Appendix 5.5 (Continued)

Hydrology (Part 10 of 15)

Appendix G – General Maintenance Plan for Castaic Creek and Hasley Canyon Drain

GENERAL MAINTENANCE PLAN

CASTAIC CREEK AND HASLEY CANYON DRAIN

Prepared for

Newhall Land
Valencia, California

Prepared by

Aquatic Consulting Services, Inc.
Ventura, California
Field Report 132.98R
September 1998
(Revised March 2002)

DOCUMENT CONCURRENCE

This document has been reviewed by the U.S. Army Corps of Engineers, California Department of Fish and Game, Los Angeles County Public Works, and Newhall Land Company. The signatures below indicate that each authorized agency/company representative concurs with the contents of this document and will abide by the general maintenance procedures for Castaic Creek and Hasley Canyon Drain described herein:

U.S. Army Corps of Engineers:

_____ _____

Signature Date

_____

Printed Name

California Department of Fish and Game:

_____ _____

Signature Date

_____

Printed Name

Los Angeles County Department of Public Works:

Signature 4/11/02

Date

PHIL SCUDAR for report dated March 2002

Printed Name

Newhall Land Company:

Signature 3/12/02

Date

ROSS PISTONE

Printed Name

I. PROJECT BACKGROUND

During July 1988, Newhall Land Company held field meetings with personnel from the U.S. Army Corps of Engineers (ACOE) and the U.S. Fish & Wildlife Service (USFWS) to discuss industrial and commercial development within Castaic and Hasley Canyon drainages. As a result of this meeting, Newhall submitted necessary project plans and supporting documents to obtain an individual permit for this planned development. The ACOE issued a Section 404 individual permit (No. 89-419-EV) for development within this drainage. The permit contained 21 special conditions. Six of these special conditions relate to revegetation of the work areas (special conditions 1, 7, 8, and 14) and/or routine maintenance work (special conditions 5, 7, and 11) within the drainage following project construction. A copy of the ACOE permit and pertinent correspondence is included within Appendix A. This 404 permit currently expires December 11, 2005 unless an extension is issued. As part of the original permitting process, the ACOE completed an Environmental Assessment for the project (Department of the Army 1990). Portions of this document have been included within this report. Figure 1 is a general location map showing the two drainages.

In October 1997, Newhall applied for a Section 401 Water Quality Certification for a channel lining project and bridge project to be constructed within Castaic Creek. Both these projects had been previously permitted under the ACOE's Individual Permit (No. 89-419-EV). In December 1997, during a telephone conversation, the Los Angeles Regional Water Quality Control Board (LARWQCB) decided that since both projects were previously permitted under an existing ACOE Section 404 permit, a Section 401 Water Quality Certification was not required and that the Board would take no further actions on these projects. The LARWQCB also requested that Newhall withdraw their application and request a refund of all application fees. A letter dated December 12, 1997 was sent to the Board formally withdrawing the two permit applications and requesting the application fees be refunded. A copy of this letter is included in Appendix B. Subsequently, on December 17, 1997, the LARWQCB formally waived Section 401 Water Quality Certification since the ACOE had issued an individual permit for construction of the bridge and flood-control structures within this drainage. A copy of the LARWQCB's letter is included within Appendix B.

Site development required construction of infrastructure consisting of flood-control structures, roadways, and bridges. These structures were necessary to provide flood protection to lands contiguous to the creek. Development of flood protection has been divided into three phases:

A. PHASE I

Phase I includes construction of a flood-control channel and bridge within central Hasley Canyon with concrete sides and an 80-foot-wide soft bottom along an existing man-made ditch. This phase of the project temporarily impacted a total of 5.4 acres of "waters" devoid of wetlands. The 1603 Agreement (#5-160-90) issued for this phase of work required that 2.0 acres of sandy wash habitat within the new flood-control channel be naturally revegetated as mitigation (0.37:1) for these projects. A copy of this agreement is included in Appendix C. Both projects were completed in 1992. Revegetation work was completed in 1993 and the area has since developed into valuable habitat. Approximately 5,530 linear feet of bank stabilization remain to be constructed within upper Hasley Canyon drainage and 2,850 linear

General Location Map f Hasley Canyon Drainage and
Castaic Creek in Relatu ighway 126 and Interstate 5

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feet of bank stabilization remain to be constructed within lower Hasley Canyon drainage. Together these projects will impact 9.33 acres of habitat. The completed soft-bottom drain will connect with outlet structures already constructed as part of the Castaic Creek Bridge project. Figure 2 shows the general location of bridges and bank stabilization projects within both Castaic Creek and Hasley Canyon drainage that have already been approved by the ACOE.

B. PHASE II

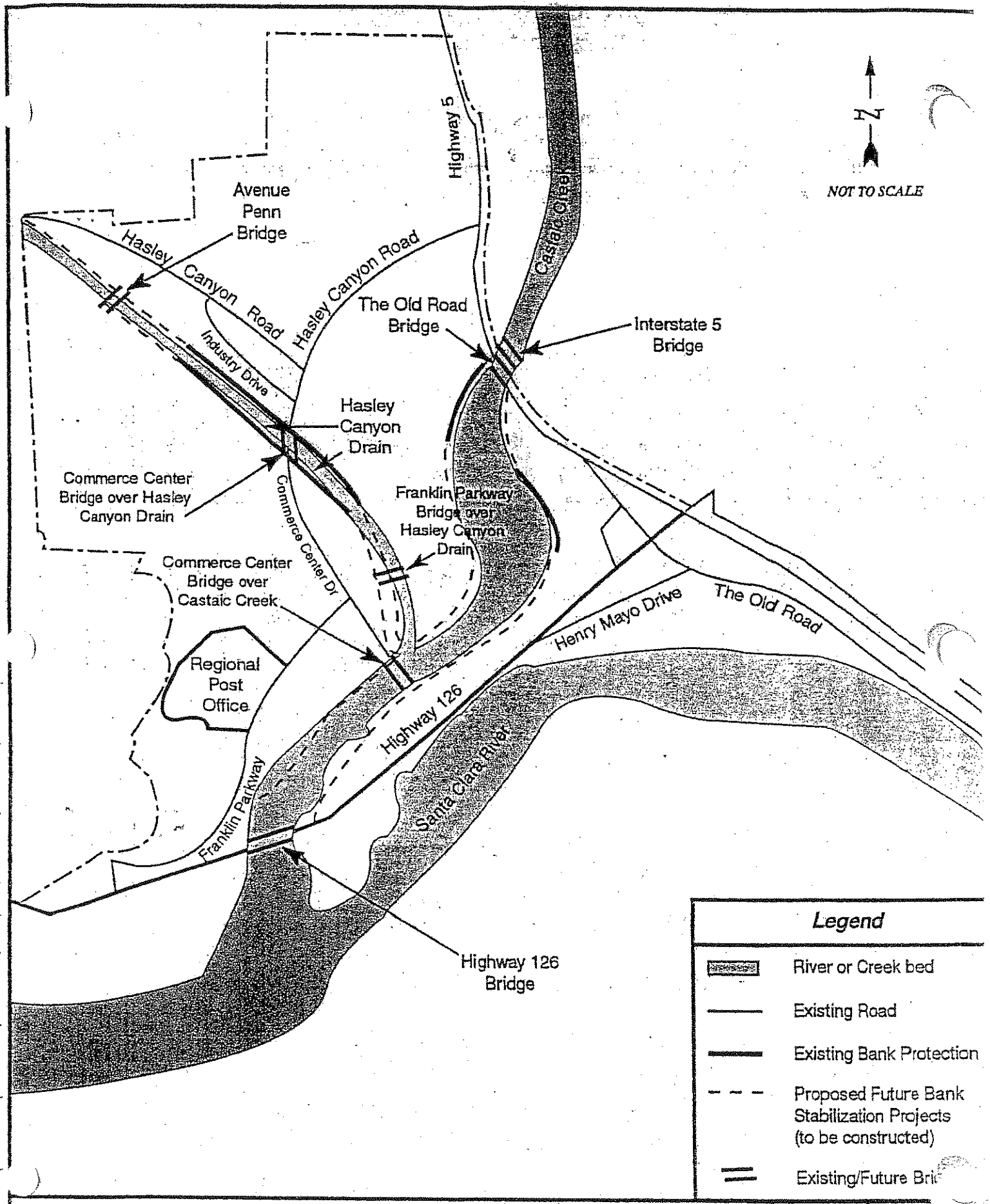
This phase involves discharge of fill into 4.0 acres of an ephemeral streambed to construct an underground stormdrain for the U.S. Postal Service general mail facility. No wetlands were affected. The 1603 Agreement #5-081-90 issued for this work required that Newhall Company establish, through aided or natural revegetation, four acres of sandy wash habitat within the completed flood-control channel in Hasley Canyon. . This mitigation work was completed in 1993. A copy of this agreement is included in Appendix C.

C. PHASE III

Phase III involves stabilization of a 1.7-mile-long reach of Castaic Creek banks with 19,400 feet of bank stabilization (2:1 graded slope). Construction also includes installation of Commerce Center Bridge crossing over Castaic Creek immediately north of Highway 126. Portions of phase III work that began in the spring of 1998 included construction of Commerce Center Bridge over Castaic Creek and 2,070 linear feet of bank stabilization along the Castaic Creek east bank upstream of the bridge. The CDFG issued two Streambed Alteration Agreements (#5-346-97 and 5-370-97) for the bank stabilization and bridge projects constructed in 1998. These two agreements also imposed conditions relating to revegetation and routine channel maintenance (conditions #4, 9, 10, 11, and 12 in Agreement No. 5-346-97 and conditions #4, 9, 10, 11, and 12 in Agreement No.5-370-97). Copies of both agreements are included within Appendix C.

The large site maps at the end of the document indicate the general location of future revegetation areas within Castaic Creek. The first phase of revegetation work that was completed within this area was associated with the Castaic Creek Bridge (Commerce Center Bridge) and the initial channel-lining project located along the east bank. These projects were authorized under USACOE #89-419-EV, CDFG 1603 Agreements # 5-370-97 and 5-346-97 respectively. Following discussions with the agencies, the two-revegetation projects were combined to create one large area, immediately west of the channel-lining site (Figure 3). This 8.98-acre site contained four contiguous areas that provided suitable topographic features. This site also expanded an existing riparian corridor to provide a valuable wildlife corridor. Selection of this composite site was based upon discussions with both agencies during June 1999. This area will not be subject to any future development. This site was subsequently revegetated during September 1999, and has been monitored and weeded as required by the agencies. Revegetation monitoring reports were submitted in 2000, 2001, and 2002.

Approximately 17,400 linear feet of bank stabilization still need to be constructed. Figure 2 shows the general locations of future bank stabilization along Castaic Creek that have already



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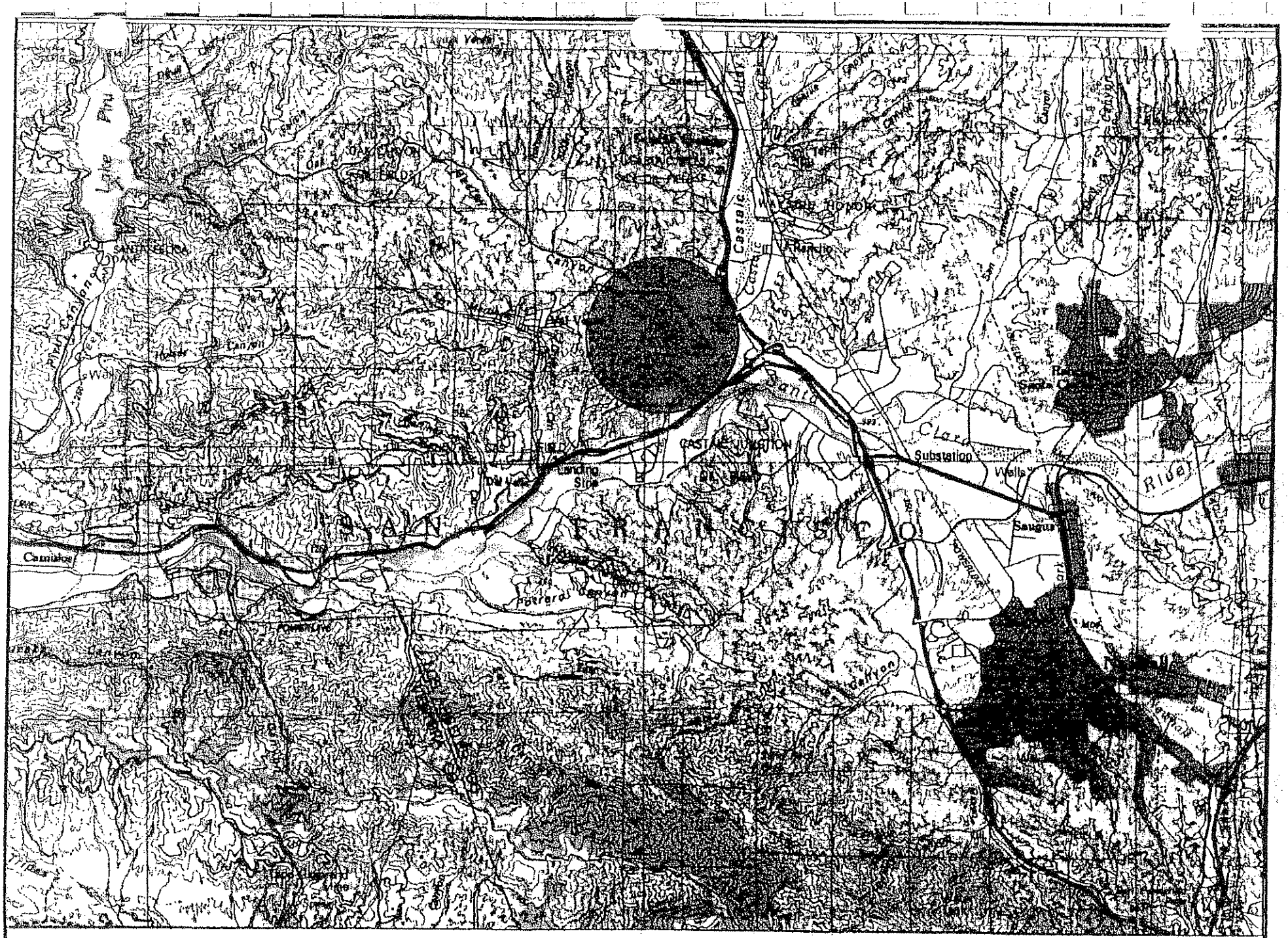
Castaic Creek and Hasley Canyon Drainage, Showing Approximate Locations of Existing and Proposed Future Bank Stabilization Projects and Bridges

FIGURE 2



General Location Map f Hasley Canyon Drainage and
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Signature Date

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California Department of Fish and Game:

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Printed Name

Los Angeles County Department of Public Works:

[signature] 4/11/02

Signature Date

PHIL SCUDAR for report dated March 2002

Printed Name

Newhall Land Company:

Ron Pistone 3/12/02

Signature Date

ROSS PISTONE

Printed Name

GENERAL MAINTENANCE PLAN

CASTAIC CREEK AND HASLEY CANYON DRAIN

Prepared for

Newhall Land
Valencia, California

Prepared by

Aquatic Consulting Services, Inc.
Ventura, California
Field Report 132.98R
September 1998
(Revised March 2002)

APPENDIX B

"General Maintenance Plan Castaic Creek and Hasley Canyon Drain," prepared by Aquatic Consulting Services, Inc. dated March 2002 and accepted by LACDPW on April 11, 2002.

approved by ACOE. Two large GMP maps for Castaic Creek (southern half area map) and Hasley Canyon drain (northern half area map), included in the envelope at the back of this report, shows the approximate locations of future bank stabilization projects, proposed future revegetation areas, and County of Los Angeles Department of Public Works (County) access corridors, as discussed within this plan. As part of the normal permitting process, the County will review and approve all project grading and Site Development Plans.

Since completed flood-control projects will ultimately be transferred County jurisdiction, it is critical to have their concurrence with any proposed routine flood-control maintenance activities within these two drainages. On May 12, 1998, a joint meeting was held with the ACOE, California Department of Fish and Game (CDFG), Los Angeles County Department of Public Works (LACPW), and the Newhall Land Company. The purpose of this meeting was to discuss future flood-control maintenance activities within the Castaic and Hasley Canyon drainages relative to specific revegetation projects as required under existing 1998 project permits. One goal was to identify those routine flood-maintenance activities that would be required for the entire drainage once all identified flood-control projects were constructed. Subsequent to this meeting, County personnel provided additional information concerning specific maintenance activities within Hasley Canyon drainage. The present plan was revised and also incorporated general management concepts presented in the EIS/EIR jointly prepared by the ACOE and CDFG for Newhall's Natural River Management Plan (ACOE and CDFG 1997 and 1998). The revised draft General Maintenance Plan (GMP), dated October 1998, was again submitted to the ACOE and CDFG for review and comment during the spring of 1999. Their written comments were used to update the current plan. Copies of agency responses are included in Appendix D.

The purpose of the current GMP is to describe general operational guidelines for routine maintenance procedures to be used within the Castaic Creek and Hasley Canyon drainage. This document represents consensus of the regulatory agencies (ACOE and CDFG), Newhall Land Company, and the Los Angeles Department of Public Works.

II. GENERAL MAINTENANCE GUIDELINES

Routine maintenance activities within the two drainages could potentially impact natural vegetation areas or revegetation areas created as mitigation for present and future projects. Following discussions with the County, ACOE, and CDFG, it became obvious that two specific factors could impact vegetated areas. The first factor was the physical design of the bridge or channel-lining project. If the flood-control structure or bridge was designed with the appropriate Manning's "n" value (n = roughness coefficient), then it did not matter where vegetation naturally grows or where revegetation areas were created within the channel. Properly designed structures incorporating the correct Manning's coefficient would theoretically permit vegetation to grow along the entire channel bottom without reducing flood flow capacity. However, routine channel-maintenance and repair activities following completion of project construction requires periodic access into the channel along the lateral edges. Provision would need to be made for periodic access into the channel bottom within

controlled access corridors. Based upon discussions with County staff, it was determined that a 45-foot-wide access corridor between the new bank stabilization and revegetation area would need to be kept clear of all vegetation for projects located within Castaic Creek. This width would conform to the work area defined as 30 feet from the levee at the invert as presented in the NRMP. All vegetation will be routinely cleared from this area.

The second factor involved areas where the appropriate Manning coefficient could not be incorporated because the channel would be too narrow. Vegetation growing along the bottom of these channels would also need to be periodically cleared to maintain adequate flood-flow capacity. The criteria to be used for initiating channel clearance would need to be clearly defined. This factor specifically relates to the Hasley Canyon drainage.

A successful General Maintenance Program must specifically address these two factors to provide adequate protection for any natural vegetation growing within the channel bottom or any revegetation project to be installed within the two drainages.

Typical County flood-maintenance programs include the following components:

- Periodic clearing of vegetation immediately upstream and downstream of certain existing bridges which were not designed in accordance with the proper Manning's coefficient.
- Periodic removal of woody vegetation from rip-rap to protect its structural integrity.
- Periodic clearing of stormdrain outlets to ensure proper drainage.
- Periodic removal of ponded water that cause odor problems.
- As-needed repairs of bridges.
- As-needed repairs of bank protection.
- Clearing vegetation from Hasley Canyon drainage channel bottom.
- Water diversions around work areas.

III. SPECIFIC WORK ACTIVITIES

The following detailed description of each proposed County flood-maintenance activity was taken from the Natural River Management Plan (Tettemer, 1997). These activities have been previously accepted by LACDPW (Vandermost, personal communication, 1997). The language has been modified as necessary to specifically apply to Castaic and Hasley Canyon drainages. The environmental protection measures and notification procedures (and form) to inform CDFG and the ACOE for all required maintenance activities are also included (see Appendix E). There are specific differences in the maintenance programs for Castaic Creek and Hasley Canyon drain because of their different design criteria.

A. CHANNEL CLEARING NEAR BRIDGES

Vegetation and/or debris will be removed from around the following bridges, on an as-needed basis, as determined by LACDPW:

- Highway 126 Bridge over Castaic Creek - 50 feet upstream and 50 feet downstream;
- Commerce Center Drive Bridge over Castaic Creek – 50 feet upstream and 50 feet downstream;
- Commerce Center Drive Bridge over Hasley Canyon drain – 50 feet upstream and 50 feet downstream;
- Franklin Parkway Bridge over Hasley Canyon drain - 50 feet upstream and 50 feet downstream;
- Avenue Penn Bridge over Upper Hasley Canyon drain – 50 feet upstream and 50 feet downstream;
- The Old Road Bridge over Castaic Creek – 50 feet upstream and 50 feet downstream;
- Interstate 5 Bridge over Castaic Creek – 50 feet upstream and 50 feet downstream of the structure.

Vegetation and debris may be removed by heavy equipment (D-8 dozer or equivalent). Equipment within the streambed shall be operated within the above-described removal areas, which will be demarcated with fencing or staking. This work shall be conducted between September 1 and March 15, to avoid impacting nesting birds.

B. REMOVAL OF VEGETATION FROM ROCK RIP-RAP (CASTAIC CREEK)

Control of vegetation on the rock face of the levee to the invert access roads by LACDPW shall proceed under current policies, procedure, and practices. Careful attention to chemical handling and wind drift shall be observed. Chemicals shall be suitable for use around aquatic areas. For existing and new levees constructed within Castaic Creek, LACDPW may remove trees that grow in levees, and remove large trees, defined as trees with trunks four inches or more in diameter at breast height (dbh), within 15 feet of the levee toe in order to maintain the structural integrity of the levees. Whenever possible, this work shall be performed from the levee access road. If access to the bottom of the creek is required, the work area shall be limited to a 30-foot-wide zone extending outward from the levee at the invert and 15 feet upstream and downstream on either side of the tree to be removed. Hand-held equipment shall be used. Whenever possible, this work shall occur between September 1 and March 15, which is outside of the nesting season of the least Bell's vireo.

C. REMOVAL OF VEGETATION FROM RIP-RAP (HASLEY CANYON DRAIN)

Control of vegetation on the rock face of the levee to the invert access roads by LACDPW shall proceed under current policies, procedure, and practices. Careful attention to chemical handling and wind drift shall be observed. Chemicals shall be suitable for use around aquatic

areas. For existing and new levees constructed within Hasley Canyon drain, LACDPW may remove trees that grow in levees, and remove large trees, defined as trees with trunks four inches or more in diameter at breast height (dbh), within 15 feet of the levee toe in order to maintain the structural integrity of the levees. Whenever possible, this work shall be performed from the levee access road. If access to the bottom of the creek is required, the work area shall be limited to a 30-foot-wide zone extending outward from the levee at the invert and 15 feet upstream and downstream on either side of the tree to be removed. Hand-held equipment shall be used. Whenever possible, this work shall occur between September 1 and March 15, which is outside of the nesting season of the least Bell's vireo. Only one side of the levee can be cleared of large trees in any one year.

D. CLEANING STORM-DRAIN OUTLETS

Sediment buildup at existing drains shall be removed on an as-needed basis as determined by the LACDPW. The County shall use light equipment to create a swale up to 75 feet in length and up to 10 feet wide, to allow water to drain. Light equipment such as a Caterpillar D-6 or equivalent may enter areas of the creek as long as they avoid areas of ponded or flowing water (not including water discharging from the side drains) to remove sediment. Large riparian trees defined as trees with trunks in excess of four inches in diameter at breast height (dbh) shall be avoided. The maintenance area will be demarcated with flagging. New side drains will be designed with a rock apron to maintain a clear area large enough to provide sufficient hydraulic capacity to maintain flow from the side drain. Equipment shall be introduced into the creek by means of an earth ramp constructed on the side slope in the immediate vicinity, or from an adjacent invert access ramp if within 1,000 feet of the area to be maintained. If the equipment must access the creek, care will be taken to minimize impacts to vegetation and to avoid destruction of large trees, defined as trees with trunks in excess of four inches in diameter at breast height (dbh).

E. CONTROL OF ODOR FROM STAGNANT PONDS

In order to drain stagnant water that is causing an odor problem, LACDPW shall dig a swale using a Caterpillar D-6 or its equivalent or may hand shovel a swale, up to 75 feet in length and up to 10 feet wide to allow ponded water to percolate. LACDPW will notify the ACOE and CDFG prior to performing this work. Prior to initiating in-channel maintenance activities, all work sites and access roads shall be inspected by a qualified biologist for the presence of sensitive aquatic species. The ACOE and CDFG shall be notified of the inspection and have the option of attending. If ACOE and CDFG feel that there is a concern about endangered species being present in an area, every effort will be made to schedule a field meeting within ten working days. At the field meeting, the ACOE and/or CDFG will determine if the work can be completed without take of an endangered species. The ACOE is expected to coordinate with the USFWS regarding the presence of endangered species in the area. If a take will occur, the County will apply for the appropriate endangered species permits.

F. BRIDGE REPAIR

Whenever practical, repairs to bridges shall be made from the bridge deck. If this is not practical, minimum encroachment upstream and/or downstream of the bridge will be acceptable. The maintenance work area for structural repairs shall be limited to 30 feet on either side of the bridge and under the bridge itself. Equipment shall be introduced into the creekbed by means of an earth ramp constructed on the side slope in the immediate vicinity, or from an adjacent invert access ramp if within 1,000 feet of the bridge. If the equipment must access the creekbed, care shall be taken to minimize impacts to vegetation and to avoid destruction of large trees, defined as trees with trunks in excess of four inches diameter at breast height (dbh). Prior to conducting the work in non-emergency situations, LACDPW shall contact the ACOE and CDFG two weeks in advance, or in emergency situations, shall notify the ACOE and CDFG within two weeks of work being initiated. Non-emergency maintenance should be scheduled between September 1 and March 15 to avoid the least Bell's vireo nesting season.

G. REPAIRS TO BANK PROTECTION

Structural repairs to levees, bridges, side drains, water quality facilities, utility crossings, etc., shall be performed on an as-needed basis to maintain the integrity of the structure. The work area shall be limited to the section of the structure, plus a 30-foot work area extending out from the levee at the invert and upstream and downstream within the 30-foot width of the structure to be repaired. The ACOE and CDFG will be notified two weeks in advance of any work that encroaches into the creekbed unless it is emergency work, in which case the ACOE and CDFG shall be notified within two weeks of initiation of work.

H. CLEARING VEGETATION FROM THE BOTTOM OF HASLEY CANYON DRAIN

Since the new Hasley Canyon drainage channel design will not conform to the required Manning's "n" of 0.085, periodic clearing of the channel bottom will be required to provide flood-flow capacity. Existing native vegetation growing along the channel bottom will be cleared whenever there is more than 50-percent vegetative cover over three feet tall within the channel. When this criteria is met or exceeded, only one side of the channel bottom (extending out 40 feet from the toe of the lining with the existing channel bottom) will be cleared in any one year. Heavy equipment will be used to clear the vegetation. Any vegetative clearing that is necessary within 100 feet of the Castaic Creek confluence shall only be done using hand.

I. WATER DIVERSIONS AROUND WORK AREAS NEAR ENDANGERED SPECIES AQUATIC SITES

If water diversions are required to perform work, LACDPW shall provide for the protection of any aquatic species that may exist within the surface water. This would include securing appropriate endangered species permits. The following provisions apply:

1. Prior to initiating construction, the site shall be inspected by a qualified biologist for the presence of any sensitive aquatic species. ACOE and CDFG will be notified of the inspection and will have the option of attending. If either agency is not represented, the

biologist will file a written report of the inspection with the agency not in attendance within ten days of completion of the survey. If any sensitive species is present, the following conditions will apply:

- The site will be surveyed and cleared of the sensitive species immediately before the work is to be carried out, immediately before any equipment is moved into or through the stream, and immediately before diverting any stream water. Any species collected will be moved out of the work area and returned to the stream in a manner and at a location to ensure their survival.

- Blocking nets, or fences with 1/4-inch square mesh, 18-inches high, and buried 6 inches, will be placed upstream and downstream of the work area to assure that no sensitive species moves into the work area.

- A qualified biologist will be present at the moment any stream diversion takes place and will patrol the area, both within and downstream of the work area, to rescue any species stranded by diversion of surface water. If there is a possibility that additional downstream sections of the stream will be dewatered, additional biologists will be available for downstream patrol. These rescue patrols will continue until all dewatered portions of the stream are determined to be cleared.

- Once it is determined that the construction site or a portion of the site and work area boundary does not contain sensitive species, the site shall be fenced with construction fencing along the stream side, and maintenance personnel and equipment will not enter the creek beyond the fence.

- A water-control system will be installed to intercept stream flow upstream of the work area and carry it around the work site. The system will be completed before turning water into it. The process of turning water into this bypass system shall be done so as to minimize sediment movement.

- LACDPW will use best efforts to ensure that no debris, bark, slash, sawdust, rubbish, cement, concrete, or washings thereof, oil or petroleum products, or other organic material from construction or associated activity will be allowed to enter into or be placed where it may be washed by rainfall or runoff into the creek. Sediment control best management practices (BMPs) shall be utilized during construction.

- Impacts to endangered species may require obtaining appropriate endangered species permits.

2. If no sensitive aquatic species is found in the area, standard diversion practices shall be utilized as follows:

   - Pilot Channel - pilot channels constructed to divert flows around work areas shall be sized to maintain existing water velocities, with wide, shallow channels being utilized.

The channel should be kept as small as possible, extending no more than 25 feet upstream and downstream of the work area. Construction of pilot channels should start at the downstream end. Once water is diverted into the new channel, the original channel should be visually inspected, and any stranded fish shall be removed and returned to the water downstream of the diversion. Once the diversion is no longer needed, the area shall be restored as closely as practical to its original configuration.

- Pump - the use of a pump to divert flows around a work site is also acceptable. The pump must have at least a 1/4-inch mesh screen. Water should be discharged downstream, within 25 feet of the work area. Any dams installed across flowing water for the diversion shall be removed upon completion of construction, and the area shall be restored as closely as practical to its original configuration.

LACDPW will contact the ACOE and CDFG to identify areas of potential endangered species habitat. If either agency believes the work may adversely impact endangered species or its habitat resources, or if the LACDPW wishes to consult with the either agency, a field meeting will be scheduled. At the field meeting, the agencies will provide information regarding endangered or threatened species that could be impacted by the project. If take of an endangered species will occur, the appropriate endangered species permits will be required. To the extent that a CDFG Section 2081 Memorandum of Agreement has been completed for the species present, the mitigation measures shall be implemented and maintenance activities may proceed as described above.

IV. NOTIFICATION GUIDELINES

This GMP will require that the County first obtain a long-term maintenance permit from the ACOE (Section 404 permit). Under the ACOE's current permit program, long-term maintenance activities within existing flood control facilities would qualify under Nationwide Permit #31. These activities will not result in discharge of fill into "waters of the U.S." The County will also need to establish a renewable general maintenance 1601 Agreement with the CDFG. This agreement would permit the routine flood control maintenance activities previously described and could be extended for five-year terms.

Routine maintenance operations within Castaic and Hasley Canyon drainages will require notification be sent to both ACOE and CDFG. The type of notification (non-emergency or emergency project) will depend on whether or not the activity is considered to be a routine operation or occurring as part of an emergency situation. The notification form is included as Appendix E.

The Operator shall use the General Maintenance Notification (Emergency/Non-emergency) form (Appendix E) to describe the type of work to be performed. In non-emergency situations, the form should be filled out and faxed to ACOE and CDFG at least two weeks in advance of the work. LACDPW may contact ACOE and CDFG to identify areas of potential endangered species habitat. If the ACOE and CDFG believe the work may adversely impact an endangered species or its habitat resources, or if the LACDPW wishes to consult with ACOE and CDFG, a field

meeting will be scheduled. At the field meeting, ACOE and CDFG will provide information regarding endangered or threatened species that could be impacted by the project. If take of an endangered species will occur, the appropriate endangered species permits will be required. To the extent that a USFWS Section 7 and CDFG Section 2081 Memorandum of Agreement have already been completed for the species present, the identified mitigation measures will be implemented, and maintenance activities may proceed as outlined in these documents.

The notification is provided to demonstrate consistency with the policies of the GMP. In non-emergency situations, CDFG must respond to the notification within twenty working days. If CDFG believes that the work is inconsistent with the GMP, a field meeting will be scheduled to review the site and determine how the work may proceed. If CDFG does not respond within twenty working days, the work shall proceed as described in the notification. However, appropriate endangered species permits may be required for any impacts to endangered species.

If the project qualifies under the law as an emergency, LACDPW shall complete a GMP Notification form describing how the emergency work was performed in conformance with the guidelines in the GMP. This form will be mailed to ACOE and CDFG within ten days of initiating work activities.

V. LITERATURE CITED

Department of the Army, Los Angeles District Corps of Engineers 1990. Environmental Assessment 404(b)(1) Evaluation Public Interest Review. Permit Application Number 90-419-EV. Applicant: Valencia Company.

Tettemer, J.M., Vance, H.A. and Vandermost, J. 1993. U.S. Army Corps of Engineers General Section 404 Permit Santa Clara River from Castaic Creek to one-half mile above the Los Angeles Aqueduct and portions of San Francisquito Creek and the Santa Clara River, South Fork Los Angeles County, California for levee linings, bridges, storm drain outlets, and related drainage and water quality projects proposed by the Valencia Company. July.

Tettemer, John and Associates, Ltd. 1997. Natural River Management Plan for Santa Clara River from Castaic Creek to One-half Mile above the Los Angeles Aqueduct and Portions of San Francisquito Creek and the Santa Clara River, South Fork, Los Angeles County, California. Prepared for the Valencia Company.

U.S. Army Corps of Engineers and California Department of Fish and Game. 1997. Draft Environmental Impact Statement/Environmental Impact Report. 404 Permit and 1603 Streambed Alteration Agreement for Portions of the Santa Clara River and its Tributaries, Los Angeles. December.

U.S. Army Corps of Engineers and California Department of Fish and Game. 1998. Final Environmental Impact Statement/Environmental Impact Report. 404 Permit and 1603 Streambed Alteration Agreement for Portions of the Santa Clara River and its Tributaries, Los Angeles. August.

DATE: March 4, 2002

TO: Project Files

FROM: Louis Courtois LC

SUBJECT: Update to CESPL-CO-R May 26, 1999 ACOE Memorandum For The Record: Castaic Creek Maintenance/Revegetation Plan 90-00419-EV

ACOE Comment #1 - Please refer to page 11 of latest (March 2002) General Maintenance Plan.

ACOE Comment #2 - The ACOE permit referred to was #90-00419-EV. Following a June 14, 1999 telephone discussion with the CDFG, a revised revegetation plan specific to the Castaic Creek Bridge and Castaic Creek Channel Lining projects was submitted to the agencies (June 18, 1999). This plan included an expanded planting plan that showed the location of revegetation site in relation to the channel lining project site and planting acreage of each area. Combined the two projects required that 549 trees (312 cottonwoods and 237 willows) be planted. However, a total of 868 trees were planted during the first week of August 1999. The extra 319 trees were to be used for mitigating future projects. These extra trees were planted because the revegetation site was larger than required by the two projects. Monitoring reports have been submitted to the agencies for 2000, 2001, and 2002.

1891 Goodyear Avenue, Suite 619 • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-8270 • aquaserv@west.net

DATE: March 4, 2002

TO: Project Files

FROM: Louis Courtois LC

SUBJECT: Update to CDFG May 27, 1999 letter regarding Castaic Creek General Maintenance and Revegetation Plan (1603 No. 5-346-97 and 5-370-97)

I discussed these two comments with Ms. Leslie MacNair (CDFG) on June 14, 1999. At that time she said Newhall could amend the existing 1603 Agreements to add in maintenance activities. She requested Newhall submit a revegetation plan for each site or alternatively, combine the revegetation requirements for both sites together and plant a larger area. Newhall decided to combine the two project's revegetation requirements together and plant one large site. The revegetation site is located immediately opposite (west) the channel lining site. Combined the two projects required that 549 trees (312 cottonwoods and 237 willows) be planted. However, a total of 868 trees were planted during the first week of August 1999. The extra 319 trees were to be used for mitigating future projects. These extra trees were planted because the revegetation site was larger than required by the two projects. Monitoring reports have been submitted to the agencies for 2000, 2001, and 2002.

CDFG Comment #1 - A detailed revegetation plan (dated 6-18-99) was submitted to the agencies. This plan included an expanded planting plan that showed existing creek topography and the location and acreage for each area.

CDFG Comment #2 - The detailed revegetation plan (dated 6-18-99) provided detailed procedures for weed eradication.

APPENDIX A

404 PERMIT NO. 89-00419-AOA

ACOE CORRESPONDENCE

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

November 16, 2000

REPLY TO
ATTENTION OF:
Office of the Chief
Regulatory Branch

Mr. Ross Pistone
Valencia Company
23823 Valencia Boulevard
Valencia, California 91355-2194

Dear Mr. Pistone:

Reference is made to your request of November 3, 2000 to amend Permit No. 89-00419-AOA which authorized you to construct flood control and site drainage facilities for the construction of the Valencia Commerce Center in Castaic Creek in the City of Santa Clarita, Los Angeles County, California.

Under the provisions of 33 Code of Federal Regulations 325.6(d), the start date is to remain the same and the completion date is extended from December 11, 2000 to December 11, 2005.

Please be aware that the above project is located in proposed critical habitat for the arroyo southwestern toad. The Corps has determined that this project would not adversely modify the proposed critical habitat and, as a result, a Conference is not required for this permit extension. However, if the project area is designated as critical habitat for the arroyo southwestern toad, the Corps may have to suspend this permit to complete an informal/formal Section 7 Consultation with the U.S. Fish and Wildlife Service.

The terms and conditions of Permit No. 8900419-AOA, except as changed herein, remain in full force and effect.

Please note that a copy of this letter is being forwarded to those agencies on the enclosed list.

Sincerely,

Mark Durham

George L. Beams, P.E.
Chief, Construction -
Operations Division

for

Enclosure

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
300 NORTH LOS ANGELES STREET
LOS ANGELES, CALIFORNIA 90012

REPLY TO
ATTENTION OF:

Office of the Chief
Regulatory Branch

November 15, 1995

Mark Subbotin
Senior Vice President, Planning
Valencia Company
23823 Valencia Boulevard
Valencia, California 91355-2194

Dear Mr. Subbotin:

Reference is made to your request of August 21, 1995 to amend Permit No. 89-00419-EV which authorized you to construct flood control and site drainage facilities associated with the Valencia Commerce Center in Castaic Creek near the City of Santa Clarita, Los Angeles County, California.

Under the provisions of 33 Code of Federal Regulation 325.6(d), the start date is to remain the same and the completion date is extended from December 11, 1995 to December 11, 2000.

The terms and conditions of Permit No. 89-00419-EV, except as changed herein, remain in full force and effect.

In response to your request for a ten year extension, the Corps of Engineers rarely, if ever, grants permit extensions for that amount of time. Your reference to 33 CFR Part 325.6(b) does not apply to time extensions for pending projects but for completed projects (e.g. a dam, once completed, would not require a new 404 authorization every five years).

Please note that a copy of this letter is being forwarded to those agencies on the enclosed list. If you have any questions, please contact Aaron Allen at (213) 894-0349.

Sincerely,

Richard J. Schubel

Richard J. Schubel
Acting Chief, Regulatory Branch

Enclosure

Copies forwarded:

U.S. Fish and Wildlife Service
Attn: Field Supervisor
2140 Eastman Avenue, Suite 100
Ventura, California 93003

U.S. Environmental Protection Agency
Attn: Mr. Jeff Rosenblum
Wetlands and Dredged Material Section (W-7-2)
75 Hawthorne Street
San Francisco, California 94105

California Department of Fish and Game
Attn: Mr. Curt Taucher
330 Golden Shore, Suite 50
Long Beach, California 90802

Valencia Company

23823 Valencia Boulevard, Valencia, California 91355-2194 • (805) 255-4000

805-255-4069

WRITER'S DIRECT DIAL NUMBER

August 21, 1995

Mr. David Castanon
Chief, North Coast Section
Department of the Army
Los Angeles District Corps of Engineers
Ventura Field Office
2151 Allesandro Drive, Suite 255
Ventura, CA 93001

CERTIFIED MAIL

Dear Mr. Castanon:

In review of your letter dated December 9, 1993, which granted Valencia Company a two year extension to the Valencia Commerce Center, Individual Permit No. 89-419-EV, we are asking for an additional extension of ten years. Current market conditions in the Santa Clarita Valley and Southern California as a whole are such that implementation and completion of this permit by December 11, 1995, would cause an undue financial burden. Significant reliance has been made by Valencia on the continued use of the permit.

The scope of work under this permit is for an activity of a permanent nature and the provisions of 33 Code of Federal Regulation 325.6 (b) would allow a permit with an indefinite duration, or certainly longer than two years for a project of this extent.

Thank you for your attention to this matter. Please call me if you have any questions or I can provide further clarification.

Sincerely yours,

Mark Subbotin
Senior Vice President
Planning

bcc: Phil Stidham
Ross Pistone
Steve Kessler
Ron Horn

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2711
LOS ANGELES, CALIFORNIA 90053-2325

DEC 14

December 9 ,1993

REPLY TO
ATTENTION OF
Office of the Chief
Regulatory Branch

Valencia Company
(Att: Mark Subbotin)
23823 W. Valencia Boulevard
Valencia, California 91355

Gentlemen:

Reference is made to your request dated June 9, 1993 to amend Permit No. 89-419-EV which authorized you to:

1. Line of approximately 19,400 feet of bank as protection along both sides of a 1.7 mile stretch of Castaic Creek;

2. Construct a flood control channel in Halsey Canyon along an existing man-made ditch that will impact a total of 5.4 acres of watercourse;

3. Discharge fill into 4.0 acres of an ephemeral streambed to construct an underground storm drain.

These activities are located in Castaic Creek at a site adjacent to Interstate 5 and State Route 126, Halsey Canyon watershed draining into Castaic Creek and an unnamed drainage in the vicinity, also feeding Castiac Creek, Los Angeles County, California.

Under the provisions of 33 Code of Federal Regulation 325.6(d), the start date is to remain the same and the completion date is extended from December 11, 1993 to December 11, 1995.

The terms and conditions of Permit No. 89-419-EV, except as changed herein, remain in full force and effect. In addition, as per Condition A in After-the-Fact Permit No. 86-255, the applicant shall include the above project (No. 89-419-EV) in the NEPA document scope of analysis for the Valencia Long-Range Plan. Any further time extensions for permit No. 89-419-EV will be based on the results from the above referenced study.

Please note that a copy of this letter is being forwarded to those agencies on the enclosed list.

Sincerely,

Diane K. Noda

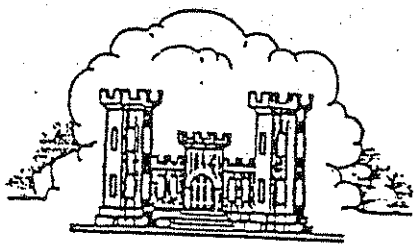
for John A. Gill
Chief, Regulatory Branch

Enclosure
Copies Forwarded:

Fish and Wildlife Enhancement
U.S. Fish and Wildlife Service
Attn: Mr. Jack Fancher
2730 Loker Avenue West
Carlsbad, California 92008

U.S. Environmental Protection Agency
Attn: Mr. Clyde Morris
Wetlands and Dredged Material Section (W-7-2)
75 Hawthorne Street
San Francisco, California 94105

California Department of Fish and Game
Attn: Mr. Bruce Eliason
330 Golden Shore, Suite 50
Long Beach, California 90802



LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

CERTIFICATION OF COMPLIANCE WITH DEPARTMENT OF THE ARMY PERMIT

Permit Number: 89-419-EV

Name of Permittee: Valencia Company
23823 Valencia Boulevard
Valencia, CA 91355

Date of Issuance: December 11, 1990

Upon completion of the activity authorized by this permit, sign this certification and return it to the following address:

U.S. Army Engineer District
ATTN: SPLCO-R-89-419-EV
P.O. Box 2711
Los Angeles, California 90053-2325

Please note that your permitted activity is subject to a compliance inspection by an Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit.

_____
Signature of Permittee

Valencia Company

23823 Valencia Boulevard, Valencia, California 91355 • (805) 255-4000

December 11, 1990

WRITER'S DIRECT DIAL NUMBER

(805) 255-4069

Liz Varnhagen
Department of the Army, Los Angeles District
Corps of Engineers, Regulatory Branch
P.O. Box 2711
Los Angeles, CA 90053

SUBJECT: VALENCIA COMPANY INDIVIDUAL PERMIT 89-419-EV

Dear Liz:

Attached is an original copy of the 404 Permit for Castaic Creek signed by Stephen Schmidt. You will also find a check in the amount of $100.00 and the notification of commencement of work for the unnamed drainage and that portion of Hasley Creek for which we have executed 1603 Agreements.

The 1603 Agreements are attached for your file, pursuant to Condition #17 of the 404 Permit.

Again, I want to thank you for all your efforts in this process and look forward to working with you in the future as we make headway with Flood Control District.

Sincerely,

Mark Subbotin
Assistant Vice President

MAS:jw

cc: John Gray

LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY PERMIT

Permittee:

Valencia Company
23823 Valencia Boulevard
Valencia, CA 91355

Permit Number:

89-419-EV

Issuing Office:

Los Angeles District

Note: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description:

1) Install bank protection along the 1.7-mile stretch of Castaic Creek from the bridge of The Old Road, downstream to the Route 126 Bridge just above its confluence with the Santa Clara River. The bank protection shall be in the form of either shotcrete, closed, or open-celled articulating precast concrete tiles as specified on the attached drawing. Portions of the natural bank of the Creek shall be excavated and other areas filled, and graded to a 2H:1V slope to achieve a smooth bank alignment as illustrated in Figure 2 attached

to this permit.

Construct Backer Road Bridge across Castaic Creek at the location shown in the attached drawing, and install an energy dissipator in the creekbed below the bridge.

2) Fill the unnamed tributary to Castaic Creek that is approximately 1,500 feet long and empties into the Creek about 800 feet upstream of the Route 126 bridge as shown in Figure 1 attached to this permit.

3) Widen and install shotcrete lining on Hasley Creek as shown in Figure 1. Energy dissipators will be installed approximately every 300 to 500 feet.

Project Location: In Castaic Creek, H sley Creek, and an unnamed tributary to Castaic Creek at a 1.7 mile stretch between The Old Road bridge and Highway 126 bridge, Los Angeles County.

Permit Conditions

General Conditions:

1. The time limit for completing the authorized activity ends on ecember 11, 1993. If you find that you need more time to complete the thorized activity, submit your request for a time extension to this ffice for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification from this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this uthorization.

. If a conditioned water quality certification has been issued for your

project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished with the terms and conditions of your permit.

Special Conditions: See attached sheet.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

Section 404 of the Clean Water Act (33 U.S.C. 1344).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measure ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give you favorable consideration to a request for an extension of this time limit.

You signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Stephen C. Eckhardt
(PERMITTEE)

12-11-90
(DATE)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

for David L. Castaños
CHARLES M. HOLT, P.E.
Chief, Regulatory Branch
(for the District Engineer)

12-11-90
(DATE)

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE)

(DATE)

SPECIAL CONDITIONS FOR THE VALENCIA COMMERCE CENTER PERMIT, APPLICATION NUMBER 89-419-EV

1. Low-growing dry wash vegetation shall be allowed to establish naturally within the bottom of Hasley Creek to compensate for the loss of dry wash habitat along the unnamed drainage. There shall be no clearing of any native riparian vegetation that establishes itself within the creek channel unless it grows excessively dense so as to impede water flow. Any vegetative clearing that is necessary within 100 feet of the confluence with Castaic Creek shall be done by hand only.

2. The permittee shall record in deed the Castaic Creek corridor as a conservation easement for the purpose of retaining and enhancing fish and wildlife values in perpetuity. Copies of these deed restrictions shall be furnished to the Corps of Engineers, the U.S. Fish and Wildlife Service and the California Department of Fish and Game for our files prior to approval of final construction drawings as set forth in condition 6 below, and within twelve months of the issuance of this permit.

3. The permittee shall require through project conditions, covenants and restrictions any industrial user which handles toxic or hazardous substances within the Valencia Commerce Center, to build an on-site self-containment system in accordance with applicable local, state, and federal laws that will prevent these substances from accidentally entering Hasley Creek or Castaic Creek. This measure shall minimize the potential of contaminating the unarmored three-spine stickleback and least Bell's vireo habitats downstream in the event of an accident. This shall be verified by the Corps personnel making inspections of the channel each year for the duration of the construction period.

4. Parking lots in the Valencia Commerce Center shall have a drainage system to divert non-storm flows to an oil and grease trap that will separate such contaminants before the runoff is diverted to Hasley or Castaic Creek. These parking lot runoff control systems shall be verified by Corps personnel while making annual inspections of the channels for the duration of the construction period.

5. Prior to the initiation of any construction in Castaic Creek, or any maintenance clearing within the bottom 100 feet of Hasley Creek, the permittee shall furnish the Corps with a letter that is signed by Los Angeles County Department of

Public Works which declares that they agree to comply with the special conditions of this permit. Maintenance vegetative clearing is permitted only in the upper portion of Hasley Creek, and for emergency repair work to structures within the channel and the bank lining. Under such conditions, clearing of vegetation should be kept to a minimum, and the permittee shall perform remedial replacement of damaged vegetation (especially from the construction of access roads if they are necessary) immediately upon completion.

6. Installation of the channel lining and storm drain system shall occur during the period of April 1 to November 1 to avoid winter runoff. Erosion and sediment control measures shall be established prior to all construction activities in any water course on the project site. In the event that the contractors are not able to finish the construction in this time window, the permittee shall inform the Corps in advance of November 1 in writing, and request permission for a one or two month time extension.

7. Bank protection that allows for growth of native herbaceous vegetation shall be utilized along the sides of Castaic Creek as indicated on the attached map, except on portions of the creek where there is a high propensity for scouring under high flow conditions, or adjacent to certain structures. The preferred form of bank protection is articulating concrete tiles of the open-cell variety. These and closed cell tiles which are permitted only in areas where open cell tiles cannot provide adequate protection, shall be installed in areas as indicated on the attached concept map. Gunite lining shall also be used only where explicitly indicated on the concept map. This plan has been reviewed by the U.S. Fish and Wildlife Service and their objection to the issuance of this permit has been lifted largely based on the assumption that this concept map shall be implemented. Final construction drawings of all haul-routes, channel lining, bridges, point stabilizers, outlets, and appurtenant facilities in and along the entire stretch of Castaic Creek within project boundaries, shall be submitted to the Corps in coordination with the USFWS prior to the initiation of any phased construction on Castaic Creek for final review and approval.

8. The new lining along Castaic Creek shall be seeded with native herbaceous vegetation and initially irrigated after installation to encourage the development of low-growing riparian growth.

9. The areal extent and duration of construction activities along Castaic Creek shall be minimized as much as possible. Construction zones for the installation of bank protection and haul routes shall be flagged and staked in the field to minimize intrusion and disturbance of existing vegetation shown on the bypass concept (attached as Exhibit B). All marshalling and equipment storage areas shall be located outside of the channel. The staked boundaries of the impact zone shall be verified by the Corps and the U.S. Fish and Wildlife Service prior to the commencement of construction.

10. The permittee shall replace all living and dead willow and cottonwood trees that have a diameter at breast height of 6 inches or more, at a ratio of 1.5 new trees for each tree lost. These trees shall not be any smaller than those out of five gallon containers, and preferably a mixture of large sizes. Replacement plants shall be placed in augered holes in portions of the Castaic Creek channel that appear to have suitable environmental conditions for such trees to establish naturally. Potentially suitable areas are shown on the attached bypass concept (Attached).

Prior to construction in Castaic Creek, a formal mitigation plan shall be submitted to the Corps for review and approval in coordination with the U.S. Fish and Wildlife Service (USFWS). This plan shall include the numbers of the different species of trees to be planted, the sizes, and locations of planting. The plan shall also describe maintenance of the planted area with regard to irrigation (as needed) and weed iradication. These replacement trees shall be monitored for five years following the completion of the construction phase of channel, to ensure their successful establishment.

Survey and re-vegetation plan monitoring documents shall be submitted to the Corps and USFWS in the form of annual reports in December of each year. These shall be reviewed and amended as necessary to ensure success. All failed plantings shall be replaced. If the agencies determine that restoration has not been successful, the program shall be re-assessed, irrigation introduced if necessary, and restoration efforts shall continue on a year-to-year basis until success has been demonstrated.

In the event of significant flood flows which wipe out much of the existing and newly planted vegetation within the five year monitoring and maintenance period, the applicant shall restore

the mitigation site(s) in accordance with the approved mitigation plan.

11. Emergency repair of the channel lining or bridges across Castaic Creek or Hasley Creek shall occur as needed. Any sensitive riparian habitat in the vicinity shall be staked in advance to minimize the area of adverse impacts to vegetation. Routine maintenance in the form of vegetative clearing within and along Castaic Creek shall not occur in vegetated or mitigation areas. All riparian vegetation disturbed by maintenance and repair shall be replaced at a ratio of 1:1.

12. The permittee shall remove the existing road that crosses Castaic Creek near its confluence with Hasley Creek, immediately following the construction of the new bridge. The area shall be restored to match the surrounding creek contours and revegetated with native willow and mulefat cuttings and trees at sizes and densities similar to those in the immediate vicinity.

13. Excavation of mounds of tailings from past sand and gravel mining operations within the creek may occur, but any trees and shrubs removed in the process that are greater than 6 inches at breast height shall be replaced on site at a 1.5:1 ratio.

14. A weed eradication and control program shall be established as part of the restoration efforts and implemented on a regular basis during the five-year restoration period. During monitoring efforts, a crew shall examine all disturbed portions of Castaic Creek and remove by hand (and by topical application of approved herbicides) stands of Arundo donax, Tamarisk, castor bean and tree tobacco.

15. As this permit will expire before all elements of the project along waters of the United States have been installed at least six months prior to its expiration, the permittee shall request an extension in writing.

16. Surveys for the presence of the least Bell's vireo, (Vireo belli pusillus), shall be conducted at weekly intervals during the months of April and May, for the duration of the construction of the bank protection in Castaic Creek. Following the culmination of these surveys, documentation and results of the surveys shall be submitted to the Corps for review. In the event that a vireo is spotted, the surveys shall be extended through June or until a nest is located. If

nesting vireos occur in the area, then any construction within 300 feet of the nest shall be discontinued until the nest is abandoned. The vireo shall not be harassed in any way, and if one is hurt or killed, the U.S. Fish and Wildlife Service shall be notified immediately pursuant to the Endangered Species Act.

17. This permit is not valid without valid Streambed Alteration Agreements from the California Department of Fish and Game for the individual portion(s) of the project about to be constructed. Final copies of these executed agreements and their renewals shall be submitted to the Corps for the file.

18. Landscaping along the top of the bank protection shall utilize native drought tolerant plants.

19. The following measures shall be implemented for cultural and paleontological resources:

(a) Prior to the installation of lining along Hasley Creek, detailed field surveys will be conducted at the Pyle Ranch and Tsavangu Rancheria sites, particularly in croplands.

(b) The Pyle Ranch site shall be fully documented and limited subsurface testing shall be conducted prior to grading.

(c) A qualified archaeologist shall be hired to perform the monitoring and shall send a letter to the Corps stating that he or she has been retained in order for the permittee to comply with the conditions of the permit.

(d) All grading and subsurface excavation work in the course of constructing bank stabilization for the Valencia Commerce Center will be monitored by the archaeologist. If he or she decides it is unnecessary to monitor any portion of the project area, he will include in his report with justification for the avoidance. All monitoring will be conducted to satisfy the terms of Section 106 of the National Historic Preservation Act.

(e) The archeologist shall provide the Corps with periodic progress reports of the monitoring. The reports will be submitted bi-weekly or monthly, depending on the length of time estimated for the subsurface activities to take place. The archeologist will indicate which is appropriate.

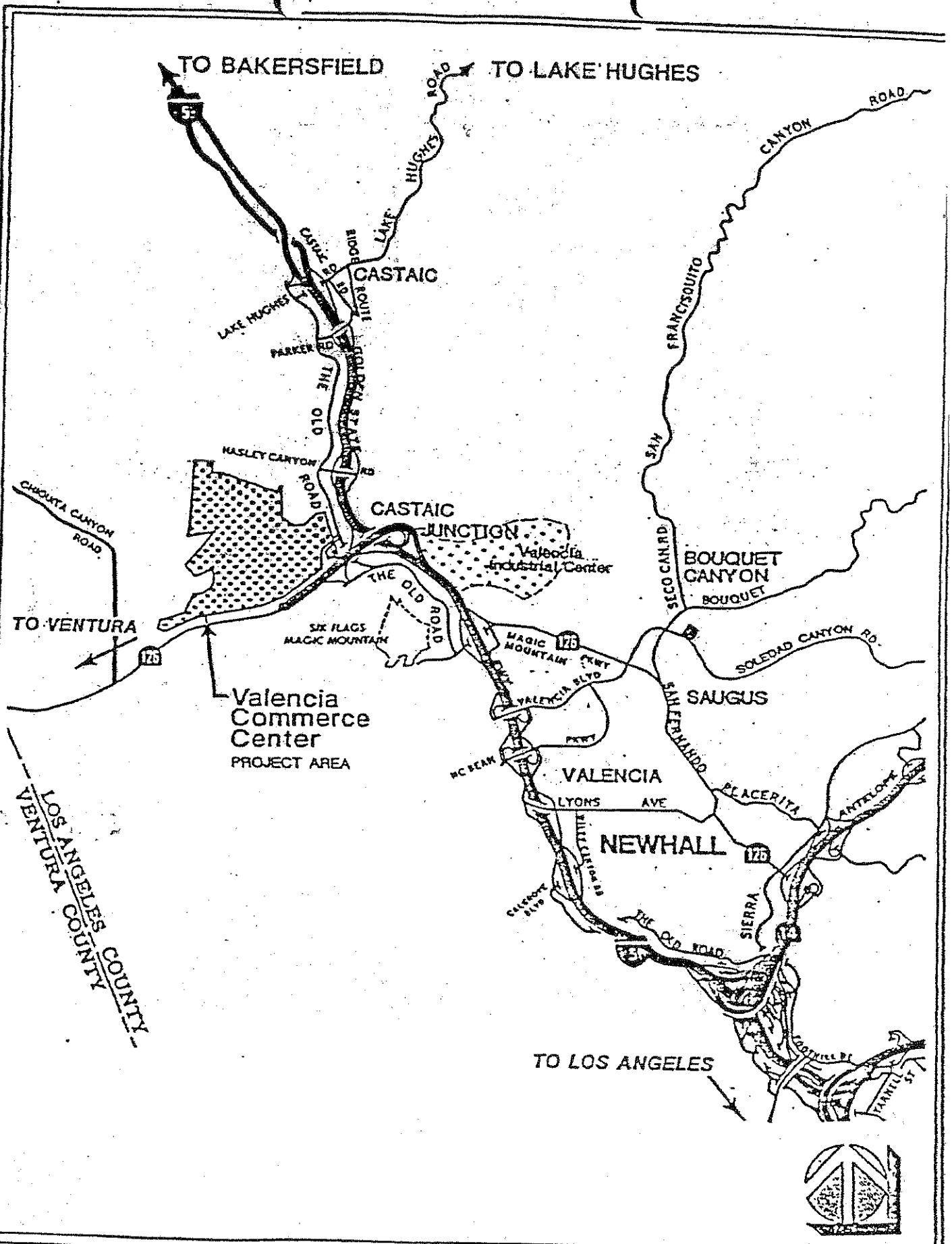
(f) After completion of the monitoring project, the archeologist will immediately submit a report to the Corps for evaluation.

If a negative report is accepted by the Corps, no further archeological work will be required.

If an archeological deposit is found, the Corps should be notified immediately. Additional subsurface testing may be required.

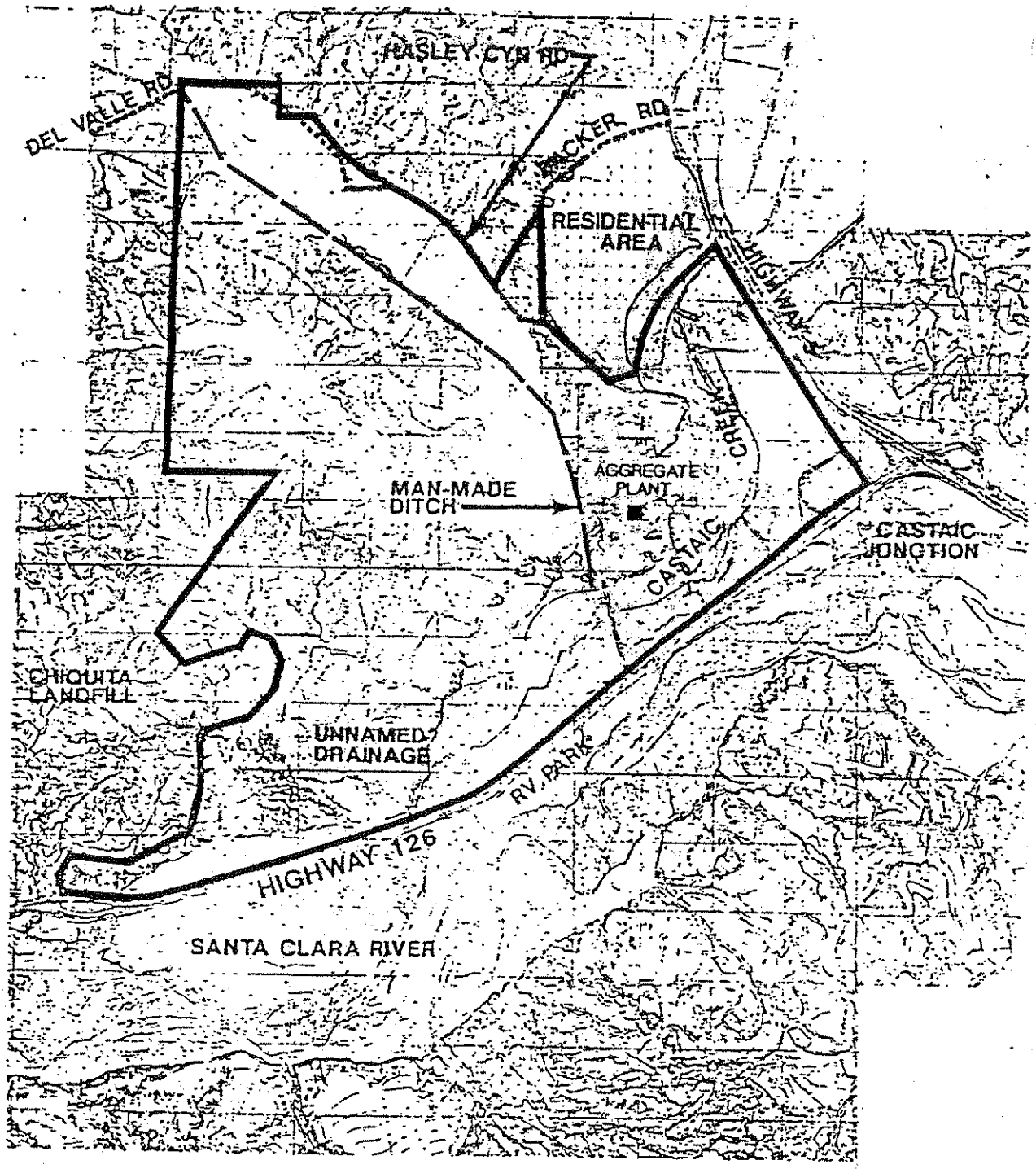
20. Prior to excavation activities associated with installation of the channel lining and storm drain, the permittee shall contact a qualified paleontologist to conduct a full survey of the area to be affected and identify locations that could potentially contain significant fossils. The paleontologist shall provide recommendations on the need and scope of construction monitoring at these locations in order to salvage significant fossils. The report with these recommendations will be submitted to the Corps for our files, and to the Los Angeles County Museum for review. If construction monitoring and salvage are deemed necessary, the recommendations by the Museum concerning artifact handling, curation and documentation will be followed.

21. The permittee shall coordinate with Caltrans for work in the State right-of-way near the Route 126 Bridge and the Old Road bridge. A complete set of project engineering plans including details on the lining tie-in to the bridges, and data on flood velocities and elevations at the structures will be submitted to Caltrans.



Regional Location of Project Area
Valencia Commerce Center

FIGURE
1



Project Area
Valencia Commerce Center

FIGURE
2

Preliminary Bank Stabilization Plan for Castaic Creek
Valencia Commerce Center

FIGURE 4

APPENDIX B

LOS ANGELES
REGIONAL WATER QUALITY CONTROL BOARD

401 WATER QUALITY WAIVER

EPA

Los Angeles
Regional Water
Quality Control
Board

01 Centre Plaza Drive
Monterey Park, CA
1754-2156
213) 266-7500
AX (213) 266-7600

Pete Wilson
Governor

December 17, 1997

Mr. Ross Pistone
Valencia Company
23823 Valencia Blvd.
Valencia, CA 91355

WITHDRAWAL OF APPLICATION FOR SECTION 401 WATER QUALITY CERTIFICATION - PROPOSED CASTAIC CREEK CHANNEL LINING PROJECT, CITY OF SANTA CLARITA, LOS ANGELES COUNTY (File No. 97-148)

We received your request to withdraw your application for a Section 401 Water Quality Certification (WQC) for the subject project. According to the submitted application packet, the proposed project is covered under an existing Section 404 permit (No. 90-419-EV) issued by the U. S. Army Corps of Engineers. If no other federal permit or license is required for this project, then no additional Section 401 WQC is required. However, the work implemented shall be in compliance with all the water quality objectives, prohibitions, and policies set forth in the *Water Quality Control Plan, Los Angeles Region (1994)*. Appendix I summarizes a subset of these objectives that may apply to the proposed project. In addition, this project may be subject to other State requirements (see Appendix II). No unpermitted discharges to surface waters of non-stormwater runoff are allowed. These activities would require coordination and approval from this Regional Board.

We have processed a refund request of $3,800.00 with the State Water Resources Control Board. We are retaining $200.00 to cover costs already incurred on your project. Please contact Darlene McCoy at (916) 657-1225, Division of Administrative Services, State Board, for further information.

Should you have any questions regarding this letter, please contact Rueen-Fang Wang at (213) 266-7533.

J. MICHAEL LYONS
Chief, Surveillance Unit

enclosures

cc: Becky Jones, Streambed Alteration Team,
California Department of Fish and Game (Long Beach)
Mary Meyer, California Department of Fish and Game (Ojai)
Aaron Allen, U.S. Army Corps of Engineers (Los Angeles) (No. 89-00419-EV)
Field Supervisor, U.S. Fish and Wildlife Service (Ventura)
Becky Tuden, U.S. Environmental Protection Agency (San Francisco, WTR-8)
Louis A. Courtois, Aquatic Consulting Services, 6416 Curlew Place, Ventura, CA 93003

Appendix I

In accordance with the *Porter-Cologne Water Quality Control Act* (§13243), the following represent specific water quality objectives contained in the *Water Quality Control Plan (Basin Plan), Los Angeles Region (1994)* that may apply to the proposed project:

- Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.
- Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.
- Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect beneficial uses.
- Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.
- Waters shall not contain floating materials, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.
- All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in, human, plant, animal, or aquatic life.
- Waters shall be free of substances that result in increases in the biochemical oxygen demand (BOD_5) which adversely affects beneficial uses.
- Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.
- Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use.
- Exotic vegetation shall not be introduced around stream courses to the extent that such growth causes nuisance or adversely affects beneficial uses.

The following are specific water quality objectives for protection of wetlands contained in the Regional Board's *Basin Plan (1994)* that may apply to the proposed project:

- Natural hydrologic conditions necessary to support the physical, chemical, and biological characteristics present in wetlands shall be protected to prevent significant adverse effects on:
  - natural temperature, pH, dissolved oxygen, and other natural physical/chemical conditions,
  - movement of aquatic fauna,
  - survival and reproduction of aquatic flora and fauna, and
  - water levels.

- Existing habitats and associated populations of wetlands fauna and flora shall be maintained by:
  - maintaining substrate characteristics necessary to support flora and fauna which would be present naturally,
  - protecting food supplies for fish and wildlife,
  - protecting reproductive and nursery areas, and
  - protecting wildlife corridors.

Appendix II

This project may be subject to the following State requirements:

(√) For inland disposal of nonhazardous contaminated soils and materials, contact Rodney Nelson, Groundwater Regulatory Unit, at (213) 266-7548 regarding Waste Discharge Requirements. All waste material removed must be relocated to a legal point of disposal or recycled for use as a soil amendment, if applicable. A legal point of disposal is defined as one for which Waste Discharge Requirements have been established by a California Regional Water Quality Control Board, and is in full compliance therewith.

(√) If the overall project area is larger than five acres, the proposed project may be subject to the State Board's General Construction Activity Storm Water Permit. For further information, please contact:

(√) Mark Pumford, Watershed I - Ventura Coastal Unit, at (213) 266-7596;
( ) Winnie Jesena, Watershed II - L.A. Coastal Unit, at (213) 266-7593;
( ) Joshua Workman, Watershed III - L.A. Inland Unit, at (213) 266-7615.

( ) The proposed project may be subject to the State Board's General Industrial Activities Storm Water Permit. For further information, please contact Dan Radulescu, Watershed III - L.A. Inland Unit, at (213) 266-7630.

(√) Any construction and/or groundwater dewatering, if required, would be subject to NPDES/Waste Discharge Requirements if water is discharged to surface waters or storm drains, including dry streambeds. For further information, please contact:

(√) Mark Pumford, Watershed I - Ventura Coastal Unit, at (213) 266-7596;
( ) Winnie Jesena, Watershed II - L.A. Coastal Unit, at (213) 266-7593;
( ) Joshua Workman, Watershed III - L.A. Inland Unit, at (213) 266-7615.

(√) Any construction and/or groundwater dewatering, if required, would be subject to Waste Discharge Requirements if water is discharged to groundwater or land. For further information, please contact Rodney Nelson, Groundwater Regulatory Unit, at (213) 266-7548 .

(√) The project shall also comply with the local regulations associated with the Regional Board's stormwater permit that is issued to:

(√) Los Angeles County and co-permittees under NPDES No. CAS614001 and Waste Discharge Requirements Order No. 96-054;
( ) Ventura County and co-permittees under NPDES No. CAS063339 and Waste Discharge Requirements Order No. 94-082.

AQUATIC CONSULTING SERVICES

December 12, 1997

Ms. Rueen-Fang Wang
Surveillance Unit
California Regional Water Quality Control Board
Los Angeles Region
101 Centre Plaza Drive
Monterey Park, CA 91754-2156

RE: Application for Section 401 Water Quality Certification for Castaic Creek Channel-Lining and Bridge Projects (Valencia Company)

Dear Ms. Wang:

This letter is a follow-up to your telephone call today concerning Valencia Company's application for a Water Quality Certification for the projects to be constructed within Castaic Creek. Based upon your telephone call, the Board has decided that since these projects were previously permitted under an existing U.S. Army Corps Individual 404 Section Permit (No. 90-419-EV), a Section 401 certification would not be required. It is also my understanding that the Board will take no further action on these projects. You also asked that Valencia Company withdraw their application and request a refund of all application fees. This letter formally withdraws the two permit applications and requests that a refund of application fees be sent directly to the Valencia Company at 23823 Valencia Blvd., Valencia, CA 91355-2194.

Please do not hesitate to call me at (805) 644-1208 if you have any further questions about this project.

Respectfully,

Louis A. Courtois

Louis A. Courtois, Ph.D.
Consultant

cc: Ross Pistone, Valencia Company

6416 Curlew Place • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-8220

APPENDIX C

1603 AGREEMENTS:

#5-160-90
#5-081-90
#5-346-97
#5-370-97

Hasley Creek #5-160-90

CALIFORNIA DEPARTMENT OF FISH AND GAME
330 Golden Shore, Suite 50
Long Beach, California 90802

Notification No. 5-160-90
Page 1 of 3

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and the Valencia Company, State of California, hereinafter called the Operator, is as follows:

WHEREAS, pursuant to Section 1603 of California Fish and Game Code, the Operator, notified the Department that they intend to substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed of, the following water: Hasley Canyon, Los Angeles County, California, Section 11, Township 4N, Range 16W.

WHEREAS, the Department (represented by DAVID P. DRAKE has made an inspection of subject area and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including: sandy wash habitat and herptofauna.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife resources during the Operator's work. The Operator hereby agrees to accept the following measures/conditions as part of the proposed work: (see attached list of proposed measures).

If the Operator's work changes from that stated in the notification specified above, this Agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this Agreement and with other pertinent code sections, including but not limited to Fish and Game Code Sections 2081, 3503, 3503.5, 5650, 5652, 5937 and 5948 may result in prosecution.

Nothing in this Agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. A consummated Agreement does not constitute Department of Fish and Game endorsement of the proposed operation, or assure the Department's concurrence with permits required from other agencies.

This Agreement becomes effective on date of Operator's signature and terminates 1 year from initiation of construction activities for project construction only. This Agreement shall remain in effect for that time necessary to satisfy the terms/conditions of this Agreement. If project construction does not begin within 90 days of the Operator's signing of the Agreement this Agreement shall be voided.

CONCURRENCE

Operator signature

Stephen C. Schmidt
(signature) (date)

California Department of Fish and Game

David P. Drake June 8, 1990
(signature) (date)

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-160-90

1. The following provisions constitute the limit of activities agreed to and resolved by this agreement. The signing of this agreement does not imply that the Operator is precluded from doing other activities, at the site. However, activities not specifically agreed to and resolved by this agreement are subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq..

2. The Operator proposes to alter the streambed for extension of Backer Road, realignment of Hasley Canyon Road and construction of a flood control channel..

* 3. The Operator shall submit to the Department for review and approval prior to initiation of project activities a detailed maintenance plan for the new channel that will allow for the establishment of at least 2 acres of sandy wash habitat to remain undisturbed by human activitiy. This area shall not be subject to flood control activities.

4. The Operator shall comply with all litter and pollution laws. All contractors, subcontractors and employees shall also obey these laws and it shall be the responsiblity of the Operator to insure their compliance.

5. No equipment maintenance shall be done within or near any stream channel or lake margin where petroleum products or other pollutants from the equipment may enter these areas under any flow.

6. The Department reserves the right to enter the project site at any time to ensure that there is compliance with terms/conditions of this Agreement.

7. The Department reserves the right to suspend and/or revoke this Agreement if the Department determines that the circumstances warrant. The circumstances that could require a reevaluation include, but are not limited to, the following:

a. Failure to comply with the terms/conditions of this Agreement.

b. The information provided by the Operator in support of the Agreement/Notification is determined by the Department to be incomplete, or inaccurate.

c. When new information becomes available to the Department representative(s) that was not known when preparing the original terms/conditions of this Agreement.

d. The project as described in the Notification/Agreement has changed, or conditions affecting fish and wildlife resources change.

8. The Operator shall provide a copy of this Agreement to all contractors, subcontractors, and the Operator's project supervisors. Copies of the agreement shall be readily available at work sites at all times during periods of active work and must be presented to any Department personnel, or enforcement personnel from another agency upon demand.

9. The Operator shall notify the Department, in writing, at least five(5) days prior to initiation of construction(project) activities and at least five(5) days prior to completion of construction(project) activities. Notification shall be sent to the Department at 330 Golden Shore, Suite 50, Long Beach,Ca., 90802, Attn: Environmental Services.

CONCURRENCE

(Operator's name)

Stephen C. Schmidt
(signature) (date)

Stephen C. Schmidt
Executive Vice President
Community Development

California Department of
Fish and Game

David P. Duke June 8, 1990
(signature) (date)

* Our execution of this agreement is based on the following understanding of Condition #3. If you do not concur with this interpretation, please notify us within 7 days so we can discuss the matter further.

Condition #3 requires Valencia Company to establish, through aided or natural revegetation, 2 acres of sandy wash habitat within the proposed flood control channel in Hasley Canyon subsequent to the completion of the project. This vegetation shall remain in the channel and shall not be removed or disturbed by flood control activities. If the sandy wash vegetation progresses into woody riparian vegetation over time, Valencia Company may reduce it to a low shrubby growth characteristic of sandy wash by the use of hand equipment. Prior to occupancy of the buildings abutting the flood control channel, Valencia Company shall submit to the Department for review and approval a revegetation and maintenance plan for the two-acre restored habitat. The Department shall take action on the plan within 10 days of receipt of the plan.

Post Office - Drainage #5-081-90

CALIFORNIA DEPARTMENT OF FISH AND GAME
330 Golden Shore, Suite 50
Long Beach, California 90802

Notification No. 5-081-90
Page 1 of 3

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and ~~U.S.~~ Valencia Com ~~Postal Service~~, hereinafter called the Operator, is as follows:

WHEREAS, pursuant to Section ~~1601~~ 1603 of California Fish and Game Code, the Operator, notified the Department that they intend to substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed of, the following water: unnamed tributary to Castaic Creek, Los Angeles County, California, Township 4N, Range 16W.

WHEREAS, the Department (represented by DAVID P. DRAKE has made an inspection of subject area and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including: sandy wash habitat and associated herptofauna.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife resources during the Operator's work. The Operator hereby agrees to accept the following measures/conditions as part of the proposed work: (see attached list of proposed measures).

If the Operator's work changes from that stated in the notification specified above, this Agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this Agreement and with other pertinent code sections, including but not limited to Fish and Game Code Sections 2081, 3503, 3503.5, 5650, 5652, 5937 and 5948 may result in prosecution.

Nothing in this Agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. A consummated Agreement does not constitute Department of Fish and Game endorsement of the proposed operation, or assure the Department's concurrence with permits required from other agencies.

This Agreement becomes effective on date of Operator's signature and terminates 1 year from initiation of construction activities for project construction only. This Agreement shall remain in effect for that time necessary to satisfy the terms/conditions of this Agreement. If project construction does not begin within 90 days of the Operator's signing of the Agreement this Agreement shall be voided.

CONCURRENCE

Operator signature

Stephen C. Schmitt 6/18/90
(signature) (date)
Title Executive Vice President
Community Development
Valencia Company

California Department of Fish and Game

David P. Drake June 8, 1990
(signature) (date)
Title Associate Wildlife Biologist

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-081-90

1. The following provisions constitute the limit of activities agreed to and resolved by this agreement. The signing of this agreement does not imply that the Operator is precluded from doing other activities, at the site. However, activities not specifically agreed to and resolved by this agreement are subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq..

2. The Operator proposes to fill the streambed for construction of a Postal Facility, construction of at least two retention basins and a storm drain outlet to Castaic Creek.

*3. The Operator shall submit to the Department for review and approval prior to initiation of construction activities detailed engineering plans for the retention basins and storm drain outlet. Included within those plans shall be a limit of construction boundry that shall be readily identifiable during all construction activities. The Operator shall include a revegetation plan for that area disturbed by construction of the retention basins. All revegetation shall be subject to a survival rate of 80% after the first year's growth and 100% for years two and three.

The Operator shall submit to the Department for review and approval, prior to initiation of project activities, a detailed planting palette indicating species, quantity, and location of plantings. Included with the planting palette shall be a proposed maintenance plan for the revegetation area.

*4. The Operator shall submit to the Department for review and approval prior to initiation of construction activities, a proposed mitigation area of at least four acres in size, to mitigate for the loss of habitat from project construction. This mitigation area shall be maintained in perpetuity for fish and wildlife resources through the placement of a conservation easement on said property.

5. The Operator shall comply with all litter and pollution laws. All contractors, subcontractors and employees shall also obey these laws and it shall be the responsiblity of the Operator to insure their compliance.

6. No equipment maintenance shall be done within or near any stream channel or lake margin where petroleum products or other pollutants from the equipment may enter these areas under any flow.

7. The Department reserves the right to enter the project site at any time to ensure that there is compliance with terms/conditions of this Agreement.

8. The Department reserves the right to suspend and/or revoke this Agreement if the Department determines that the circumstances warrant. The circumstances that could require a reevaluation include, but are not limited to, the following:

a. Failure to comply with the terms/conditions of this Agreement.

b. The information provided by the Operator in support of the Agreement/Notification is determined by the Department to be incomplete, or inaccurate.

c. When new information becomes available to the Department representative(s) that was not known when preparing the original terms/conditions of this Agreement.

9. The Operator shall provide a copy of this Agreement to all contractors, subcontractors, and the Operator's project supervisors. Copies of the agreement shall be readily available at work sites at all times during periods of active work and must be presented to any Department personnel, or enforcement personnel from another agency upon demand.

10. The Operator shall notify the Department, in writing, at least five(5) days prior to initiation of construction(project) activities and at least five(5) days prior to completion of construction(project) activities. Notification shall be sent to the Department at 330 Golden Shore, Suite 50, Long Beach,Ca., 90802, Attn: Environmental Services.

CONCURRENCE

(Operator's name)

Stephen C. Schmidt 6/18/90
(signature) (date)

Stephen C. Schmidt
Executive Vice President
Community Development
Valencia Company

California Department of
Fish and Game

David P. Dick June 8, 1990
(signature) (date)

Our execution of this agreement is based on the following understanding of Conditions #3 and #4. If you do not concur with this interpretation, please notify us within 7 days so we can discuss the matter further.

3. The Operator shall submit to the Department for review prior to occupancy of the Post Office the County-approved engineering plans for the retention basins and storm drain outlet. These plans shall include the limits of construction disturbance which shall also be conspicuously flagged on the field. A revegetation plan shall also be included for the retention basins. It will specify planting methods and seed mixtures to establish scrub habitat in portions of the basins that will not be subject to sediment removal. The performance goals for the revegetation plans is to achieve shrub densities (i.e., plants per square meter) that are 80% of similar nearby scrub vegetation within 3 years of planting. The plan shall specify methods to establish plants and provide long-term maintenance to ensure successful restoration of scrub habitat.

4. The Operator shall submit to the Department for review and approval prior to occupancy of the Post Office a revegetation and maintenance plan for 4 acres of sandy wash habitat to compensate for the loss of habitat from project construction. Valencia Company will establish, through aided or natural revegetation, 4 acres of sandy wash habitat within the completed flood control channel in Hasley Canyon subsequent to the completion of the project. This vegetation shall remain in the channel and shall not be removed or disturbed by flood control activities. If the sandy wash vegetation progresses into woody riparian vegetation over time, Valencia Company may reduce it to a low shrubby growth characteristic of sandy wash by the use of hand equipment. The maintenance plan shall provide long-term assurances that the mitigation habitat will remain intact and protected from any future development, thereby precluding a need for a formal conservation easement. The Department shall take action on the plan within 10 days of receipt of the plan.

Channel Lining

CALIFORNIA DEPARTMENT OF FISH AND GAME
330 Golden Shore, Suite 50
Long Beach, California 90802

Notification No. 5-346-97 (Revision 2)

December 11, 1997

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and Ross Pistone of Valencia Company, 23823 Valencia Blvd., Valencia, 91355, (805) 255-4048, State of California, hereinafter called the Operator, is as follows:

WHEREAS, pursuant to Section 1603 of California Fish and Game Code, the Operator, on the 8th day of October, 1997, notified the Department that they intend to divert or obstruct the natural flow of, or change the bed, channel, or bank of, or use material from the streambed(s) of, the following water(s): Castaic Creek, tributary to Santa Clara River, Los Angeles County, California, Section -, Township 4 N Range 17 W.

WHEREAS, the Department (represented by Leslie S. MacNair through a site visit on November 4, 1997) has determined that such construction may substantially adversely affect those existing fish and wildlife resources within the Santa Clara River, specifically identified as follows: Fishes: unarmored threespined stickleback; Amphibians: Pacific tree frog, southwestern arroyo toad, red-legged frog, California newt, and salamanders; Reptiles: western pond turtle, western fence lizard, side-blotched lizard, coastal whiptail, coast horned-lizard, Pacific gopher snake, common kingsnake, and garter snake; Birds: southwestern willow flycatcher, least Bell's vireo, Cooper's hawk, red-tailed hawk, red-shouldered hawk, sparrows, warblers, hummingbirds, and chats; Mammals: bobcat, raccoon, coyote, deer, California ground squirrel, and rabbits; Riparian vegetation which provides habitat for those species: willows, mulefat, and cottonwoods; and all other fish and wildlife resources, including that riparian vegetation which provides habitat for such species, in the area.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife resources during the Operator's work. The Operator hereby agrees to accept the following measures/conditions as part of the proposed work.

