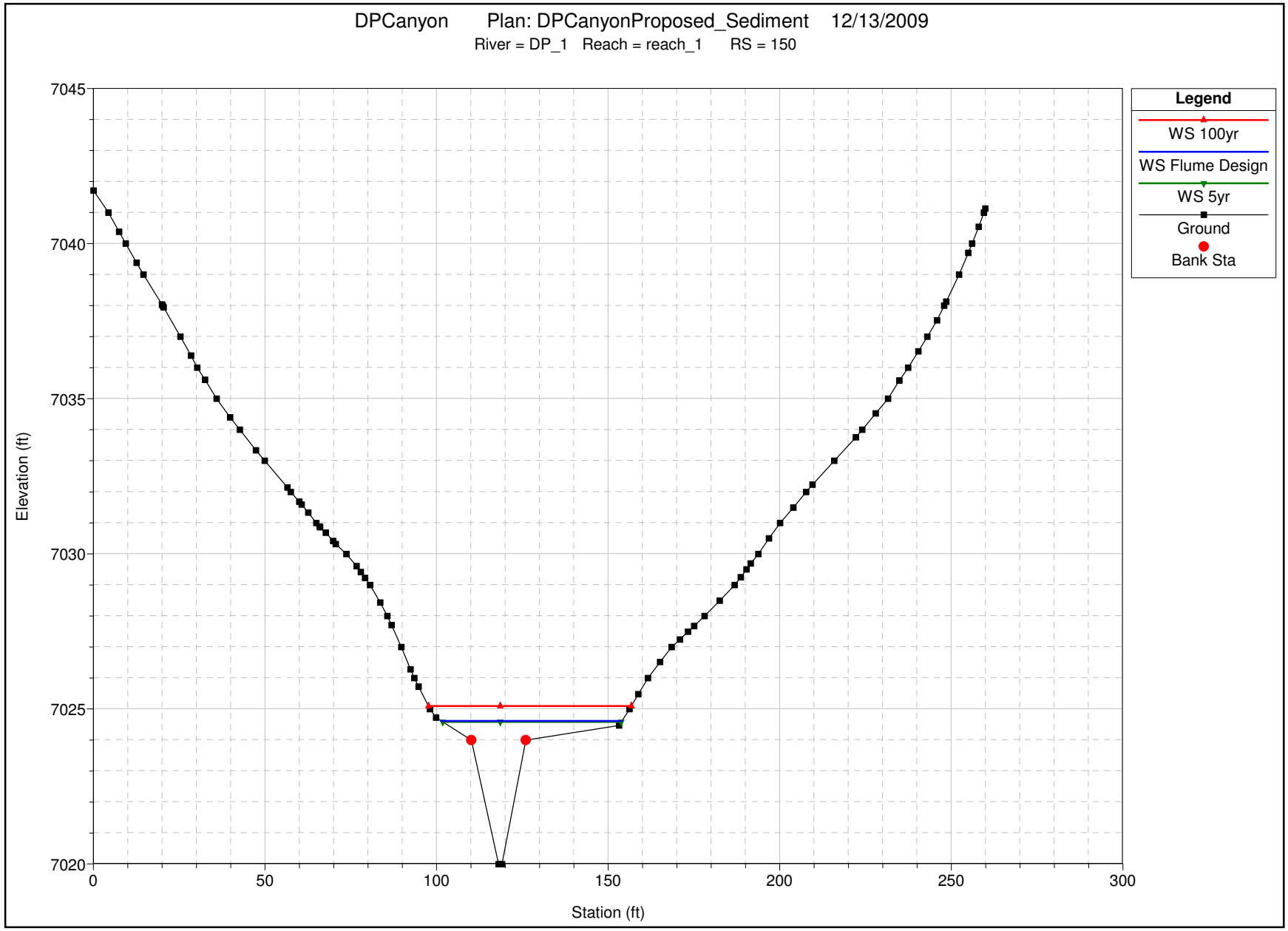
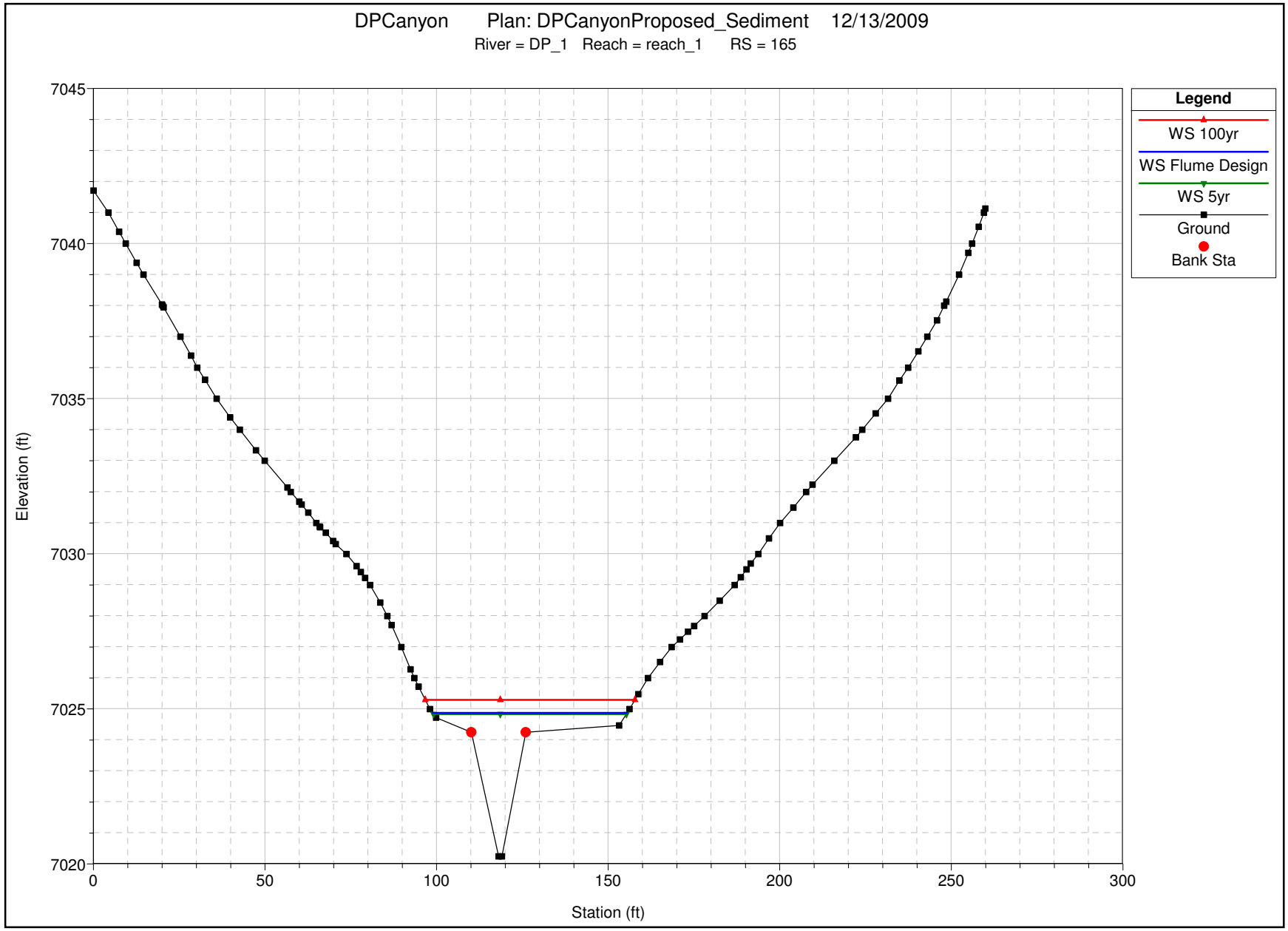
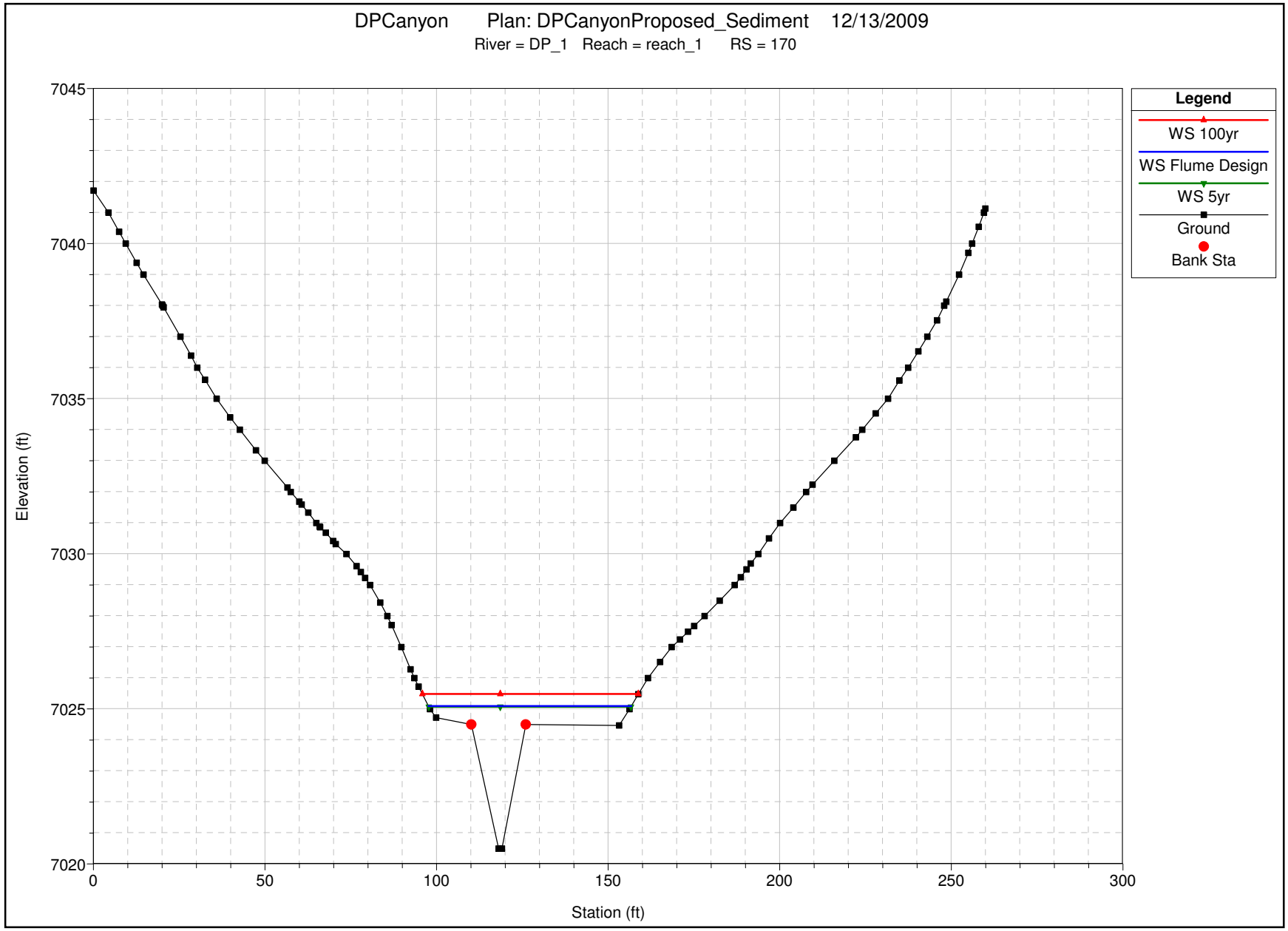
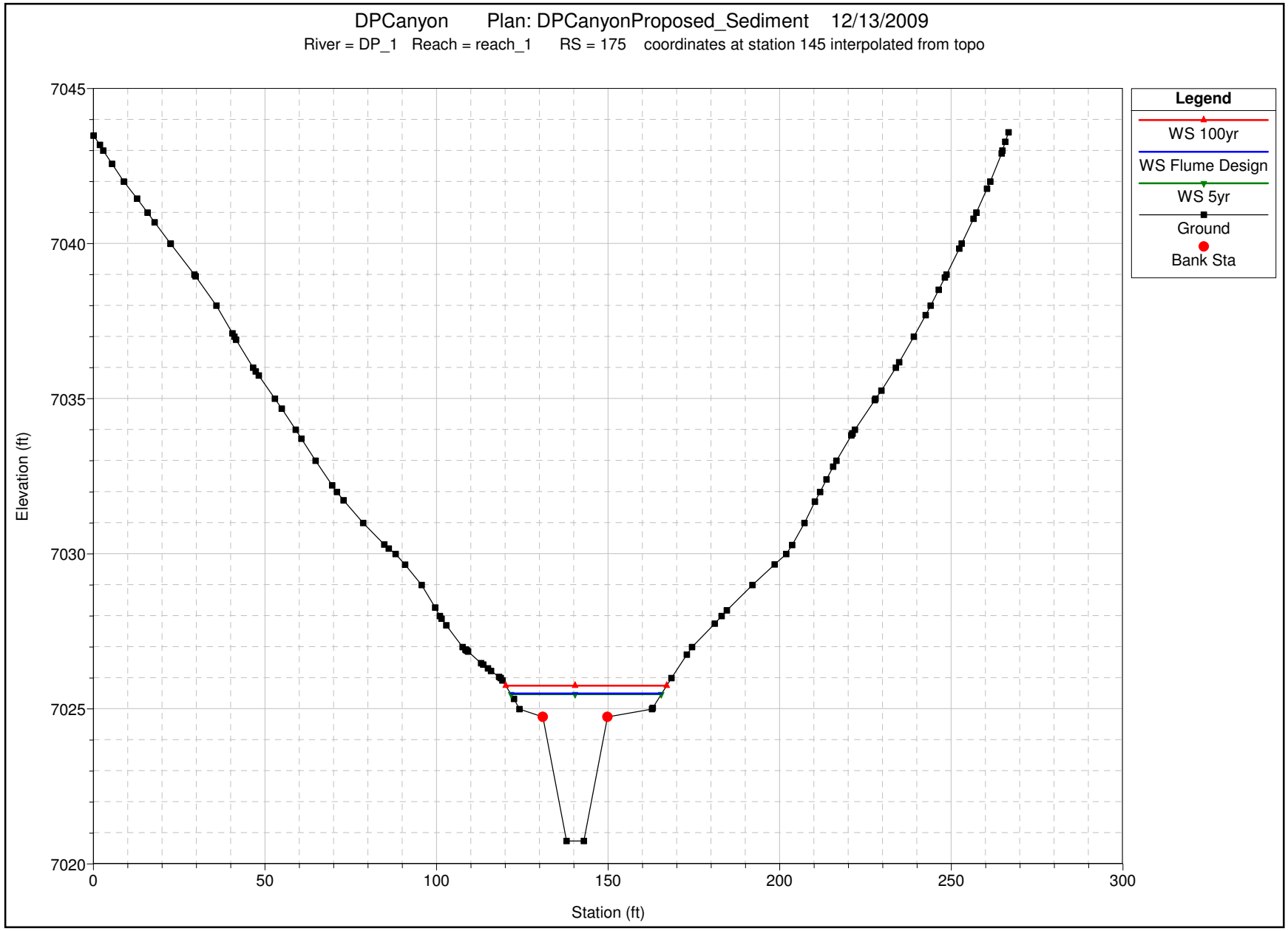
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
7015
0
50
100
150
200
250
300
Station (ft)

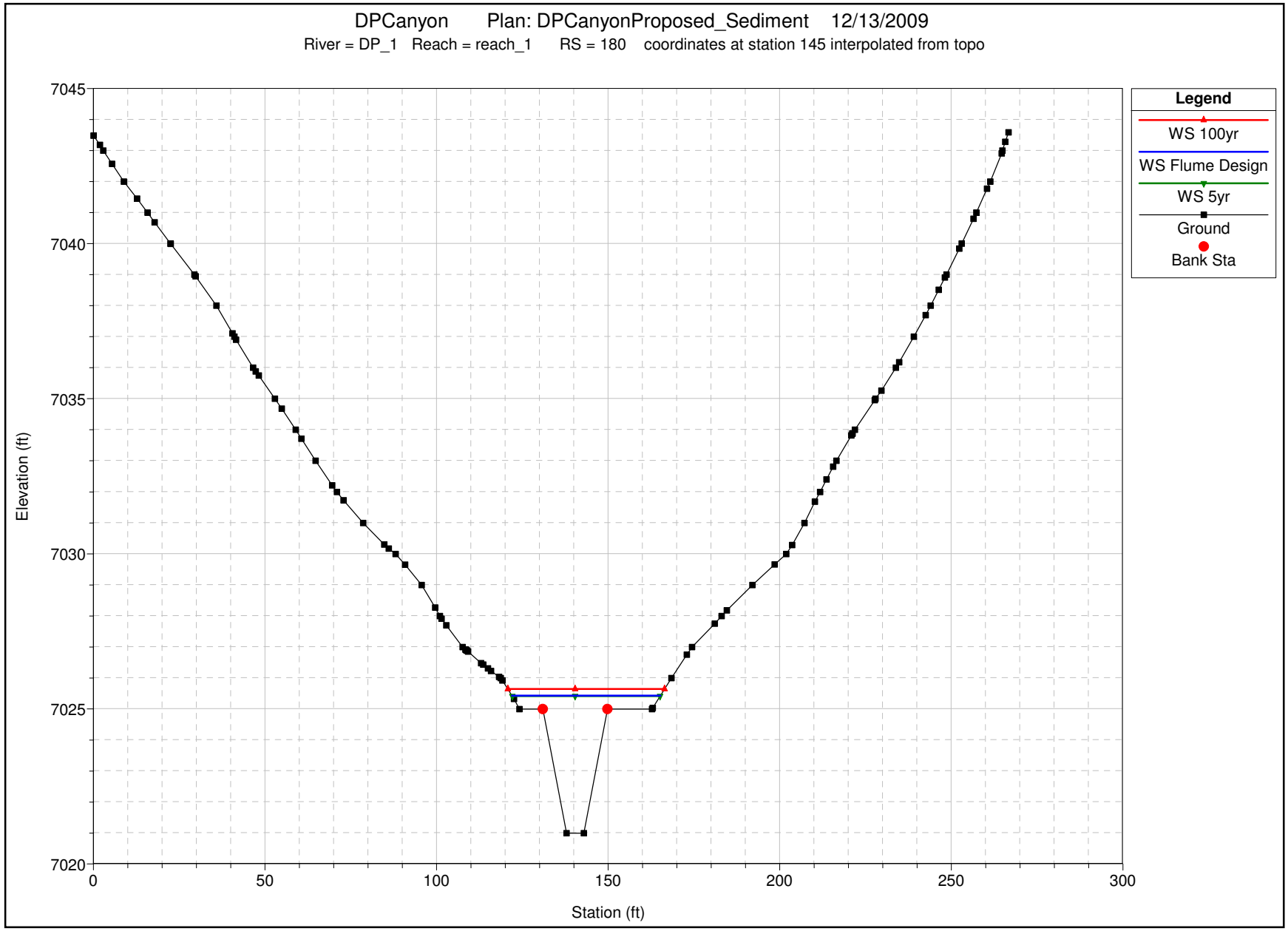

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 145
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300
Station (ft)