If the Operator's work changes from that stated in the notification specified above, this Agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this Agreement and with other pertinent code sections, including but not limited to Fish and Game Code Sections 5650, 5652, 5937, and 5948, may result in prosecution.

Nothing in this Agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. A consummated Agreement does not constitute Department of Fish and Game endorsement of the proposed operation, or assure the Department's concurrence with permits required from other agencies.

This Agreement becomes effective the date of Department's signature and terminates November 30, 1998 for project construction only. This Agreement shall remain in effect for that time necessary to satisfy the terms/conditions of this Agreement.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-346-97

1. The following provisions constitute the limit of activities agreed to and resolved by this Agreement. The signing of this Agreement does not imply that the Operator is precluded from doing other activities at the site. However, activities not specifically agreed to and resolved by this Agreement shall be subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq.

2. The Operator proposes to alter the streambed to construct 2,070 linear feet of ungrouted, rock rip-rap channel lining along the east bank of Castaic Creek to stabilize the banks. The total stream area, with cottonwood/willow riparian vegetation, impacted by the project will be 3.2 acres (2.5 acres of temporary impact and 0.7 acres of permanent impact). A total of 0.8 acres of streambed with riparian habitat will be created as a result of the project by the excavation of existing uplands. The project is located along the east bank of Castaic Creek. The north end of the channel lining is located approximately 914 feet west of the Old Road and 933 feet south of the Old Road bridge over Castaic Creek. The channel lining runs 2,070 linear feet downstream. The south end of the lining is located approximately 963 feet north of Highway 126 and 1,172 feet west of the Old Road.

3. The agreed work includes activities associated with No. 2 above. The proposed project is located in Castaic Creek, tributary to Santa Clara River, Los Angeles County. Specific work areas and mitigation measures are described on/in the plans and documents submitted by the Operator, including the "Tree Survey Along Castaic Creek Channel, Santa Clarita, California, For A Channel-Lining Project" dated September 1997 and "Field Survey of Castaic Creek Channel, Northwest of The Highway 126 and Interstate 5 Intersection, Santa Clarita, California, For A Channel-Lining Project" dated October 1997, prepared by Louis A. Courtois, Ph.D., Aquatic consulting Services for Valencia Company, and shall be implemented as proposed unless directed differently by this agreement.

4. The Operator shall not impact more than 3.2 acres of streambed with cottonwood/willow riparian habitat. A total of 31 trees (three cottonwoods and 28 willows) with a dbh of 6 inches or greater within the streambed will be removed as a result of the project. The Operator shall mitigate for the loss of riparian habitat, by revegetating the river bottom of the 2.5 acre area of temporary impact as well as the additional 0.8 acre of streambed created, with willow and cottonwood cuttings following completion of the channel lining project. A minimum of 93 trees (mixture of willows and cottonwoods) shall be planted, within the areas created and temporarily impacted in the streambed, as mitigation for the trees greater than 6 dbh and those under 6 dbh impacted by the project. The trees shall be planted so that they create a riparian corridor contiguous with the existing corridor upstream and downstream.

In addition, the Operator shall remove all non-native vegetation (including salt cedar, giant reed, tree tobacco, and castor bean) from the work area. Weed eradication shall be conducted annually, as needed, during the five-year restoration period. Weeds shall be removed by hand (and by topical application of Rodeo®).

All mitigation shall be installed no later than 180 days following project completion.

5. The Operator shall have a qualified biologist on site daily during any impacts to vegetation from March 1 through September 1. The Operator shall have a qualified biologist conduct surveys for the presence of least Bell's vireo (*Vireo belli pusillus*) and southwestern willow flycatcher *(Empidonax traillii extimus)* during the months of April and May. Surveys shall be conducted at weekly intervals during the construction period following U.S. Fish and Wildlife Service protocol. Following the culmination of these surveys, documentation and results of the surveys shall be submitted to CDFG for review. In the event that a vireo or flycatcher is spotted within the area, the surveys shall continue through June or until a nest is located. If nesting vireos and/or flycatchers occur in the area, then any construction within 300 feet of the nest shall be discontinued until the nest is abandoned. The vireos and flycatchers shall not be harassed in any way, and if one is hurt or killed, the Department shall be notified immediately, pursuant to California Endangered Species Act.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-346-97

6. If threatened or endangered species occur within the proposed work area, or could be impacted by the work proposed, the Operator shall obtain the required state and federal threatened and endangered species permits.

7. The perimeter of the work site shall be adequately fenced to prevent damage to adjacent riparian habitat.

8. The Operator shall avoid doing construction activities during the wet season, November 1 to April 1. If work needs to be conducted during the rainy season, then a surface water diversion plan shall be established to avoid siltation/turbidity to downstream stickleback habitat. The diversion plan shall be submitted to the Department for review prior to initiating diversion procedures.

9. The Operator shall implement all of the Special Conditions required by the U.S. Army Corps of Engineers (ACOE) as documented in the Operator's notification package.

10. Prior to the initiation of construction within Castaic Creek, the Operator shall obtain a letter from the Los Angeles County Department of Public Works which declares that they agree to comply with the ACOE Special Conditions as well as the conditions of this Agreement for routine maintenance activities. The language in this letter shall reflect similar language contained in the Santa Clara River Natural River Management Plan.

11. All planting shall have a minimum of 80% survival the first year and 100% survival thereafter and/or shall attain 75% cover after 3 years and 90% cover after 5 years for the life of the project. If the survival and cover requirements have not been met, the Operator is responsible for replacement planting to achieve these requirements. Replacement plants shall be monitored with the same survival and growth requirements for 5 years after planting. Should a storm event or other acts of God destroy all or part of the revegetation site, the Operator shall be responsible to replant the damaged areas one time only, not to exceed the cost of the original revegetation effort.

12. An annual report shall be submitted to the Department by Jan. 1 of each year for 5 years after planting. This report shall include the survival, % cover, and height of both tree and shrub species. The number by species of plants replaced, an overview of the revegetation effort, and the method used to assess these parameters shall also be included. Photos from designated photo stations shall be included.

13. No equipment shall be operated within the flowing stream. Vehicles shall not be driven or equipment operated in water covered portions of a stream.

14. Preparation shall be made so that runoff from steep, erodible surfaces will be diverted into stable areas with little erosion potential. Frequent water checks shall be placed on dirt roads, cat tracks, or other work trails to control erosion.

15. Water containing mud, silt or other pollutants from aggregate washing or other activities shall not be allowed to enter a lake or flowing stream or placed in locations that may be subjected to high storm flows.

16. If a stream channel has been altered during the operations, its low flow channel shall be returned as nearly as possible to pre-project conditions without creating a possible future bank erosion problem, or a flat wide channel or sluice-like area. If a lake margin has been altered, it shall be returned as nearly as possible to pre-project conditions without creating a future bank erosion problem.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-346-97

The gradient of the streambed or lake margin shall be returned to pre-project grade unless such operation is part of a restoration project, in which case, the change in grade must be approved by the Department prior to project commencement.

17. Structures and associated materials not designed to withstand high seasonal flows shall be removed to areas above the high water mark before such flows occur.

18. Staging/storage areas for equipment and materials shall be located outside of the stream.

19. The Operator shall comply with all litter and pollution laws. The Operator is responsible to inform all contractors, subcontractors, and employees about these laws. All contractors, subcontractors and employees shall also obey these laws.

20. Access to the worksite shall be via existing roads and access ramps.

21. Spoil sites shall not be located within a stream, where spoil shall be washed back into a stream, or where it will cover aquatic or riparian vegetation.

22. No equipment maintenance shall be done within or near any stream channel where petroleum products or other pollutants from the equipment may enter these areas under any flow.

23. Raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil and/or entering the waters of the state. These materials, placed within or where they may enter a stream/lake, by Operator or any party working under contract, or with the permission of the Operator, shall be removed immediately.

24. No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete or washings thereof, oil or petroleum products or other organic or earthen material from any construction, or associated activity of whatever nature shall be allowed to enter into or placed where it may be washed by rainfall or runoff into, waters of the State. When operations are completed, any excess materials or debris shall be removed from the work area. No rubbish shall be deposited within 150 feet of the high water mark of any stream or lake.

25. The Operator shall request an extension of this agreement prior to its termination. Extensions may be granted for up to 12 months from the date of termination of the agreement and are subject to Departmental approval. The extension request and fees shall be submitted to the Department's Region 5 Office at the above address. If the Operator fails to request the extension prior to the agreement's termination then the Operator shall submit a new notification with fees and required information to the Department. Any activities conducted under an expired agreement is a violation of Fish and Game Code Section 1600 et. seq. The Operator may request up to a maximum of 3 extensions of this agreement.

26. The Operator shall provide a copy of this Agreement to all contractors, subcontractors, and the Operator's project supervisors. Copies of the Agreement shall be readily available at work sites at all times during periods of active work and must be presented to any Department personnel, or personnel from another agency upon demand.

27. The Department reserves the right to enter the project site at any time to ensure compliance with terms/conditions of this Agreement.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-346-97

27. The Operator shall notify the Department, in writing, at least five (5) days prior to initiation of construction (project) activities and at least five (5) days prior to completion of construction (project) activities. Notification shall be sent to the Department at 330 Golden Shore, Suite 50, Long Beach, CA 90802, Attn: ES. SAA No. 5-346-97.

28. The Department reserves the right to suspend or cancel this Agreement for other reasons, including but not limited to the following:

a. The Department determines that the information provided by the Operator in support of the Notification/Agreement is incomplete or inaccurate;

b. The Department obtains new information that was not known to it in preparing the terms and conditions of the Agreement;

c. The project or project activities as described in the Notification/Agreement have changed;

d. The conditions affecting fish and wildlife resources change or the Department determines that project activities will result in a substantial adverse effect on the environment.

CONCURRENCE

(Operator's name)

Lou J Pistone 12-19-97
(signature) (date)

SR. VICE PRESIDENT
(title)

California Dept. of Fish and Game

Leslie A. MacNair 1/5/98
(signature) (date)

Environmental Specialist III
(title)

Castaic Bridge

CALIFORNIA DEPARTMENT OF FISH AND GAME
330 Golden Shore, Suite 50
Long Beach, California 90802

Notification No. 5-370-97 (Revision 1)

December 11, 1997

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the **Department**, and Ross Pistone of Valencia Company, 23823 Valencia Blvd., Valencia, 91355, (805) 255-4048, State of California, hereinafter called the **Operator**, is as follows:

WHEREAS, pursuant to Section 1603 of California Fish and Game Code, the Operator, on the 20th day of October, 1997, notified the Department that they intend to divert or obstruct the natural flow of, or change the bed, channel, or bank of, or use material from the streambed(s) of, the following water(s): Castaic Creek, tributary to Santa Clara River, Los Angeles County, California, Section - Township 4 N Range 17 W.

WHEREAS, the Department (represented by Leslie S. MacNair through a site visit on November 4, 1997) has determined that such construction may substantially adversely affect those existing fish and wildlife resources within the Santa Clara River, specifically identified as follows: Fishes: unarmored threespined stickleback; Amphibians: Pacific tree frog, southwestern arroyo toad, red-legged frog, California newt, and salamanders; Reptiles: western pond turtle, western fence lizard, side-blotched lizard, coastal whiptail, coast horned-lizard, Pacific gopher snake, common kingsnake, and garter snake; Birds: southwestern willow flycatcher, least Bell's vireo, Cooper's hawk, red-tailed hawk, red-shouldered hawk, sparrows, warblers, hummingbirds, and chats; Mammals: bobcat, raccoon, coyote, deer, California ground squirrel, and rabbits; Riparian vegetation which provides habitat for those species: willows, mulefat, and cottonwoods; and all other fish and wildlife resources, including that riparian vegetation which provides habitat for such species, in the area.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife resources during the Operator's work. The Operator hereby agrees to accept the following measures/conditions as part of the proposed work.

If the Operator's work changes from that stated in the notification specified above, this Agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this Agreement and with other pertinent code sections, including but not limited to Fish and Game Code Sections 5650, 5652, 5937, and 5948, may result in prosecution.

Nothing in this Agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. A consummated Agreement does not constitute Department of Fish and Game endorsement of the proposed operation, or assure the Department's concurrence with permits required from other agencies.

This Agreement becomes effective the date of Department's signature and terminates March 30, 1999 for project construction only. This Agreement shall remain in effect for that time necessary to satisfy the terms/conditions of this Agreement.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-370-97

1. The following provisions constitute the limit of activities agreed to and resolved by this Agreement. The signing of this Agreement does not imply that the Operator is precluded from doing other activities at the site. However, activities not specifically agreed to and resolved by this Agreement shall be subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq.

2. The Operator proposes to alter the streambed to construct a bridge over Castaic Creek. The Commerce Center Bridge will be constructed approximately 8,100 feet upstream from the Castaic Creek and Santa Clara River confluence. The bridge will extend approximately 565 feet across the creek using precast concrete girders resting on two abutments and six rectangular cast-in-place piers. The footprint of each of the piers will be 600 square feet, for a permanent loss 3,600 sq. feet (0.08 acres). The width of the bridge will be 98 feet wide. Therefore, approximately 1.27 acres of streambed will be shaded by the bridge. Bridge construction will temporarily disturb 3.39 acres of stream bed with cottonwood/willow riparian vegetation. Following construction, the stream bed will be returned to its preconstruction grade. The project is located in Castaic Creek north of Highway 126 and west of Interstate 5 at Commerce Center Drive.

3. The agreed work includes activities associated with No. 2 above. The proposed project is located in Castaic Creek, tributary to Santa Clara River, Los Angeles County. Specific work areas and mitigation measures are described on/in the plans and documents submitted by the Operator, including the "Tree Survey Along Castaic Creek Channel, Santa Clarita, California, For A Bridge Project" dated September 1997 and "Field Survey of Castaic Creek Channel: Northwest of The Highway 126 and Interstate 5 Intersection, Santa Clarita, California, For A Bridge Project" dated October 1997, prepared by Louis A. Courtois, Ph.D., Aquatic consulting Services for Valencia Company, and shall be implemented as proposed unless directed differently by this agreement.

4. The Operator shall not impact more than 3.39 acres of streambed with cottonwood/willow riparian habitat. A total of 152 trees (101 cottonwoods and 51 willows) with a dbh of 6 inches or greater within the streambed will be removed as a result of the project.

The Operator shall mitigate for the loss of riparian habitat, by revegetating the river bottom of the 3.39 acre area of temporary impact, with native herbaceous. A minimum of 456 cuttings (mixture of willows and cottonwoods) shall be planted, within the streambed, as mitigation for the trees greater than 6 dbh and those under 6 dbh impacted by the project. The trees shall be planted so that they create a riparian corridor contiguous with the existing corridor upstream and downstream. Any additional trees can be placed in the new area of streambed created as a result of the channel lining project upstream.

In addition, the Operator shall remove all non-native vegetation (including salt cedar, giant reed, tree tobacco, and castor bean) from the work area. Weed eradication shall be conducted annually, as needed, during the five-year restoration period. Weeds shall be removed by hand (and by topical application of Rodeo®).

All mitigation shall be installed no later than 180 days following project completion.

5. The Operator shall have a qualified biologist on site daily during any impacts to vegetation from March 1 through September 1. The Operator shall have a qualified biologist conduct surveys for the presence of least Bell's vireo (*Vireo belli pusillus*) and southwestern willow flycatcher (*Empidonax traillii extimus*) during the months of April and May. Surveys shall be conducted at weekly intervals during the construction period following U.S. Fish and Wildlife Service protocol. Following the culmination of these surveys, documentation and results of the surveys shall be submitted to CDFG for review. In the event that a vireo or flycatcher is spotted within the area, the surveys shall continue through June or until a nest is located. If nesting vireos and/or flycatchers occur in the area, then any construction

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-370-97

within 300 feet of the nest shall be discontinued until the nest is abandoned. The vireos and flycatchers shall not be harassed in any way, and if one is hurt or killed, the Department shall be notified immediately, pursuant to California Endangered Species Act.

6. If threatened or endangered species occur within the proposed work area, or could be impacted by the work proposed, the Operator shall obtain the required state and federal threatened and endangered species permits.

7. The perimeter of the work site shall be adequately fenced to prevent damage to adjacent riparian habitat.

8. The Operator shall avoid doing construction activities during the wet season, November 1 to April 1. If work needs to be conducted during the rainy season, then a surface water diversion plan shall be established to avoid siltation/turbidity to downstream stickleback habitat. The diversion plan shall be submitted to the Department for review prior to initiating diversion procedures.

9. The Operator shall implement all of the Special Conditions required by the U.S. Army Corps of Engineers (ACOE) as documented in the Operator's notification package.

10. Prior to the initiation of construction within Castaic Creek, the Operator shall obtain a letter from the Los Angeles County Department of Public Works which declares that they agree to comply with the ACOE Special Conditions as well as the conditions of this Agreement for routine maintenance activities. The language in this letter shall reflect similar language contained in the Santa Clara River Natural River Management Plan.

11. All planting shall have a minimum of 80% survival the first year and 100% survival thereafter and/or shall attain 75% cover after 3 years and 90% cover after 5 years for the life of the project. If the survival and cover requirements have not been met, the Operator is responsible for replacement planting to achieve these requirements. Replacement plants shall be monitored with the same survival and growth requirements for 5 years after planting. Should a storm event or other acts of God destroy all or part of the revegetation site, the Operator shall be responsible to replant the damaged areas one time only, not to exceed the cost of the original revegetation effort.

12. An annual report shall be submitted to the Department by Jan. 1 of each year for 5 years after planting. This report shall include the survival, % cover, and height of both tree and shrub species. The number by species of plants replaced, an overview of the revegetation effort, and the method used to assess these parameters shall also be included. Photos from designated photo stations shall be included.

13. No equipment shall be operated within the flowing stream. Vehicles shall not be driven or equipment operated in water covered portions of a stream.

14. Preparation shall be made so that runoff from steep, erodible surfaces will be diverted into stable areas with little erosion potential. Frequent water checks shall be placed on dirt roads, cat tracks, or other work trails to control erosion.

15. Water containing mud, silt or other pollutants from aggregate washing or other activities shall not be allowed to enter a lake or flowing stream or placed in locations that may be subjected to high storm flows.

16. Structures and associated materials not designed to withstand high seasonal flows shall be removed to areas above the high water mark before such flows occur.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-370-97

17. If a stream channel has been altered during the operations, its low flow channel shall be returned as nearly as possible to pre-project conditions without creating a possible future bank erosion problem, or a flat wide channel or sluice-like area. If a lake margin has been altered, it shall be returned as nearly as possible to pre-project conditions without creating a future bank erosion problem. The gradient of the streambed or lake margin shall be returned to pre-project grade unless such operation is part of a restoration project, in which case, the change in grade must be approved by the Department prior to project commencement.

18. Staging/storage areas for equipment and materials shall be located outside of the stream.

19. The Operator shall comply with all litter and pollution laws. The Operator is responsible to inform all contractors, subcontractors, and employees about these laws. All contractors, subcontractors and employees shall also obey these laws.

20. Access to the worksite shall be via existing roads and access ramps.

21. Spoil sites shall not be located within a stream, where spoil shall be washed back into a stream, or where it will cover aquatic or riparian vegetation.

22. No equipment maintenance shall be done within or near any stream channel where petroleum products or other pollutants from the equipment may enter these areas under any flow.

23. Raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil and/or entering the waters of the state. These materials, placed within or where they may enter a stream/lake, by Operator or any party working under contract, or with the permission of the Operator, shall be removed immediately.

24. No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete or washings thereof, oil or petroleum products or other organic or earthen material from any construction, or associated activity of whatever nature shall be allowed to enter into or placed where it may be washed by rainfall or runoff into, waters of the State. When operations are completed, any excess materials or debris shall be removed from the work area. No rubbish shall be deposited within 150 feet of the high water mark of any stream or lake.

25. The Operator shall request an extension of this agreement prior to its termination. Extensions may be granted for up to 12 months from the date of termination of the agreement and are subject to Departmental approval. The extension request and fees shall be submitted to the Department's Region 5 Office at the above address. If the Operator fails to request the extension prior to the agreement's termination then the Operator shall submit a new notification with fees and required information to the Department. Any activities conducted under an expired agreement is a violation of Fish and Game Code Section 1600 et. seq. The Operator may request up to a maximum of 3 extensions of this agreement.

26. The Operator shall provide a copy of this Agreement to all contractors, subcontractors, and the Operator's project supervisors. Copies of the Agreement shall be readily available at work sites at all times during periods of active work and must be presented to any Department personnel, or personnel from another agency upon demand.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-370-97

27. The Department reserves the right to enter the project site at any time to ensure compliance with terms/conditions of this Agreement.

28. The Operator shall notify the Department, in writing, at least five (5) days prior to initiation of construction (project) activities and at least five (5) days prior to completion of construction (project) activities. Notification shall be sent to the Department at 330 Golden Shore, Suite 50, Long Beach, CA 90802, Attn: ES. SAA No. 5-370-97.

29. The Department reserves the right to suspend or cancel this Agreement for other reasons, including but not limited to the following:

a. The Department determines that the information provided by the Operator in support of the Notification/Agreement is incomplete or inaccurate;

b. The Department obtains new information that was not known to it in preparing the terms and conditions of the Agreement;

c. The project or project activities as described in the Notification/Agreement have changed;

d. The conditions affecting fish and wildlife resources change or the Department determines that project activities will result in a substantial adverse effect on the environment.

CONCURRENCE

(Operator's name)

Louis J. Pistone 12-19-97
(signature) (date)

SR VICE PRESIDENT
(title)

California Dept. of Fish and Game

Leslie A. McHale 1/5/98
(signature) (date)

Environmental Specialist III
(title)

APPENDIX D

AGENCY RESPONSE TO GMP

CESPL-CO-R

May 26, 1999

MEMORANDUM FOR THE RECORD
SUBJECT: CASTAIC CREEK MAINTENANCE/REVEGETATION PLAN 90-00419-EV

A. Reference is made to your letter dated May 4, 1999 in which you requested the Corps of Engineers to review the Castaic Creek Drainage General Maintenance and Revegetation Plan associated with Permit No. 90-00419-EV. Based on our review of the above document, we have the following comments:

1. The document should contain a paragraph in Section IV which discusses long-term Section 404 authorization for the proposed maintenance activities. Specifically, the document should clarify the type of permit required and identify maintenance activities which would not result in a discharge of fill material in waters of the United States.

2. Please clarify which Army Corps General Permit is referenced on page 5 Section B "Planting Locations" and what general planting guidelines are stipulated in the above general permit.

This memorandum constitutes a preliminary approval of the general concept of the above document. If you have any questions, please contact Aaron Allen at (213) 452-3413.

Aaron O. Allen
Senior Project Manager
U.S. Army Corps of Engineers

STATE OF CALIFORNIA-THE RESOURCES AGENCY GRAY DAVIS, *Governor*

DEPARTMENT OF FISH AND GAME

Leslie S. MacNair
Habitat Conservation Planning Division
P.O. Box 6907
Laguna Niguel, CA 92607

May 27, 1999

Mr. Louis Courtois
Aquatic Consulting Services
1891 Goodyear Avenue, Suite 619
Ventura, CA 93003

Dear Mr. Courtois:

This letter is in regards to the Castaic Creek Drainage General Maintenance and Revegetation Plan prepared for the Valencia Company dated October 1998. The report was prepared as a requirement under Streambed Alteration Agreements 5-346-97 and 5-370-97 for impacts to Castaic Creek, in Los Angeles County, for channel lining and bridge construction. The plan also included maintenance guidelines to be followed for future maintenance activities within Castaic Creek and Hasley Creek by the Los Angeles County Department of Public Works. The maintenance plan was required for the construction of a bridge and flood control channel within Hasley Canyon under Streambed Alteration Agreement 5-160-90.

The Department has determined that the revegetation guidelines in the plan are acceptable, however, the following additional information is required for the revegetation plan to be deemed complete as required by the above mentioned Agreements:

1. Detailed plans indicating the locations for planting as required for each Streambed Alteration Agreement (include the size of the planting area, proposed arrangement of plants, etc.). Include on a topographic map of the Creek, the mitigation areas and reference each planting area with the associated Streambed Agreement number. The revegetation sites shall not include areas that will require future maintenance activities.

2. Weed eradication procedures as required under the Streambed Agreements.

Please submit a revised revegetation plan that includes the information described above, and that meets the revegetation requirements of the above mentioned Agreements.

Be advised that this letter does not approve the maintenance guidelines within this plan. A separate Streambed Alteration Agreement Notification Package will need to be submitted to the Department for a Maintenance Agreement before any future maintenance activities can occur within Castaic Creek and/or Hasley Creek. Once the Department reviews the notification package, a Maintenance Agreement may be prepared by the Department with measures to minimize impacts to riparian and aquatic resources.

The notification package for a maintenance agreement shall include the proposed activities required by the Operator (the County) for maintenance activities (i.e. your maintenance guidelines). Be

advised that the Natural River Management Plan (NRMP) for the Santa Clara River has been revised since 1997, and proposed maintenance activities shall follow those described in the revised NRMP. Maintenance areas shall not include mitigation/revegetation areas. All maintenance areas shall be identified on a map and each area shall reference the Agreement that the construction was permitted under. Be advised that Maintenance Agreements can only be issued for projects whose impacts were previously mitigated for under a prior Streambed Alteration Agreement.

Thank you for your cooperation in this matter. If you have any questions, you can reach me at (949) 831-7335.

Sincerely,

Leslie S. MacNair
Environmental Specialist III

AQUATIC CONSULTING SERVICES

January 26, 1998

Ms. Leslie MacNair, Environmental Specialist
California Department of Fish and Game
330 Golden Shore, Suite 50
Long Beach, CA 90802

RE: 1601 Notification for Castaic Creek Maintenance Activities

Dear Ms. MacNair:

I am writing this letter at the request of Los Angeles County Department of Public Works. They are submitting the enclosed 1601 Notification for long-term maintenance of flood control projects within the segment of Castaic Creek upstream of Highway 126 and downstream of Interstate 5. The Valencia Company will be constructing a section of channel lining (1603 Agreement #5-346-97) and a bridge (1603 Agreement #5-370-97) this year within this channel. Once completed these two projects will be transferred to the County. Once accepted, any future repairs or maintenance activities will be County responsibility.

The County will need to conduct routine maintenance activities along this channel including flood control activities. During our telephone discussion on January 23, 1998, you agreed that the County could apply for a long-term maintenance agreement for this channel. This agreement would authorize maintenance activities for a five year period. The maintenance agreement could simply be renewed by letter, each renewal lasting five years. During our recent telephone discussion you also said the general guidelines developed for the Natural River Management Plan could be incorporated for similar activities within Castaic Creek. Per you request I have attached a copy of the general guidelines for routine maintenance activities within Castaic Creek which I have also sent to the County. The County has tentatively agreed to these general guidelines but needs to have the assurance that they will be able to obtain the necessary long-term, renewable maintenance agreement for conducting this work.

I realize 1601 permit processing requires several days to complete but request that you review the enclosed general guidelines and respond to this letter at your earliest convenience. It is my understanding, based upon our recent discussion, that the Department of Fish and Game agrees with the attached general guidelines for routine maintenance procedures within this reach of Castaic Creek. Your signature on the line below indicates your agreement with the contents of this letter. Once signed and dated please mail this letter back to me in the enclosed self-addressed envelope. I would also appreciate your sending me a copy of this signed letter by facsimile as soon as it is available. My facsimile number is (805) 644-8270.

4416 Cordova Place • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-8270

Also attached to this 1601 Notification for the maintenance project is a check for $132.00 to cover the application fee. I have taken the liberty of signing for Terry Grant since time is of the essence. Should you have any questions, or need additional information, please contact me at (805) 644-1208.

Sincerely,

Louis Courtois

Louis A. Courtois, Ph.D.
Consultant

Enclosure: Self-Addressed Envelope
General Maintenance Guidelines - Castaic Creek
Check for $132.00
1601 Notification

cc: Ross Pistone, Valencia Company
Terry Grant, Los Angeles County Department of Public Works
Aaron Allen, Army Corps of Engineers

The attached guidelines cover some of the conditions required. There may be a few additional conditions or slight modifications to these conditions.

I concur with the contents of this letter

Signature: Leslie A. MacNair Date: 1/28/98
Leslie MacNair, CDFG

AQUATIC CONSULTING SERVICES, INC.

DATE: March 7, 2002

TO: Project Files

FROM: Louis Courtois

SUBJECT: Update to CESPL-CO-R May 26, 1999 ACOE Memorandum For The Record: Castaic Creek Maintenance/Revegetation Plan 90-00419-EV

ACOE Comment #1 - Please refer to page 11 of latest (March 2002) General Maintenance Plan.

ACOE Comment #2 - The ACOE permit referred to was #90-00419-EV. Following a June 14, 1999 telephone discussion with the agencies, a revised revegetation plan (dated July 1999) specific to the Castaic Creek Bridge and Castaic Creek Channel Lining projects along with the attached letter, was submitted to the Corps in July 1999. This plan included an expanded planting plan that showed the location of revegetation site in relation to the channel lining project site and planting acreage of each area. Combined the two projects required that 549 trees (312 cottonwoods and 237 willows) be planted. However, a total of 868 trees were planted during the first week of August 1999. The extra 319 trees were to be used for mitigating future projects. These extra trees were planted because the revegetation site was larger than required by the two projects. Monitoring reports have been submitted to the agencies for 2000, 2001, and 2002.

AQUATIC CONSULTING SERVICES, INC.

July 15, 1999

Mr. Aaron Allen
U.S. Army Corps of Engineers
Regulatory Branch
911 Wilshire Boulevard
Los Angeles, CA 90017

RE: Castaic Creek Maintenance/Revegetation Plan - ACOE Section 404 Permit No. 90-00419-EV (Valencia Company)

Dear Aaron:

This is a follow-up to your letter dated May 26, 1999 concerning the referenced plan. I have incorporated your previous comments into the enclosed revised plan. I would appreciate your review and comments on this latest version. If the plan is suitable to the Corps, please advise.

Valencia Company is also arranging a meeting with Los Angeles County Department of Public Works to discuss this plan and obtain their final agreement to the approach detailed in the document. Once the County concurs with the detailed approach, I will schedule a time to meet and obtain the Corps signature on the document.

I appreciate all the assistance you have provided on this effort. Should you have any questions or need additional information regarding this submittal, please contact me at (805) 644-1208.

Sincerely,

Lou Courtois

Louis A. Courtois, Ph.D.
Consultant

Enclosure: Revised Field Report 132.98R

cc: Ross Pistone, Valencia Company (w/o enclosure)
Leslie MacNair, CDFG (w/o enclosure)

1891 Goodyear Avenue, Suite 619 • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-9270

DATE: March 4, 2002

TO: Project Files

FROM: Louis Courtois

SUBJECT: Update to CDFG May 27, 1999 letter regarding Castaic Creek General Maintenance and Revegetation Plan (1603 No. 5-346-97 and 5-370-97)

I discussed these two comments with Ms. Leslie MacNair (CDFG) on June 14, 1999. At that time she said Newhall could amend the existing 1603 Agreements to add in maintenance activities. She requested Newhall submit a revegetation plan for each site or alternatively, combine the revegetation requirements for both sites together and plant a larger area. Newhall decided to combine the two project's revegetation requirements together and plant one large site. The revegetation site is located immediately opposite (west) the channel lining site. Combined the two projects required that 549 trees (312 cottonwoods and 237 willows) be planted. However, a total of 868 trees were planted during the first week of August 1999. The extra 319 trees were to be used for mitigating future projects. These extra trees were planted because the revegetation site was larger than required by the two projects. Monitoring reports have been submitted to the agencies for 2000, 2001, and 2002.

CDFG Comment #1 - A detailed revised revegetation plan dated July 1999 along with the attached cover letter was submitted to the CDFG. This plan included an expanded planting plan that showed the existing creek area in relation to the channel lining project site. The location and acreage for each revegetation area was also included.

CDFG Comment #2 - The detailed revegetation plan (July 1999) provided detailed procedures for weed eradication.

AQUATIC CONSULTING SERVICES, INC.

July 15, 1999

Ms. Leslie MacNair
California Department of Fish and Game
P.O. Box 6907
Laguna Niguel, CA 92607

RE: Castaic Creek Maintenance/Revegetation Plan - CDFG 1603 Agreements #5-346-97 and #5-370-97 (Valencia Company)

Dear Leslie:

This is a follow-up to your letter dated May 27, 1999 concerning the referenced plan. I have incorporated your previous comments into the enclosed revised plan. I would appreciate your review and comments on this latest version. If the plan is suitable to the Department, please advise.

Valencia Company is also arranging a meeting with Los Angeles County Department of Public Works to discuss this plan and obtain their final agreement to the approach detailed in the document. Once the County concurs with the detailed approach, I will schedule a time to meet and obtain the Department's signature on the document.

I appreciate all the assistance you have provided on this effort. Should you have any questions or need additional information regarding this submittal, please contact me at (805) 644-1208.

Sincerely,

Louis A. Courtois, Ph.D.
Consultant

Enclosure: Revised Field Report 132.98R

cc: Ross Pistone, Valencia Company (w/o enclosures)
Aaron Allen, ACOE (w/o enclosures)

1891 Goodyear Avenue, Suite 619 • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-3270 • [illegible]

APPENDIX E

NOTIFICATION FORM

___ Emergency Project
___ Non-Emergency Work

EXHIBIT 1

SAMPLE
GENERAL MAINTENANCE NOTIFICATION
(EMERGENCY / NON-EMERGENCY

Date: _____

District Engineer
U.S. Army Corps of Engineers
Los Angeles District-SPLCO-R
P. O. Box 2711
Los Angeles, CA 90053-2325

Field Supervisor
U.S. Fish & Wildlife Service
2140 Eastman Avenue, Suite 100
Ventura, CA 93003

Regional Manager
Region 5
California Department of Fish and Game
4949 Viewridge Avenue
San Diego, CA 92123

SUBJECT: ACOE Permit #89-419-EV
Streambed Alteration Agreement No. _____
Castaic and Hasley Creeks
NOTIFICATON OF REPAIR AND RESTORATION

In accordance with the provisions of the subject U.S. Army Corps of Engineers Section 404 Permit and California Department of Fish and Game Section 1600 Streambed Alteration Agreement (Agreement), this is to inform you that repair and restoration work has been scheduled within the subject permit area. The work site is located:

_____

Work is scheduled to commence on _____
Date

The following applies (check all applicable items):
_____ Project is located in potential endangered species habitat—field meeting required.
_____ Access to the creek is required to repair a levee(s).
Levee location: _____
Nature of repair: _____

_____ Access to the creek is required to remove trees from a levee(s).
Levee location: _____

_____ Access to the creek is required for bridge maintenance.
Name of bridge(s): _____
Maintenance required: _____

_____ A water diversion will be necessary. The diversion will conform with the requirements of the Permit and the Agreement.

_____ An alternate water diversion is necessary. Description of proposed diversion:
_____

_____ The work will impact mature wetland habitat defined as trees with trunks in excess of 4" in diameter. A field meeting is required.

_____ The work will not impact mature wetland habitat.

_____ The work must be performed during the breeding season (March 15-September 1). A field meeting is requested.

_____ The work will be performed outside of the breeding season.

_____ A "get-away channel" to clear stagnant water is required.

_____ Other

Please contact me with any questions at (phone number). Please fax back your concurrence to (fax number).

Sincerely,

LACDPW

ACOE concurs that the project may proceed:

_____
Name

_____
Signature

_____
Date

CDFG concurs that the project may proceed:

_____
Name

_____
Signature

_____
Date

Appendix H – LACDPW Hydrology Data

WATER RESOURCES DIVISION
HYDROLOGY SECTION

Q-2343

INFORMATION REQUEST SUMMARY

Date: 12/23/2014

Project Name: Castaic Creek		
Project Location: Castaic Creek between Interstate 5 and State Route 126	T.G. Page: 4459	Grid: H5-7, G-7
Project Engineer: Long Thang		
Technical Review by: Martin Araiza		
Information Requested: Q50 clear, Q50 burn, Q50 burn & bulk, and any other available flow rates		
Information Requested By: Jose Cruz, PACE		
Information To Be Used: hydraulic analysis of Castaic Creek		
Will Information Be Used In Any Litigation? ☐ *Yes* ☒ *No*		

Information Provided:

The flow rates you requested are summarized in the attached table. Also attached is a map showing the referenced reaches within your area of interest.

Please note that projects must not impact the existing floodways depicted on Los Angeles County's floodway maps and must be designed for the flow rates shown on those maps. These maps can be found at the Flood Zone Determination Website below by searching the project's location.

http://dpw.lacounty.gov/wmd/floodzone/index.cfm

If a project does impact a floodway or you would like to use the flow rate of a more recent study, a floodway map revision will be required. For more information on floodway map revisions, please contact George De La O of our Watershed Management Division at (626) 458-7155.

Date Provided: 12/23/2014 via e-mail (jcruz@pacewater.com)

References:

- 2005 Castaic Creek Special Study
- Santa Clarita Valley Flood Insurance Study, Vol. II dated 1979

Calculations, Comments, Etc.

The FEMA flow rates were calculated using a modified version of a regression equation developed by the US Army Corps of Engineers as stated in the 1979 study.

The Los Angeles County flow rates provided were calculated using the revised hydrologic method based on "rainfall isohyets" (Depth Method, refer to the 2006 Hydrology Manual). The hydrologic study calculated flows resulting from a 50-year design storm. Current landuse and drainage conditions may differ to those used/assumed in the study. The information provided should only be used for planning purposes.

2005 Los Angeles County Castaic Creek Special Study

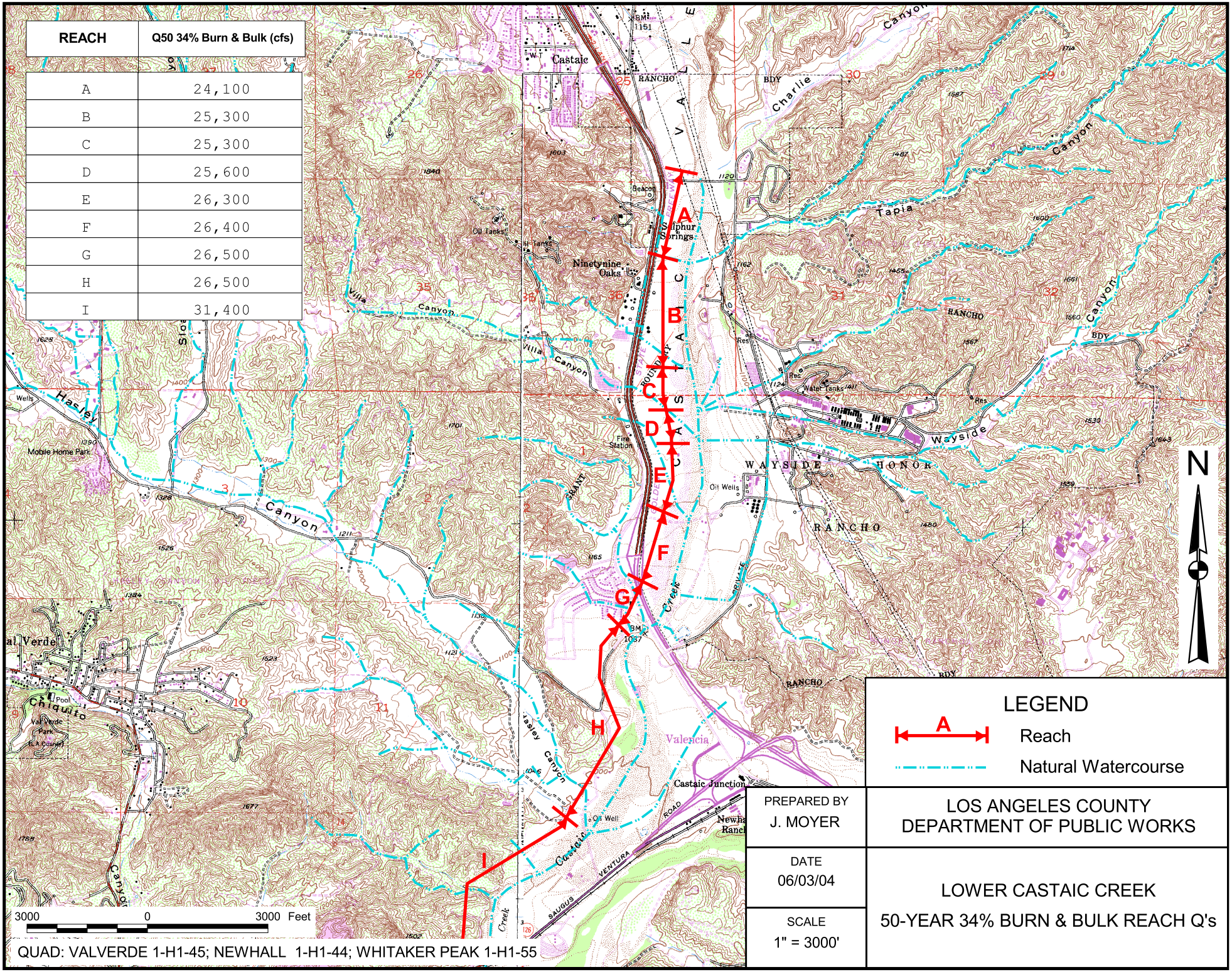
Reach	Q2 Clr (cfs)	Q2 Burn (cfs)	Q5 Clr (cfs)	Q5 Burn (cfs)	Q10 Clr (cfs)	Q10 Burn (cfs)	Q25 Clr (cfs)	Q25 Burn (cfs)	Q50 Clr (cfs)	Q50 Burn (cfs)	Q50 B&B (cfs)	Q100 Clr (cfs)	Q100 Burn (cfs)
F	3,500	3,600	7,400	7,900	10,700	11,500	15,300	16,600	19,500	21,700	26,400	22,900	25,000
G	3,600	3,700	7,500	8,000	10,700	11,600	15,400	16,700	19,700	21,800	26,500	23,000	25,200
H	3,600	3,700	7,500	8,000	10,800	11,600	15,400	16,700	19,800	21,900	26,500	23,200	25,300
I	4,200	4,400	9,000	9,600	12,900	13,900	18,500	20,000	23,900	26,200	31,400	28,000	30,300

1979 FEMA Flood Insurance Study

Reach	Q100 Burn (cfs)	Q500 (cfs)
F	n/a	n/a
G	16,400	31,100
H	16,900	32,200
I	17,600	33,400

Abreviations:

* Clr = clear
* B&B = Burn & Bulk


REACH
Q50 34% Burn & Bulk (cfs)
A 24,100
B 25,300
C 25,300
D 25,600
E 26,300
F 26,400
G 26,500
H 26,500
I 31,400
A
B
C
D
E
F
G
H
I
Castaic
Ninetynine Oaks
Sulphur Springs
Valencia
Castaic Junction
Hasley Canyon
Tapia
Charlie Canyon
Wayside Honor Rancho
Chiquito
Val Verde
Oil Wells
Oil Tanks
Mobile Home Park
Fire Station
Water Tanks
Res
Beacon
Pool
Park
Creek
Ventura
Saugus
N
3000 0 3000 Feet
LEGEND
Reach
Natural Watercourse
PREPARED BY
J. MOYER
DATE
06/03/04
SCALE
1" = 3000'
LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
LOWER CASTAIC CREEK
50-YEAR 34% BURN & BULK REACH Q's
QUAD: VALVERDE 1-H1-45; NEWHALL 1-H1-44; WHITAKER PEAK 1-H1-55

Appendix I – Launch Stone Size Technical Memo

PACE
Advanced Water Engineering

Technical Memorandum

Date: March 20, 2018

To: Andrew Ross, PE – LADPW Land Development
Michele Chimienti, PE – LADPW Land Development

From: Mark E. Krebs, PE – PACE
Jose Cruz, PE – PACE

Re: Launch Stone Design Methodology # 9862E

Introduction

Due to environmental constraints, potential high groundwater during construction, along with the difficulty and expense of dewatering, Newhall Land will be using launch stone rip-rap in conjunction with soil cement for bank protection in lieu of traditional full depth soil cement bank protection for the Mission Village - San Jose Flats project. The combination of launch stone and soil cement bank protection has been approved by LACDPW, and implemented in previous cases; however, the design procedure for launch stone is not standardized or provided in LACDPW Manual. The purpose of this memorandum is to review the current approach used to determine the volume and sizing requirements of the launch stone rip-rap, and propose an alternative approach for use with the bank stabilization design associated with San Jose Flats bank, as shown in Figure 1.

Design Procedure for Bank Protection with Launch Stone

The design of bank protection (flood and erosion protection) involves the calculation of freeboard and scour (cut-off) depth, which is used to establish the top and toe for the proposed bank protection. LACDPW has established minimum requirements for freeboard and cut-off depth, which are described in the Sedimentation Manual and Hydraulic Design Manual. In some cases, the presence of high groundwater may prevent traditional bank protection from being installed to the required cut-off depth without dewatering. In these cases, LACDPW has approved the use of launch stone, rip-rap placed above the groundwater level to provide a rip-rap apron that can provide protection against scour in areas where traditional full-depth bank protection could not be installed.

The procedure for designing the launch stone (rip-rap apron) begins with determining the minimum required volume of rip-rap material. The required volume of rip-rap is calculated based on the volume of soil cement not placed due to high groundwater encountered during construction. This volume is determined on a cross-sectional basis, where the unit volume of rip-rap is calculated at each cross-section using the groundwater elevation and the toe of bank elevation. In accordance with LACDPW requirements, the toe of bank protection is based on the required cut-off depth, which is calculated using velocity results from the HEC-RAS model using a minimum roughness value of n = 0.025 and a mixed flow regime.

Based on previous project applications and discussions with LACDPW, the volumetric ratio of 2.2 to 1 (rip-rap to soil cement) has been used to determine the minimum required launch stone rip-rap volume. Therefore, the launch stone apron will have more than twice the volume of the soil cement bank protection it replaces. A typical cross-section for bank protection using soil cement and launch stone is

shown on Figure 2, which illustrates the portion of soil cement not placed, and the corresponding volume of the launch stone apron.

Current Approach to Launch Stone Sizing

The next step in the process is to determine the rip-rap sizing to be used for the launch stone apron. In previous cases, the velocity from the proposed project condition HEC-RAS model (using manning's roughness of n = 0.025 and mixed flow regime) at each cross-section location was used and compared to the range of velocities presented in the rip-rap sizing chart in the LACFCD Hydraulic Design Manual to determine the corresponding rip-rap size. The rip-rap sizes determined for the study reach are then adjusted for consistency and to provide smooth transitions between varying rip-rap sizes. Applying this previously used methodology, without adjusting for consistency and smooth transitions, the rip-rap sizing for San Jose Flats is as shown in Table 1.

Table 1 – Hydraulic Model Results for Qcap and n=0.025

HEC-RAS River Station	Minimum Channel Invert	Water Surface Elevation	Flow Depth	Velocity	Froude Number	Launch Stone Size (D_{50})
	(ft)	(ft)	(ft)	(ft/s)	(ft/ft)	
34310	963.0	971.5	8.5	19.0	1.2	4-Ton (54")
34090	962.0	970.3	8.3	17.6	1.4	2-Ton (43")
33880	960.0	970.3	10.3	14.2	1.0	1-Ton (34")
33710	959.0	968.6	9.6	16.0	1.2	2-Ton (43")
33500	958.0	968.1	10.1	14.5	1.0	1-Ton (34")

Results of this analysis indicate abrupt changes in the HEC-RAS model flow depth and velocity between cross-section locations, and also show the flow regime fluctuating between critical and supercritical flow. Given the amount of flow in the River, these abrupt changes in depth and velocity are unexpected and appear to be a result of hydraulic model instability resulting from the combination of using a mixed flow regime with a very low manning's roughness value. The low manning's value of 0.025 is used to determine maximum cut-off depth with a factor of safety. We contend that this low manning's value is not appropriate (overly conservative) for selection of the launch stone rip-rap size.

Alternative for Manning's Roughness Value Assessment

In order to provide accurate hydraulic modeling results to be used for rip-rap sizing in launch stone design, PACE proposes to use a more suitable, yet still conservative, manning's value that represents the minimum roughness and characteristics of the study reach being analyzed. The roughness value will be determined using the Cowan method, as outlined in USGS Water Supply Paper 2339 (*Arcement, USGS, 1989*). The Cowan method estimates the effects of the type and size of the materials that compose the bed and banks of the natural channel, as well as the channel's shape, in order to determine its roughness value. In this procedure, the roughness value is defined by several characteristics of the natural channel such as surface irregularity, variation in channel geometry, obstructions in flow path, density of vegetation, and stream meandering.

The value of 'n' may be computed using the following equation:

$$n = (n_b + n_1 + n_2 + n_3 + n_4)\, m$$

Where:

n_b = base value of 'n' for a straight, uniform, smooth channel in natural materials
n_1 = correction factor for the effect of surface irregularities
n_2 = value for variations in shape and size of the channel cross section
n_3 = value for obstructions
n_4 = value for vegetation and flow conditions
m = correction factor for meandering of the channel

For sand channels, the base 'n' value may be determined by using Table 3, below, which shows the relationship between median grain size of bed material and values of 'n'. Median grain sizes for the study reach were obtained from the *Newhall Ranch-Santa Clara Phase 1 River Fluvial Study* (*PACE, 2006*) approved by LACDPW in March 2006. Sediment samples were taken at various locations along the River as part of the Fluvial Study. Based on the sediment data for sub-reaches C and D, which corresponds to the study reach for the current analysis, the median grain size for the study reach was found to be 1-mm (See Appendix C for excerpts from Fluvial Study).

Sediment data is also presented in the *Assessment of Geomorphic Processes for the Upper Santa Clara River Watershed* report (*Stillwater Sciences, 2011*). According to this study, the median grain size of the bed (D_{50}) ranges between 0.7-mm and 2-mm for Reach M12, which corresponds to the study reach discussed herein. Since the Fluvial Study was developed specifically for this specific reach of the River, and the fact that the median grain size values coincide with the range of values from the Stillwater Report, the median grain size of 1-mm was assumed for the study reach. Based on Table 2 below, the corresponding roughness value is 0.026 for a median grain size of 1-mm. However, in order to match the LACDPW recommendation of a bare channel condition, the base 'n' value used for this assessment is 0.025.

Table 2 – Base Values of Manning's n

Bed Material	Median Grain Size of Bed Material (mm)	Base 'n' value	
		Straight Uniform Channel	Smooth Channel
Sand Channels			
Sand	0.2	0.012	-
	0.3	0.017	-
	0.4	0.020	-
	0.5	0.022	-
	0.6	0.023	-
	0.8	0.025	-
	1.0	0.026	-
Stable Channels and Flood Plains			
Concrete	-	0.012-0.018	0.011
Rock Cut	-	-	0.025
Firm Soil	-	0.025-0.032	0.020
Coarse Sand	1-2	0.026-0.035	-
Fine Gravel	-	-	0.024
Gravel	2-64	0.028-0.035	-
Coarse Gravel	-	-	0.026
Cobble	64-256	0.030-0.050	-
Boulder	>256	0.040-0.070	-

**Obtained from USGS WSP 2339, Page 4, Table 1*

Channel irregularities (n_1) account for additional roughness caused by eroded and scalloped banks, projecting points, and exposed tree roots along the banks. The degree of irregularity for the sub-reaches within the area of study was assumed to be minor, corresponding to characteristics of carefully dredged channels in good condition but having slightly eroded or scoured side slopes. The range of 'n' adjustment values is between 0.001 and 0.005 for the condition of minor channel irregularity, and 0.005 was chosen based on judgement of the reach.

Roughness due to variation in channel cross section (n_2) is primarily dependent on the number of alternations of large and small sections, with the magnitude of those changes being a contributing factor. Upon careful study of the aerial photography of the study region, cross sections within the channel appear to alternate occasionally and shift from side to side due to the changes in cross sectional shape. The 'n' value adjustment for this condition ranges from 0.001 to 0.005; however, for purposes of this analysis, the adjustment for channel variation has been disregarded.

Obstructions (n_3) – such as logs, stumps, boulders, debris, pilings, and bridge piers – disturb the flow pattern in the channel and increase roughness. Due to the presence of vegetation within the River, some level of obstruction is expected to be present within the sub-reaches studied. Effects of obstruction are assumed to be minor, occupying less than 15 percent of the cross-sectional area, with spacing between obstructions such that the sphere of influence around one obstruction does not extend to the sphere of influence around another obstruction. The range of 'n' value adjustment is between 0.005 and 0.015 for minor effects of obstruction, and thus an 'n' value adjustment of 0.010 was chosen for the sub-reaches within the study area.

Vegetation (n_4) within a channel will impede and obstruct flow, thereby contributing to an increase in roughness. Assuming a condition in which most to all vegetation within the channel is removed; the 'n' value adjustment for vegetation is considered negligible. Although Table 2 of the USGS publication shows that the minimum channel condition category for vegetation is 'small' – corresponding to an 'n' value adjustment between 0.002 and 0.010 – PACE believes it is more appropriate to conservatively assume that the vegetation contribution is zero, to be in line with the County's recommendation of n = 0.025 for a bare channel condition. Substantial vegetation scouring has occurred during larger storm events, but complete removal of all vegetation has not been observed and is a conservative assumption.

The degree of meandering (m) is dependent on the ratio of the total length of the meandering channel in the reach being considered to the straight length of the channel reach. Meandering of the sub-reaches studied appears to have a ratio of 1.0 to 1.2 – corresponding to a minor condition. The contributing 'n' value adjustment for meandering is assumed to be 1.0 for the minor condition, meaning there is no impact to the total 'n' value.

Based on the Cowan method procedure, an assessment of minimum roughness values was prepared for the River in the vicinity of the subject project. Results of the Cowan method assessment are presented in Figure 3, along with a summary of the variables used in the calculation. According to the Cowan method results, a roughness value of n = 0.040 was calculated for the study reach.

Results of Revised Hydraulic Analysis

Using the roughness value of n = 0.040 from the Cowan method assessment, the proposed project condition HEC-RAS model was run to determine the hydraulic characteristics of the River in the vicinity of the project. In an effort to provide a sensitivity analysis and range of results for the designer and reviewer, the proposed project condition HEC-RAS model was also run for roughness values of 0.035 and 0.030. Values for flow depth, velocity and Froude number are presented for these conditions in the following sections.

Hydraulic Analysis for n=0.040

Results of the hydraulic model using a roughness of 0.040 indicate subcritical flow under these conditions, which produces less fluctuation in flow depth and velocity between cross-sections. The range of flow depth and velocity appears to be stable in comparison to results from the model using a roughness of 0.025. Table 3 summarizes the model results for n=0.040 in the vicinity of the project.

Table 3 – Hydraulic Model Results for Qcap and n=0.040

HEC-RAS River Station	Minimum Channel Invert	Water Surface Elevation	Flow Depth	Velocity	Froude Number	Launch Stone Size (D_{50})
	(ft)	(ft)	(ft)	(ft/s)	(ft/ft)	
34310	963.0	973.9	10.9	13.2	0.8	1-Ton (34")
34090	962.0	972.9	10.9	11.6	0.7	1/4-Ton (21")
33880	960.0	971.7	11.7	11.6	0.8	1/4-Ton (21")
33710	959.0	970.8	11.8	11.3	0.7	1/4-Ton (21")
33500	958.0	969.6	11.6	11.6	0.7	1/4-Ton (21")

Hydraulic Analysis for n=0.035

Results of the hydraulic model using a roughness of 0.035 also indicate subcritical flow under these conditions. The range of flow depth appears to be stable; however, the range of velocity has amplified due to the reduction in roughness value. Table 4 summarizes the model results for n=0.035 in the vicinity of the project.

Table 4 – Hydraulic Model Results for Qcap and n=0.035

HEC-RAS River Station	Minimum Channel Invert	Water Surface Elevation	Flow Depth	Velocity	Froude Number	Launch Stone Size (D_{50})
	(ft)	(ft)	(ft)	(ft/s)	(ft/ft)	
34310	963.0	973.2	10.2	14.7	0.9	1-Ton (34")
34090	962.0	972.3	10.3	12.6	0.8	1/2-Ton (27")
33880	960.0	971.1	11.1	12.7	0.9	1/2-Ton (27")
33710	959.0	970.2	11.2	12.3	0.8	1/2-Ton (27")
33500	958.0	968.9	10.9	12.9	0.8	1/2-Ton (27")

Hydraulic Analysis for n=0.030

Results of the hydraulic model using a roughness of 0.030 indicate a flow regime that fluctuates between subcritical and supercritical flow under these conditions, which produces more variation in flow depth and velocity between cross-sections. The range of flow depth and velocity appears to be unstable in comparison to results from the model using a roughness of 0.040 and 0.035. Table 5 summarizes the model results for n=0.035 in the vicinity of the project

Table 5 – Hydraulic Model Results for Q_{cap} and n=0.030

HEC-RAS River Station	Minimum Channel Invert	Water Surface Elevation	Flow Depth	Velocity	Froude Number	Launch Stone Size (D_{50})
	(ft)	(ft)	(ft)	(ft/s)	(ft/ft)	
34310	963.0	972.8	9.8	15.4	0.9	1-Ton (34")
34090	962.0	970.8	8.8	15.9	1.2	1-Ton (34")
33880	960.0	970.3	10.3	14.2	1.0	1-Ton (34")
33710	959.0	969.8	10.8	13.1	0.9	1-Ton (34")
33500	958.0	968.2	10.2	14.4	1.0	1-Ton (34")

Summary and Recommendations

The use of launch stone protection has previously been used on projects where high groundwater was encountered during construction of soil cement bank protection. Since the presence of groundwater was not anticipated for these projects, an alternative design solution was not considered during the design phase. Due to the immediate need for a solution in these cases, and the minimal length of bank protection affected by groundwater, the design of the launch stone apron was based on assumptions and guidance from the LACDPW standard design procedure for traditional bank protection. At the time, the cost of delaying construction greatly outweighed the additional costs associated with the launch stone, so the need to refine the design process was not of the utmost importance. However, in the case of the San Jose Flats bank stabilization and other upcoming projects, the need for launch stone protection is anticipated due to the expectation of groundwater above the bank protection to elevation in the vicinity of the proposed project bank protections.

Upon review of the rip-rap sizing methods and calculations presented in this memorandum, PACE recommends the use of Cowan's method for selecting the appropriate manning's roughness value used in the rip-rap sizing calculations for launch stone design. The method previously used for design of launch stone results in a near-critical flow regime, which generates zones of high velocities, thus requiring a larger rip-rap gradation. PACE believes using Cowan's method to determine a more suitable roughness value that represents the characteristics of the study reach being analyzed results in consistent flow depths and velocities, which produces rip-rap sizing that is economically feasible, more practical, and better suited for use in launch stone application. It must be noted that this method is to be used strictly for rip-rap sizing, and not intended to replace the current procedures used to calculate top and toe elevations for bank protection design.

V. References

1. Pacific Advanced Civil Engineering, Inc., *Newhall Ranch – Santa Clara River Phase I Fluvial Study*. March, 2006.

2. Stillwater Sciences, *Assessment of Geomorphic Processes for the Upper Santa Clara River Watershed*. May, 2011.

3. Los Angeles County Flood Control District (1989). "Hydraulic Design Manual," Los Angeles, California, p. F-32.

4. Arcement, George J., and Schneider, V. R., 1989, Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains: U.S. Geological Survey Water-Supply Paper 2339, p. 1-8.

5. HEC-RAS, Version 4.1.0 River Analysis System, U.S. Army Corps of Engineers, Davis, California 2004.

VICINITY MAP
SCALE 1"=4000'

CLARA RIVER

SANTA

32265
32605
32795
33115
33310
33500
33710
33880
34090
34310
34495
34720
34860

"SAN JOSE FLATS BANK"
PROPOSED SOIL
CEMENT BANK PROTECTION

NORTH

200 100 0 200 400

TITLE
CROSS SECTION
LOCATION AERIAL MAP

JOB
MISSION VILLAGE
SAN JOSE FLATS
BANK PROTECTION
LOS ANGELES COUNTY CA

SCALE	1"= 200'
DESIGNED	JC
DRAWN	JEP
CHECKED	JC
DATE	MARCH 2018
JOB NO.	9862

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FIGURE
01

Dimscale = 1000; LTscale = 0.5; PSltscale = 1; Acad Ver. = 21.0s (LMS Tech); Visretain = 1

P:\9862\FP_MissionVillageFinalDesign\Engineering\9862-03 San Jose Flats 01's\exhibits\9862-FIG-01-02-03-CROSS SECTION LOCATION AERIA

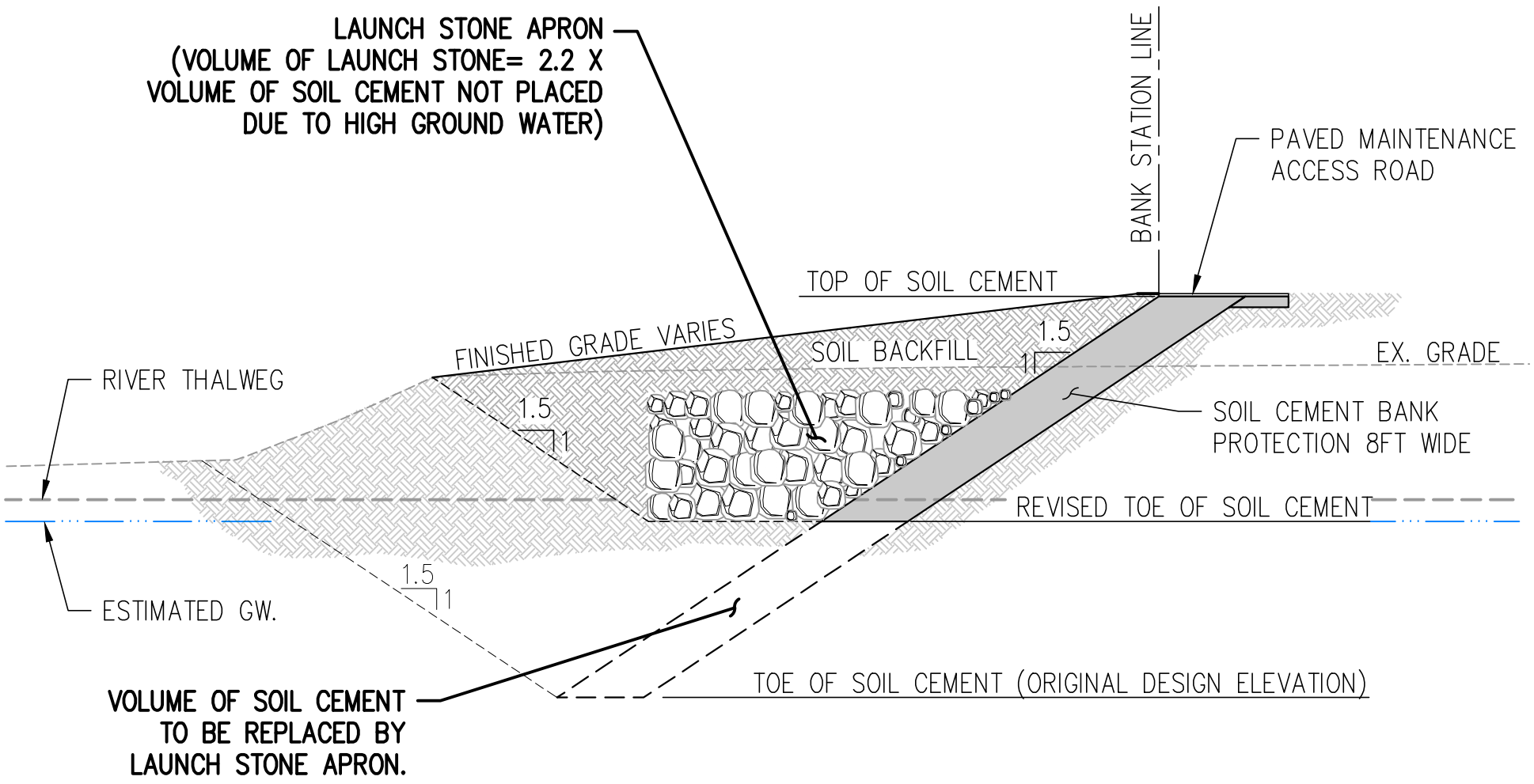

FIGURE 02 - SOIL CEMENT / LAUNCH STONE BANK PROTECTION TYPICAL SECTION

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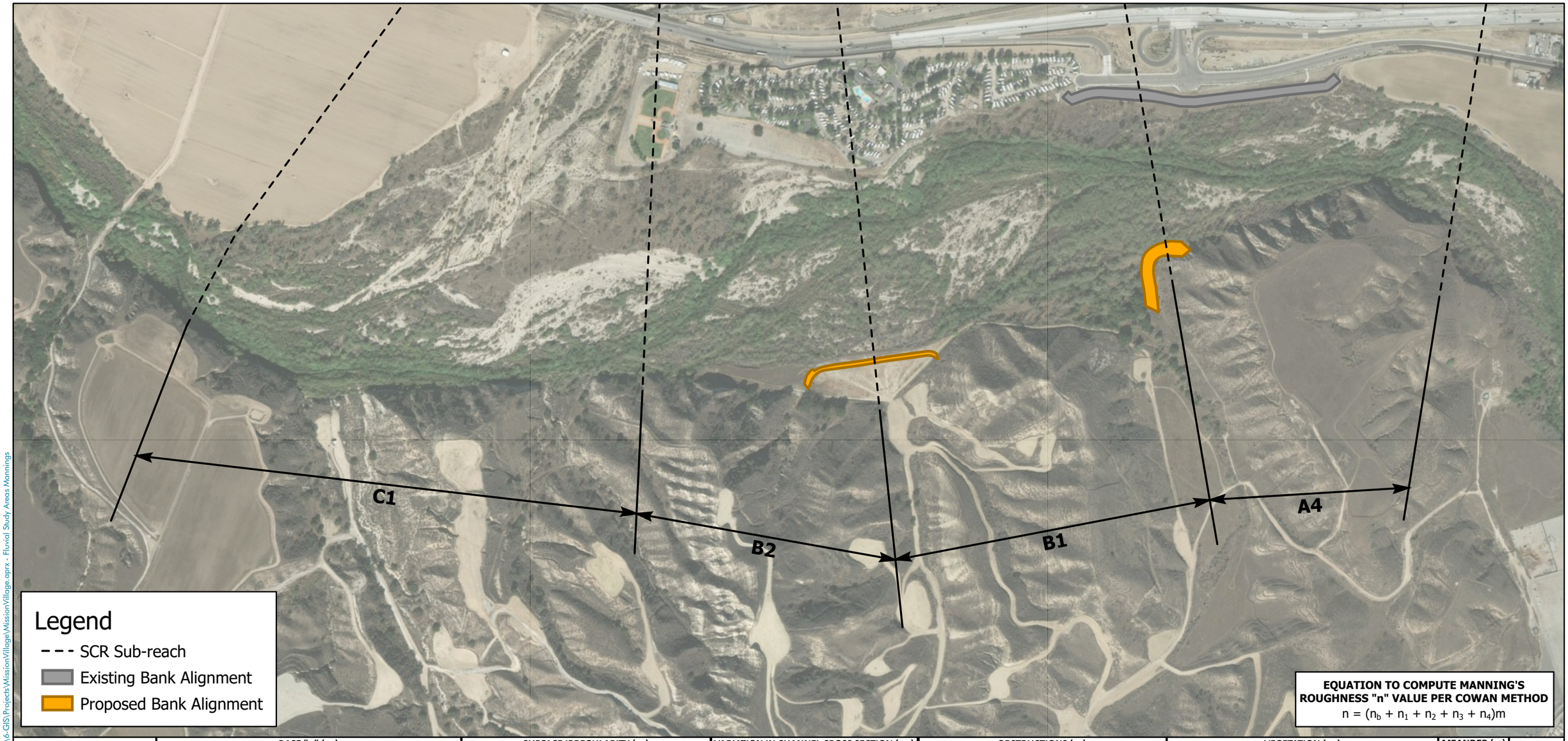
P: (714) 481-7300 | www.pacewater.com

Dimscale = 1; LTscale = 0.5; PSltscale = 1; Acad Ver. = 21.0s (LMS Tech); Visretain = 1
P:\9862EP_MissionVillageFinalDesign\Engineering\9862-03 San Jose Flats CD's\exhibits\9862-FIG-01-02-03-CROSS SECT LOCATION MAP EXH\9862-Fig-02-SA



River Study Reach[1]	BASE "n" (n_b)					SURFACE IRREGULARITY (n_1)				VARIATION IN CHANNEL CROSS SECTION (n_2)			OBSTRUCTIONS (n_3)				VEGETATION (n_4)				MEANDER (m)	TOTAL "n"
	0.026 - 0.035	0.025 - 0.032	0.024 - 0.035	0.012 - 0.018	0.03 - 0.07	0	0.001 - 0.005	0.006 - 0.010	0.011 - 0.020	0	0.001 - 0.005	0.010 - 0.015	0.000 - 0.004	0.005 - 0.015	0.020 - 0.030	0.040 - 0.050	0.002 - 0.010	0.010 - 0.025	0.025 - 0.050	0.050 - 0.100	1	
	Sand[2]	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
A4	0.025						0.005			0				0.01			0				1	0.04
B1	0.025						0.005			0				0.01			0				1	0.04
B2	0.025						0.005			0				0.01			0				1	0.04
C1	0.025						0.005			0				0.01			0				1	0.04

(1) From Newhall Ranch Santa Clara River Fluvial Study
(2) Manning's value of 0.025 used for SCR to be consistent with LADPW guidelines for bare channel condition

P:\9862EP_MissionVillageFinalDesign\6-GIS\Projects\MissionVillage\MissionVillage.aprx - Fluvial Study Areas Mannings

MISSION VILLAGE FINAL DESIGN

ASSESSMENT OF MANNING'S ROUGHNESS COEFFICIENT

PACE Advanced Water Engineering

0 350 700 1,400 Feet

Date: 3/20/2018

Job Number: 9862E

Figure 3

HEC-RAS Plan: Pr.025 River: SCR Reach: Project Profile: Rev BB

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)	
Project	35245	Rev BB	116236.00	968.00	980.43	980.59	983.82	0.003569	15.23	8281.71	1384.87	0.93
Project	35040	Rev BB	116236.00	967.00	978.13	979.26	982.83	0.004904	19.11	7369.78	1224.09	1.08
Project	34860	Rev BB	116236.00	966.00	976.44	977.77	981.72	0.007556	18.45	6301.14	1146.45	1.39
Project	34720	Rev BB	116236.00	965.50	974.95	976.42	980.55	0.008618	18.99	6121.96	1125.22	1.43
Project	34495	Rev BB	116236.00	964.00	972.68	974.29	978.47	0.009850	19.32	6017.04	1168.24	1.50
Project	34310	Rev BB	116236.00	963.00	971.51	972.96	976.79	0.006864	18.98	6653.48	1244.36	1.23
Project	34090	Rev BB	116236.00	962.00	970.29	971.47	975.08	0.007393	17.56	6617.98	1291.36	1.37
Project	33880	Rev BB	116236.00	960.00	970.33	970.34	973.47	0.004095	14.22	8171.80	1338.20	1.01
Project	33710	Rev BB	116236.00	959.00	968.58	969.30	972.53	0.006009	15.96	7280.69	1344.75	1.21
Project	33500	Rev BB	116236.00	958.00	968.14	968.18	971.24	0.004393	14.49	8451.55	1377.94	0.96
Project	33310	Rev BB	116236.00	957.00	966.20	966.98	970.20	0.005901	16.07	7234.62	1389.73	1.24
Project	33115	Rev BB	116236.00	956.00	964.41	965.40	968.75	0.008945	16.71	6958.09	1356.27	1.30
Project	32795	Rev BB	116236.00	954.00	965.37	964.35	967.65	0.002550	12.12	9590.41	1361.00	0.80
Project	32605	Rev BB	116236.00	952.00	965.41	963.52	967.06	0.001732	10.30	11280.74	1501.14	0.66
Project	32265	Rev BB	140776.00	950.00	962.83	962.83	966.06	0.003663	14.42	9761.50	1508.87	1.00

HEC-RAS Plan: Prop.040 River: SCR Reach: Project Profile: Rev BB

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)	
Project	35245	Rev BB	116236.00	968.00	981.26	980.59	983.89	0.006430	13.51	9430.79	1390.26	0.78
Project	35040	Rev BB	116236.00	967.00	979.68	979.26	982.54	0.006476	15.12	9288.49	1254.24	0.79
Project	34860	Rev BB	116236.00	966.00	978.23	977.77	981.22	0.008565	13.89	8370.00	1164.18	0.91
Project	34720	Rev BB	116236.00	965.50	976.62	976.42	979.89	0.009891	14.50	8017.70	1136.14	0.96
Project	34495	Rev BB	116236.00	964.00	975.01	974.28	977.74	0.008078	13.25	8774.65	1195.48	0.86
Project	34310	Rev BB	116236.00	963.00	973.91	972.96	976.37	0.005955	13.23	9723.93	1292.84	0.75
Project	34090	Rev BB	116236.00	962.00	972.90	971.47	974.99	0.005681	11.61	10012.75	1310.99	0.74
Project	33880	Rev BB	116236.00	960.00	971.70	970.35	973.79	0.005762	11.60	10019.35	1348.06	0.75
Project	33710	Rev BB	116236.00	959.00	970.80	969.28	972.78	0.005500	11.29	10297.37	1365.05	0.72
Project	33500	Rev BB	116236.00	958.00	969.63	968.19	971.61	0.005634	11.63	10513.98	1386.48	0.70
Project	33310	Rev BB	116236.00	957.00	968.83	966.99	970.59	0.004584	10.64	10920.93	1403.89	0.67
Project	33115	Rev BB	116236.00	956.00	968.32	965.41	969.68	0.003545	9.36	12415.44	1422.21	0.56
Project	32795	Rev BB	116236.00	954.00	967.13	964.35	968.57	0.003417	9.61	12092.23	1456.03	0.59
Project	32605	Rev BB	116236.00	952.00	966.71	963.52	967.91	0.002741	8.79	13230.27	1508.31	0.52
Project	32265	Rev BB	140776.00	950.00	962.83	962.83	966.06	0.009377	14.42	9761.50	1508.87	1.00

HEC-RAS Plan: Prop.035 River: SCR Reach: Project Profile: Rev BB

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)	
Project	35245	Rev BB	116236.00	968.00	980.59	980.59	983.81	0.006522	14.87	8503.76	1385.92	0.90
Project	35040	Rev BB	116236.00	967.00	979.16	979.26	982.50	0.006116	16.28	8640.27	1244.13	0.87
Project	34860	Rev BB	116236.00	966.00	977.55	977.77	981.20	0.008771	15.34	7577.37	1156.88	1.06
Project	34720	Rev BB	116236.00	965.50	976.14	976.42	979.90	0.009374	15.56	7471.86	1133.06	1.07
Project	34495	Rev BB	116236.00	964.00	973.85	974.29	977.69	0.010470	15.74	7386.49	1181.94	1.11
Project	34310	Rev BB	116236.00	963.00	973.16	972.96	976.21	0.006196	14.66	8764.93	1286.73	0.86
Project	34090	Rev BB	116236.00	962.00	972.28	971.47	974.75	0.005597	12.62	9207.21	1306.36	0.84
Project	33880	Rev BB	116236.00	960.00	971.06	970.35	973.56	0.005779	12.71	9148.77	1343.43	0.86
Project	33710	Rev BB	116236.00	959.00	970.21	969.28	972.54	0.005399	12.25	9487.98	1359.63	0.82
Project	33500	Rev BB	116236.00	958.00	968.89	968.19	971.34	0.005974	12.90	9490.33	1382.25	0.81
Project	33310	Rev BB	116236.00	957.00	968.12	966.99	970.25	0.004683	11.72	9919.42	1400.05	0.78
Project	33115	Rev BB	116236.00	956.00	967.73	965.41	969.29	0.003413	10.04	11577.97	1418.38	0.62
Project	32795	Rev BB	116236.00	954.00	966.62	964.35	968.25	0.003153	10.25	11341.43	1450.34	0.65
Project	32605	Rev BB	116236.00	952.00	966.31	963.52	967.62	0.002423	9.21	12620.64	1506.09	0.56
Project	32265	Rev BB	140776.00	950.00	962.83	962.83	966.06	0.007179	14.42	9761.50	1508.87	1.00

HEC-RAS Plan: Prop.030 River: SCR Reach: Project Profile: Rev BB

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)	
Project	35245	Rev BB	116236.00	968.00	980.59	980.59	983.81	0.004792	14.87	8503.76	1385.92	0.90
Project	35040	Rev BB	116236.00	967.00	978.53	979.26	982.63	0.005902	17.93	7854.68	1231.78	0.99
Project	34860	Rev BB	116236.00	966.00	976.95	977.77	981.37	0.008457	16.86	6893.46	1151.30	1.21
Project	34720	Rev BB	116236.00	965.50	975.52	976.42	980.10	0.009238	17.17	6771.58	1129.02	1.24
Project	34495	Rev BB	116236.00	964.00	973.28	974.28	977.93	0.010230	17.30	6718.92	1175.28	1.28
Project	34310	Rev BB	116236.00	963.00	972.83	972.96	976.21	0.005276	15.40	8331.10	1283.96	0.92
Project	34090	Rev BB	116236.00	962.00	970.82	971.47	974.75	0.008082	15.91	7304.04	1295.35	1.18
Project	33880	Rev BB	116236.00	960.00	970.34	970.34	973.47	0.005865	14.20	8187.57	1338.29	1.01
Project	33710	Rev BB	116236.00	959.00	969.77	969.30	972.42	0.004817	13.07	8893.44	1355.64	0.90
Project	33500	Rev BB	116236.00	958.00	968.19	968.19	971.24	0.006170	14.38	8519.10	1378.22	0.95
Project	33310	Rev BB	116236.00	957.00	966.73	966.98	970.03	0.006478	14.57	7976.47	1392.59	1.07
Project	33115	Rev BB	116236.00	956.00	967.07	965.40	968.92	0.003299	10.91	10649.63	1414.28	0.70
Project	32795	Rev BB	116236.00	954.00	966.04	964.35	967.94	0.002884	11.06	10507.70	1443.98	0.72
Project	32605	Rev BB	116236.00	952.00	965.88	963.52	967.34	0.002085	9.71	11975.56	1503.72	0.61
Project	32265	Rev BB	140776.00	950.00	962.83	962.83	966.06	0.005274	14.42	9761.50	1508.87	1.00

Appendix J – Alternative Analysis

Appendix 5.5d

Hasley Creek Drainage Concept

LAND DEVELOPMENT DIVISION
HYDROLOGY UNIT

TO:	Pacific Advanced Civil Engineering, Inc.	Date: 03/22/2022
	17520 Newhope Street, Suite 200	
	Fountain Valley, CA 92708	
ATTN:	Jose Cruz	

REVIEW OF REVISED HYDROLOGY STUDY

TR NO. **82498**

DATE OF REPORT **01/24/2022**
PLAN CHECK NO. **3**
PLAN CASE NO. **ESTU2019000489**

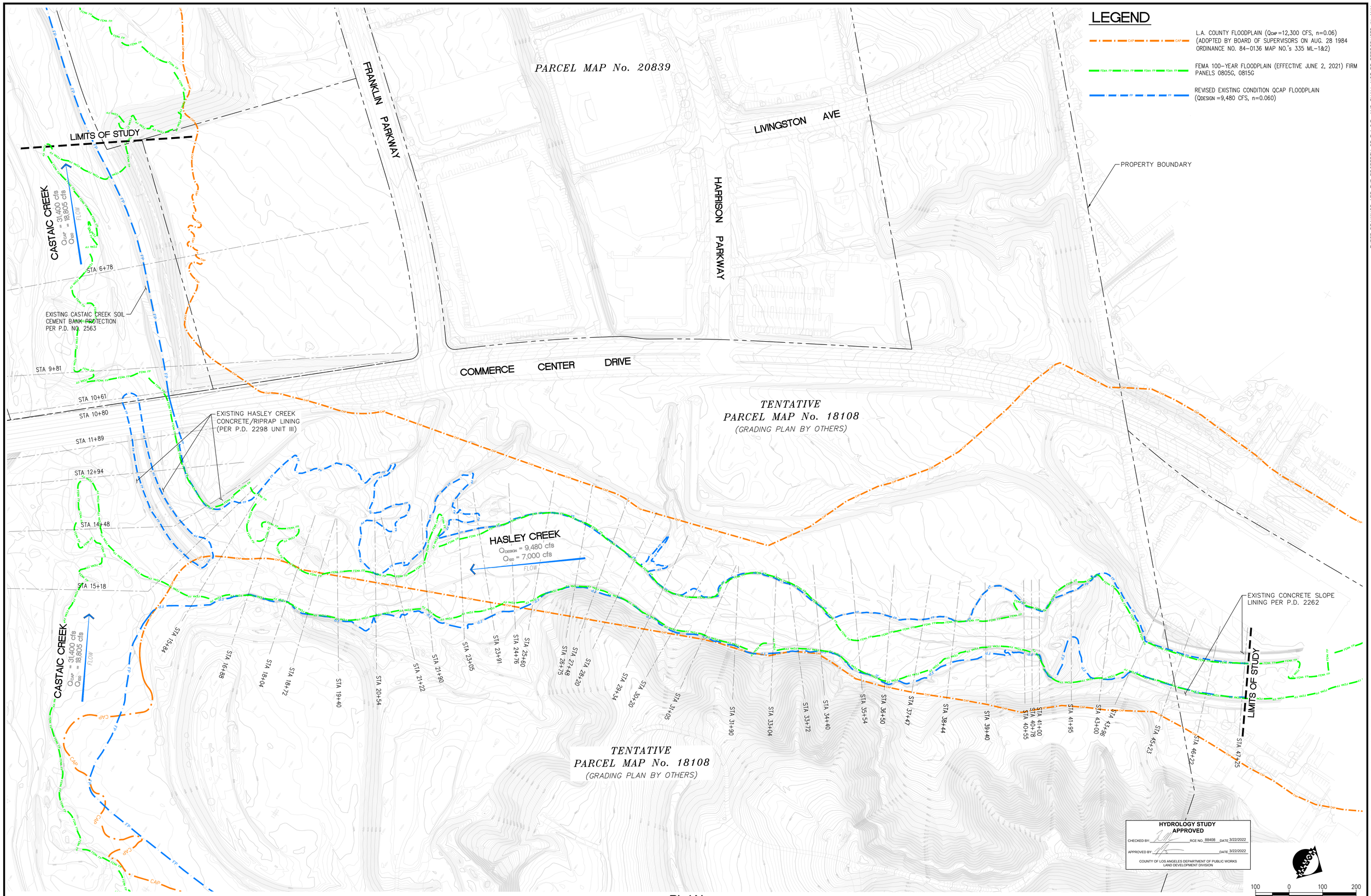
We have reviewed your Hydrology Study.

[X] The Hydrology Study has been approved.

REVIEWED BY _____

ALEX MIKHAILPOOR (626) 458-4921

APPROVED BY: _____



PLAN

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NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK

SOIL CEMENT BANK PROTECTION

TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
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PREPARED JOSE CRUZ
PROJECT ENGINEER
R.C.E. NO. 72249
EXP. 06/30/2022
DRAWN BDP | SCALE AS SHOWN
DESIGNED JC
CHECKED MEK | DATE 7/13/2021

REGISTERED PROFESSIONAL ENGINEER JOSE CRUZ No. 72249 Exp. 06-30-22 CIVIL STATE OF CALIFORNIA

TITLE

EXISTING CONDITION FLOODPLAIN MAPPING

EIMP. 2019000489

FIGURE 05

JOB NO. A535

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LEGEND

- REVISED EXISTING CONDITION FLOODPLAIN (Q_{DW}=9,480 CFS n=.060)
- PROPOSED CONDITION FLOODPLAIN (Q_{DW}=9,480 CFS n=.060)
- FEMA 100-YEAR FLOODPLAIN EFFECTIVE JUNE 2, 2021) FIRM PANELS 0805G, 0815G

PROPERTY BOUNDARY

PARCEL MAP No. 20839

FRANKLIN PARKWAY

LIVINGSTON AVE

HARRISON PARKWAY

COMMERCE CENTER DRIVE

LIMITS OF STUDY

CASTAIC CREEK
Q_{DESIGN} = 31,400 cfs
Q_{100} = 18,805 cfs
FLOW

EXISTING CASTAIC CREEK SOIL CEMENT BANK PROTECTION PER P.D. NO. 2563

EXISTING HASLEY CREEK CONCRETE/RIPRAP LINING (PER P.D. 2298 UNIT III)

STA 10+50.89
BEGIN WEST BANK SOIL CEMENT
=TIE-IN EXISTING HASLEY CREEK LINING

EXISTING FLOW DIVERSION BERM PER PD 2298 UNIT III (LENGTH TO BE MODIFIED AS SHOWN)

STA 10+00.00
BEGIN EAST BANK SOIL CEMENT
=STA 10+00 TIE-IN
TO CASTAIC CREEK WEST BANK

PROPOSED GRADE CONTROL STRUCTURE #1

HASLEY CREEK
Q_{DESIGN} = 9,480 cfs
Q_{100} = 7,000 cfs
FLOW

PROPOSED GRADE CONTROL STRUCTURE #2

PROPOSED DROP/STILLING BASIN STRUCTURE

STA 39+89.01
END WEST BANK SOIL CEMENT JOIN EXISTING CONCRETE SLOPE LINING

EXISTING CONCRETE SLOPE LINING PER P.D. 2262

STA 39+91.02
END EAST BANK SOIL CEMENT JOIN EXISTING CONCRETE SLOPE LINING

CASTAIC CREEK SOIL CEMENT BANK PROTECTION PER DCR VOL. II OF V PREPARED BY PACE

TENTATIVE
PARCEL MAP No. 18108
(GRADING PLAN BY OTHERS)

HYDROLOGY STUDY APPROVED
CHECKED BY: RCE NO. 88408 DATE 3/22/2022
APPROVED BY: DATE 3/22/2022
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION

100 0 100 200
SCALE 1"=100'

PLAN

NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK
SOIL CEMENT BANK PROTECTION
TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
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PREPARED JOSE CRUZ
PROJECT ENGINEER
R.C.E. NO. 72249
EXP. 06/30/2022
DRAWN BDP | SCALE AS SHOWN
DESIGNED JC
CHECKED MEK | DATE 7/13/2021

REGISTERED PROFESSIONAL ENGINEER JOSE CRUZ No. 72249 Exp. 06-30-22 CIVIL STATE OF CALIFORNIA

TITLE

PROPOSED CONDITION FLOODPLAIN MAPPING

EIMP. 20190000489

FIGURE 06

JOB NO. A535

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Valencia Commerce Center TPM No. 18108

Drainage Concept Report Volume III of V
Hasley Canyon Creek Bank Protection
EIMP No. 2019000489

October 2021
February 2015 (Revised)
March 2008 (Revised)
January 2008 (Revised)

Prepared For:

FIVEPOINT

FivePoint Communities, LLC
25124 Springfield Court
Valencia, CA 91335

HYDROLOGY STUDY APPROVED

CHECKED BY: _____ RCE NO. 88408 DATE 3/22/2022

APPROVED BY: _____ DATE 3/22/2022

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION

Submittal To:

LACDPW
900 South Fremont Avenue
Alhambra, CA 91803

Prepared By:

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REGISTERED PROFESSIONAL ENGINEER
JOSE CRUZ
No. 72249
Exp. 06-30-20
CIVIL
STATE OF CALIFORNIA

Contact Person:
Jose Cruz, MS, PE
Paige Brue, MS, PE

PACE JN A535

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Appendices

Appendix A: Existing Condition HEC-RAS Output (n = 0.060)

Appendix B: Proposed Condition HEC-RAS Output (n = 0.060)

Appendix C: Proposed Condition HEC-RAS Output (n = 0.085)

Appendix D: Proposed Condition HEC-RAS Output (n = 0.025)

Appendix E: Los Angeles County Department of Public Works Freeboard and Toe-Down Calculation Spreadsheets

Appendix F: Fluvial Study Calculations and Supporting Documents

Appendix G: Rock Chute and Stilling Basin Design

Appendix H: Alternative Design Approach

Appendix I: Castaic Creek and Hasley Canyon General Maintenance Plan

Appendix J: Water Resources Division Hydrology Section Information Request Summaries

Appendix K: As-Built Drawings

1 Introduction

Pacific Advanced Civil Engineering, Inc. (PACE) has been retained by FivePoint Communities to prepare a Drainage Concept Report (DCR) Volume III of V for the proposed creek improvements at Valencia Commerce Center (VCC) Industrial Park Development in Tentative Parcel Map (TPM) No. 18108. The proposed creek improvements associated with the VCC project include soil cement bank protection along both banks of Hasley and Castaic Creeks. The analysis presented in this DCR will focus only on the improvements located along Lower Hasley Canyon Creek; a separate DCR was prepared by PACE for the improvements located along Castaic Creek (DCR Volume II of V).

The purpose of this DCR is to describe the HEC-RAS analyses performed based on the Los Angeles County Department of Public Works (LACDPW) Capital Flood (Q_{CAP}) event and the 100-year storm (Q_{100}) event. This report also discusses the existing and post-project impacts to Lower Hasley Canyon Creek for the Q_{CAP} storm event and presents the proposed structural bank protection. A hydraulic analysis is required to verify that the top and toe of the proposed Lower Hasley Canyon Creek soil cement bank protection on the east and west banks will satisfy LACDPW freeboard and toe-down (scour) requirements.

The VCC project site is located in an unincorporated area of Los Angeles County, west of the Interstate 5 freeway (I-5) and north of highway State Route 126 (SR-126). The proposed Lower Hasley Canyon Creek bank protection consists of buried soil cement bank protection and two grade control structures. The bank protection improvements will be located east of Commerce Center Drive and west of Castaic Creek, along the east and west banks of Hasley Canyon Creek. The proposed bank protection along the east and west banks of Hasley Canyon Creek will be approximately 3,000 linear feet and will protect the VCC Industrial Park Development from potential flooding and erosion. At the upstream end, the bank protection along both the east and west banks will join with the existing concrete slope lining (PD 2262). At the downstream end, the proposed Hasley Canyon Creek “East” bank protection joins the proposed Castaic Creek “West” bank protection, and the Hasley Canyon Creek “West” bank protection joins the existing concrete/rip-rap lining (PD 2298-Unit III). See **Figure** 1 - **Vicinity Map 1** for a vicinity map of the project site location.

PACE performed the following analyses in support of the Lower Hasley Canyon Creek bank protection design:

- HEC-RAS model of applying the Q_{CAP} and Manning’s roughness value (n) of 0.060 to identify any hydraulic impacts to existing conditions based on proposed project improvements (see **Section 4**).
- Freeboard calculations using water surface elevations from a HEC-RAS applying the Q_{CAP} and a Manning’s roughness value (n) of 0.085 with proposed project improvements (see **Appendix E**).
- Toe-down calculations using flow velocities from HEC-RAS models applying the Q_{100} and Manning’s roughness value (n) of 0.025 with proposed project improvements (see **Appendix E**).

The proposed soil cement bank protection will consist of an 8-foot wide soil cement section with varied height and a 1.5:1 (H:V) slope (to be verified in the final geotechnical analyses). The bank will then be buried with soil backfill with a variable slope of 3:1 (H:V) or flatter. The river bed excavation required to construct the bank protection will be backfilled and returned to existing grade.

The proposed project condition HEC-RAS model includes the following existing improvements:

- Upper Hasley Canyon Creek – Concrete Slope Protection (PD 2262)
- Castaic Creek – Concrete/Rip-Rap Lined Berm (PD 2298, Unit III, Linings B and C)
- Castaic Creek – Concrete Lining (PD 2298, Unit III)
- Commerce Center Drive Bridge over Castaic Creek (Bridge No. B3794)

The proposed project condition HEC-RAS model includes the following proposed improvements:

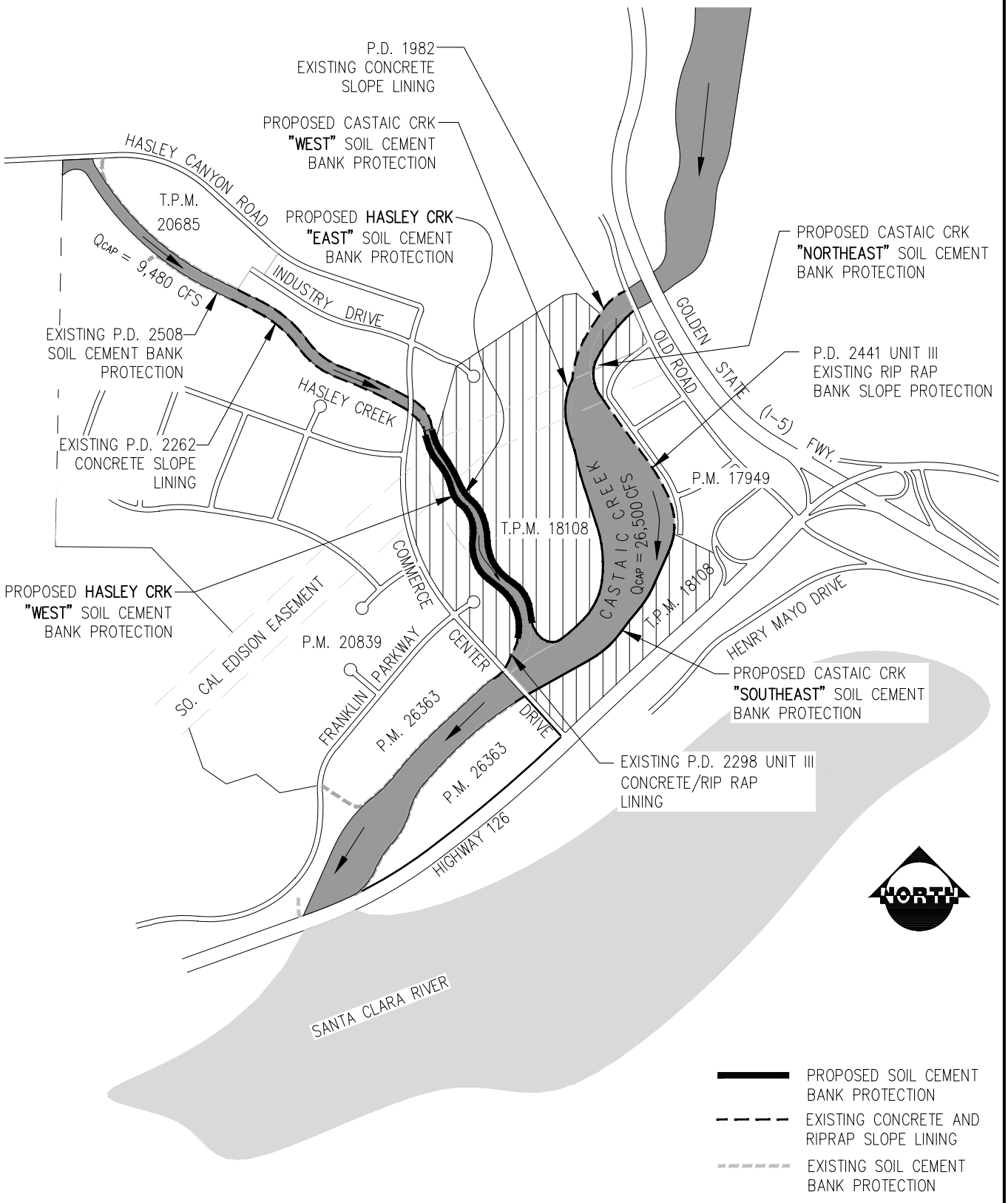
- Lower Hasley Canyon Creek – "East" and "West" Soil Cement Bank Protection;
- Franklin Parkway Bridge over Hasley Creek; and,
- Existing concrete/rip-rap lined berm (PD 2298, Unit III) that will be modified to measure 150-feet in length upstream of the bridge in order to allow flows to enter Castaic Creek upstream of Commerce Center Drive Bridge.

The proposed Lower Hasley Canyon Creek bank protection also includes the construction of two grade control structures. The purpose of the grade control structures is to maintain the stability of the natural streambed by controlling headcutting and reducing long-term scour in the channel. The top of the proposed grade control structures will be set at existing grade, and the structures will be buried deep enough to ensure that they will not be undermined during peak flows. The design toe elevations will be located near groundwater elevations in order to avoid a significant amount of dewatering.

Upon approval of this DCR, a separate Federal Emergency Management Agency (FEMA) Conditional Letter of Map Revision (CLOMR) for the Hasley Canyon Creek Project will be submitted (see **Section 8.2**). Additionally, a separate analysis will be prepared for the revisions to the LACDPW Floodway Maps (ML Map No. 388-ML-1 and No. 335-ML-1) for the reach of Hasley Canyon Creek in the vicinity of the VCC Industrial Park Development project (see **Section 8.1**).

Geotechnical firm Allan E. Seward Engineering Geology, Inc. prepared a preliminary geotechnical report for the proposed Hasley Canyon Creek and Castaic Creek bank protection projects. Only one location was sampled within Hasley Canyon Creek. This sampling point is located just upstream of Commerce Center Drive. The data from the preliminary geotechnical report was used for the analysis presented in this DCR. A specific geotechnical report will be prepared for the reach of interest during final design. The soil cement bank protection construction documents for the Hasley Canyon Creek Bank Protection will incorporate the geotechnical investigation of the site to determine the specific locations of on-site soils suitable for use with soil cement and potentially high groundwater levels.

This report was prepared for LACDPW's review and approval. The bank protection design procedure, details and specifications described in this report follow LACDPW Standards. All water surface elevations and topography in the models, report and exhibits are referenced to the North American Vertical Datum (NAVD) of 1988.



PACE
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SCALE	N.T.S.
DESIGNED	JC
DRAWN	BDP
CHECKED	JC
DATE	August 1, 2019
JOB NO.	A535-E

HASLEY CREEK
SOIL CEMENT BANK PROTECTION
TPM # 18108 DCR VOL. III OF V

INDEX MAP

FIGURE
01

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2 Hydrology

The Hasley Canyon Creek Watershed encompasses 7.95 square-miles, as shown on **Figure 2**. The Creek lies within the jurisdiction of the LACDPW, which has completed an extensive hydrologic analysis of the watershed and provided updated Capital Flood flow rates for this reach of the Creek.

All proposed grading located within the VCC Industrial Park development site adjacent to the proposed bank protection for Hasley Canyon Creek is currently above, or will be filled to raise it above, the Q_{CAP} floodplain. Therefore, adjacent sites should not be subject to flood hazards from the Creek.

PACE obtained hydrology data for the Hasley Canyon Creek Watershed from the LACDPW Water Resources Division (WRD). The Los Angeles County Flood Control District (LACFCD) analyzes conditions based on the Capital Flood (Q_{CAP}) event, which assumes a burned watershed and the resulting bulked peak flows. Additionally, FEMA has published maps to designate flood hazard zones that are accepted as the floodplain boundaries for a specific Flood Insurance Study (FIS). The Q_{CAP} event is in excess of the flow anticipated by the 100-year FEMA storm event (see **Table 1** for the design hydrology).

The FEMA Flood Insurance Rate Map (FIRM) 100-year flood hazard area is accepted as the floodplain boundary for insurance purposes. LACDPW analyzes conditions based on the Capital Flood (Q_{CAP}), which assumes a burned watershed and resulting bulked flows. The Q_{CAP} is in excess of the flow anticipated by the base flood or 100-year FEMA storm event. Although the FEMA 100-year storm is used for flood insurance purposes, the design storm established by LACDPW is the Capital Flood which is defined as follows:

1. The design storm is assumed to occur on saturated soils over a period of four days, with the maximum rainfall falling on the fourth day. During the 24-hour period of maximum rainfall, the rainfall intensity typically increases during the first 70-90% of the period and decreases in the remaining time. Furthermore, approximately 80% of the amount of the 24-hour rainfall falls within the same 70-90% of the period.
2. When converting rainfall to runoff, rainfall that is not lost due to hydrologic processes of interception, evaporation, transpiration, depression storage, infiltration or percolation is assumed to be surface runoff.
3. The natural portions of the watershed are assumed to have been burned by fire, which decreases soil infiltration.
4. A bulking factor is assumed. In the area where a watershed is burned, the runoff would carry with it a large layer of eroded topsoil, burned trees and brush. To account for the quantity of debris, the design flow rate is artificially increased by a percentage increase in flow rate, or bulking factor.

The hydrology data shows that the current Q_{CAP} is less than both the old Q_{CAP} and 100-year flow rate (Q_{100}). The analysis and design for the top of bank of the proposed bank protection is based on the old Q_{CAP} of 9,480 cfs in order to match the design capacity of the Upper Hasley Canyon Creek soil cement bank protection improvements that were prepared by PACE in 2004 (PD No. 2508). The analysis used to determine the toe of the proposed bank protection is based on the Q_{100} (7,000 cfs). The hydrology data for Lower Hasley Canyon Creek obtained from LACDPW (see **Appendix J**) is summarized in **Table 1**.

Table 1 - Design Hydrology

HEC-RAS River Section	Q_{100}[1] (cfs)	Current Q_{CAP}[2] (cfs)	Old Q_{CAP}[3] (cfs)	Location
4725	7,000	5,900	9,480	Upper Hasley Canyon Creek Outlet to Castaic Creek Confluence
1080[4]	—	31,400	—	Castaic Creek Confluence to D/S of Commerce Center Drive Bridge

Notes:

1. *Q_{100} was obtained from Water Resources Division Hydrology Section Information Request Summary dated May 5, 2014 included in **Appendix J**.*
2. *Current Q_{CAP} Flow Rate was obtained from Water Resources Division Hydrology Section Information Request Summary dated May 5, 2014 included in **Appendix J**.*
3. *Old Q_{CAP} Flow Rate was obtained from Water Resources Division Hydrology Section Information Request Summary dated January 7, 2003 included in **Appendix J**.*

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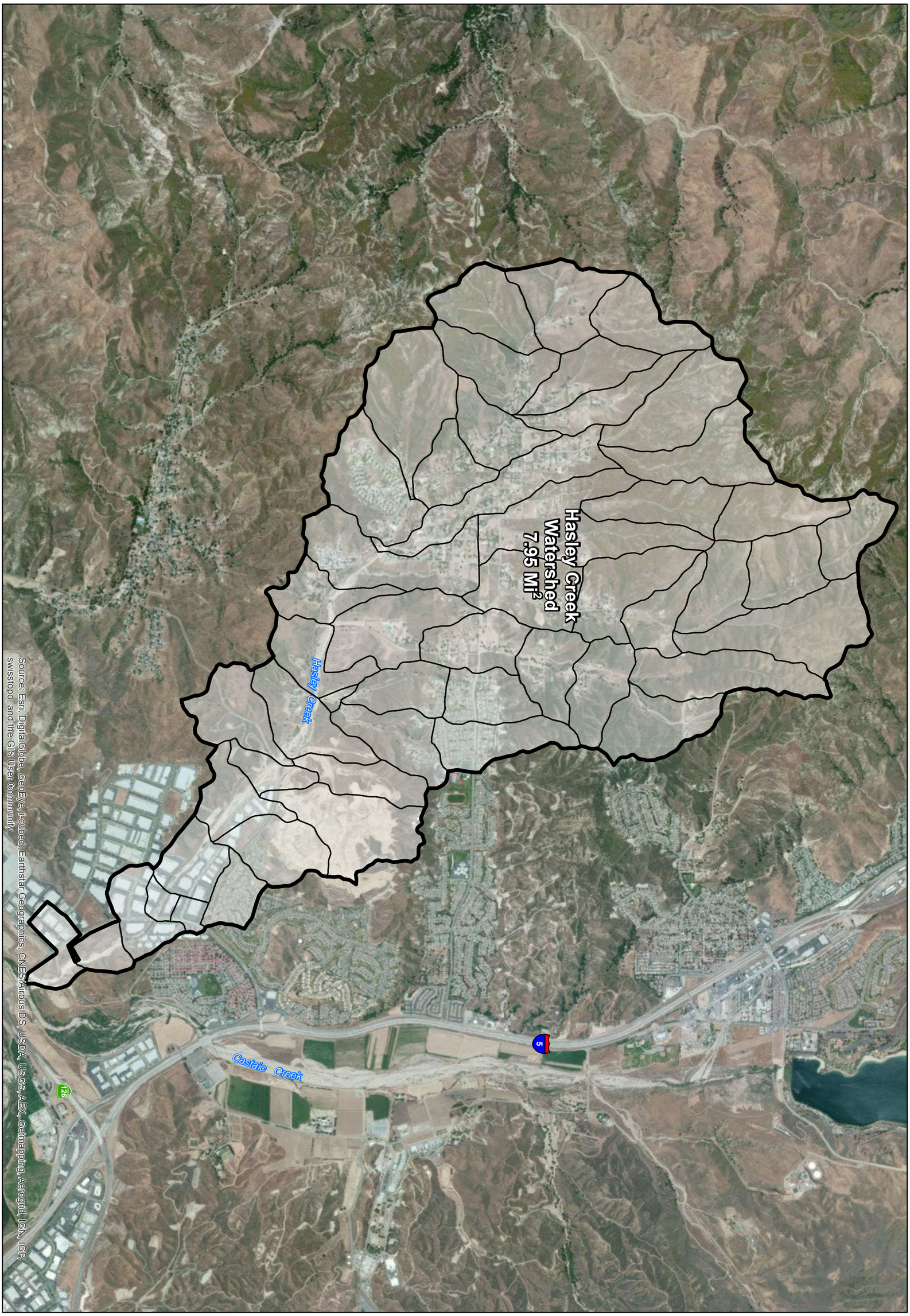

FIGURE				
2	PACE Advanced Water Engineering	SCALE 1"= 2500'	JOB HASLEY CREEK SOIL CEMENT BANK PROTECTION T.P.M. 18108-DCR Vol. III of V	TITLE HASLEY CREEK WATERSHED BOUNDARY
		DESIGNED TH		
		DRAWING TH		
		CHECKED JC		
		DATE 02/09/2015		
		JOB NO. A535	LOS ANGELES CO. CA	

3 HEC-RAS Modeling

An analysis was performed to determine floodplain limits, as well as the top and toe elevations for the proposed bank protection associated with the VCC Industrial Park Development project.

3.1 HEC-RAS Models Developed for Hasley Canyon Creek

For this study, PACE has prepared the following HEC-RAS models of Hasley Canyon Creek in the vicinity of the project:

1. *Hasley Canyon Creek Existing Condition HEC-RAS Model*
2. *Hasley Canyon Creek Proposed Condition (Design Slope) HEC-RAS Model*
3. *Hasley Canyon Creek Proposed Condition (Stable Slope) HEC-RAS Model*

Each HEC-RAS model is described below.

"Hasley Canyon Creek Existing Condition" HEC-RAS model represents the existing condition of the Hasley Canyon in the area of the VCC Industrial Park Development project, which includes the following structures:

- *Existing "Upper Hasley Canyon Creek – Concrete Slope Protection"* – approximately 3,700 LF of concrete slope protection along the east and west banks of Hasley Canyon (PD No. 2262), located immediately upstream of the proposed project improvements from HEC-RAS River Sections 4396 and 4725.
- *Existing Flow Diversion Berm (PD 2298, Unit III, Linings B and C) at Castaic Creek/Hasley Canyon Creek Confluence* – The portion of the existing berm that is upstream of the Commerce Center Drive Bridge (approximately 350 LF) is modeled as a lateral weir between HEC-RAS River Sections 1294 and 1518 to adequately represent the flow along the west bank. The portion of the existing berm that extends from the downstream end of Commerce Center Drive Bridge (HEC-RAS River Section 1061) to HEC-RAS River Section 1448 is represented in the cross section geometry.
- *Existing "Commerce Center Drive Bridge"* – located between HEC-RAS River Sections 1080 and 1189, the span is approximately 560 LF with six piers (Bridge No. B3794).

"Hasley Canyon Creek Proposed Condition (Design Slope)" HEC-RAS model represents the proposed condition where the Hasley Canyon Creek improvements related to the VCC Industrial Park Development have been constructed, but the conditions within the channel are the same as the existing condition. This model contains the following structures:

- *Existing "Upper Hasley Canyon Creek – Concrete Slope Protection"* – approximately 3,700 LF of concrete slope protection along the east and west banks of Hasley Canyon (PD No. 2262), located immediately upstream of the proposed project improvements from HEC-RAS River Sections 4725 and 4396.
- *Proposed "Lower Hasley Canyon Creek – Soil Cement Bank Protection"* – approximately 3,000 LF of buried soil cement along the east and west bank of Hasley Canyon Creek, from HEC-RAS River Sections 1448 to 4396.
- *Proposed "Franklin Parkway Bridge"* – located between HEC-RAS River Sections 2190.5 and 2305.5, the span is approximately 380 LF with two piers.
- *Modified Flow Diversion Berm (PD 2298, Unit III, Linings B and C) at Castaic Creek/Hasley Canyon Creek Confluence* – As previously mentioned in **Section 1**, a portion of the berm (150 LF in length) will be modified to allow more flow to be conveyed through Commerce Center Drive Bridge. The modified berm is modeled as a lateral weir between HEC-RAS River Stations 1294 and 1448. The portion of the existing berm that extends from the downstream end of Commerce Center Drive Bridge (HEC-RAS River Section 1061) to HEC-RAS River Section 1448 is represented in the cross section geometry.

- *Existing "Commerce Center Drive Bridge"* – located between HEC-RAS River Stations 1080 and 1189, the span is approximately 560 LF with six piers (Bridge No. B3794).

"Hasley Canyon Creek Proposed Condition (Stable Slope)" HEC-RAS model represents the proposed condition where the Hasley Canyon Creek improvements related to the VCC Industrial Park Development have been constructed, but the conditions within the channel are stable (at the equilibrium slope). The stable slope HEC-RAS model represents a shorter reach of Hasley Creek than the design slope HEC-RAS model. This is because including Commerce Center Drive Bridge and the area downstream of Commerce Center Drive Bridge, which is where Halsey Canyon Creek joins Castaic Creek, was causing instabilities in the sediment transport modeling. Therefore, the downstream end of the stable slope model is located approximately 200 feet upstream of the existing Commerce Center Drive Bridge. The stable slope model contains the following structures:

- *Existing "Upper Hasley Canyon Creek – Concrete Slope Protection"* – approximately 3,700 LF of concrete slope protection along the east and west banks of Hasley Canyon (PD No. 2262), located immediately upstream of the proposed project improvements from HEC-RAS River Stations 4725 and 4396.
- *Proposed "Lower Hasley Canyon Creek – Soil Cement Bank Protection"* – approximately 3,000 LF of buried soil cement along the east and west bank of Hasley Canyon Creek, from HEC-RAS River Stations 1448 to 4396.
- *Proposed "Franklin Parkway Bridge"* – located between HEC-RAS River Stations 2190.5 and 2305.5, the span is approximately 380 LF with two piers.
- *Modified Flow Diversion Berm (PD 2298, Unit III, Linings B and C)* – The modified berm is represented in model geometry at HEC-RAS Sections 1353 and 1428. Unlike the other HEC-RAS models, the berm was not represented with a lateral weir for the stable slope condition because the lateral weir caused instabilities in the sediment transport modeling.

In addition to the different geometric configurations, PACE considered two design conditions in accordance with LACDPW design methodology for determining top and toe elevations of proposed bank protection. These two conditions involve using a Manning's roughness value of 0.085 to represent a fully vegetated channel condition and a Manning's roughness value of 0.025 to represent a bare channel condition. The Manning's roughness value of 0.085 was applied to the proposed conditions model (design slope). The Manning's roughness value of 0.025 was applied to each of the proposed conditions models discussed above (design slope and stable slope) in an effort to determine the most conservative toe elevations for the proposed bank protection. A Manning's roughness value of 0.060 was applied to the proposed conditions (design slope) model to assess impacts to floodplain area and adjacent properties. Refer to **Table 2** for the various HEC-RAS model computations used in the hydraulic analysis.

Table 2 - HEC-RAS Models of Lower Hasley Canyon Creek

Creek Condition	Description	Purpose
Existing Condition	Existing vegetation n = 0.060, Q_{CAP} = 9,480 cfs	To determine the existing conditions water surface elevations and flow velocities within Hasley Canyon Creek from RS 678 to RS 4396
Proposed Condition[1] (Design Slope)	Existing vegetation n = 0.060, Q_{CAP} = 9,480 cfs	To determine proposed conditions water surface elevations and flow velocities within Hasley Canyon Creek from RS 678 to RS 4725
Proposed Condition[2] (Design Slope)	Full vegetation n = 0.085, Q_{CAP} = 9,480 cfs	To generate water surface elevations for the purpose of determining the required top of bank elevations within Hasley Canyon Creek from RS 678 to RS 4725
Proposed Condition (Design Slope)	No vegetation n = 0.025, Q_{100} = 7,000 cfs	To generate flow velocities for the purpose of determining the required toe of bank elevations within Hasley Canyon Creek from RS 678 to RS 4725
Proposed Condition (Stable Slope)	No vegetation n = 0.025, Q_{100} = 7,000 cfs	To generate flow velocities for the purpose of determining the required toe of bank elevations within Hasley Canyon Creek from RS 1353 to RS 4725

Notes:
1. The HEC-RAS models representing the design slope geometric configuration were used to evaluate the impact of the proposed improvements. Because the proposed conditions model with the stable slope configuration represent a different longitudinal channel slope, differences between the existing and proposed conditions could be attributed to the different channel configuration as well as the proposed improvements. Therefore, only the design slope models were used to evaluate impacts to water surface elevations and flow velocities.
*2. The top of bank elevation was determined using output from the design slope HEC-RAS model because the stable slope HEC-RAS model represents a condition where the channel has eroded to its equilibrium slope. This erosion would provide the channel with additional capacity. Therefore, determining the top of bank elevations based on the design slope condition is the most conservative approach. See **Section 6** for a more detailed discussion.*
*3. The lesser of the calculated design slope toe of bank elevation and the calculated stable slope toe of bank elevation at each HEC-RAS section was determined to be the maximum required toe of bank elevation. See **Section 6** for a more detailed discussion.*

Analyses and calculations for the Q_{CAP} event using a Manning's roughness value of 0.060 are presented to identify the changes in water surface elevation and velocity between the existing and proposed conditions.

Additional analyses and calculations for the Capital Flood event using a Manning's value of 0.085 were presented to determine maximum water surface elevations and to calculate the bank protection freeboard values. As discussed in **Section 2**, the HEC-RAS models used for the freeboard analysis applied the old Capital Flood flow rate (Q_{CAP}) in order to match the design capacity of the Upper Hasley Canyon Creek improvements (PD No. 2508). In contrast, the 100-year flow rate (Q_{100}) was used for the toe-down analysis. Unlike freeboard, channel capacity is not associated with toe-down. Therefore, PACE compared the current Q_{CAP} and the current Q_{100} flow rates. Because the current Q_{100} is larger than the current Q_{CAP}, the Q_{100} was used to determine toe-down. Analyses and calculations for the Q_{100} event using a Manning's value of 0.025 are also presented to show maximum flow velocities for the proposed condition and to determine bank protection scour (toe-down) values.

The boundary conditions for Hasley Canyon Creek Capital Flood analysis were established based on 2013 topographic data. The upstream and downstream boundary conditions use normal depth, which requires an input for the slope of the hydraulic grade line at the boundary limits. The slope of the hydraulic grade line is estimated using the slope of the channel invert at the upstream and downstream ends of the model. See **Table 3** for a list of the boundary conditions applied to each HEC-RAS model.

Table 3 - HEC-RAS Model Boundary Conditions for Capital Flood (Q_{CAP}) and 100-yr Flood (Q_{100})

HEC-RAS Model Plan	Downstream Boundary Condition[1] (STA 678)	Upstream Boundary Condition[2] (STA 4725)
Existing Conditions n = 0.060, Q_{CAP} = 9,480 cfs	Normal Depth S = 0.0185	Normal Depth S = 0.007
Proposed Conditions n = 0.060, Q_{CAP} = 9,480 cfs	Normal Depth S = 0.0185	Normal Depth S = 0.007
Proposed Conditions[3] n = 0.085, Q_{CAP} = 9,480 cfs	Normal Depth S = 0.0185	Normal Depth S = 0.007
Proposed Conditions[3] n = 0.025, Q_{100} = 7,000 cfs	Normal Depth S = 0.0185	Normal Depth S = 0.007

Notes:

1. *For the downstream boundary condition, the Slope (S) value at HEC-RAS River Station 678 for Normal Depth is estimated from the 2013 topography.*
2. *For the upstream boundary condition, the Slope (S) value at HEC-RAS River Station 4725 for Normal Depth is estimated from the 2013 topography.*

4 Summary of HEC-RAS Results

4.1 Existing vs. Proposed Condition (n = 0.060)

PACE utilized the HEC-RAS analyses for Q_{CAP} and Manning's roughness value of 0.060 to identify changes in Capital Flood water surface elevations and flow velocities for the existing and proposed (design slope) creek conditions. This analysis indicated that increases in water surface elevation or velocity are contained within FivePoint property. Therefore, it can be concluded that there are no impacts to adjacent properties located outside of the VCC Industrial Park project boundary caused by the proposed Hasley Canyon Creek bank protection. The results of the existing and proposed condition HEC-RAS models based on a Manning's roughness value of 0.060 are shown on **Table 4**. HEC-RAS model cross-section locations for the existing condition are shown on **Figure 5** and detailed model results are provided in **Appendix A**. Additionally, HEC-RAS model cross section locations for the proposed condition are shown on **Figure 6** and detailed model results are provided in **Appendix B**.

Table 4 - Hydraulic Analysis Results – Existing Condition vs. Proposed Condition
(Q_{CAP} = 9,480 cfs, n = 0.06)

HEC-RAS River Station	Water Surface Elevation Comparison			Velocity Comparison		
	Existing Condition WSE (ft)	Proposed Condition WSE (ft)	Change in WSE (ft)	Existing Condition Velocity (fps)	Proposed Condition Velocity (fps)	Change in Velocity (fps)
4055.5	1045.6	1043.5	**-2.1**	8.8	6.8	**-2.0**
3940.5	1044.2	1041.6	**-2.6**	8.9	8.9	0.0
3844	1040.6	1039.5	**-1.1**	13.5	8.1	**-5.4**
3747	1039.1	1038.4	**-0.7**	9.9	7.1	**-2.8**
3650	1037.6	1036.6	**-1.0**	8.9	8.4	**-0.5**
3554	1036.9	1034.4	**-2.5**	7.4	9.8	**2.4**
3440.5	1034.5	1033.6	**-0.9**	10.9	6.3	**-4.6**
3372	1033.7	1031.5	**-2.2**	9.1	10.0	**0.9**
3304	1033.0	1031.0	**-2.0**	8.0	6.9	**-1.1**
3190.5	1032.2	1030.2	**-2.0**	6.9	6.2	**-0.7**
3105	1031.7	1029.1	**-2.6**	6.9	8.0	**1.1**
3020	1030.4	1028.2	**-2.2**	9.0	6.9	**-2.1**
2934	1026.8	1026.2	**-0.6**	14.7	9.6	**-5.1**
2820.5	1023.1	1023.5	**0.4**	14.3	9.2	**-5.1**
2748	1022.3	1022.6	**0.3**	11.4	7.5	**-3.9**
2675.5	1020.9	1021.2	**0.3**	10.4	8.0	**-2.4**
2560.5	1018.9	1018.6	**-0.3**	8.6	9.8	**1.2**
2476	1017.7	1017.7	0.0	7.7	6.7	**-1.0**
2391	1016.4	1016.9	**0.5**	8.0	7.1	**-0.9**
2305.5	1015.9	1016.6	**0.7**	6.1	5.9	**-0.2**
Proposed Franklin Parkway Bridge						
2190.5	1014.9	1012.6	**-2.3**	7.3	9.0	**1.7**
2122	1012.9	1011.1	**-1.8**	11.4	9.2	**-2.2**
2054	1010.4	1009.6	**-0.8**	12.9	9.2	**-3.7**
1940.5	1008.6	1008.7	**0.1**	6.7	7.6	**0.9**
1872	1007.6	1006.5	**-1.1**	8.2	10.4	**2.2**
1804	1005.5	1005.0	**-0.5**	10.9	9.8	**-1.1**
1688.62	1005.5	1004.2	**-1.3**	5.1	6.6	**1.5**

HEC-RAS River Station	Water Surface Elevation Comparison			Velocity Comparison		
	Existing Condition WSE (ft)	Proposed Condition WSE (ft)	Change in WSE (ft)	Existing Condition Velocity (fps)	Proposed Condition Velocity (fps)	Change in Velocity (fps)
1584	1005.6	1004.2	**-1.4**	2.4	3.8	**1.4**
Downstream Limit of Lower Hasley (East) Bank Protection/Confluence with Castaic Creek						
1518	1005.3	1003.1	**-2.2**	4.2	6.9	**2.7**
1448	1002.9	1000.9	**-2.0**	12.0	9.8	**-2.2**
Downstream Limit of Lower Hasley (West) Bank Protection						
1294	1000.9	997.5	**-3.4**	12.2	10.9	**-1.3**
1189	1000.1	996.7	**-3.4**	10.5	8.2	**-2.3**
Commerce Center Drive Bridge/Downstream Limit of Castaic Creek (Southeast) Bank Protection						
1080	993.7	992.9	**-0.8**	6.6	6.2	**-0.4**
1061	993.7	992.9	**-0.8**	6.5	6.0	**-0.5**
981	992.6	991.9	**-0.7**	8.5	8.0	**-0.5**
678	990.7	989.9	**-0.8**	8.2	7.7	**-0.5**

Notes:

1. *Existing Condition WSE and Velocity are based on a Manning's roughness value of 0.060 for entire width of channel.*
2. *Proposed Condition WSE and Velocity are based on Manning's roughness value of 0.060 for entire width of channel for the proposed Hasley Canyon Creek Bank Protection.*
3. *Due to the proposed rock chute, cross sections upstream of 4055.5 are entirely different for the existing and proposed condition models. Therefore, cross sections are shown between HEC-RAS River Stations 678 and 4055.5 to accurately convey the impacts of the proposed bank protection to water surface elevations and flow velocities.*
4. *Note that cross sections at HEC-RAS River Stations 3940, 3747, 3650, 3372, 3190, 3105, 3020, 2675, 2560, 1940, and 1584 have been moved slightly such that existing and proposed cross section geometry are different. However, the geometries are similar enough for comparison purposes.*

4.2 Proposed Condition Model Results and Top of Bank Protection Determination

The results of the HEC-RAS analysis applying the Q_{CAP} and a Manning's roughness value of 0.085 to the design slope geometric configuration were used to determine the proposed condition water surface elevations. Other hydraulic parameters from this HEC-RAS analysis were used to calculate minimum freeboard values based on LACDPW requirements. HEC-RAS output data for the HEC-RAS models applying a Manning's roughness value of 0.085 are provided in **Appendix C**. **Table E.1** is a detailed freeboard calculation spreadsheet for Hasley Canyon Creek "East" bank protection, and **Table E.2** is a detailed freeboard calculation spreadsheet for Hasley Canyon Creek "West" bank protection (see **Appendix E**). Top of bank elevations were calculated by adding the required freeboard depth to the water surface elevation from the HEC-RAS model described above. The design top of bank elevations for the East Bank and West Bank are summarized in **Tables 5 and 6**, respectively**.**

Table 5 - Hasley Canyon Creek "East" Design Top of Bank Elevations

HEC-RAS River Station	Design Slope WSE[1] (ft)	Freeboard Depth[2] (ft)	Minimum Required Top of Bank Elevation[3] (ft)
4396	1066.39	9.44	1075.83
4300	1045.43	14.02	1059.45
4282	1039.42	14.91	1054.33
4276	1045.49	2.50	1047.99
4270	1045.68	2.50	1048.18
4265	1045.18	2.50	1047.68
4258	1045.17	2.50	1047.67
4157	1045.18	2.50	1047.68
4055.5	1044.33	2.50	1046.83
3940.5	1042.61	2.50	1045.11
3844	1040.58	2.50	1043.08
3747	1039.36	2.50	1041.86
3650	1038.00	2.50	1040.50
3554	1035.83	2.50	1038.33
3440.5	1034.23	2.50	1036.73
3372	1032.80	2.50	1035.30
3304	1032.08	2.50	1034.58
3190.5	1031.12	2.50	1033.62
3105	1030.10	2.50	1032.60
3020	1028.99	2.50	1031.49
2934	1027.15	2.50	1029.65
2820.5	1024.59	2.50	1027.09
2748	1023.47	2.50	1025.97
2675.5	1021.88	2.50	1024.38
2560.5	1019.92	2.50	1022.42
2476	1018.91	2.50	1021.41
2391	1018.06	2.50	1020.56
2305.5	1017.59	2.50	1020.09
2190.5	1013.72	2.50	1016.22
2122	1012.19	2.50	1014.69
2054	1010.80	2.50	1013.30
1940.5	1009.54	2.50	1012.04
1872	1007.69	2.50	1010.19
1804	1006.39	2.50	1008.89
1688.62	1005.28	2.50	1007.78
1584	1005.11	2.50	1007.61

Notes:

1. *Water Surface Elevations (WSEs) were obtained from Proposed Condition (n=0.085) HEC-RAS Output Summary for the Design Slope condition included in **Appendix C**.*
2. *Design Slope Freeboard values were obtained from **Table E.1** included in **Appendix E**.*
3. *Design Slope Top of Bank Elevations were calculated by adding the Design Slope WSE (n=0.085) values and the Design Slope Freeboard values.*

Table 6 - Hasley Canyon Creek "West" Design Top of Bank Elevation

HEC-RAS River Station	Design Slope WSE[1] (ft)	Freeboard Depth[2] (ft)	Minimum Required Top of Bank Elevation[3] (ft)
4396	1066.39	9.44	1075.83
4300	1045.43	14.02	1059.45
4282	1039.42	14.92	1054.34
4276	1045.49	2.50	1047.99
4270	1045.68	2.50	1048.18
4265	1045.20	2.50	1047.70
4258	1045.17	2.50	1047.67
4157	1045.18	2.50	1047.68
4055.5	1044.33	2.50	1046.83
3940.5	1042.61	2.50	1045.11
3844	1040.58	2.50	1043.08
3747	1039.36	2.50	1041.86
3650	1038.00	2.50	1040.50
3554	1035.83	2.50	1038.33
3440.5	1034.23	2.50	1036.73
3372	1032.80	2.50	1035.30
3304	1032.08	2.50	1034.58
3190.5	1031.12	2.50	1033.62
3105	1030.10	2.50	1032.60
3020	1028.99	2.50	1031.49
2934	1027.15	2.50	1029.65
2820.5	1024.59	2.50	1027.09
2748	1023.47	2.50	1025.97
2675.5	1021.88	2.50	1024.38
2560.5	1019.92	2.50	1022.42
2476	1018.91	2.50	1021.41
2391	1018.06	2.50	1020.56
2305.5	1017.59	2.50	1020.09
2190.5	1013.72	2.50	1016.22
2122	1012.19	2.50	1014.69
2054	1010.80	2.50	1013.30
1940.5	1009.54	2.50	1012.04
1872	1007.69	2.50	1010.19
1804	1006.39	2.50	1008.89
1688.62	1005.28	2.50	1007.78
1584	1005.11	2.50	1007.61
1518	1003.88	2.50	1006.38
1448	1001.36	2.50	1003.86

Notes:

1. *Water Surface Elevations (WSEs) were obtained from Proposed Condition (n=0.085) HEC-RAS Output Summary for the Design Slope condition included in **Appendix C**.*
2. *Design Slope Freeboard values were obtained from **Table E.1** included in **Appendix E**.*
3. *Design Slope Top of Bank Elevations were calculated by adding the Design Slope WSE (n=0.085) values and the Design Slope Freeboard values.*

4.3 Proposed Condition Model Results and Toe of Bank Protection Determination

The HEC-RAS analyses for the Q_{100} and a Manning's roughness value of 0.025 were used to determine the proposed condition flow velocities. Other hydraulic parameters from these HEC-RAS analyses were used to calculate minimum required toe-down (cut-off depth) values based on LACDPW requirements. Output data from the HEC-RAS models based on a Manning's roughness value of 0.025 is provided in **Appendix D**. **Tables E.3 and E.5** are detailed toe-down calculation spreadsheets for the Lower Hasley Canyon Creek "East" bank protection (see **Appendix E**). **Tables E.4 and E.6** are detailed toe-down calculation spreadsheets for Hasley Canyon Creek "West" bank protection (see **Appendix E**). Toe of bank elevations were computed by subtracting the required toe-down from the minimum channel invert elevation. For each HEC-RAS Section, the minimum required toe of bank elevation was designated as the lesser of the design slope toe of bank elevation and the stable slope toe of bank elevation. The minimum required toe of bank elevations are summarized in **Tables 7 and 8**.

Table 7 - Hasley Canyon Creek "East" Design Toe of Bank Elevations

HEC-RAS River Station	Design Slope Minimum Channel Elevation[1] (ft)	Design Slope Toe-Down[2] (ft)	Calculated Design Slope Toe of Bank Elevation[3] (ft)	Stable Slope Minimum Channel Elevation[4] (ft)	Stable Slope Toe-Down[5] (ft)	Calculated Stable Slope Toe of Bank Elevation[6] (ft)	Final Design Toe of Bank Elevation[7] (ft)
4258	1037.00	4.67	**1032.33**	1037.00	4.88	1032.12	1032.11
4157	1035.56	9.89	**1025.67**	1031.84	4.09	1027.75	1025.67
4055.5	1033.00	15.15	**1017.85**	1030.71	12.15	1018.56	1017.85
3940.5	1031.00	15.21	**1015.79**	1029.75	12.84	1016.91	1015.79
3844	1030.00	10.53	**1019.47**	1028.59	7.23	1021.36	1019.47
3747	1029.17	10.38	**1018.79**	1027.62	7.80	1019.83	1018.79
3650	1028.00	8.76	**1019.24**	1026.64	5.23	1021.41	1019.24
3554	1027.00	9.54	**1017.46**	1025.64	6.68	1018.97	1017.46
3440.5	1025.32	9.39	**1015.93**	1024.49	6.60	1017.89	1015.93
3372	1025.00	9.00	**1016.00**	1023.77	6.05	1017.72	1016.00
3304	1023.50	8.47	**1015.03**	1023.14	6.27	1016.87	1015.03
3190.5	1022.00	7.41	1014.59	1022.00	8.03	**1013.97**	1013.97
3105	1021.00	20.15	**1000.85**	1009.98	7.07	1002.91	1000.85
3020	1019.68	19.56	1000.12	1009.27	9.86	**999.41**	999.41
2934	1018.19	15.65	**1002.54**	1008.60	5.79	1002.81	1002.54
2820.5	1016.37	15.39	1000.98	1007.69	8.41	**999.29**	999.29
2748	1015.00	14.49	1000.51	1007.11	7.92	**999.19**	999.19
2675.5	1014.00	14.53	999.47	1006.43	7.10	**999.33**	999.33
2560.5	1012.00	13.24	**998.76**	1005.68	5.19	1000.49	998.76
2476	1010.49	12.27	998.22	1004.94	7.83	**997.12**	997.12
2391	1009.71	11.87	**997.84**	1004.26	6.06	998.20	997.84
2305.5	1007.87	19.84	988.03	1003.68	16.70	**986.98**	986.98
2190.5	1006.00	22.42	**983.58**	1002.89	18.39	984.50	983.58
2122	1004.00	11.45	992.55	1002.22	9.75	**992.47**	992.47
2054	1003.00	10.59	**992.41**	1001.60	9.17	992.43	992.41
1940.5	1001.76	9.29	992.47	1000.87	8.49	**992.38**	992.38
1872	1001.00	6.96	**994.04**	1000.19	5.82	994.37	994.04
1804	999.65	5.50	994.15	999.65	5.57	**994.08**	994.08
1688.62	997.49	10.07	**987.43**	993.63	5.49	988.15	987.43
1584	995.00	7.22	987.78	992.83	5.39	**987.44**	987.44

Notes:

1. *Design Slope Minimum Channel Elevations were obtained from the HEC-RAS output included in **Appendix D**.*
2. *Design Slope Toe-Down values were obtained from **Table E.3** included in **Appendix E**.*
3. *Calculated Design Slope Toe of Bank Elevations were calculated by subtracting Design Slope Toe-Down from the Design Slope Minimum Channel Elevation.*
4. *Stable Slope Minimum Channel Elevations were obtained from the HEC-RAS output included in **Appendix D**.*
5. *Stable Slope Toe-Down values were obtained from **Table E.5** included in **Appendix E**.*
6. *Calculated Stable Slope Toe of Bank Elevations were calculated by subtracting Stable Slope Toe-Down from the Design Slope Minimum Channel Elevation.*
7. *The Final Design Toe of Bank Elevation is the minimum of the Calculated Design Slope Toe of Bank Elevation and the Calculated Stable Slope Toe of Bank Elevation.*

Table 8 - Hasley Canyon Creek "West" Design Toe of Bank Elevations

HEC-RAS River Station	Design Slope Minimum Channel Elevation[1] (ft)	Design Slope Toe-Down[2] (ft)	Calculated Design Slope Toe of Bank Elevation[3] (ft)	Stable Slope Minimum Channel Elevation[4] (ft)	Stable Slope Toe-Down[5] (ft)	Calculated Stable Slope Toe of Bank Elevation[6] (ft)	Final Design Toe of Bank Elevation[7] (ft)
4258	1037.00	7.55	**1029.23**	1037.00	7.46	1029.54	1029.23
4157	1035.56	13.97	**1021.59**	1031.84	9.73	1022.11	1021.59
4055.5	1033.00	9.55	**1023.45**	1030.71	5.29	1025.42	1023.45
3940.5	1031.00	8.59	**1022.41**	1029.75	5.40	1024.35	1022.41
3844	1030.00	10.53	**1019.47**	1028.59	7.23	1021.36	1019.47
3747	1029.17	10.38	**1018.79**	1027.62	7.80	1019.83	1018.79
3650	1028.00	10.88	**1017.12**	1026.64	7.77	1018.87	1017.12
3554	1027.00	10.19	**1016.81**	1025.64	7.47	1018.17	1016.81
3440.5	1025.32	9.39	**1015.93**	1024.49	6.60	1017.89	1015.93
3372	1025.00	9.00	**1016.00**	1023.77	6.05	1017.72	1016.00
3304	1023.50	8.47	**1015.03**	1023.14	6.27	1016.87	1015.03
3190.5	1022.00	4.57	1017.43	1022.00	5.89	**1016.11**	1016.11
3105	1021.00	17.04	**1003.96**	1009.98	5.16	1004.82	1003.96
3020	1019.68	17.69	**1001.99**	1009.27	4.97	1004.30	1001.99
2934	1018.19	15.65	**1002.54**	1008.60	5.79	1002.81	1002.54
2820.5	1016.37	15.39	1000.98	1007.69	8.41	**999.29**	999.29
2748	1015.00	14.49	1000.51	1007.11	7.92	**999.19**	999.19
2675.5	1014.00	16.39	997.61	1006.43	9.56	**996.87**	996.87
2560.5	1012.00	15.91	996.09	1005.68	10.89	**994.79**	994.79
2476	1010.49	14.36	996.13	1004.94	9.72	**995.22**	995.22
2391	1009.71	13.94	995.77	1004.26	10.30	**993.96**	993.96
2305.5	1007.87	19.84	988.03	1003.68	16.70	**986.98**	986.98
2190.5	1006.00	22.42	**983.58**	1002.89	18.39	984.50	983.58
2122	1004.00	8.93	**995.07**	1002.22	6.64	995.48	995.07
2054	1003.00	8.30	**994.70**	1001.60	6.12	994.71	994.70
1940.5	1001.76	7.41	**994.35**	1000.87	6.17	994.37	994.35
1872	1001.00	6.96	**994.04**	1000.19	5.82	994.08	994.04
1804	999.65	5.50	994.15	999.65	5.57	**988.12**	988.12
1688.62	997.49	10.07	**987.43**	993.63	5.49	988.15	987.43
1584	995.00	7.22	987.78	992.83	5.39	**987.44**	987.44

Notes:

1. *Design Slope Minimum Channel Elevations were obtained from the HEC-RAS output included in **Appendix D**.*
2. *Design Slope Toe-Down values were obtained from **Table E.4** included in **Appendix E**.*
3. *Calculated Design Slope Toe of Bank Elevations were calculated by subtracting Design Slope Toe-Down from the Design Slope Minimum Channel Elevation.*
4. *Stable Slope Minimum Channel Elevations were obtained from the HEC-RAS output included in **Appendix D**.*
5. *Stable Slope Toe-Down values were obtained from **Table E.6** included in **Appendix E**.*
6. *Calculated Stable Slope Toe of Bank Elevations were calculated by subtracting Stable Slope Toe-Down from the Design Slope Minimum Channel Elevation.*
7. *The Final Design Toe of Bank Elevation is the minimum of the Calculated Design Slope Toe of Bank Elevation and the Calculated Stable Slope Toe of Bank Elevation.*

5 Fluvial Study

5.1 Introduction

The following section describes the detailed analysis performed to evaluate the fluvial characteristics and long-term stability of the portion of Halsey Creek that is in the vicinity of the Lower Hasley Creek improvements. The proposed soil cement bank protection, which will be installed on the east and west banks, will provide long-term erosion protection from lateral migration of the thalweg and flood protection for the adjacent proposed developments. The purpose of this fluvial study is to evaluate the impacts from (1) fluvial modifications of the streambed from a single hypothetical storm event and (2) long-term changes in the floodplain fluvial operation.

5.1.1 Types of Adjustment

Bed adjustment in feet quantify the fluvial modifications and long-term changes of the streambed. A positive adjustment indicates bed aggradation, while a negative adjustment indicates bed degradation. PACE considered several types of adjustment in this study including:

- *Long-Term Adjustment* which accounts for fluvial processes that occur over many rainy seasons and contribute to fluctuations in the creek's bed elevation. **Section 0** outlines the methodology used to determine the long-term adjustment.
- *General Adjustment* which accounts for scour that occurs during an individual storm event. Aggradation describes a situation in which the quantity of sediment that enters a given reach is higher than the quantity of sediment that exits the same reach, and degradation describes a situation in which sediment outflow exceeds inflow for a given reach. **Section 5.4** outlines the methodology used for determining general adjustment.
- *Other Scour* is comprised of local scour, bend scour, low-flow incisement, and bed form height.

The total vertical adjustment (total scour) is the sum of the general adjustment, long-term adjustment, and other scour. **Section 5.7** summarizes the results of this fluvial study and presents the total scour calculated for each HEC-RAS cross section.

5.1.2 Study Objectives

The primary objective of this report is to present the technical processes used to determine total scour at Hasley Creek, including a comprehensive assessment of short-term bed adjustment and long-term bed adjustment based on the available information. The objectives of this fluvial assessment are as follows:

1. To determine fluvial parameters that are representative of Hasley Canyon Creek's bed characteristics.
2. To model the bed characteristics and fluvial processes associated with the proposed conditions.
3. To conduct a preliminary assessment of the total scour by determining sediment transport capacities within different reaches of the floodplain.

5.2 HEC-RAS Models

The fluvial study utilized HEC-RAS models in addition to the models discussed in **Section 3.1**. The following section describes these additional HEC-RAS models.

5.2.1 Geometric Configurations

The fluvial study utilized the following HEC-RAS geometry files:

1) **Design Slope Geometry** – The design slope geometry represents a condition where the Hasley Canyon Creek improvements related to the VCC Industrial Park Development have been constructed, but the conditions within the channel are the same as the existing condition. The Design Slope HEC-RAS model is described in **Section 3.1.**

2) **Stable Slope Geometry** – This geometric configuration depicts the situation in which the design reaches have degraded to their long-term equilibrium. The structures included in the Stable Slope Geometry are described in **Section 3.1. Section 0** discusses stable invert elevations calculations.

3) **Supply Reach Geometry** – The supply reach supplies sediment to the design reach and is located immediately upstream of the design reach. HEC-RAS models with this geometry compute hydraulic parameters used to determine the supply reach's sediment transport rate. The Supply Reach geometry originates from a previous PACE study: *Hydraulic Analysis Technical Assessment Report for Engineered Earthen-Bottom Flood Control Channels Located within the Santa Clara River Watershed & Antelope Valley Watershed*, dated August 2017. An excerpt of this study is included in **Appendix F**. The supply reach is "Reach 110" in the 2017 study, which spans approximately 4,200 feet, ending at the upstream end of the design reach. The original model geometry featured 55 cross-sections cut from 2006 Light Detection and Ranging (LIDAR) topographic data provided by LACDPW. The LIDAR data indicated that one side of the channel had been recently maintained, leading to a half-dredged channel. In an effort to be conservative, the current study also considers the condition in which the channel had not undergone maintenance. This approach involved taking the highest point of the bed at each cross section, and "filling in" the cross section, which resulted in a uniform bed elevation. Sediment transport capacity was calculated for each of these conditions and was larger for the original channel configuration. Because a smaller sediment supply results in more degradation, the "filled in" geometry configuration was used to generate more conservative estimates of general and long-term scour.

5.2.2 Manning's Roughness

The Manning's roughness values used for the long-term adjustment and general adjustment analyses was calculated using Cowan's Method. This Manning's roughness value was applied to the models used to determine long-term adjustment and general adjustment values in order to represent the true site conditions. Cowan's Method involves defining the Manning's roughness by several characteristics of the natural channel such as surface irregularity, variation in channel geometry, obstructions to the flow path, density of the vegetation, and stream meandering. For Hasley Canyon Creek, a Manning's roughness of 0.038 was calculated using the Cowan Method (see **Appendix F**).

The supply reach contains the existing conditions Manning's roughness, including 0.015 on the concrete banks of the channel and values ranging from 0.121 to 0.032 in the soft-bottom areas. The 2017 study that analyzed the supply reach reported using Cowan's Method to calculate a Manning's roughness value for soft-bottom areas in order to model the existing conditions of the channel.

In accordance with LACDPW design methodology, a Manning's roughness value of 0.025 was applied to the design slope and stable slope geometries used for toe down calculations.

5.2.3 Reach Delineation

Lower Hasley Canyon Creek was divided into three subreaches for sediment transport calculations. Hydraulic parameters were then averaged across each reach for the general adjustment and long-term adjustment calculations. Analysis of key hydraulic parameters, including top width, energy slope, and velocity, did not reveal trends from which to delineate the reaches. Therefore, the design reaches were divided at the locations of the buried rock grade control structures. The delineation of the three design reaches is defined in **Table 9**.

Table 9 - Hasley Canyon Creek Reach Delineation

Reach	Upstream HEC-RAS River Section	Downstream HEC-RAS River Section
1	4157	3190.5
2	3190.5	1804
3	1804	1448

5.2.4 Flow Rates

As discussed in **Section 2**, Q_{100} (7,000 cfs) was used for the toe-down calculations because it is larger than the current Q_{CAP} (5,900 cfs). For long-term scour, the Los Angeles County Sedimentation Manual (LACSM) recommends using the dominant discharge to compute hydraulic parameters, which can be taken as 25% of the Capital Flood discharge (Q_{CAP}). Since the design and analysis for toe of the bank in Hasley Canyon Creek is based on Q_{100}, the dominant discharge was assumed to be 1,750 cfs (25% of 7,000 cfs). The general adjustment calculations did not involve a single flow rate. Rather, a variety of flow rates were considered to create rating curves of sediment transport and hydraulic parameters. Rating curves were used in conjunction with 100-year, 24-hour hydrographs to calculate general scour. For further discussion of the general scour analysis and hydrographs used in the calculations, see **Sections 5.4.2 and 5.4.4**.

5.2.5 Flow Regime

All models were run with the mixed flow regime. The mixed flow regime applies subcritical and supercritical profiles and uses the momentum equation to model hydraulic jumps.

5.2.6 Boundary Conditions

The upstream boundary conditions of the HEC-RAS models are normal depth for each geometry configuration, whereas the downstream boundary conditions are critical depth for adjustment calculations and normal depth for toe down calculations. For the design reach geometries for adjustment calculations, Castaic Creek was assumed to be dry. When Castaic Creek is dry, there is no backwater effect in Hasley Canyon Creek, which results in higher velocities where flow enters Castaic Creek. Critical flow is expected as water flows into Castaic Creek at the downstream end of Hasley Canyon Creek. Critical flow is also expected at the downstream end of the supply reach, where there is a drop structure that connects the supply reach to the design reach. The toe down geometries extend further into Castaic Creek, where normal depth is expected. The slopes of the hydraulic grade lines at the upstream and downstream ends of the design geometry was estimated using the slope of the channel invert and 2013 topographic data. **Table 10** outlines the upstream and downstream boundary conditions of each geometry.

Table 10 - Upstream and Downstream Boundary Conditions

Geometry	Upstream Boundary Condition	Downstream Boundary Condition
Design Slope for Adjustment Calculations	Normal Depth S = 0.0185	Critical Depth
Stable Slope for Adjustment Calculations	Normal Depth S = 0.0185	Critical Depth
Supply Reach for Adjustment Calculations	Normal Depth S = 0.022	Critical Depth
Design Slope for Toe Down Calculations	Normal Depth S = 0.0185	Normal Depth S = 0.007
Stable Slope for Toe Down Calculations	Normal Depth S = 0.0185	Normal Depth S = 0.007

5.3 Sediment Characterization and Analysis

Sediment data was obtained upstream of the design reach for the sediment transport analysis. The long-term and general adjustment analyses involve continuity analyses. These analyses assume the sediment supply from upstream is transported through the reach to the next downstream reach. When the sediment supply is equal to the sediment transport capacity within the reach, the reach is in equilibrium. Therefore, the sediment transported through the reach originates from an upstream supply, and sediment gradation data from the upstream supply is an accurate representation of the sediment transported throughout the supply and design reaches.

Sediment data was taken from results of a gradation laboratory test completed by R.T. Franklin & Associates, dated March 2003. Sediment gradation curves were provided for five samples: two samples within the Hasley Canyon supply reach, and three samples upstream of this supply reach. The supply reach has been modified since 2003, however, the area upstream of the supply reach remains in its natural state. Therefore, the three samples upstream of the supply reach were used to determine an average gradation curve for the analysis. The result is a poorly sorted sand. Gradation laboratory test results are included in **Appendix F**.

5.4 General Adjustment

5.4.1 Overview

The general adjustment analysis for Hasley Canyon Creek was completed using HEC-RAS and SAM. HEC-RAS was used to model the hydraulics of Hasley Canyon Creek, and SAM was used to determine the transport potential based on hydraulic inputs. The results of these models were used to create a rating curve of sediment transport potential to discharge, which was then used to determine the scour caused by two hydrographs.

5.4.2 Hydrology

The general scour analysis considered two possible 100-year hydrographs: (1) a Soil Conservation Service (SCS) hydrograph; and (2) a HEC-1 hydrograph.

5.4.2.1 SCS Hydrograph

An estimated SCS hydrograph was determined by scaling the SCS Unit Hydrograph by the peak flow and event duration. The event duration was taken as 24 hours, while the peak flow was set to the 100-year discharge of 7,000 cfs. The SCS Hydrograph is displayed in **Figure 3**.

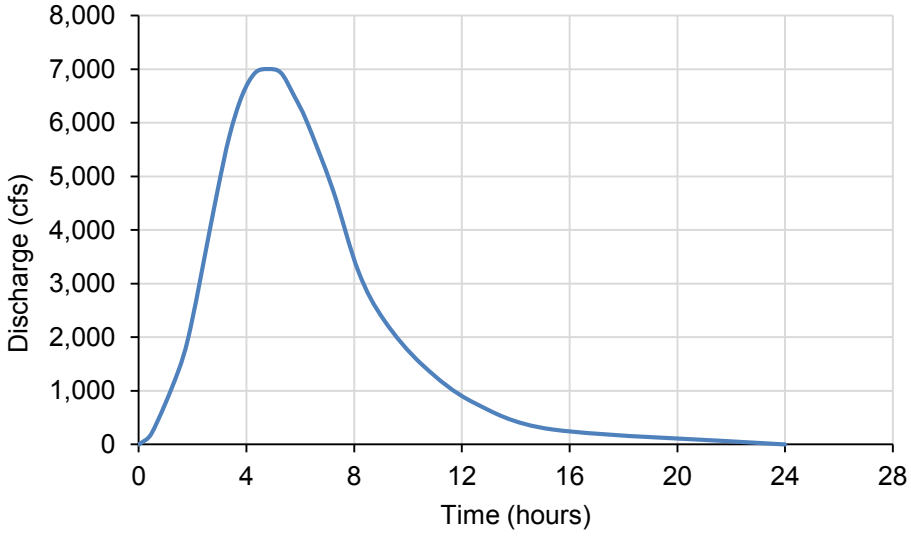

Figure 3 - Estimated SCS hydrograph for a peak flow of 7,000 cfs

5.4.2.2 HEC-1 Hydrograph

PACE calculated a hydrograph using LAPRE-1 and HEC-1 for the 24-hour, 100-year storm event in Hasley Canyon Creek. The HEC-1 model uses the Orange County rainfall distribution pattern with NOAA Atlas 14 rainfall values for the 5-minute, 30-minute, 1-hour, 3-hour, 6-hour, and 24-hour storm durations in the Hasley Canyon Creek watershed. The percent of soil loss for low loss rate and the maximum loss rate were calculated based on curve number and impervious area, following guidelines in the Orange County Hydrology manual. The weighted average curve number was estimated based on land use. The program transformed the rainfall to runoff with a Mountain S-graph. The result of the HEC-1 model is a 43.5-hour hydrograph with a peak flow of 2,529 cfs, which is displayed in **Figure 4**. The HEC-1 model and calculation of inputs are included in **Appendix F**.

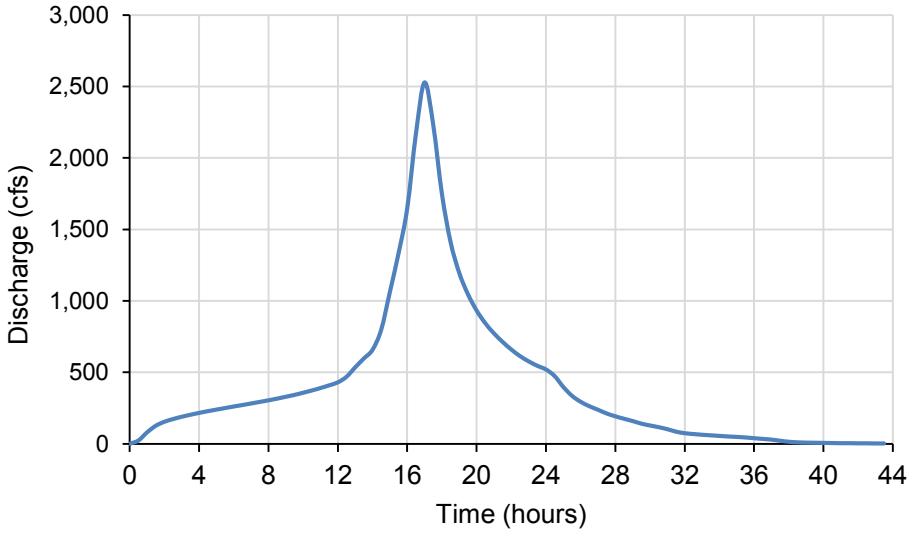

Figure 4 - Hydrograph of the 24-hour, 100-year storm calculated with the use of HEC-1

5.4.3 Sediment Transport Equation

The Yang sediment transport equation was used for all SAM calculations. This function was selected using the SAMaid subroutine, which determines the most representative transport function for a reach by comparing hydraulic parameters (slope, velocity, width, and depth) and sediment data (D_{50}) with the results of 20 peer-reviewed sediment transport studies. Average hydraulic parameters for the design and supply reach were entered into the program, and the application revealed that the Van Rijn, Yang, and Ackers-White transport functions are the best fit for the data. Next, the sediment transport functions were used to calculate sediment transport rate within the supply reach. While the results of the Van Rijn and Yang equations were similar, the Ackers-White equation produced results an order of magnitude larger than the other two equations. The Yang equation was then selected, since it is more widely available than the Van Rijn function; for example, the HEC-6 program has the capabilities of using the Yang equation for sediment transport, whereas the program does not support the Van Rijn function.

5.4.4 Rating Curves

To create sediment transport rating curves, HEC-RAS analyses consisted of flow rates ranging from 50 to 7,000 cfs. HEC-RAS results were used to calculate weighted average hydraulic parameters for each flow rate in each reach. Outliers were not included in the hydraulic averages, as they are not representative of the overall channel hydraulics. For example, in the stable slope condition, rock grade control structures become exposed, so hydraulics at the crest and toe of these structures are omitted. Hydraulic parameters include velocity, effective depth, top width, and energy grade slope. These parameters were used as inputs for the SAM model, which calculated transport potential for each reach and flow rate. Transport potential was plotted against flow rate, and curves were fit to the data.

Rating curves for top width were also required for scour calculations. The weighted average top width from the HEC-RAS results was plotted against flow rate, and polynomial functions were fit to the data (see **Appendix F**).

5.4.5 Continuity Analysis

The scour caused by a storm event was calculated with a continuity analysis. The transport potential at each time step of the hydrograph was calculated using the sediment transport rating curve and the average flow rate at that time step. The transport potential deficit or surplus in each reach was calculated at each time step by subtracting the transport potential of the given reach from the potential of the reach immediately upstream. A deficit indicates potential scour, while a surplus indicates aggradation. The top width rating curve was also used in conjunction with a time step's average flow rate to determine the top width at each time step. Once these values were determined, the following equation was used to determine the change in bed elevation in each reach at each time step:

$$\Delta_{\text{bed elevation}} = \frac{\Delta\text{TP} \times \Delta\text{t} \times 2{,}000\,\frac{\text{lbs}}{\text{ton}}}{\rho \times \text{RL} \times \text{b}}$$

where,

ΔTP = transport potential deficit or surplus (tons/day)
Δt = time step (days)
P = density of rock (taken as 165.36 lbs/ft^3)
RL = reach length (ft)
b = top width (ft)

Finally, the change in bed elevation of caused by the storm was determined by summing the changes in bed elevation at each time step of the hydrograph.

5.4.6 Results

Table 11 outlines the results for the two slope conditions and the two hydrographs. Results varied between hydrographs and invert conditions, and subsequent toe down calculations utilize the largest value of scour. The stable slope in Reach 2 resulted in positive values of general adjustment; therefore, no general scour is expected in this condition. The values of general adjustment in reach 3 were not realistic, likely due to the drastic change in channel geometry; the channel widens and steepens as it approaches Castaic Creek. Additionally, this area would likely experience two-dimensional flow, so the HEC-RAS 1D model and the zero-dimensional SAM model are not an accurate representation of the sediment transport and hydraulics at Reach 3. For toe-down calculations, the general scour for Reach 2 was applied to Reach 3 in order to present a realistic estimation of scour at Reach 3.

Table 11 - General Adjustment (GA) Results

Reach	HEC-RAS River Station	Design Slope GA[1,4] (ft)		Stable Slope GA[5] (ft)	
		HEC-1 Hydrograph	SCS Hydrograph	HEC-1 Hydrograph	SCS Hydrograph
1	3190.5 to 4157	**-2.03**	1.47	7.00	12.58
2	1804 to 3190.5	0.67	**-0.78**	5.43	5.88

Notes:

1. *GA= General Adjustment.*
2. *Values in bold indicate the larger scour calculated from the two hydrographs. This value was used in subsequent toe down calculations.*
3. *General adjustment results from Reach 3 were not realistic and are omitted from this table.*
4. *The design slope refers to the proposed slope on the plans.*
5. *Stable slope refers to the long-term equilibrium slope of the channel.*

5.5 Long-Term Adjustment

Long-term scour within Hasley Creek was estimated in accordance with guidance outlined in the LACSM. The generalized approach for determining long-term scour involved performing a sediment transport analysis to determine Hasley Canyon Creek's equilibrium slope, which is the longitudinal slope where the channel no longer degrades or aggrades.

According to the LACSM, the first step in determining long-term scour is to determine the discharge predominately responsible for the fluvial characteristics of Hasley Canyon Creek. As discussed in **Section 5.2.4**, the dominant discharge used for the long-term scour analysis was 1,750 cfs.

The next step of the sediment transport analysis was identifying the supply reach, which is a reach upstream of Hasley Canyon Creek that will contribute sediment to Hasley Canyon Creek. As discussed in **Section 5.2**, the supply reach is a 4,200-ft reach of an engineered channel located upstream of Hasley Canyon Creek. The supply reach geometry was obtained from a HEC-RAS model used for a previous study (PACE, 2017). This geometric data was modified to represent a "no maintenance" condition because this condition will result in a more conservative estimate of long-term scour.

The supply reach's hydraulic parameters were determined using output from a steady flow HEC-RAS model that applies a flow rate of 1,750 cfs and a Manning's roughness coefficient of 0.025. These hydraulic parameters were used to evaluate the sediment transport rate of the supply reach. PACE used the SAM Hydraulic Design Package for Channels (SAM) to perform the sediment transport calculations. There are over 20 equations available in SAM to calculate sediment transport. PACE used the SAMaid tool to select the most sediment relationship that is most appropriate for the bed material and hydraulic condition, which was determined to Yang. According to the software documentation, SAM is a zero-dimensional computational package that is based on a single cross section at a particular point in time. Therefore, the hydraulic parameters for each cross section of the modeled supply reach were averaged to create a representative cross section. PACE used the hydraulic parameters for this representative cross section, the dominant discharge, and the sediment data described in **Section 5.3** to calculate sediment transport with the Yang equation. This yielded a sediment transport rate of 347,985.6 tons/day.

Then PACE conducted an iterative process that involved adjusting the longitudinal channel slope up or down and calculating sediment transport rate in SAM until the sub-reach transport capacity is equal to the supply reach sediment transport capacity. This iterative process was performed for each sub-reach described in **Section 5.2.3**. Note that the representative cross section for each iteration did not include the crest and toe of drop structures as flow velocities and shear stresses at these grade control structures are not representative of the sub-reach. **Table 12** summarizes the results of the SAM modeling performed for the long-term scour analysis.

Table 12 - Summary of SAM Results

Reach	Sediment Transport Rate[1] (tons/day)	Supply Reach[2] Transport Rate (tons/day)	Difference[3]	Slope (ft/ft)
1	324,241.4	347,985.6	3.4%	0.010
2	314,750.8	347,985.6	0.5%	0.008

Notes:

1. *The Sediment Transport Rate was calculated using the hydraulic parameters of the representative cross section, the dominant discharge (1,750 cfs), and the sediment data described in **Section 5.3** as inputs for the Yang equation.*
2. *The Supply Reach Transport Rate was calculated using the hydraulic parameters of the supply reach's representative cross section, the dominant discharge (1,750 cfs), and the sediment data described in **Section 5.3** as inputs for the Yang equation.*
3. *%Difference was calculated as the absolute value of the difference of the Sediment Transport Rate and Supply Reach Transport Rate divided by the average of the Sediment Transport Rate and Supply Reach Transport Rate.*
4. *Reach 3 was not included in the analysis, as the sediment transport rate did not balance.*

The long-term scour at each HEC-RAS section is presented in **Table 13**.

Table 13 - Long-Term Scour Results

HEC-RAS River Station	Reach	Slope (ft/ft)	Long-Term Scour Depth (ft)
4055.5	1	0.010	2.3
3940.5	1	0.010	1.3
3844	1	0.010	1.4
3747	1	0.010	1.5
3650	1	0.010	1.4
3554	1	0.010	1.4
3440.5	1	0.010	0.8
3372	1	0.010	1.2
3304	1	0.010	0.4
3105	2	0.008	11.0
3020	2	0.008	10.4
2934	2	0.008	9.6
2820.5	2	0.008	8.7
2748	2	0.008	7.9
2675.5	2	0.008	7.6
2560.5	2	0.008	6.3
2476	2	0.008	5.6
2391	2	0.008	5.5
2305.5	2	0.008	4.2
2190.5	2	0.008	3.1
2122	2	0.008	1.8
2054	2	0.008	1.4
1940.5	2	0.008	0.9
1872	2	0.008	0.8
1688.62	3	0.008	3.86
1584	3	0.008	2.17
1518	3	0.008	2.84

5.6 Other Scour

Local scour describes scour that occurs near a flow obstruction such as bridge piers, flow contractions, or levees. Bend scour describes the scour that occurs due to differential velocity gradients around curves in open channel flow. Low-flow incisement represents thalweg or low-flow channel depth. Bed form height is the distance between the crest and the trough of the bed form and is estimated using velocity data from HEC-RAS. Methodology outlined in the LACSM was used to calculate three components of other scour including bend scour, low-flow incisement, and bed form height. HEC-18 procedures in HEC-RAS were used to calculate local scour at Franklin Parkway Bridge.

5.6.1 Local Scour

Local scour due to bank protection was assumed to be 2.0 feet if bank protection will be present. Local scour at Hasley Creek was estimated due to the presence of Franklin Parkway Bridge. The HEC-18 procedures in HEC-RAS were used to estimate contraction scour and pier scour.

5.6.1.1 Contraction Scour

Contraction scour describes scour that occurs when the flow area of a stream is reduced by a natural contraction in the channel, a bridge, or another structure that restricts the flow. Several factors contribute to the depth of contraction scour such as natural channel contraction, the presence of road embankments at the approach of the bridge, bridge abutments projecting into the main channel, bridge piers that are blocking a significant portion of the flow area, or a drop in the downstream tailwater.

There are two forms of contraction scour that may occur and are a function of the quantity of bed material being transported upstream of the contraction reach: (1) live-bed contraction scour and (2) clear-water contraction scour. Live-bed contraction scour occurs when sediment-laden water flows into the contracted section, while clear-water contraction scour occurs when sediment transport upstream of the contraction is negligible. To determine the appropriate type of contraction scour, sediment transport upstream of the contraction must be established. HEC-RAS calculates the critical velocity for motion (V_c) of the mean grain size and compares it with the mean velocity (V) upstream of the bridge. If the critical velocity is greater than the mean velocity (V_c>V), then clear-water contraction scour is assumed. In contrast, if the critical velocity is less than the mean velocity (V_c<V), then live-bed contraction scour is assumed. The critical velocity is calculated using the Laursen (1963) equation given by:

$$V_C = K_U y_z^{1/6} D_{50}^{1/3}$$

where,

V_c = critical velocity above which material of size D_{50} and smaller will be transported (fps)
K_U = 11.17 (English units)
y_z = average depth of flow in the main channel (ft)
D_{50} = mean particle size (ft)

The modified Laursen's (1960) live-bed contraction scour equation is given by:

$$y_2 = y_1 \left[\frac{Q_2}{Q_1}\right]^{6/7} \left[\frac{W_1}{W_2}\right]^{K_1}$$

$$y_s = y_2 - y_0$$

where,

y_s = average depth of contraction scour (ft)
y_2 = average depth after scour in the contraction (ft)
y_1 = average depth in the main channel (ft)
y_0 = average depth in the contracted section before scour (ft)
Q_1 = flow in the main channel which is transporting sediment (cfs)
Q_2 = flow in the main channel in the contracted section which is transporting sediment (cfs)
W_1 = bottom width in the main channel, approximated as the top width of the active flow area in HEC-RAS (ft)
W_2 = bottom width of the main channel in the contracted section minus pier widths, approximated as the top width of the active flow area (ft)
K_1 = exponent for mode of bed material transport

The recommended clear-water contraction scour equation by HEC-18 is an equation based on research from Laursen (1963):

$$y_s = \left[\frac{Q_2^2}{C D_m^{2/3} W_2^2}\right]^{3/7}$$

$$y_s = y_2 - y_0$$

where,

D_m = diameter of the smallest non-transportable particle in the bed material (1.25 D_{50}) in the contracted section (ft)
D_{50} = median diameter of the bed material (ft)
C = 130 (English units)

5.6.1.2 Local Scour at Piers

Pier scour is a function of the acceleration of flow around the pier and the formation of flow vortices. The vortices remove material from the base of the pier, forming a scour depression. As the depth of scour increases, the magnitude of the vortex decreases thereby reducing the rate of scour. The factors that control the depth of local scour at a pier are the velocity of the flow, depth of flow, width of the pier, length of the pier in the direction of flow, gradation of the bed material, angle of attack of flow, shape of the pier, and debris. HEC-18 uses the Richardson (1990) equation for calculating pier scour:

$$y_s = 2.0K_1K_2K_3K_4a^{0.65}y_1^{0.35}Fr_1^{0.43}$$

where,

y_s = depth of scour (ft)
K_1 = correction factor for pier nose shape
K_2 = correction factor for angle of attack of flow
K_3 = correction factor for bed condition
K_4 = correction factor for armoring of bed material
a = pier width (ft)
y_1 = flow depth (ft)
Fr_1 = Froude number

HEC-RAS includes the addition of the pier width when computing pier scour.

5.6.2 Bend Scour

Bend scour was calculated using equation Q-6A from the LACSM, given as (Zeller, 1981):

$$Z_{bs} = \frac{0.0685YV^{0.8}}{Y_h^{0.4}S_e^{0.3}}\left[1.59\left(\frac{w}{r}\right)^{0.2} - 1\right]$$

where,

Z_{bs} = bend scour depth (ft)
V = mean flow velocity (ft/s)
Y = maximum depth of flow (ft)
Y_h = hydraulic depth of flow (ft)
S_e = energy slope (ft/ft)
w = top width (ft)
r = radius of curvature to the centerline of the channel

5.6.3 Low-Flow Incisement

The LACSM states that low-flow incisement is equal to the greater of the low flow depth or two feet for design purposes. Low flow depths were obtained from a HEC-RAS model that applied a Manning's roughness value of 0.025 and a flow rate of 300 cfs.

5.6.4 Bedform Height

HEC-RAS output data was used to calculate bedform height. Bedform height was determined using equation Q-8 of the LACSM:

$$h = 0.027V^2$$

where,

h = bedform height (ft)
V = mean flow velocity (ft/s)

5.7 Total Scour

The total scour at each HEC-RAS cross section is the sum of the general adjustment, long-term adjustment, and other scour components. The total scour at the design slope and the stable slope were calculated, and the scour that led to the lowest toe down elevation was used in the design. As previously mentioned, the general scour for each slope configuration was taken as the larger of the scour calculated for the two hydrographs. Because general scour results were unreasonable for Reach 3, the general scour of Reach 2 was applied to Reach 3. Long-term scour varied by cross-section and was defined as the difference between the proposed invert elevation and the stable slope. There is no long-term scour in the stable slope configuration. **Table 14** outlines the long-term and general scour for each total scour analysis.

Table 14 - Summary of General and Long-Term Scour Used In Toe-Down Calculations

Reach	HEC-RAS River Sections	General Scour[1,2] (ft)		Long-Term Scour	
		Design Slope Configuration	Stable Slope Configuration	Design Slope Configuration	Stable Slope Configuration
1	4157 to 3190.5	-2.03	0	Difference between design invert and 1.0% slope	0
2	3190.5 to 1804	-0.78	0	Difference between design invert and 0.8% slope	0
3	1448 to 1804	-0.78	0	Difference between design invert and 0.8% slope	0

Notes:

1. *General scour for each reach is the larger scour computed from the two hydrographs. The sediment transport modeling for the long-term scour and short-term scour indicated aggradation. Therefore, a value of zero was applied to the general scour and long-term scour.*
2. *General scour for Reach 3 is the larger scour from Reach 1 and Reach 2.*

Table 15 summarizes the results of the total scour analysis, which includes the scour depth and elevation for the two geometric configurations.