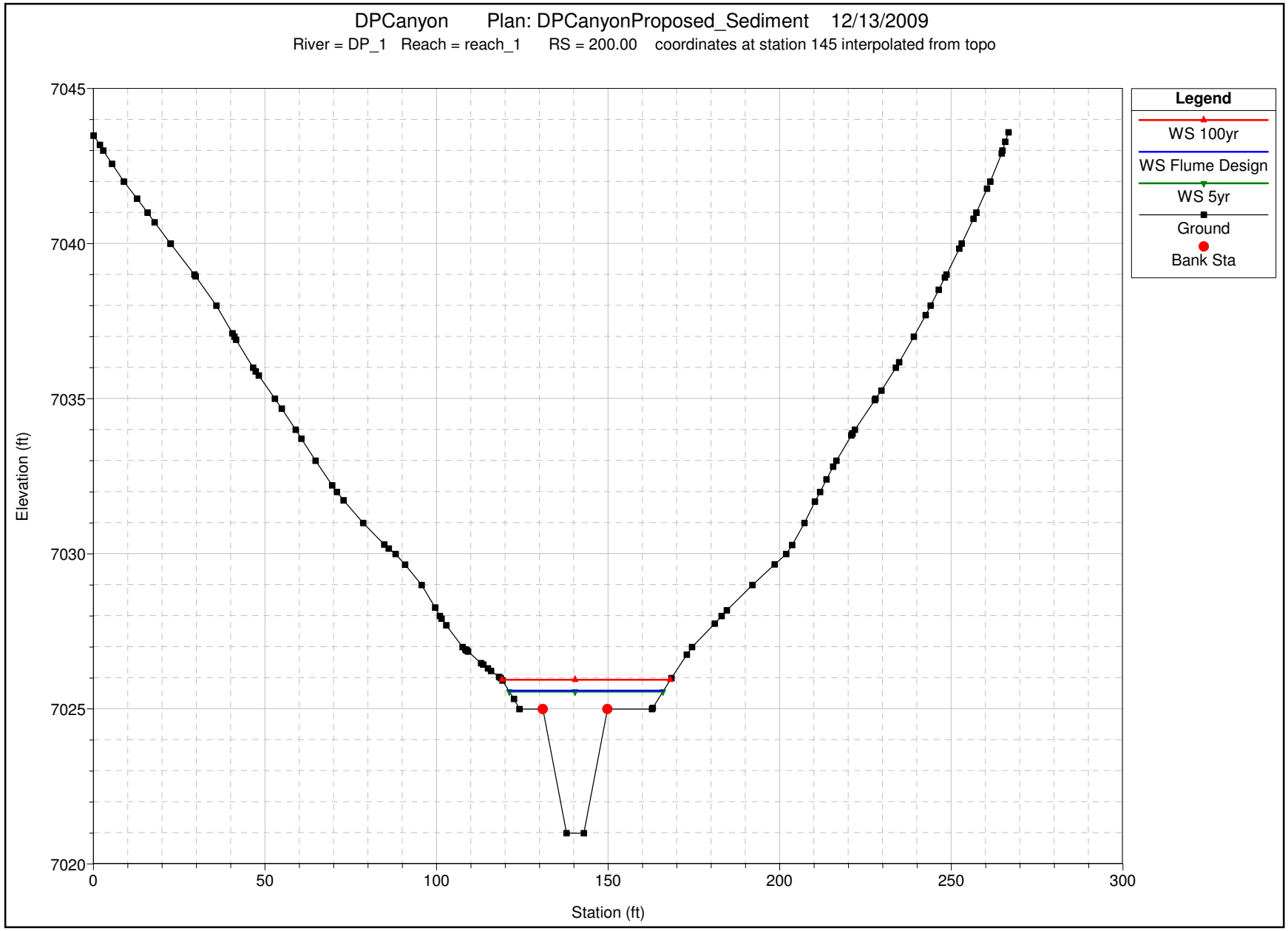

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 150
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300
Station (ft)

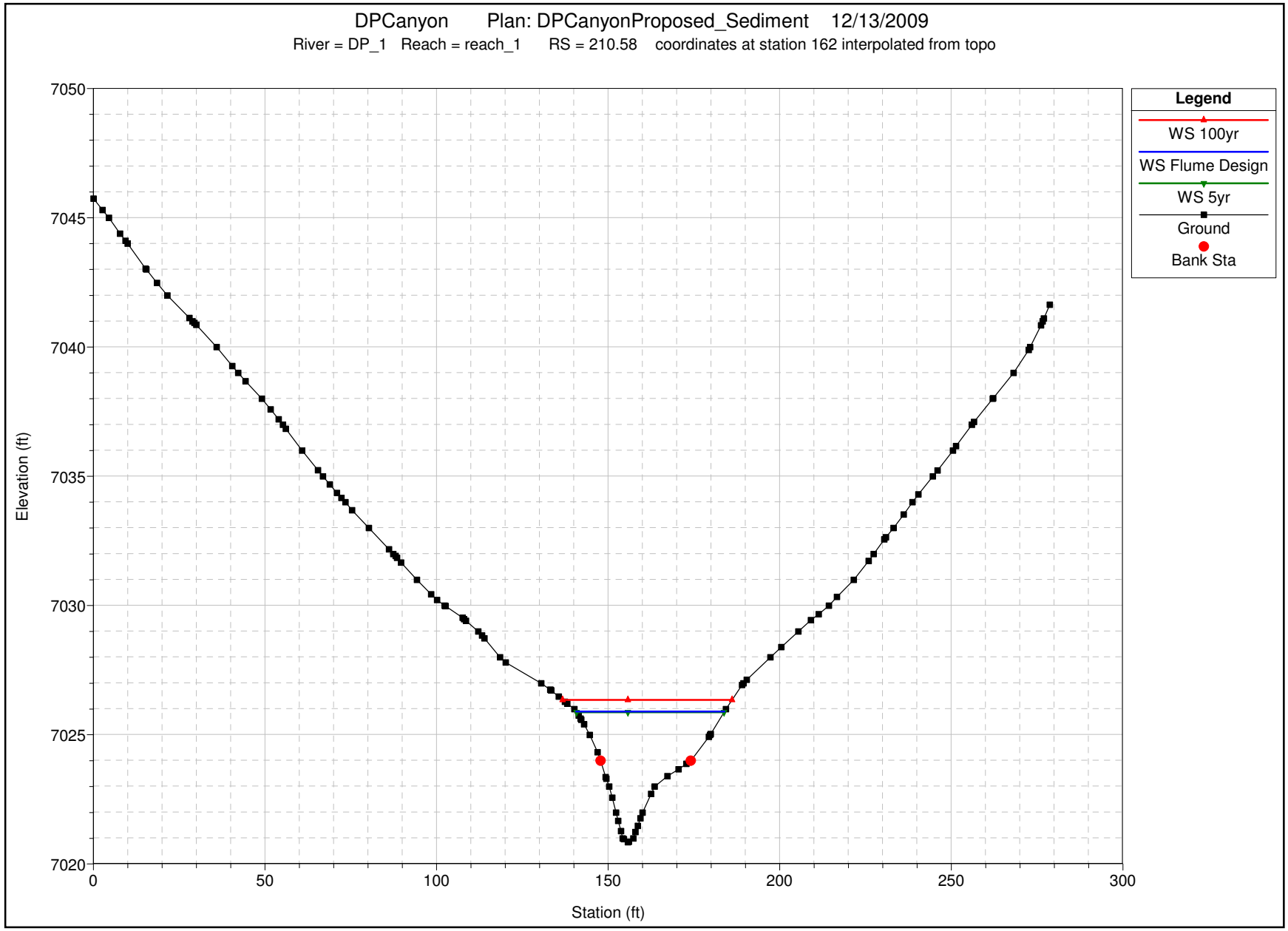

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 165
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300
Station (ft)

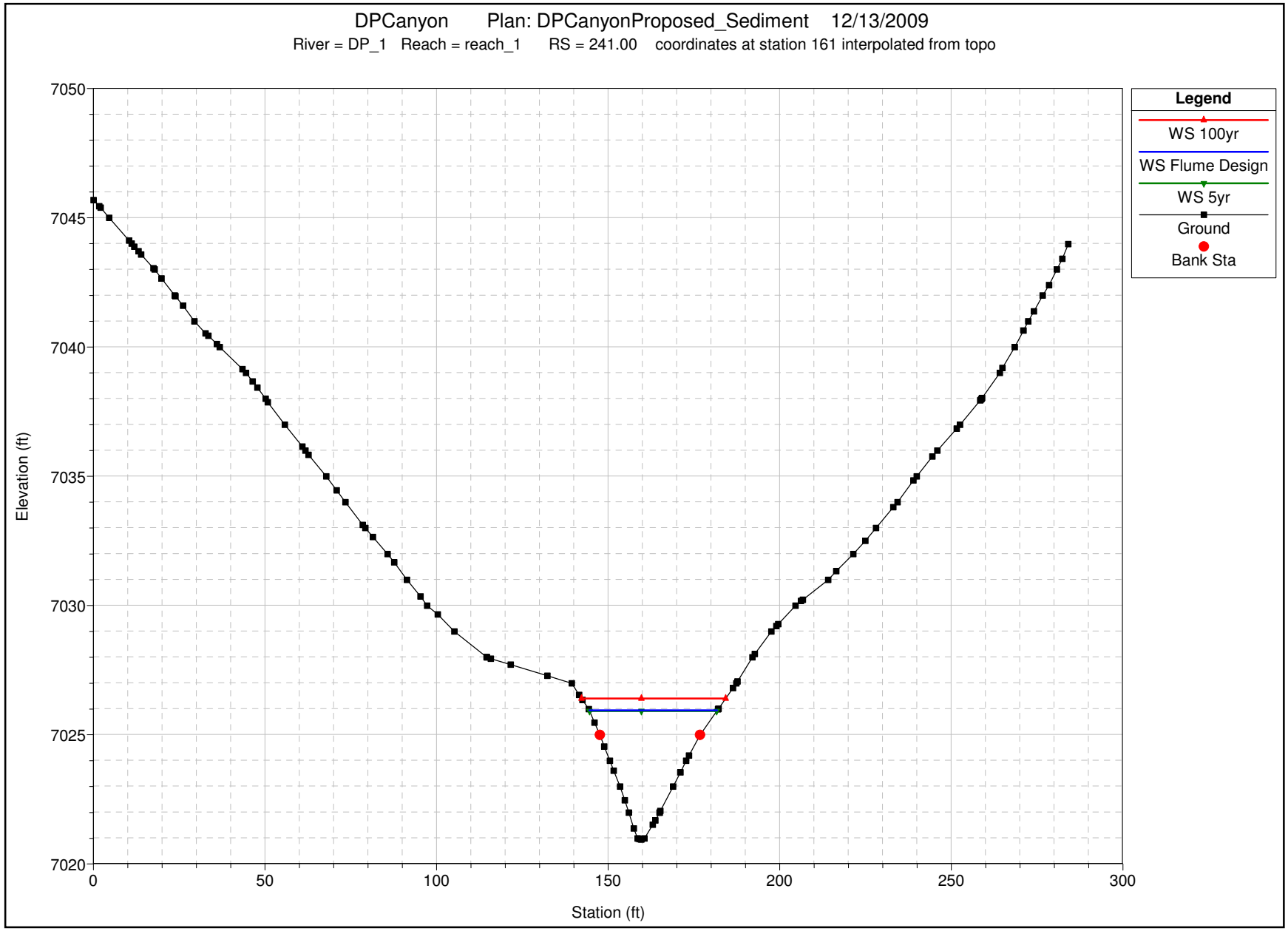

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 170
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7045
7040
7035
7030
7025
7020
Station (ft)
0
50
100
150
200
250
300


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 175 coordinates at station 145 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 180 coordinates at station 145 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

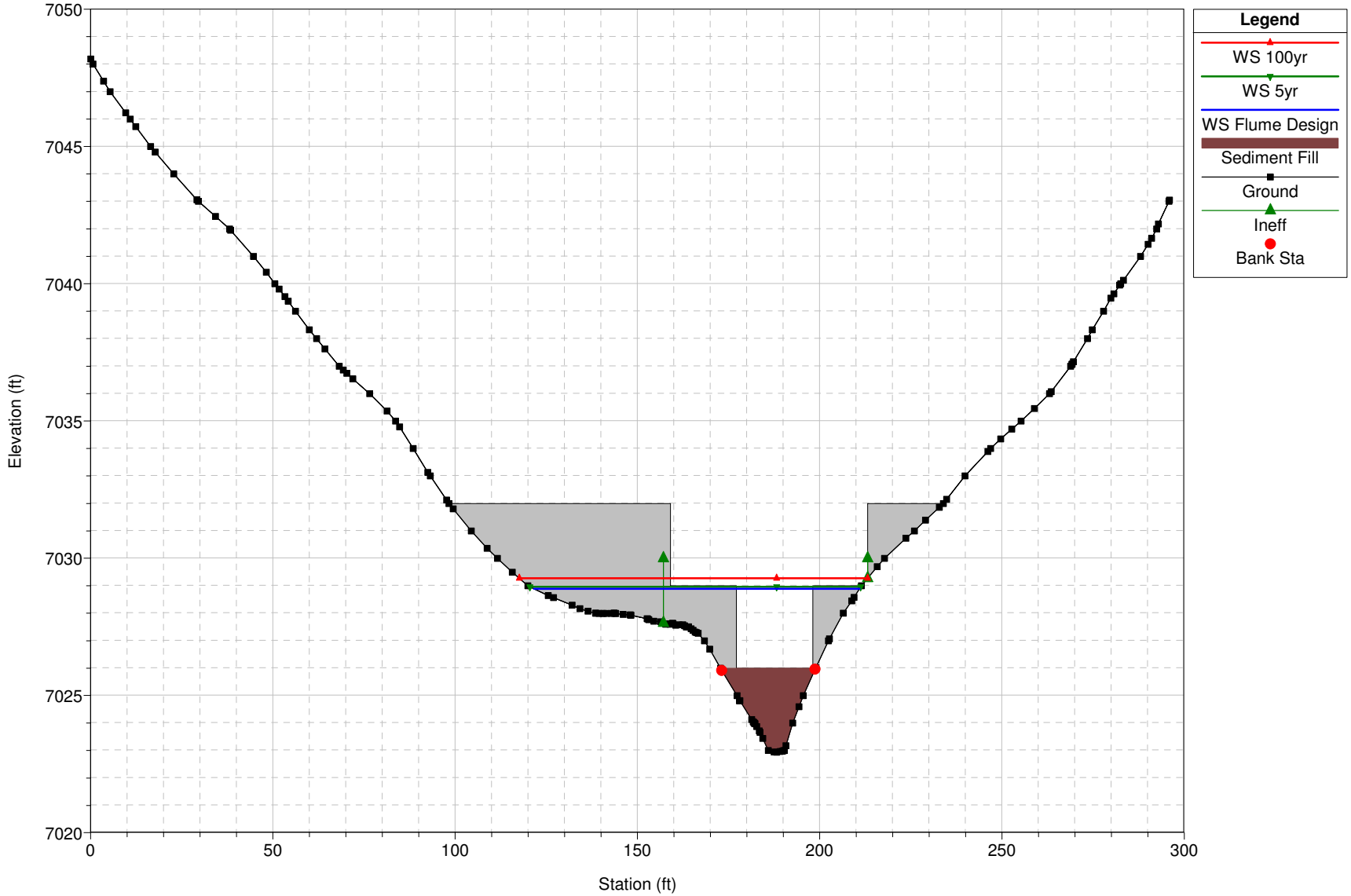

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 200.00 coordinates at station 145 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

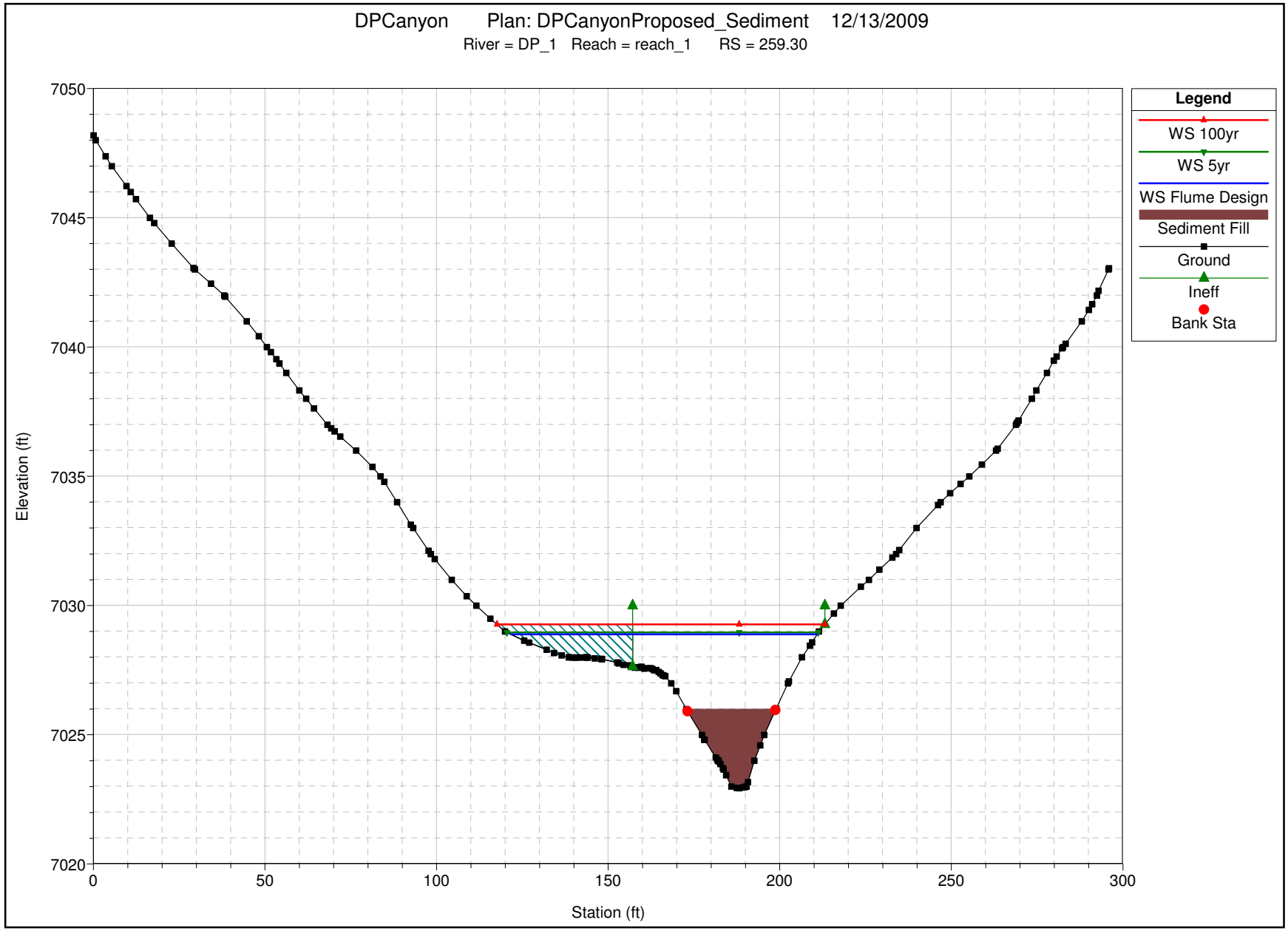

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 210.58 coordinates at station 162 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