Table 15 - Summary of Total Scour Results

HEC-RAS Section	Design Invert Elevation[1] (ft)	Stable Slope Invert Elevation[2] (ft)	East Bank				West Bank			
			Design Slope Toe-Down[3] (ft)	Design Slope Scour Elevation[4] (ft)	Stable Slope Toe-Down[5] (ft)	Stable Slope Scour Elevation[6] (ft)	Design Slope Toe-Down[7] (ft)	Design Slope Scour Elevation[4] (ft)	Stable Slope Toe-Down[8] (ft)	Stable Slope Scour Elevation[6] (ft)
4157	1035.56	1031.84	9.89	**1025.67**	4.09	1027.75	13.97	**1021.59**	9.73	1022.11
4055.5	1033.00	1030.71	15.15	**1017.85**	12.15	1018.56	9.55	**1023.45**	5.29	1025.42
3940.5	1031.00	1029.75	15.21	**1015.79**	12.84	1016.91	8.59	**1022.41**	5.40	1024.35
3844	1030.00	1028.59	10.53	**1019.47**	7.23	1021.36	10.53	**1019.47**	7.23	1021.36
3747	1029.17	1027.62	10.38	**1018.79**	7.80	1019.83	10.38	**1018.79**	7.80	1019.83
3650	1028.00	1026.64	8.76	**1019.24**	5.23	1021.41	10.88	**1017.12**	7.77	1018.87
3554	1027.00	1025.64	9.54	**1017.46**	6.68	1018.97	10.19	**1016.81**	7.47	1018.17
3440.5	1025.32	1024.49	9.39	**1015.93**	6.60	1017.89	9.39	**1015.93**	6.60	1017.89
3372	1025.00	1023.77	9.00	**1016.00**	6.05	1017.72	9.00	**1016.00**	6.05	1017.72
3304	1023.50	1023.14	8.47	**1015.03**	6.27	1016.87	8.47	**1015.03**	6.27	1016.87
3190.5	1022.00	1022.00	7.41	1014.59	8.03	**1013.97**	4.57	1017.43	5.89	**1016.11**
3105	1021.00	1009.98	20.15	**1000.85**	7.07	1002.91	17.04	**1003.96**	5.16	1004.82
3020	1019.68	1009.27	19.56	1000.12	9.86	**999.41**	17.69	**1001.99**	4.97	1004.30
2934	1018.19	1008.60	15.65	**1002.54**	5.79	1002.81	15.65	**1002.54**	5.79	1002.81
2820.5	1016.37	1007.69	15.39	1000.98	8.41	**999.29**	15.39	1000.98	8.41	**999.29**
2748	1015.00	1007.11	14.49	1000.51	7.92	**999.19**	14.49	1000.51	7.92	**999.19**
2675.5	1014.00	1006.43	14.53	999.47	7.10	**999.33**	16.39	997.61	9.56	**996.87**
2560.5	1012.00	1005.68	13.24	**998.76**	5.19	1000.49	15.91	996.09	10.89	**994.79**
2476	1010.49	1004.94	12.27	998.22	7.83	**997.12**	14.36	996.13	9.72	**995.22**
2391	1009.71	1004.26	11.87	**997.84**	6.06	998.20	13.94	995.77	10.30	**993.96**
2305.5	1007.87	1003.68	19.84	988.03	16.70	**986.98**	19.84	988.03	16.70	**986.98**
2190.5	1006.00	1002.89	22.42	**983.58**	18.39	984.50	22.42	**983.58**	18.39	984.50
2122	1004.00	1002.22	11.45	992.55	9.75	**992.47**	8.93	**995.07**	6.64	995.58
2054	1003.00	1001.60	10.59	**992.41**	9.17	992.43	8.30	**994.70**	6.12	995.48
1940.5	1001.76	1000.87	9.29	992.47	8.49	**992.38**	7.41	**994.35**	6.17	994.71
1872	1001.00	1000.19	6.96	**994.04**	5.82	994.37	6.96	**994.04**	5.82	994.37
1804	999.65	999.65	5.50	994.15	5.57	**994.08**	5.50	994.15	5.57	**994.08**
1688.6	997.49	994.49	10.07	**987.43**	5.49	988.15	10.07	**987.43**	5.49	988.12
1584	995.00	993.63	7.22	987.78	5.39	**987.44**	7.22	**987.78**	5.39	987.44

Notes:

1. *Design Slope invert elevations were obtained from HEC-RAS output for the design slope configuration (see **Appendix B**)*
2. *Stable Slope invert elevations were obtained from HEC-RAS output for the stable slope configuration (see **Appendix D**)*
3. *Design Slope Toe-Down for the East Bank was obtained from **Table E.3**.*
4. *Design Slope Scour Elevations were calculated by subtracting the Design Slope Toe-Down from the Design Invert Elevation.*
5. *Stable Slope Toe-Down for the East Bank was obtained from **Table E.5**.*
6. *Stable Slope Scour Elevations were calculated by subtracting the Stable Slope Toe-Down from the Stable Slope Invert Elevation.*
7. *Design Slope Toe-Down for the West Bank was obtained from **Table E.4**.*
8. *Stable Slope Toe-Down for the West Bank was obtained from **Table E.6**.*
9. ***Bold values** indicate the Final Design Scour Elevation.*

5.8 Plunge Scour

5.8.1 Plunge Scour Calculations

When the rock-grade control structures are exposed, there is potential for additional scour, or plunge scour, at the toe of these structures. The design of rock at the toe of these grade control structures considered plunge scour. The Veronese (1937) method is an empirical equation commonly used to calculate scour at the toe of a drop structure. The present analysis used the Veronese equation, which defines scour depth measured from tailwater surface:

$$D = 0.202 \frac{q^{0.54} H^{0.225}}{d^{0.42}}$$

where,

D = Scour depth measured from tailwater surface
H = Difference between upstream and downstream water surface elevations
q = Discharge per unit width, taken as Y×V
Y = Depth of water at the crest of the drop
V = Velocity of water at the crest of the drop
d = Mean sediment grain size, taken as $\frac{d_{16}+d_{84}}{2}$

HEC-RAS computed the hydraulics at the crest of the drop structure for the Q_{100} and a Manning's roughness of 0.025. The following equation defined the corresponding water depth at the toe of the drop (y_1) ignoring head loss, and was derived from energy balance across the drop:

$$Q = y_1 \times B \times \sqrt{V_0^2 + 2g(z_0 - z_1 + y_0 - y_1)}$$

where,

Q = Discharge in Hasley Canyon Creek (7,000 cfs)
y_1 = Water depth at the toe of the drop structure (ft)
B_1 = Channel width (ft)
z_0 = Elevation of the crest of the drop structure (ft)
V_0 = Velocity at the crest of the drop structure (ft/s)
g = Gravitational acceleration (ft/s^2)
z_1 = Elevation at the toe of the drop structure (ft)
y_0 = Water depth at the crest of the drop (ft)

Table 16 outlines the results of the plunge scour calculations.

Table 16 - Summary of Plunge Scour Results

Structure Number	Description	HEC-RAS Section at Crest	Plunge Scour[1] (ft)
1	End sill of stilling basin	4258	3.97
2	Rock grade control structure	3190.5	4.94
3	Rock grade control structure	1804	-

Notes:

1. *The plunge scour equation does not apply at Structure Number 3 because the drop height was not large enough to create a hydraulic jump.*

5.8.2 *Hydraulic Jump Length Calculations*

The hydraulic jump length at each drop structure provides an estimate of the required length of the rip rap aprons. The HEC-RAS model provided results for the water depth. The hydraulics at the toe of the drop structure calculated above were used to compute the hydraulic jump length.

The sequent depth for the hydraulic jump was calculated using momentum balance across the hydraulic jump:

$$(P + M)_1 = (P + M)_2$$

The following equation defines the pressure plus momentum terms for trapezoidal cross-sections, and was used to iteratively solve for the sequent depth:

$$(P + M) = \frac{Q^2}{g(By+zm)} + \frac{y^2}{6}(2my + 3B)$$

where,

Q = Discharge in Hasley Canyon Creek (7000 cfs),
A = Cross-sectional area (ft^2)
B = Channel width (ft),
g = gravitational acceleration (ft/s^2),
y = Water depth (ft), and
m = Side slope (H:V)

Finally, the hydraulic jump length is 6 times the sequent depth. **Table 17** outlines the hydraulic jump lengths. Note that the drop in height across structure number 3 is not large enough to cause a hydraulic jump.

Table 17 - Drop Structure Hydraulic Jump Lengths

Structure Number	Description	HEC-RAS Section at Crest	Hydraulic Jump Length (ft)
1	End sill of stilling basin	4258	40
2	Grade control structure	3190.5	56
3	Grade control structure	1804	-

5.8.3 *Volume of Launch Stone*

Launch stone will be placed in front of each buried rock grade control structure. If the rock grade control structures are ever exposed, the launch stone will protect the toe of the structure from plunge scour without lowering the toe of the soil cement. If the drop structure becomes completely exposed, the launch stone will line the channel downstream of the rock grade control structure. The resulting riprap apron lengths will be longer than the hydraulic jump length at each drop structure, and thus will provide adequate scour protection. As shown in **Table 18**, the volume of launch stone to be placed at each structure is greater than the minimum required volume of launch stone.

Table 18 - Launch Stone Unit Volume for Plunge Scour

Structure Number	HEC-RAS Section at Crest	Unit Volume of Soil Cement Replaced (ft^3/ft)	Minimum Required Launch Stone Unit Volume (ft^3/ft)[1]	Launch Stone Unit Volume[2] (ft^3/ft)
1	4258	32	70.4	421
2	3190.5	40	88	650

Notes:
1. *The minimum required launch stone unit volume was calculated by multiplying the unit volume of soil cement replaced by 2.2.*
2. *The volume of launch stone to be placed between the toe of the structure and the channel invert of the stable slope*

6 Proposed Bank Top and Bank Toe Elevations

The top and toe elevations of the proposed bank protection were determined based on HEC-RAS modeling analysis for the full build-out condition. The full build-out condition includes all of the proposed soil cement bank protection projects along the portion of Hasley Canyon Creek and Castaic Creek between Commerce Center Drive and the confluence with Castaic Creek. The project specific analysis provided in this report includes the top of bank elevations for the Q_{CAP} flow rate and the toe of bank elevations for the Q_{100} flow rate.

6.1 Hasley Canyon Creek "East" Bank Top and Toe Design

The profiles for the bank top and bank toe shown on **Figure 7** were initially set using the design elevations shown in **Tables 5 and 7,** respectively. The bank top and toe elevations were then modified to eliminate numerous changes in grade along the top of the proposed bank protection. Grade break locations were sent so the top and toe of bank elevations satisfied the freeboard and toe-down requirements. The design top elevations, design toe elevations, actual top elevations and actual toe elevations per **Figure 7** for the soil cement bank protection are shown in **Table 19**.

Table 19 - Hasley Canyon Creek "East" Soil Cement Bank Protection Top and Toe Elevations

HEC-RAS River Station	Bank Station (ft)	Final Design Top Elevation[1] (ft)	Actual Top Elevation[2] (ft)	Final Design Toe Elevation[3] (ft)	Actual Toe Elevation[4] (ft)	Bank Height[5] (ft)
End Toe SC	40+30.45	-	**-**	-	**1044.65**	-
End Top SC	40+29.97	-	**-**	-	1044.65	-
-	40+02.98	-	**-**	-	1044.51	-
4396	39+91.02	1075.83	**1071.06***	-	**1044.45**	26.6
4300	39+29.98	1059.45	1064.95	-	1028.79	36.2
-	39+13.09	1053.81	1063.27	-	**1024.45**	38.8
4282	39+11.65	1053.33	1063.12	-	1024.45	38.7
4276	38+74.34	1047.99	1059.39	-	1024.45	34.9
4270	38+43.10	1048.18	1056.26	-	1024.45	31.8
4265	38+32.25	1047.68	1055.18	-	1024.45	30.7
4258	38+20.42	1047.67	1054.00	1032.11	1024.45	29.6
-	38+17.27	1047.67	1053.68	1031.83	**1024.45**	29.2
	38+11.47	1047.67	1053.10	1031.41	**1021.48**	31.6
	38+01.37	1047.67	**1052.09**	1030.48	1021.48	30.6
4157	37+48.37	1047.68	1051.50	1025.67	**1021.48**	30.0
4055.5	36+60.38	1046.83	1050.53	1017.85	**1017.75**	32.7
-	35+53.94	1045.11	1049.34	1015.80	1015.66	33.7
3940.5	35+53.64	1045.11	**1049.34**	1015.79	**1015.65**	33.7
3844	34+26.58	1043.08	1047.17	1019.47	**1019.35**	27.8
3747	33+25.47	1041.86	1045.45	1018.79	1018.41	27.0
3650	32+40.49	1040.50	1044.00	1019.24	1017.62	26.4
3554	31+63.21	1038.33	1042.68	1017.46	1016.91	25.8
3440.5	30+45.90	1036.73	1040.68	1015.93	**1015.82**	24.9
3372	29+63.35	1035.30	1039.27	1016.00	1015.35	23.9
3304	28+84.58	1034.58	1037.93	1015.03	1014.90	23.0
-	28+39.00	1034.23	1037.15	1014.64	**1014.64**	22.5
-	27+91.02	1033.85	1036.33	1014.23	**1002.02**	34.3
3190.5	27+60.89	1033.62	1035.82	1013.97	**1002.02**	33.8
3105	26+56.85	1032.60	1034.05	1000.85	1000.72	33.3

HEC-RAS River Station	Bank Station (ft)	Final Design Top Elevation[1] (ft)	Actual Top Elevation[2] (ft)	Final Design Toe Elevation[3] (ft)	Actual Toe Elevation[4] (ft)	Bank Height[5] (ft)
3020	25+44.48	1031.49	**1032.13**	999.41	**999.31**	32.8
-	25+22.44	1031.05	1031.59	1000.17	999.30	32.3
2934	24+53.29	1029.65	1029.89	1002.54	999.25	30.6
2820.5	23+39.34	1027.09	**1027.09**	999.29	**999.17**	27.9
-	23+17.17	1026.65	1026.73	999.25	998.99	27.7
2748	22+82.85	1025.97	1026.16	999.19	998.71	27.5
2675.5	22+15.00	1024.38	1025.04	999.33	998.16	26.9
2560.5	21+36.58	1022.42	1023.75	998.76	997.53	26.2
2476	20+70.49	1021.41	1022.66	997.12	996.99	25.7
2391	20+00.15	1020.56	1021.51	997.84	996.42	25.1
-	19+91.95	1020.52	1021.37	996.80	**996.35**	25.0
2305.5	19+14.24	1020.09	1020.09	986.98	**983.50**	36.6
2190.5	18+09.13	1016.22	1018.36	983.58	**983.50**	34.9
2122	17+41.40	1014.69	1017.24	992.47	**992.26**	25.0
2054	16+40.43	1013.30	1015.58	992.41	992.26	23.3
1940.5	15+36.82	1012.04	**1013.88**	992.38	992.26	21.6
1872	14+22.46	1010.19	1011.95	994.04	992.26	19.7
-	13+65.24	1009.16	1010.98	994.07	**992.26**	18.7
1804	13+50.46	1008.89	1010.73	994.08	989.65	21.1
-	13+34.51	1008.74	1010.46	993.17	**986.83**	23.6
1688.62	12+34.30	1007.78	**1008.77**	987.43	**986.10**	22.7
-	11+62.29	1007.69		987.44	984.10	24.0
1584	10+97.28	1007.61		987.44	982.30	25.3
Begin Top SC	10+00.00	-	**1006.79**	-	**979.60**	-
Begin Toe SC	8+83.83	-	**-**	-	**976.38**	-

Notes:

1. *Design Top Elevation values were obtained from **Table 5**.*
2. *Actual Top Elevation values shown in **bold** font indicate Grade Break locations as shown on **Figure 7.***
3. *Design Toe Elevations were obtained from **Table 7.***
4. *Actual Toe Elevation values shown in **bold** font indicate Grade Break locations as shown on **Figure 7.***
5. *Bank Height is the difference of the Actual Top Elevation and the Actual Toe Elevation.*

** The Actual Top Elevation is lower than the Design Top Elevation because the soil cement is tying into the existing concrete lining (P.D. 2262).*

6.2 Hasley Canyon Creek "West" Bank Top and Toe Design

The profiles for the bank top and bank toe shown on **Figure 8** were initially generated using the final design top and toe elevations obtained from **Tables 6 and 8**, respectively. The bank top and toe elevations were then modified to eliminate numerous changes in grade along the top of the proposed bank protection. Grade break locations were sent so the top and toe of bank elevations satisfied the freeboard and toe-down requirements. The final design top elevations, final design toe elevations, actual top elevations and actual toe elevations per **Figure 8** for the soil cement bank protection are shown in **Table 20**.

Table 20 - Hasley Canyon Creek "West" Soil Cement Bank Protection Top and Toe Elevations

HEC-RAS River Station	Bank Station (ft)	Final Design Top Elevation[1] (ft)	Actual Top Elevation[2] (ft)	Final Design Toe Elevation[3] (ft)	Actual Toe Elevation[2] (ft)	Bank Height (ft)
End Toe of SC	40+27.04	-	**-**	-	**1044.66**	-
4396/**End Top of SC**	39+89.01	1075.83	**1071.09**	-	**1044.45**	26.6
4300	39+27.91	1059.45	1064.98	-	1029.04	35.9
-	39+09.69	1054.71	1063.16	-	**1024.45**	38.7
4282	39+08.28	1054.34	1063.02	-	1024.45	38.6
4276	38+65.51	1047.97	1058.74	-	1024.45	34.3
-	38+08.15	1048.18	**1053.00**	-	1024.45	28.6
4270	38+07.80	1048.18	1053.00	-	1024.45	28.6
4265	37+97.72	1047.68	1052.89	-	1024.45	28.4
4258	37+85.91	1047.68	1052.76	-	1024.45	28.3
-	37+82.74	1047.68	1052.72	-	**1024.45**	28.3
-	37+76.79	1047.68	1052.66	-	**1021.47**	31.2
4157	37+09.64	1047.68	1051.92	1021.59	1021.47	30.5
4055.5	35+63.04	1046.83	1050.30	1023.45	**1021.47**	28.8
3940.5	34+77.22	1045.11	**1049.36**	1022.41	1020.51	28.8
-	34+70.32	1044.98	1049.24	1022.22	1020.43	28.8
3844	33+70.62	1043.08	1047.50	1019.47	1019.31	28.2
3747	32+79.01	1041.86	1045.90	1018.79	1018.29	27.6
3650	31+64.34	1040.50	1043.89	1017.12	**1017.00**	26.9
3554	30+37.39	1038.33	1041.68	1016.81	1016.37	25.3
3440.5	29+23.41	1036.73	1039.68	1015.93	**1015.80**	23.9
3372	28+60.84	1035.30	1038.59	1016.00	1015.31	23.3
3304	28+08.81	1034.58	1037.68	1015.03	1014.90	22.8
-	27+71.46	1034.25	1037.03	1015.40	**1014.61**	22.4
-	27+23.42	1033.82	1036.19	1015.89	**1002.02**	34.2
3190.5	27+01.61	1033.62	1035.81	1016.11	**1002.02**	33.8
3105	26+53.53	1032.60	1034.97	1003.96	1001.97	33.0
3020	25+83.13	1031.49	1033.74	1001.99	**1001.89**	31.9
2934	25+02.70	1029.65	1032.33	1002.54	1000.72	31.6
2820.5	23+87.44	1027.09	1030.32	999.29	999.05	31.3
2748	23+00.00	1025.97	1028.79	999.19	997.78	31.0
2675.5	21+95.89	1024.38	1026.97	996.87	996.27	30.7
2560.5	20+87.57	1022.42	1025.08	994.79	**994.69**	30.4
2476	19+64.82	1021.41	1022.94	995.22	994.23	28.7
2391	18+61.46	1020.56	1021.13	993.96	**993.85**	27.3
2305.5	18+01.98	1020.09	**1020.09**	986.98	**983.48**	36.6
2190.5	16+83.64	1016.22	1017.98	983.58	**983.48**	34.5
2122	15+77.90	1014.69	1016.10	995.07	**994.87**	21.2
2054	15+24.32	1013.30	1015.15	994.70	994.27	20.9
1940.5	14+47.40	1012.04	**1013.77**	994.35	993.41	20.4
-	14+46.23	1012.00	1013.75	994.34	993.40	20.4
1872	13+93.42	1010.19	1013.00	994.04	992.80	20.2
-	13+44.93	1009.20	1012.30	994.07	**992.26**	20.0

HEC-RAS River Station	Bank Station (ft)	Final Design Top Elevation[1] (ft)	Actual Top Elevation[2] (ft)	Final Design Toe Elevation[3] (ft)	Actual Toe Elevation[2] (ft)	Bank Height (ft)
1804	13+30.05	1008.89	1012.09	994.08	989.65	22.4
-	13+14.10	1008.74	1011.86	993.17	**986.83**	25.0
1688.62	12+13.58	1007.78	1010.42	987.43	**986.49**	23.9
1584	11+45.70	1007.61	1009.45	987.44	982.30	27.2
Begin Toe of SC	11+02.71	1006.56	1008.83	986.30	**979.65**	29.2
1518	10+95.52	1006.38	1008.73	986.11	-	-
1448	10+55.11	1003.86	1008.15	984.07	-	-
Begin Top of SC	10+44.81	-	**1008.00**	-	**-**	-

Notes:

1. *Design Top Elevation values were obtained from **Table 6**.*
2. *Actual Top Elevation values shown in **bold** font indicate Grade Break locations shown on **Figure 8**.*
3. *Design Toe Elevations were obtained from **Table 8**.*
4. *Actual Toe Elevation values shown in **bold** font indicate Grade Break locations as shown on **Figure 8**.*
5. *Bank Height is the difference of the Actual Top Elevation and the Actual Toe Elevation.*

7 Proposed Bank Protection

7.1 Bank Protection Project Description

The Lower Hasley Canyon Creek bank protection spans nearly 3,000 linear feet and is located along the east and west banks of the Creek, beginning upstream of Commerce Center Drive Bridge. The proposed bank protection improvements provide protection against potential flooding and erosion from the Creek for the proposed VCC Industrial Park Development project site, which is located immediately east and west of the proposed bank protection.

7.2 Design of Soil Cement Bank Protection

The "structural" segment of the proposed Lower Hasley Creek bank protection consists of LACDPW standard buried soil cement to provide the appropriate level of freeboard and scour protection for all storm events up to the Capital Flood. The critical factors in determining the design of the bank protection were based on the following criteria:

1. Flood control stability and durability of bank protection.
2. Safety concerns regarding access to and from the channel in dry and wet conditions.
3. Bank protection maintenance considerations.
4. Environmental compatibility with the native area and resource enhancement concepts, and aesthetic considerations.
5. Constructability and cost of construction.

Soil cement bank protection is constructed as a monolithic and homogenous structure consisting of approximately 90% native soils and 10% cement. The typical section consists of 8-foot wide and 6 to 12-inch thick layers of soil cement. Each layer of soil cement is set back from the edge of the previous layer, at a 1.5:1 slope. The entire section varies in total height based on varying freeboard, flow depth and toe-down requirements.

The proposed soil cement bank protection addresses the above design criteria as follows:

1. Soil cement provides a stable riverbank protection material, in terms of both surface erosion and structural stability. Preliminary geotechnical analysis indicates that locally available native soils are considered acceptable for use in soil cement mix.
2. For the majority of the reach, soil cement bank protection will be completely buried with a variable backfill slope of 3:1 (H:V) or flatter. Near the upstream tie in to the existing concrete slope protection within the chute, the soil cement will be partially buried. The exposed top portion of the soil cement will be aesthetically compatible with the native earth re-vegetated resource area. The natural soil cement color makes the proposed soil cement embankment system highly desirable.

7.2.1 Material Suitability for Soil Cement

The following excerpts were taken from various ACI and PCA publications referenced in the bibliography.

The erosion and overtopping of river banks by floodwaters is a significant flood control concern in the southwest. In order to protect valuable land, bridges, and buildings from such erosion, many communities have found that stabilized soil, in the form of soil cement, meets the criteria of cost-effectiveness, performance, functional life, and aesthetics.

The American Concrete Institute (ACI 116R) defines soil cement as "a mixture of soil and measured amounts of cement and water compacted to a high density." Soil cement can be further defined as a material produced by blending, compacting, and curing a mixture of soil/aggregate, Portland cement, possibly admixtures including pozzolans, and water, to form a hardened material with specific engineering properties. The soil/aggregate particles are bonded by cement paste, but unlike concrete, the individual particle is not completely coated with cement paste.

A wide variety of soils can be used to make durable soil cement. In fact, most soils in Southern California are suitable for use in soil cement. Ideally, sand to silty sand with the highest dry unit weight possible should be used to make soil cement, as that material is more likely to be well graded. For maximum economy and most efficient construction, the Portland Cement Association (PCA) recommends that:

1. The soil contains no material retained on a 3-inch (75 mm) sieve.
2. Between 60 percent and 90 percent passes the No. 4 (4.75 mm) sieve.
3. Between 5 percent and 25 percent passes the No. 200 (0.074 mm) sieve.
4. The Plasticity Index (PI) of the fines should not exceed eight.

The following is the analysis of soil classification, cement content, borrows area/earthwork and groundwater levels as stated in the geotechnical report for T.P.M No. 18108 dated May 31, 2007, prepared by GeoLabs:

7.2.1.1 Soil Classification

Preliminary borings for the Lower Hasley Canyon Creek project site indicate that some of the soil along the proposed limits of excavation is generally suitable for use with soil cement. However, other sources of material, whether found on-site or imported, may need to be blended in to optimize the soil cement mix design. Additional geotechnical investigation will be required to determine the suitability of soils for use with soil cement for the final design. The ideal base material gradation for soil cement is based on several PCA soil cement publications and previous experience. The ideal base material gradation is the following:

- 100-80% passing through ¾" sieve, 90-60% passing through No. 4 sieve
- 50-30 percent passing through No. 40 sieve, and
- 25-5% passing through No. 200 sieve.

A well graded material with some fine sands, and minimal or no clays are recommended for most economical design. The gradation test data of various borings, provided in the geotechnical report, were used to determine the location of borrow sites.

7.2.1.2 Cement Content

An efficient mix utilizes the minimum cement content necessary to reach the specified design strengths. For this mix, base cement content of 7% to 10%, by weight will be used. Per the project specifications, the final cement content will be based on testing of the actual soil cement base material stockpile. Based on strength and durability relationships developed by the PCA, the cement content will be determined based on achieving a 7-day unconfined compressive strength of approximately 750 psi.

7.2.1.3 Aggregate Location and Volumes

The project Geotechnical Engineer has drilled several borings along the existing creek banks to analyze soil gradations and determine whether they are suitable for soil cement base. Based on numerous tests performed by PCA, the ideal base material for soil cement, in general, is well-graded sand with some gravel and some fines. The soils that are extracted from the trench excavations are typically well graded sands and, therefore, used for the soil cement mix.

7.2.1.4 Groundwater Levels

All dewatering activities will be limited to the area from the soil cement grading daylight line to a maximum of 15 feet towards the Creek. The contractor may request in writing an extension of the area for dewatering, except that in no case shall any dewatering or construction activities take place within the United States Army Corps of Engineers (ACOE) or California Department of Fish and Wildlife (CDFW) resource area without prior authorization.

All information on groundwater levels will be based on geotechnical investigations of the bank protection project site. Any groundwater data should not be assumed to be accurate during the period of construction. The contractor is responsible for obtaining and reviewing copies of the project geotechnical report and should independently determine groundwater levels and appropriate dewatering efforts necessary to prepare excavation for soil cement construction.

7.3 Grade Control Structures

Two grade control structures will be constructed as part of the Lower Hasley Canyon Creek bank protection design. One of the proposed grade control structures will be placed at HEC-RAS River Station 1804, and the other proposed grade control structure will be placed between HEC-RAS River Stations 3190.5 and 3305. Both grade control structures will be constructed of riprap, and the top of the structures will be set at the existing grade. The structures will be buried deep enough to prevent peak flows from undermining the structure.

7.4 Rock Chute and Stilling Basin Design

At the upstream termination/junction point of the proposed soil cement bank protection and the existing concrete slope bank protection, a rock chute and stilling basin are required to convey flow over the roughly 20-foot drop, to dissipate the energy and to provide erosion protection along the channel bottom. The crest of the rock chute is designed to tie in with the channel invert at the end of the existing concrete slope-lined channel (PD No. 2262) as indicated in the as-built drawings provided in **Appendix K**. The chute and stilling basin will be rock lined along the bottom with exposed soil cement along the side slopes. The chute will be designed with a 3:1 H:V slope along the invert and 1.5:1 H:V side slopes for the exposed soil cement. The bottom width of the channel is approximately 85 feet at the crest of the chute and approximately 50 feet at the toe of the chute. The stilling basin will be level along the invert and will extend approximately 100 feet downstream. The end of the stilling basin will have a 2.5:1 H:V slope to tie in with the invert of the channel, and the end sill will extend roughly ten feet downstream. From this point, a cut-off will be provided that will extend down to the toe of soil cement elevation at a 2:1 H:V slope. Details for the chute and stilling basin design are illustrated on **Figure 9**.

7.4.1 Rock Sizing

The required size of rock will be determined using equation 9 of *Design of Rock Chutes* (Robinson, 1998). Based on this report, the median rock size (D_{50}) for rock chutes is a function of the slope and unit flow rate. Because the equation is set up for metric units, conversion factors have been applied for imperial units. The equation to calculate D_{50} follows as:

$$D_{50} = 0.039\left[\frac{0.0929 \cdot q}{(8.07 \times 10^{-6}) \times S_0^{-0.58}}\right]^{\frac{1}{1.89}}$$

For $0.10 \leq S_0 \leq 0.40$

where,

D_{50} = particle size for which 50% of sample is finer (in)

q = Q/B = unit discharge (cfs/ft)

Q = 100-yr flow rate (cfs)

B = A/d = bottom width (ft)

A = cross-sectional area of flow (ft^2)

d = hydraulic depth (ft)

S_0 = decimal slope (dimensionless)

Using the hydraulic output from the HEC-RAS model for a Manning's roughness value of 0.025 and Q_{100} flow rate, the D_{50} calculated is approximately 48 inches. The actual rock size is increased to 54 inches, which corresponds to 4-Ton rock in accordance with the rock size table shown on Table F-32 of the Los Angeles County Hydraulics Manual.

7.5 Modifications to the Existing Flow Diversion Berm

As previously mentioned in **Section 3.1,** a portion of the existing concrete and riprap lined berm (see Linings B and C on PD 2298, Unit III) located at the Castaic Creek and Hasley Canyon Creek confluence will be modified to allow flow to be conveyed through a larger opening of the Commerce Center Drive Bridge and minimize the amount of sediment buildup at the western portion of the bridge. **Figures 6 and 7** depict the portion of the flow diversion berm that is to be removed.

According to the as-built drawings, the existing flow diversion berm is approximately 500 feet in length and is 16-feet-wide as measured along the top of the berm. The berm consists of two linings. Lining B is a concrete lining that was installed along the Hasley Canyon Creek side of the berm. Lining C is comprised of mostly rip-rap and was placed along the side of the berm facing Castaic Creek. The as-built drawings (PD 2298, Unit III) for the flow diversion berm are provided in **Appendix K.** It should be noted that the elevations shown on PD 2298, Unit III are referenced to the NGVD 1929. A datum shift of +2.638 feet should be applied to convert NGVD 1929 elevations to NAVD 1988 elevations.

A portion of the upstream end of this existing flow diversion berm will be removed such that the modified flow diversion berm will be 150 feet in length upstream of Commerce Center Drive Bridge. Rip-rap will be placed at the upstream end of the berm. The portion of the flow diversion berm above the estimated scour elevations will be removed. **Figure 10** shows how the flow diversion berm will be modified.

8 Existing and Proposed Floodplain Mapping

8.1 Los Angeles County ML Floodplain Mapping

LACDPW has mapped the existing floodplain for the Creek in the VCC Industrial Park Development project reach according to maps 388-ML-1 and 335-ML-1. Map No. 388-ML-1 was adopted by the Board of Supervisors in November 1980 by Ordinance No. 12260. In addition, Map No. 335-ML-1 was adopted by the Board of Supervisors in August 1984 by Ordinance No. 84-0136. Upon completion of the project, Los Angeles County Capital Floodway Map No. 388-ML-1 and No. 335-ML-1 will be revised to reflect the current Lower Hasley Canyon Creek bank alignment. PACE will prepare a ML revision analysis (DCR Volume IV of V).

8.2 FEMA CLOMR Floodplain Mapping

Currently, the VCC Industrial Park Development project site is located under Zone A on FIRM Community No. 065043-0800F and Zone A/AO on FIRM Community No. 065043-0805F. PACE will prepare a Conditional Letter of Map Revision (CLOMR) for this project (DCR Volume V of V). In addition, a FEMA Letter of Map Revision (LOMR) will be prepared following the completion of the project bank protection construction.

9 Planning and Environmental Issues

The major environmental and planning issues impacting the proposed bank protection are the presence of aquatic resources subject to state and federal regulation. At a few locations, the proposed limit of construction disturbance encroaches upon areas delineated as waters of the United States and/or waters of the State. No discharge of dredged or fill material, or activities that may substantially divert, change, or obstruct the natural flow of the stream channel, may occur within these jurisdictional limits without prior approval from the United States Army Corps of Engineers (ACOE), California Department of Fish and Wildlife (CDFW) and/or the Regional Water Quality Control Board (RWQCB). Required approvals may include a Clean Water Act (CWA) Section 404 Permit from the ACOE, CWA Section 401 water quality certification and/or waste discharge requirements from the RWQCB, and a Fish and Game Code Section 1602 streambed alteration agreement from the CDFW. In addition, any potential impacts to species listed under the California Endangered Species Act (CESA) or Federal ESA, or their designated critical habitat, associated with these activities may require additional agency review by CDFW and/or the U.S. Fish and Wildlife Service to ensure compliance with the CESA and the ESA. The project proponent will submit applications to the relevant regulatory agencies to obtain the necessary approvals prior to commencing work within jurisdictional areas.

Jurisdictional areas impacted by project construction will be revegetated with native plant species. The excavation required to construct the bank protection will be backfilled to facilitate revegetation. For the majority of the reach, the upper portion of the bank protection above the Creek invert will be backfilled at a slope of 3:1 (H:V) or flatter. At the location of the tie-in with the existing concrete slope protection, the top portion of the bank protection above the creek invert will be left exposed. However, the banks will blend in with native material, since 90% of soil cement bank is composed of native soils.

Following the completion of project construction, LADPW will require periodic access into the channel along the lateral edges for flood control maintenance purposes. A General Maintenance Plan (GMP) for Castaic Creek and Hasley Canyon, dated March 2002 and approved by LACDPW in April 2002, was reviewed and adopted by ACOE and CDFW as part of other development activities on Castaic Creek and the Hasley Creek within the Valencia Commerce Center development. The GMP defines the allowable routine channel maintenance and repair activities within the creek. The GMP is included in **Appendix I**.

10 Conclusion

The purpose of this drainage concept report is to present the results of the hydraulic analysis in order to provide design guidelines for the proposed bank protection measures and to evaluate potential floodplain impacts caused by the project. The analysis evaluates (1) fluvial modifications of the riverbed from the Capital Flood event and (2) changes in the floodplain fluvial mechanics over the long-term. The proposed bank protection design adheres to LACDPW requirements, as specified in the LACDPW Hydraulic Design Manual and the LACDPW Sedimentation Manual.

Currently, the VCC Industrial Park Development project site is located under Zone A on FIRM Community No. 065043-0800F and A/AO on FIRM Community No. 065043-0805F. PACE will provide FivePoint with a Conditional Letter of Map Revision (CLOMR) application to revise the FIRM to reflect the proposed condition. Upon completion of the project, a Letter of Map Revision (LOMR) application will be submitted to FEMA, requesting that the FIRM be revised to reflect the proposed condition. In the area of the proposed Lower Hasley Canyon Creek bank protection, Los Angeles County Capital floodway maps for the Creek were adopted by the Board of Supervisors by Ordinance No. 12260 (November 1980) and by Ordinance No. 84-0136 (August 1984). A ML revision analysis (DCR Volume IV of V) of Los Angeles County Capital Floodway Map No. 388-ML-1 and No. 335-ML-1 will be prepared prior to plan approval/construction of the project. After construction of the project is complete, Los Angeles County Capital Floodway Map No. 388-ML-1 and No. 335-ML-1s will be officially revised.

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"Suggested Specifications for Soil-Cement Slope Protection for Embankments" (Central-Plant-Mixing Method), IS052.03W, Portland Cement Association, 1976.

Ven Te Chow, Open Channel Hydraulics, McGraw-Hill, Inc., 1959.

LEGEND

- L.A. COUNTY FLOODPLAIN (Q_{CAP} =12,300 CFS, n=0.06) (ADOPTED BY BOARD OF SUPERVISORS ON AUG. 28 1984 ORDINANCE NO. 84-0136 MAP NO.'s 335 ML-1&2)
- FEMA 100-YEAR FLOODPLAIN (EFFECTIVE JUNE 2, 2021) FIRM PANELS 0805G, 0815G
- REVISED EXISTING CONDITION QCAP FLOODPLAIN (Q_{DESIGN} =9,480 CFS, n=0.060)

PARCEL MAP No. 20839

FRANKLIN PARKWAY

LIVINGSTON AVE

HARRISON PARKWAY

PROPERTY BOUNDARY

LIMITS OF STUDY

CASTAIC CREEK
Q_{CAP} = 31,400 cfs
Q_{100} = 18,805 cfs
FLOW

STA 6+78

EXISTING CASTAIC CREEK SOIL CEMENT BANK PROTECTION PER P.D. NO. 2563

STA 9+81

COMMERCE CENTER DRIVE

STA 10+61

STA 10+80

STA 11+89

STA 12+94

EXISTING HASLEY CREEK CONCRETE/RIPRAP LINING (PER P.D. 2298 UNIT III)

STA 14+48

STA 15+18

TENTATIVE
PARCEL MAP No. 18108
(GRADING PLAN BY OTHERS)

HASLEY CREEK
Q_{DESIGN} = 9,480 cfs
Q_{100} = 7,000 cfs
FLOW

CASTAIC CREEK
Q_{CAP} = 31,400 cfs
Q_{100} = 18,805 cfs
FLOW

STA 15+84
STA 16+88
STA 18+04
STA 18+72
STA 19+40
STA 20+54
STA 21+22
STA 21+90
STA 23+05
STA 23+91
STA 24+76
STA 25+60
STA 26+75
STA 27+48
STA 28+20
STA 29+24
STA 30+20
STA 31+05
STA 31+90
STA 33+04
STA 33+72
STA 34+40
STA 35+54
STA 36+50
STA 37+47
STA 38+44
STA 39+40
STA 40+55
STA 40+78
STA 41+00
STA 41+95
STA 43+00
STA 43+98
STA 45+23
STA 46+22
STA 47+25

EXISTING CONCRETE SLOPE LINING PER P.D. 2262

LIMITS OF STUDY

TENTATIVE
PARCEL MAP No. 18108
(GRADING PLAN BY OTHERS)

100 0 100 200
SCALE 1"=100'

PLAN

NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK
SOIL CEMENT BANK PROTECTION
TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
P: (714) 481-7300 | www.pacewater.com

PREPARED	JOSE CRUZ
PROJECT ENGINEER R.C.E. NO.	72249
EXP.	06/30/2022
DRAWN	BDP
SCALE	AS SHOWN
DESIGNED	JC
CHECKED	MEK
DATE	7/13/2021

REGISTERED PROFESSIONAL ENGINEER JOSE CRUZ No. 72249 Exp. 06-30-22 CIVIL STATE OF CALIFORNIA

TITLE

EXISTING CONDITION FLOODPLAIN MAPPING

EIMP. 2019000489

FIGURE 05

JOB NO. A535

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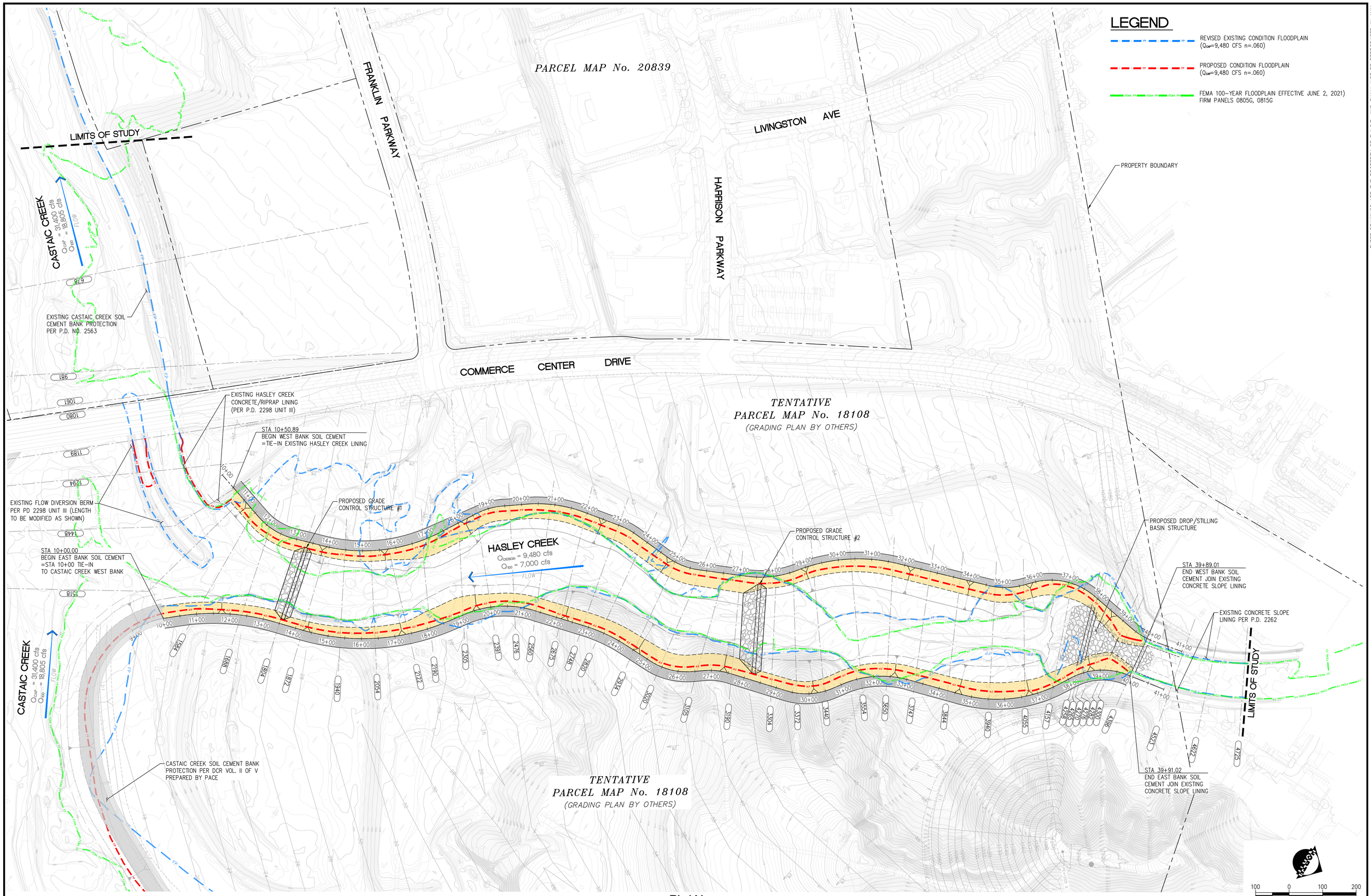

PLAN

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P:\A535\Engineering\Global\Exhibits\A535-32 DCR REVISED EXHIBITS\A535-32-Figure-06.dwg — Tab: Layout By: bphan on Jul 13, 2021 at 10:30 am

NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK

SOIL CEMENT BANK PROTECTION

TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

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EXP.	06/30/2022
DRAWN	BDP
SCALE	AS SHOWN
DESIGNED	JC
CHECKED	MEK
DATE	7/13/2021

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TITLE

PROPOSED CONDITION FLOODPLAIN MAPPING

EIMP. 20190000489

FIGURE 06

JOB NO. A535

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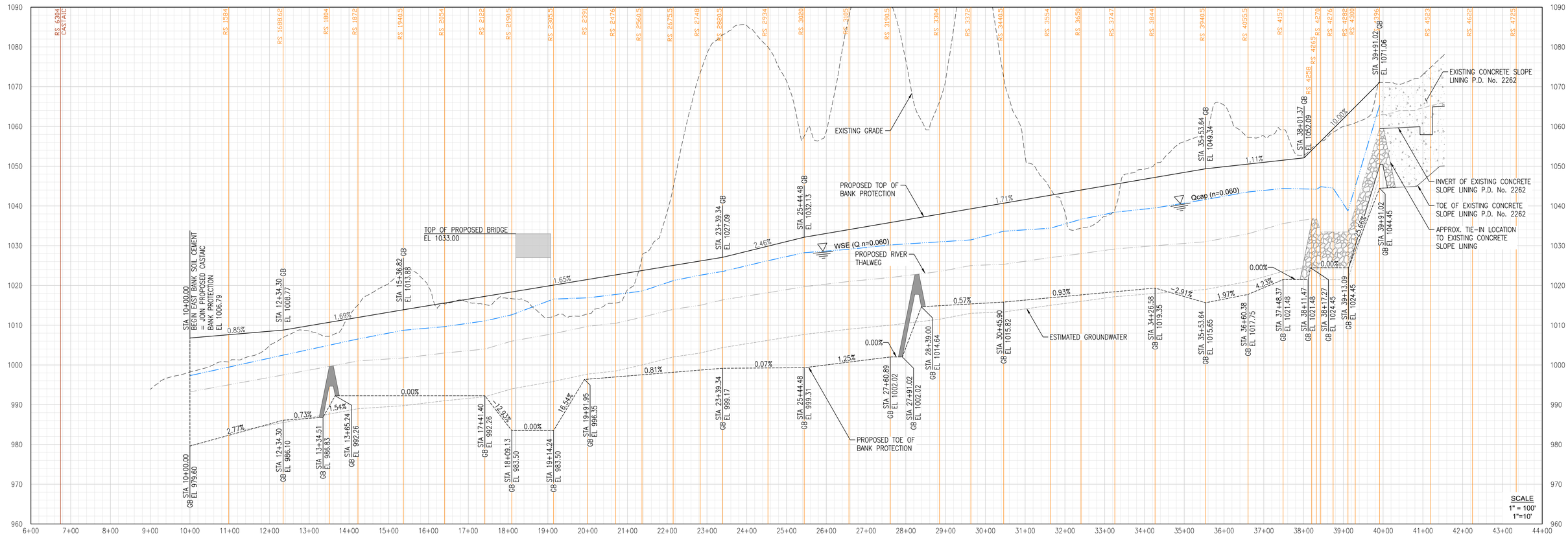
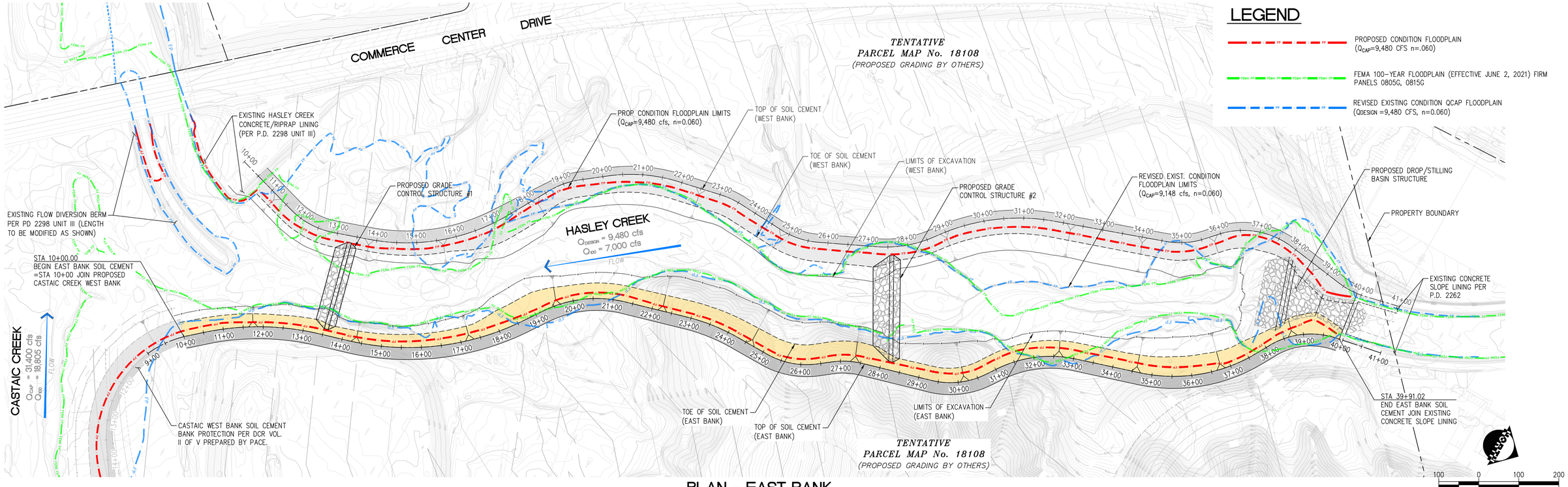


PROFILE - EAST BANK



PLAN - EAST BANK

NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK
SOIL CEMENT BANK PROTECTION
TPM. #18108 DCR VOL. III OF V

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PROJECT ENGINEER R.C.E. No.	72249
EXP.	06/30/2022
DRAWN	BDP
SCALE	AS SHOWN
DESIGNED	JC
CHECKED	MEK
DATE	7/13/2021

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TITLE

EAST BANK PROTECTION PLAN AND PROFILE

EIMP. 20190000489

FIGURE 07

JOB NO. A535

P:\A535\Engineering\Global\Exhibits\A535-32 DCR REVISED EXHIBITS\A535-32-Figure-07.dwg - Tab: Layout By: bphan on Jul 13, 2021 at 10:38 am

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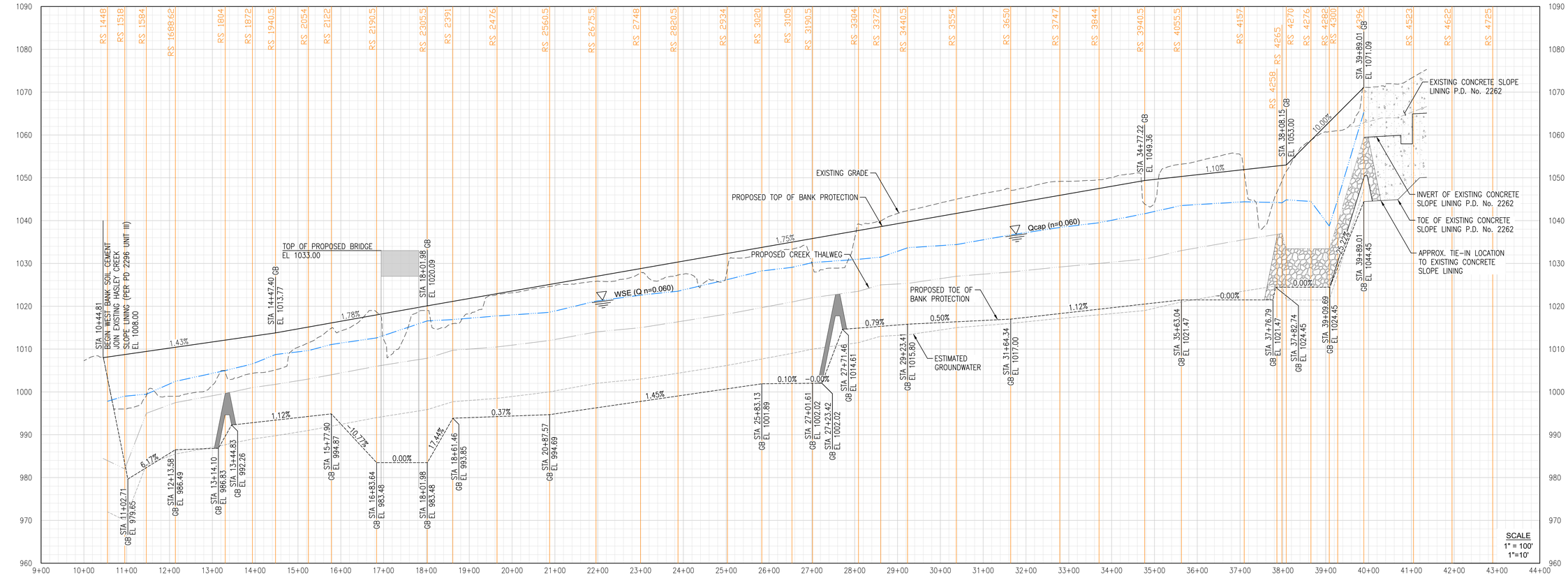
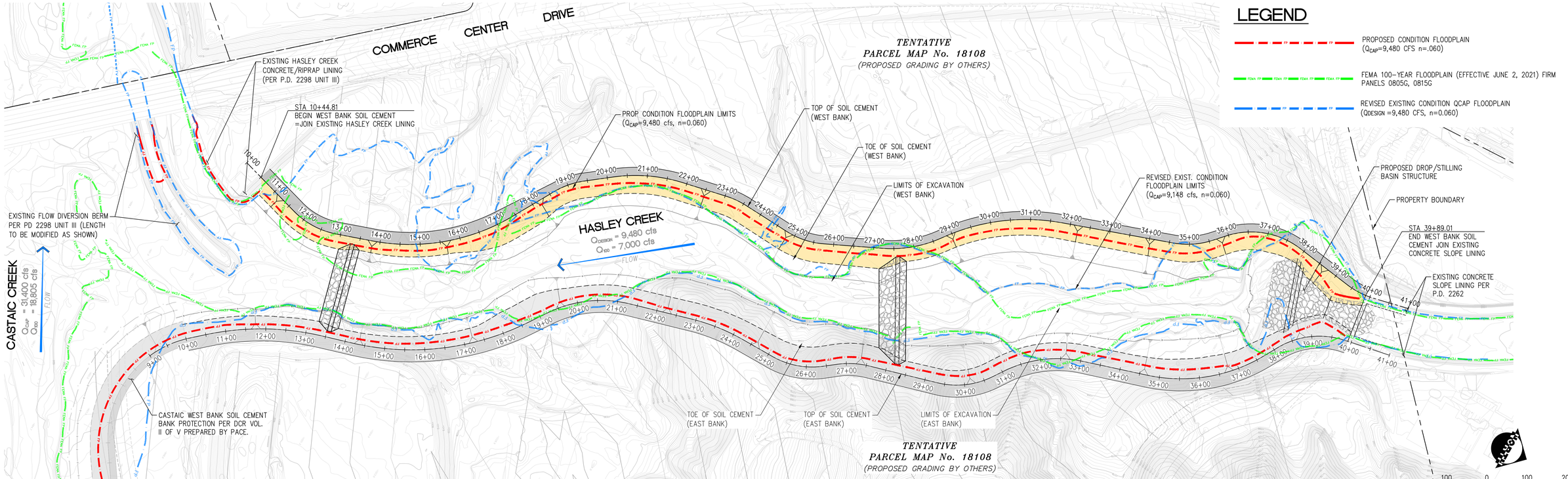


PROFILE - WEST BANK



PLAN - WEST BANK

NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK

SOIL CEMENT BANK PROTECTION

TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

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PREPARED JOSE CRUZ
PROJECT ENGINEER
R.C.E. No. 72249
EXP. 06/30/2022
DRAWN BDP | SCALE AS SHOWN
DESIGNED JC
CHECKED MEK | DATE 7/13/2021

REGISTERED PROFESSIONAL ENGINEER JOSE CRUZ No. 72249 Exp. 06-30-22 CIVIL STATE OF CALIFORNIA

TITLE

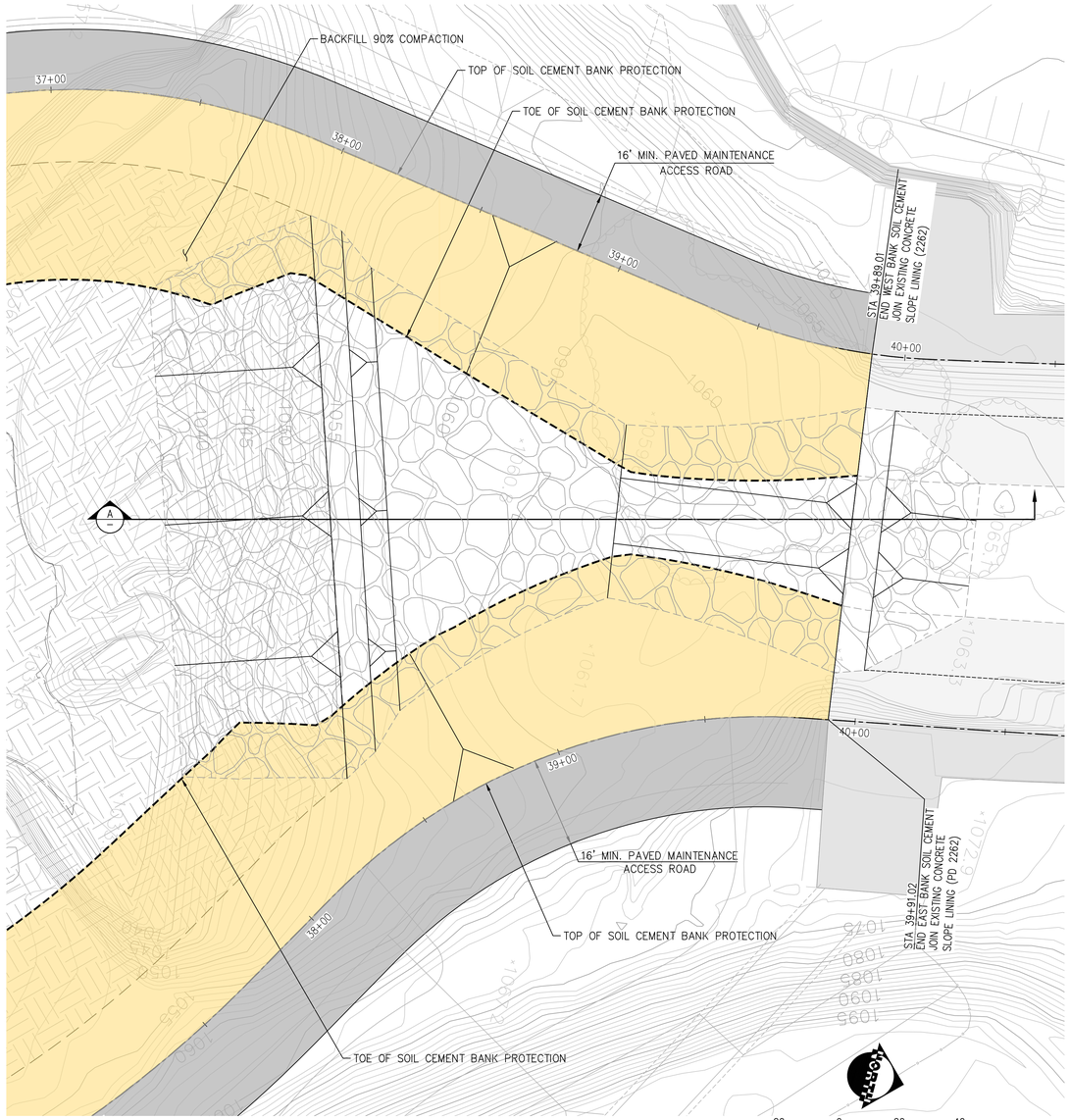
WEST BANK PROTECTION PLAN AND PROFILE

EIMP. 20190000489

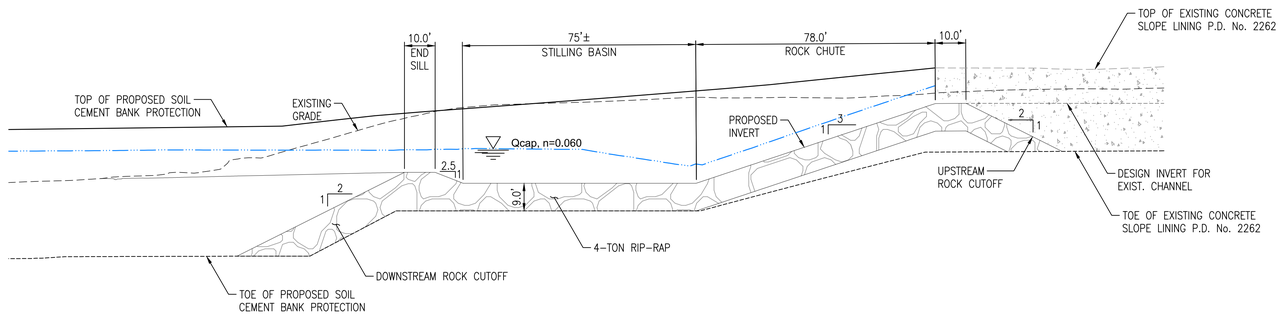
FIGURE 08

JOB NO. A535

P:\A535\Engineering\Global\Exhibits\A535-32 DCR REVISED EXHIBITS\A535-32-Figure-08.dwg - Tab: Layout By: bphan on Jul 13, 2021 at 10:42 am



TYPICAL DROP STRUCTURE PLAN



DROP STRUCTURE SECTION 'A'

SCALE 1"=20'

NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK

SOIL CEMENT BANK PROTECTION

TPM. #18108 DCR VOL. III OF V

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PROJECT ENGINEER R.C.E. No.	72249
EXP.	06/30/2022
DRAWN	BDF
SCALE	AS SHOWN
DESIGNED	JC
CHECKED	MEK
DATE	7/13/2021

REGISTERED PROFESSIONAL ENGINEER JOSE CRUZ No. 72249 Exp. 06-30-22 CIVIL STATE OF CALIFORNIA

TITLE

SOIL CEMENT DROP STRUCTURE/STILLING BASIN DETAILS

EIMP. 20190000489

FIGURE 09

JOB NO. A535

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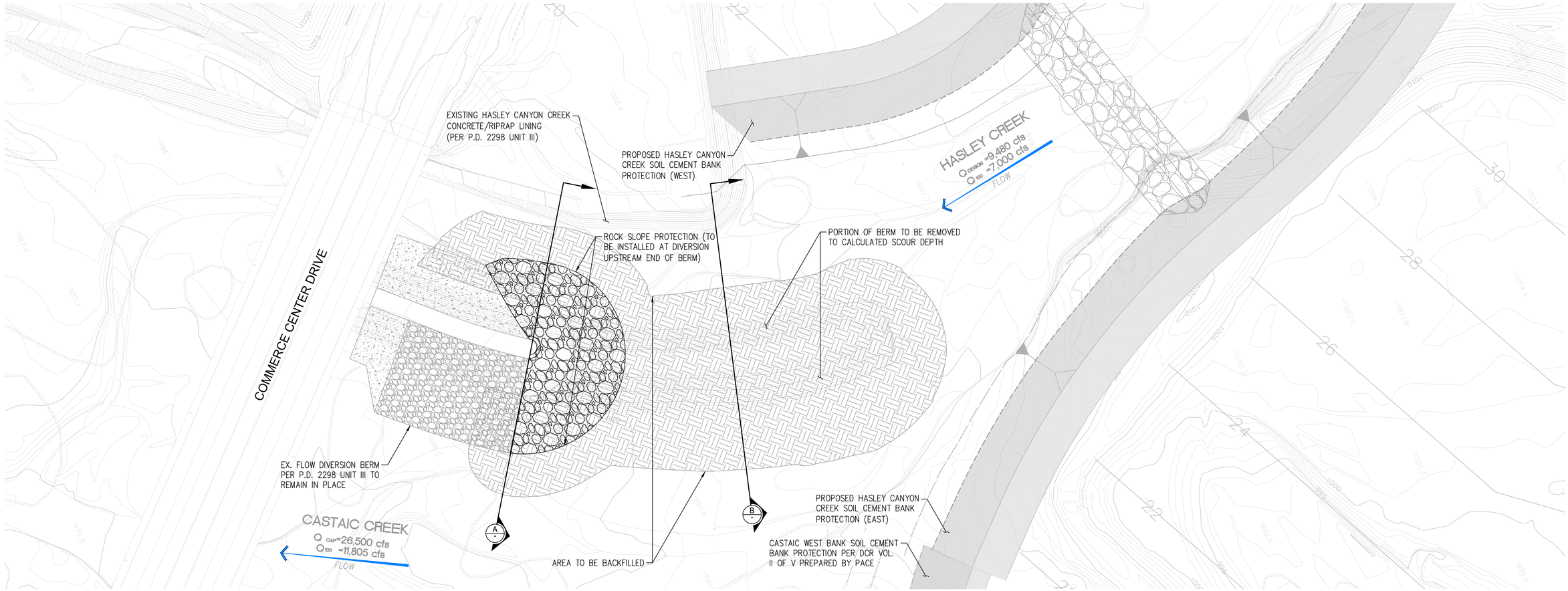
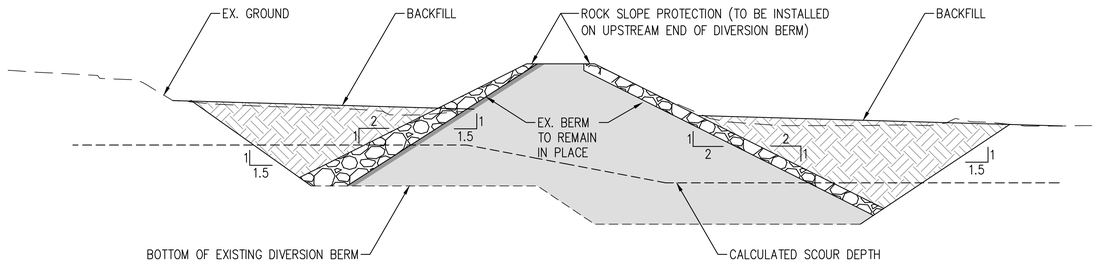


PLAN - MODIFIED DIVERSION BERM

NORTH

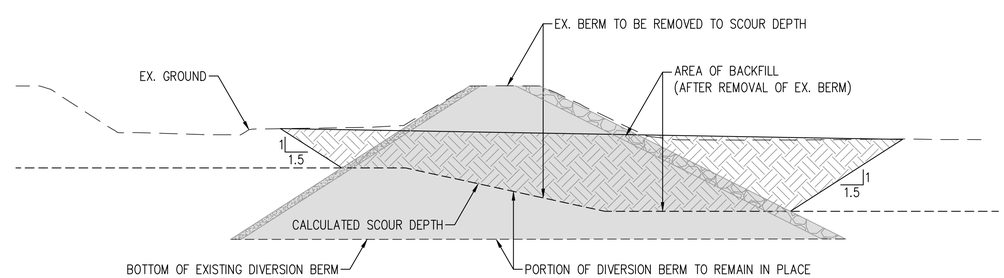
40 0 40 80

SCALE 1"=40'



SECTION A - PORTION OF DIVERSION BERM TO REMAIN

SCALE 1"=20'



SECTION B - PORTION OF DIVERSION BERM TO MODIFY

SCALE 1"=20'

NO	BY	DATE		DATE	APP.
1					
2					
3					
4					
5					

JOB

HASLEY CREEK

SOIL CEMENT BANK PROTECTION

TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

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R.C.E. NO.	72249
EXP.	06/30/2022
DRAWN	BDP
SCALE	AS SHOWN
DESIGNED	JC
CHECKED	MEK
DATE	9/30/2021

REGISTERED PROFESSIONAL ENGINEER
JOSE CRUZ
No. 72249
Exp. 06-30-22
CIVIL
STATE OF CALIFORNIA

TITLE

MODIFICATION OF DIVERSION BERM

EIMP. 2019000489

FIGURE

10

JOB NO. A535

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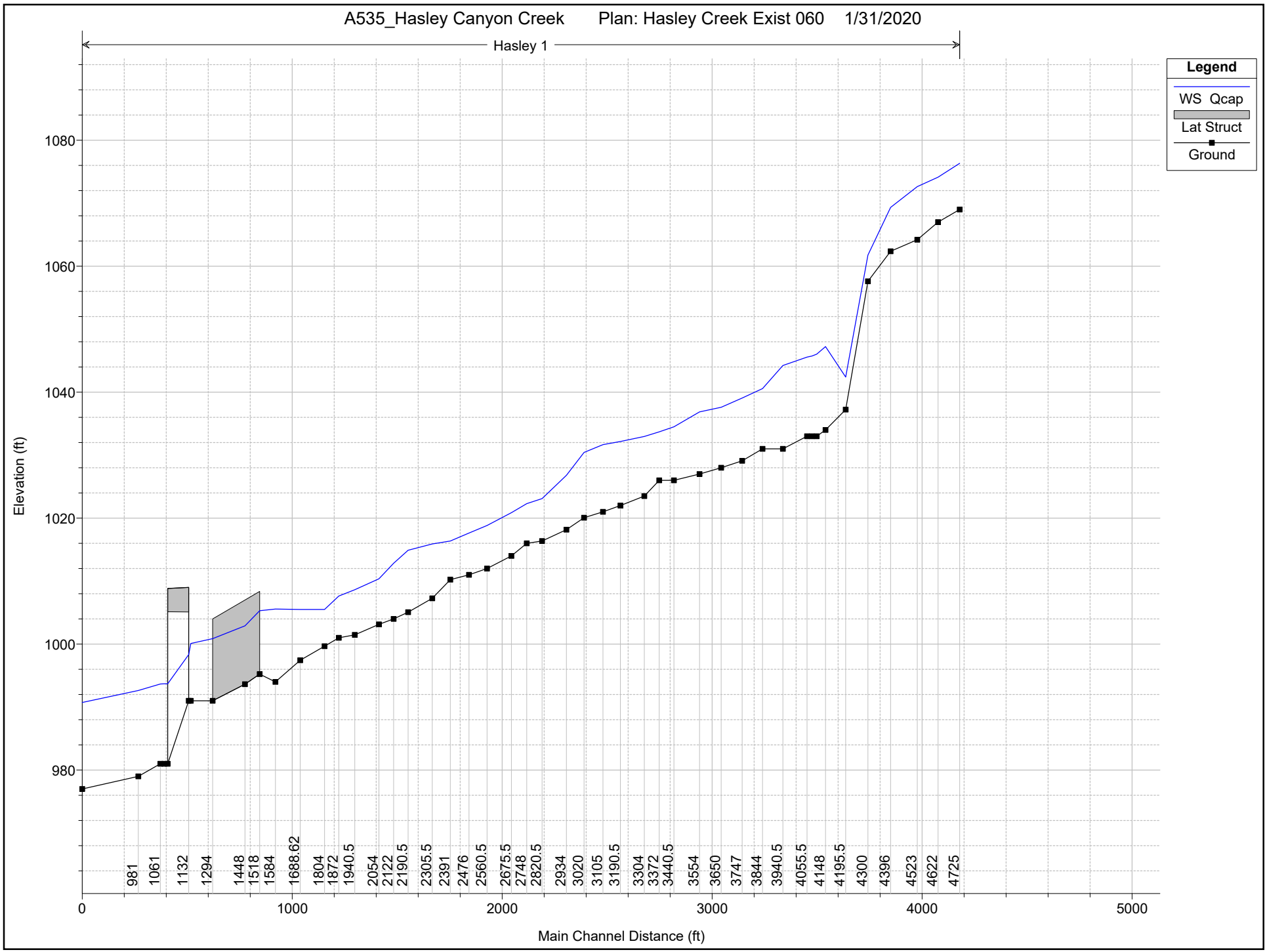
Appendix A: Existing Condition (n = 0.060) HEC-RAS Model Results

Appendix A- Existing Condition HEC-RAS Model Results (n=0.060)

Water Surface Profile



1 in Horiz. = 600 ft 1 in Vert. = 20 ft

Appendix A- Existing Condition HEC-RAS Model Results (n=0.060)

Output Summary Table

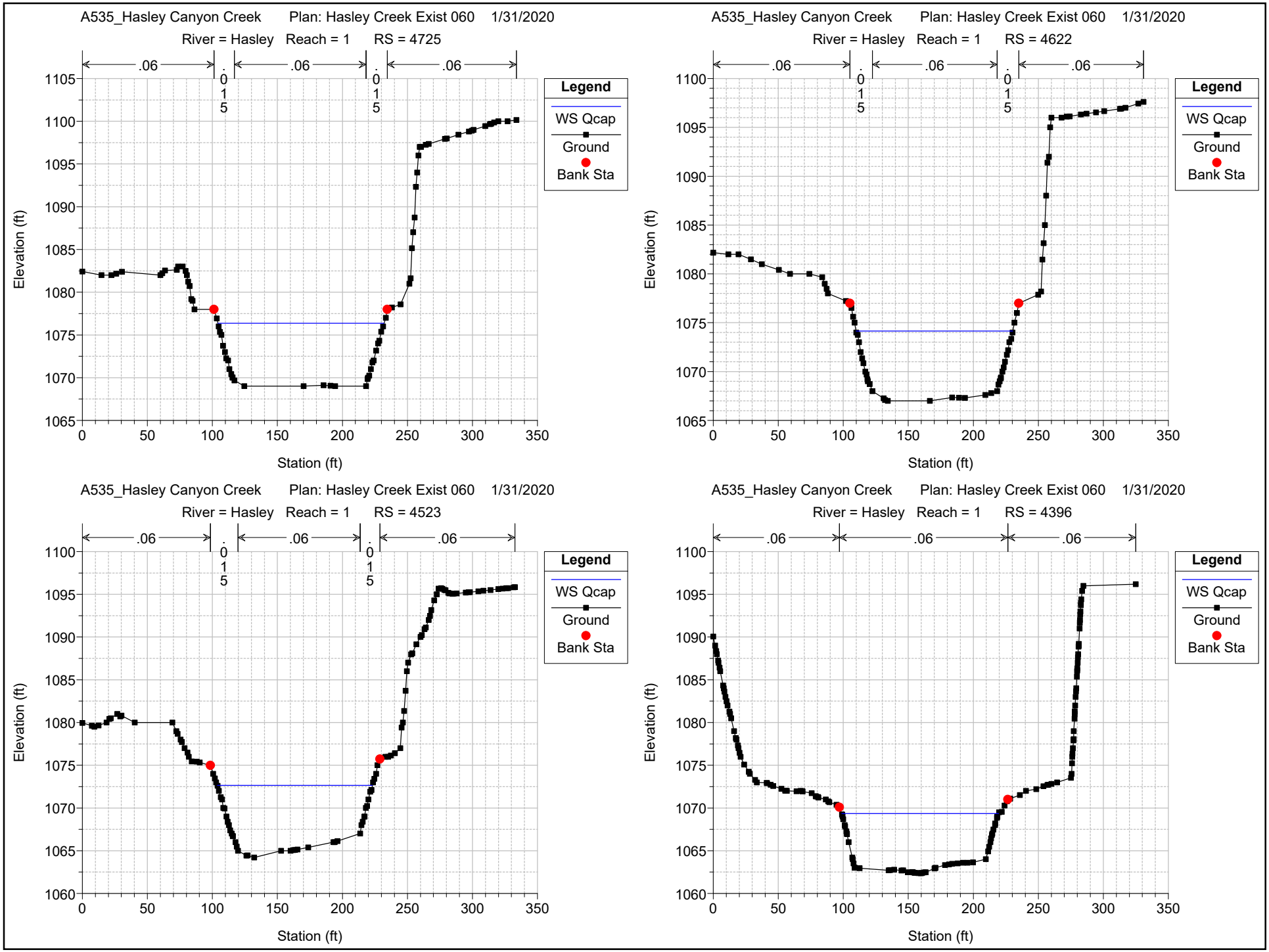
PACE

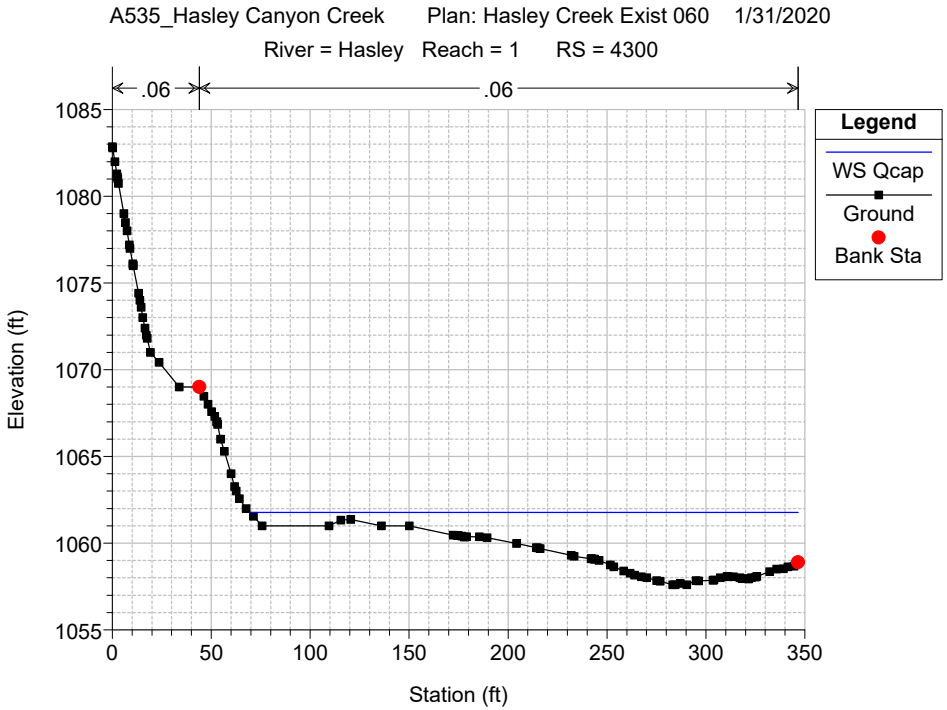
HEC-RAS Plan: Exist_060 River: Hasley Reach: 1 Profile: Qcap

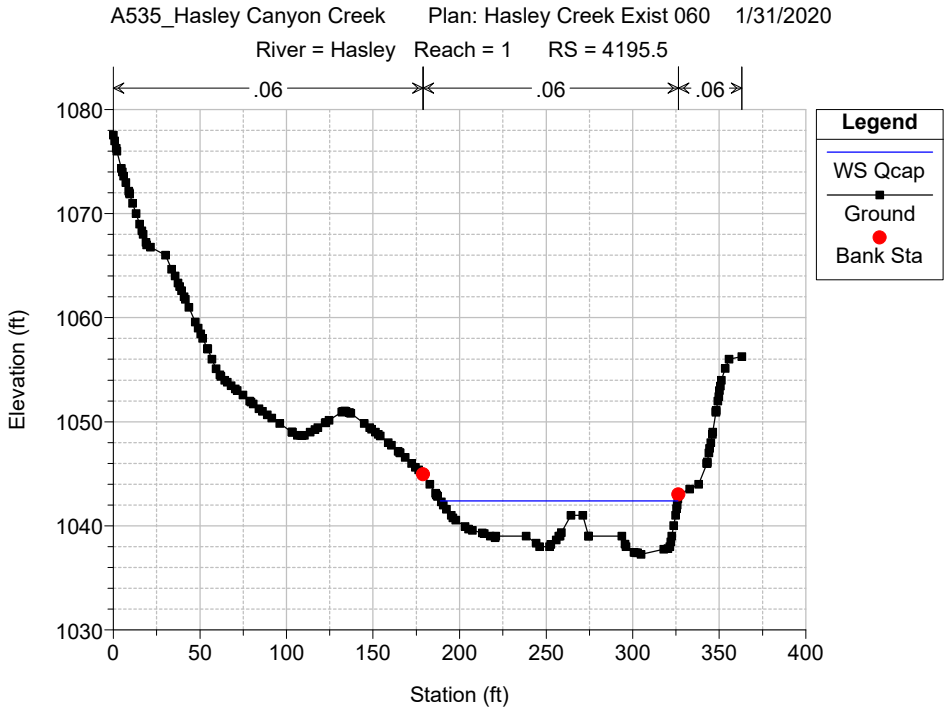
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	4725	Qcap	9480.00	1069.00	1076.35	1075.27	1078.35	0.013121	11.32	837.45	127.70	0.78
1	4622	Qcap	9480.00	1067.00	1074.16	1073.74	1076.70	0.018335	12.80	740.74	120.54	0.91
1	4523	Qcap	9480.00	1064.20	1072.66	1071.89	1074.97	0.015337	12.22	775.98	119.27	0.84
1	4396	Qcap	9480.00	1062.36	1069.36	1069.36	1072.25	0.030532	13.65	694.69	120.73	1.00
1	4300	Qcap	9480.00	1057.60	1061.78	1062.97	1065.80	0.156362	16.08	589.56	277.16	1.94
1	4195.5	Qcap	9480.00	1037.25	1042.40	1044.48	1049.22	0.150655	20.96	452.23	137.03	2.03
1	4148	Qcap	9480.00	1034.00	1047.25	1040.11	1047.47	0.001079	3.75	2525.44	243.76	0.21
1	4100.5	Qcap	9480.00	1033.00	1046.04	1042.72	1047.27	0.008627	8.87	1068.47	133.26	0.55
1	4078	Qcap	9480.00	1033.00	1045.75	1042.95	1047.05	0.010009	9.13	1038.43	138.71	0.59
1	4055.5	Qcap	9480.00	1033.00	1045.59	1042.54	1046.79	0.009844	8.81	1075.48	150.13	0.58
1	3940.5	Qcap	9480.00	1031.00	1044.23	1042.67	1045.46	0.013626	8.91	1064.35	187.35	0.66
1	3844	Qcap	9480.00	1031.00	1040.59	1040.59	1043.40	0.031100	13.45	704.71	125.37	1.00
1	3747	Qcap	9480.00	1029.11	1039.06	1038.19	1040.57	0.018785	9.86	961.39	189.55	0.77
1	3650	Qcap	9480.00	1028.00	1037.61	1036.35	1038.85	0.014464	8.93	1061.52	198.45	0.68
1	3554	Qcap	9480.00	1027.00	1036.89	1034.09	1037.74	0.006878	7.38	1284.37	179.44	0.49
1	3440.5	Qcap	9480.00	1026.00	1034.51	1033.54	1036.35	0.018496	10.89	870.27	143.95	0.78
1	3372	Qcap	9480.00	1026.00	1033.71	1032.60	1034.99	0.015446	9.08	1044.19	201.78	0.70
1	3304	Qcap	9480.00	1023.50	1032.96	1031.44	1033.96	0.011744	8.03	1180.44	222.25	0.61
1	3190.5	Qcap	9480.00	1022.00	1032.18	1029.47	1032.91	0.006420	6.86	1382.58	211.39	0.47
1	3105	Qcap	9480.00	1021.00	1031.67	1028.58	1032.41	0.005811	6.88	1378.77	191.74	0.45
1	3020	Qcap	9480.00	1020.08	1030.44	1027.45	1031.69	0.009737	8.95	1059.06	143.57	0.58
1	2934	Qcap	9480.00	1018.19	1026.80	1026.80	1030.16	0.029736	14.70	644.78	95.24	1.00
1	2820.5	Qcap	9480.00	1016.37	1023.12	1023.45	1026.31	0.036388	14.32	662.16	121.04	1.08
1	2748	Qcap	9480.00	1016.00	1022.30	1021.77	1024.31	0.022923	11.38	832.74	154.48	0.86
1	2675.5	Qcap	9480.00	1014.00	1020.89	1020.33	1022.56	0.022239	10.37	914.20	190.41	0.83
1	2560.5	Qcap	9480.00	1012.00	1018.85	1018.14	1020.01	0.019298	8.63	1098.98	273.26	0.76
1	2476	Qcap	9480.00	1011.00	1017.66	1016.44	1018.59	0.013007	7.73	1226.23	268.02	0.64
1	2391	Qcap	9480.00	1010.23	1016.39	1015.28	1017.38	0.014247	7.98	1188.17	265.21	0.66
1	2305.5	Qcap	9480.00	1007.28	1015.91	1013.49	1016.48	0.006096	6.11	1551.95	272.75	0.45
1	2190.5	Qcap	9480.00	1005.06	1014.92	1011.68	1015.75	0.006295	7.30	1298.60	177.25	0.48
1	2122	Qcap	9480.00	1004.00	1012.86	1012.02	1014.88	0.023361	11.41	830.97	154.98	0.87
1	2054	Qcap	9480.00	1003.13	1010.36	1010.36	1012.95	0.030949	12.90	734.88	141.96	1.00
1	1940.5	Qcap	9480.00	1001.47	1008.63	1006.82	1009.25	0.007194	6.72	1531.06	302.21	0.49
1	1872	Qcap	9480.00	1001.00	1007.63	1006.53	1008.53	0.012284	8.15	1278.43	289.22	0.63
1	1804	Qcap	9480.00	999.69	1005.51	1005.51	1007.18	0.031684	10.94	927.43	261.24	0.96
1	1688.62	Qcap	9480.00	997.43	1005.52	1002.21	1005.90	0.003320	5.11	1944.88	326.62	0.34
1	1584	Qcap	9480.00	994.00	1005.59	999.20	1005.68	0.000553	2.44	3937.41	460.68	0.15
1	1518	Qcap	9480.00	995.24	1005.32	999.85	1005.60	0.001587	4.25	2232.48	253.33	0.25
1	1500		Lat Struct									
1	1448	Qcap	9480.00	993.63	1002.92	1001.77	1005.16	0.012124	12.00	789.84	109.46	0.79
1	1294	Qcap	9480.00	991.00	1000.88	999.79	1003.19	0.013528	12.20	777.33	108.48	0.80
1	1189	Qcap	9480.00	991.00	1000.11	998.03	1001.82	0.009637	10.49	903.62	112.61	0.65
1	1132		Bridge									
1	1080	Qcap	31400.00	981.01	993.71	989.27	994.40	0.003688	6.64	4726.36	530.68	0.39
1	1061	Qcap	31400.00	981.00	993.67	988.94	994.32	0.003296	6.50	4831.72	520.20	0.38
1	981	Qcap	31400.00	979.00	992.64	989.88	993.77	0.007775	8.52	3685.65	474.45	0.54
1	678	Qcap	31400.00	977.00	990.73	987.60	991.77	0.007007	8.19	3832.78	482.39	0.51