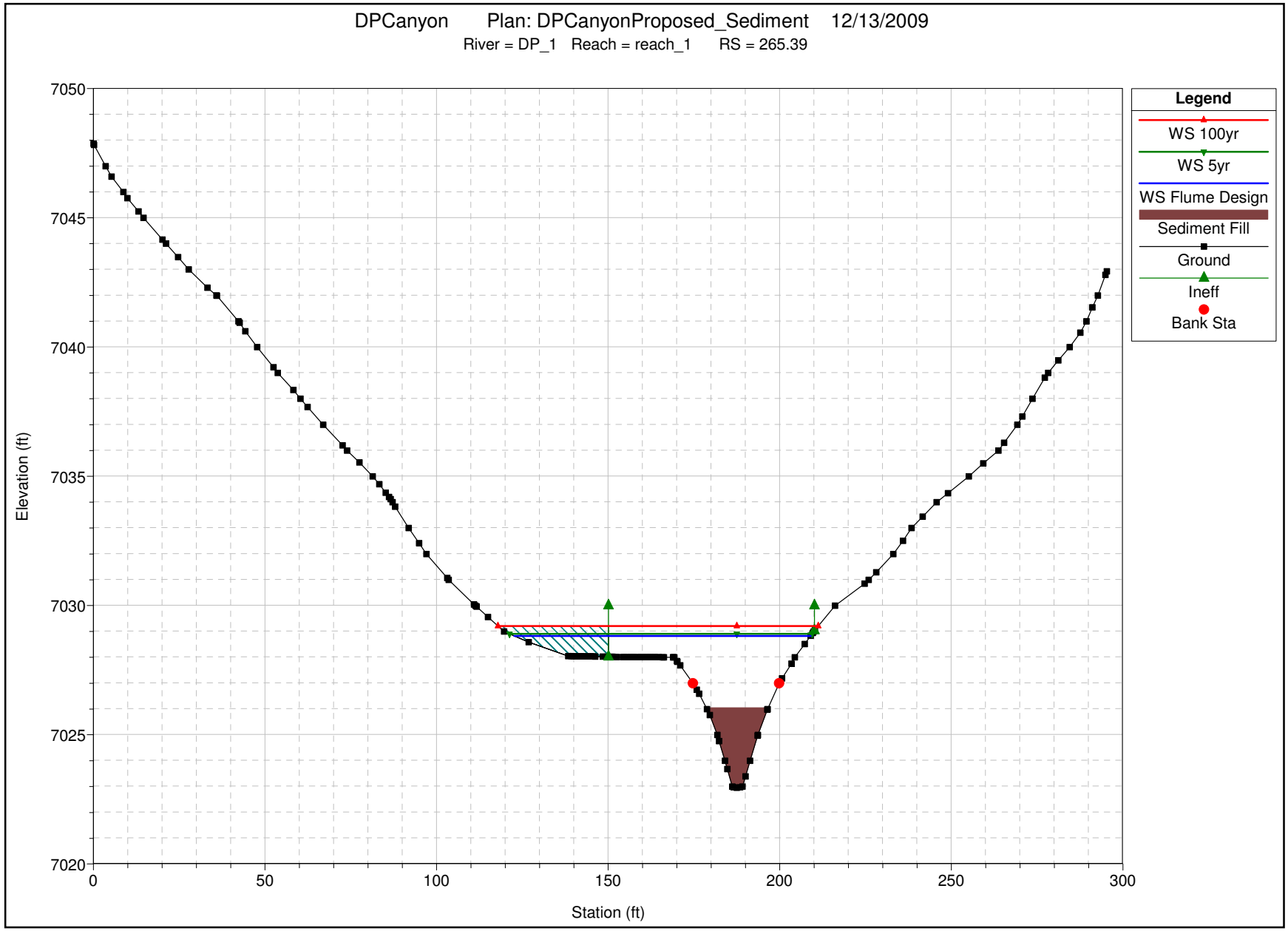

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 241.00 coordinates at station 161 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300

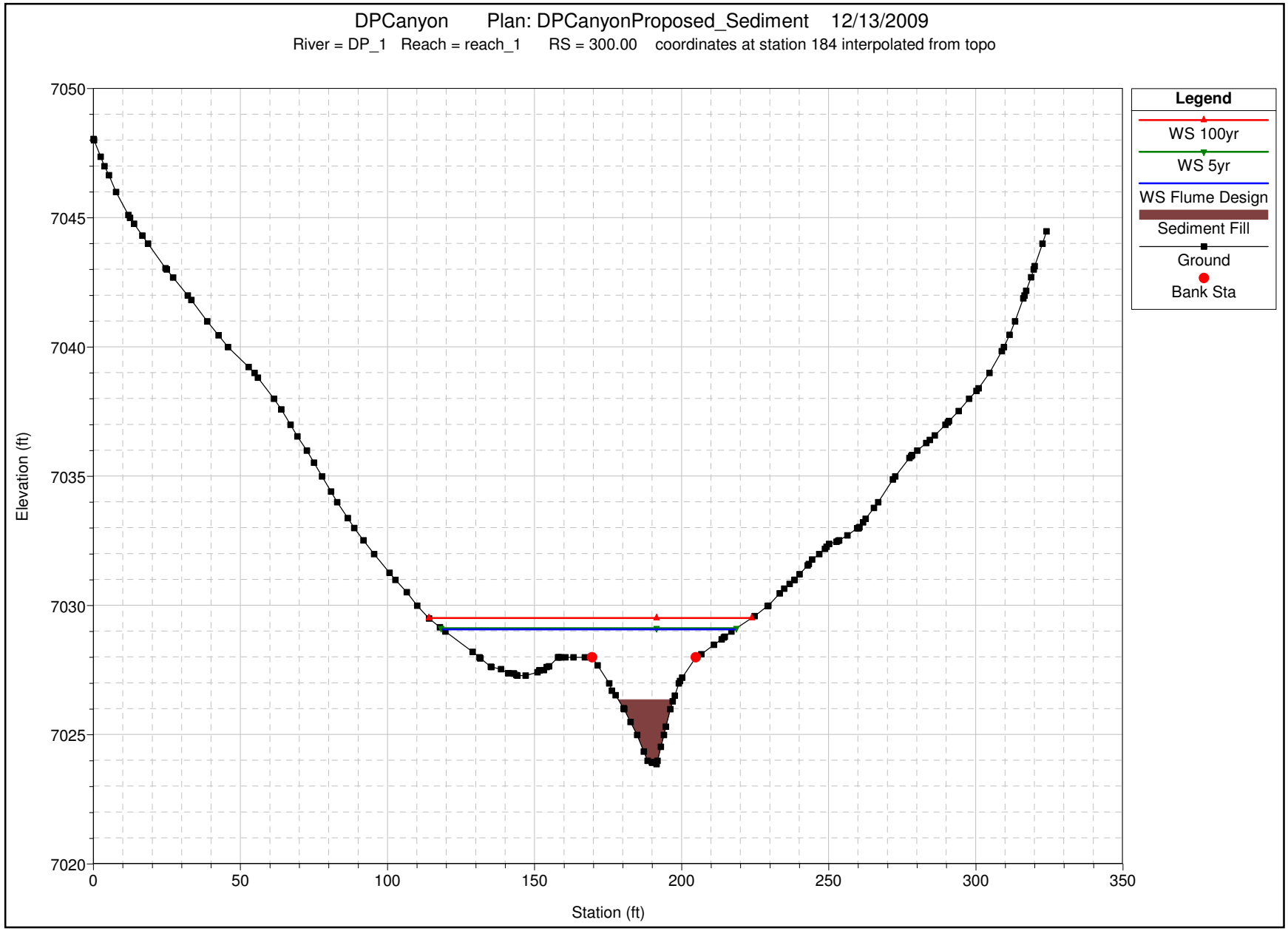
DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009

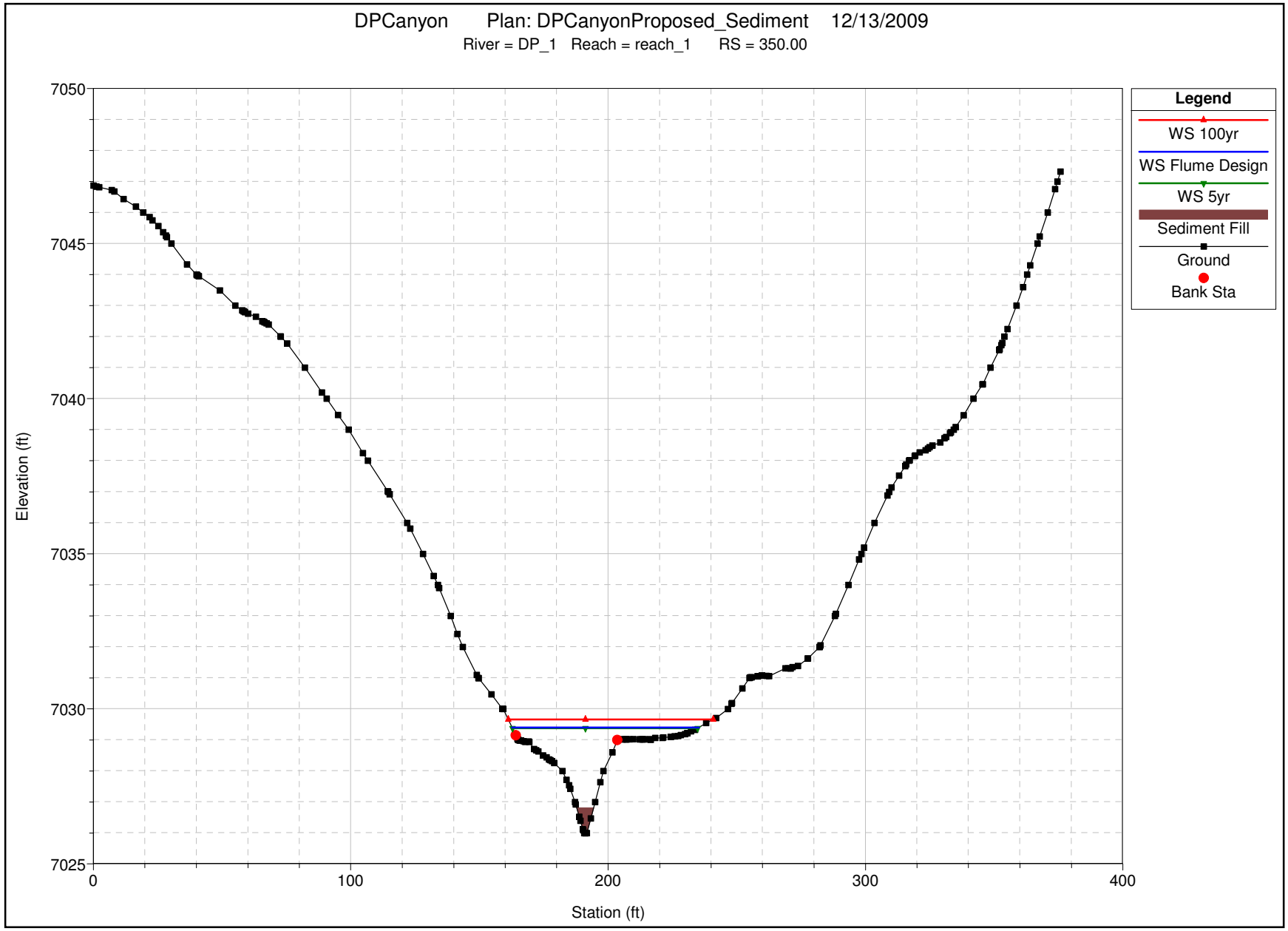
River = DP_1 Reach = reach_1 RS = 259 IS DP Canyon Gabion Grade Control Structure

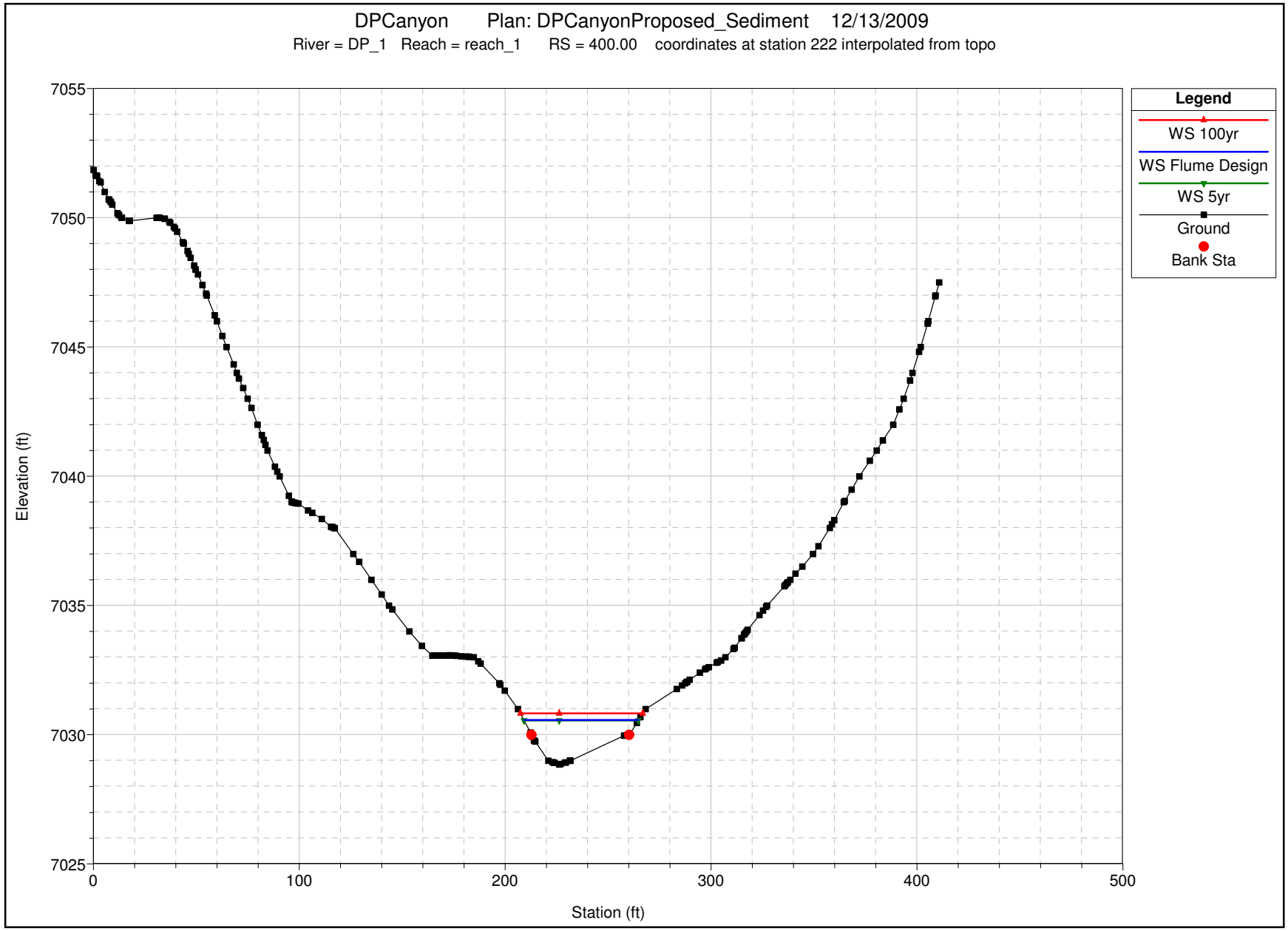


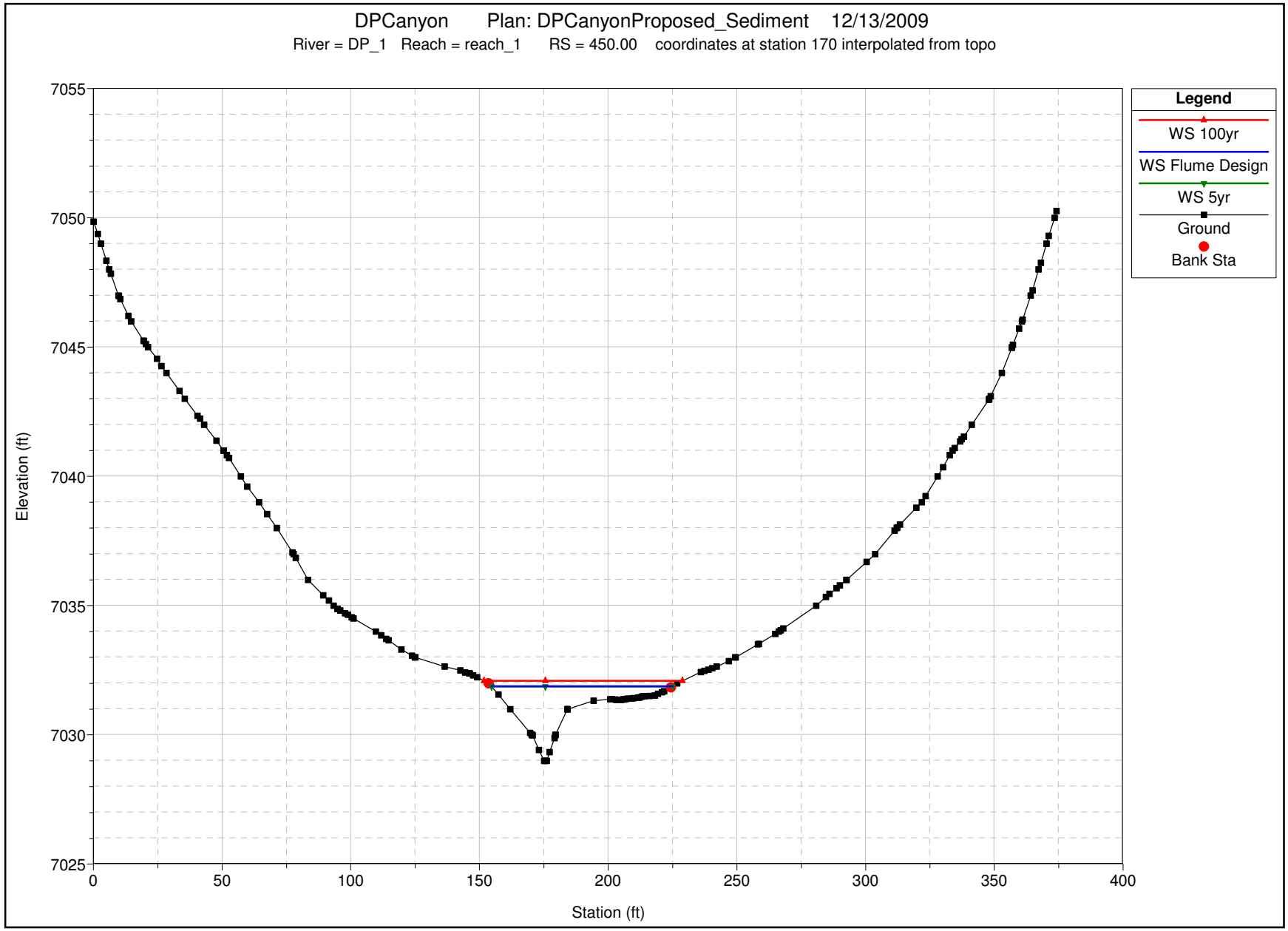

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 259.30
Elevation (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Sediment Fill
Ground
Ineff
Bank Sta

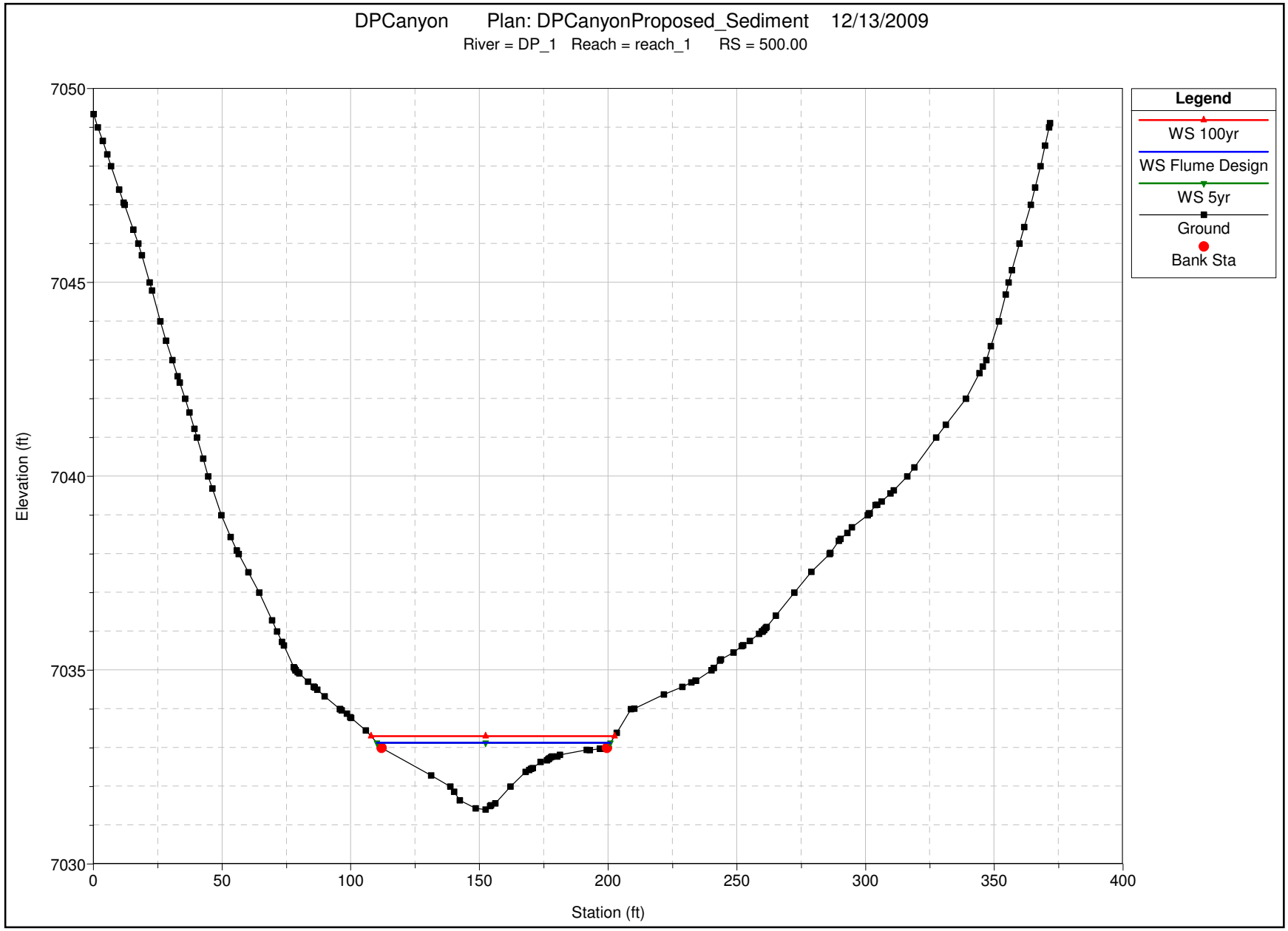

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 265.39
Elevation (ft)
7050
7045
7040
7035
7030
7025
7020
0
50
100
150
200
250
300
Station (ft)
Legend
WS 100yr
WS 5yr
WS Flume Design
Sediment Fill
Ground
Ineff
Bank Sta

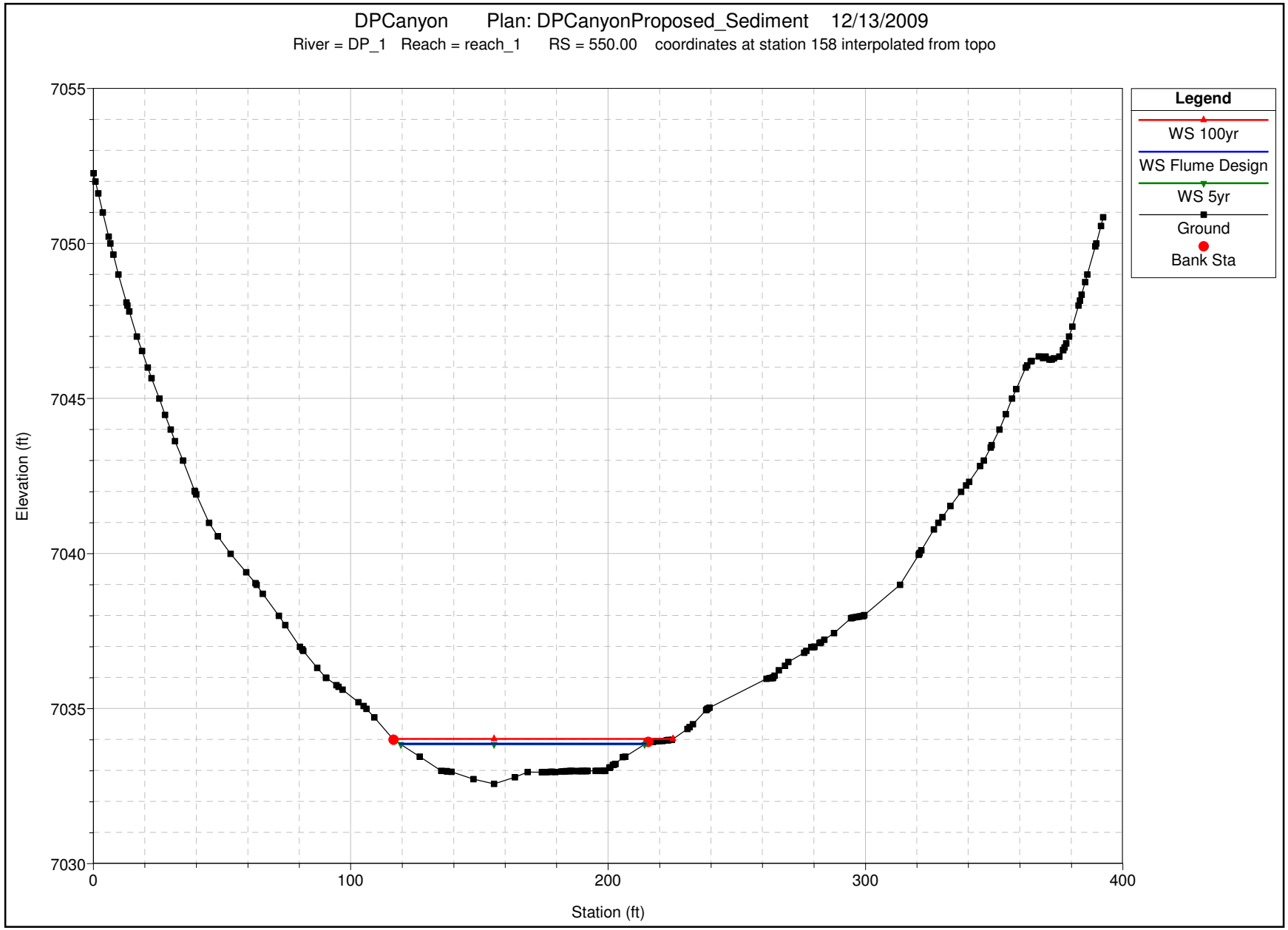

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 300.00 coordinates at station 184 interpolated from topo
Legend
WS 100yr
WS 5yr
WS Flume Design
Sediment Fill
Ground
Bank Sta
Elevation (ft)
7050
7045
7040
7035
7030
7025
7020
Station (ft)
0
50
100
150
200
250
300
350

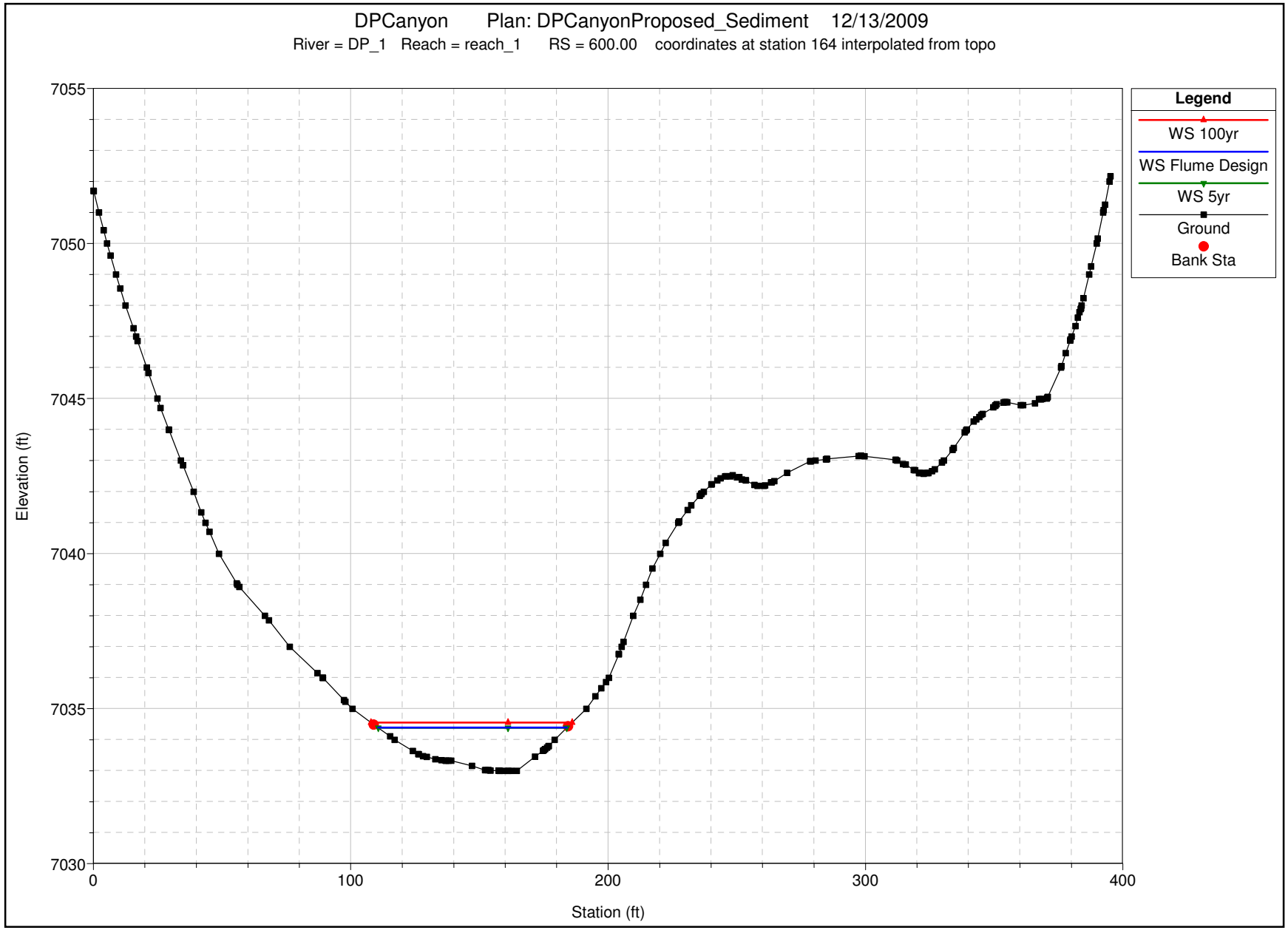

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 350.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Sediment Fill
Ground
Bank Sta
Elevation (ft)
7050
7045
7040
7035
7030
7025
0
100
200
300
400
Station (ft)

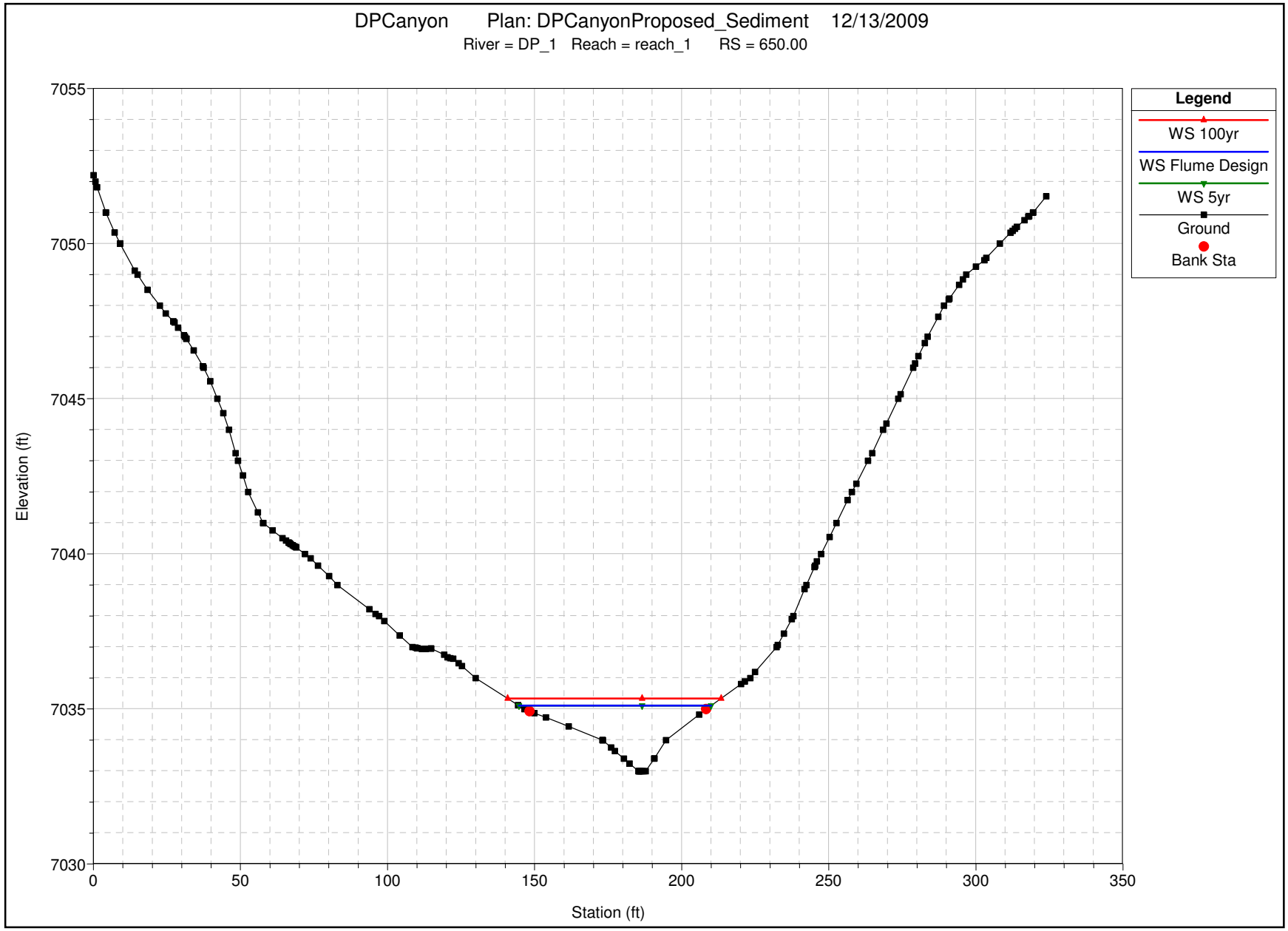

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 400.00 coordinates at station 222 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
7050
7045
7040
7035
7030
7025
0
100
200
300
400
500
Station (ft)


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 450.00 coordinates at station 170 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7055
7050
7045
7040
7035
7030
7025
0
50
100
150
200
250
300
350
400


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 500.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7050
7045
7040
7035
7030
Station (ft)
0
50
100
150
200
250
300
350
400