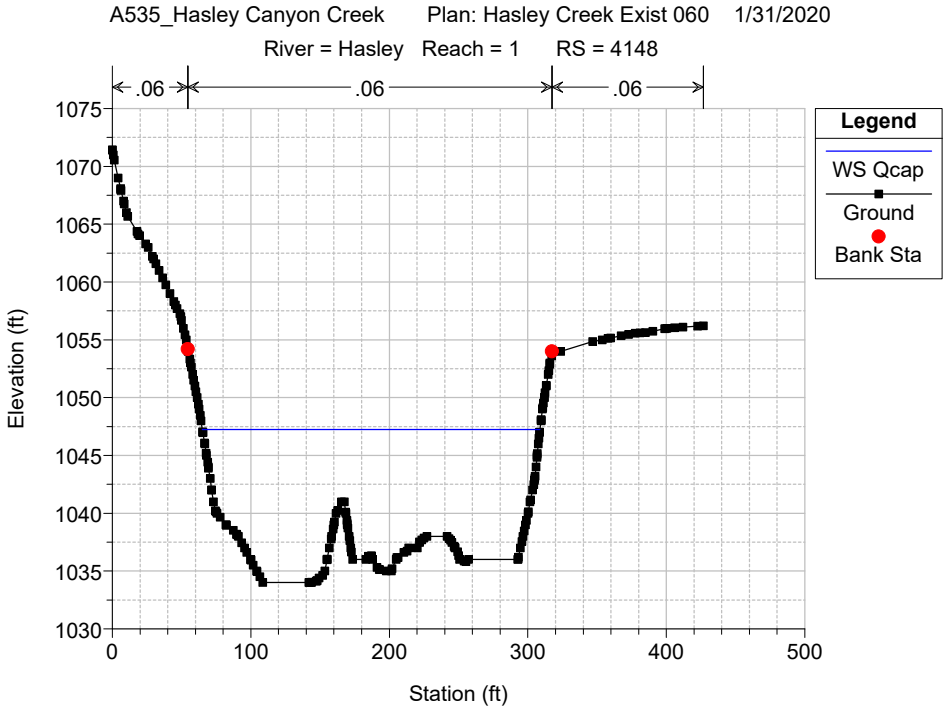
Appendix A- Existing Condition HEC-RAS Model Results (n=0.060)

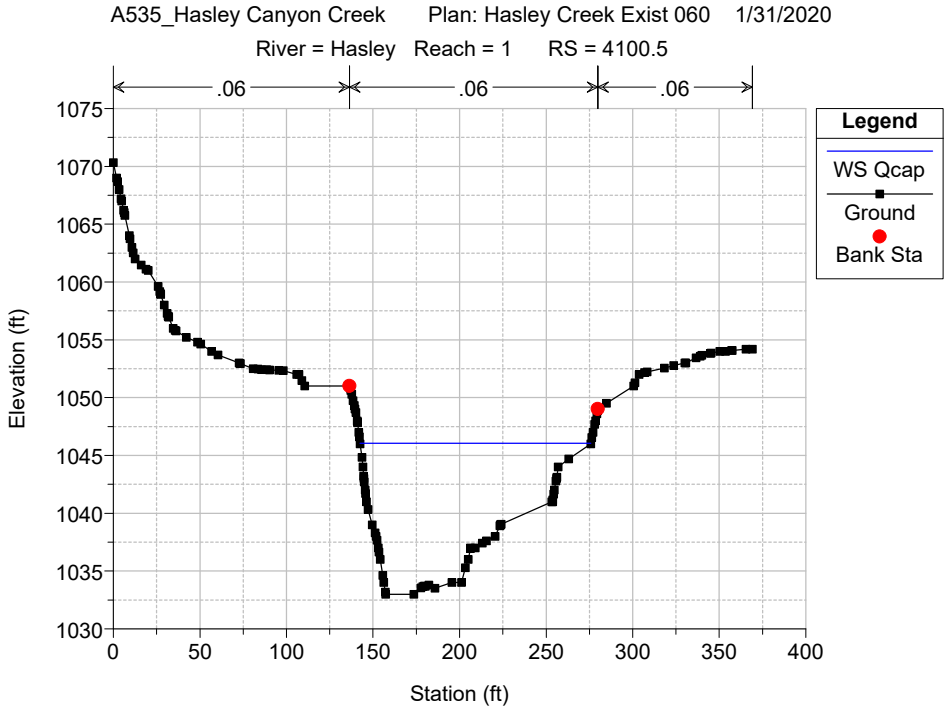
Cross Section Plots

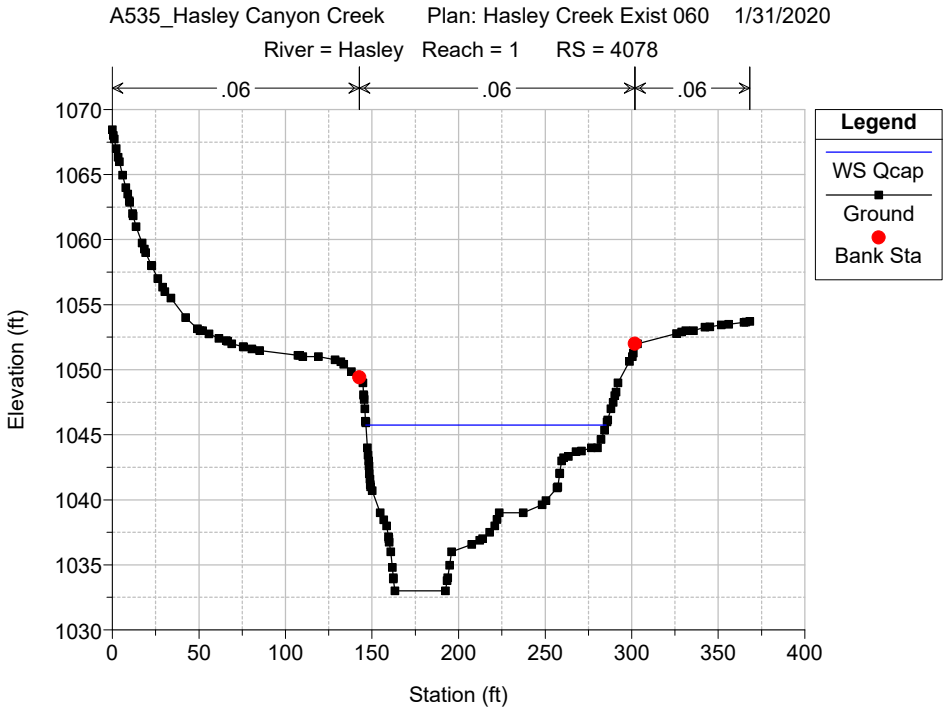

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4725
.06
.015
.06
.015
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4622
.06
.015
.06
.015
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4523
.06
.015
.06
.015
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4396
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

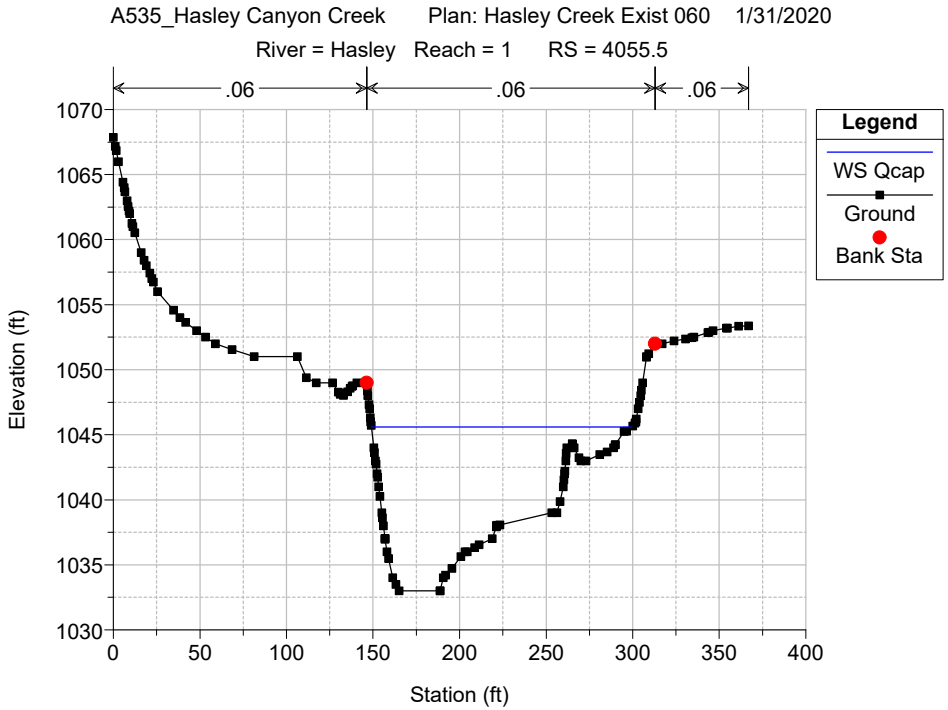

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4300
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4195.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4148
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4100.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4078
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1070
1065
1060
1055
1050
1045
1040
1035
1030
0
50
100
150
200
250
300
350
400


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 4055.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1070
1065
1060
1055
1050
1045
1040
1035
1030
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50
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200
250
300
350
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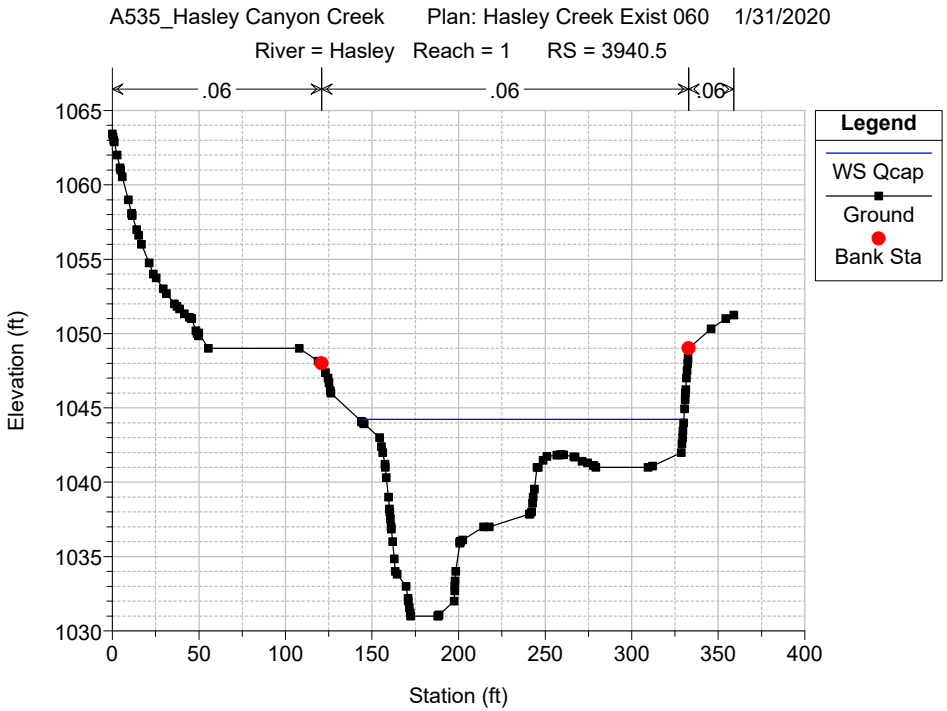
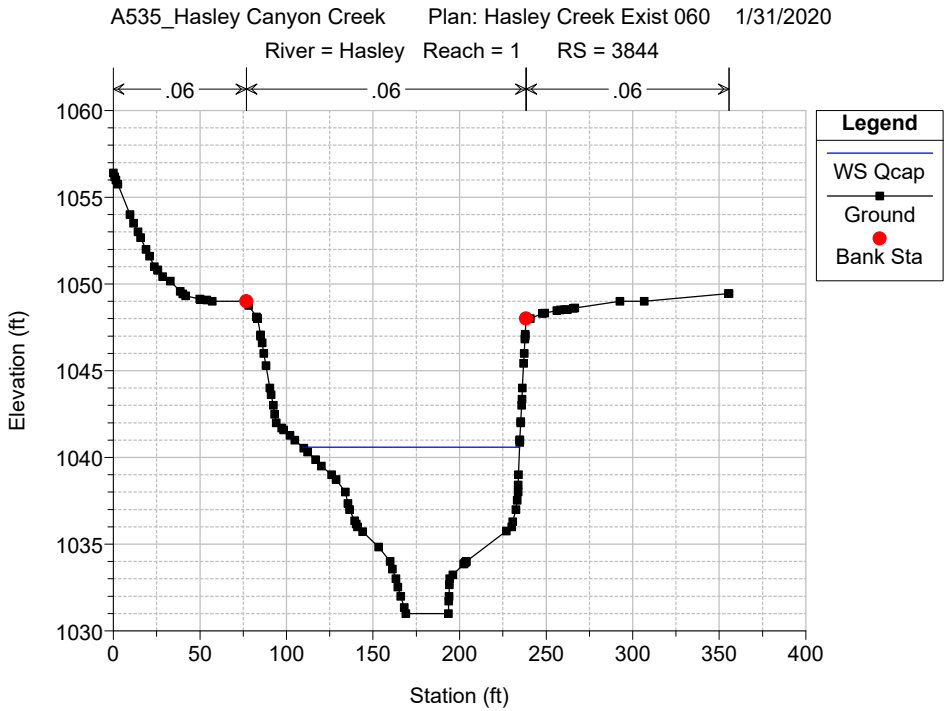
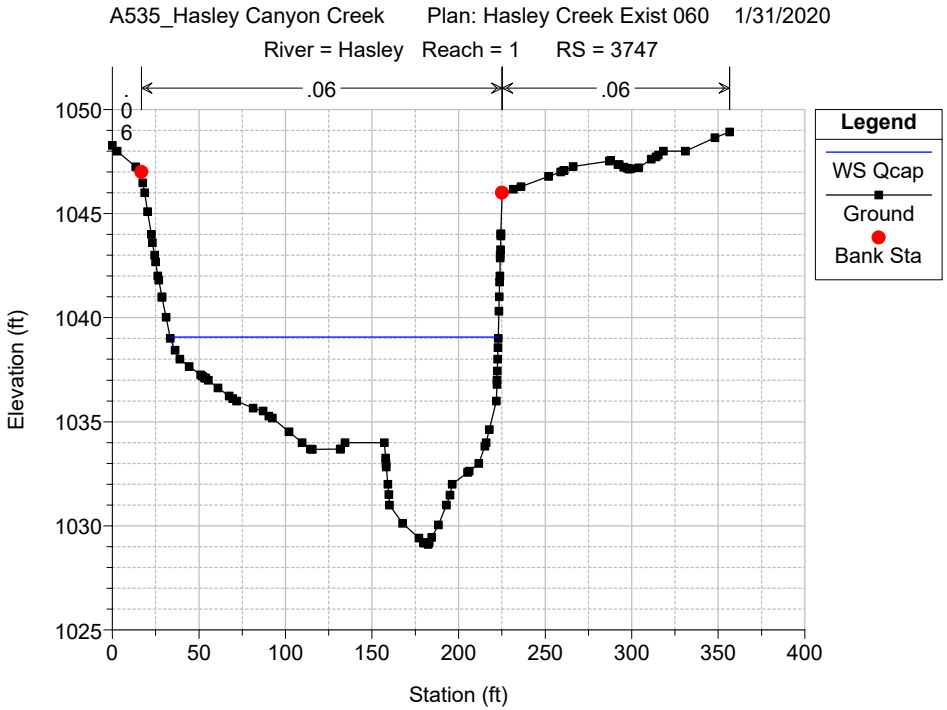
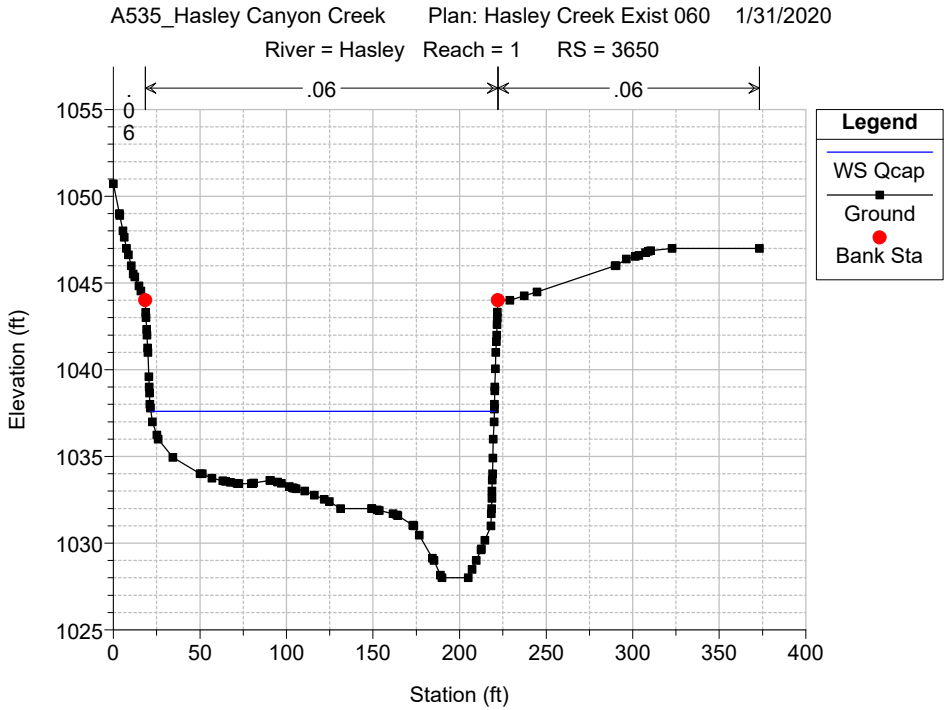
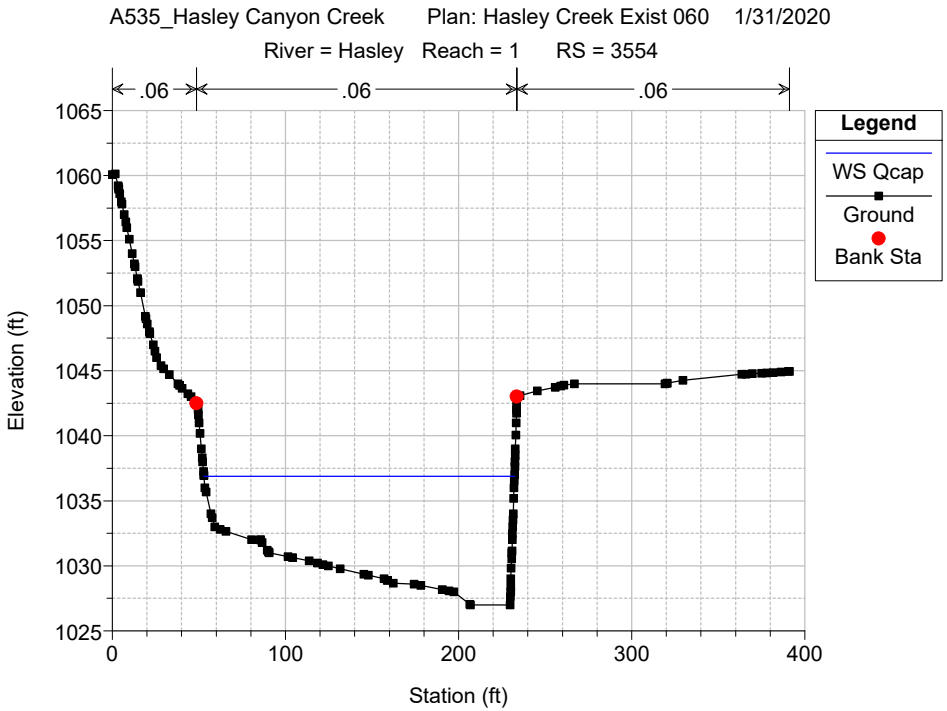
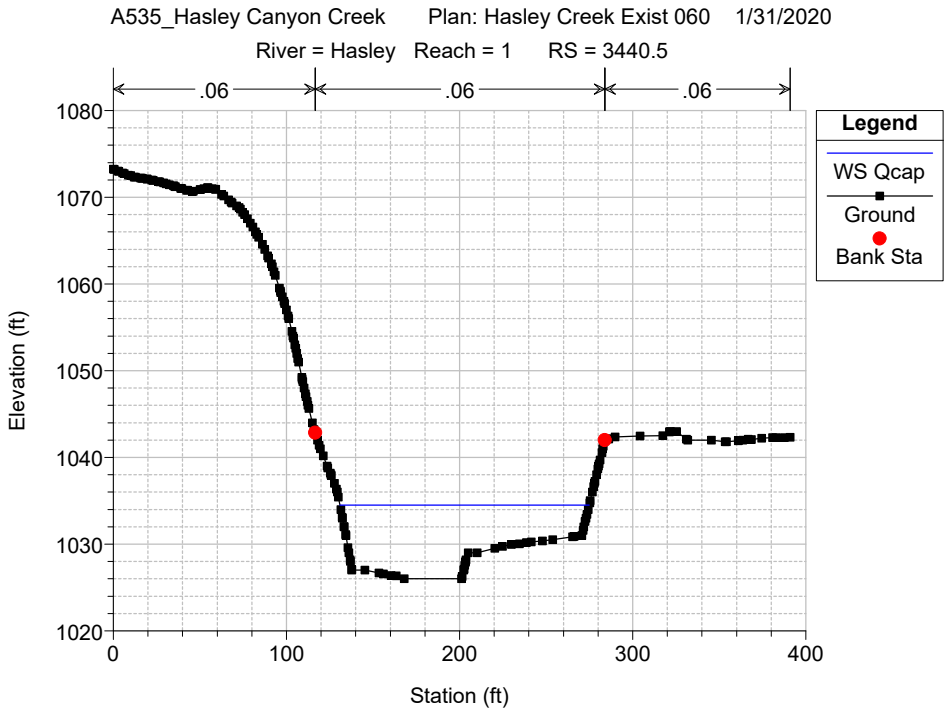

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3940.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1065
1060
1055
1050
1045
1040
1035
1030
0
50
100
150
200
250
300
350
400

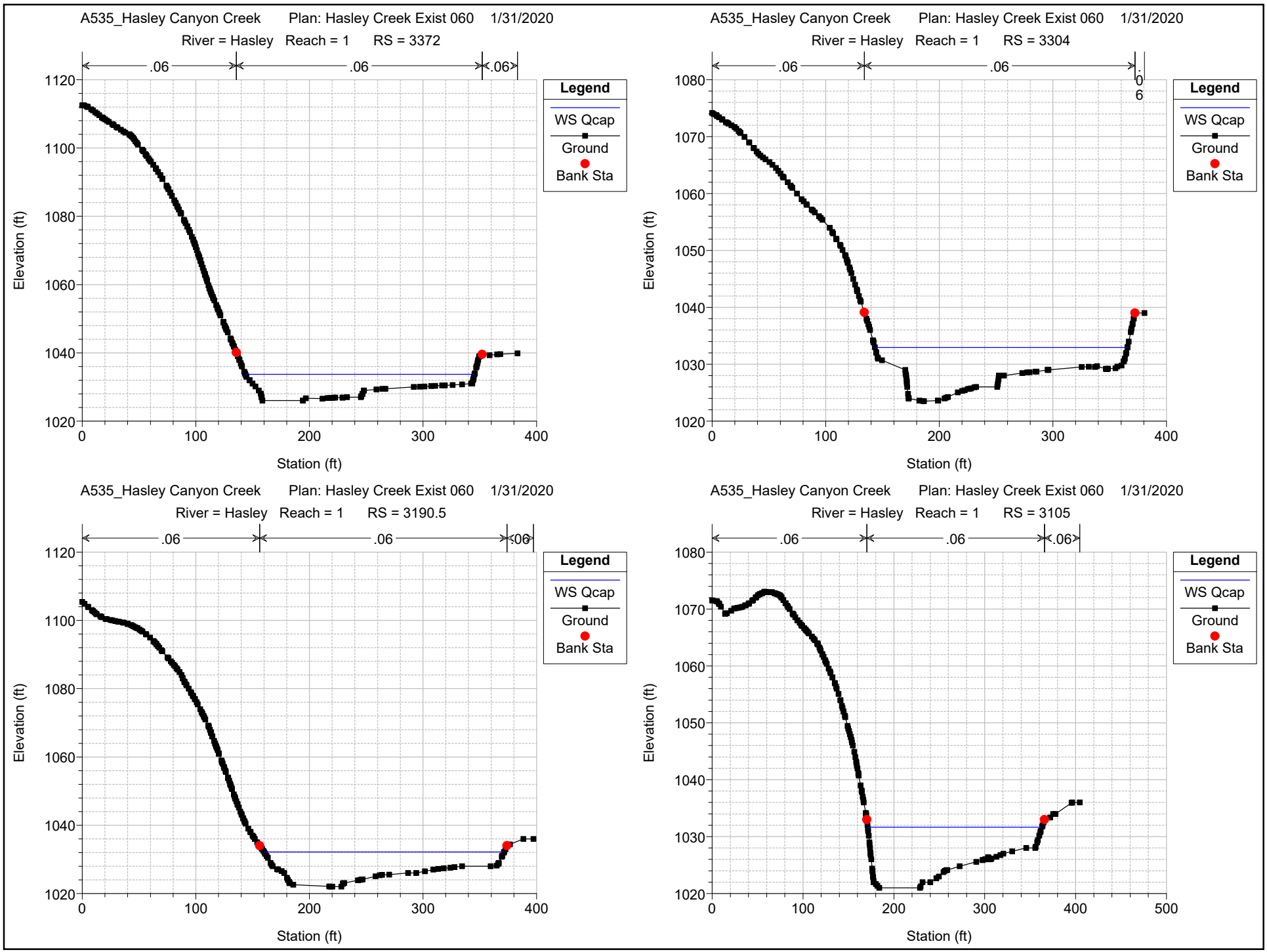

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3844
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1060
1055
1050
1045
1040
1035
1030
0
50
100
150
200
250
300
350
400

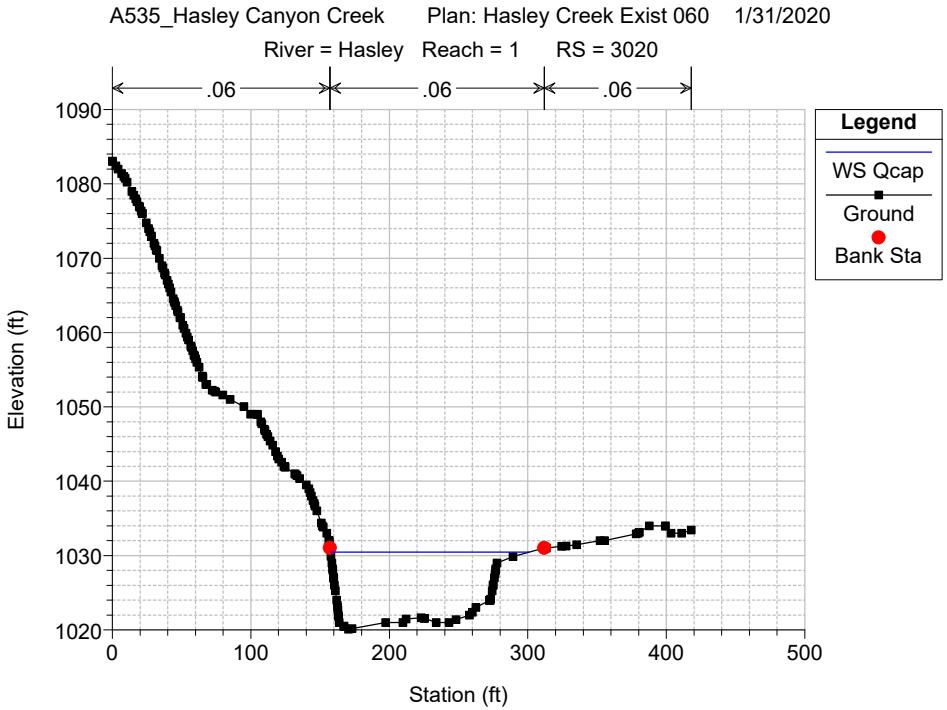

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3747
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1050
1045
1040
1035
1030
1025
0
50
100
150
200
250
300
350
400

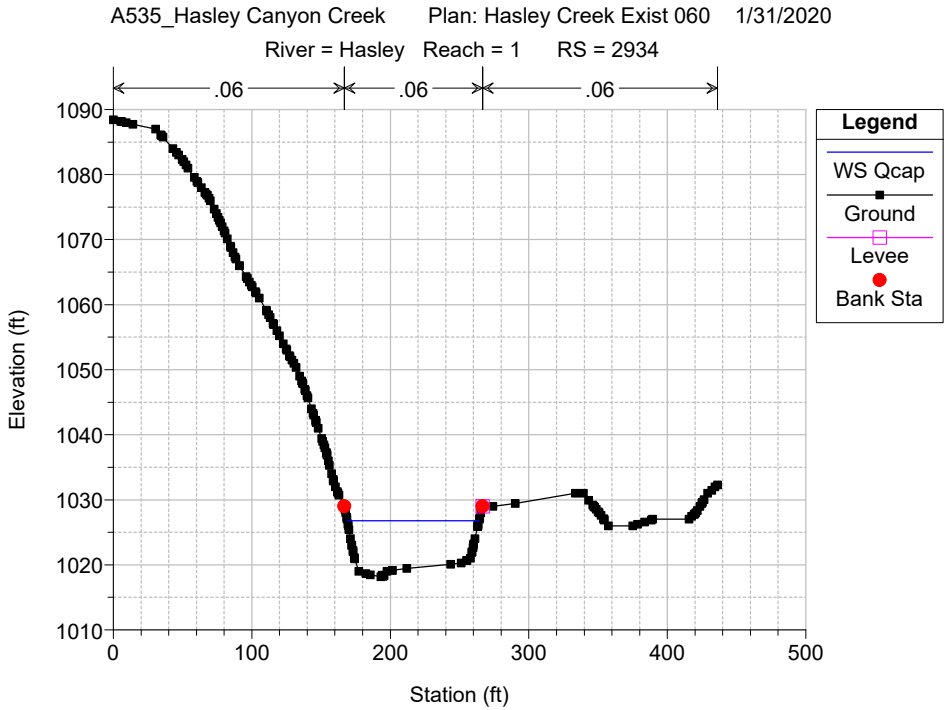

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3650
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
1025
0
50
100
150
200
250
300
350
400

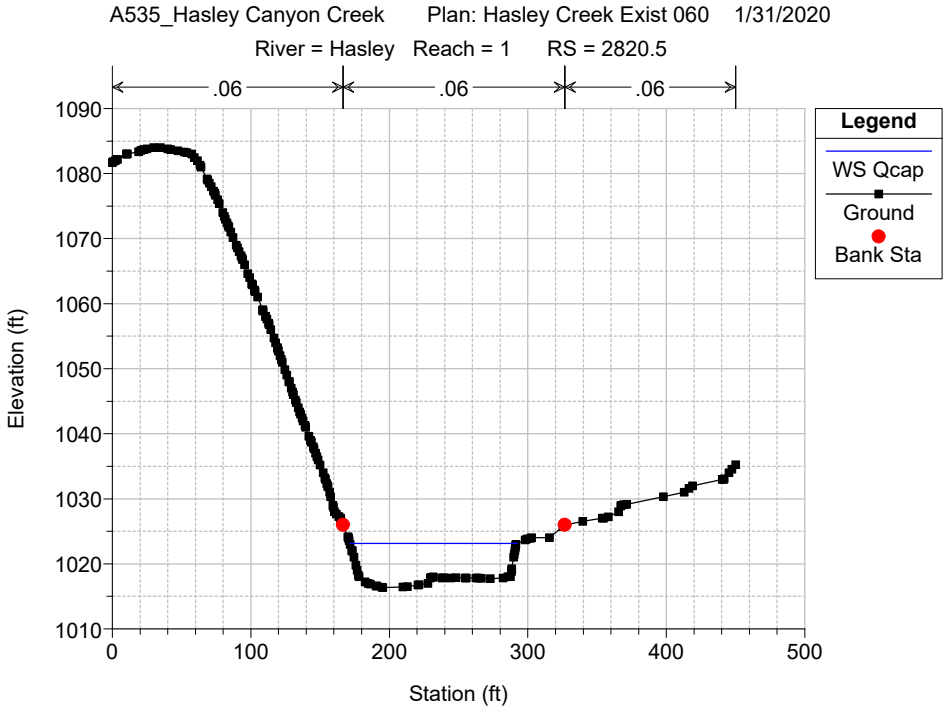

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3554
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1065
1060
1055
1050
1045
1040
1035
1030
1025
0
100
200
300
400

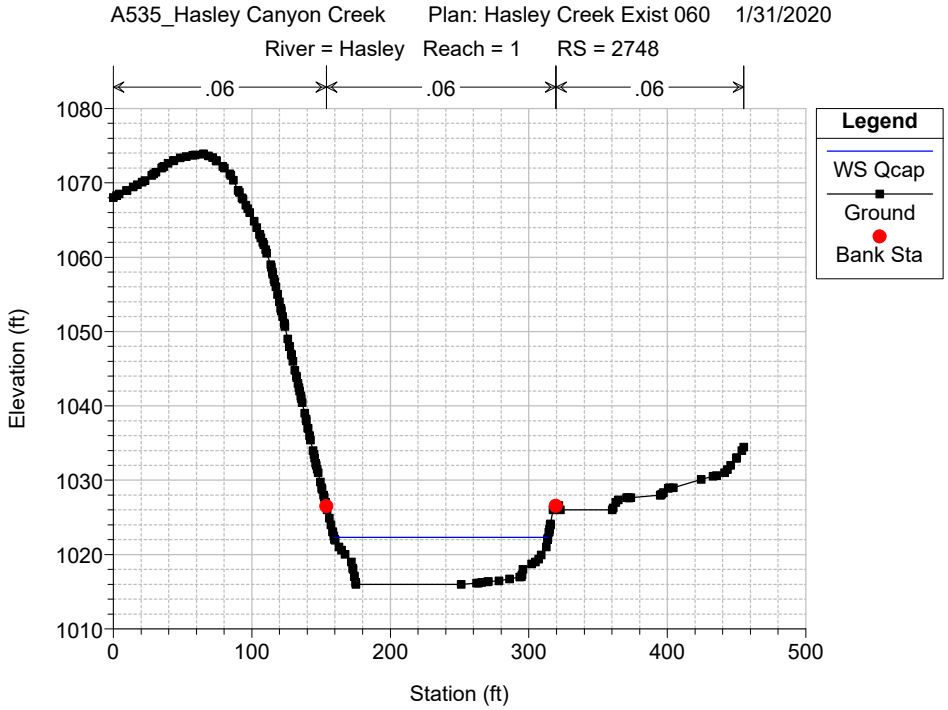

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3440.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1080
1070
1060
1050
1040
1030
1020
0
100
200
300
400

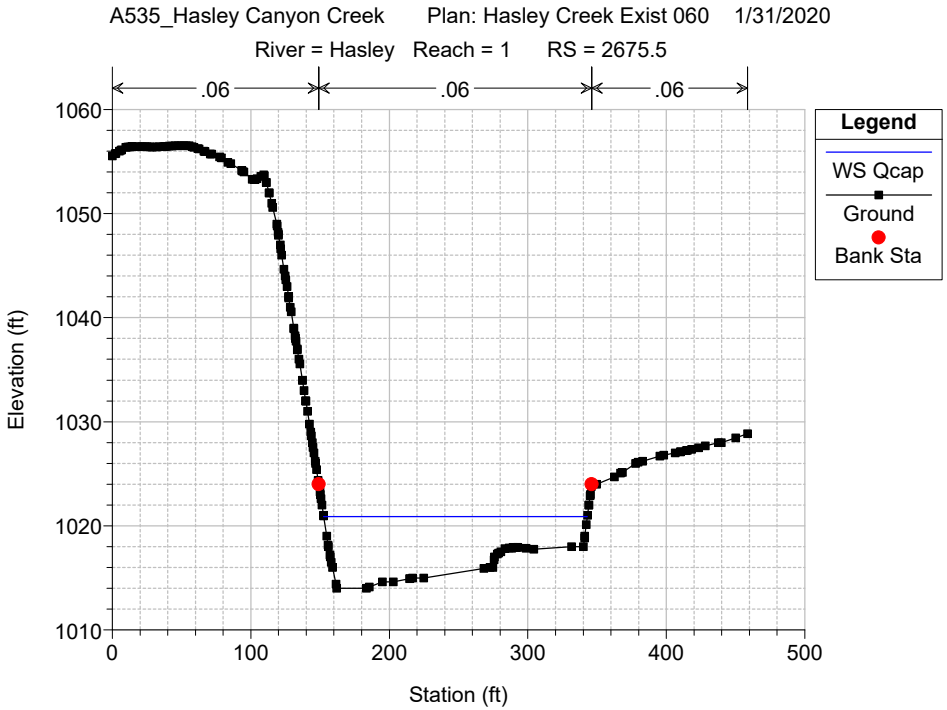

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3372
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3304
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3190.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3105
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

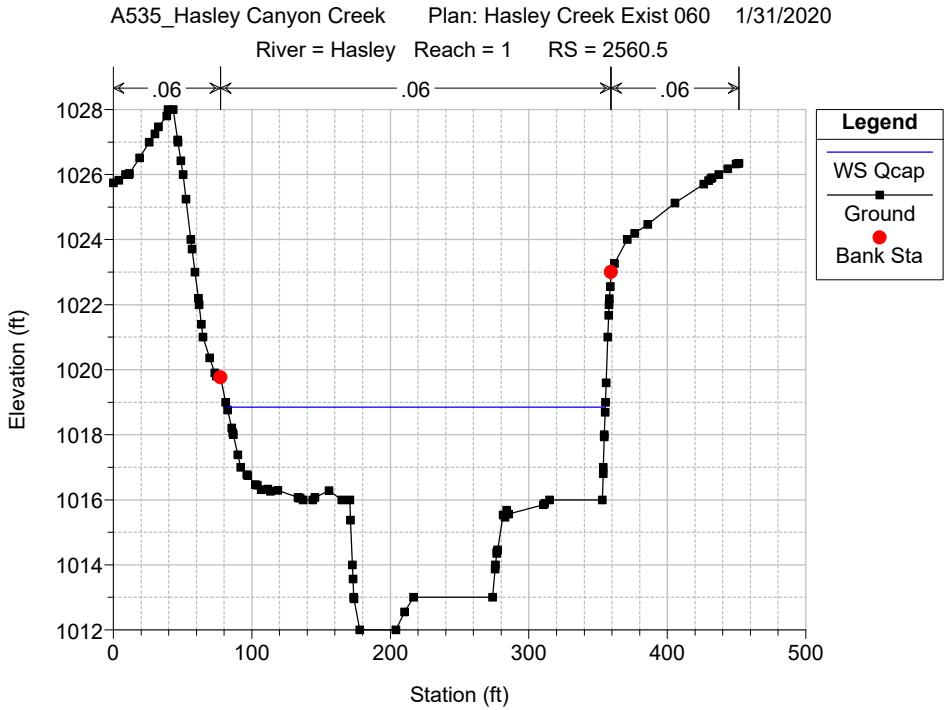

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 3020
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

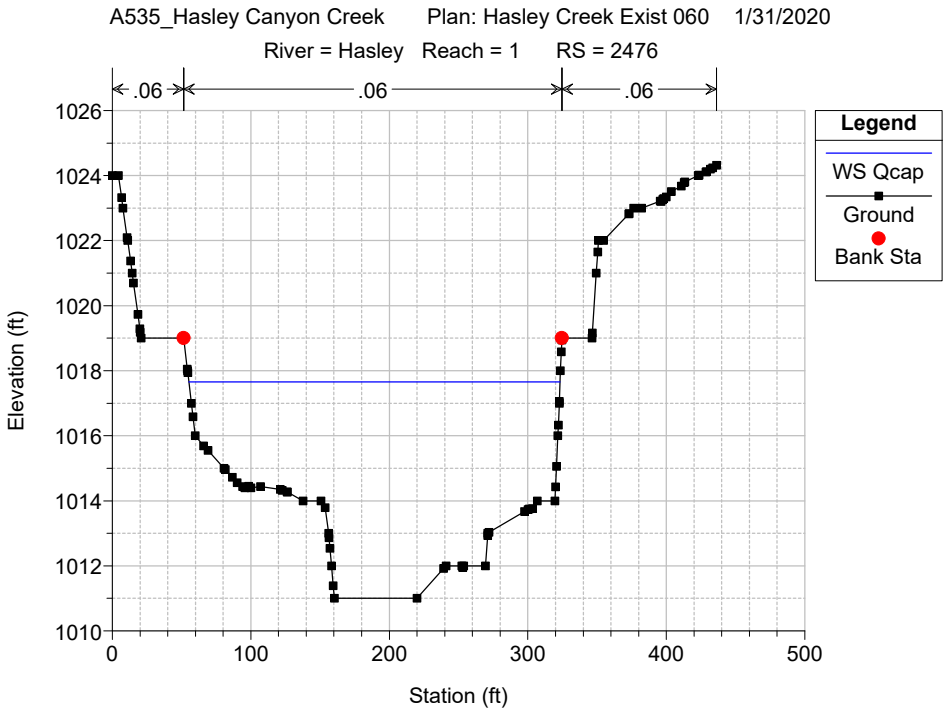

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2934
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

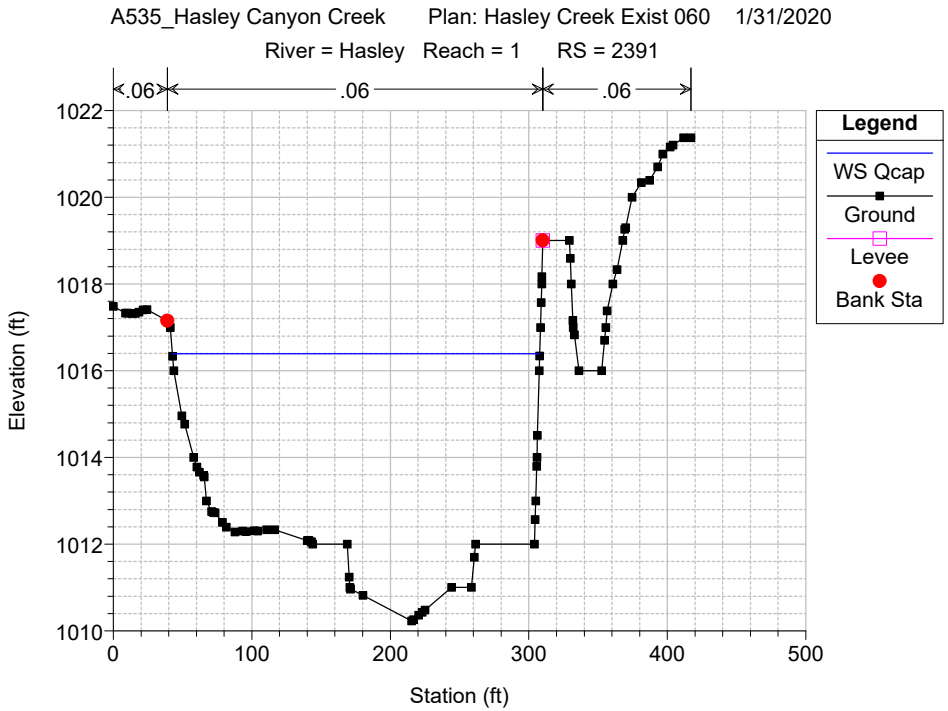

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2820.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

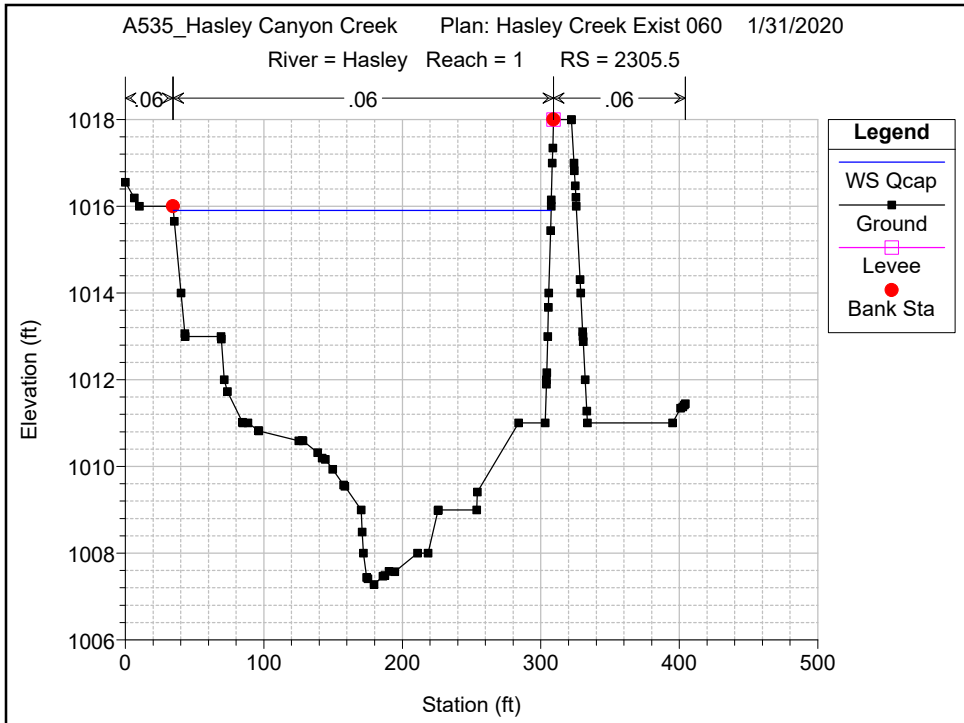

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2748
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

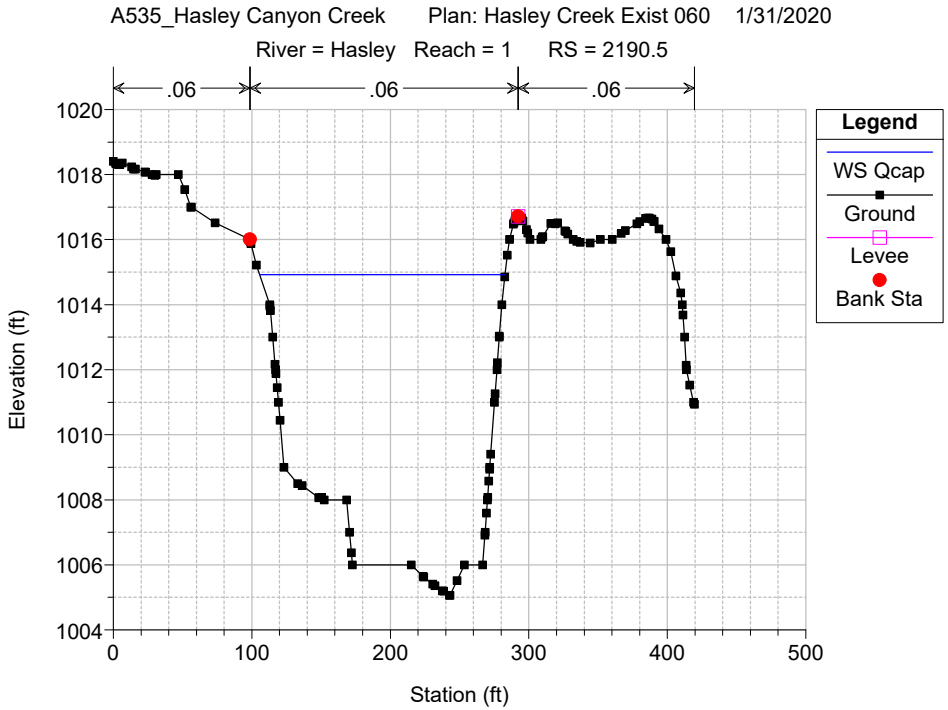

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2675.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1060
1050
1040
1030
1020
1010
0
100
200
300
400
500

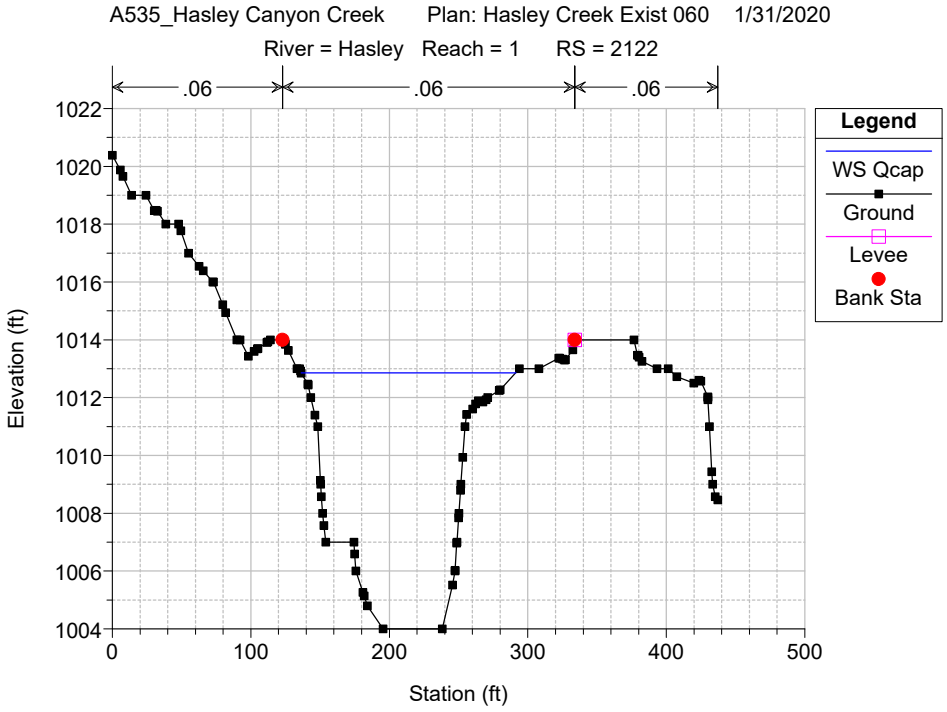

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2560.5
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1028
1026
1024
1022
1020
1018
1016
1014
1012
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2476
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1026
1024
1022
1020
1018
1016
1014
1012
1010
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2391
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1022
1020
1018
1016
1014
1012
1010
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2305.5
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1018
1016
1014
1012
1010
1008
1006
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2190.5
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1020
1018
1016
1014
1012
1010
1008
1006
1004
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2122
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1022
1020
1018
1016
1014
1012
1010
1008
1006
1004
0
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200
300
400
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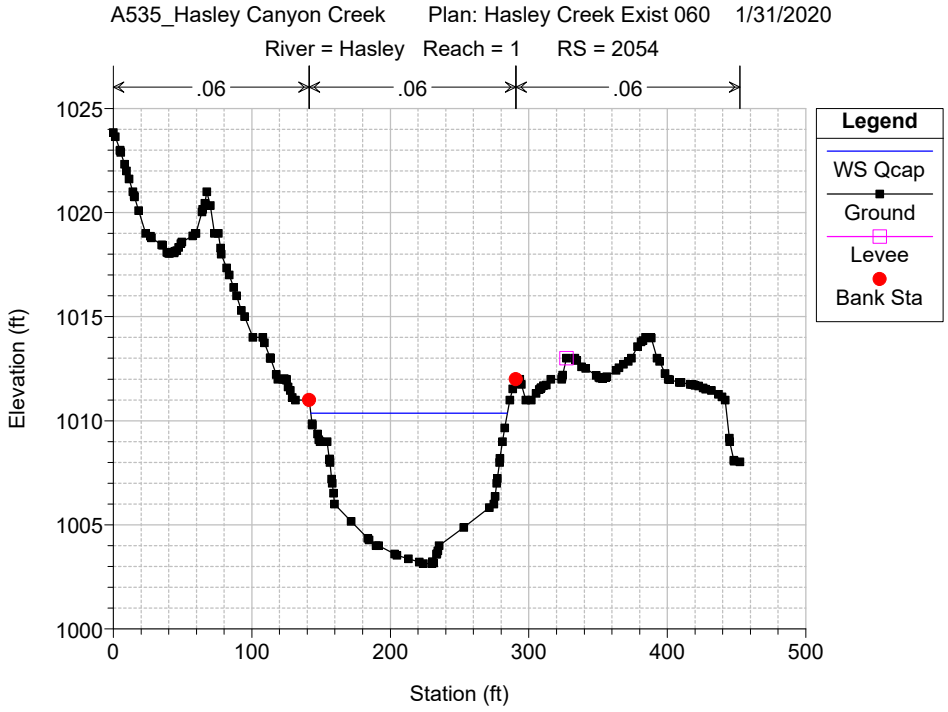
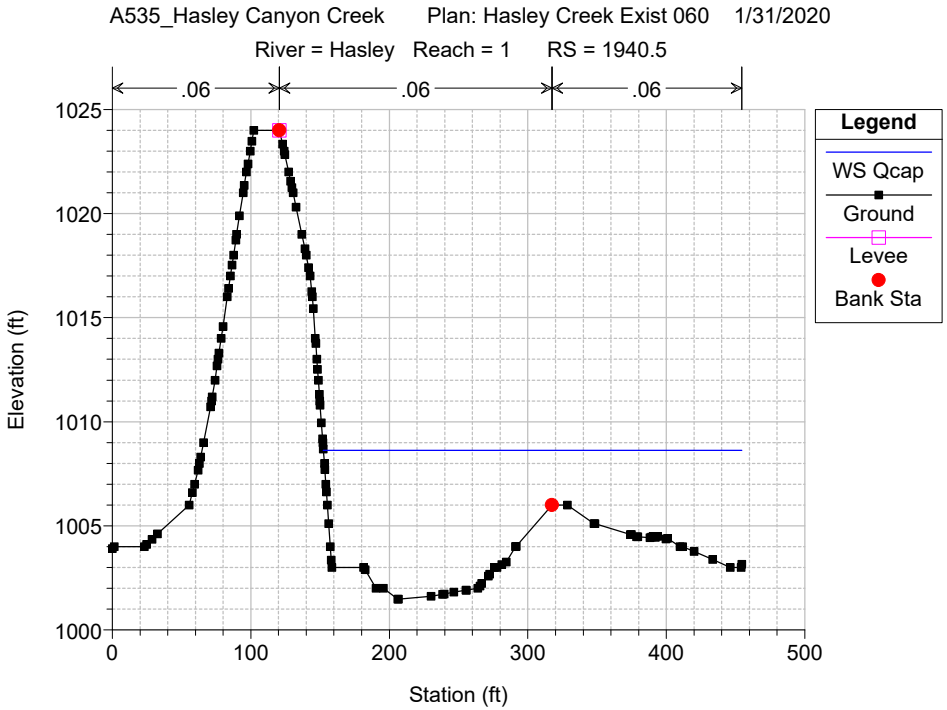
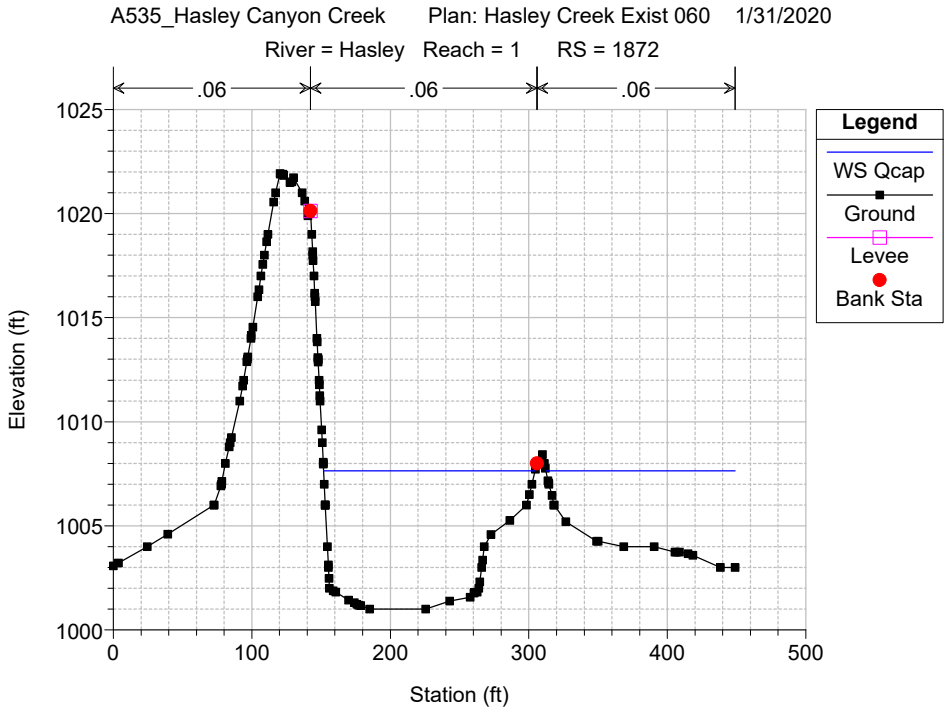
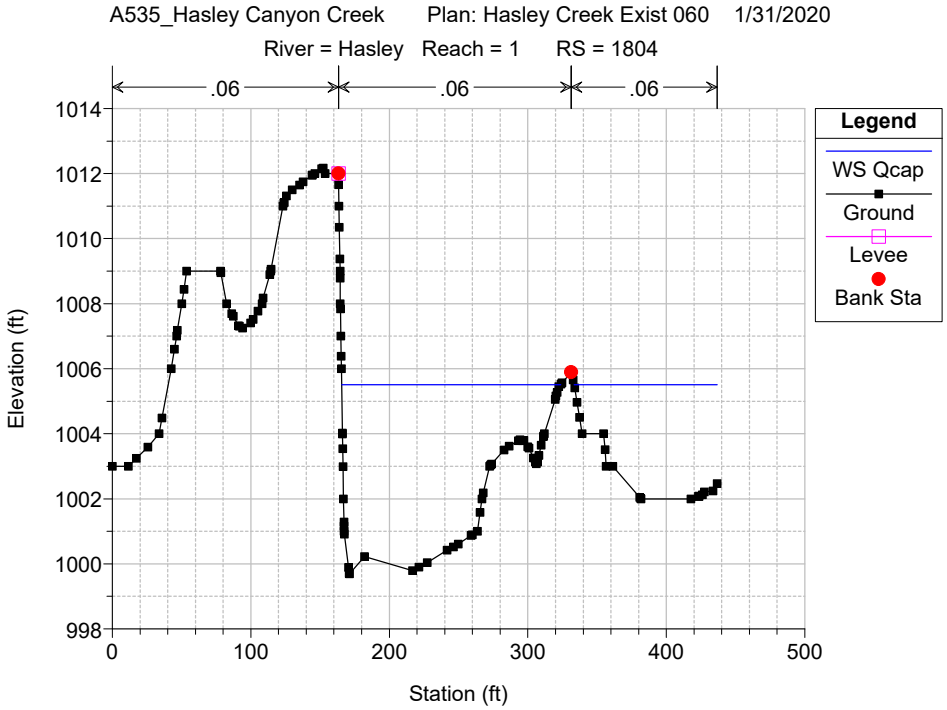
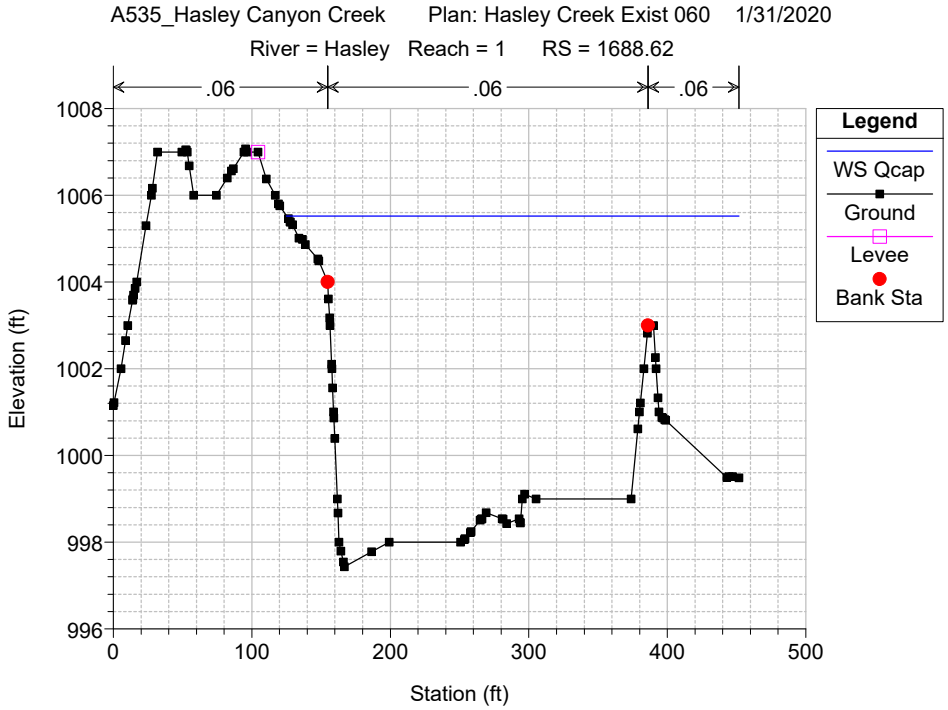
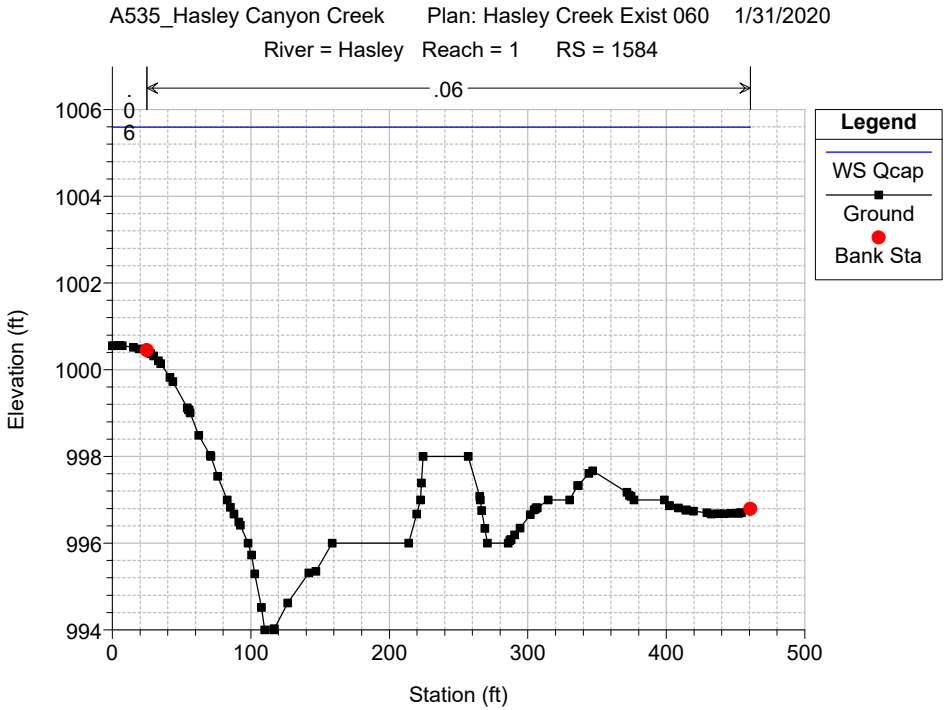

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 2054
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1025
1020
1015
1010
1005
1000
0
100
200
300
400
500

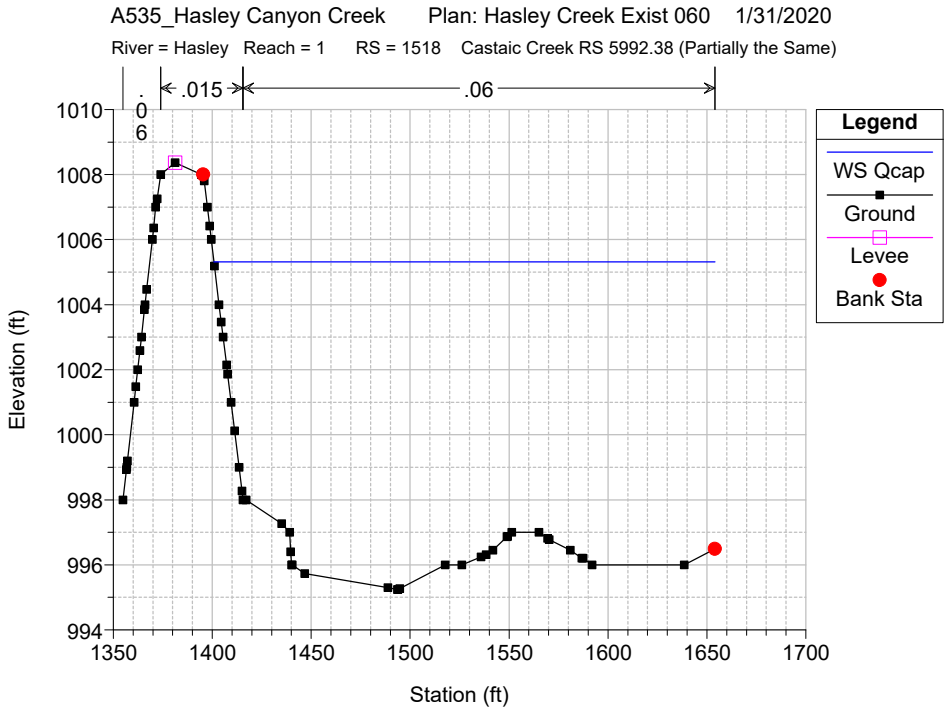

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1940.5
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1025
1020
1015
1010
1005
1000
0
100
200
300
400
500

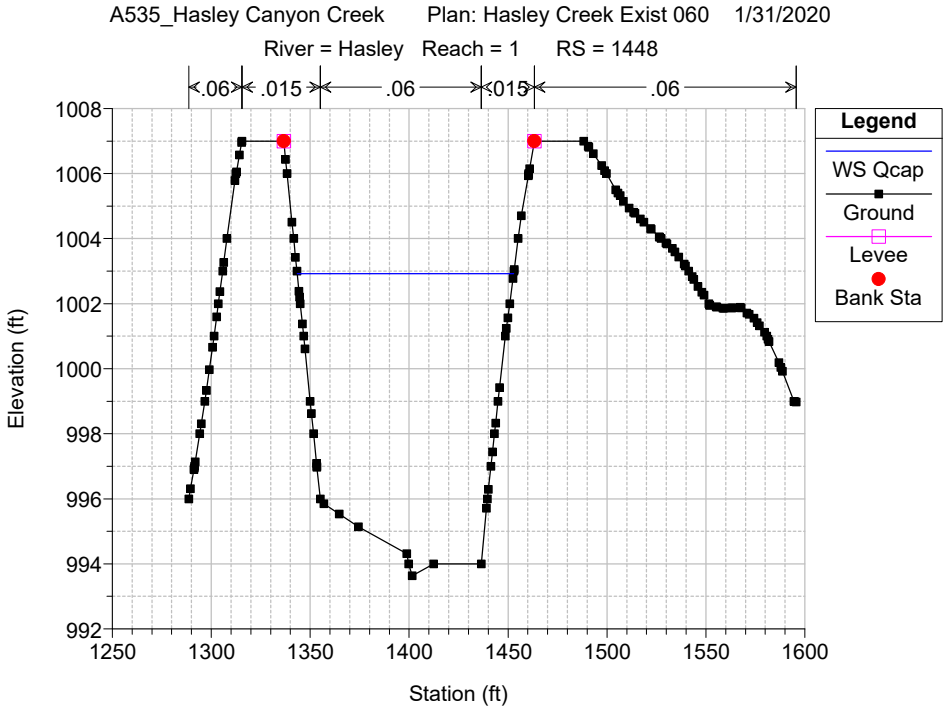

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1872
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1025
1020
1015
1010
1005
1000
0
100
200
300
400
500

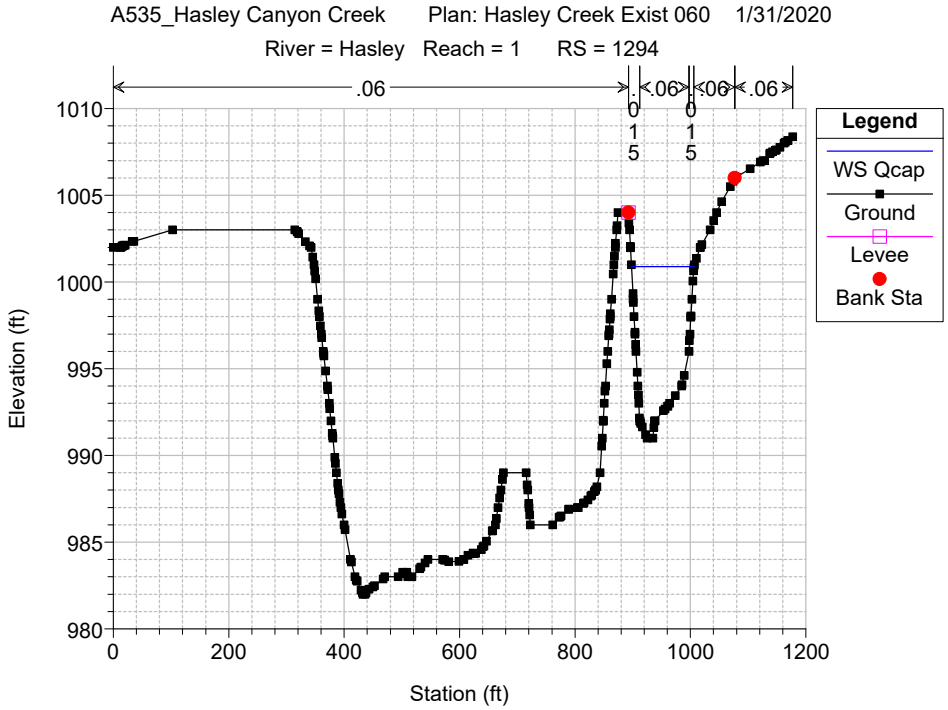

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1804
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1014
1012
1010
1008
1006
1004
1002
1000
998
0
100
200
300
400
500

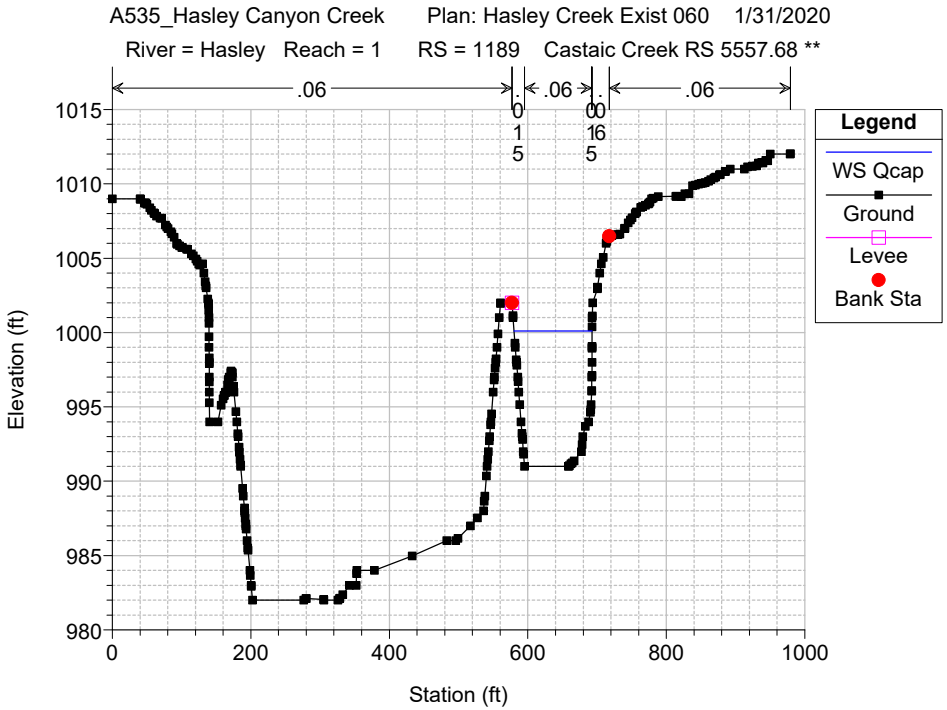

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1688.62
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
1008
1006
1004
1002
1000
998
996
0
100
200
300
400
500

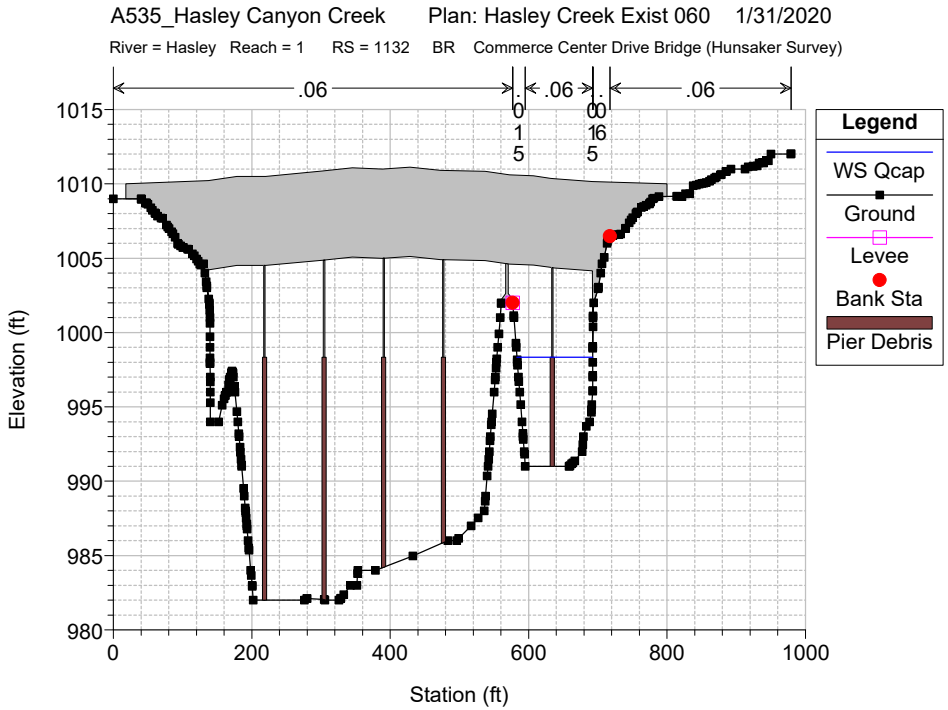

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1584
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

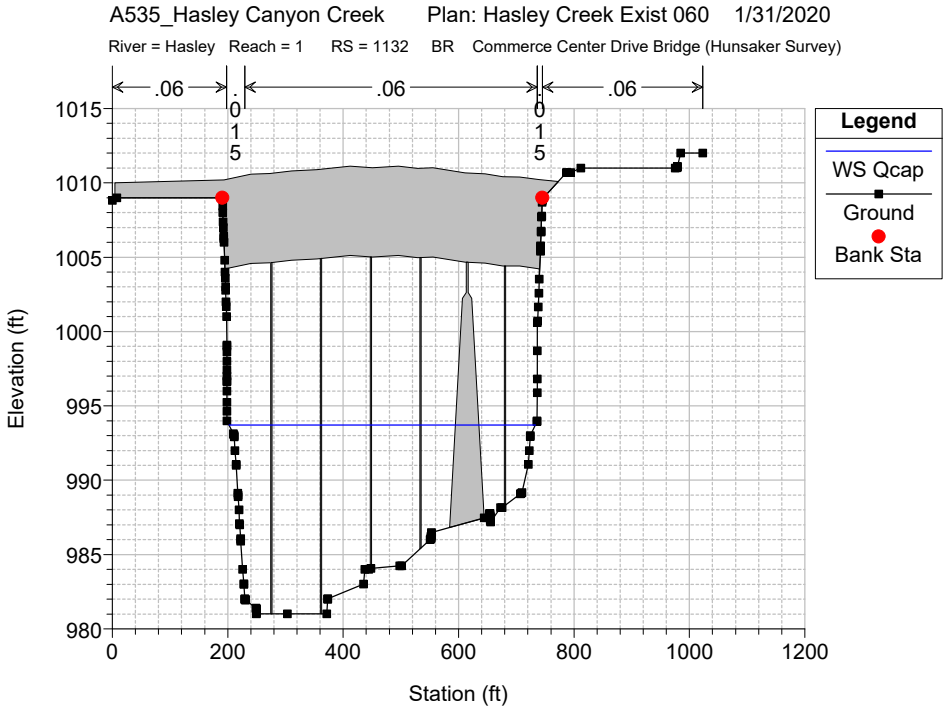

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1518 Castaic Creek RS 5992.38 (Partially the Same)
.015
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

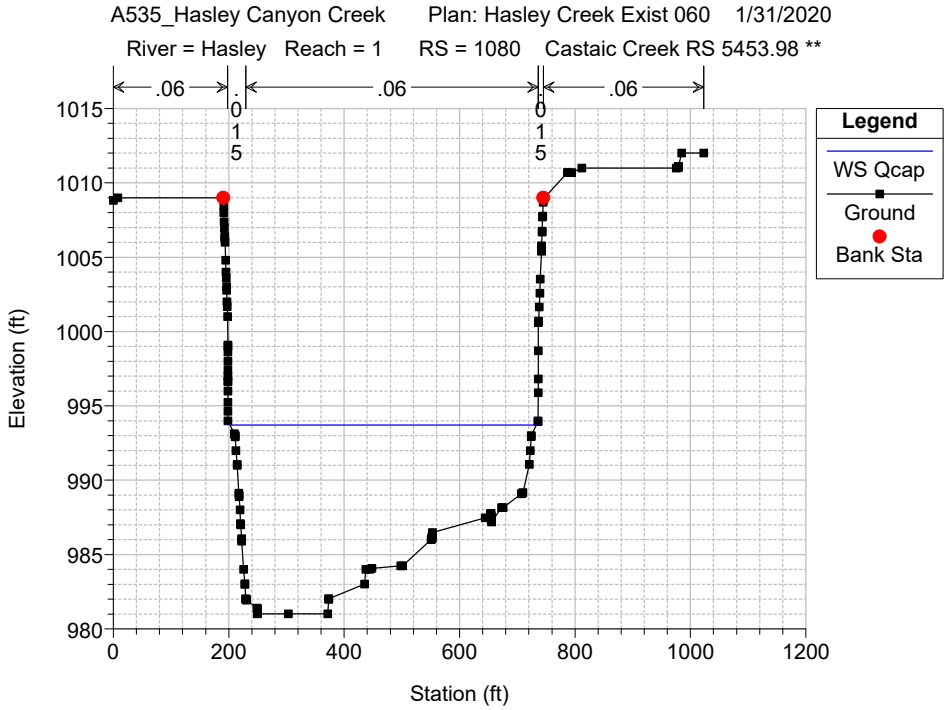

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1448
.06
.015
.06
.015
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

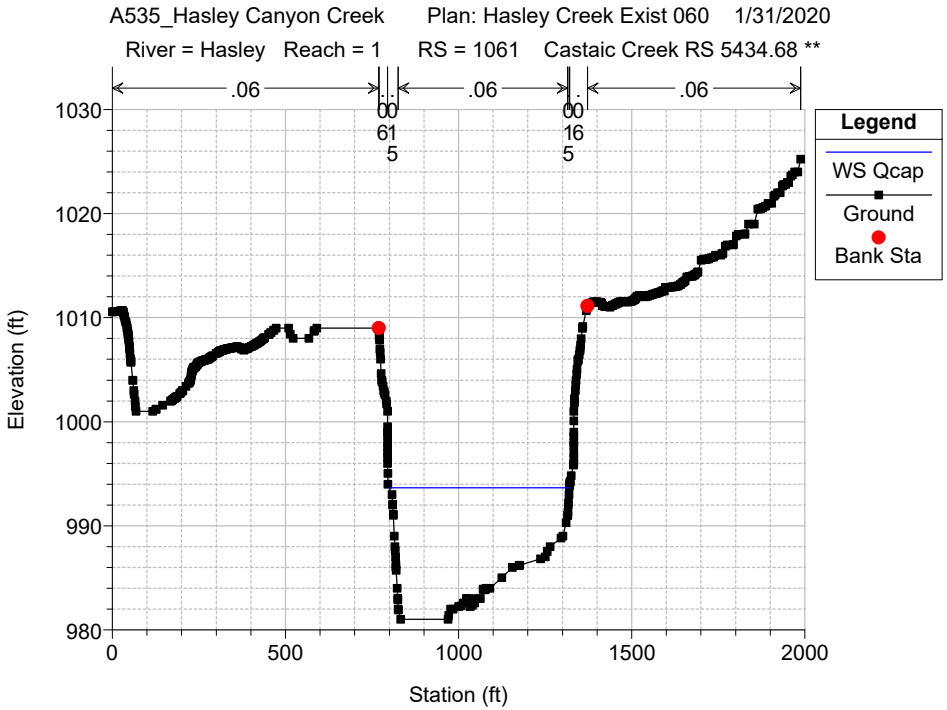

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1294
.06
.06
.06
.06
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

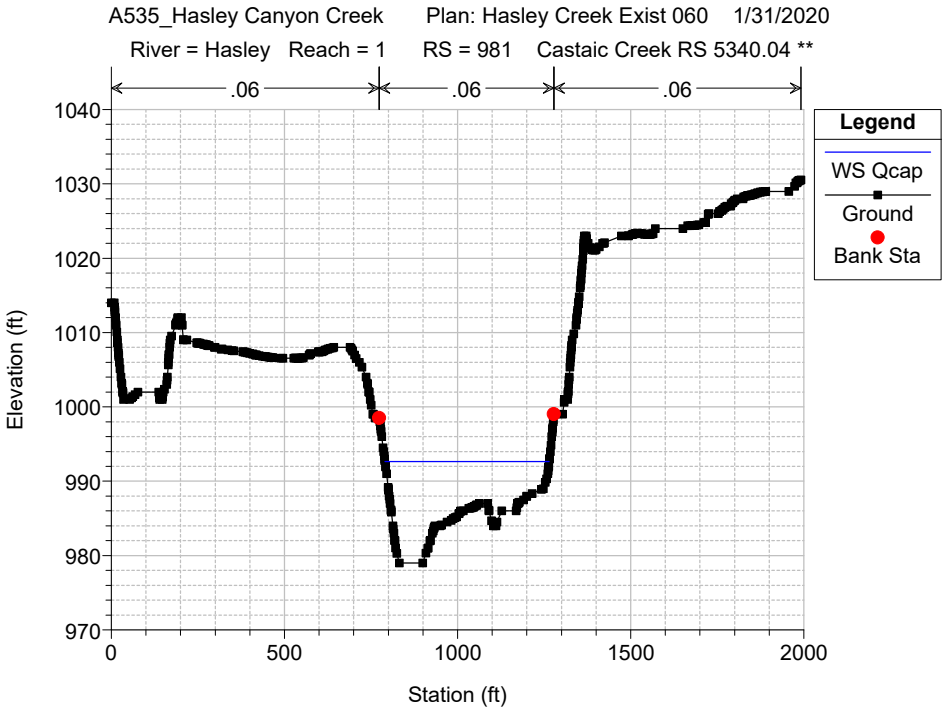

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1189 Castaic Creek RS 5557.68 **
.06
.06
.06
.015
.00165
Legend
WS Qcap
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
980
985
990
995
1000
1005
1010
1015
0
200
400
600
800
1000

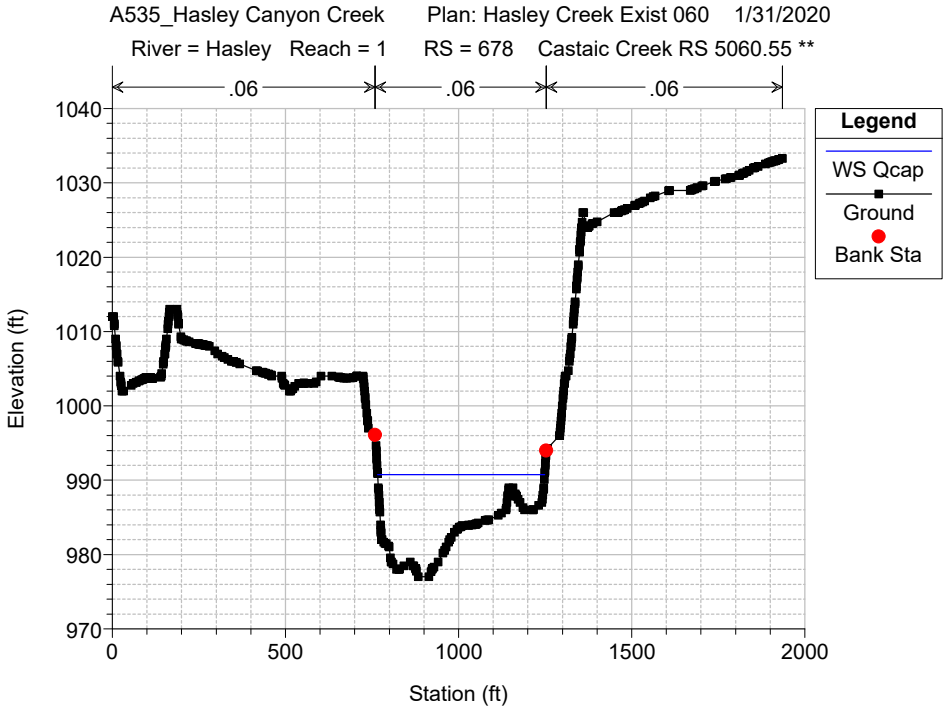

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)
.06
.06
.06
.015
.00165
Legend
WS Qcap
Ground
Levee
Bank Sta
Pier Debris
Elevation (ft)
Station (ft)
980
985
990
995
1000
1005
1010
1015
0
200
400
600
800
1000


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)
.06
.06
.06
.015
.015
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
980
985
990
995
1000
1005
1010
1015
0
200
400
600
800
1000
1200


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1080 Castaic Creek RS 5453.98 **
.06
.06
.06
.015
.015
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
980
985
990
995
1000
1005
1010
1015
0
200
400
600
800
1000
1200


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 1061 Castaic Creek RS 5434.68 **
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 981 Castaic Creek RS 5340.04 **
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

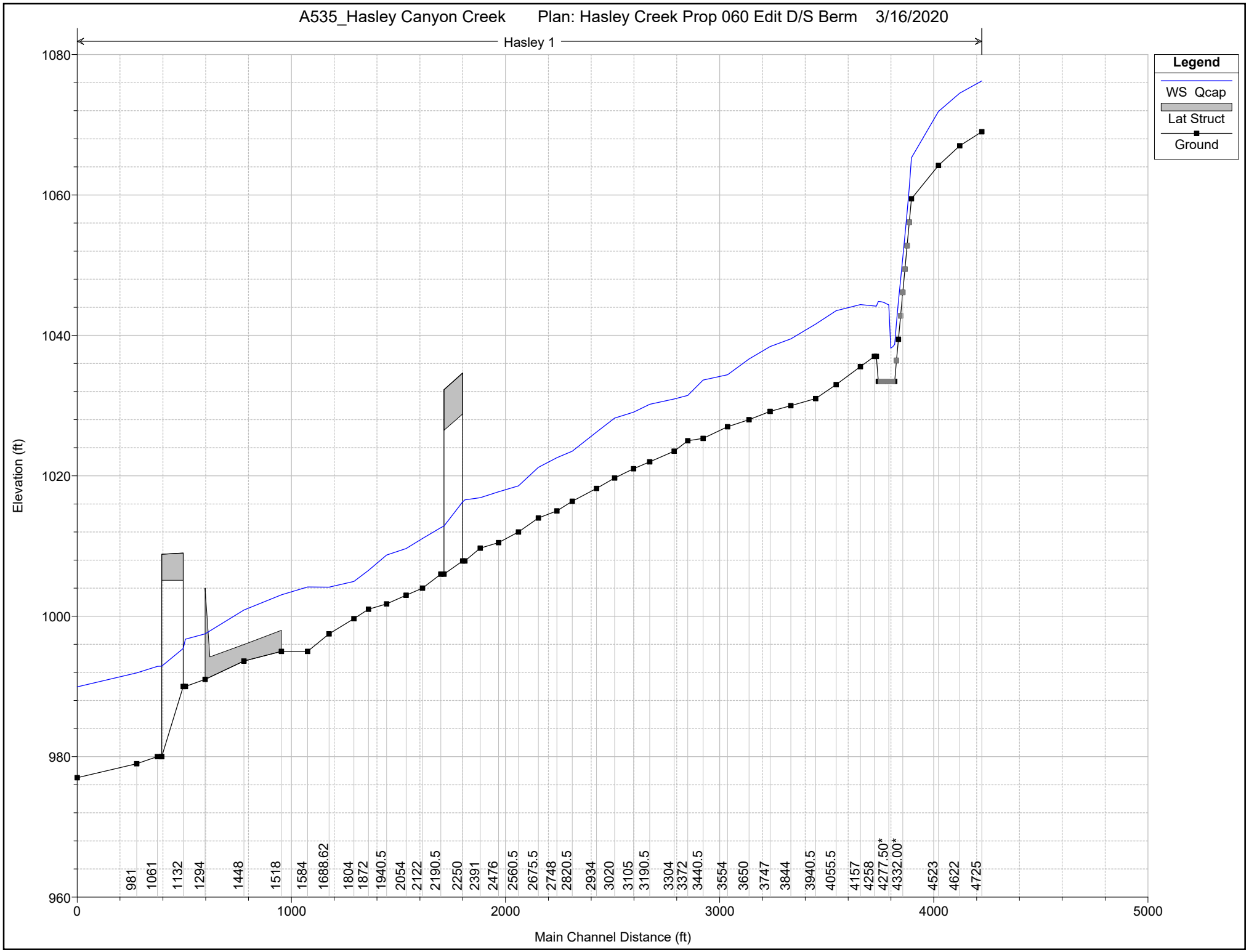

A535_Hasley Canyon Creek Plan: Hasley Creek Exist 060 1/31/2020
River = Hasley Reach = 1 RS = 678 Castaic Creek RS 5060.55 **
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

PACE
Advanced Water Engineering

Appendix B: Proposed Condition (n = 0.060) HEC-RAS Model Results

Appendix B- Proposed Condition HEC-RAS Model Results (n=0.060)

Water Surface Profile


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
Hasley 1
Legend
WS Qcap
Lat Struct
Ground
Elevation (ft)
Main Channel Distance (ft)
1080
1060
1040
1020
1000
980
960
0
1000
2000
3000
4000
5000
981
1061
1132
1294
1448
1518
1584
1688.62
1804
1872
1940.5
2054
2122
2190.5
2250
2391
2476
2560.5
2675.5
2748
2820.5
2934
3020
3105
3190.5
3304
3372
3440.5
3554
3650
3747
3844
3940.5
4055.5
4157
4258
4277.50*
4332.00*
4523
4622
4725

Appendix B- Proposed Condition HEC-RAS Model Results (n=0.060)

Output Summary Table

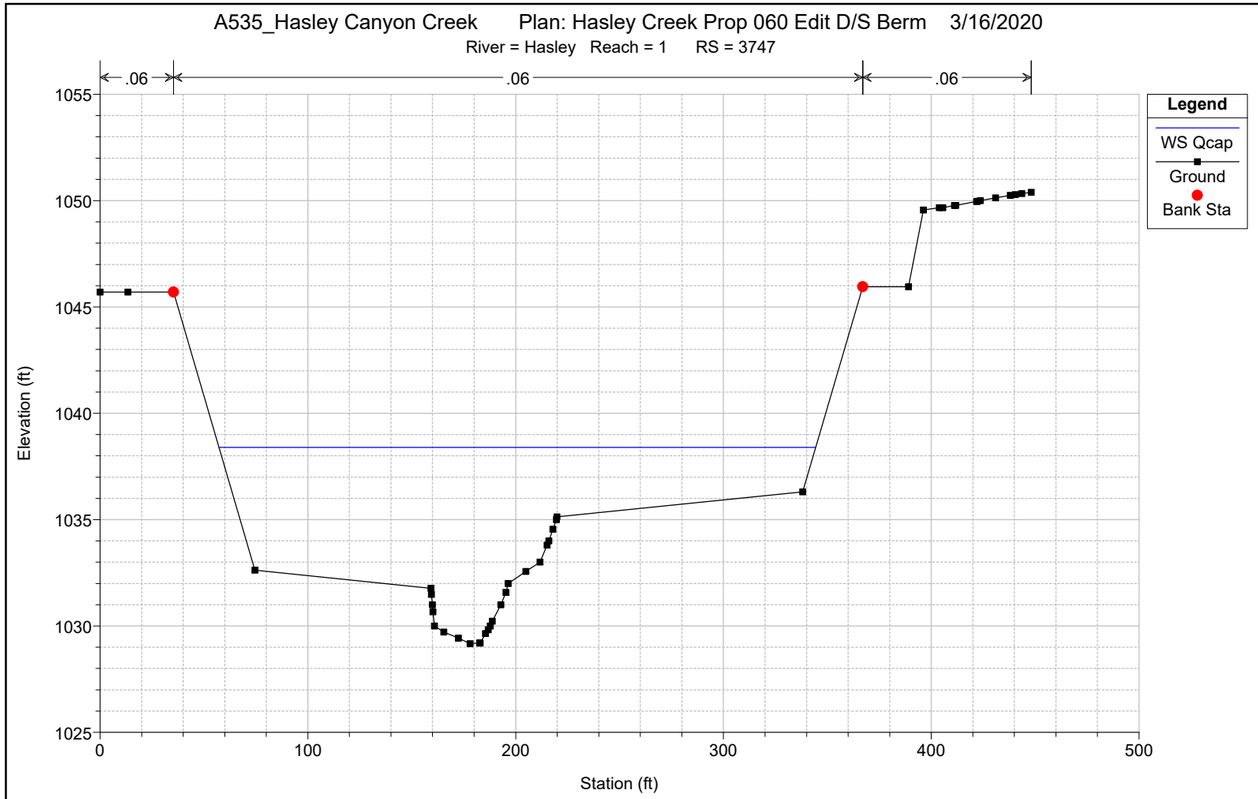
HEC-RAS Plan: Prop 060_Edit_Berm River: Hasley Reach: 1 Profile: Qcap

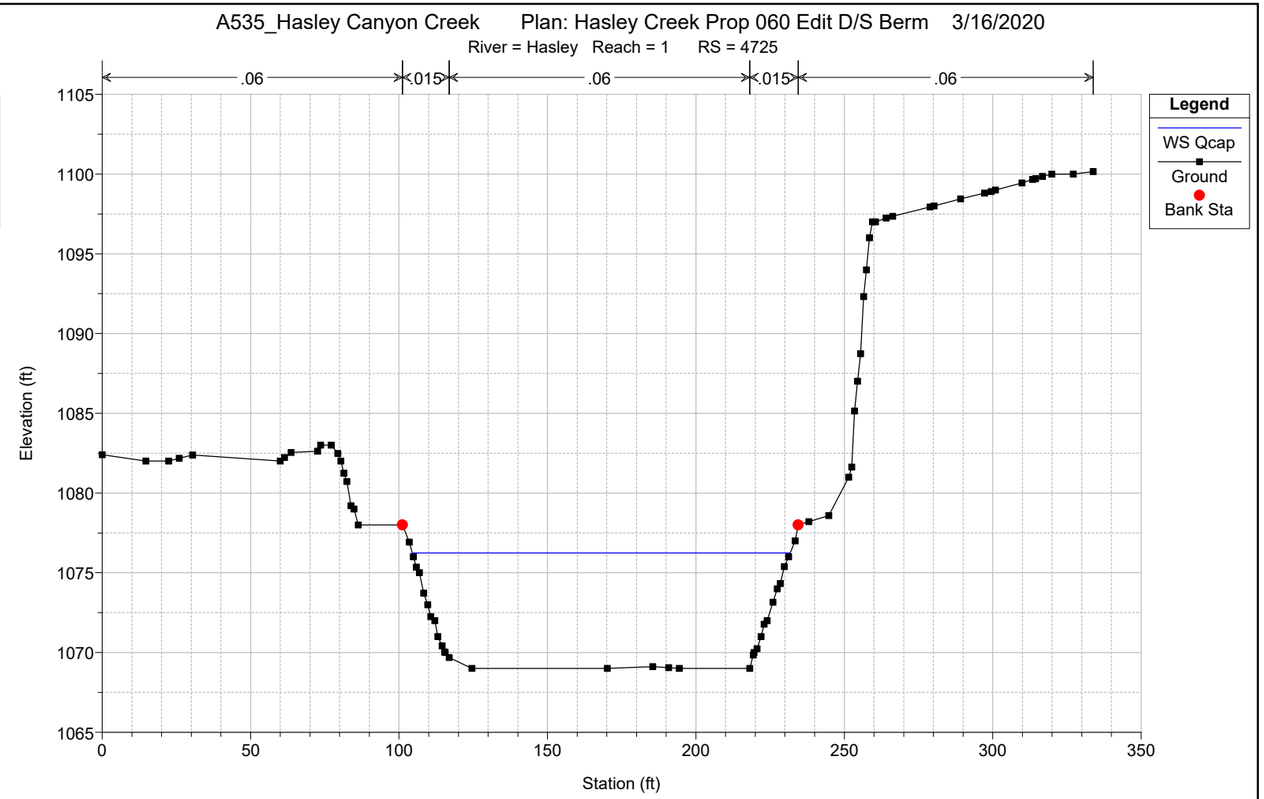
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	4725	Qcap	9480.00	1069.00	1076.25	1075.27	1078.31	0.013827	11.50	824.22	127.31	0.80
1	4622	Qcap	9480.00	1067.00	1074.49	1073.74	1076.78	0.015395	12.14	781.07	121.48	0.84
1	4523	Qcap	9480.00	1064.20	1071.89	1071.89	1074.86	0.023052	13.83	685.48	116.27	1.00
1	4396	Qcap	9480.00	1059.45	1065.29	1066.42	1069.92	0.073386	17.26	549.33	102.80	1.32
1	4380.00*	Qcap	9480.00	1056.12	1061.05	1063.36	1068.61	0.149289	22.06	429.68	94.63	1.83
1	4364.00*	Qcap	9480.00	1052.78	1057.55	1060.33	1066.76	0.190195	24.35	389.38	88.75	2.05
1	4348.00*	Qcap	9480.00	1049.45	1054.26	1057.33	1064.64	0.213346	25.84	366.89	83.45	2.17
1	4332.00*	Qcap	9480.00	1046.12	1051.08	1054.38	1062.36	0.225465	26.94	351.84	78.45	2.24
1	4316.00*	Qcap	9480.00	1042.78	1047.95	1051.45	1060.00	0.230824	27.85	340.43	73.66	2.28
1	4300	Qcap	9480.00	1039.45	1044.89	1048.59	1057.62	0.231350	28.62	331.24	69.06	2.30
1	4291.00*	Qcap	9480.00	1036.45	1041.80	1045.69	1055.61	0.194969	29.81	318.07	67.44	2.42
1	4282	Qcap	9480.00	1033.45	1038.73	1042.83	1053.65	0.215206	30.99	305.92	65.86	2.53
1	4280.50*	Qcap	9480.00	1033.45	1038.39	1042.01	1051.12	0.192424	28.62	331.19	74.44	2.39
1	4279.00*	Qcap	9480.00	1033.45	1038.19	1041.32	1048.86	0.165718	26.21	361.73	83.44	2.22
1	4277.50*	Qcap	9480.00	1033.45	1044.36	1040.75	1045.66	0.007492	9.13	1038.41	111.53	0.53
1	4276	Qcap	9480.00	1033.45	1044.48	1040.25	1045.52	0.005819	8.19	1157.28	121.49	0.47
1	4274.50*	Qcap	9480.00	1033.45	1044.65	1039.54	1045.38	0.003891	6.88	1378.06	139.88	0.39
1	4273.00*	Qcap	9480.00	1033.45	1044.74	1038.96	1045.29	0.002802	5.95	1593.67	158.05	0.33
1	4271.50*	Qcap	9480.00	1033.45	1044.81	1038.53	1045.23	0.002120	5.25	1806.56	176.12	0.29
1	4270	Qcap	9480.00	1033.45	1044.85	1038.14	1045.19	0.001663	4.70	2017.59	194.13	0.26
1	4265	Qcap	9480.00	1037.00	1044.17	1041.70	1045.10	0.007970	7.76	1220.87	181.15	0.53
1	4258	Qcap	9480.00	1037.00	1044.19	1041.45	1044.99	0.006643	7.14	1328.55	195.56	0.48
1	4157	Qcap	9480.00	1035.56	1044.39	1039.04	1044.64	0.001592	4.03	2350.03	279.51	0.25
1	4055.5	Qcap	9480.00	1033.00	1043.52	1041.83	1044.23	0.009335	6.77	1401.07	290.30	0.54
1	3940.5	Qcap	9480.00	1031.00	1041.62	1041.10	1042.84	0.023034	8.86	1069.51	288.40	0.81
1	3844	Qcap	9480.00	1030.00	1039.49	1038.60	1040.51	0.016811	8.11	1169.14	287.96	0.71
1	3747	Qcap	9480.00	1029.17	1038.40	1036.89	1039.18	0.010567	7.07	1341.05	287.12	0.58
1	3650	Qcap	9480.00	1028.00	1036.65	1035.98	1037.75	0.019870	8.44	1123.65	295.34	0.76
1	3554	Qcap	9480.00	1027.00	1034.40	1033.33	1035.88	0.016822	9.78	969.28	175.85	0.73
1	3440.5	Qcap	9480.00	1025.32	1033.64	1032.01	1034.25	0.008914	6.30	1504.14	337.28	0.53
1	3372	Qcap	9480.00	1025.00	1031.46	1031.46	1033.02	0.036523	10.01	946.59	305.15	1.00
1	3304	Qcap	9480.00	1023.50	1030.96	1029.30	1031.69	0.009530	6.87	1379.78	285.60	0.55
1	3190.5	Qcap	9480.00	1022.00	1030.19	1027.65	1030.80	0.006083	6.24	1519.63	259.30	0.45
1	3105	Qcap	9480.00	1021.00	1029.08	1028.01	1030.07	0.014809	8.02	1182.47	268.94	0.67
1	3020	Qcap	9480.00	1019.68	1028.24	1026.51	1028.96	0.009333	6.85	1383.84	281.54	0.54
1	2934	Qcap	9480.00	1018.19	1026.23	1025.85	1027.67	0.025618	9.61	986.05	258.09	0.87
1	2820.5	Qcap	9480.00	1016.37	1023.52	1023.05	1024.84	0.023504	9.23	1027.20	268.41	0.83
1	2748	Qcap	9480.00	1015.00	1022.59	1021.22	1023.48	0.013173	7.54	1256.51	287.73	0.64
1	2675.5	Qcap	9480.00	1014.00	1021.20	1019.83	1022.20	0.016711	8.00	1184.72	296.60	0.71
1	2560.5	Qcap	9480.00	1012.00	1018.58	1018.43	1020.07	0.031507	9.80	967.70	287.36	0.94
1	2476	Qcap	9480.00	1010.49	1017.73	1015.95	1018.43	0.008772	6.71	1413.53	285.42	0.53
1	2391	Qcap	9480.00	1009.71	1016.88	1015.05	1017.66	0.009096	7.07	1340.04	256.42	0.55
1	2305.5	Qcap	9480.00	1007.87	1016.58	1013.44	1017.13	0.004809	5.93	1597.99	246.34	0.41
1	2250		Bridge									
1	2190.5	Qcap	9480.00	1006.00	1012.61	1011.64	1013.88	0.016744	9.01	1051.78	221.25	0.73
1	2122	Qcap	9480.00	1004.00	1011.07	1010.25	1012.38	0.018386	9.19	1031.93	225.67	0.76
1	2054	Qcap	9480.00	1003.00	1009.64	1008.82	1010.95	0.018602	9.21	1029.42	226.81	0.76
1	1940.5	Qcap	9480.00	1001.76	1008.73	1006.94	1009.62	0.009978	7.58	1249.99	231.14	0.57
1	1872	Qcap	9480.00	1001.00	1006.53	1006.27	1008.21	0.027955	10.40	911.28	227.22	0.92
1	1804	Qcap	9480.00	999.65	1004.97	1004.45	1006.46	0.022543	9.79	968.25	225.24	0.83
1	1688.62	Qcap	9480.00	997.49	1004.15	1001.96	1004.84	0.007331	6.64	1427.91	255.87	0.50
1	1584	Qcap	9480.00	995.00	1004.18	999.47	1004.40	0.001635	3.76	2548.84	398.45	0.24
1	1518	Qcap	9480.00	995.00	1003.06	1000.59	1003.75	0.006300	6.90	1438.03	231.53	0.47
1	1500		Lat Struct									
1	1448	Qcap	7787.66	993.63	1000.89	999.71	1002.18	0.012765	9.75	867.24	159.74	0.71
1	1294	Qcap	4740.00	991.00	997.49	997.18	999.33	0.022142	10.89	435.44	96.58	0.90
1	1189	Qcap	4740.00	990.00	996.73	995.16	997.76	0.010071	8.16	581.21	106.68	0.62
1	1132		Bridge									
1	1080	Qcap	26660.00	980.01	992.89	988.63	993.48	0.003506	6.19	4305.66	509.75	0.38
1	1061	Qcap	26660.00	980.00	992.86	988.20	993.41	0.003046	5.96	4474.36	510.07	0.35
1	981	Qcap	26660.00	979.00	991.94	989.35	992.92	0.007660	7.97	3345.77	470.92	0.53
1	678	Qcap	26660.00	977.00	989.95	986.97	990.87	0.007003	7.69	3467.92	480.47	0.50

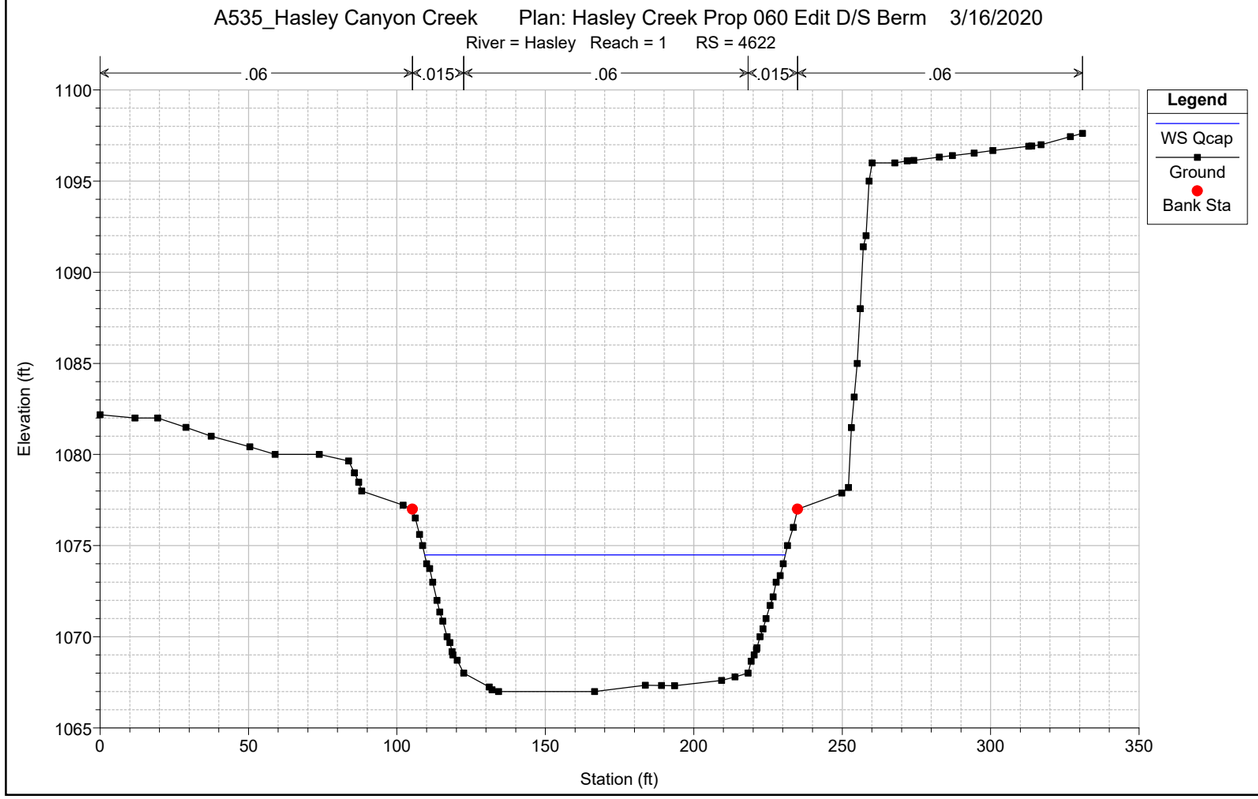
Appendix B- Proposed Condition HEC-RAS Model Results (n=0.060)

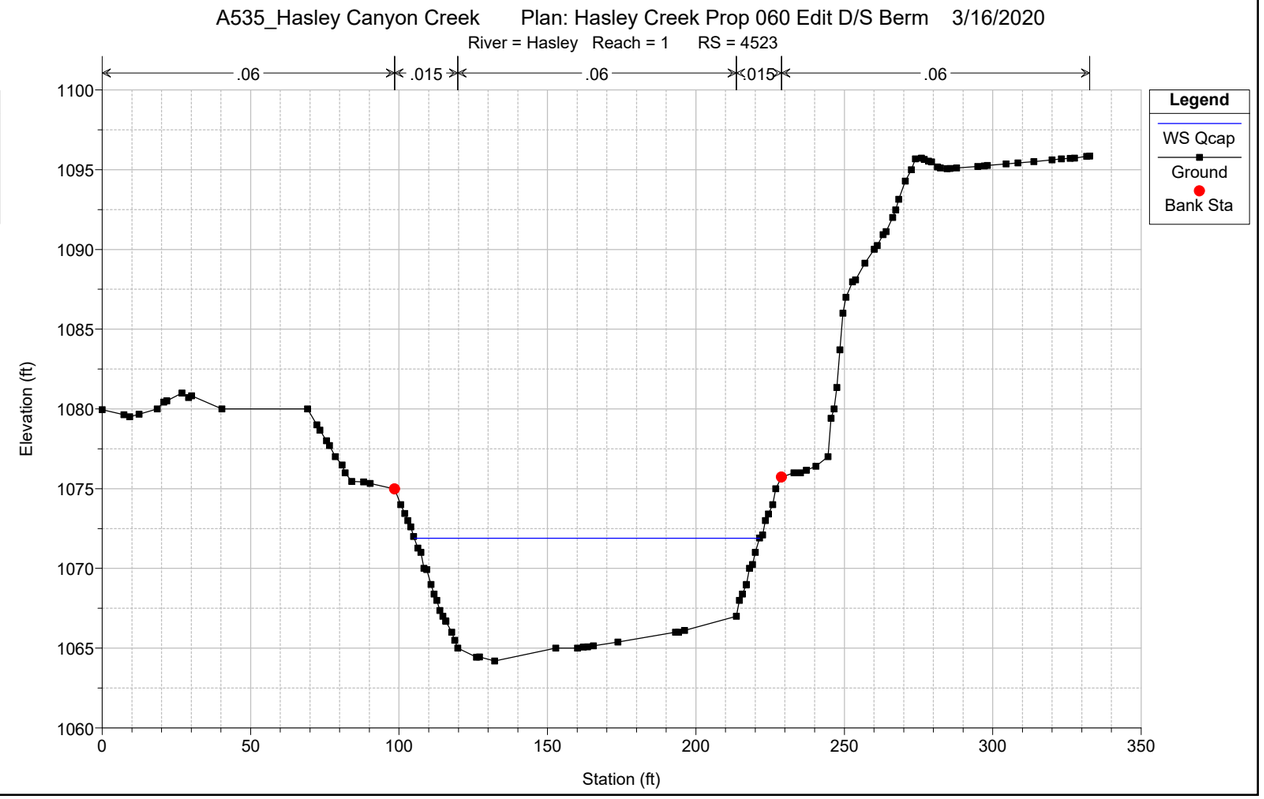
Cross Section Plots

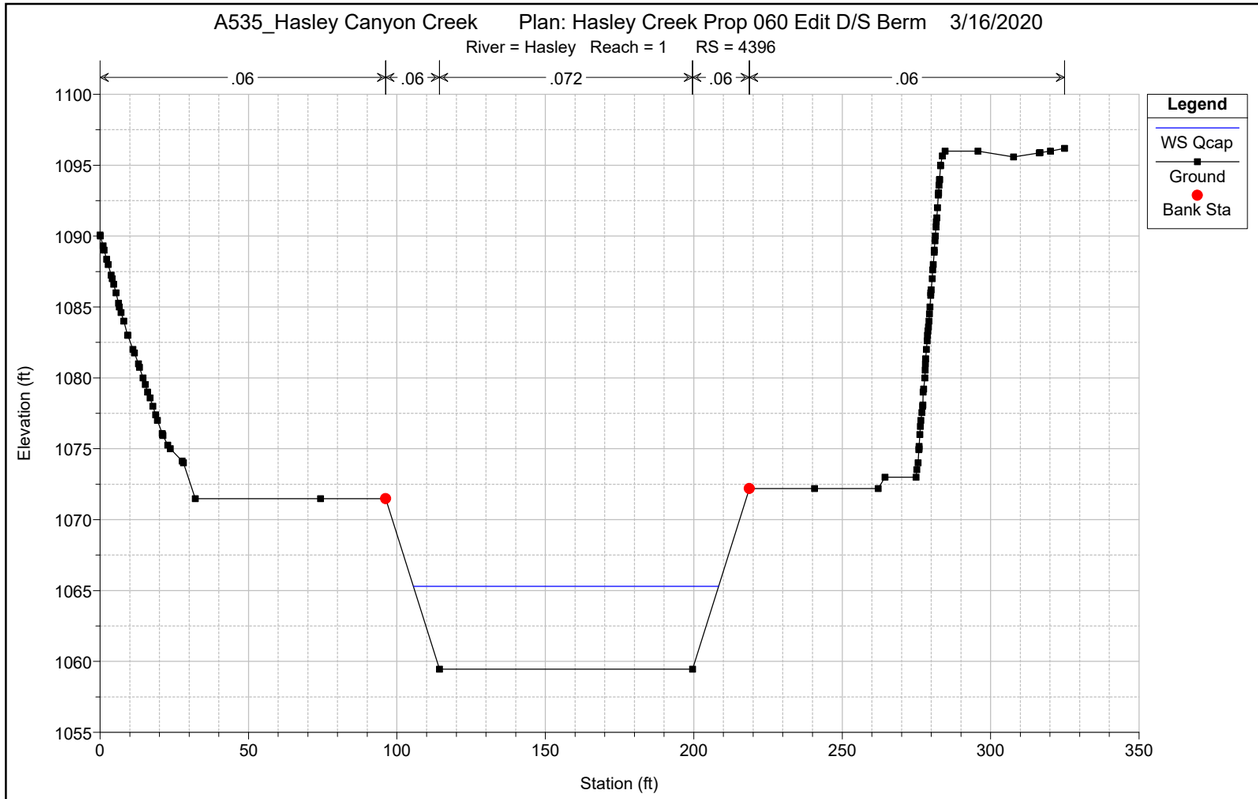
PACE

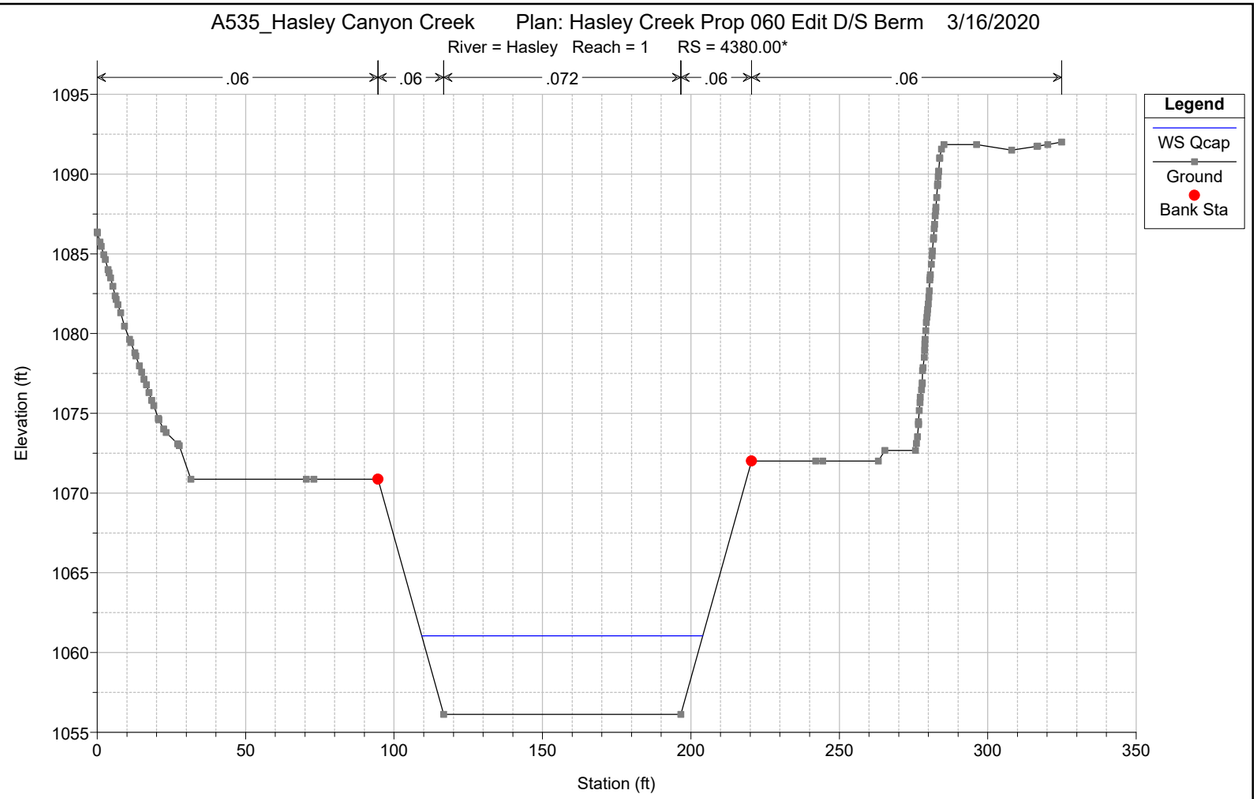

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 3747
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

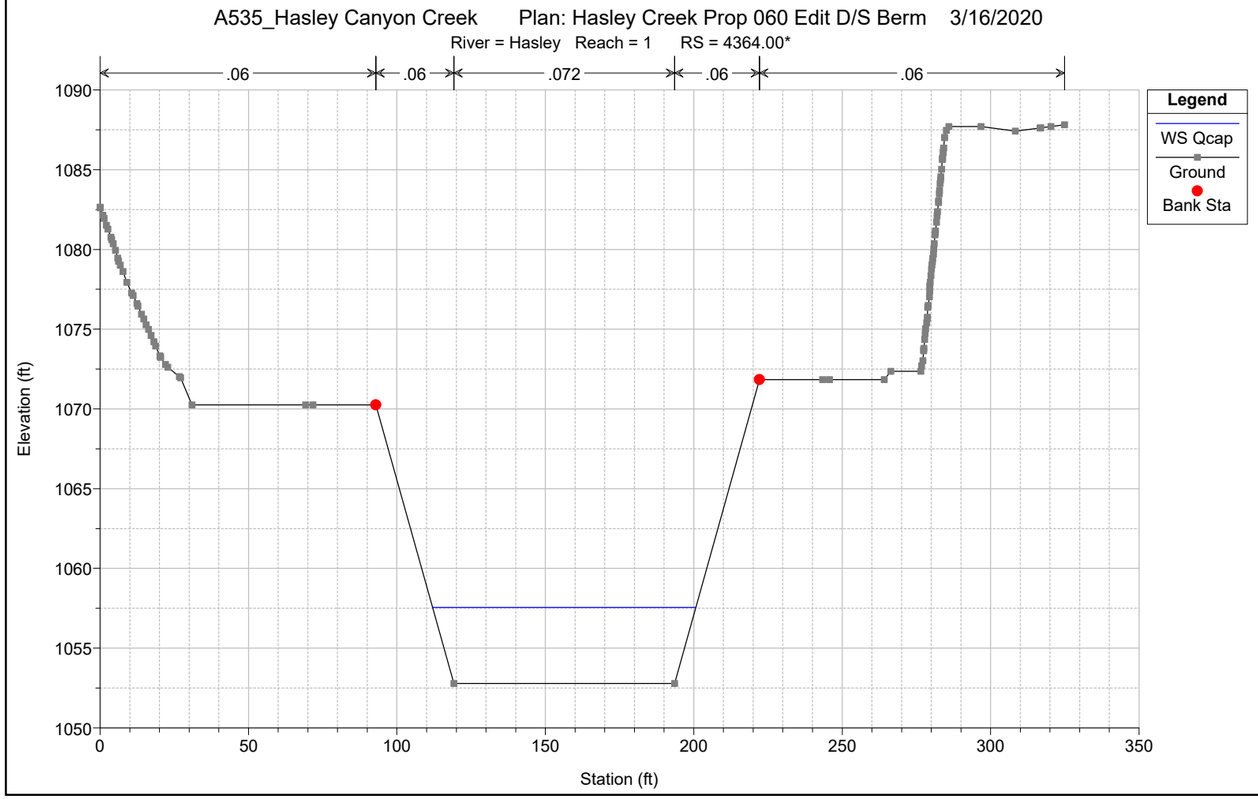

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 4725
.06
.015
.06
.015
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

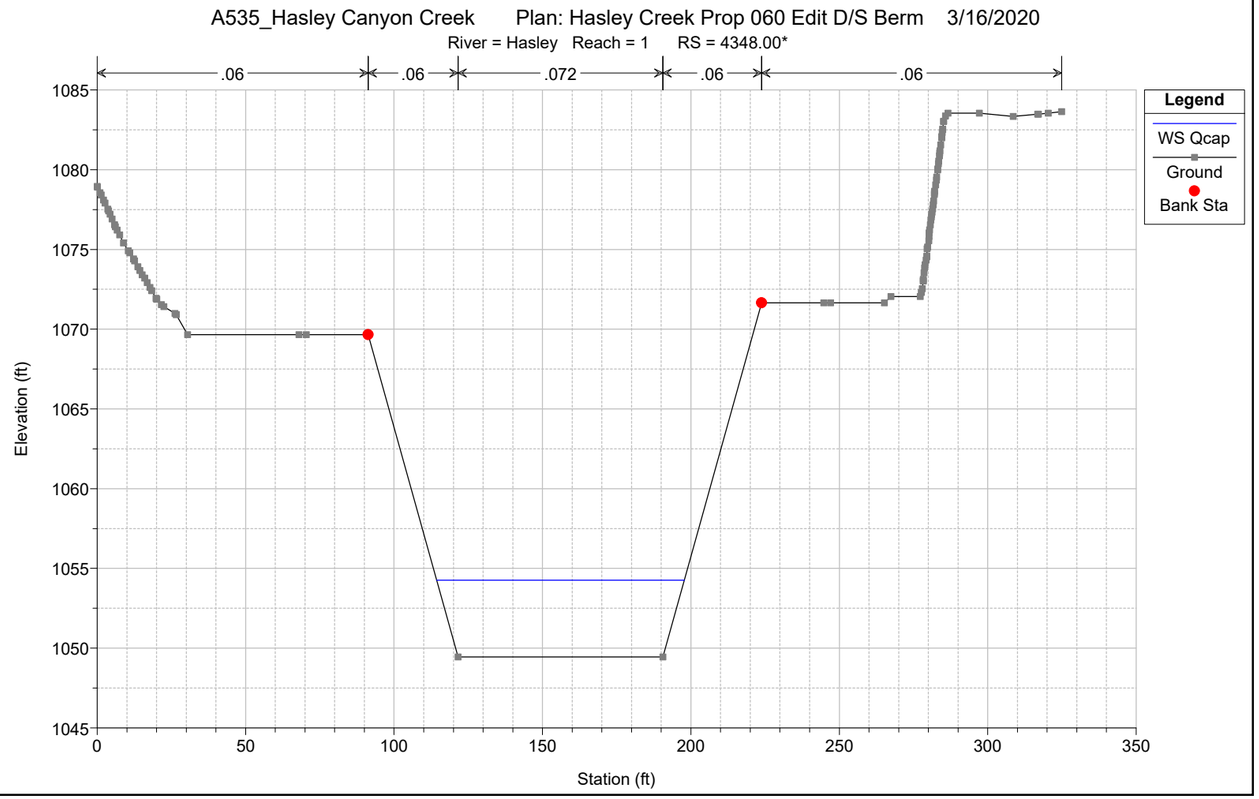

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 4622
.06
.015
.06
.015
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 4523
.06
.015
.06
.015
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 4396
.06
.06
.072
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

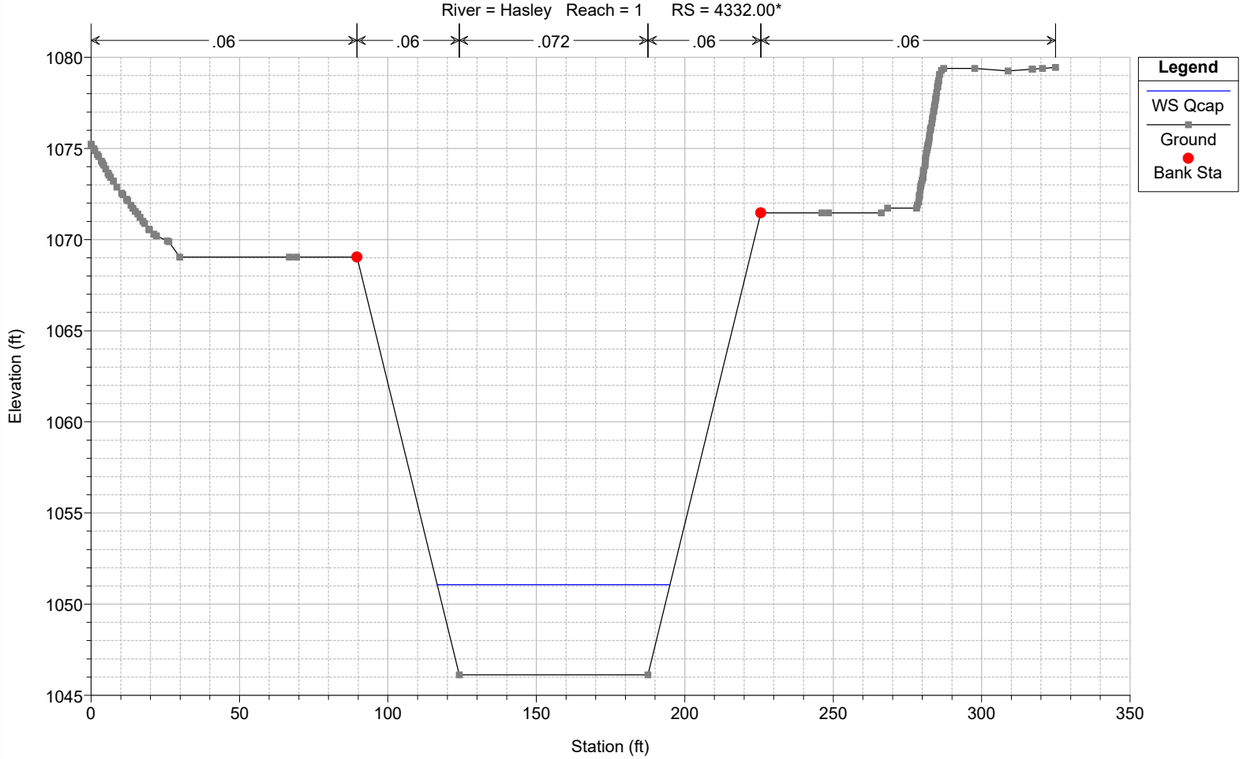

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 4380.00*
.06
.06
.072
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 4364.00*
.06
.06
.072
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 4348.00*
.06
.06
.072
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

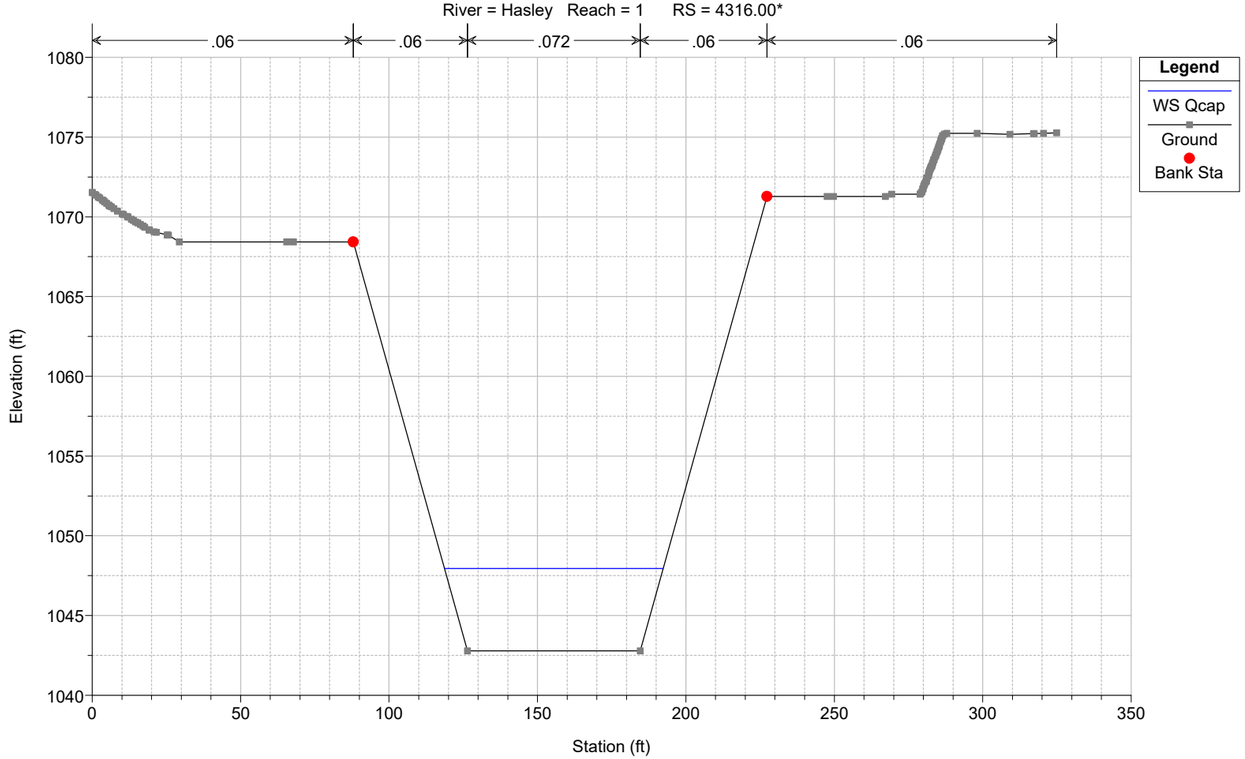
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4332.00*



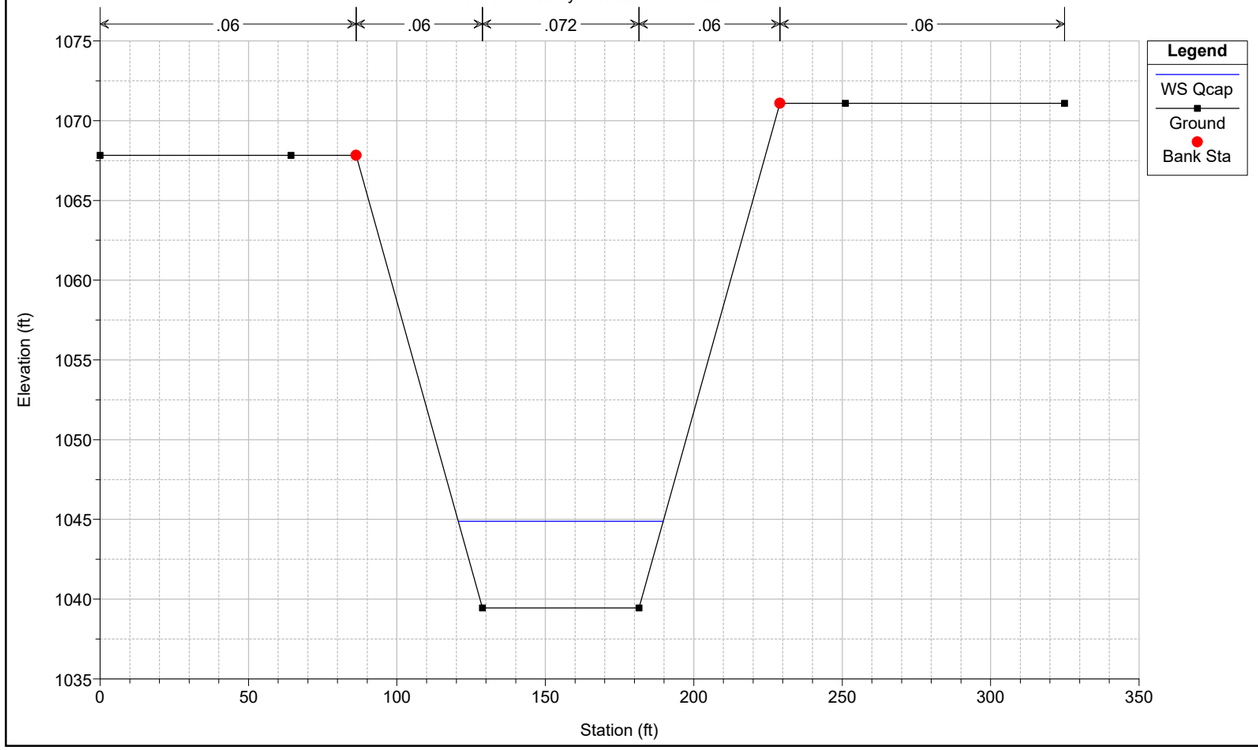
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4316.00*



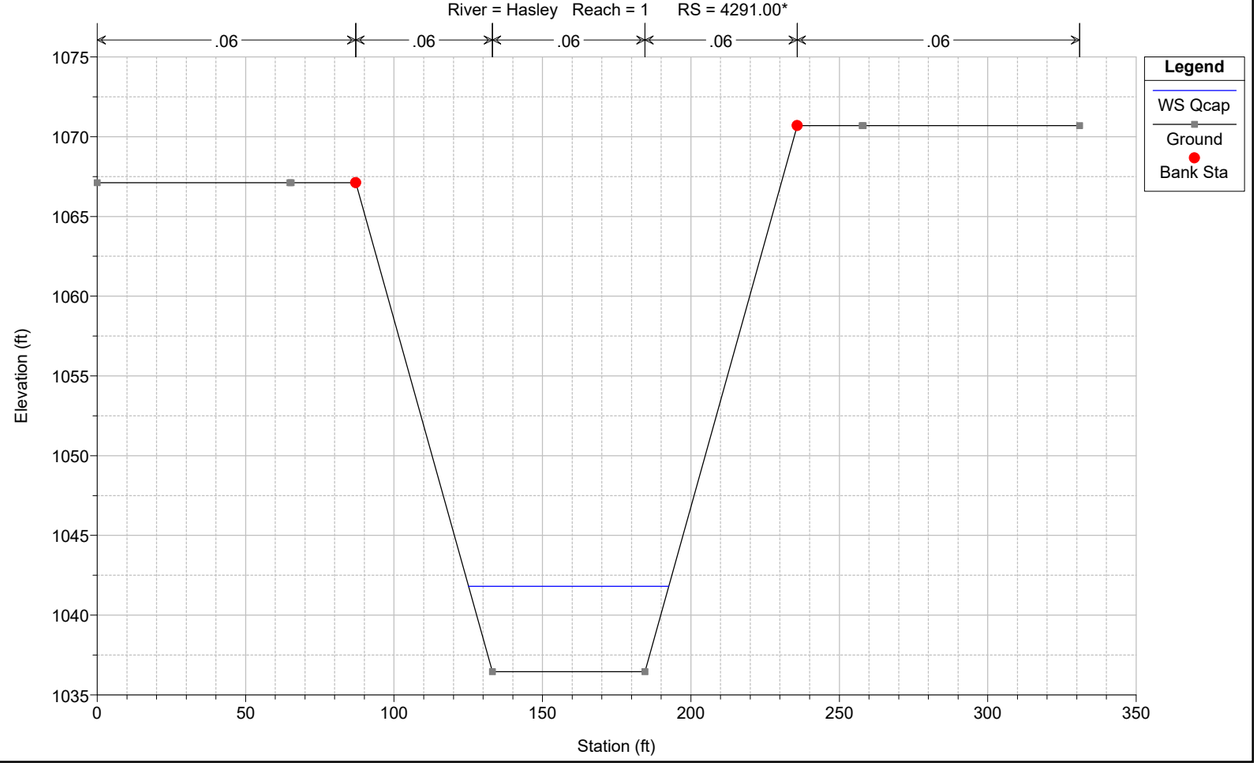
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4300



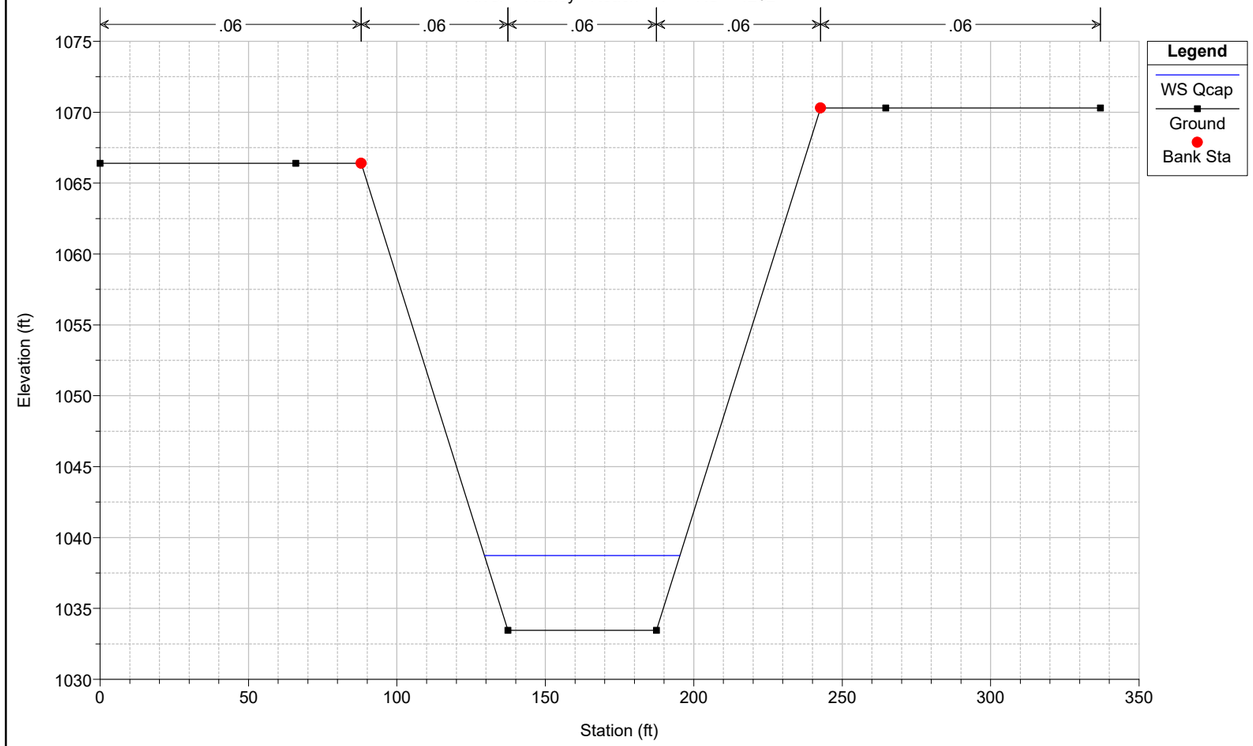
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4291.00*



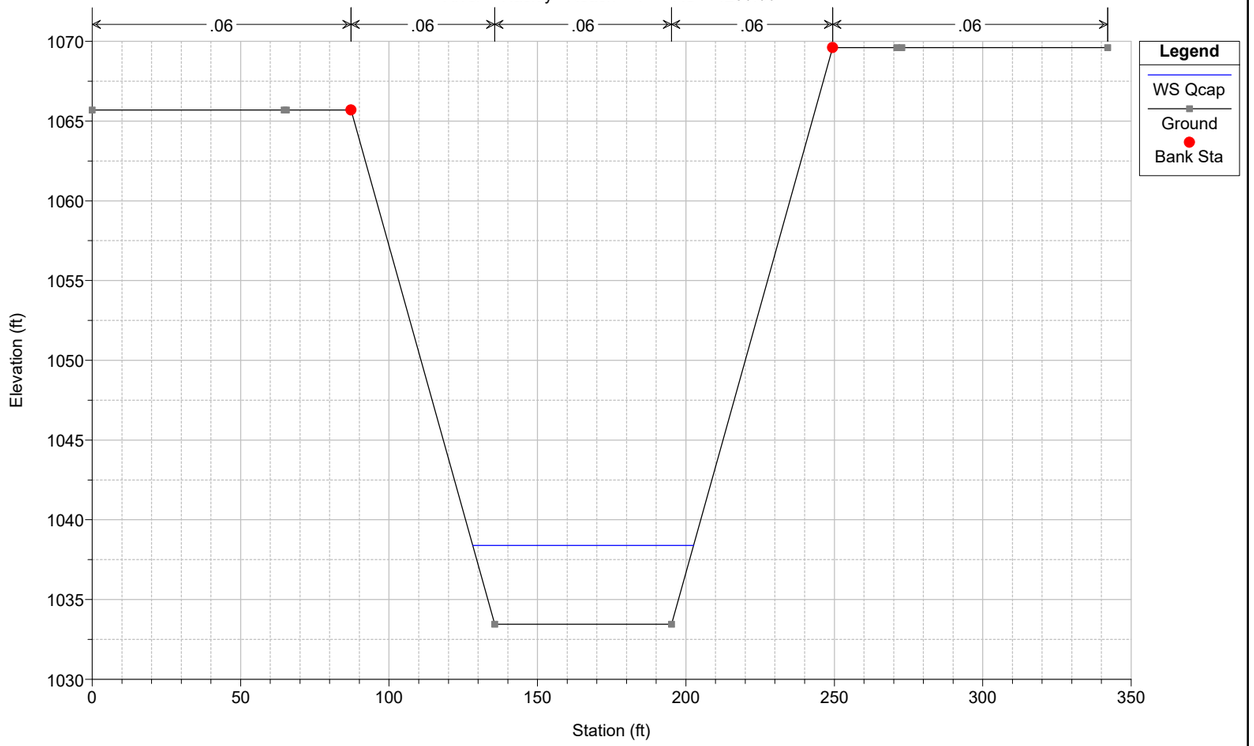
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4282



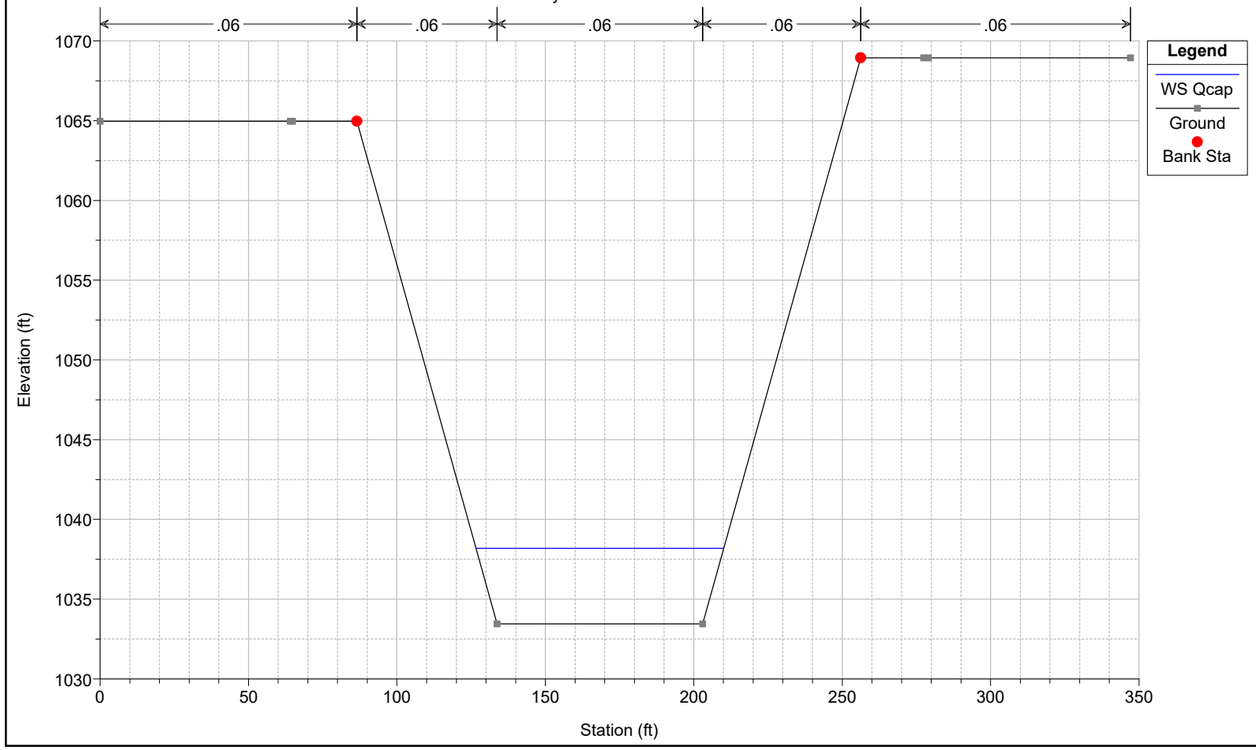
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4280.50*



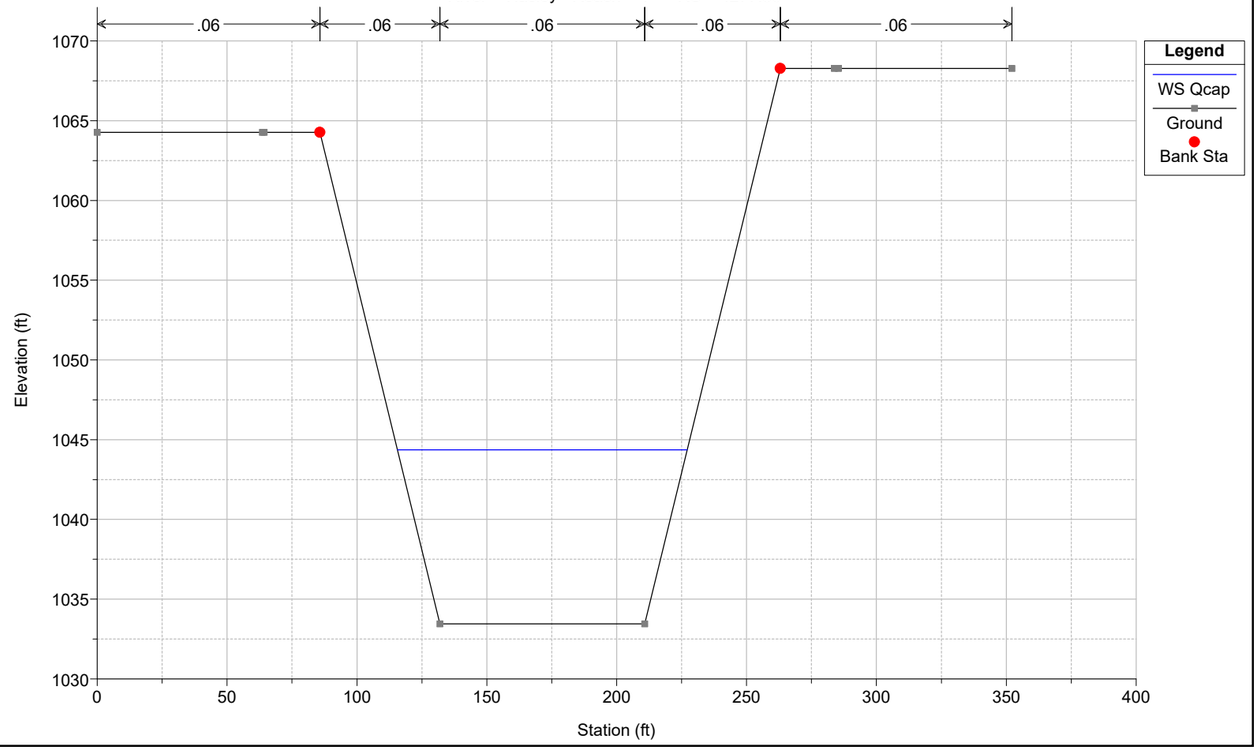
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4279.00*



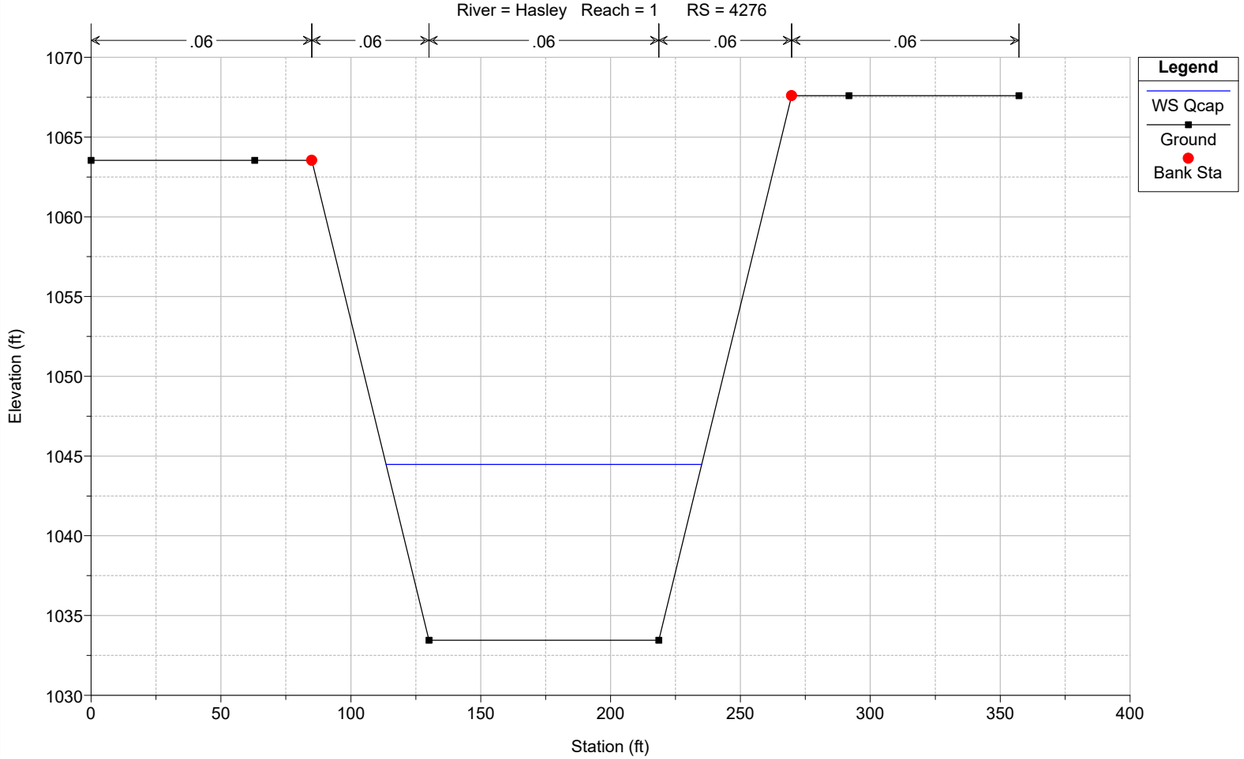
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4277.50*



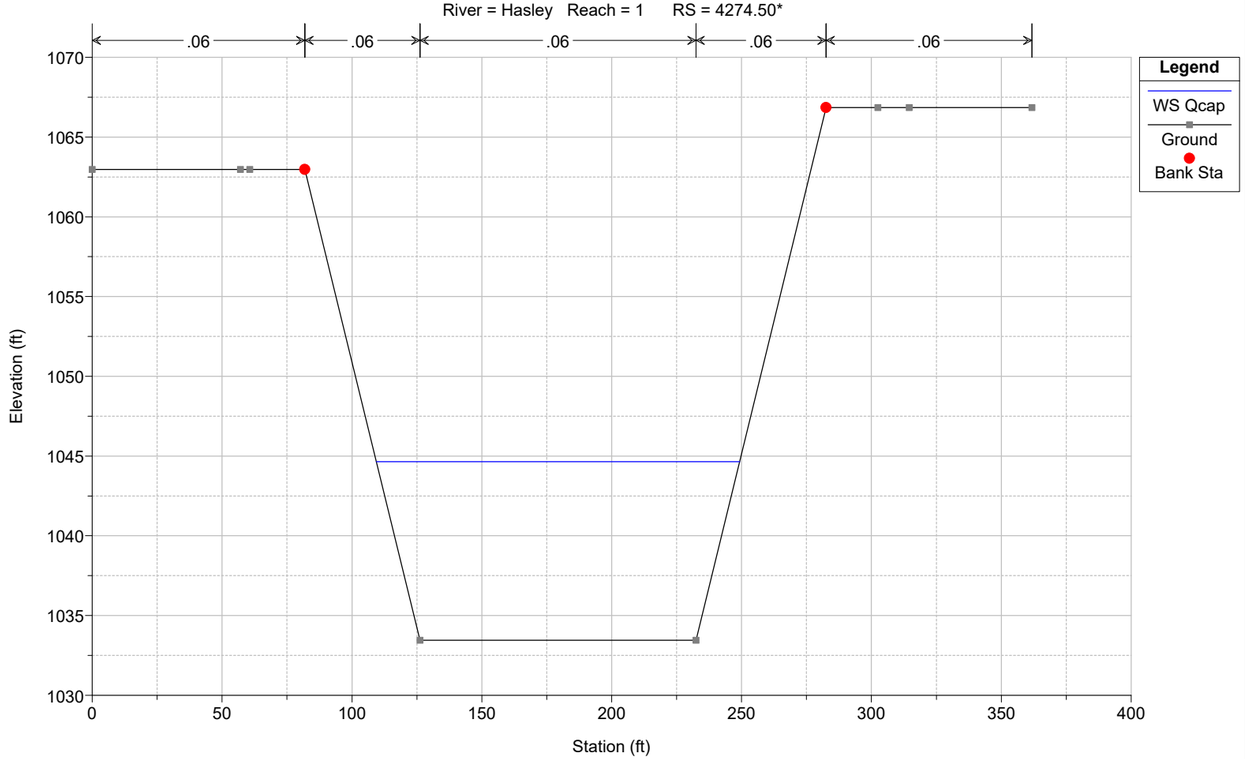
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4276



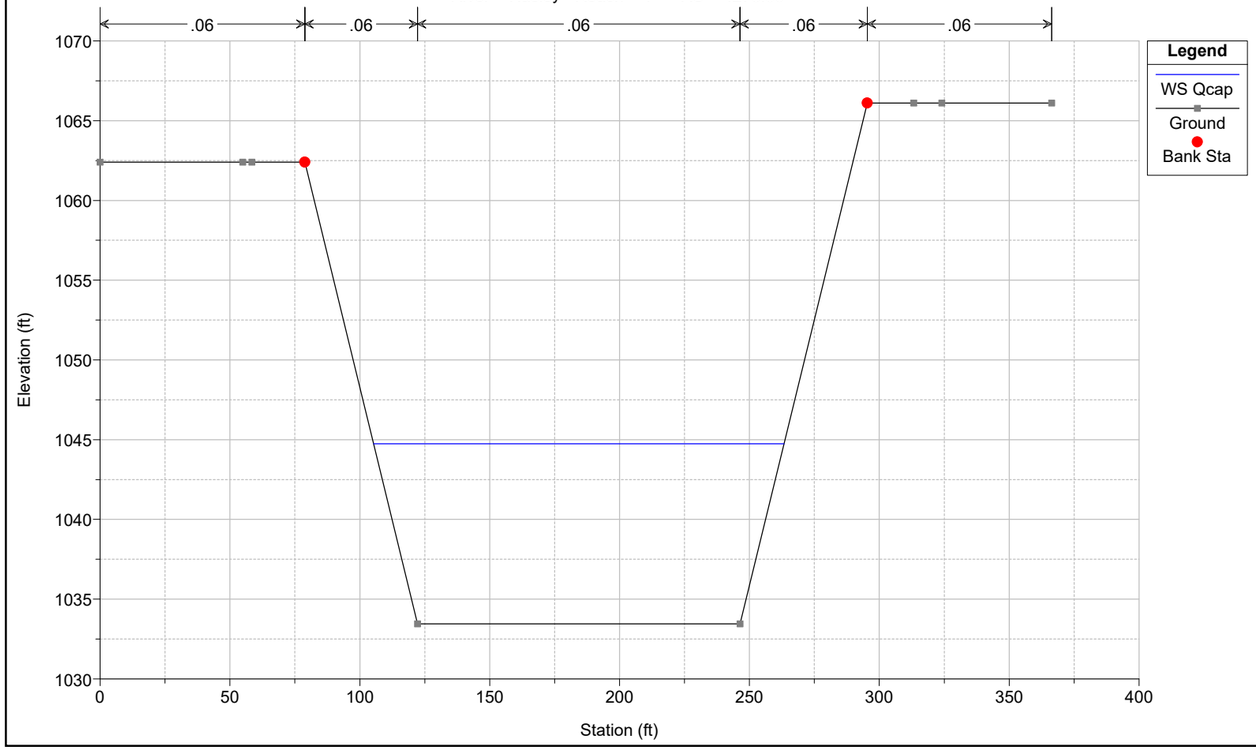
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4274.50*



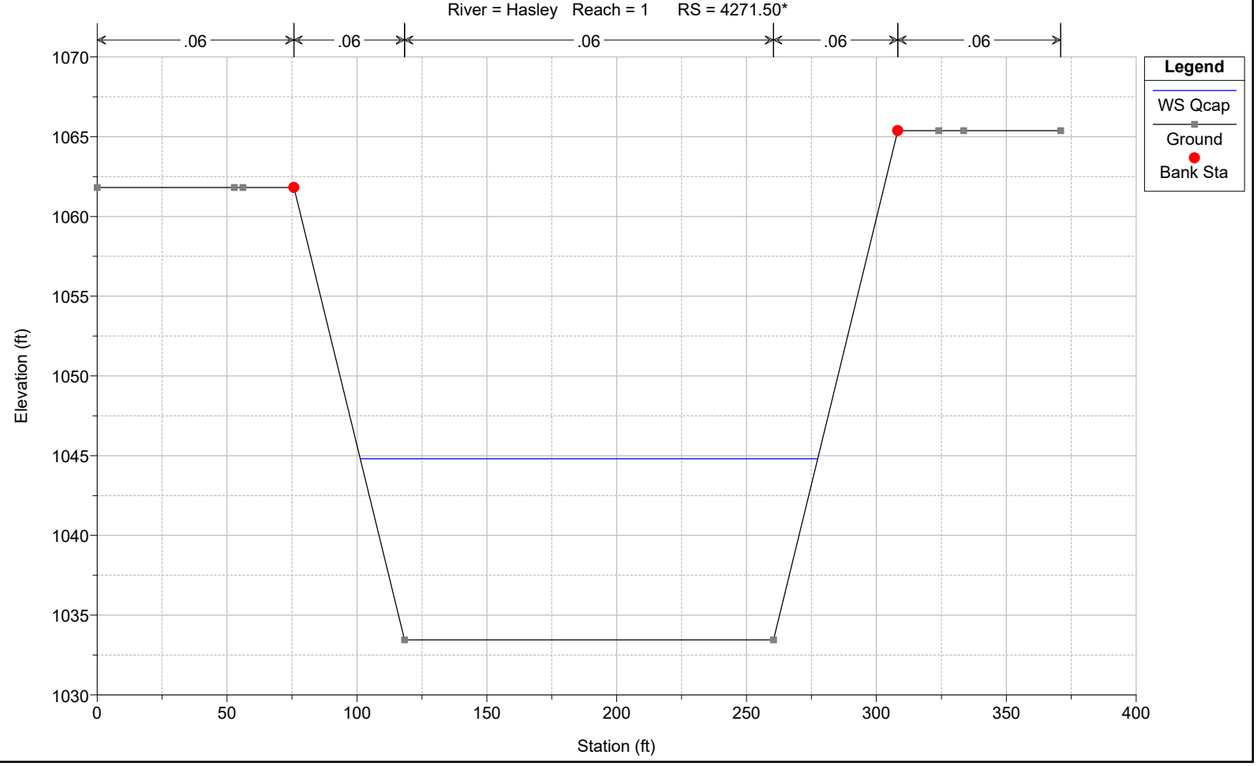
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4273.00*



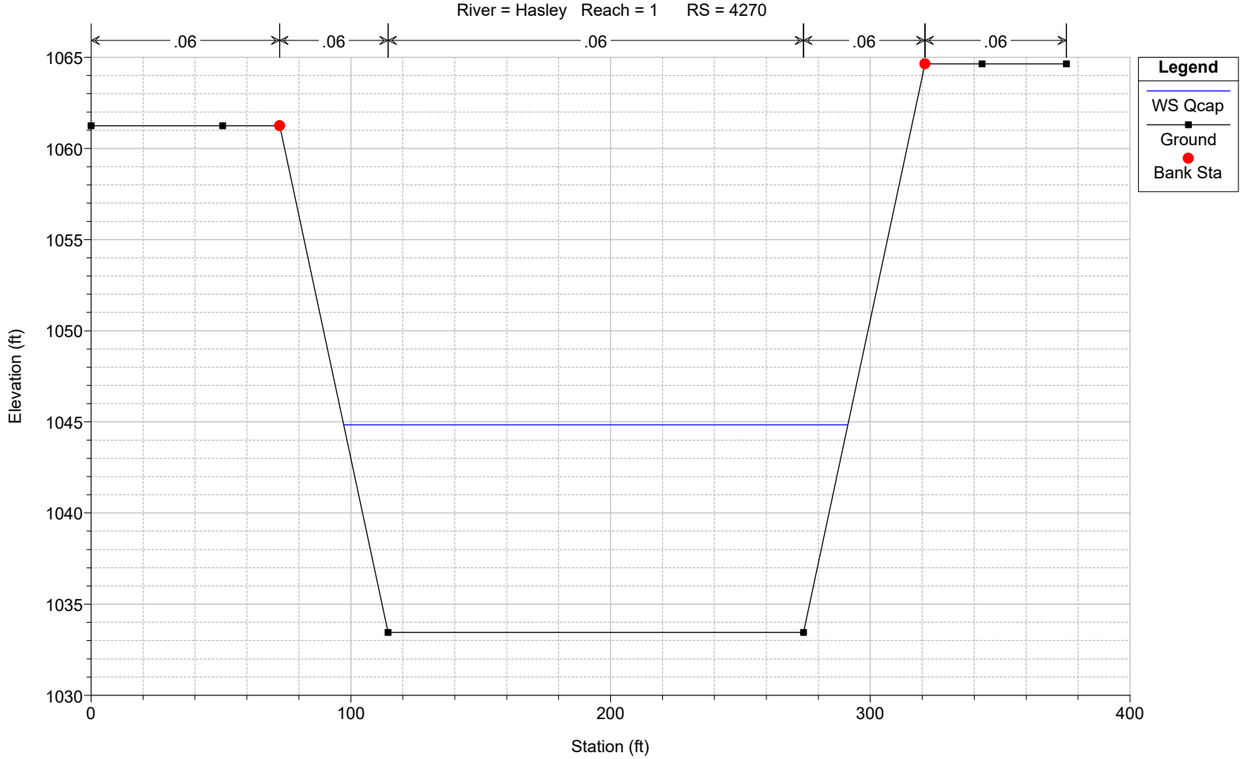
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4271.50*



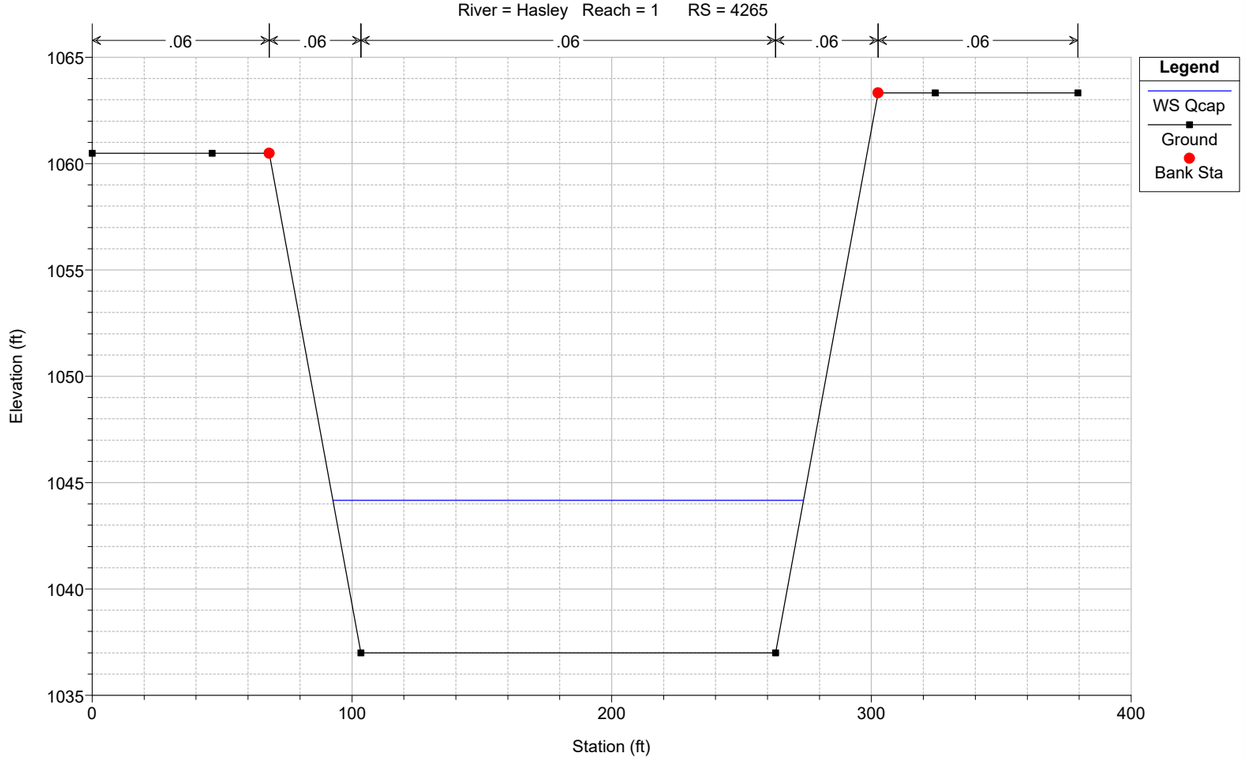
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4270