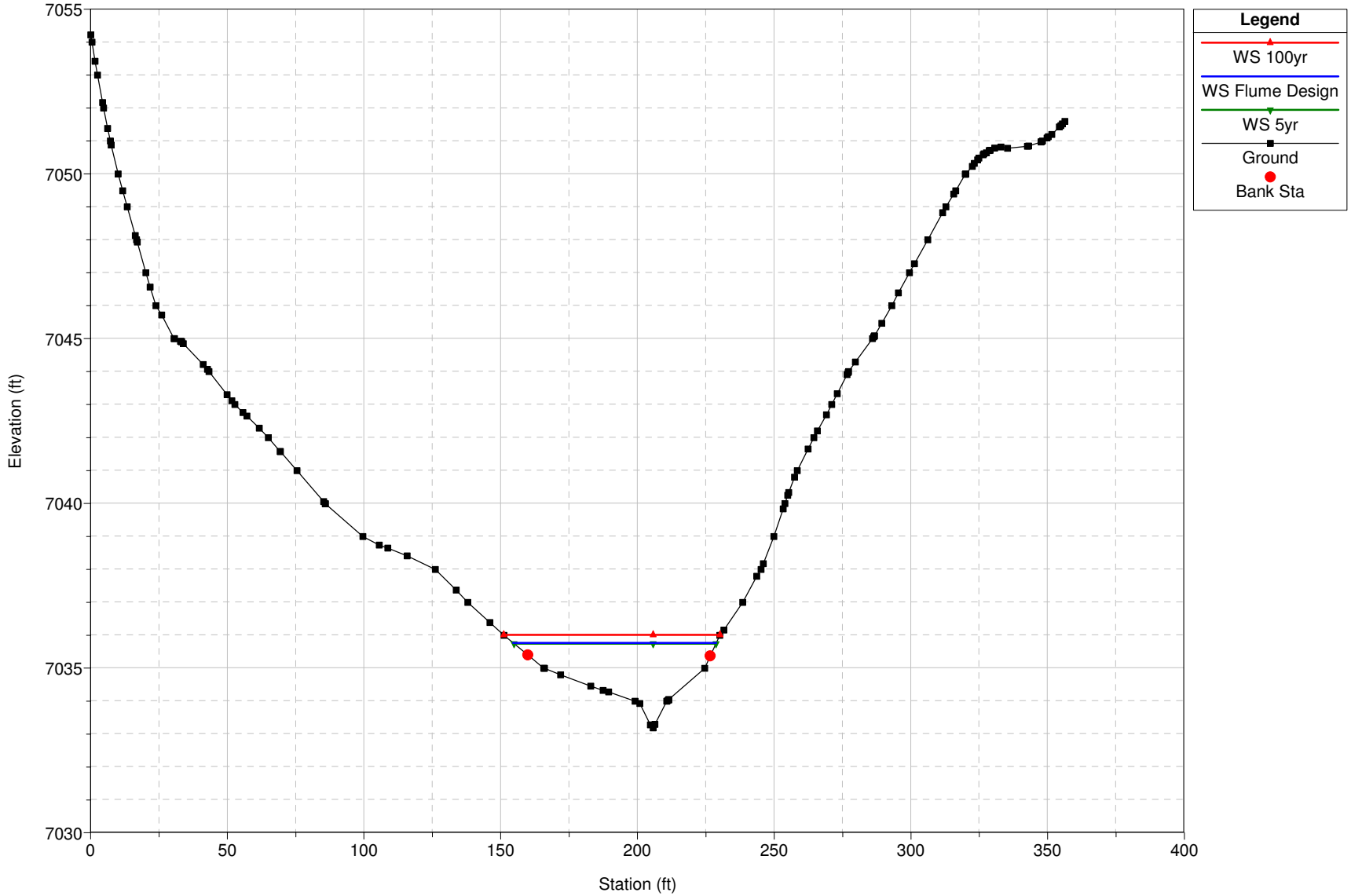

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 550.00 coordinates at station 158 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
7050
7045
7040
7035
7030
0
100
200
300
400
Station (ft)

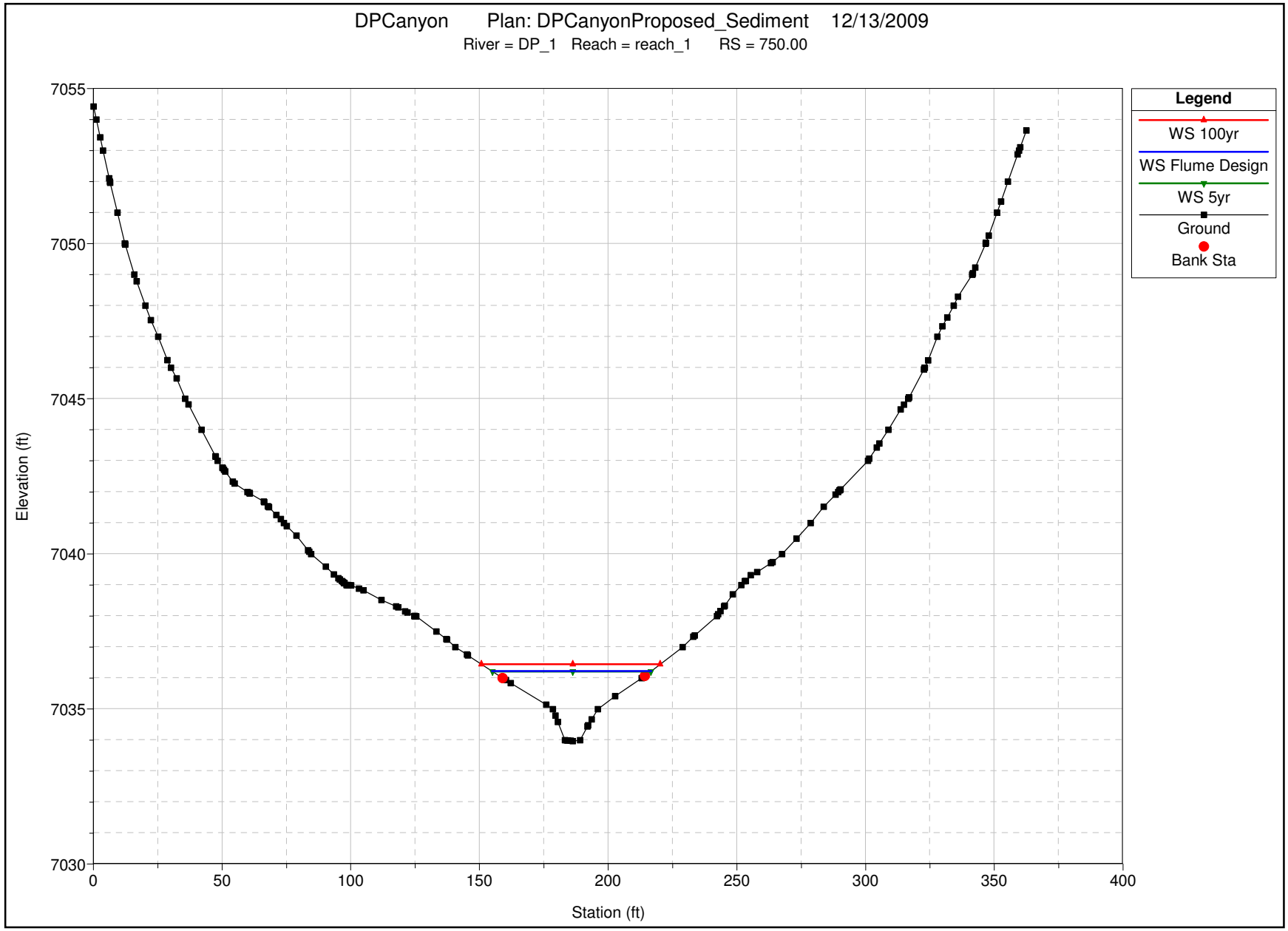

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 600.00 coordinates at station 164 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
7050
7045
7040
7035
7030
0
100
200
300
400
Station (ft)

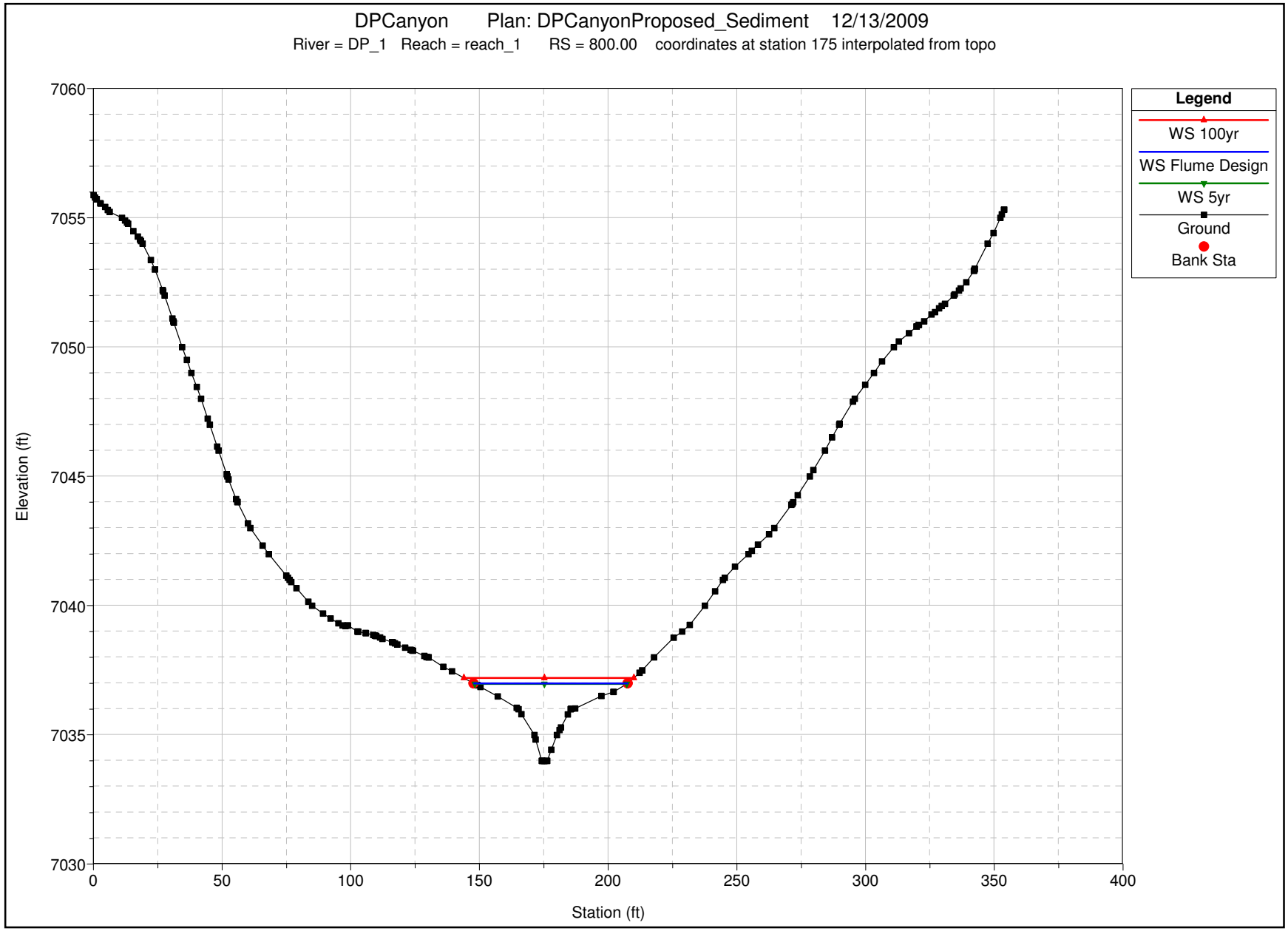

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 650.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
7050
7045
7040
7035
7030
Station (ft)
0
50
100
150
200
250
300
350

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009

River = DP_1 Reach = reach_1 RS = 700.00 coordinates at station 200 interpolated from topo

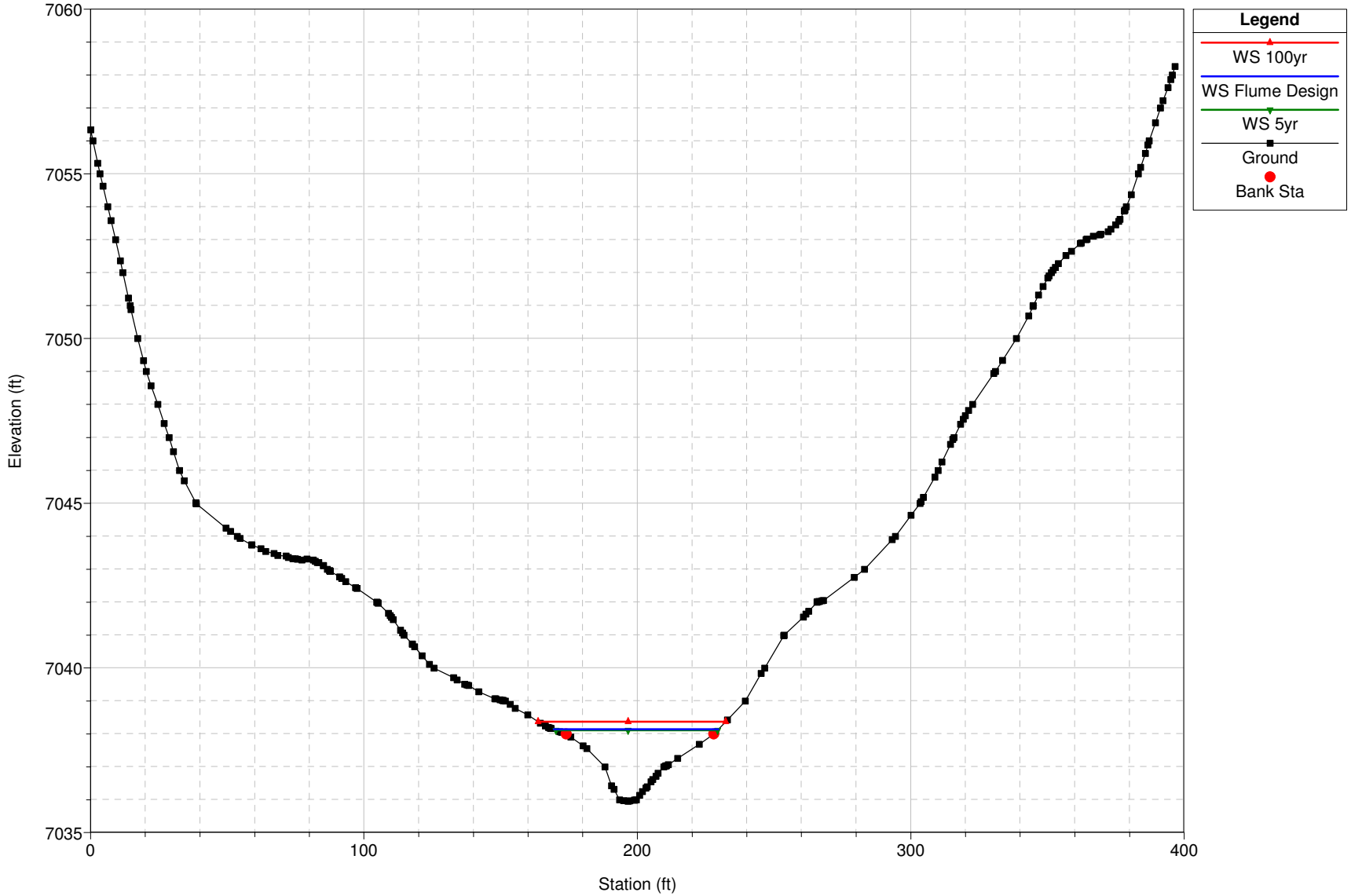


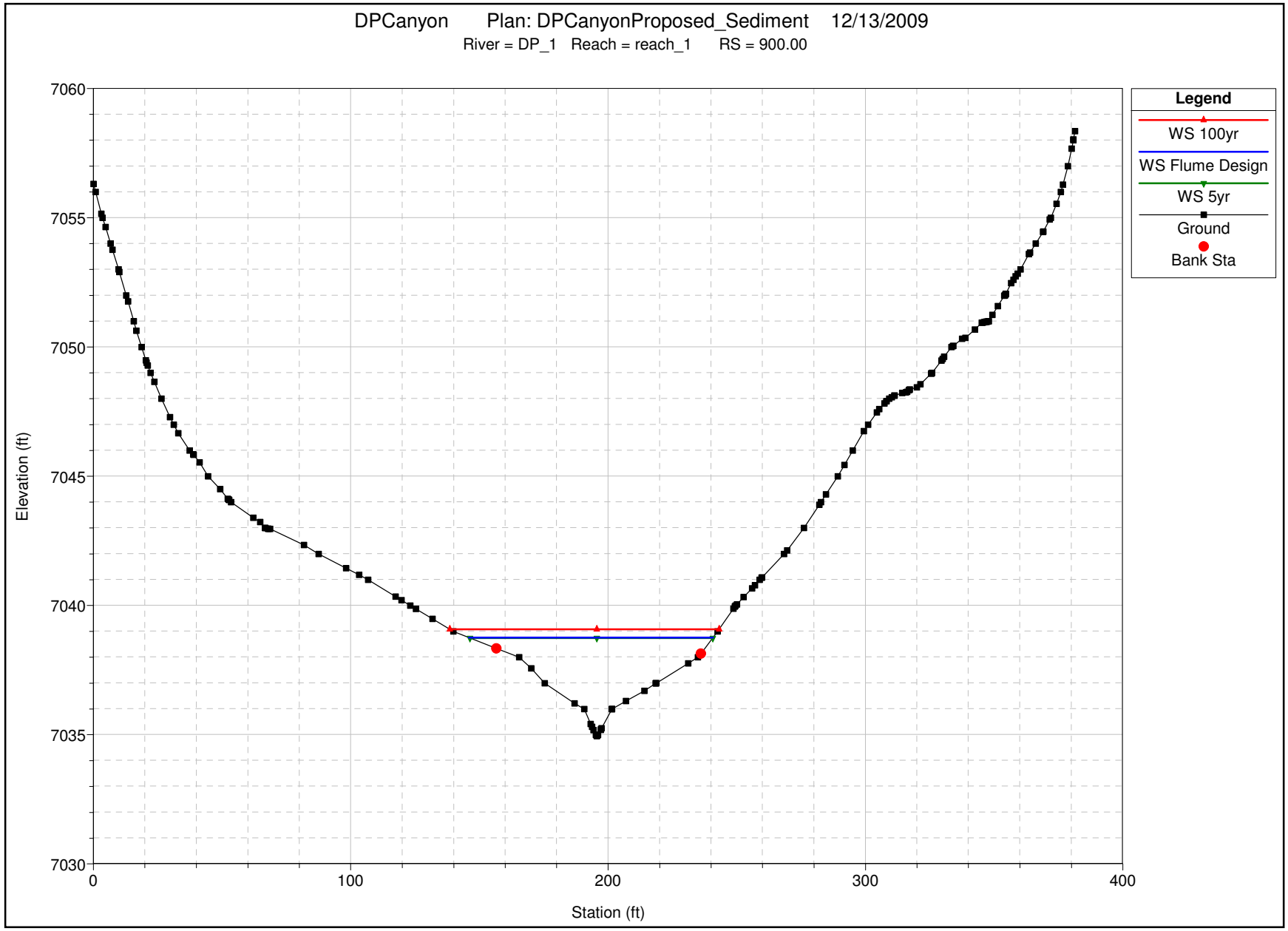

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 750.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7055
7050
7045
7040
7035
7030
0
50
100
150
200
250
300
350
400
Station (ft)

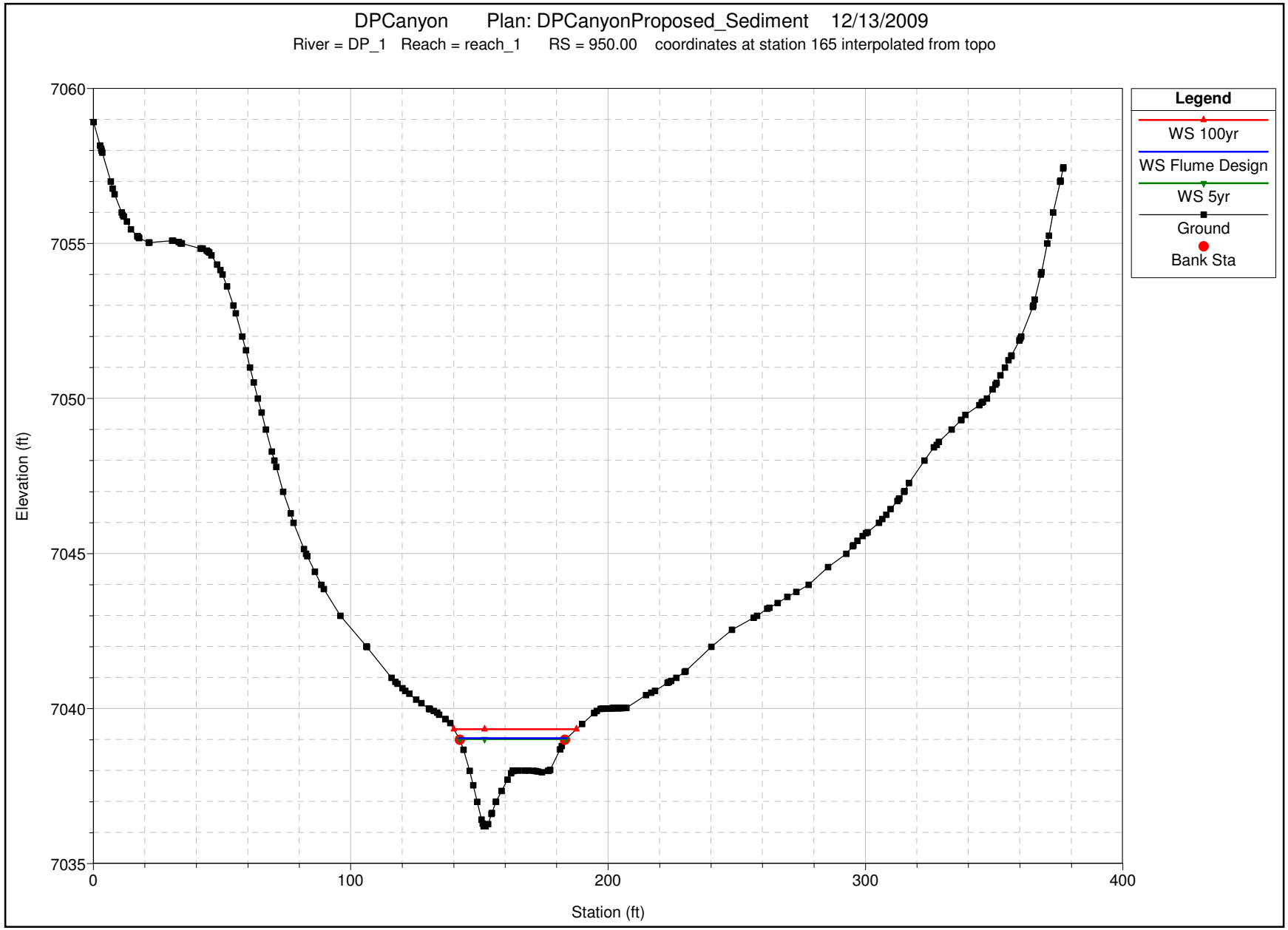

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 800.00 coordinates at station 175 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7060
7055
7050
7045
7040
7035
7030
0
50
100
150
200
250
300
350
400

DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009

River = DP_1 Reach = reach_1 RS = 850.00 coordinates at station 199 interpolated from topo

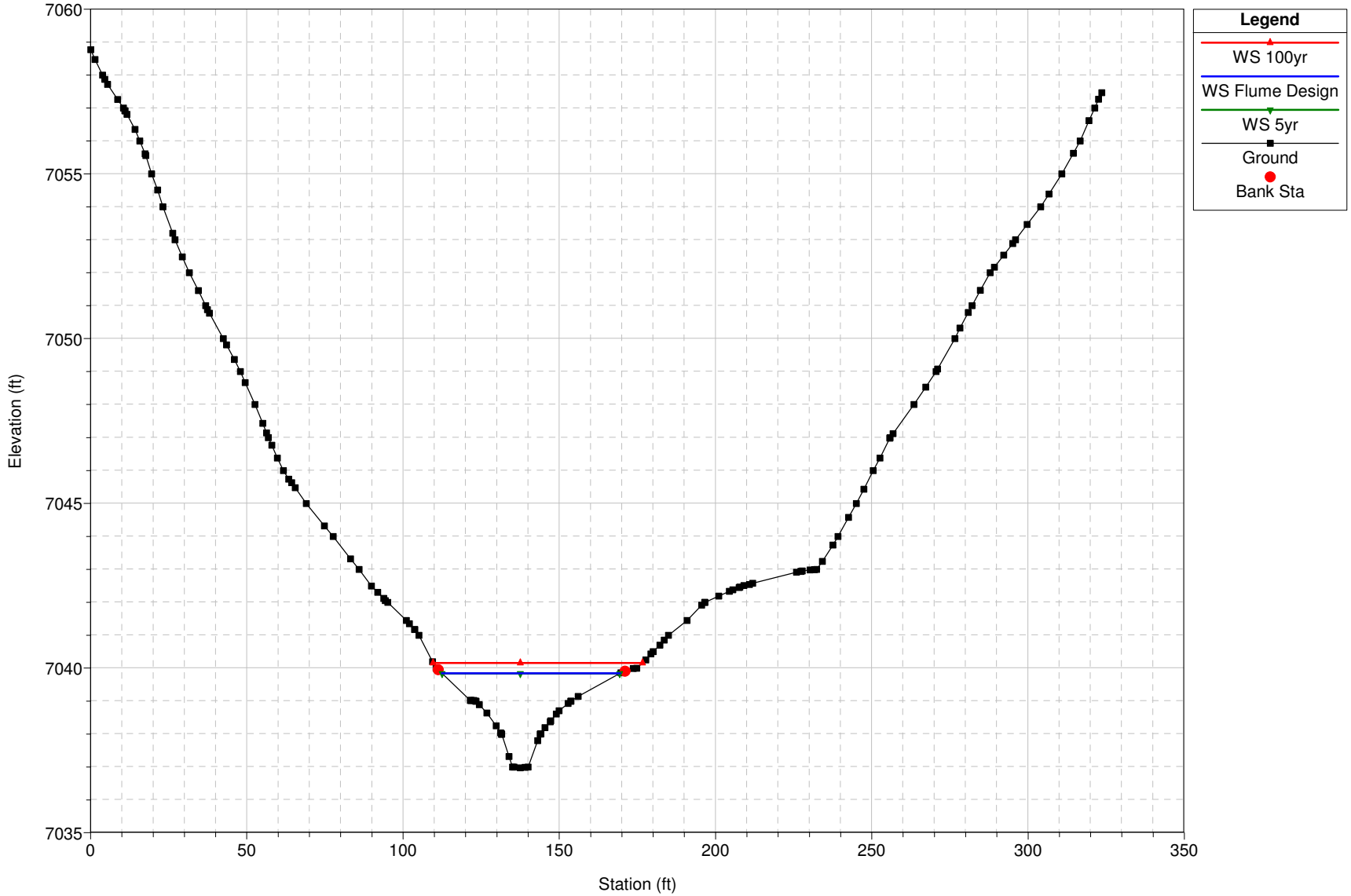



DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 900.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7060
7055
7050
7045
7040
7035
7030
0
100
200
300
400
Station (ft)


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 950.00 coordinates at station 165 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
7060
7055
7050
7045
7040
7035
0
100
200
300
400

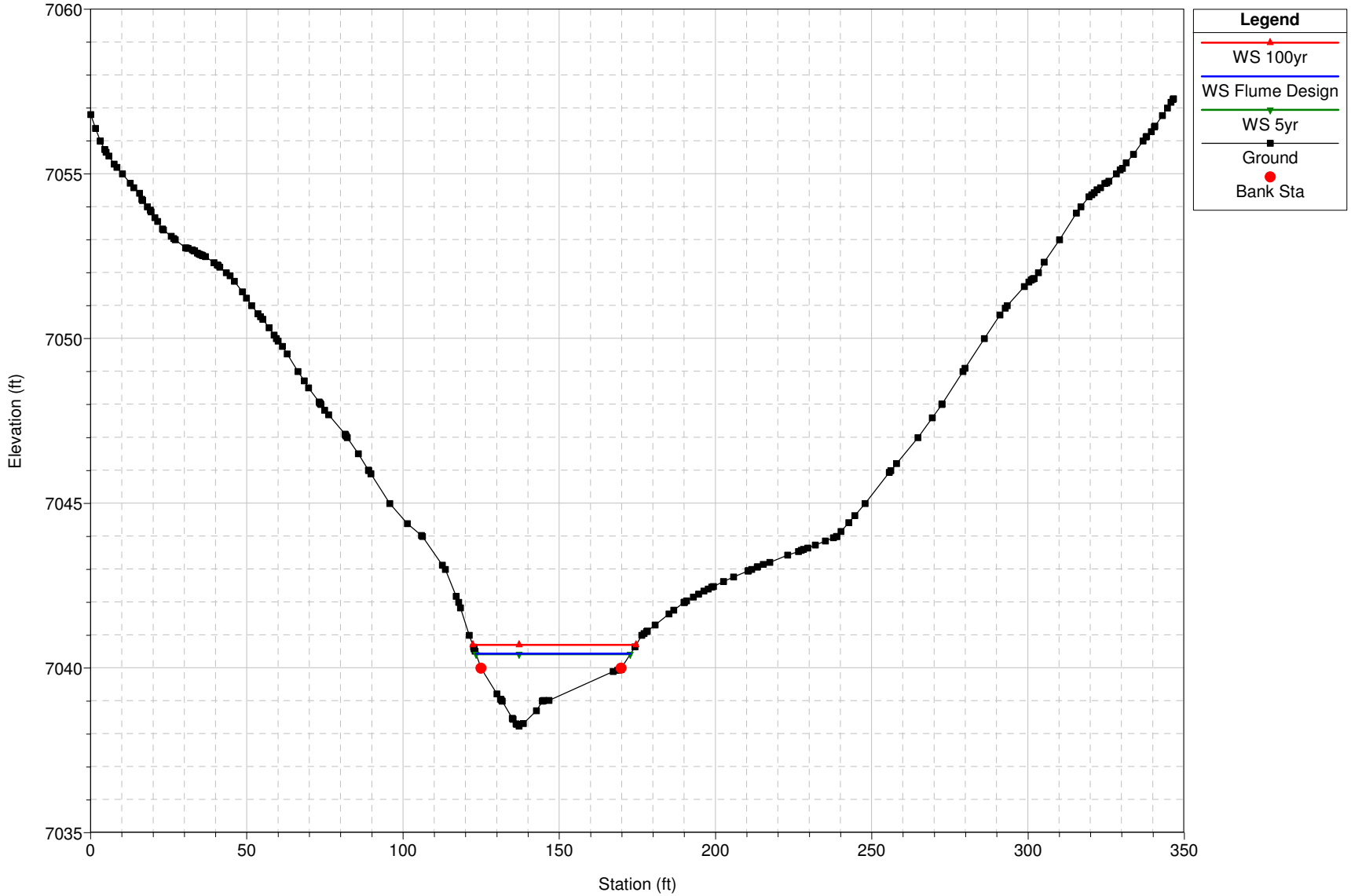
DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009

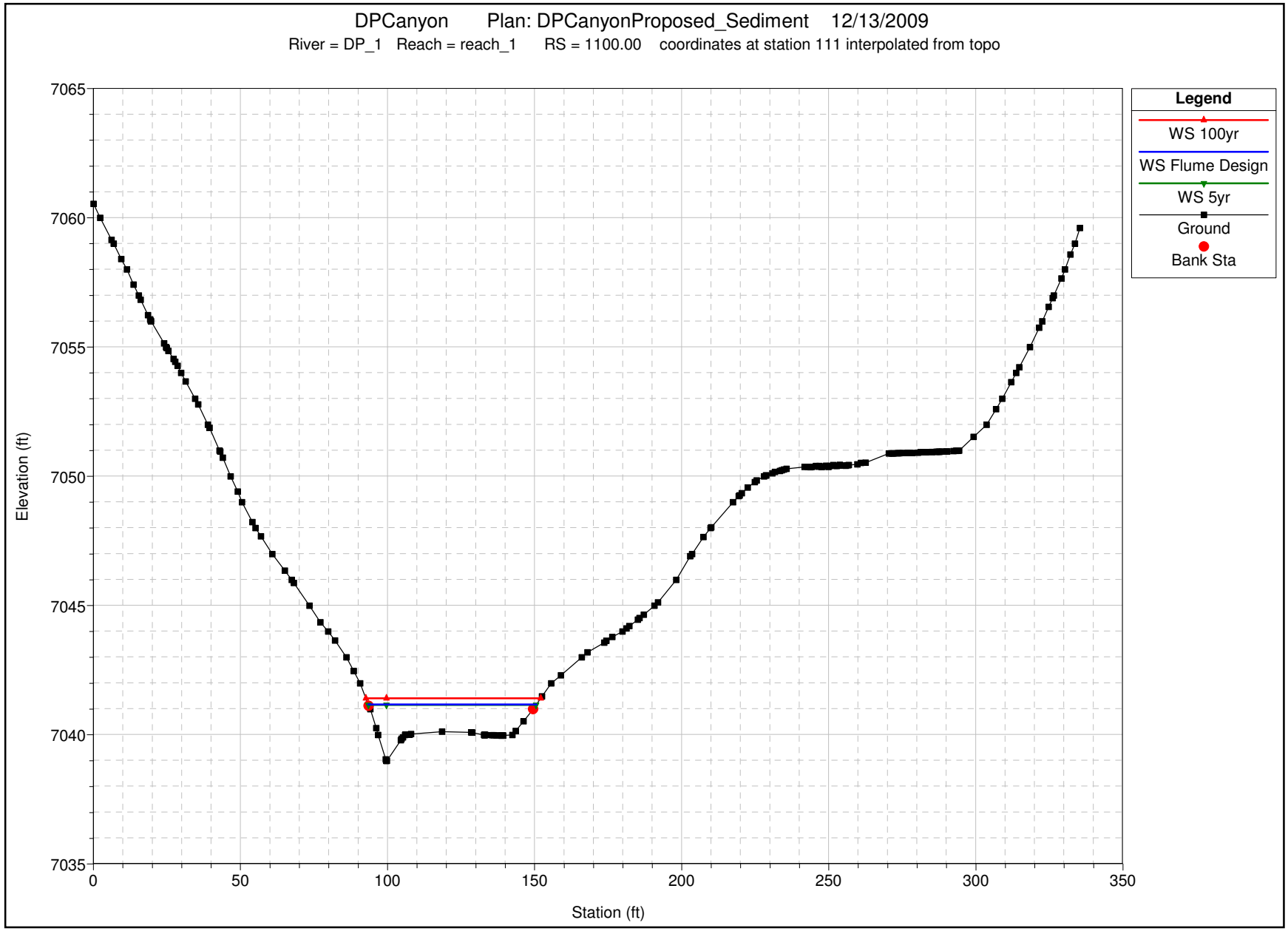
River = DP_1 Reach = reach_1 RS = 1000.00 coordinates at station 130 interpolated from topo