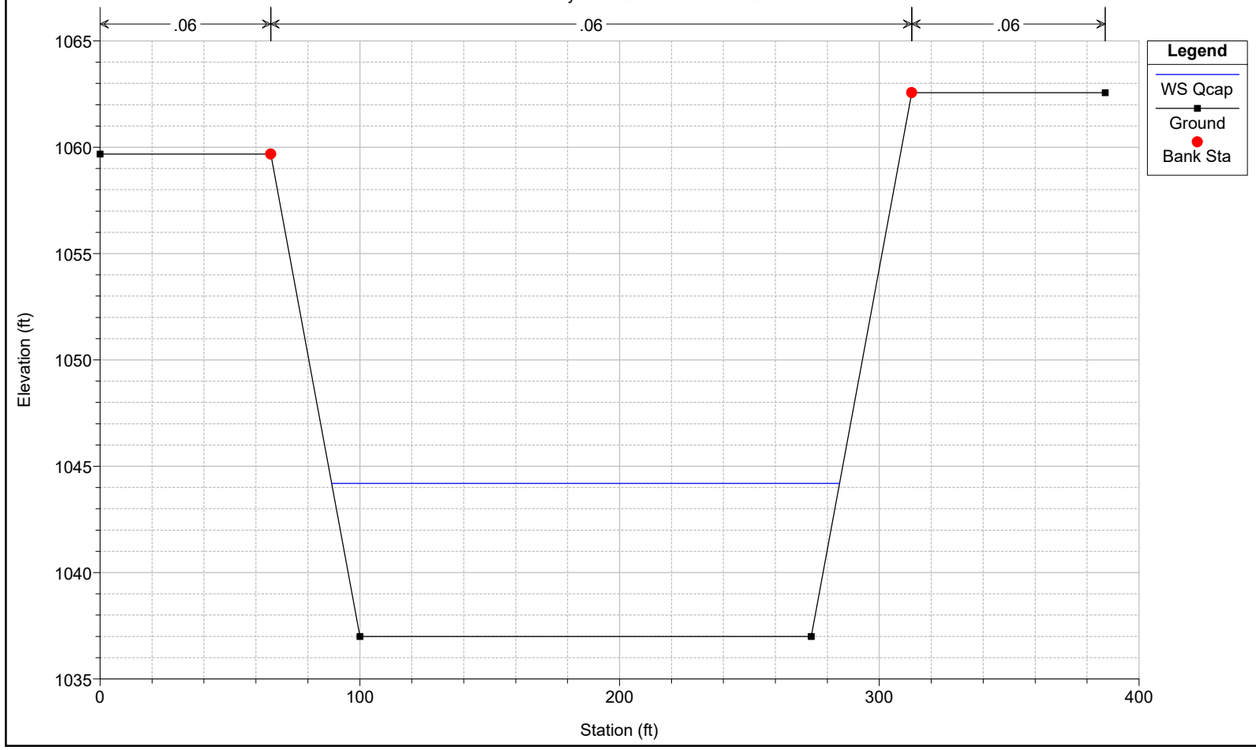
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4265



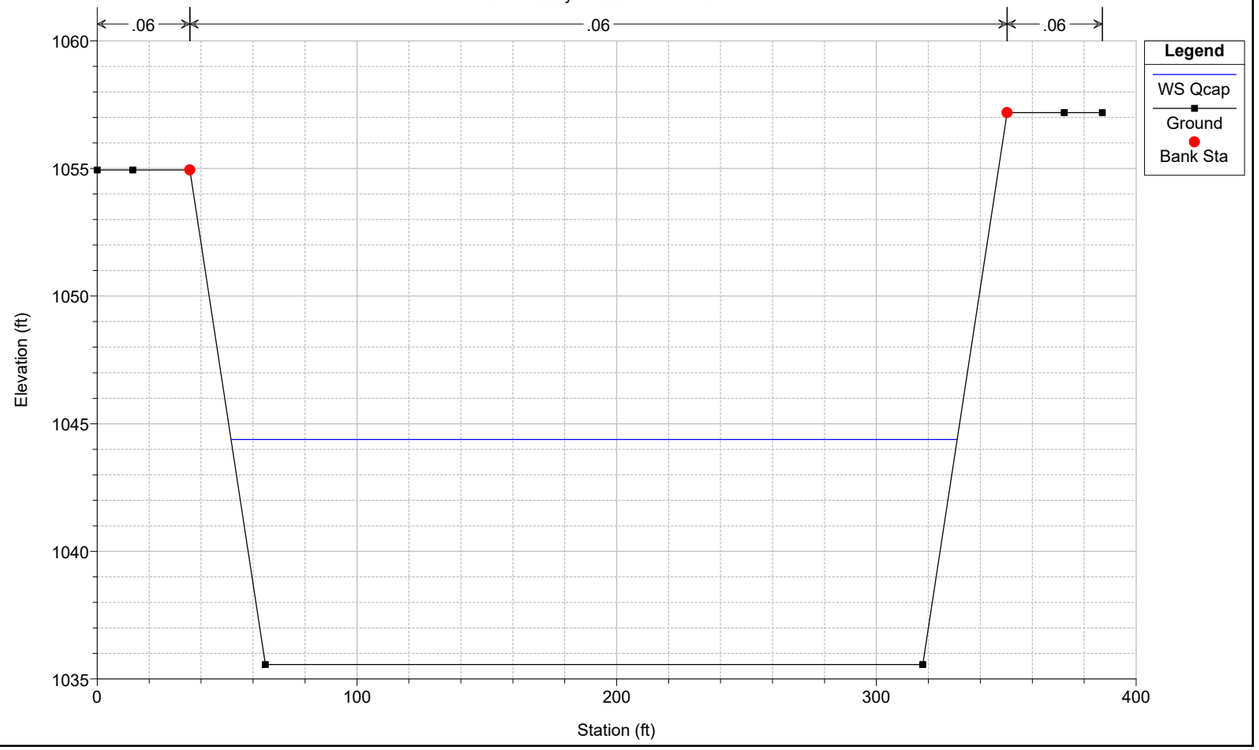
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 4258

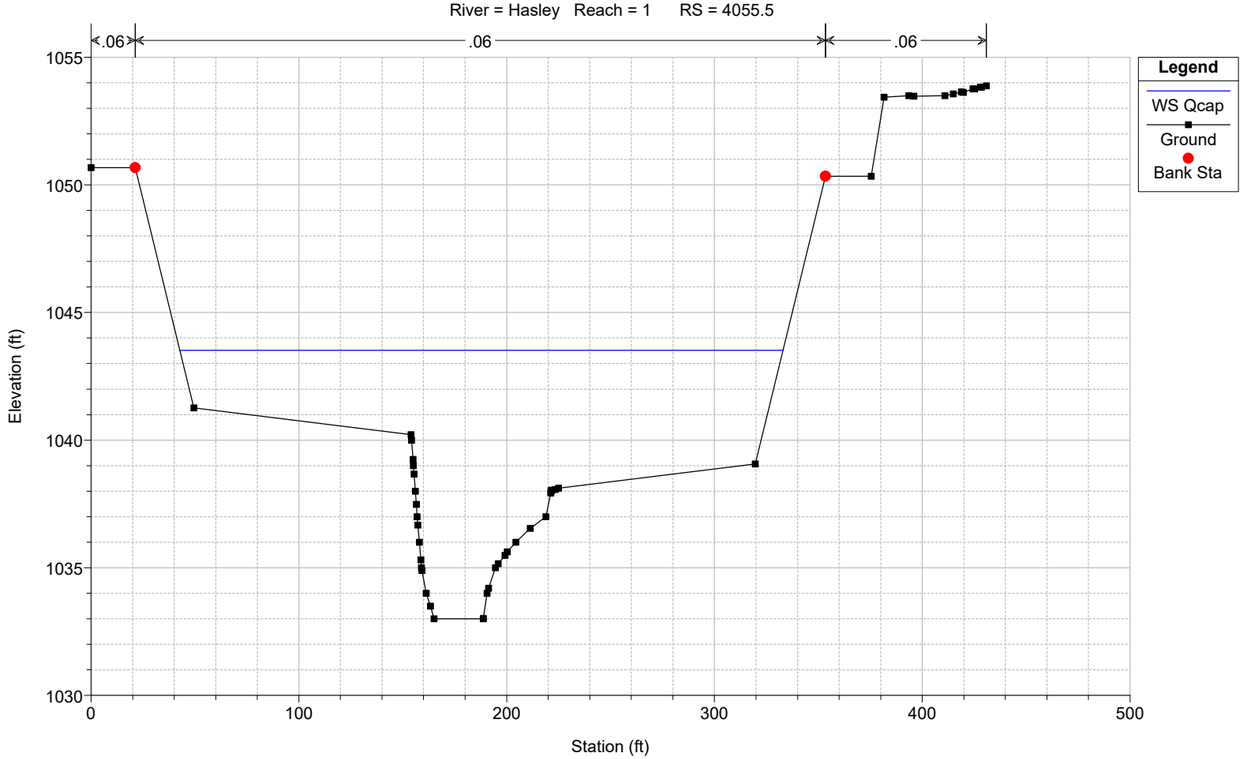


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

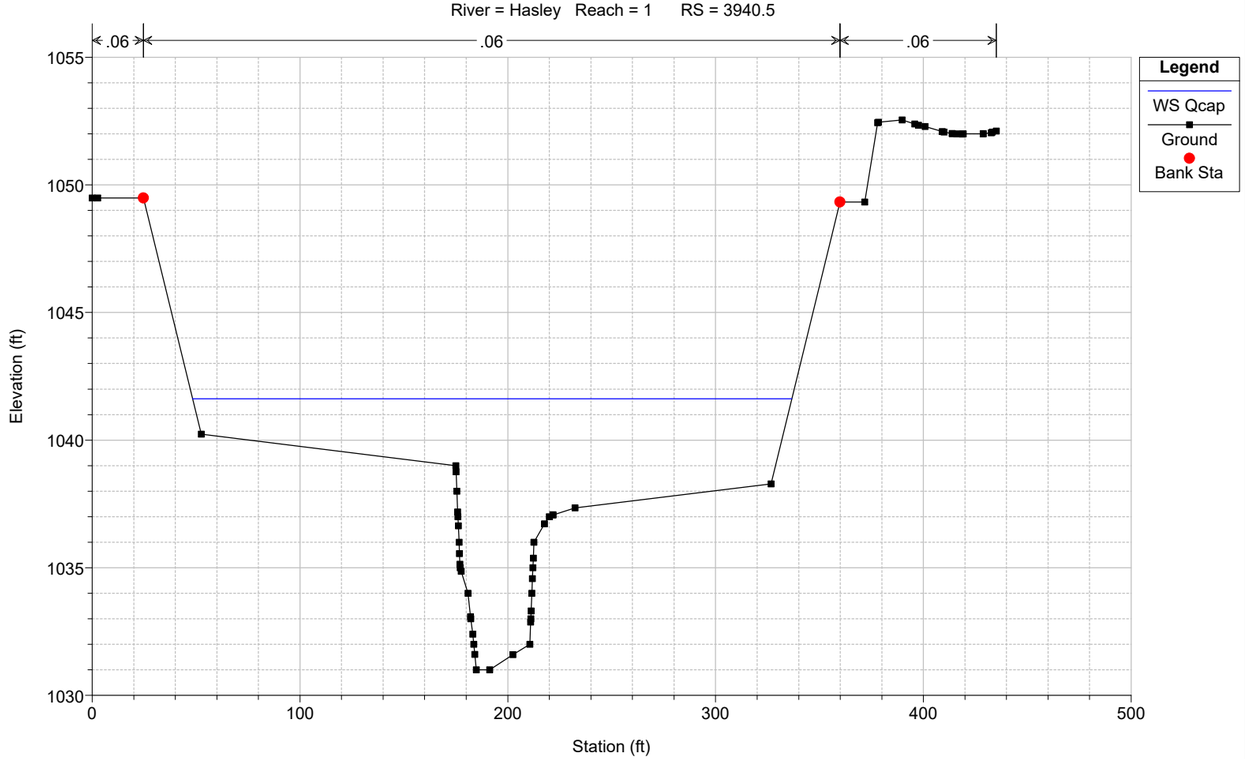
River = Hasley Reach = 1 RS = 4157



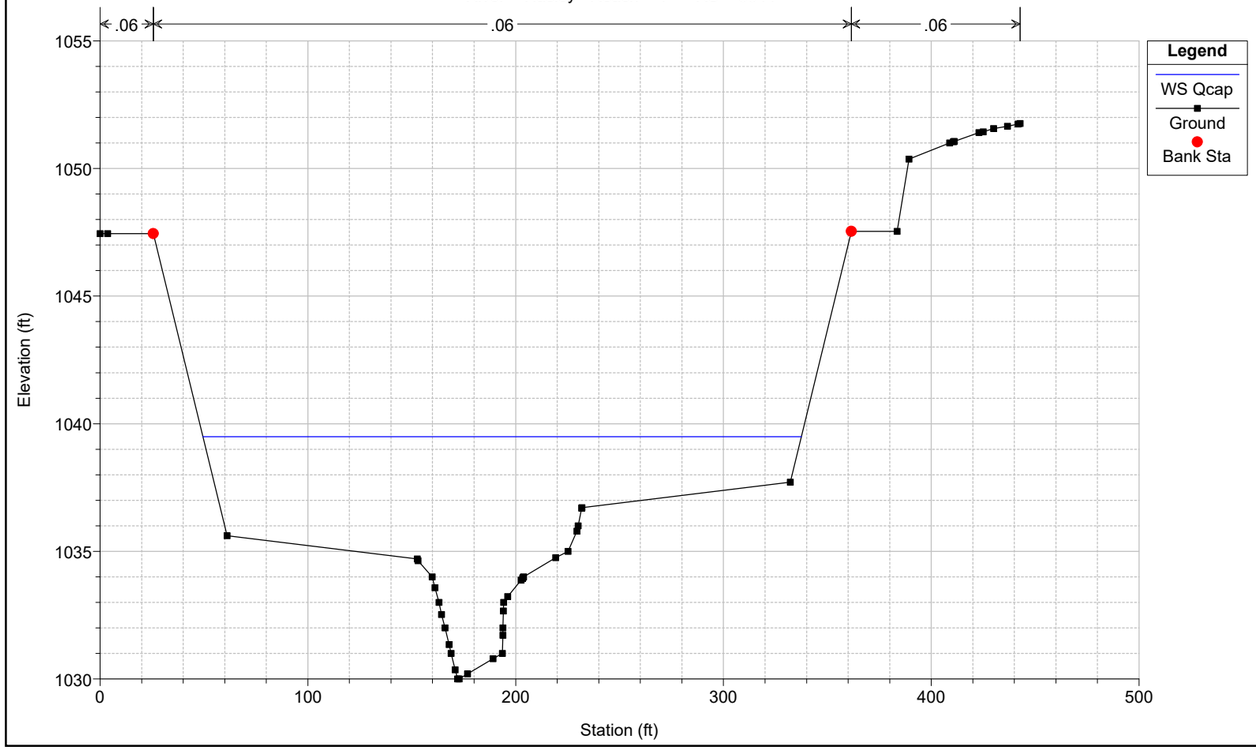
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 4055.5



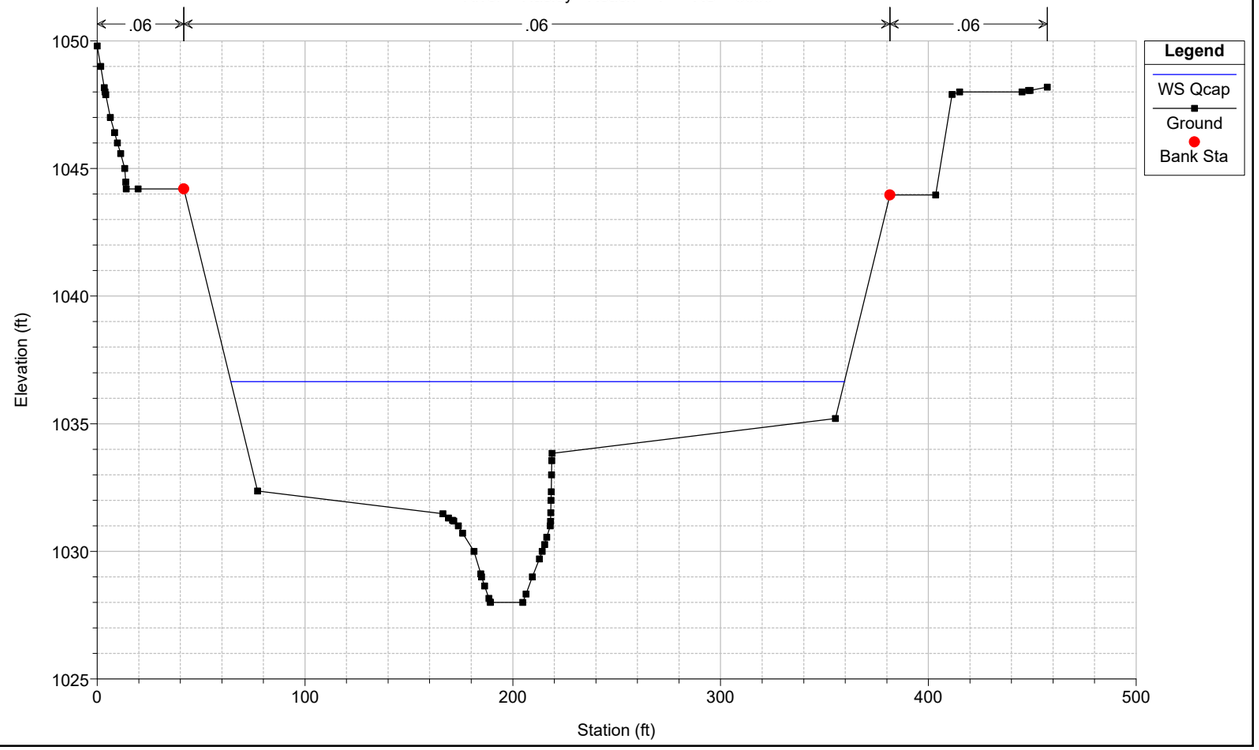
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 3940.5

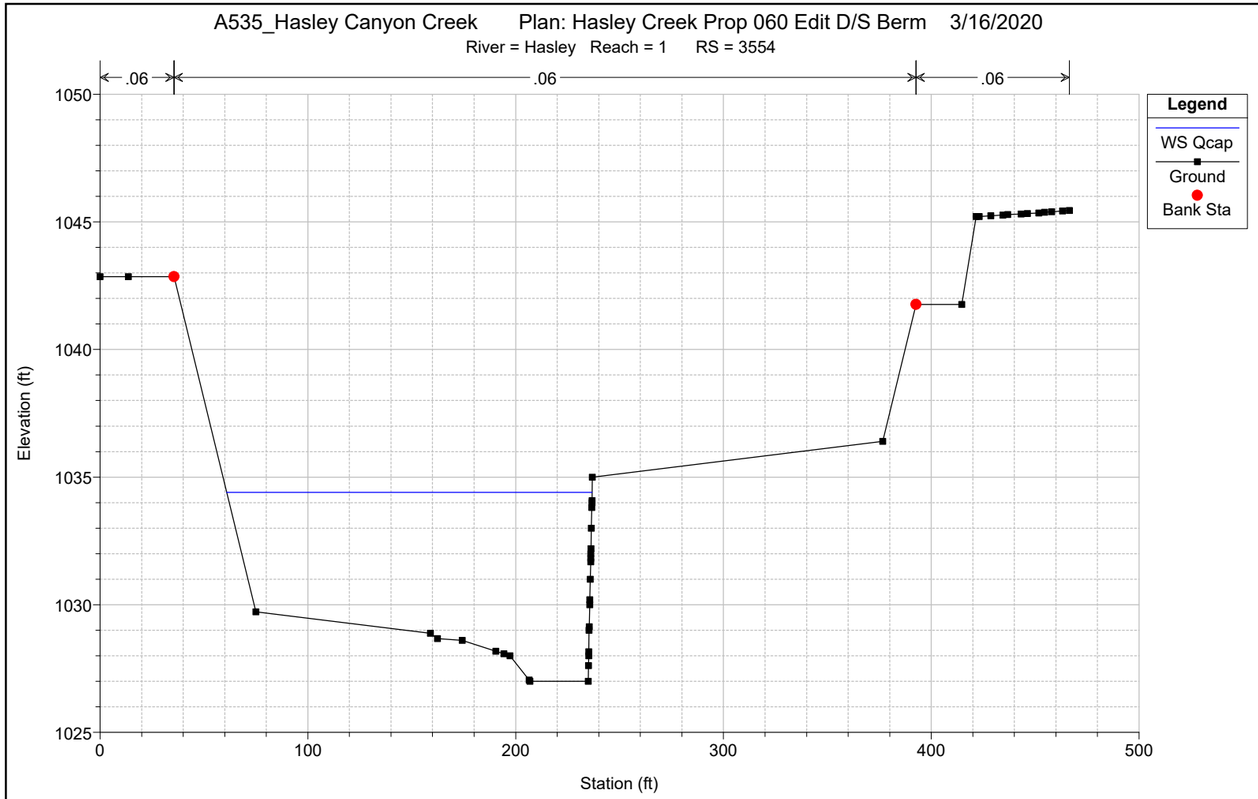


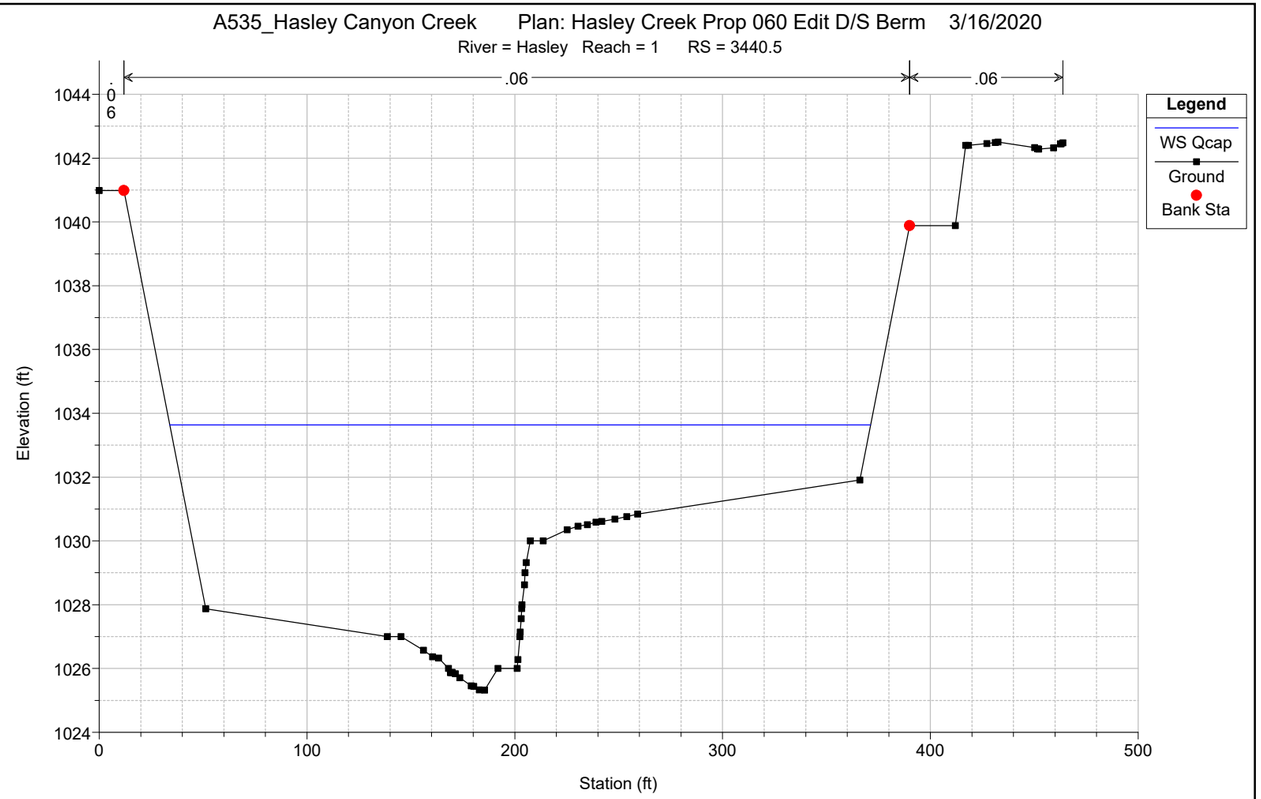
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 3844



A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 3650




A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 3554
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 3440.5
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1044
1042
1040
1038
1036
1034
1032
1030
1028
1026
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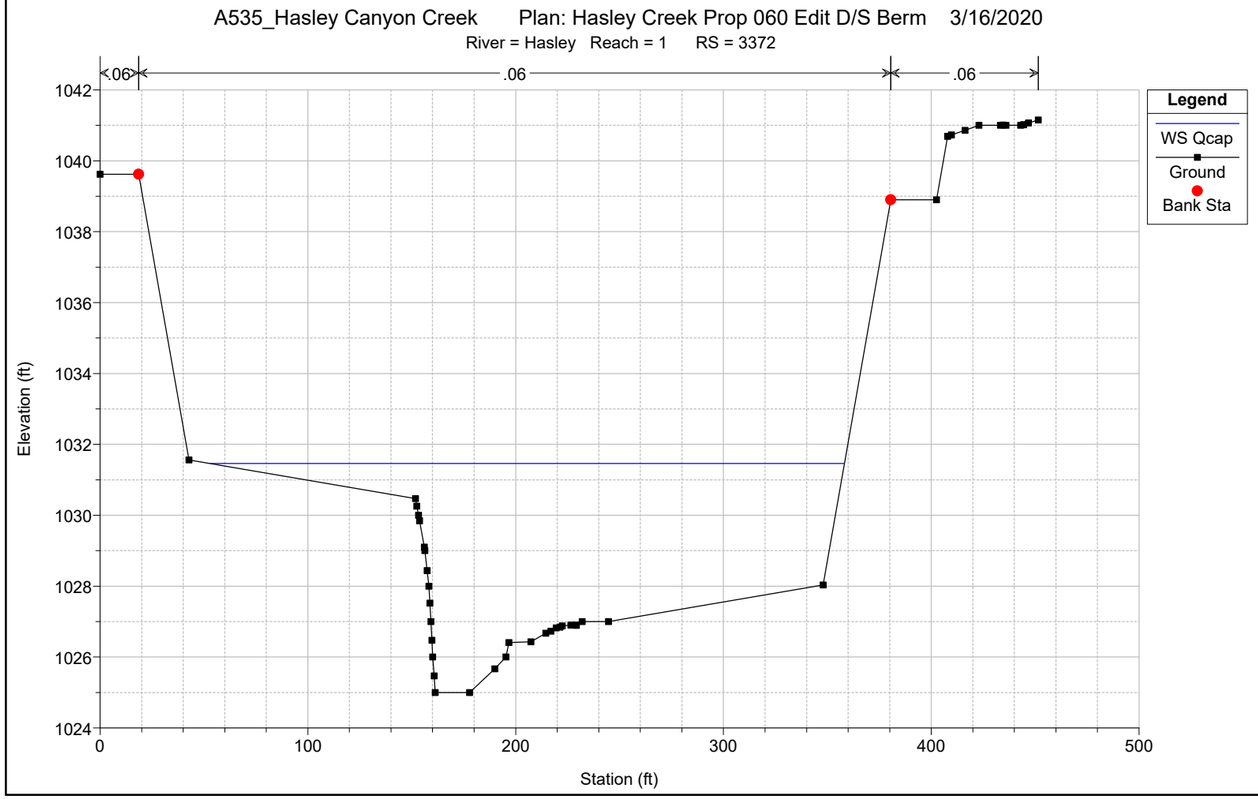
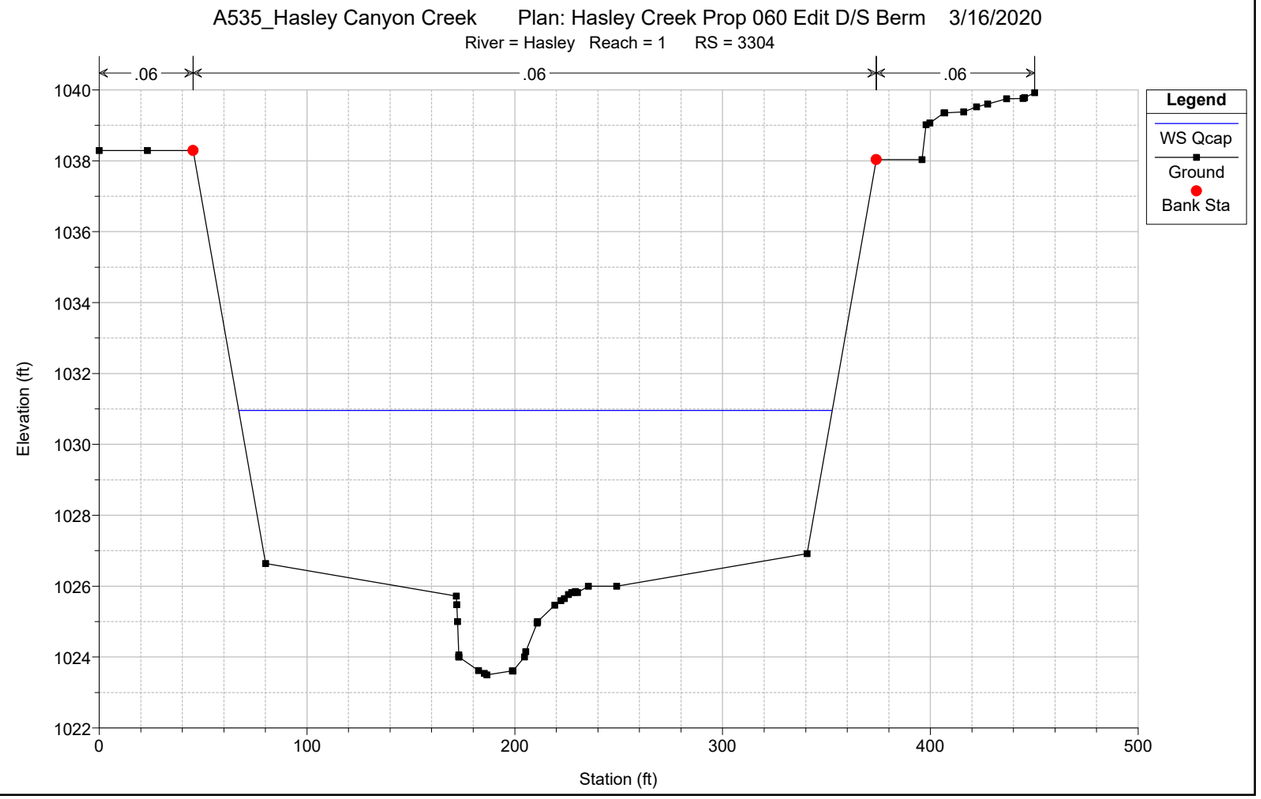
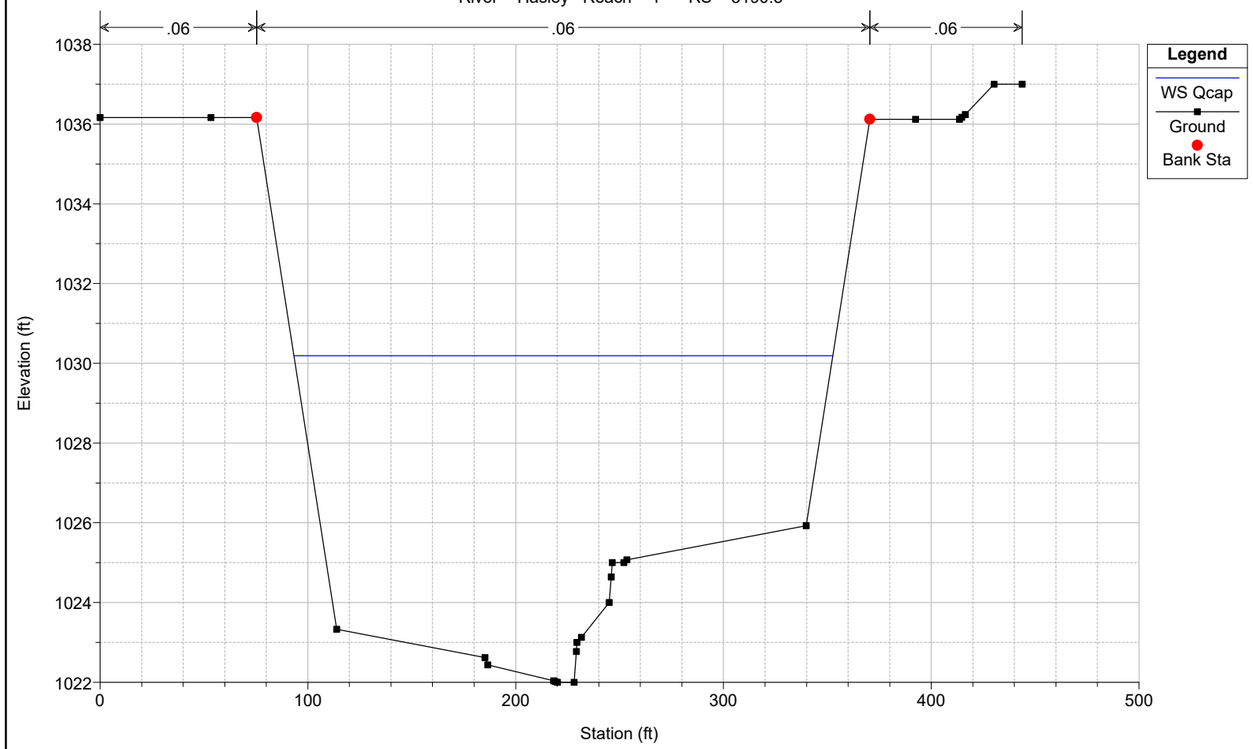
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 3372
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1042
1040
1038
1036
1034
1032
1030
1028
1026
1024
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 3304
.06
.06
.06
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1040
1038
1036
1034
1032
1030
1028
1026
1024
1022
0
100
200
300
400
500

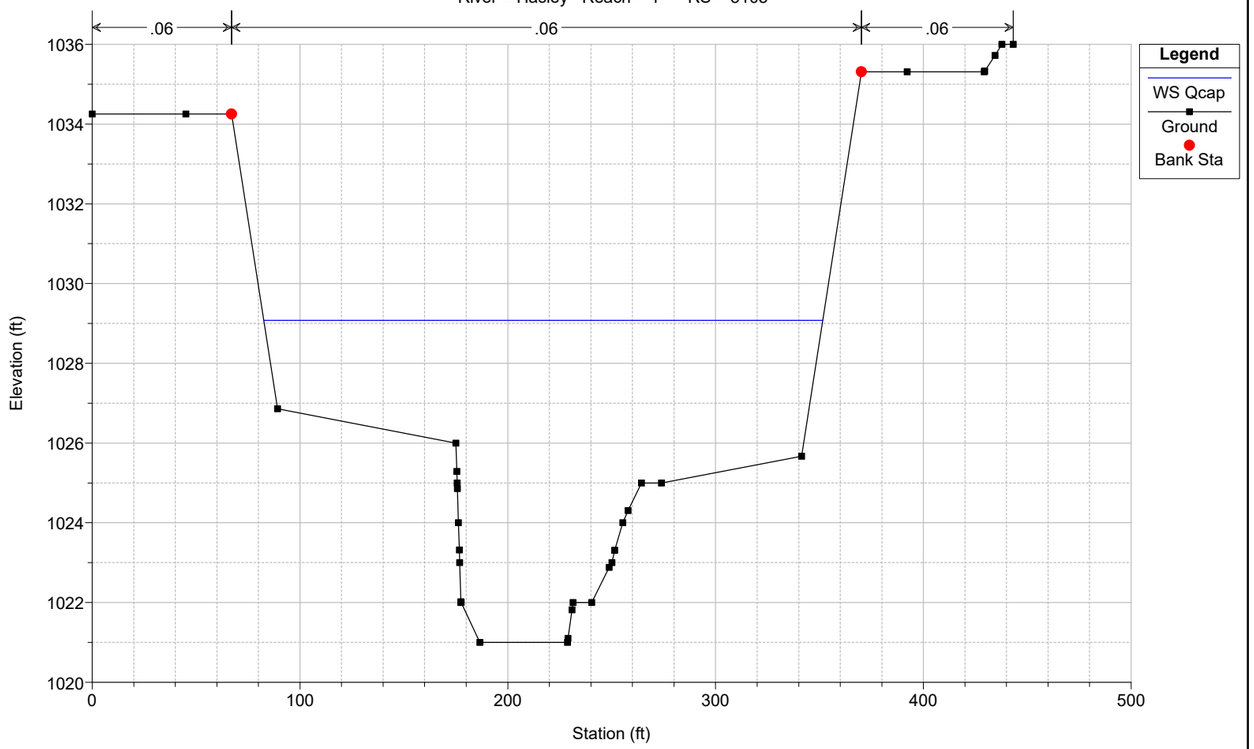
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 3190.5



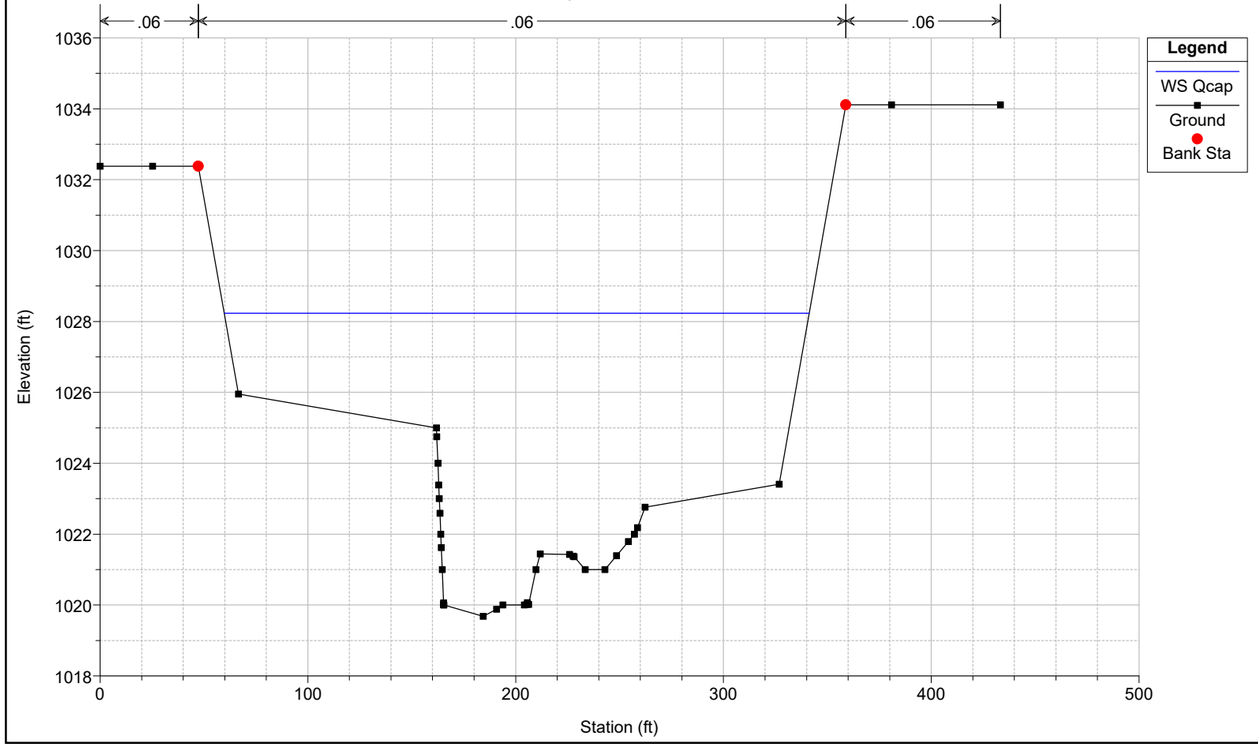
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 3105



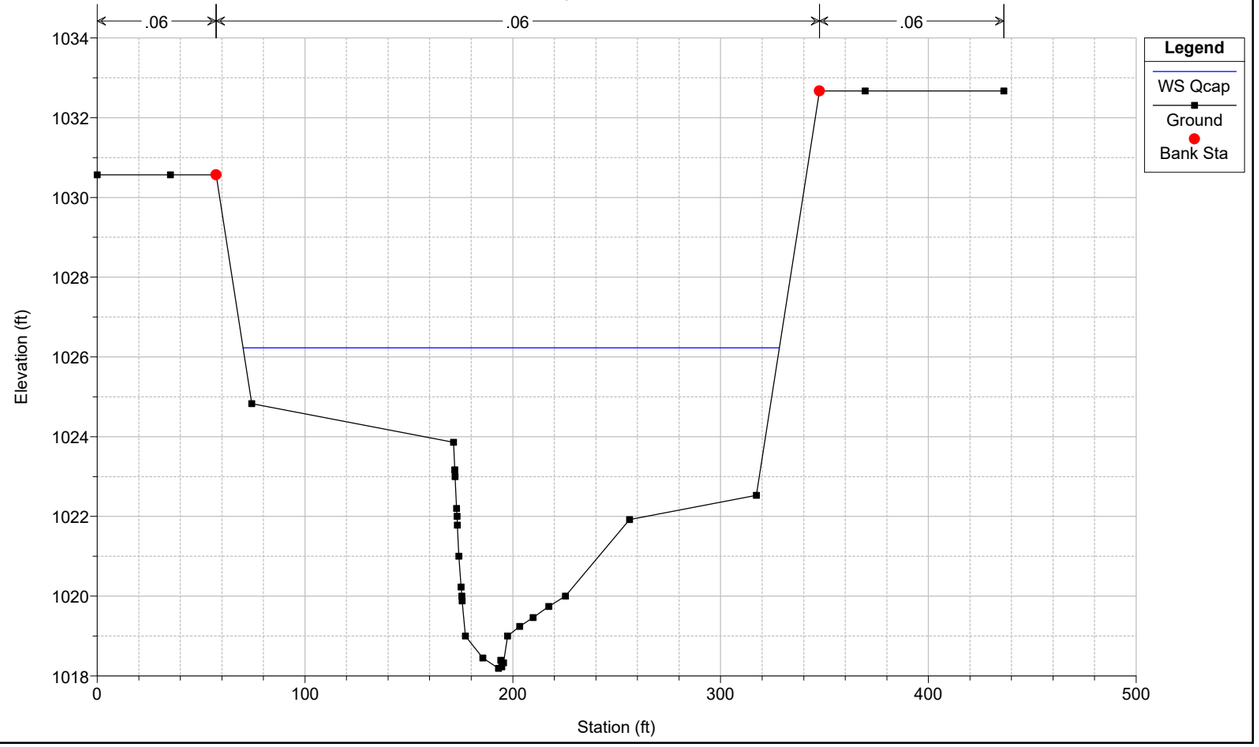
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 3020

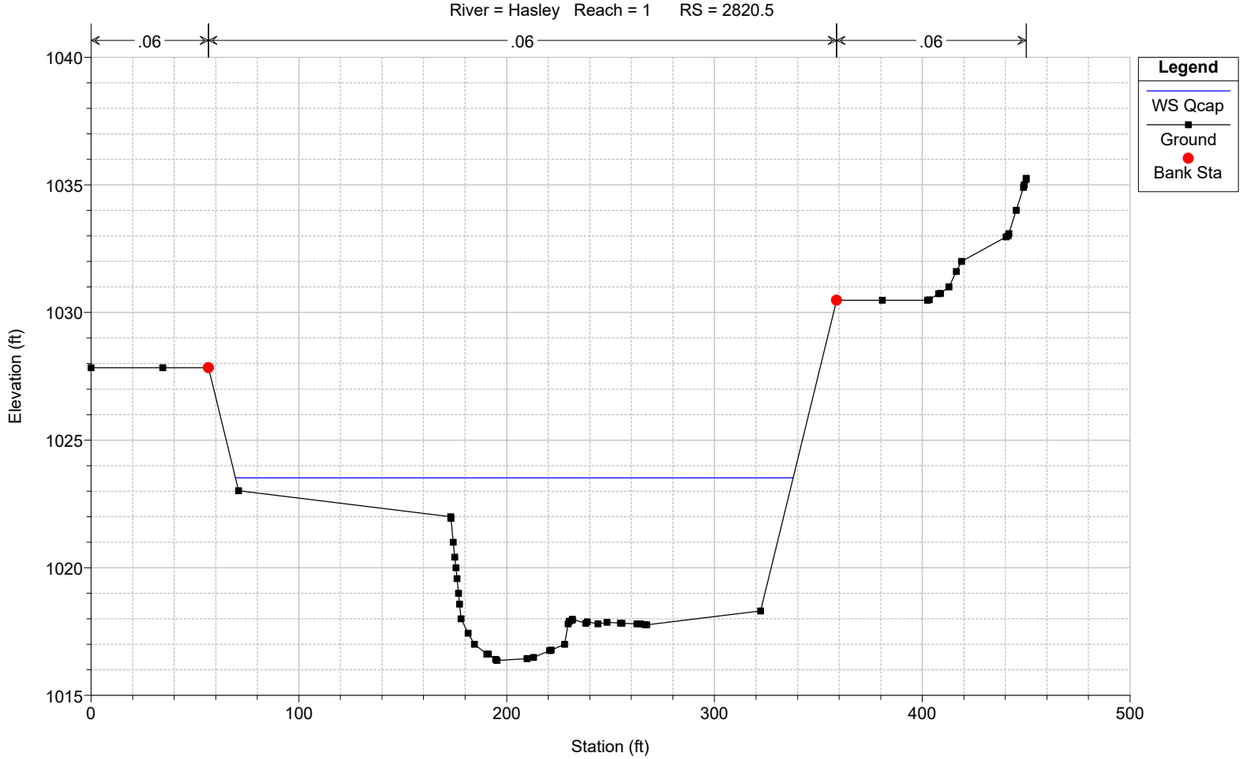


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

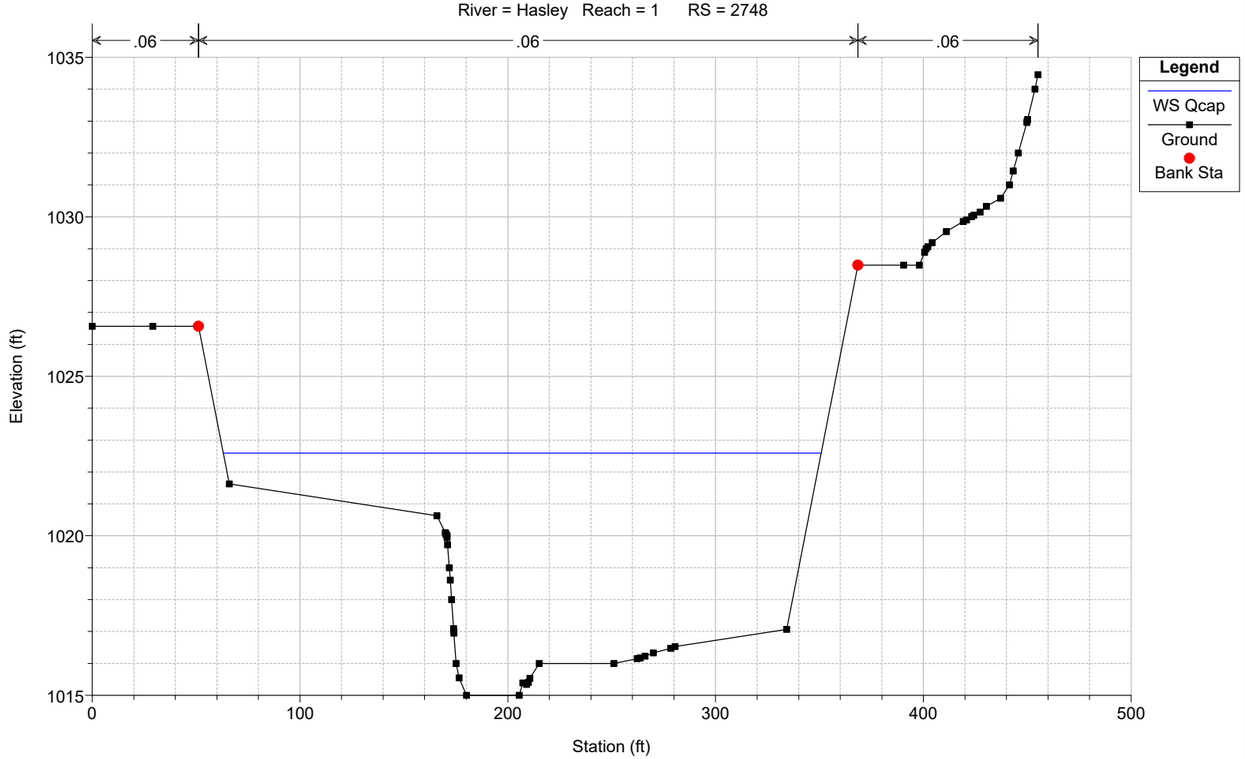
River = Hasley Reach = 1 RS = 2934



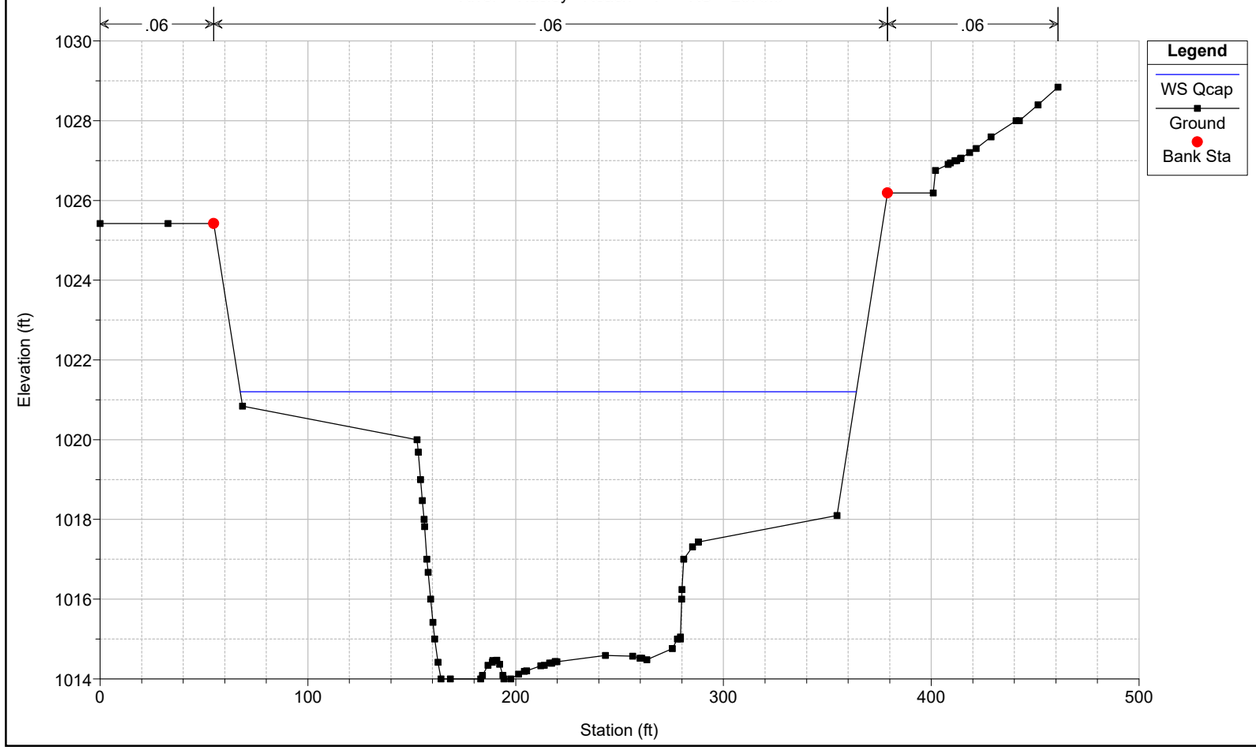
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 2820.5



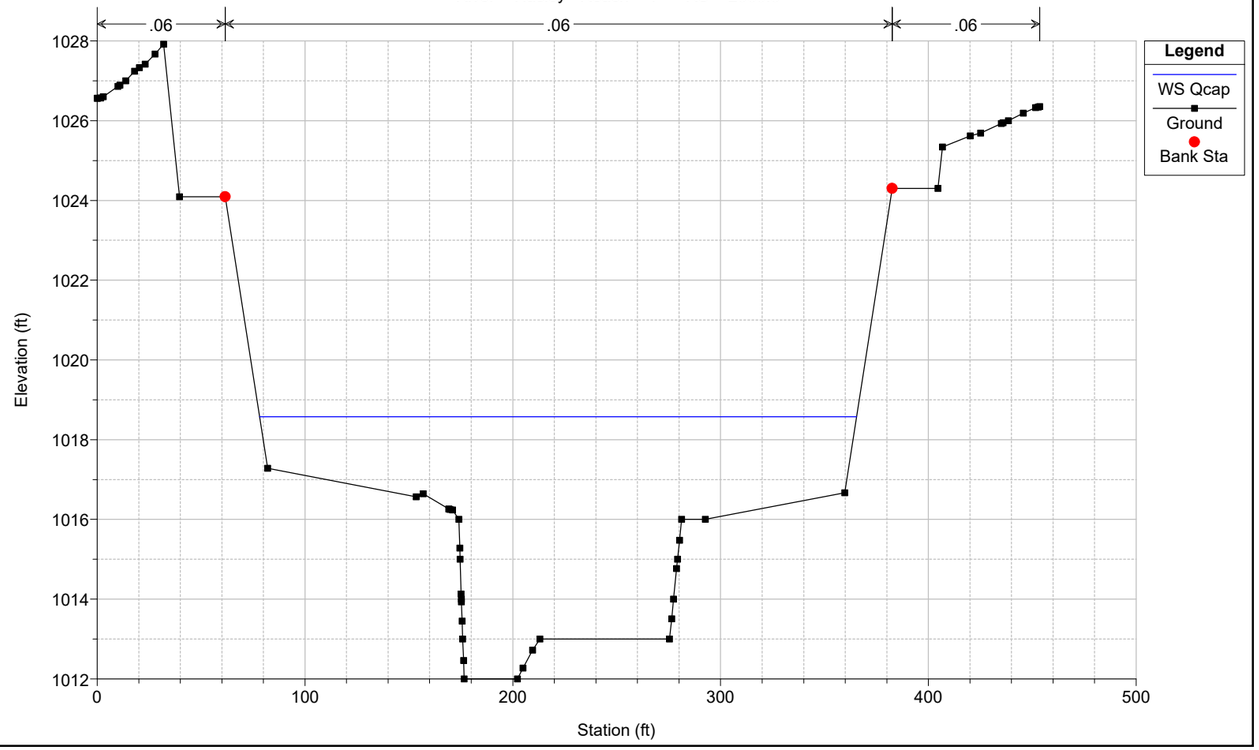
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 2748



A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 2675.5

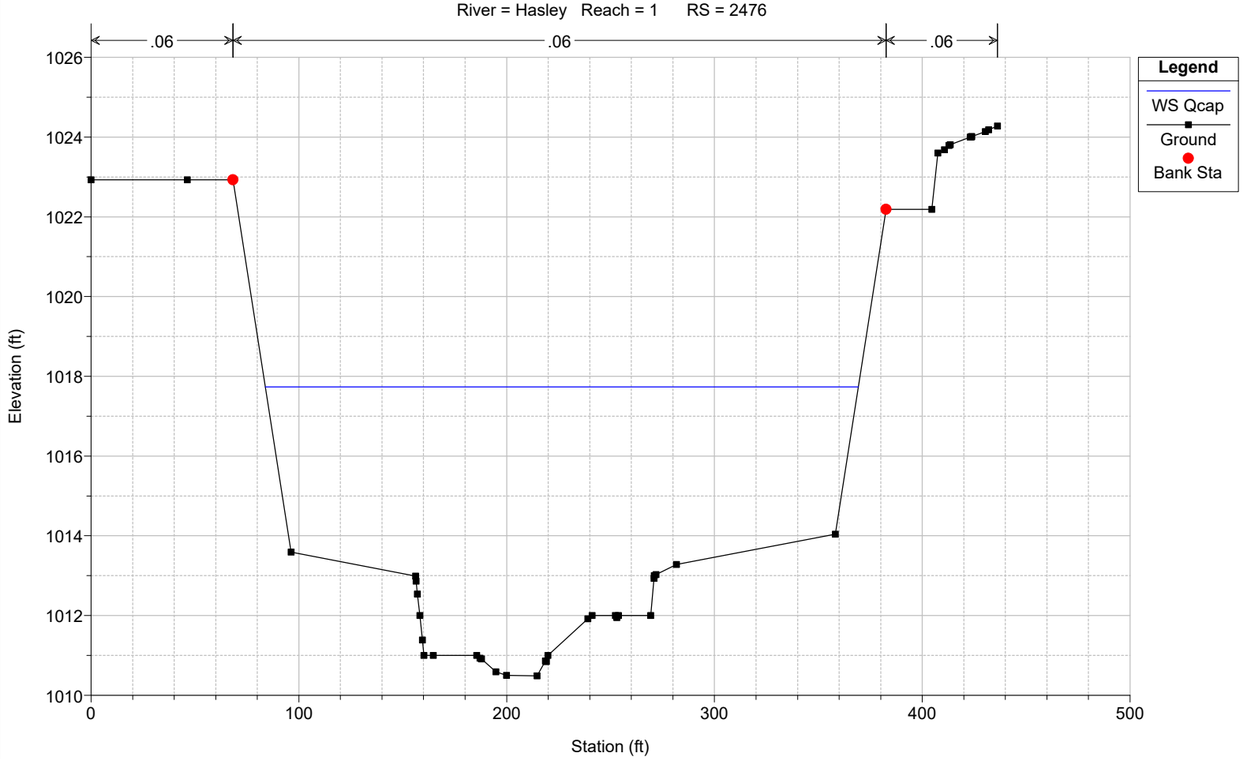


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 2560.5



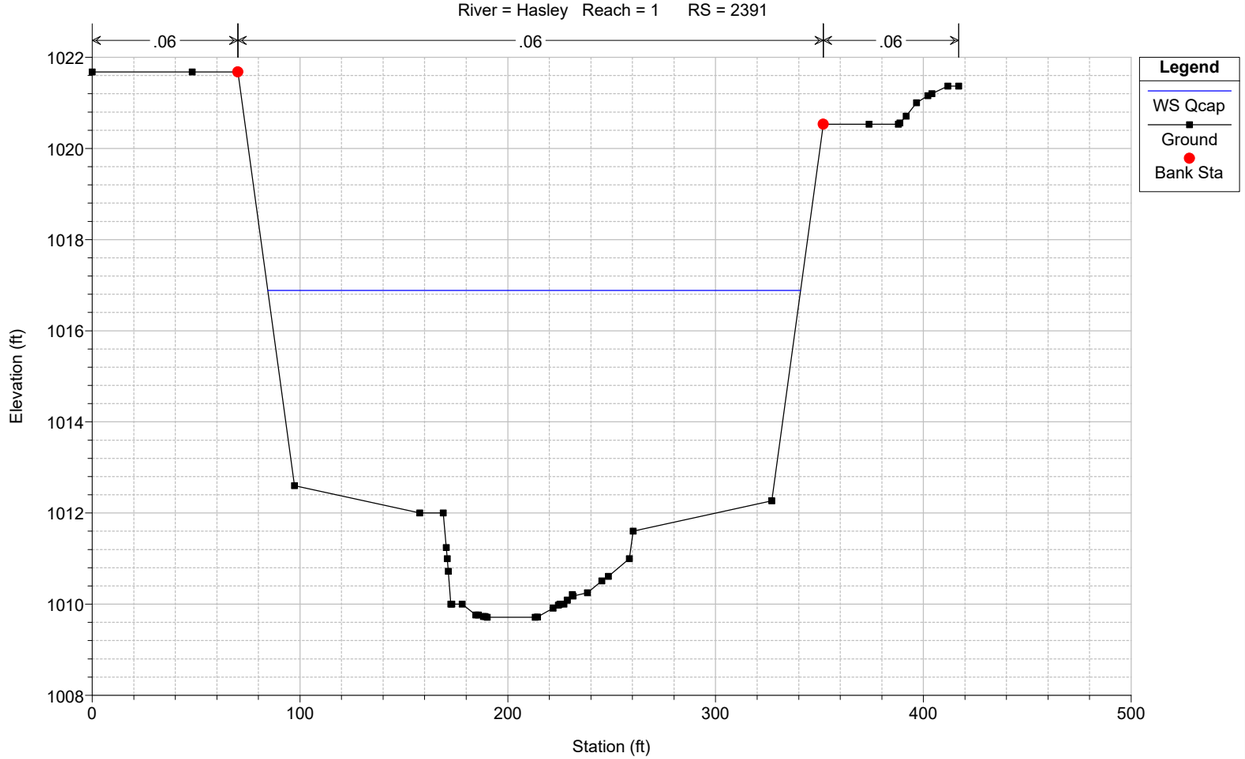
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 2476



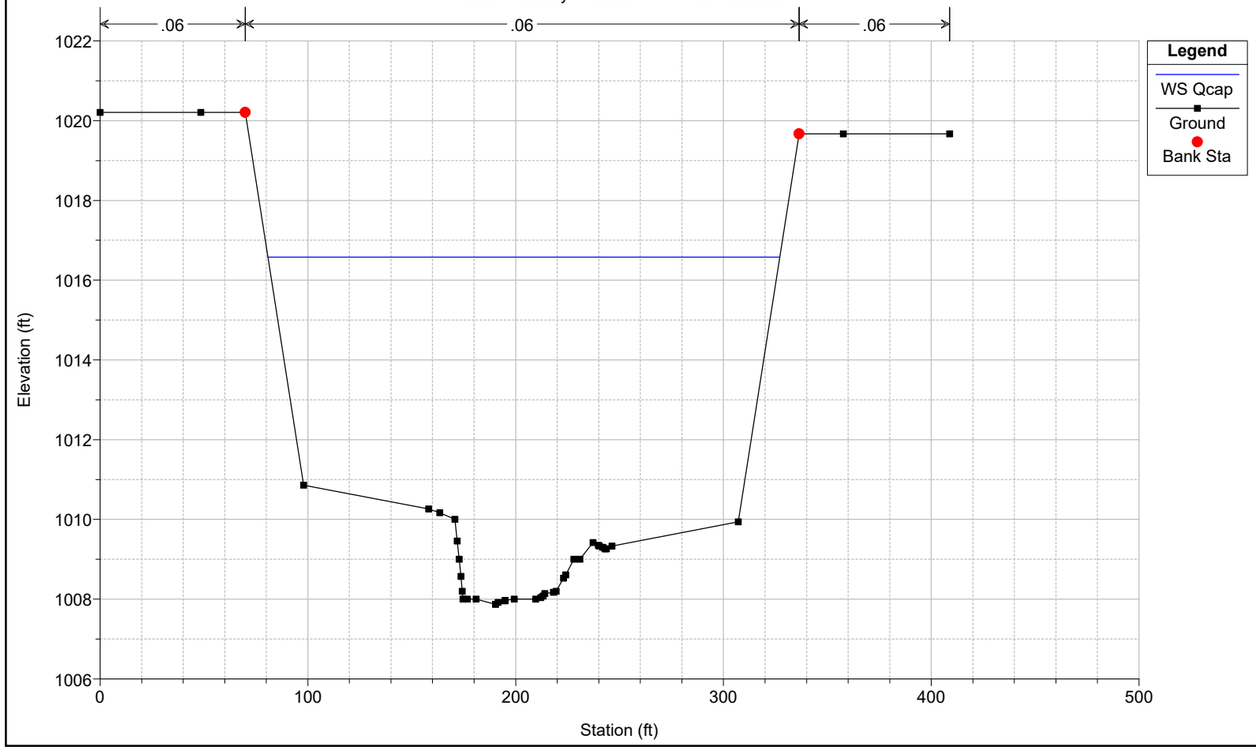
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 2391



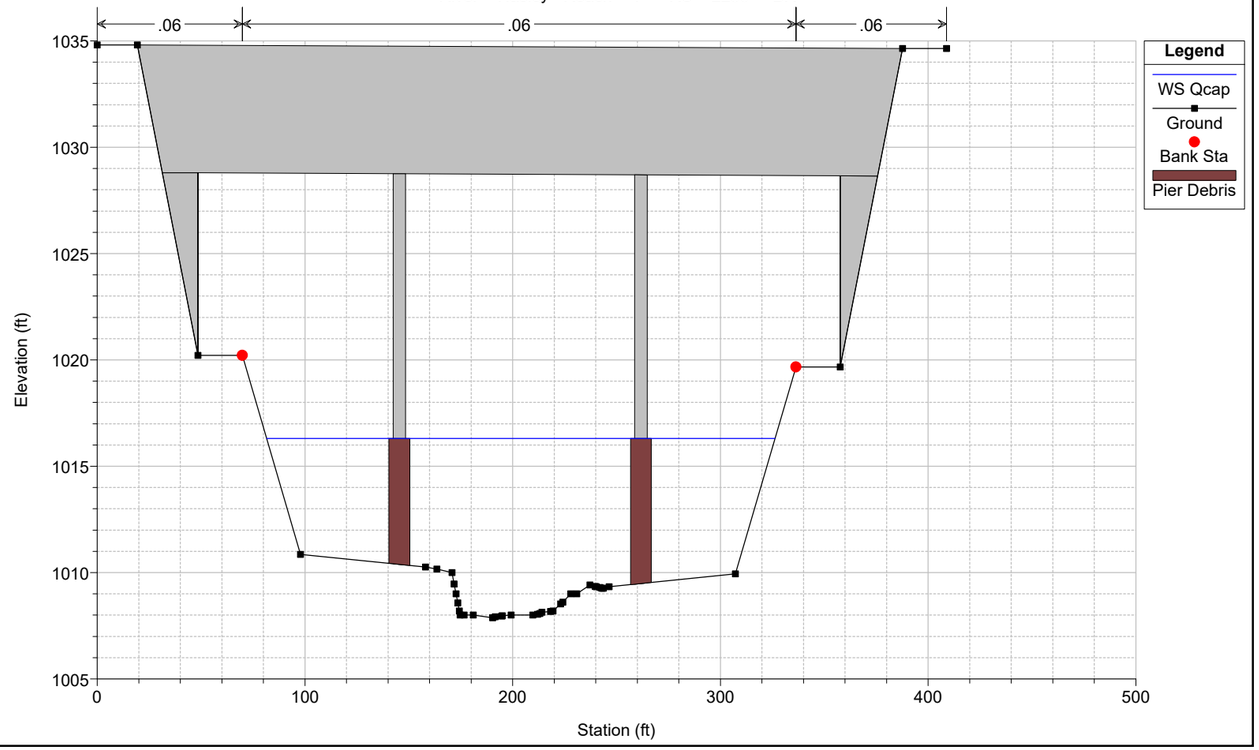
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 2305.5



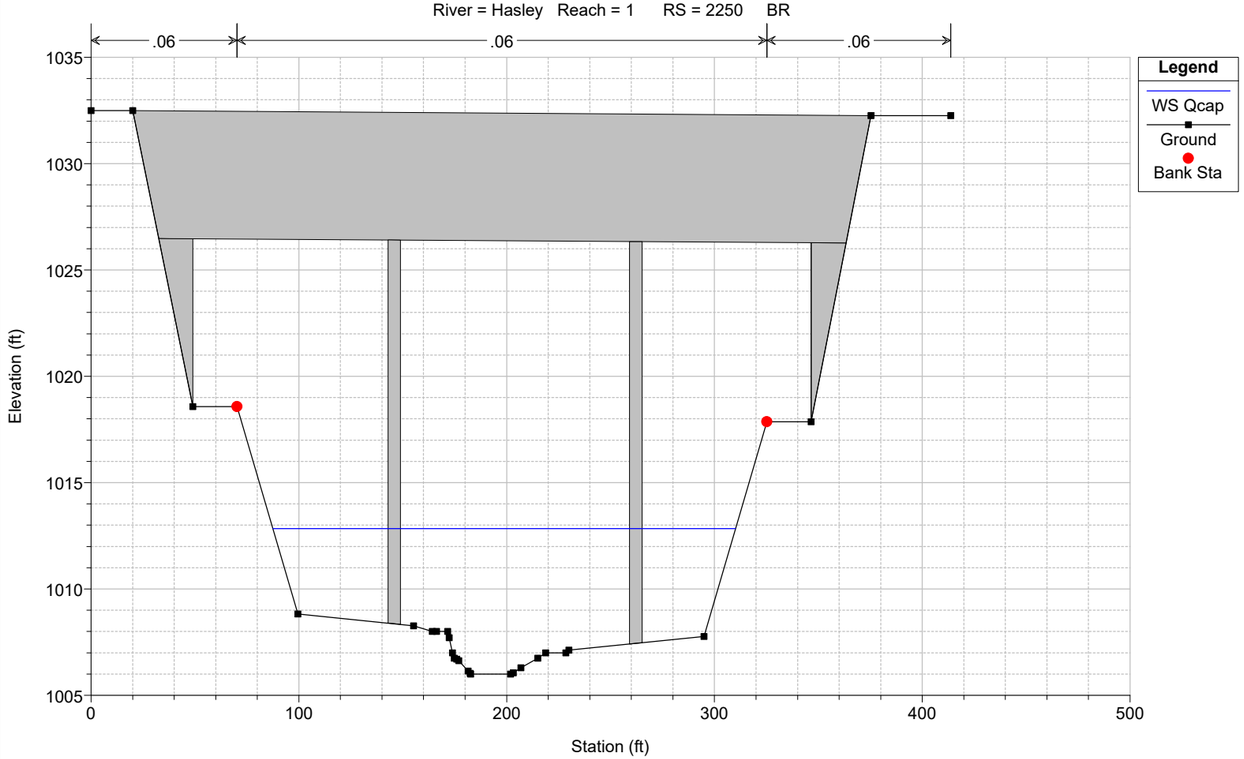
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 2250 BR



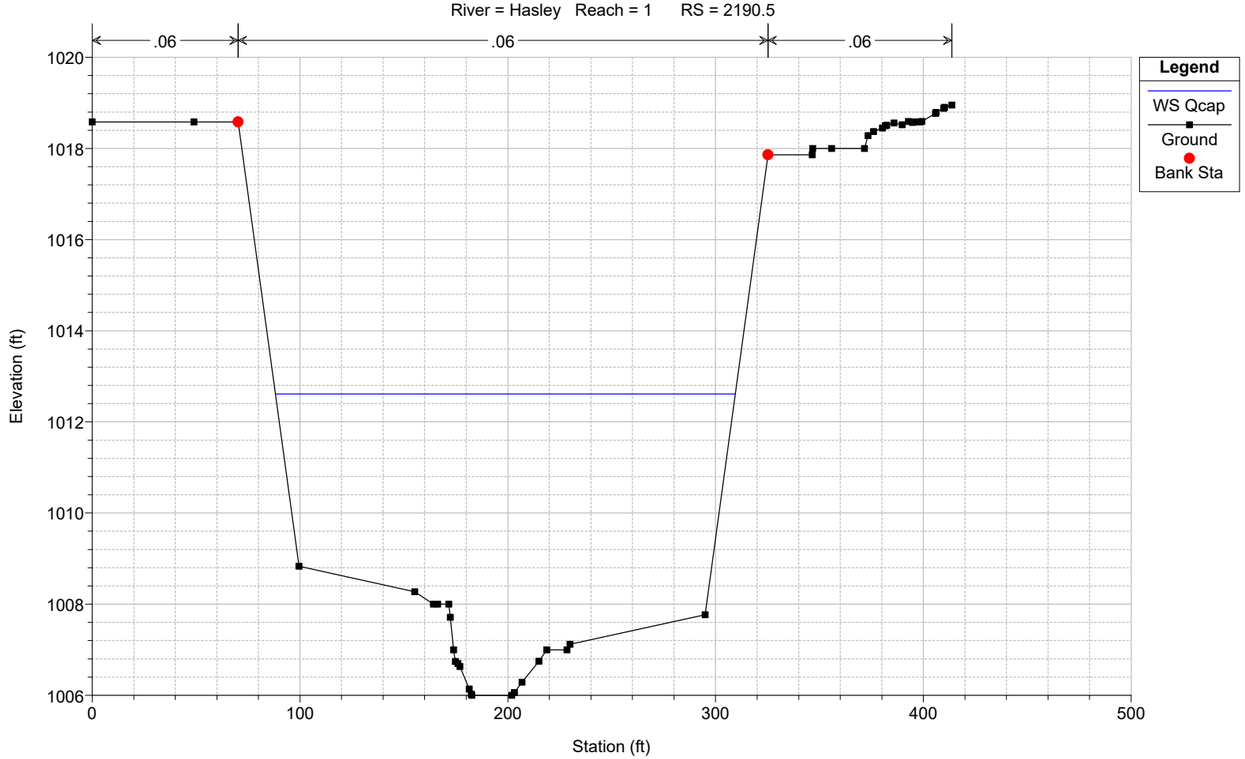
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 2250 BR



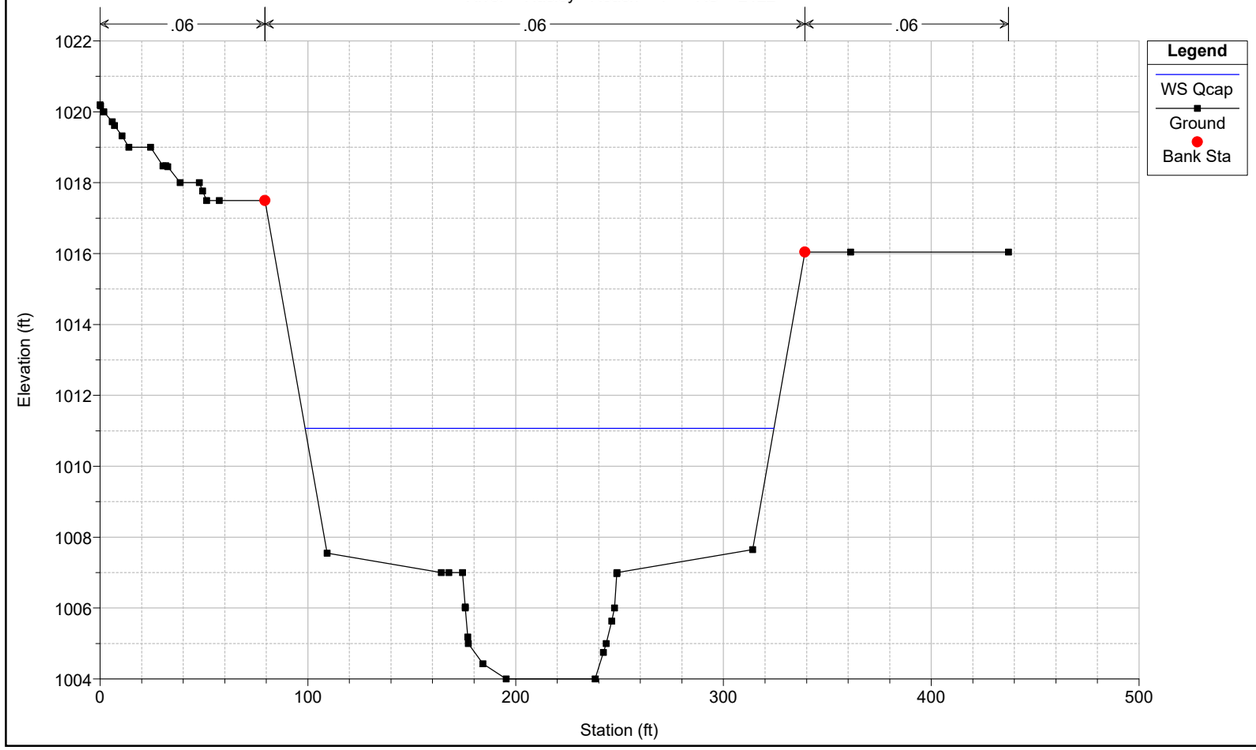
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 2190.5



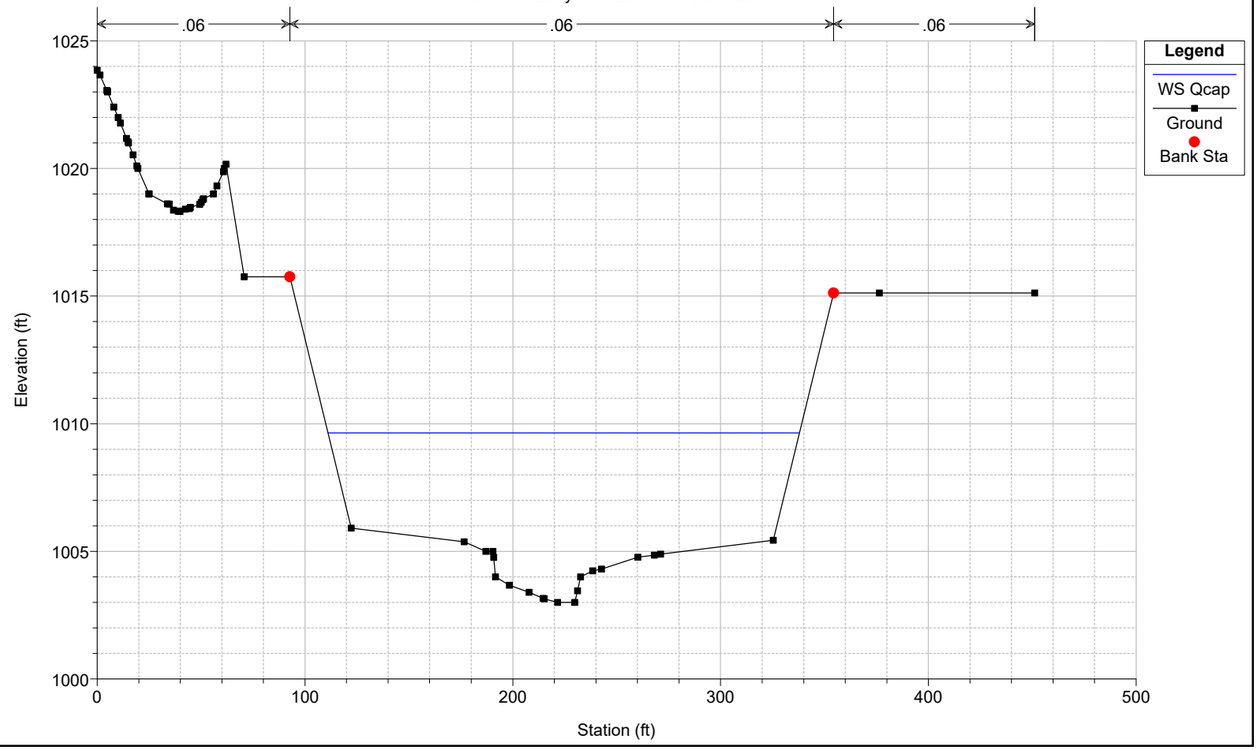
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 2122

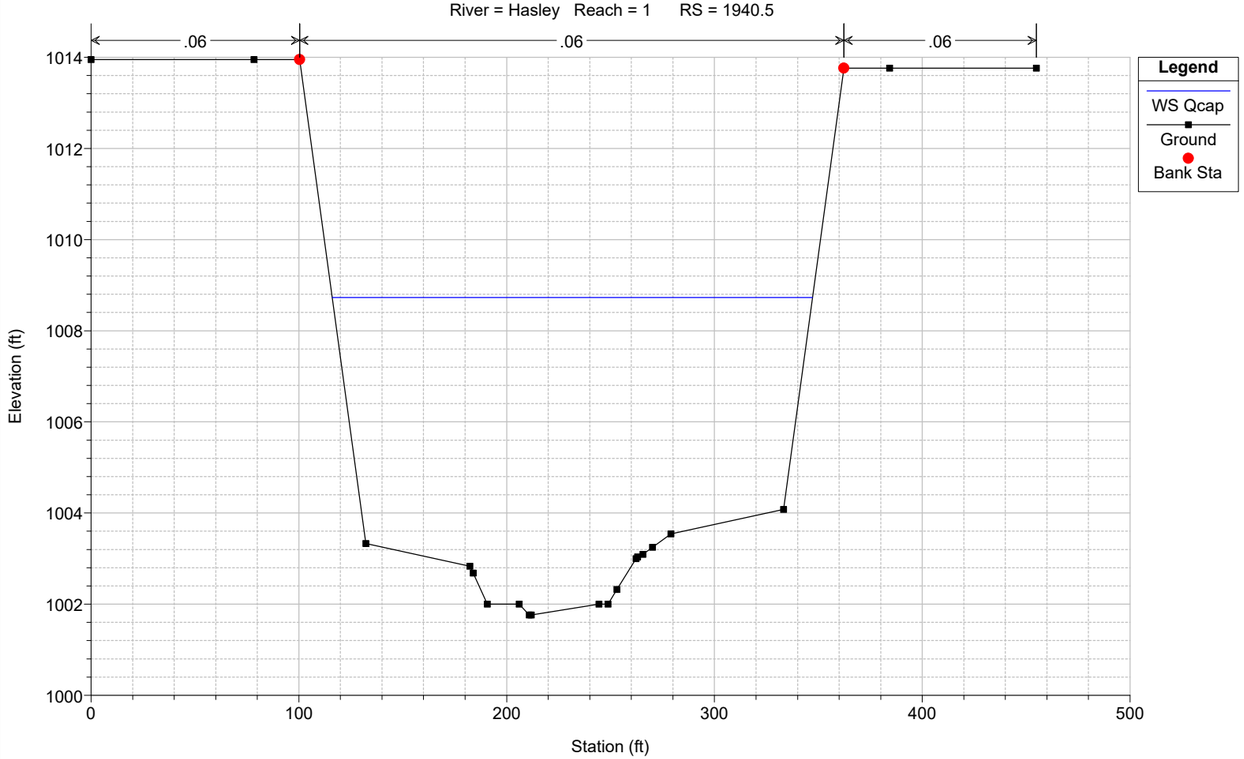


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

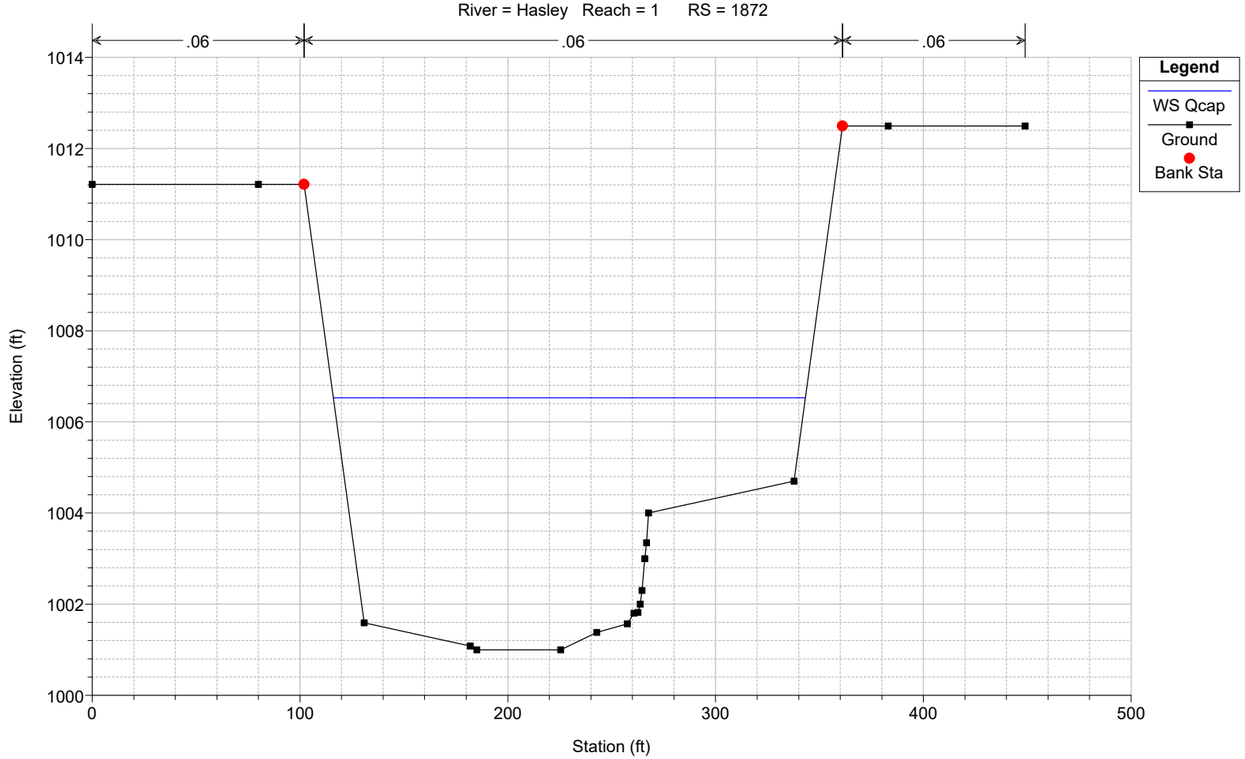
River = Hasley Reach = 1 RS = 2054



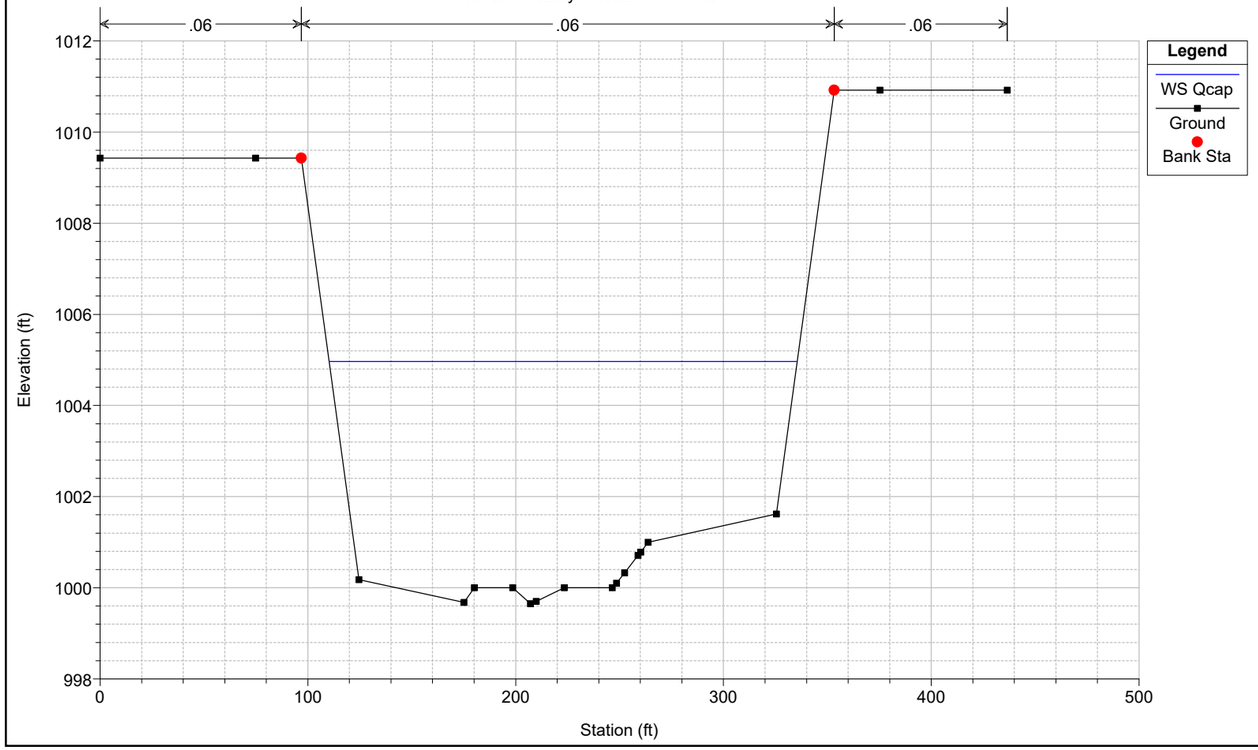
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 1940.5