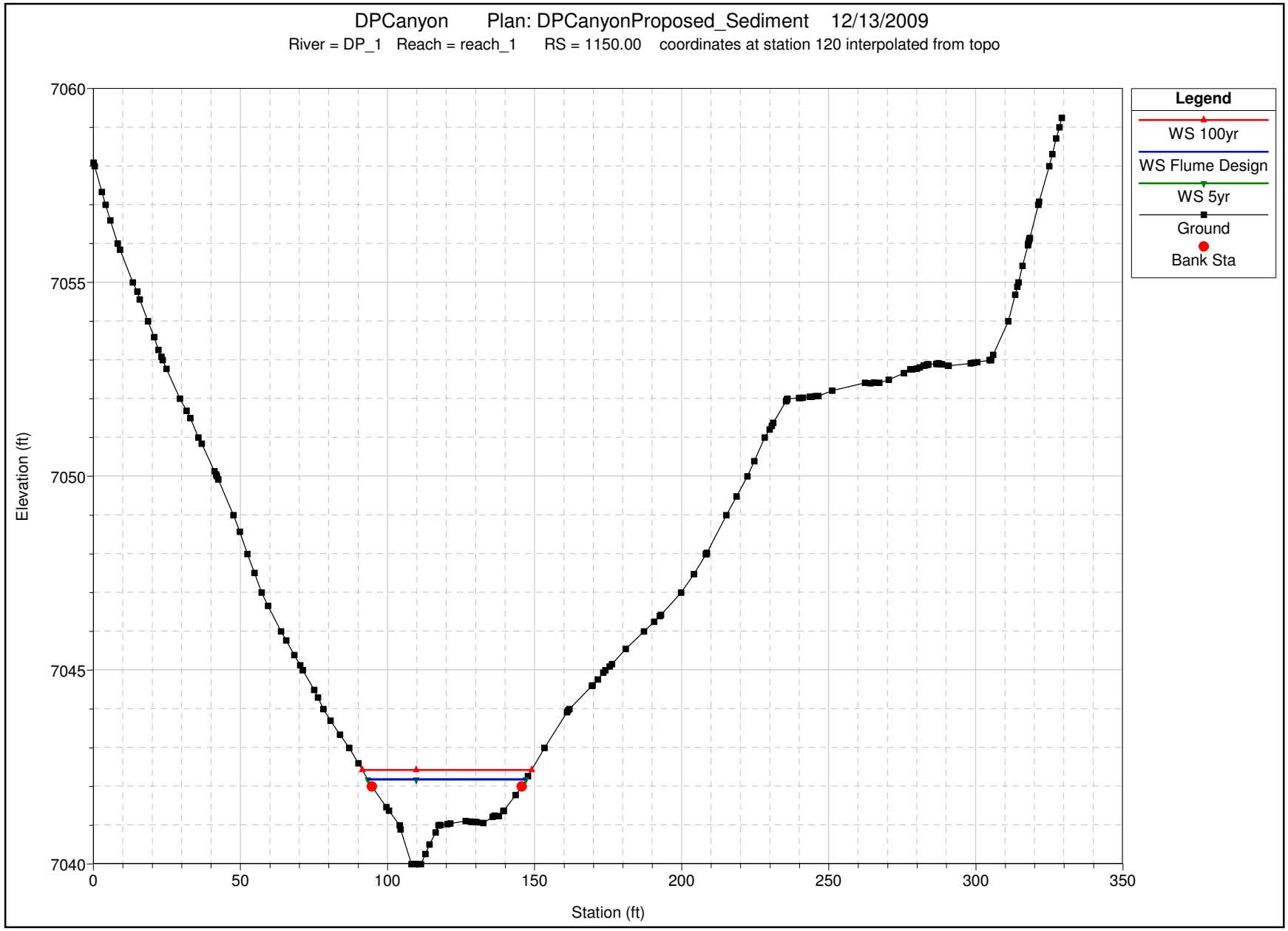


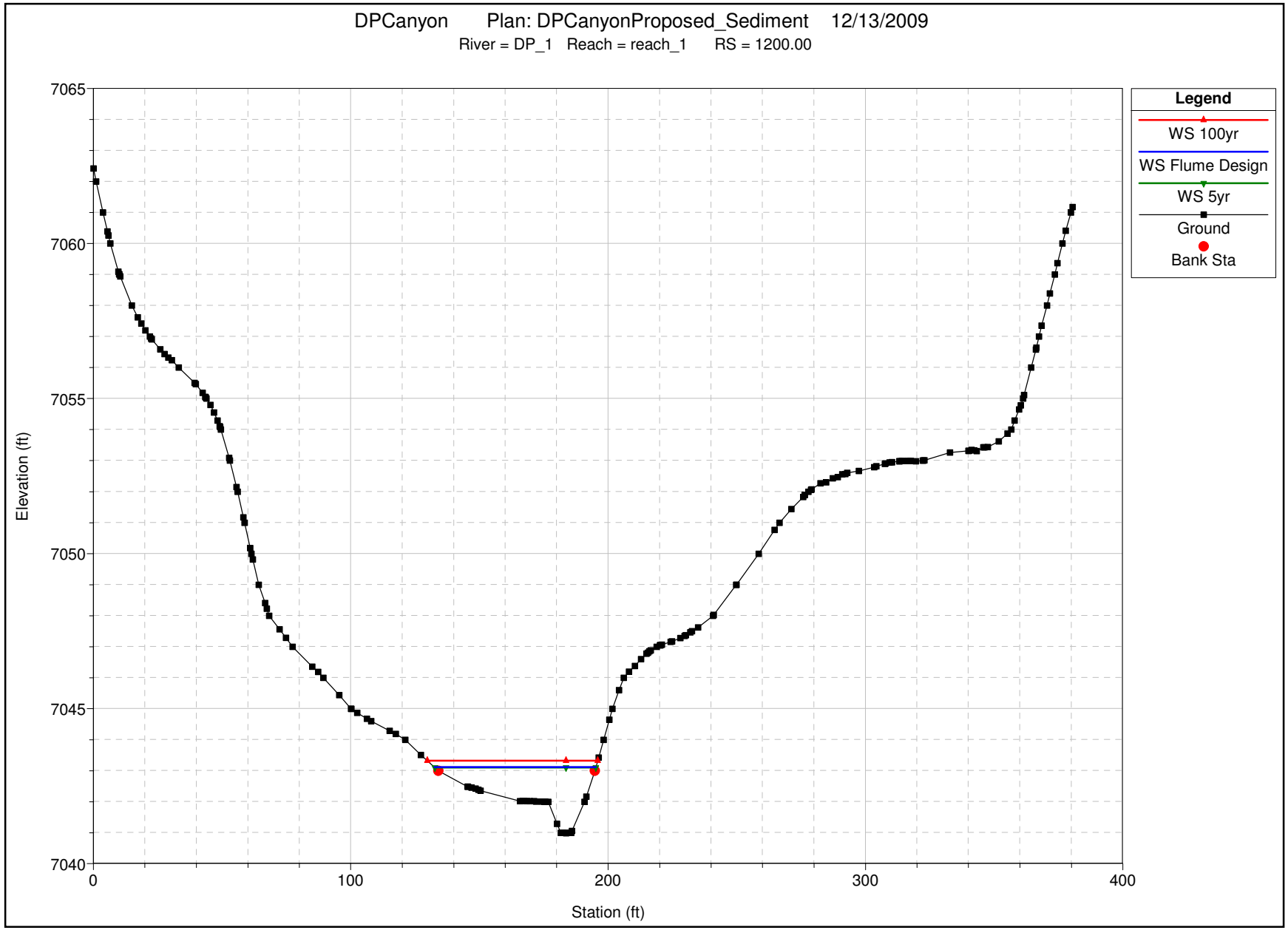
DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009

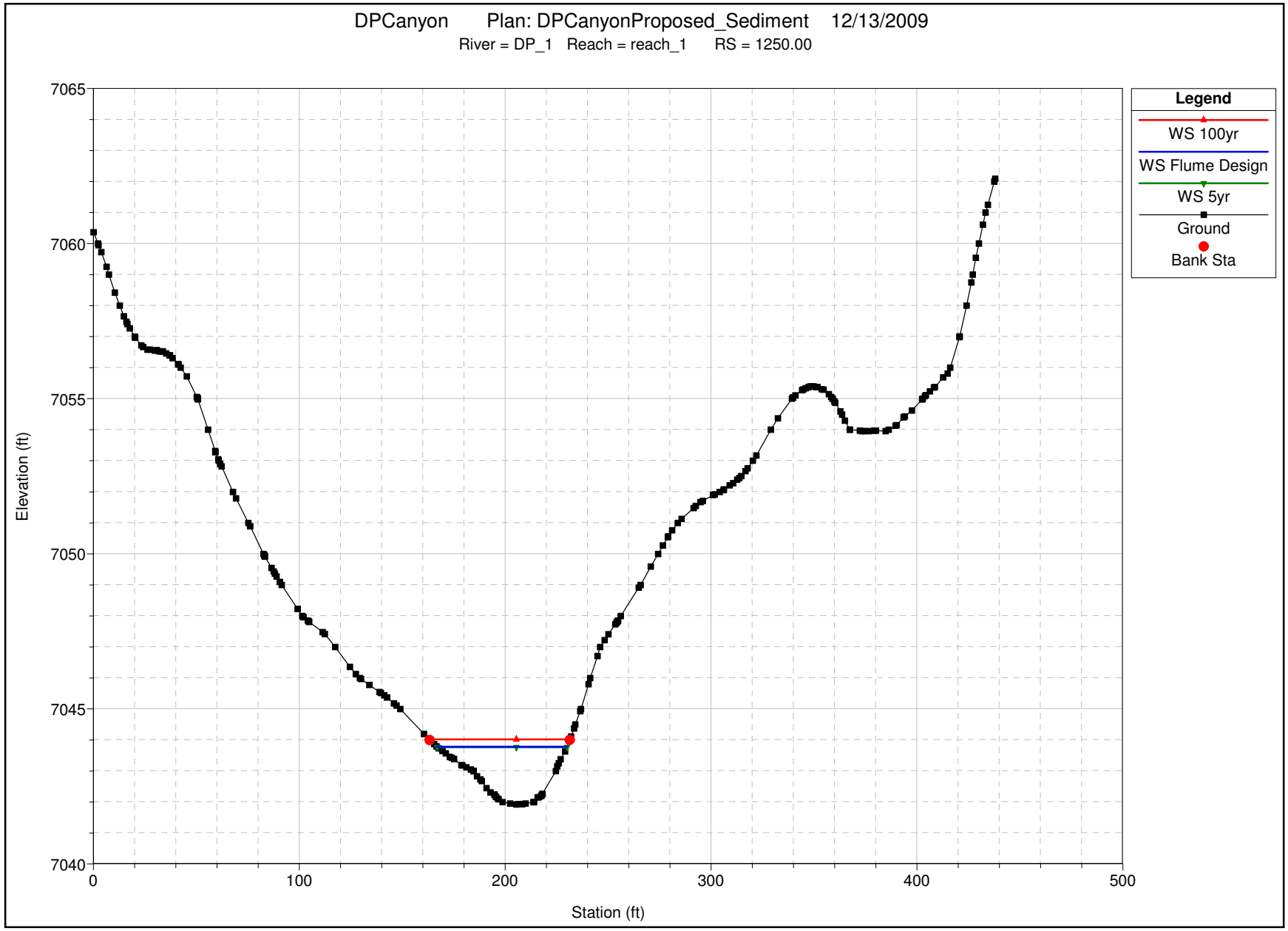
River = DP_1 Reach = reach_1 RS = 1050.00 coordinates at station 140 interpolated from topo

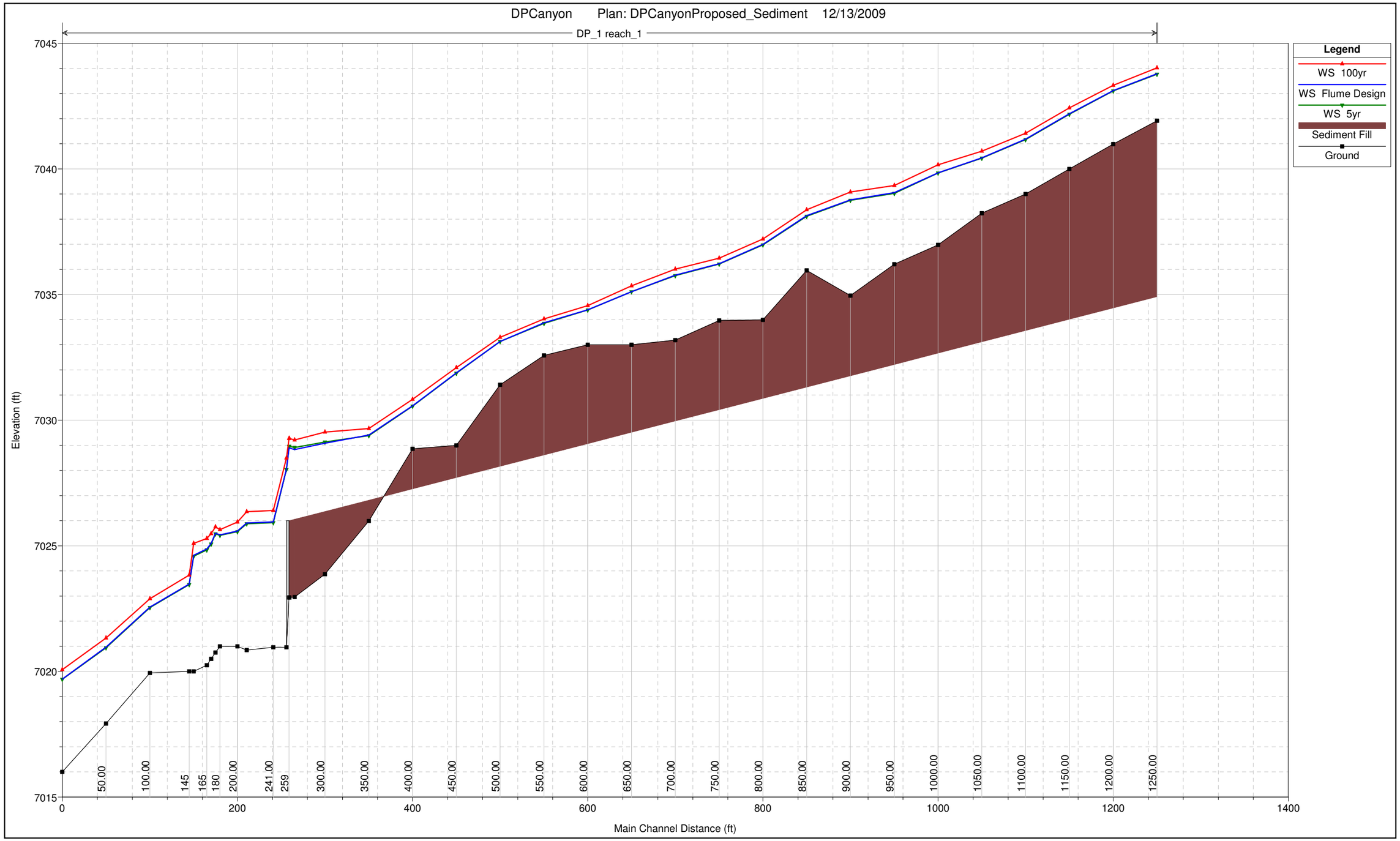



DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 1100.00 coordinates at station 111 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7065
7060
7055
7050
7045
7040
7035
0
50
100
150
200
250
300
350
Station (ft)


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 1150.00 coordinates at station 120 interpolated from topo
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7060
7055
7050
7045
7040
Station (ft)
0
50
100
150
200
250
300
350


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 1200.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7065
7060
7055
7050
7045
7040
0
100
200
300
400
Station (ft)


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
River = DP_1 Reach = reach_1 RS = 1250.00
Legend
WS 100yr
WS Flume Design
WS 5yr
Ground
Bank Sta
Elevation (ft)
7065
7060
7055
7050
7045
7040
0
100
200
300
400
500
Station (ft)


DPCanyon Plan: DPCanyonProposed_Sediment 12/13/2009
DP_1 reach_1
Legend
WS 100yr
WS Flume Design
WS 5yr
Sediment Fill
Ground
Elevation (ft)
7045
7040
7035
7030
7025
7020
7015
0
200
400
600
800
1000
1200
1400
Main Channel Distance (ft)
50.00
100.00
145
165
180
200.00
241.00
259
300.00
350.00
400.00
450.00
500.00
550.00
600.00
650.00
700.00
750.00
800.00
850.00
900.00
950.00
1000.00
1050.00
1100.00
1150.00
1200.00
1250.00

HEC-RAS Plan: DPCanyonProp_Sed River: DP_1 Reach: reach_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	1250.00	5yr	343.00	7041.92	7043.77		7044.15	0.008636	4.92	69.76	63.01	0.82
reach_1	1250.00	Flume Design	350.00	7041.92	7043.79		7044.17	0.008677	4.95	70.65	63.33	0.83
reach_1	1250.00	100yr	465.00	7041.92	7044.02		7044.47	0.008741	5.40	86.06	68.50	0.85
reach_1	1200.00	5yr	343.00	7040.99	7043.10	7043.10	7043.60	0.013331	5.68	60.51	62.50	1.00
reach_1	1200.00	Flume Design	350.00	7040.99	7043.12	7043.12	7043.62	0.013241	5.71	61.40	62.74	1.00
reach_1	1200.00	100yr	465.00	7040.99	7043.33	7043.33	7043.94	0.012512	6.29	74.75	66.22	1.00
reach_1	1150.00	5yr	343.00	7040.00	7042.18	7042.18	7042.74	0.012964	6.04	57.01	53.65	1.01
reach_1	1150.00	Flume Design	350.00	7040.00	7042.19	7042.19	7042.77	0.012922	6.08	57.80	53.88	1.01
reach_1	1150.00	100yr	465.00	7040.00	7042.43	7042.43	7043.12	0.012014	6.66	71.05	57.53	1.00
reach_1	1100.00	5yr	343.00	7039.00	7041.17	7041.11	7041.64	0.010929	5.52	62.21	57.03	0.92
reach_1	1100.00	Flume Design	350.00	7039.00	7041.19	7041.12	7041.66	0.010768	5.54	63.27	57.20	0.92
reach_1	1100.00	100yr	465.00	7039.00	7041.42	7041.34	7042.00	0.010049	6.08	77.11	59.44	0.92
reach_1	1050.00	5yr	343.00	7038.24	7040.43	7040.43	7041.04	0.012534	6.29	55.37	49.32	1.01
reach_1	1050.00	Flume Design	350.00	7038.24	7040.44	7040.44	7041.07	0.012585	6.35	56.02	49.46	1.01
reach_1	1050.00	100yr	465.00	7038.24	7040.71	7040.71	7041.44	0.011471	6.91	69.53	52.27	1.00
reach_1	1000.00	5yr	343.00	7036.98	7039.84		7040.25	0.008951	5.17	66.34	56.80	0.84
reach_1	1000.00	Flume Design	350.00	7036.98	7039.85		7040.27	0.009136	5.23	66.87	57.08	0.85
reach_1	1000.00	100yr	465.00	7036.98	7040.16		7040.62	0.007517	5.43	86.69	67.00	0.80
reach_1	950.00	5yr	343.00	7036.21	7039.02	7039.02	7039.69	0.012942	6.57	52.23	41.31	1.02
reach_1	950.00	Flume Design	350.00	7036.21	7039.05	7039.05	7039.72	0.012465	6.55	53.49	41.91	1.01
reach_1	950.00	100yr	465.00	7036.21	7039.34	7039.34	7040.13	0.011393	7.14	66.20	47.59	1.00
reach_1	900.00	5yr	343.00	7034.96	7038.75		7038.83	0.000973	2.32	150.69	94.34	0.30
reach_1	900.00	Flume Design	350.00	7034.96	7038.77		7038.85	0.000980	2.35	152.45	94.95	0.30
reach_1	900.00	100yr	465.00	7034.96	7039.08		7039.19	0.001013	2.65	184.31	104.63	0.32
reach_1	850.00	5yr	343.00	7035.96	7038.12	7038.12	7038.66	0.013245	5.94	58.00	59.12	1.01
reach_1	850.00	Flume Design	350.00	7035.96	7038.14	7038.14	7038.69	0.012747	5.92	59.52	60.19	1.00
reach_1	850.00	100yr	465.00	7035.96	7038.38	7038.38	7039.02	0.011673	6.45	74.69	68.57	0.99
reach_1	800.00	5yr	343.00	7033.99	7036.98	7036.98	7037.50	0.013651	5.77	59.40	59.07	1.01
reach_1	800.00	Flume Design	350.00	7033.99	7036.99	7036.99	7037.52	0.013735	5.81	60.21	59.56	1.02
reach_1	800.00	100yr	465.00	7033.99	7037.21	7037.21	7037.84	0.012724	6.35	73.79	66.00	1.01
reach_1	750.00	5yr	343.00	7033.97	7036.22	7036.22	7036.74	0.012692	5.81	59.54	61.47	0.99
reach_1	750.00	Flume Design	350.00	7033.97	7036.23	7036.23	7036.76	0.012682	5.86	60.36	61.93	0.99
reach_1	750.00	100yr	465.00	7033.97	7036.45	7036.45	7037.09	0.012025	6.45	74.69	69.40	1.00
reach_1	700.00	5yr	343.00	7033.19	7035.75		7035.98	0.004203	3.87	89.79	73.87	0.59
reach_1	700.00	Flume Design	350.00	7033.19	7035.77		7036.01	0.004156	3.89	91.31	74.28	0.59
reach_1	700.00	100yr	465.00	7033.19	7036.01		7036.31	0.004218	4.37	109.74	79.13	0.61
reach_1	650.00	5yr	343.00	7033.00	7035.11	7035.11	7035.61	0.013119	5.68	60.78	65.25	1.00
reach_1	650.00	Flume Design	350.00	7033.00	7035.12	7035.12	7035.63	0.013440	5.77	61.10	65.40	1.01
reach_1	650.00	100yr	465.00	7033.00	7035.35	7035.35	7035.94	0.011901	6.22	76.93	72.55	0.99
reach_1	600.00	5yr	343.00	7033.00	7034.38	7034.35	7034.80	0.012329	5.16	66.52	73.18	0.95
reach_1	600.00	Flume Design	350.00	7033.00	7034.39	7034.36	7034.82	0.012528	5.22	67.09	73.41	0.96
reach_1	600.00	100yr	465.00	7033.00	7034.56	7034.56	7035.09	0.012979	5.84	79.75	78.24	1.00
reach_1	550.00	5yr	343.00	7032.58	7033.85	7033.79	7034.18	0.011527	4.56	75.23	94.71	0.90
reach_1	550.00	Flume Design	350.00	7032.58	7033.88		7034.19	0.011122	4.53	77.23	95.50	0.89
reach_1	550.00	100yr	465.00	7032.58	7034.03	7033.98	7034.42	0.011336	5.03	92.96	108.81	0.92
reach_1	500.00	5yr	343.00	7031.41	7033.13	7033.13	7033.53	0.014453	5.03	68.31	90.62	1.01
reach_1	500.00	Flume Design	350.00	7031.41	7033.13	7033.13	7033.54	0.014986	5.13	68.40	90.65	1.02
reach_1	500.00	100yr	465.00	7031.41	7033.30	7033.30	7033.79	0.013810	5.61	83.87	94.55	1.02
reach_1	450.00	5yr	343.00	7029.00	7031.87	7031.87	7032.34	0.014306	5.49	62.54	70.29	1.02
reach_1	450.00	Flume Design	350.00	7029.00	7031.88	7031.88	7032.36	0.014342	5.53	63.29	70.54	1.02
reach_1	450.00	100yr	465.00	7029.00	7032.09	7032.09	7032.64	0.012772	5.95	78.73	77.06	1.00
reach_1	400.00	5yr	343.00	7028.86	7030.56	7030.56	7031.14	0.012298	6.11	58.01	55.50	0.99
reach_1	400.00	Flume Design	350.00	7028.86	7030.57	7030.57	7031.16	0.012382	6.17	58.66	55.67	1.00
reach_1	400.00	100yr	465.00	7028.86	7030.83	7030.83	7031.52	0.011233	6.70	73.45	59.49	0.98
reach_1	350.00	5yr	343.00	7026.82	7029.38	7029.38	7029.96	0.010425	6.19	63.14	71.95	0.93
reach_1	350.00	Flume Design	350.00	7026.82	7029.41	7029.41	7029.99	0.010168	6.19	64.94	72.58	0.92
reach_1	350.00	100yr	465.00	7026.82	7029.67	7029.67	7030.34	0.009639	6.75	84.57	79.65	0.92

HEC-RAS Plan: DPCanyonProp_Sed River: DP_1 Reach: reach_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
reach_1	300.00	5yr	343.00	7026.37	7029.13		7029.28	0.001506	3.37	153.62	100.36	0.39
reach_1	300.00	Flume Design	350.00	7026.37	7029.09		7029.25	0.001690	3.53	149.09	99.27	0.41
reach_1	300.00	100yr	465.00	7026.37	7029.53		7029.70	0.001524	3.76	194.98	109.76	0.40
reach_1	265.39	5yr	343.00	7026.06	7028.91	7028.00	7029.20	0.002237	4.53	101.99	88.13	0.48
reach_1	265.39	Flume Design	350.00	7026.06	7028.83	7027.97	7029.16	0.002616	4.81	97.23	86.30	0.52
reach_1	265.39	100yr	465.00	7026.06	7029.21	7028.49	7029.61	0.002733	5.38	120.05	93.29	0.55
reach_1	259.30	5yr	343.00	7026.00	7028.96	7027.77	7029.16	0.001422	3.85	121.87	90.72	0.39
reach_1	259.30	Flume Design	350.00	7026.00	7028.89	7027.81	7029.11	0.001617	4.04	118.08	89.29	0.42
reach_1	259.30	100yr	465.00	7026.00	7029.28	7028.13	7029.56	0.001813	4.65	139.10	95.51	0.45
reach_1	259		Inl Struct									
reach_1	241.00	5yr	343.00	7020.96	7025.92		7026.15	0.001415	3.82	92.93	37.02	0.39
reach_1	241.00	Flume Design	350.00	7020.96	7025.95		7026.18	0.001423	3.86	94.09	37.28	0.39
reach_1	241.00	100yr	465.00	7020.96	7026.41		7026.71	0.001571	4.44	112.06	42.00	0.42
reach_1	210.58	5yr	343.00	7020.85	7025.88		7026.11	0.001366	3.90	100.42	42.96	0.38
reach_1	210.58	Flume Design	350.00	7020.85	7025.91		7026.14	0.001376	3.94	101.75	43.26	0.38
reach_1	210.58	100yr	465.00	7020.85	7026.36		7026.66	0.001539	4.54	122.48	49.40	0.42
reach_1	200.00	5yr	343.00	7021.00	7025.57		7026.06	0.003395	5.71	71.25	44.75	0.57
reach_1	200.00	Flume Design	350.00	7021.00	7025.59		7026.09	0.003430	5.77	72.37	45.03	0.58
reach_1	200.00	100yr	465.00	7021.00	7025.94		7026.60	0.004011	6.70	88.96	49.08	0.63
reach_1	180	5yr	343.00	7021.00	7025.42		7025.98	0.004096	6.06	64.63	43.02	0.62
reach_1	180	Flume Design	350.00	7021.00	7025.44		7026.01	0.004156	6.14	65.51	43.26	0.63
reach_1	180	100yr	465.00	7021.00	7025.65		7026.49	0.005676	7.50	74.78	45.64	0.74
reach_1	175	5yr	343.00	7020.75	7025.48		7025.92	0.002864	5.42	74.61	43.76	0.53
reach_1	175	Flume Design	350.00	7020.75	7025.50		7025.96	0.002908	5.49	75.58	44.01	0.53
reach_1	175	100yr	465.00	7020.75	7025.75		7026.41	0.003874	6.66	87.00	46.89	0.62
reach_1	170	5yr	343.00	7020.50	7025.07	7025.07	7025.87	0.007028	7.43	64.89	58.86	0.80
reach_1	170	Flume Design	350.00	7020.50	7025.10	7025.10	7025.90	0.007011	7.47	66.47	59.13	0.80
reach_1	170	100yr	465.00	7020.50	7025.48	7025.48	7026.37	0.006940	8.11	89.92	62.91	0.81
reach_1	165	5yr	343.00	7020.25	7024.84	7024.84	7025.68	0.007230	7.57	60.12	56.19	0.81
reach_1	165	Flume Design	350.00	7020.25	7024.87	7024.87	7025.72	0.007153	7.59	61.99	56.59	0.81
reach_1	165	100yr	465.00	7020.25	7025.29	7025.29	7026.21	0.006820	8.15	86.82	61.05	0.81
reach_1	150	5yr	343.00	7020.00	7024.59	7024.59	7025.49	0.007582	7.74	54.93	52.02	0.83
reach_1	150	Flume Design	350.00	7020.00	7024.62	7024.62	7025.52	0.007495	7.76	56.77	52.73	0.83
reach_1	150	100yr	465.00	7020.00	7025.10	7025.10	7026.04	0.006741	8.19	83.58	59.10	0.80
reach_1	145	5yr	343.00	7020.00	7023.46	7023.46	7024.22	0.012340	6.99	49.15	34.22	1.01
reach_1	145	Flume Design	350.00	7020.00	7023.48	7023.48	7024.25	0.012511	7.05	49.71	34.55	1.02
reach_1	145	100yr	465.00	7020.00	7023.84	7023.84	7024.71	0.010667	7.52	63.59	42.66	0.98
reach_1	100.00	5yr	343.00	7019.94	7022.54	7022.54	7023.29	0.011581	6.96	50.63	38.14	1.00
reach_1	100.00	Flume Design	350.00	7019.94	7022.56	7022.56	7023.32	0.011559	7.01	51.35	38.34	1.00
reach_1	100.00	100yr	465.00	7019.94	7022.89	7022.89	7023.78	0.010536	7.62	64.52	41.79	0.98
reach_1	50.00	5yr	343.00	7017.93	7020.94	7020.94	7021.75	0.011790	7.21	47.58	29.92	1.01
reach_1	50.00	Flume Design	350.00	7017.93	7020.97	7020.97	7021.78	0.011730	7.23	48.43	30.23	1.01
reach_1	50.00	100yr	465.00	7017.93	7021.33	7021.33	7022.26	0.011271	7.75	60.12	34.61	1.01
reach_1	0.00	5yr	343.00	7016.00	7019.69	7019.69	7020.49	0.011807	7.21	47.61	30.35	1.00
reach_1	0.00	Flume Design	350.00	7016.00	7019.70	7019.70	7020.53	0.012068	7.31	47.95	30.52	1.02
reach_1	0.00	100yr	465.00	7016.00	7020.07	7020.07	7021.02	0.010622	7.85	60.75	38.48	0.99

Appendix D

Photo Documentation

This appendix contains a series of photographs depicting the work progress on the DP Canyon Grade Control Structure and associated Stream Gauge E039.1. Photos are representative of the work performed and completed as of the date noted. Although field work commenced October 26, 2010, photos were not allowed to be taken until November 14, 2009. These photos range from November 16, 2009 through final seeding on May 4, 2010.

November 16, 2009

Photo 1 Existing Stream Gage E039

Photo 2 Excavation for structure, looking northwest

Photo 3 Clearing for structure, looking south

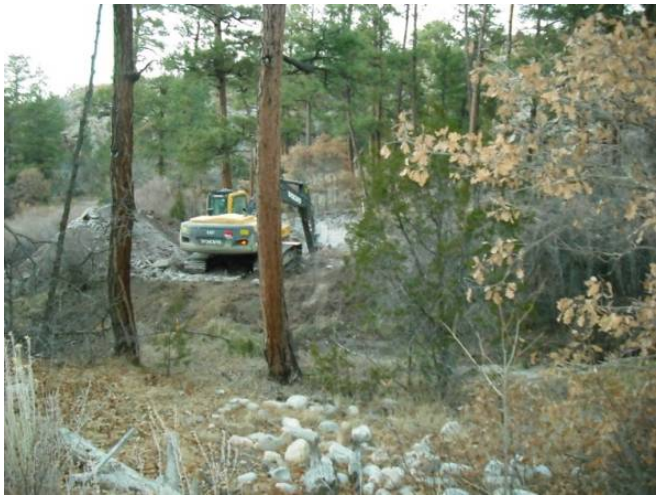


Photo 4 Excavation for structure

November 16, 2009 (continued)

Photo 5 Structure excavation, looking north

Photo 6 Structure excavation, looking northwest

November 17, 2009

Photo 1 Gabion basket assembly area

Photo 2 Center line of structure length

November 18, 2009

Photo 1 Gabion stone stockpile area

Photo 2 Diversion channel

November 20, 2009

Photo 1 Structure construction, looking north

Photo 2 Gabion basket assembly area

Photo 3 Structure subgrade gabion baskets, looking north

November 28, 2009

Photo 1 Gabion basket assembly area

Photo 2 Gabion stone stockpile

Photo 3 North half of structure subgrade compaction, looking north

Photo 4 Structure subgrade compaction, north half, looking north

November 28, 2009 (continued)

Photo 5 Excavated north half of structure

Photo 6 Water intrusion in north-half excavation

Photo 7 Subgrade compaction, north half

December 3, 2009

Photo 1 Gabion assembly area, looking east

Photo 2 Access road and stone stockpile, looking west

Photo 3 Structure with geotextile fabric wrapped on upstream face, on north half of structure, pumping groundwater from stilling basin excavation

Photo 4 Structure with geotextile fabric wrapped on upstream face on north half of structure

December 5, 2009

Photo 1 Water intrusion in stilling basin excavation

Photo 2 Structure, looking north; subgrade and above grade gabion baskets

Photo 3 Water intrusion in stilling basin excavation

Photo 4 Structure construction, looking north/northwest

December 5, 2009 (continued)

Photo 5 North-half structure construction; water intrusion in stilling basin excavation

Photo 6 High water mark within stilling basin excavation area

Photo 7 Water intrusion, high water mark in stilling basin excavation

Photo 8 Stilling basin excavation, looking northeas

Photo 9 Stilling basin water intrusion

Photo 10 Structure construction, north half, pumping groundwater from stilling basin excavatior

December 17, 2009

Photo 1 Placing concrete cap on low-flow and overflow weir

Photo 2 Placing concrete cap on low-flow and overflow weir

Photo 3 Concrete cap covered for curing, structure facing north, water intrusion downstream of stilling basin

Photo 4 Concrete cap covered for curing, structure facing north, water intrusion downstream of stilling basin

January 3, 2010

Photo 1 Looking downstream at structure, concrete blankets covering concrete cap

Photo 2 Looking northeast at structure, concrete blankets covering concrete cap

Photo 3 Looking northeast at structure, concrete blankets covering concrete cap

Photo 4 Looking north at structure, ice covers stilling basin

January 7, 2010

Photo 1 Looking north, at structure and concrete cap

Photo 2 Riser pipe, before extension

Photo 3 Excavation for downstream installation of Class A and Class B rip rap

Photo 4 Structure, looking north; concrete cap on low-flow and overflow weir crests

January 9, 2010

Photo 1 Upstream face of structure, riser pipe before extension

Photo 2 Structure, looking north, downstream north slope prepared for Class B rip rap installation

Photo 3 Looking downstream towards flume location

Photo 4 Looking at upstream side of structure, flume location in backgound

January 9, 2010 (continued)

Photo 5 Downstream, facing side of structure, ice-filled stilling basin, looking northwest

Photo 6 Downstream, facing side of structure, ice-filled stilling basin, looking west

January 14, 2010

Photo 1 Structure, looking north

Photo 2 Upstream approach to structure

January 14, 2010 (continued)

Photo 3 Access road crossing southern confinement wall gabion baskets, looking east

Photo 4 Completed structure, looking south

Photo 5 Forms for flume headwall concrete placement, looking northeast from access road

Photo 6 Flume headwall forms, looking downstream from structure

January 26, 2010

No work due to weather.

Photo 1 Riser pipe (fully extended) looking northeast

Photo 2 Riser pipe looking northwest

February 18, 2010

Photo 1 Newly placed concrete headwall covered with blanket to cure

Photo 2 Excavation for Class B rip rap installation upstream of flume

Photo 3 Downstream side of structure rip rap installation work, fully extended riser pipe in foreground

Photo 4 Newly placed flume headwalls covered with concrete blankets to cure

February 18, 2010 (continued)

Photo 5 Flume headwall forms prior to placing concrete

Photo 6 Preparing north slope, downstream of structure, for rip rap installation

Photo 7 Preparing north slope, downstream of structure, for rip rap installation

Photo 8 Concrete blankets cover newly placed concrete headwalls

Photo 9 East headwall form, prior to concrete placement

Photo 10 West headwall form, prior to concrete placement

February 18, 2010 (continued)

Photo 11 Concrete for headwall placement

Photo 12 Headwall concrete slump test

Photo 13 Monitoring headwall concrete temperature

Photo 14 Setting up for concrete test

Photo 15 Concrete Test

Photo 16 Placing headwall concrete

February 18, 2010 (continued)

Photo 17 Placing headwall concrete

Photo 18 Placing headwall concrete

Photo 19 Placing headwall concrete

February 19, 2010

Photo 1 Class B rip rap installation, on north slope, downgradient of structure

Photo 2 Class B rip rap installation, on north slope, downgradient of structure; water being pumped from Class B excavation area

February 20, 2010

Photo 1 Class B rip rap on south slope, downgradient of structure

Photo 2 Class B rip rap on north slope, downgradient side of structure; pumping water from rip rap excavation area to keep flume subgrade dry

Photo 3 Preparing flume subgrade, concrete headwalls complete

Photo 4 Concrete headwall

February 20, 2010 (continued)

Photo 5 Class B rip rap, on south slope and downgradient of stilling basin, looking south

Photo 6 Looking upstream at downstream, facing side of structure from flume location

Photo 7 Preparing flume subgrade

Photo 8 Looking northeast from access road at flume subgrade preparation

February 21, 2010

Photo 1 Flume subgrade covered with concrete blanket to keep warm and dry

Photo 2 Removal of blanket from flume subgrade to continue preparation of flume subgrade

Photo 3 Compaction of flume subgrade

February 23, 2010

Photo 1 Grade control structure, looking south

Photo 2 Work on flume subgrade

February 24, 2010

Photo 1 Forming flume for concrete placement

Photo 2 Forming flume for concrete placement

Photo 3 Wire mesh reinforcement installed in flume form prior to concrete placement

Photo 4 Wire mesh reinforcement installed in flume form prior to concrete placement

Photo 5 Measuring concrete temperature for flume concrete placement

Photo 6 Measuring flume subgrade temperature prior to concrete placement

February 24, 2010 (continued)

Photo 7 Flume concrete placement

Photo 8 Concrete test of flume

Photo 9 Concrete test cylinders for flume concrete placement

Photo 10 Slump Test for flume concrete placement

Photo 11 Flume concrete placement and finishing

Photo 12 Flume concrete placement and finishing

February 24, 2010 (continued)

Photo 13 Gage Station stilling well placed in concrete

Photo 14 Finished flume concrete

Photo 15 Photo of water being pumped from upstream of flume to keep flume area dry

February 25, 2010

Photo 1 Flume concrete covered with concrete blankets to cure, looking northeast

Photo 2 Flume concrete covered with concrete blankets to cure, looking northeast from access road

February 26, 2010

Photo 1 Installation of Class A rip rap on upstream and downstream sides of flume

Photo 2 Installation of Class A rip rap on upstream and downstream sides of flume

February 27, 2010

Photo 1 Upstream face of structure with downstream rip rap and flume in background

Photo 2 Gage Station stilling well, looking northeast from access road

Photo 3 Completed Class B rip rap on north slope, on downgradient side of structure

Photo 4 Looking east, towards Stream Gage stilling well and access road

Photo 5 Completed Class B rip rap, upgradient of flume; Class A rip rap installation continues

Photo 6 Upstream face of structure; riser pipe in foreground and flume in background

March 5, 2010

Photo 1 Completed flume, looking east/northeast

Photo 2 Completed flume, looking west/northwest

Photo 3 Looking downstream at structure, riser pipe in foreground and flume in background

May 4, 2010

Photo 1 DP Canyon hydroseeding

Photo 2 DP Canyon hydroseeding

Photo 3 DP Canyon hydroseeding

Photo 4 DP Canyon hydroseeding

Photo 5 DP Canyon hydroseeding