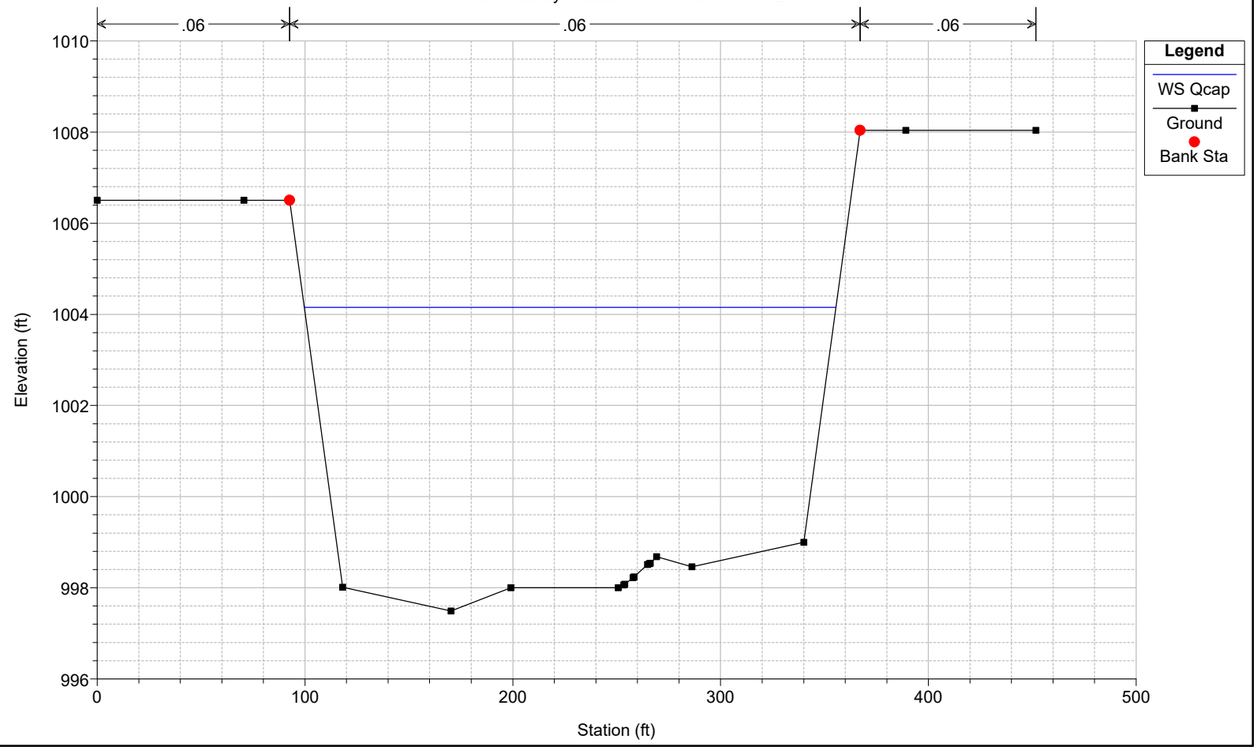
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 1872



A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 1804

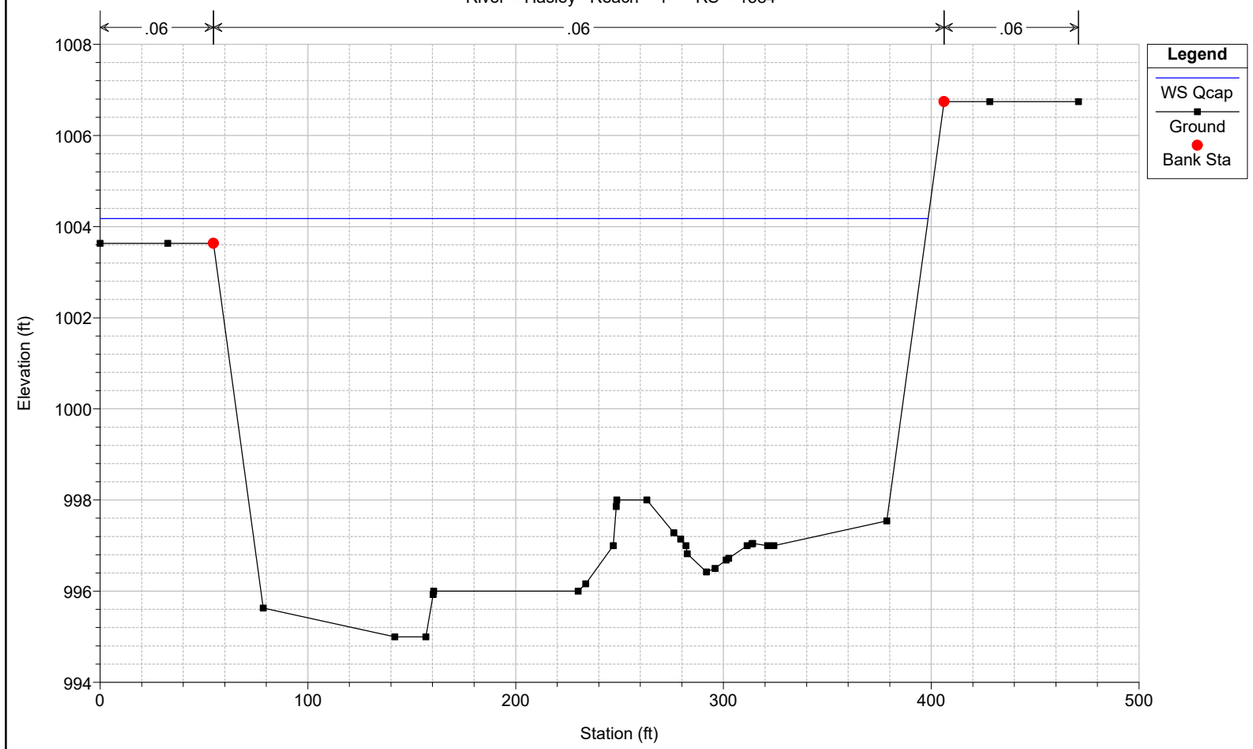


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020
River = Hasley Reach = 1 RS = 1688.62



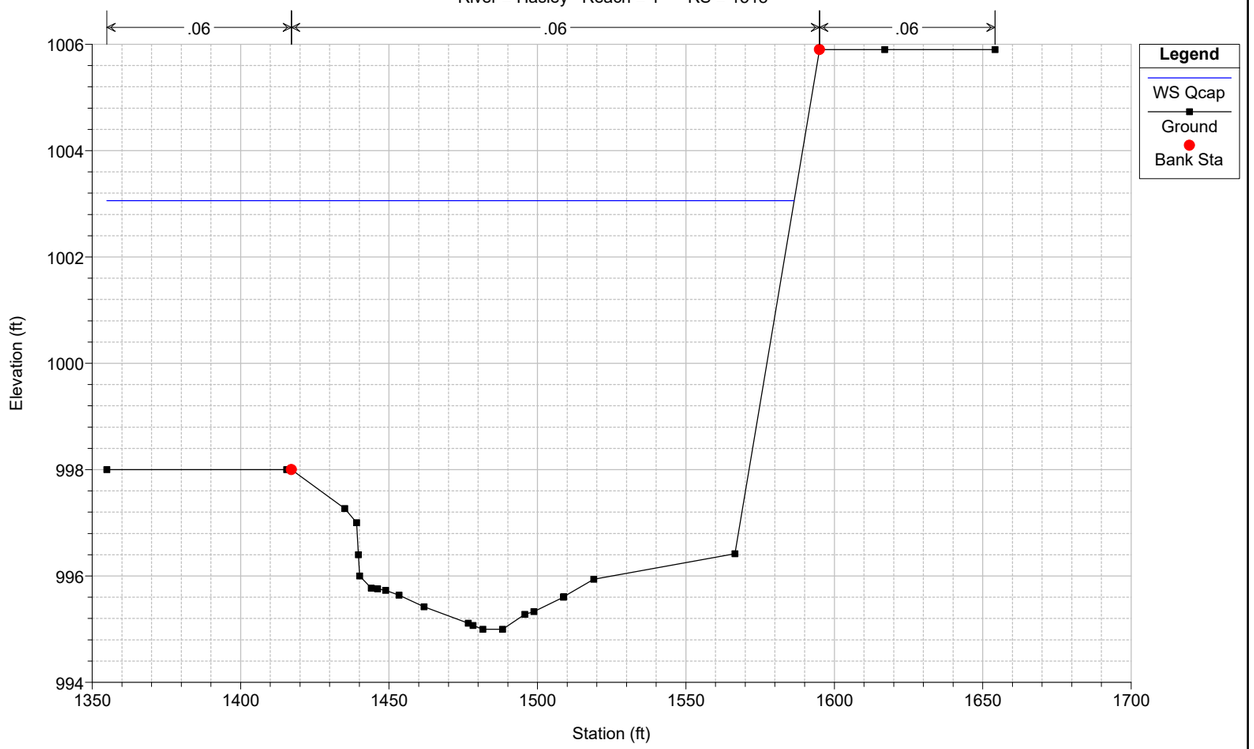
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1584



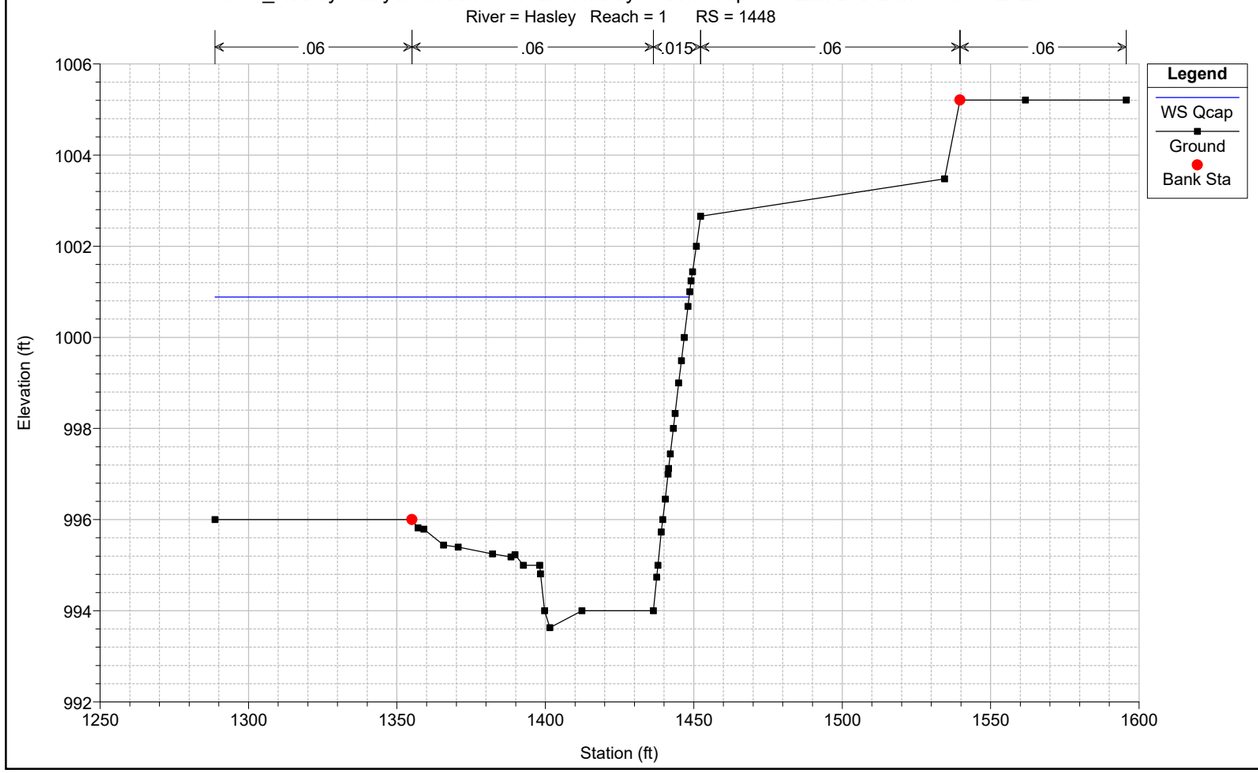
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1518



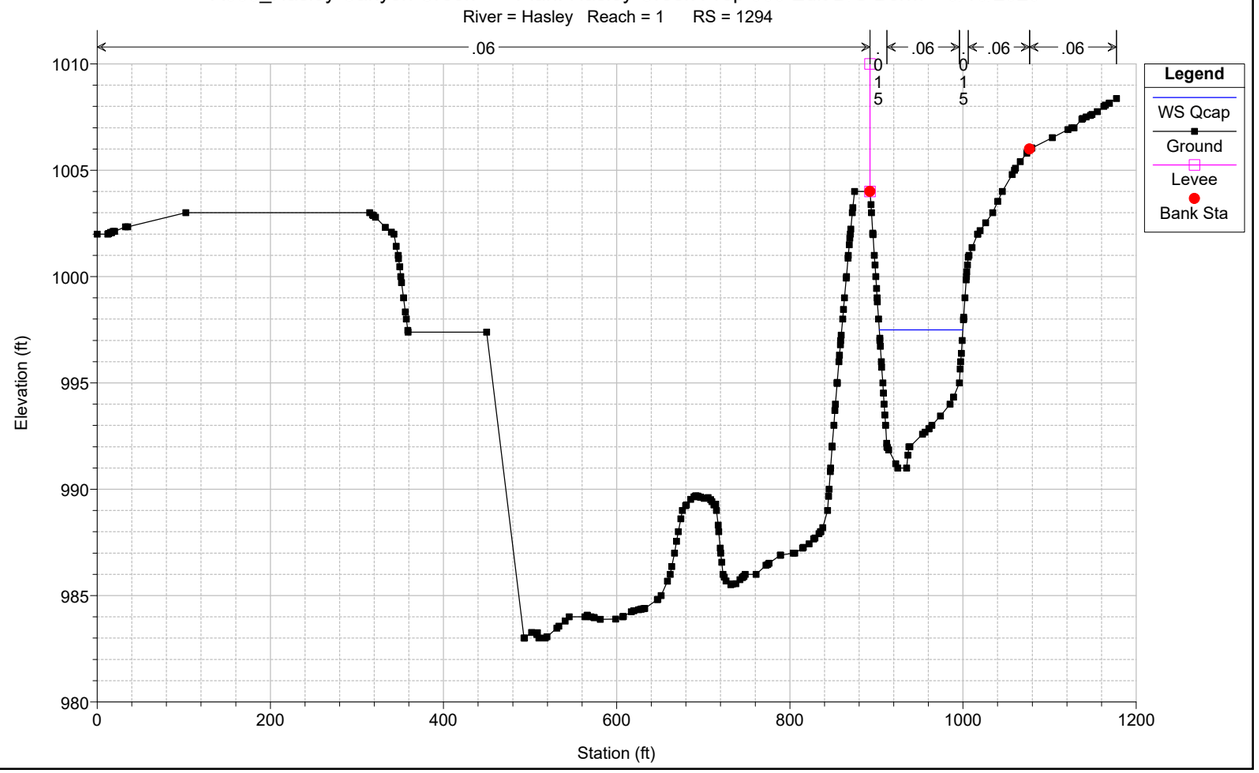
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1448



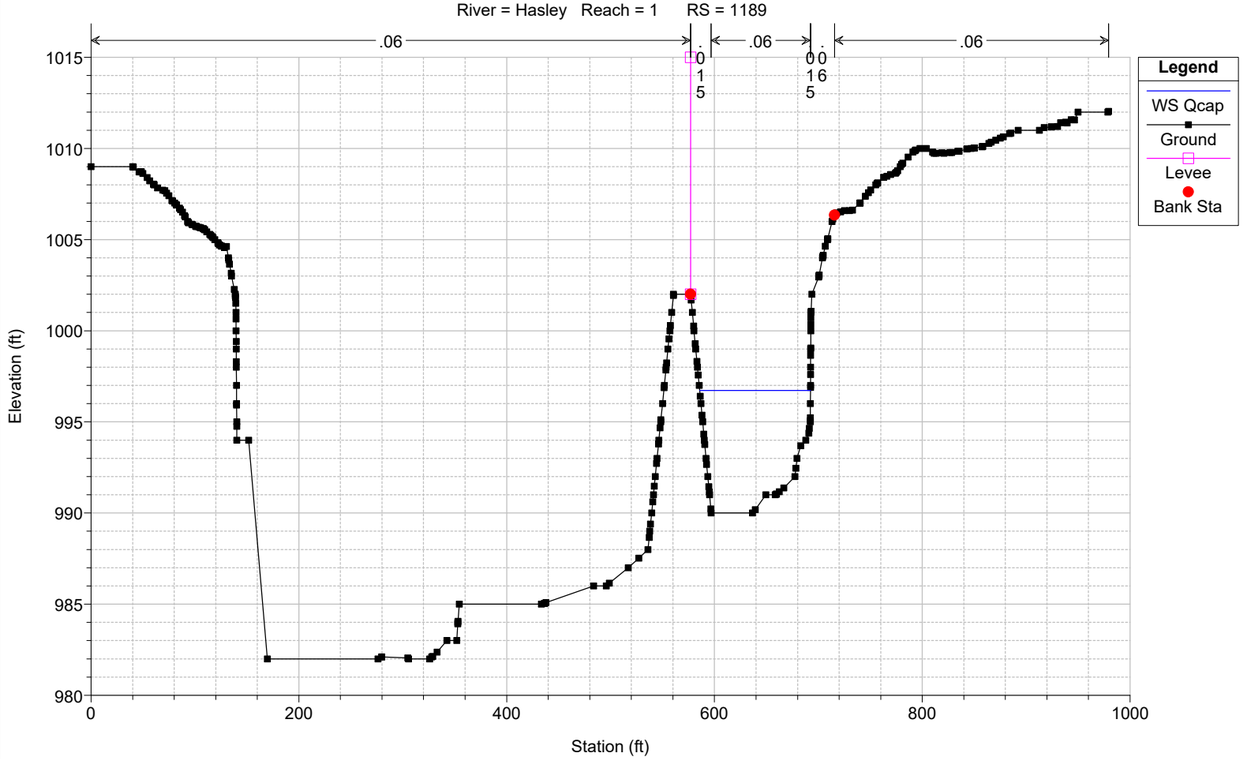
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1294



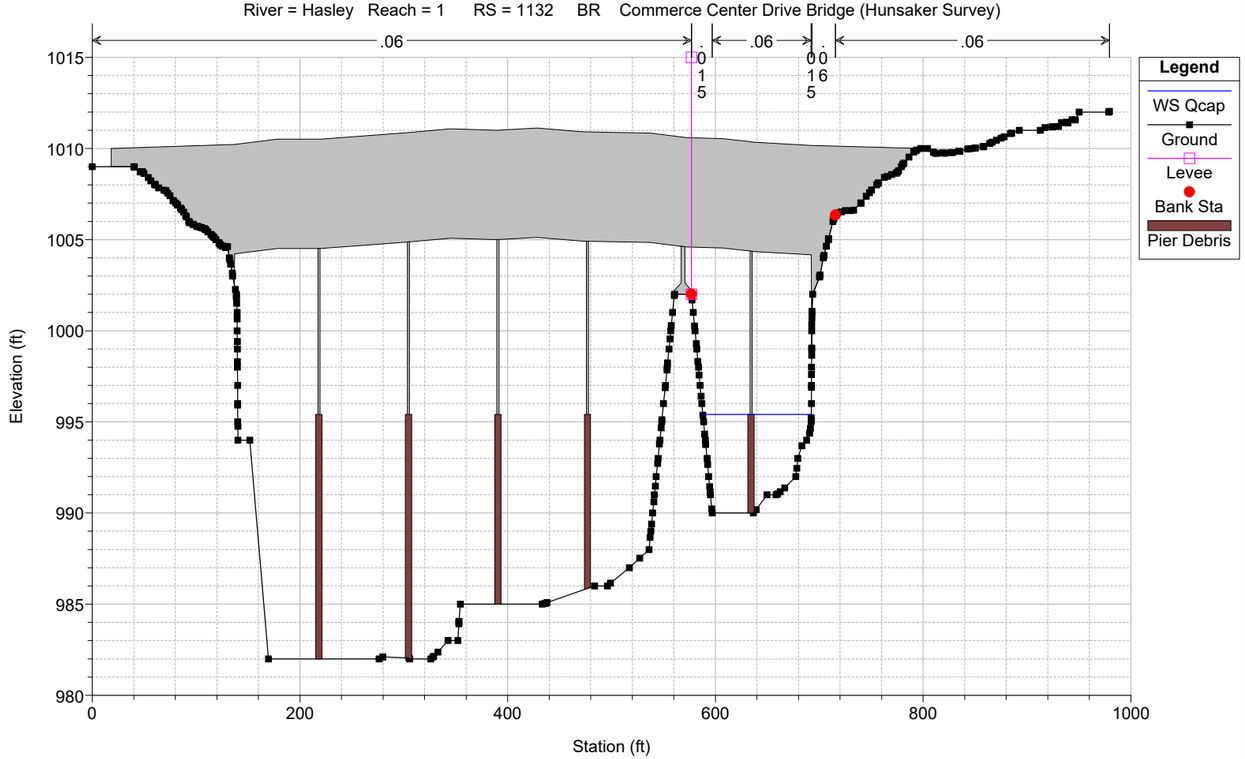
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1189



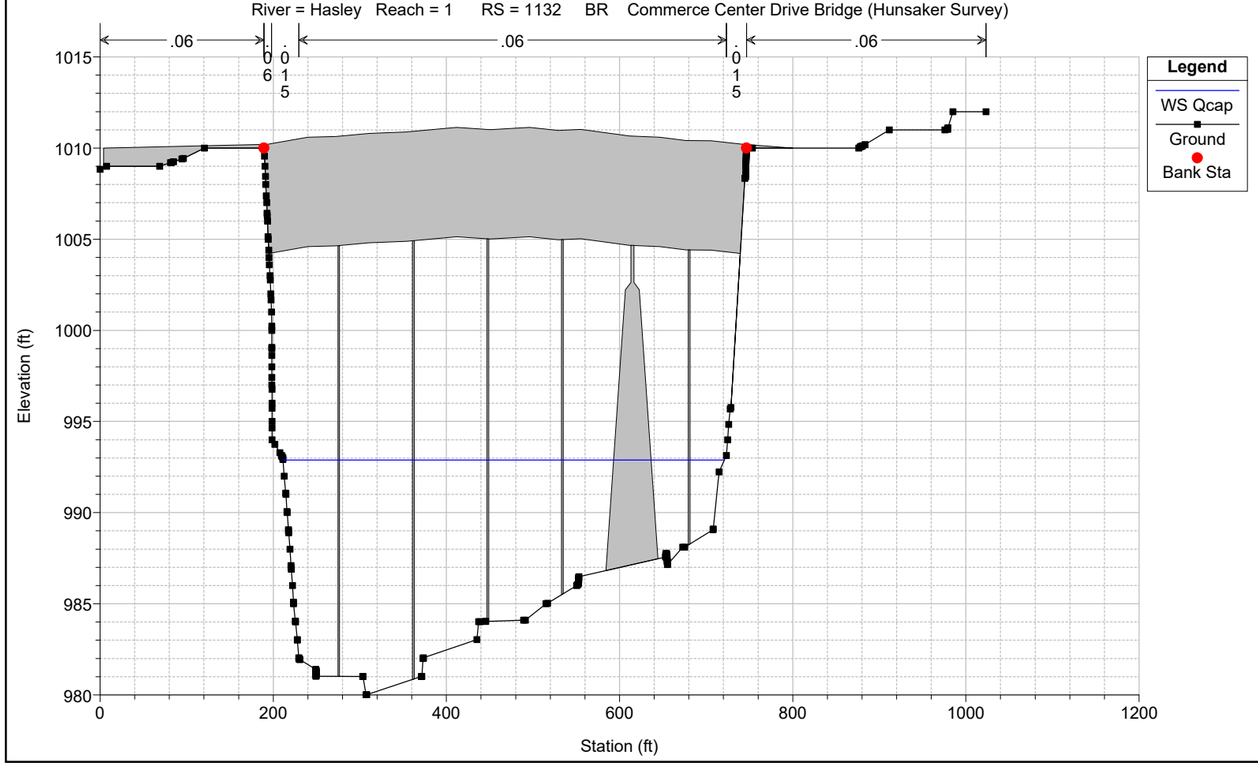
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)



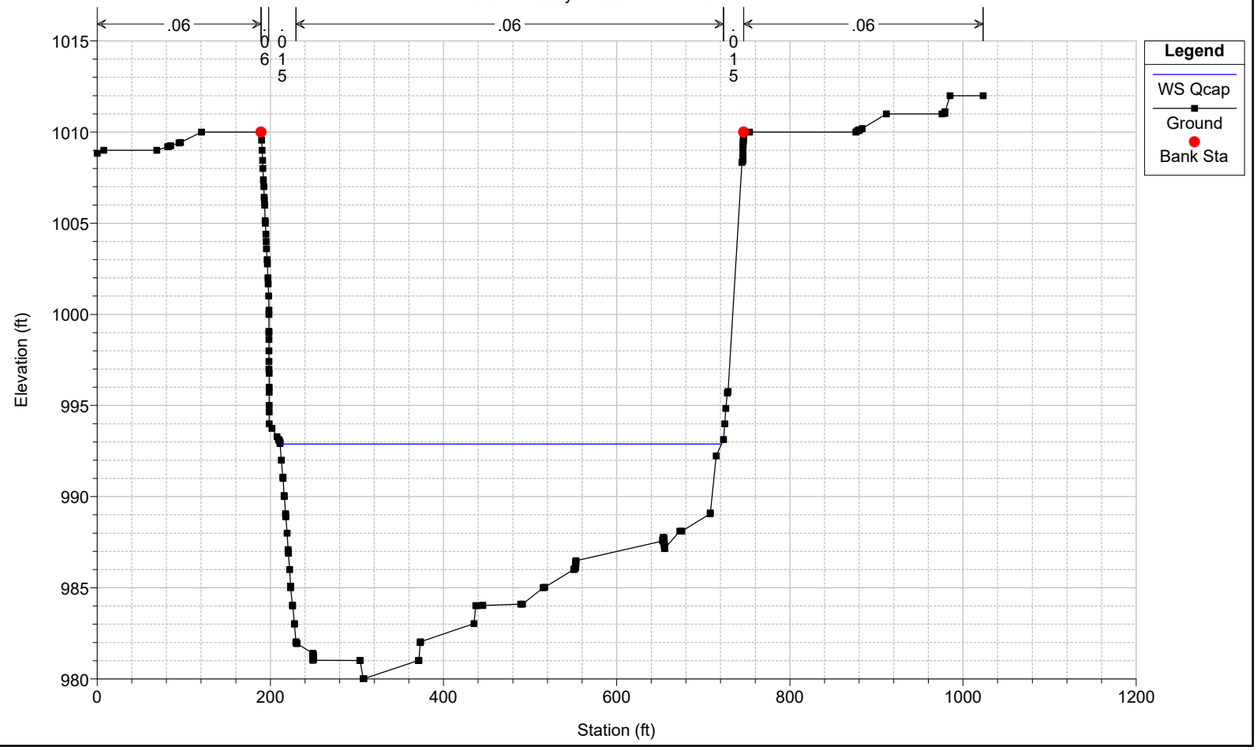
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)



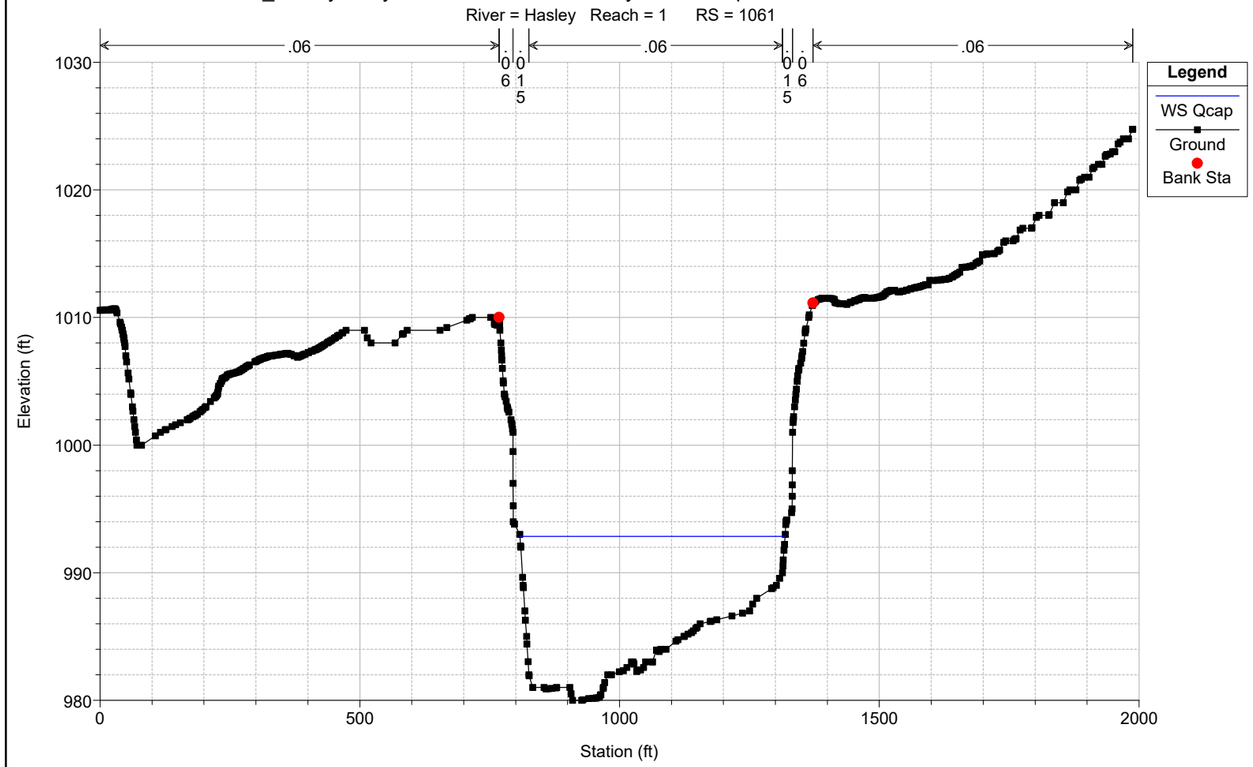
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1080



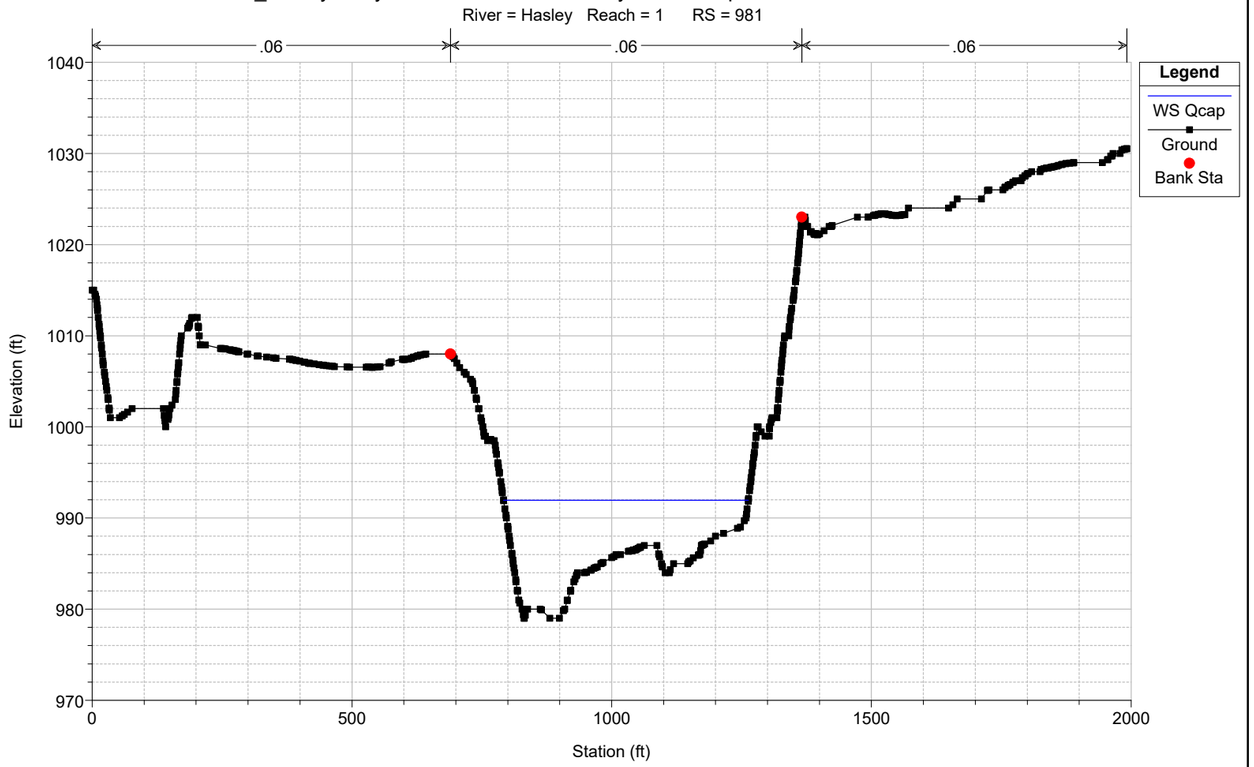
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 1061



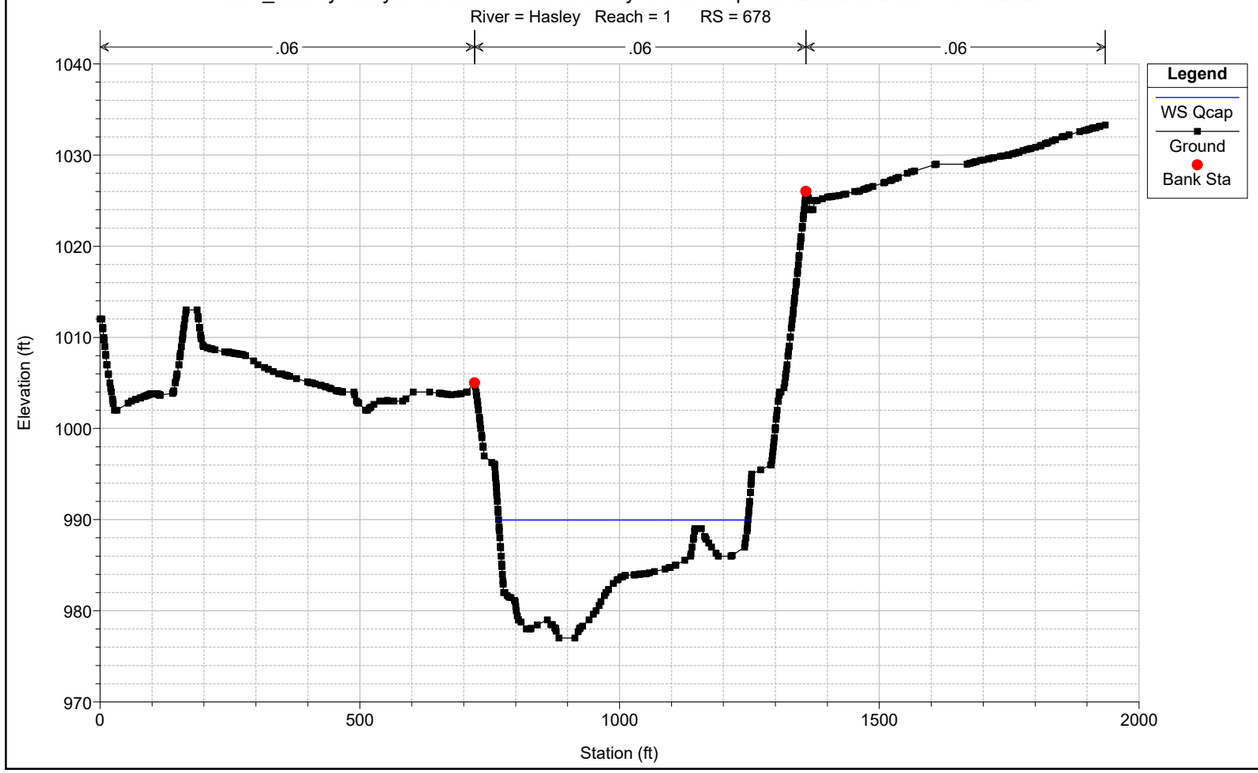
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 981



A535_Hasley Canyon Creek Plan: Hasley Creek Prop 060 Edit D/S Berm 3/16/2020

River = Hasley Reach = 1 RS = 678

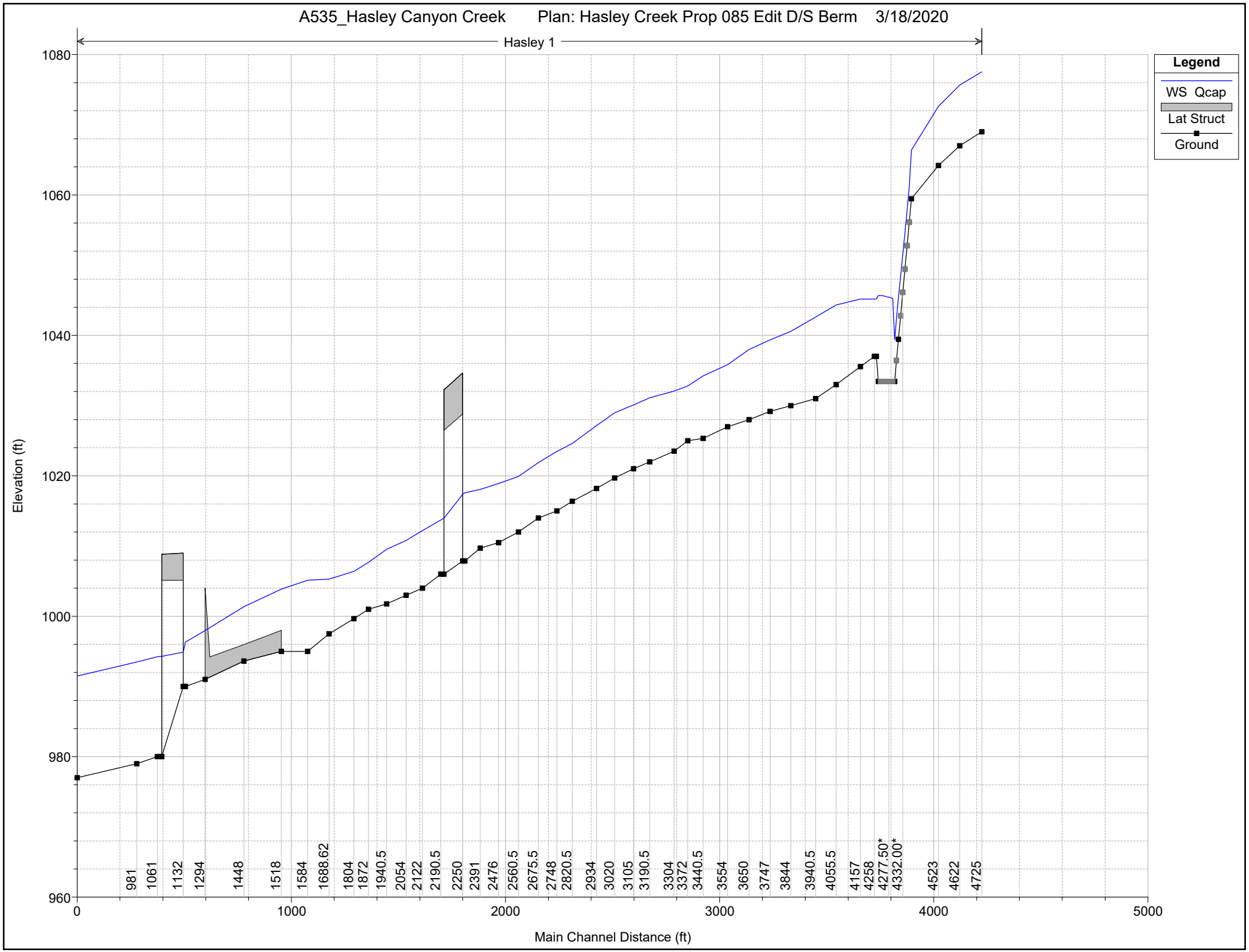


PACE
Advanced Water Engineering

Appendix C: Proposed Condition (n = 0.085) HEC-RAS Model Results

Appendix C: Proposed Condition HEC-RAS Model Results (n=0.085)

Water Surface Profile- Design Slope


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
Hasley 1
Legend
WS Qcap
Lat Struct
Ground
Elevation (ft)
Main Channel Distance (ft)
1080
1060
1040
1020
1000
980
960
0
1000
2000
3000
4000
5000
981
1061
1132
1294
1448
1518
1584
1688.62
1804
1872
1940.5
2054
2122
2190.5
2250
2391
2476
2560.5
2675.5
2748
2820.5
2934
3020
3105
3190.5
3304
3372
3440.5
3554
3650
3747
3844
3940.5
4055.5
4157
4258
4277.50*
4332.00*
4523
4622
4725

Appendix C: Proposed Condition HEC-RAS Model Results (n=0.085)

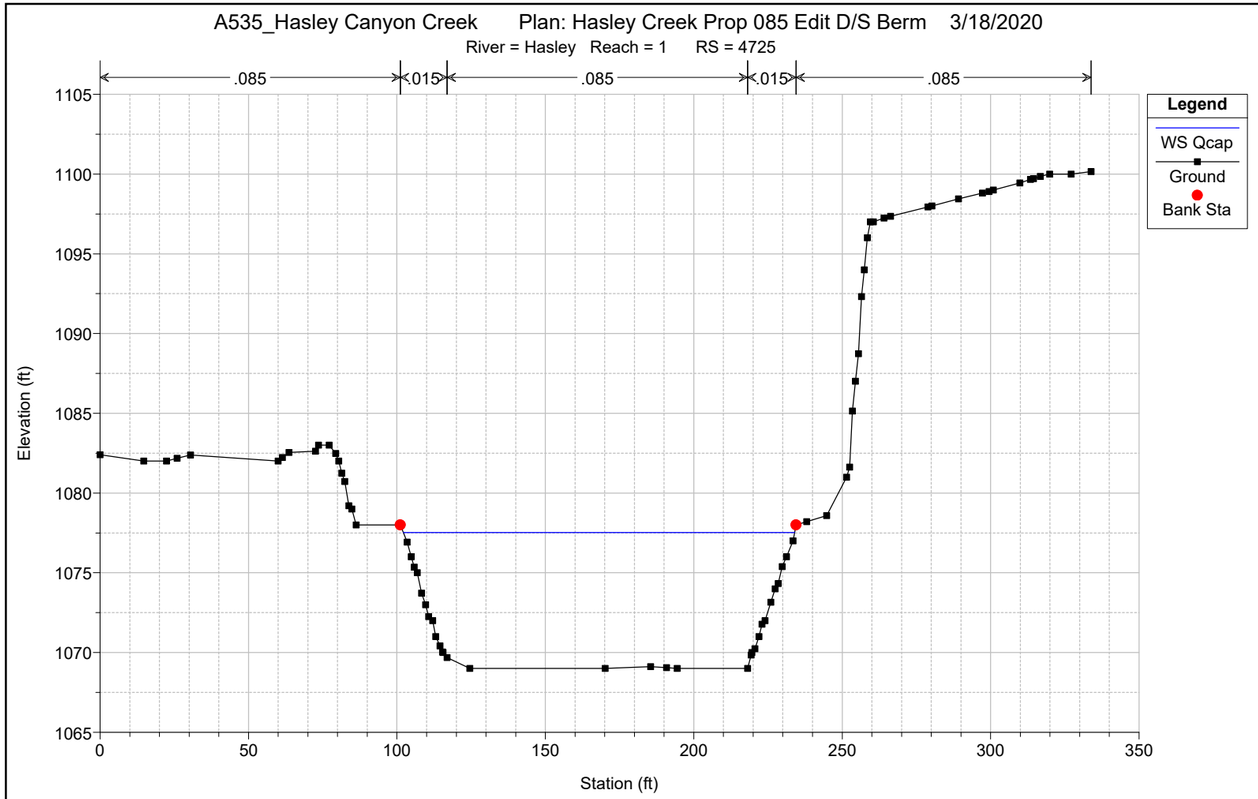
Output Summary Table- Design Slope

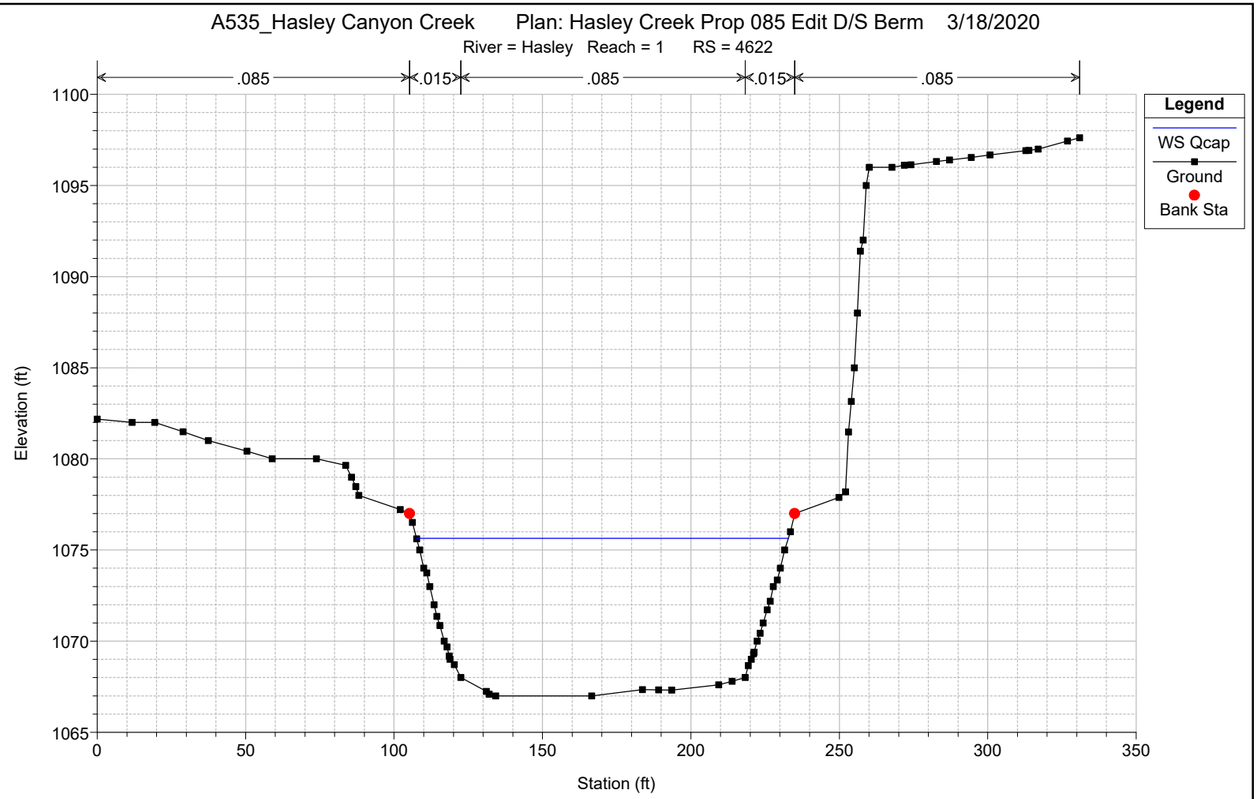
HEC-RAS Plan: Prop 085_Edit_Berm River: Hasley Reach: 1 Profile: Qcap

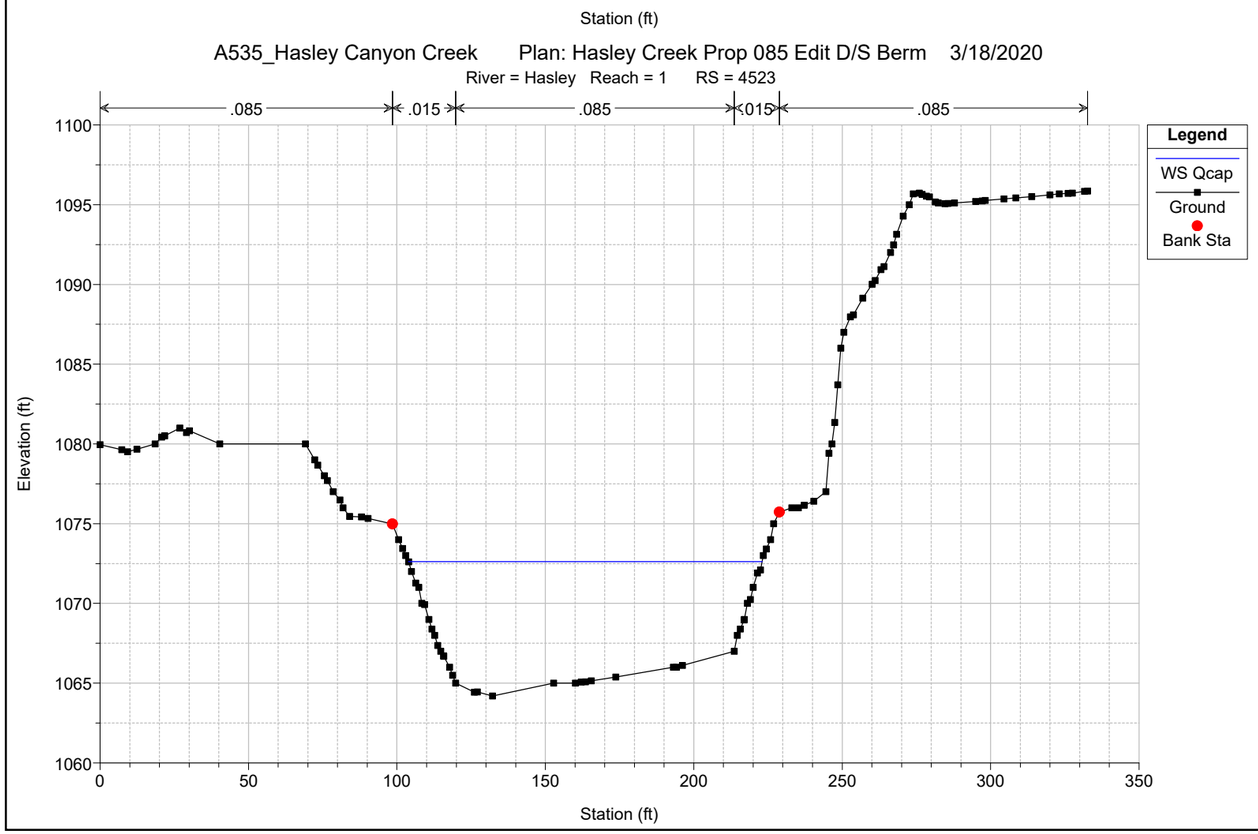
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Max Chl Dpth
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)
1	4725	Qcap	9480.00	1069.00	1077.53	1075.27	1078.96	0.014814	9.57	990.67	131.82	0.62	8.53
1	4622	Qcap	9480.00	1067.00	1075.64	1073.74	1077.28	0.017416	10.27	923.33	125.25	0.67	8.64
1	4523	Qcap	9480.00	1064.20	1072.62	1071.89	1074.96	0.030709	12.28	771.73	119.15	0.85	8.42
1	4396	Qcap	9480.00	1059.45	1066.39	1066.39	1069.56	0.060767	14.27	664.48	106.10	1.01	6.94
1	4380.00*	Qcap	9480.00	1056.12	1061.25	1063.36	1068.18	0.193093	21.13	448.63	95.23	1.72	5.12
1	4364.00*	Qcap	9480.00	1052.78	1057.84	1060.33	1065.95	0.231594	22.85	414.85	89.60	1.87	5.06
1	4348.00*	Qcap	9480.00	1049.45	1054.62	1057.33	1063.48	0.248725	23.87	397.14	84.53	1.94	5.17
1	4332.00*	Qcap	9480.00	1046.12	1051.50	1054.38	1060.89	0.255038	24.58	385.62	79.73	1.97	5.38
1	4316.00*	Qcap	9480.00	1042.78	1048.43	1051.45	1058.29	0.256760	25.18	376.44	75.11	1.98	5.65
1	4300	Qcap	9480.00	1039.45	1045.43	1048.59	1055.68	0.254698	25.68	369.10	70.68	1.98	5.98
1	4291.00*	Qcap	9480.00	1036.45	1042.40	1045.69	1053.24	0.272327	26.42	358.88	69.23	2.05	5.95
1	4282	Qcap	9480.00	1033.45	1039.42	1042.83	1050.70	0.283900	26.94	351.88	67.92	2.09	5.97
1	4280.50*	Qcap	9480.00	1033.45	1045.26	1042.01	1046.93	0.019009	10.38	913.34	95.05	0.59	11.81
1	4279.00*	Qcap	9480.00	1033.45	1045.38	1041.31	1046.67	0.014015	9.12	1038.93	105.00	0.51	11.93
1	4277.50*	Qcap	9480.00	1033.45	1045.44	1040.75	1046.48	0.010824	8.17	1160.99	114.78	0.45	11.99
1	4276	Qcap	9480.00	1033.45	1045.49	1040.25	1046.34	0.008634	7.40	1281.29	124.51	0.41	12.04
1	4274.50*	Qcap	9480.00	1033.45	1045.58	1039.54	1046.20	0.005930	6.28	1510.40	142.69	0.34	12.13
1	4273.00*	Qcap	9480.00	1033.45	1045.64	1038.96	1046.10	0.004338	5.46	1736.15	160.73	0.29	12.19
1	4271.50*	Qcap	9480.00	1033.45	1045.67	1038.53	1046.03	0.003316	4.84	1960.07	178.72	0.26	12.22
1	4270	Qcap	9480.00	1033.45	1045.69	1038.14	1045.98	0.002620	4.34	2182.62	196.66	0.23	12.24
1	4265	Qcap	9480.00	1037.00	1045.20	1041.70	1045.90	0.010168	6.72	1409.79	184.25	0.43	8.20
1	4258	Qcap	9480.00	1037.00	1045.17	1041.45	1045.78	0.008683	6.23	1521.62	198.53	0.40	8.17
1	4157	Qcap	9480.00	1035.56	1045.18	1039.04	1045.39	0.002391	3.68	2573.71	281.90	0.21	9.62
1	4055.5	Qcap	9480.00	1033.00	1044.33	1041.83	1044.85	0.011364	5.78	1639.10	295.18	0.43	11.33
1	3940.5	Qcap	9480.00	1031.00	1042.61	1041.10	1043.37	0.021515	6.99	1356.64	294.31	0.57	11.61
1	3844	Qcap	9480.00	1030.00	1040.58	1038.60	1041.21	0.015664	6.38	1485.53	294.47	0.50	10.58
1	3747	Qcap	9480.00	1029.17	1039.36	1036.89	1039.89	0.011617	5.85	1619.83	292.88	0.44	10.19
1	3650	Qcap	9480.00	1028.00	1038.00	1035.98	1038.60	0.014806	6.20	1529.77	303.47	0.49	10.00
1	3554	Qcap	9480.00	1027.00	1035.83	1033.33	1036.71	0.023870	7.53	1259.06	263.20	0.61	8.83
1	3440.5	Qcap	9480.00	1025.32	1034.23	1032.01	1034.71	0.011904	5.55	1707.20	340.88	0.44	8.91
1	3372	Qcap	9480.00	1025.00	1032.80	1031.46	1033.54	0.022809	6.89	1375.22	323.16	0.59	7.80
1	3304	Qcap	9480.00	1023.50	1032.08	1029.30	1032.56	0.009783	5.56	1703.66	292.32	0.41	8.58
1	3190.5	Qcap	9480.00	1022.00	1031.12	1027.65	1031.57	0.007678	5.38	1761.93	264.85	0.37	9.11
1	3105	Qcap	9480.00	1021.00	1030.10	1028.01	1030.75	0.015154	6.49	1460.92	275.09	0.50	9.10
1	3020	Qcap	9480.00	1019.68	1028.99	1026.51	1029.54	0.011850	5.93	1598.14	286.07	0.44	9.31
1	2934	Qcap	9480.00	1018.19	1027.15	1025.85	1028.08	0.025616	7.73	1226.01	263.61	0.63	8.96
1	2820.5	Qcap	9480.00	1016.37	1024.59	1023.05	1025.39	0.021257	7.19	1317.61	274.82	0.58	8.22
1	2748	Qcap	9480.00	1015.00	1023.47	1021.22	1024.08	0.014634	6.27	1511.87	293.01	0.49	8.47
1	2675.5	Qcap	9480.00	1014.00	1021.88	1019.83	1022.60	0.020267	6.84	1385.76	300.65	0.56	7.88
1	2560.5	Qcap	9480.00	1012.00	1019.92	1018.43	1020.67	0.021213	6.98	1358.41	295.41	0.57	7.92
1	2476	Qcap	9480.00	1010.49	1018.91	1015.95	1019.37	0.008861	5.40	1754.71	292.50	0.39	8.42
1	2391	Qcap	9480.00	1009.71	1018.06	1015.05	1018.57	0.009554	5.76	1645.87	263.48	0.41	8.35
1	2305.5	Qcap	9480.00	1007.87	1017.59	1013.44	1018.00	0.006128	5.12	1849.94	252.40	0.33	9.72
1	2250		Bridge										
1	2190.5	Qcap	9480.00	1006.00	1013.72	1011.64	1014.54	0.017283	7.29	1299.92	227.88	0.54	7.72
1	2122	Qcap	9480.00	1004.00	1012.19	1010.25	1013.03	0.018306	7.35	1289.17	232.41	0.55	8.19
1	2054	Qcap	9480.00	1003.00	1010.80	1008.82	1011.63	0.018012	7.31	1297.35	233.79	0.55	7.80
1	1940.5	Qcap	9480.00	1001.76	1009.54	1006.94	1010.22	0.012886	6.59	1439.24	236.00	0.47	7.78
1	1872	Qcap	9480.00	1001.00	1007.69	1006.27	1008.70	0.024739	8.03	1179.87	234.20	0.63	6.69
1	1804	Qcap	9480.00	999.65	1006.39	1004.45	1007.22	0.018130	7.33	1293.85	233.75	0.55	6.74
1	1688.62	Qcap	9480.00	997.49	1005.28	1001.96	1005.76	0.008192	5.51	1720.85	262.65	0.38	7.79
1	1584	Qcap	9480.00	995.00	1005.11	999.47	1005.28	0.002188	3.31	2923.37	401.26	0.20	10.11
1	1518	Qcap	9480.00	995.00	1003.88	1000.59	1004.41	0.008558	6.07	1627.90	233.98	0.39	8.87
1	1500		Lat Struct										
1	1448	Qcap	7370.03	993.63	1001.36	999.55	1002.34	0.017356	8.50	942.56	160.63	0.60	7.73
1	1294	Qcap	3891.71	991.00	997.96	996.64	998.98	0.021314	8.09	480.79	98.10	0.64	14.96
1	1189	Qcap	3891.71	990.00	996.32	994.65	997.13	0.017462	7.24	537.65	105.98	0.57	14.32
1	1132		Bridge										
1	1080	Qcap	25811.71	980.01	994.28	988.51	994.69	0.003953	5.13	5030.23	526.55	0.29	14.27
1	1061	Qcap	25811.71	980.00	994.23	988.07	994.61	0.003532	4.98	5185.02	528.00	0.28	14.23
1	981	Qcap	25811.71	979.00	993.49	989.24	994.11	0.007604	6.32	4081.44	478.67	0.38	14.49
1	678	Qcap	25811.71	977.00	991.49	986.87	992.07	0.007002	6.13	4209.49	484.45	0.37	14.49

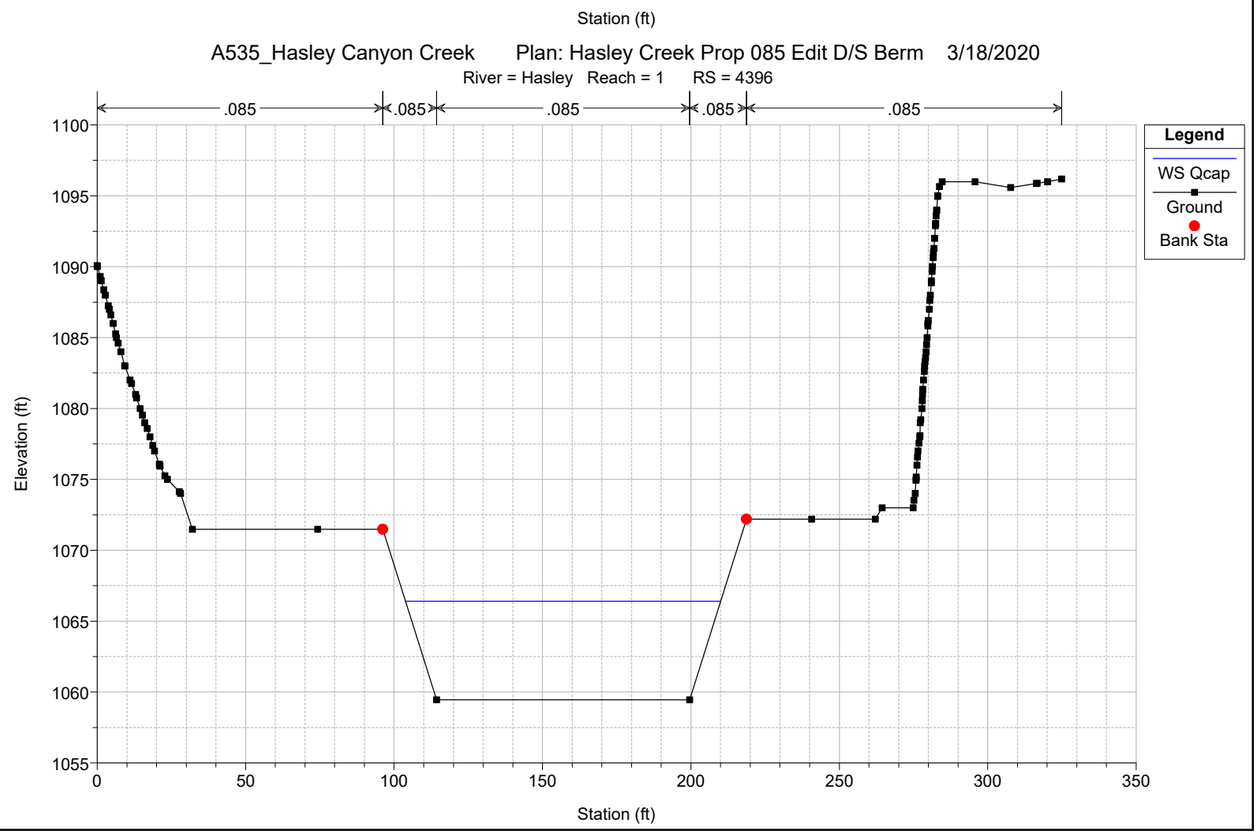
Appendix C: Proposed Condition HEC-RAS Model Results (n=0.085)

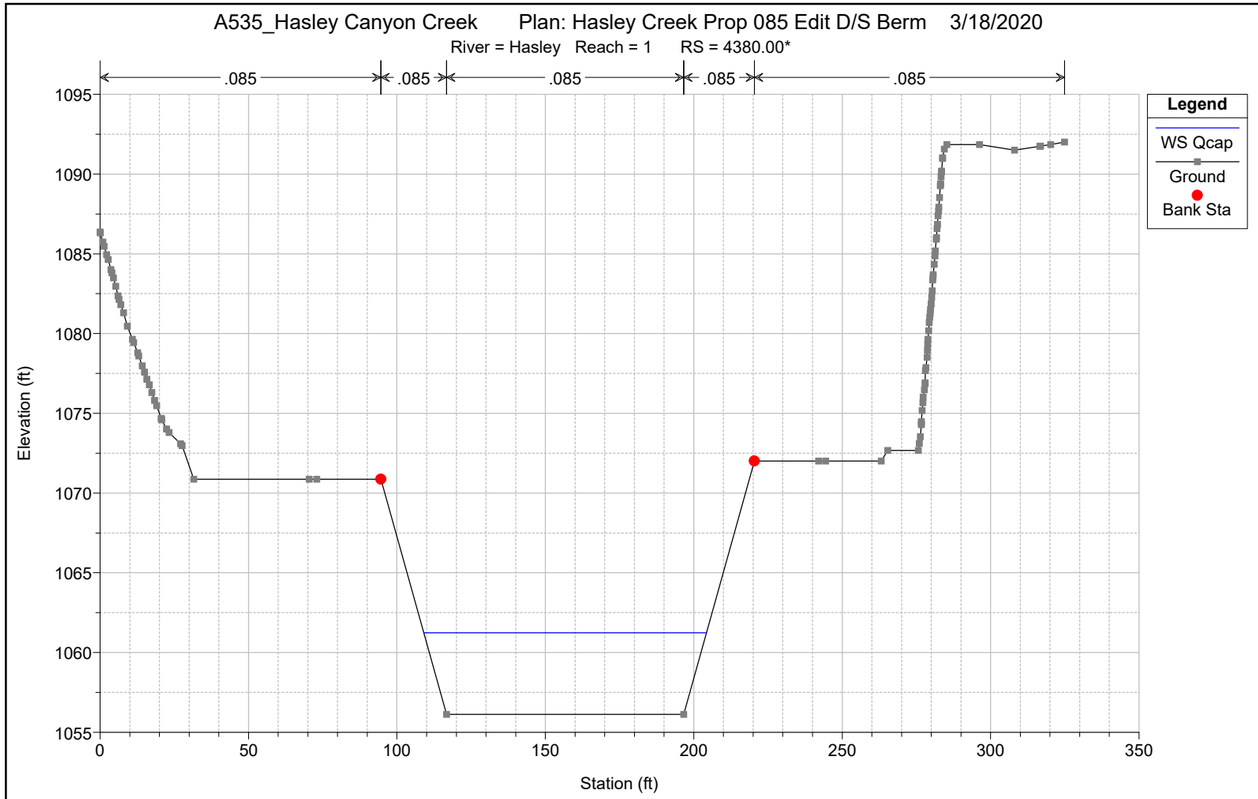
Cross Section Plots- Design Slope

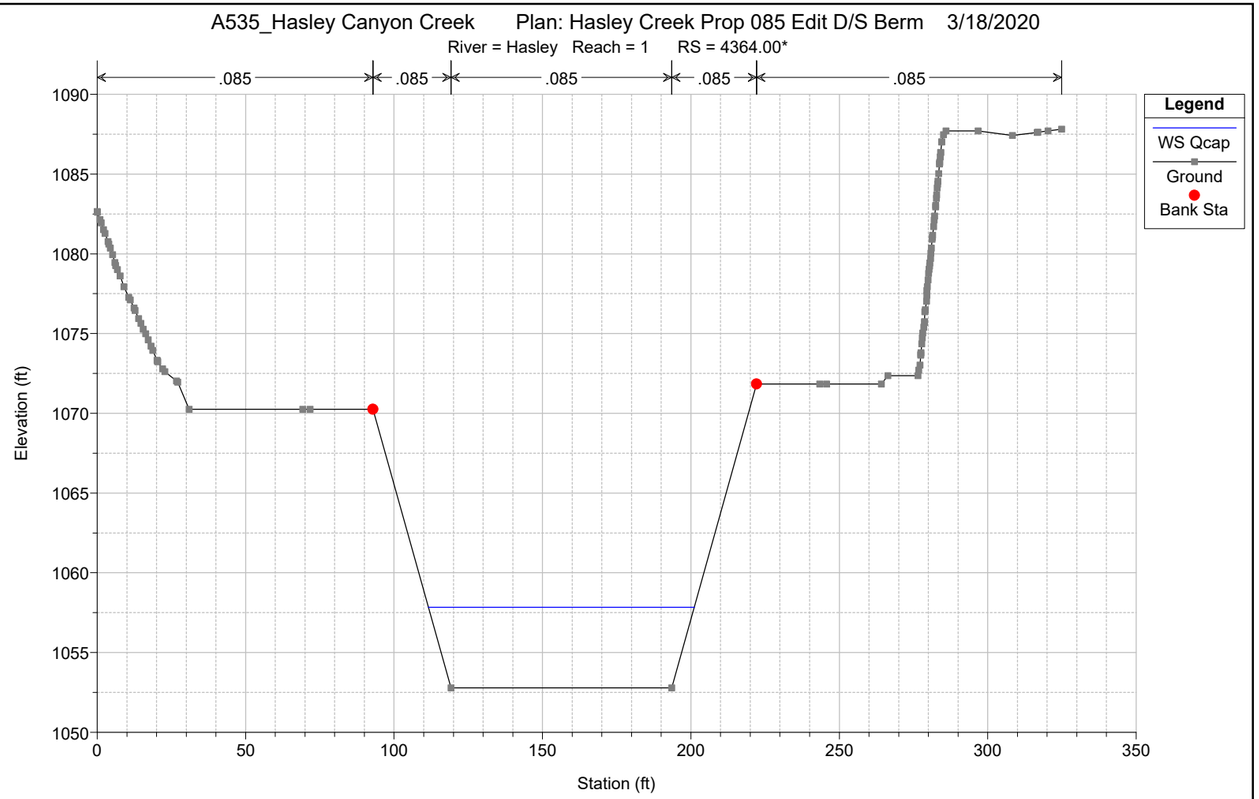

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 4725
.085
.015
.085
.015
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

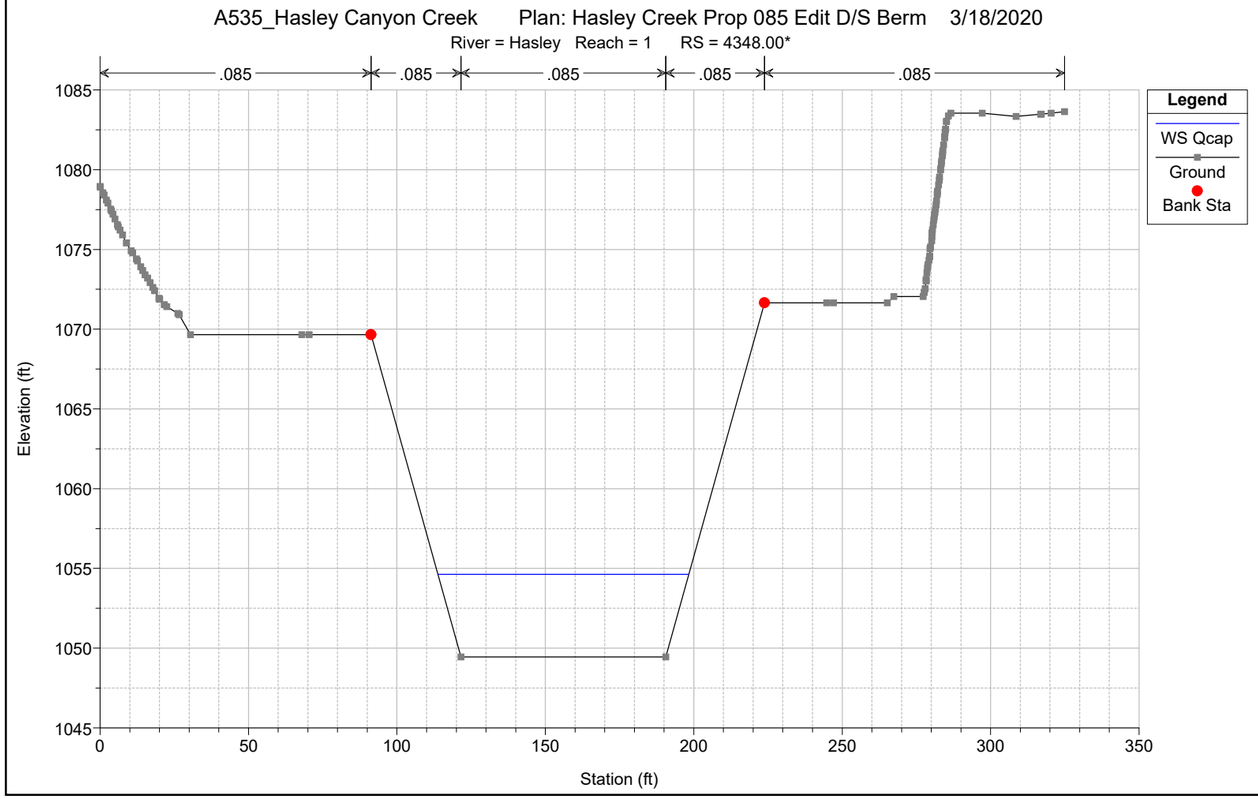

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 4622
.085
.015
.085
.015
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

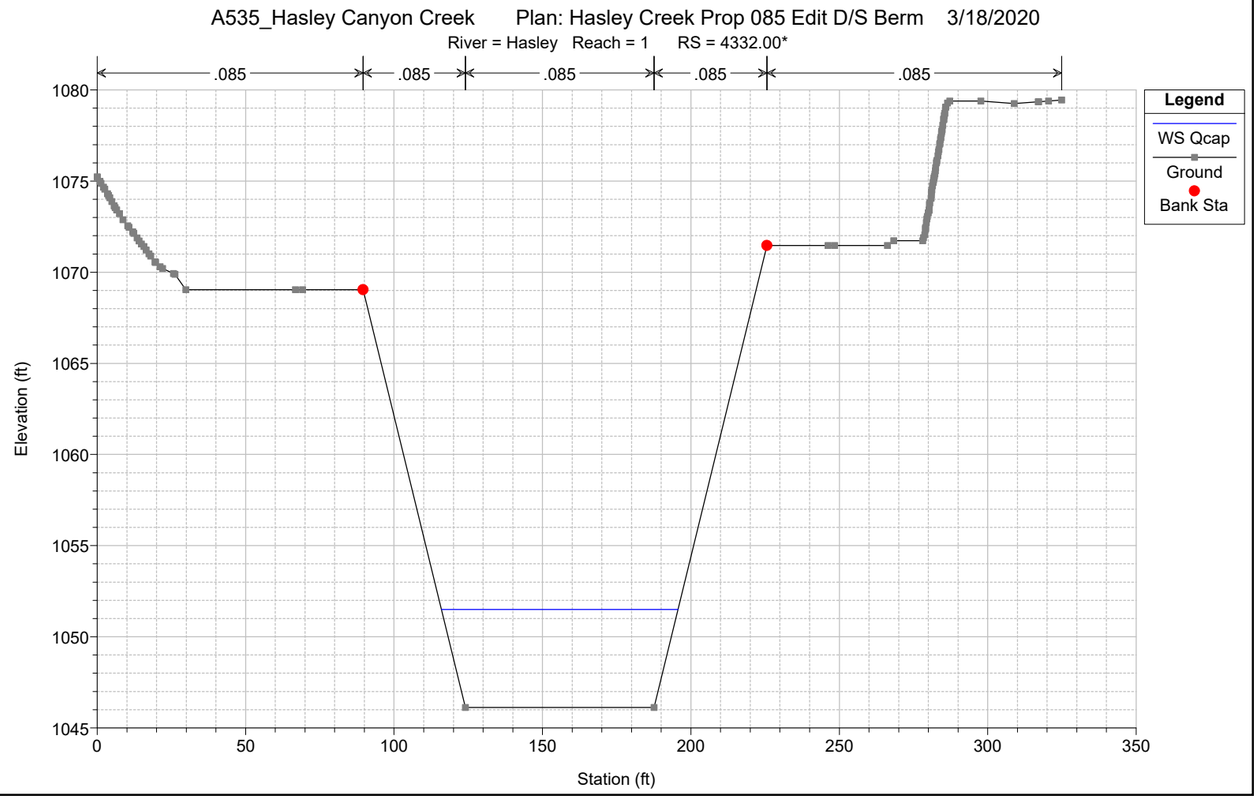

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 4523
.085
.015
.085
.015
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 4396
.085
.085
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 4380.00*
.085
.085
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

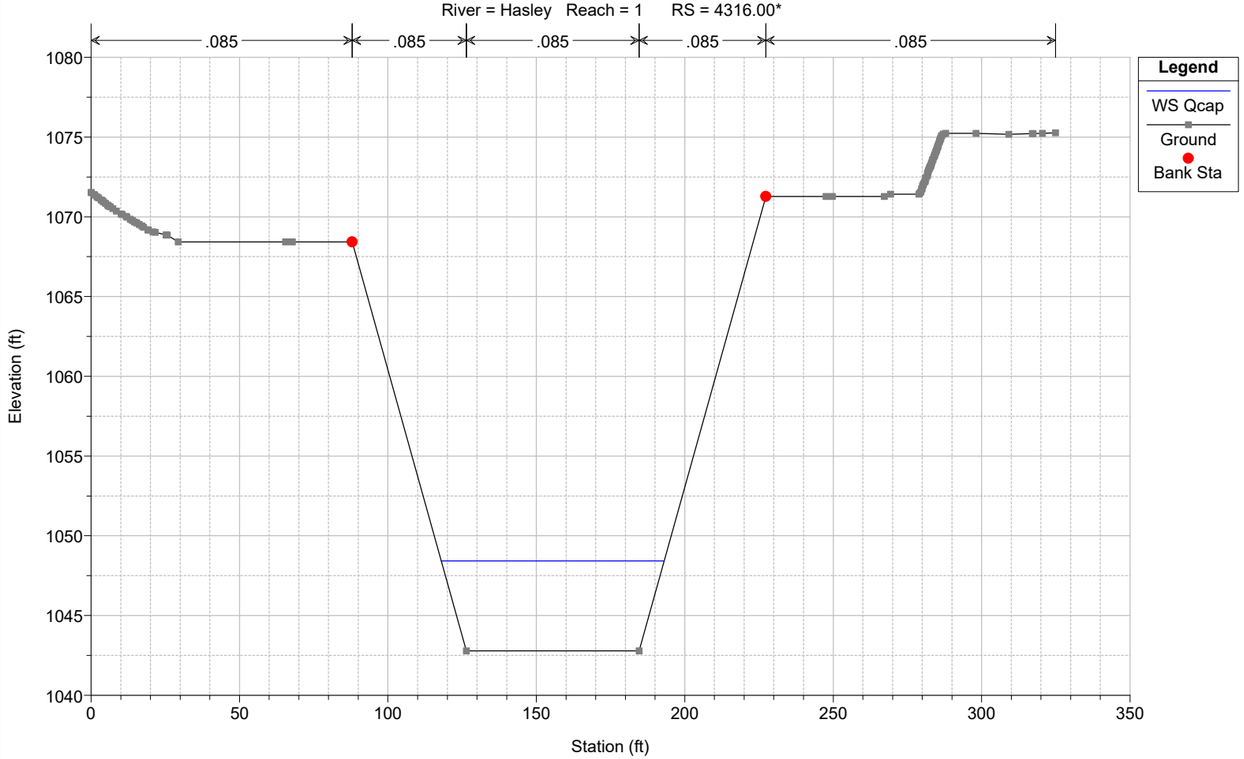

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 4364.00*
.085
.085
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 4348.00*
.085
.085
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 4332.00*
.085
.085
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)

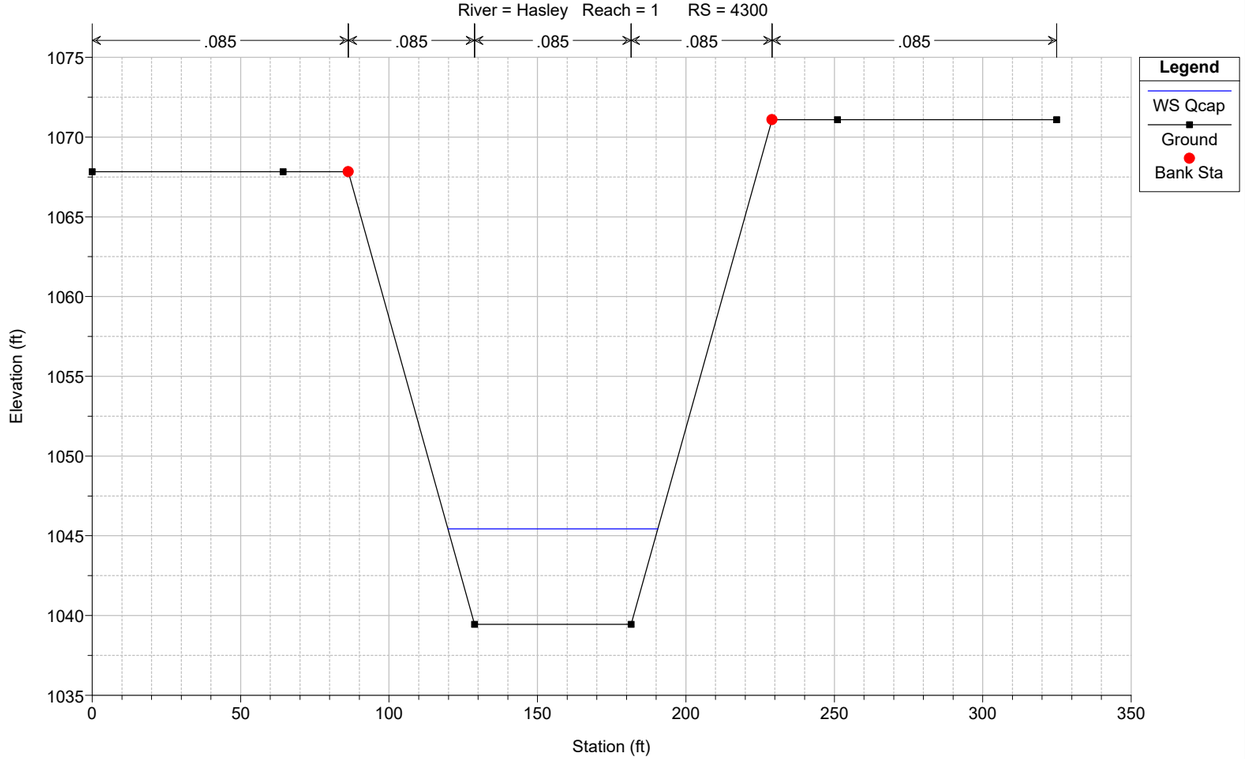
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4316.00*



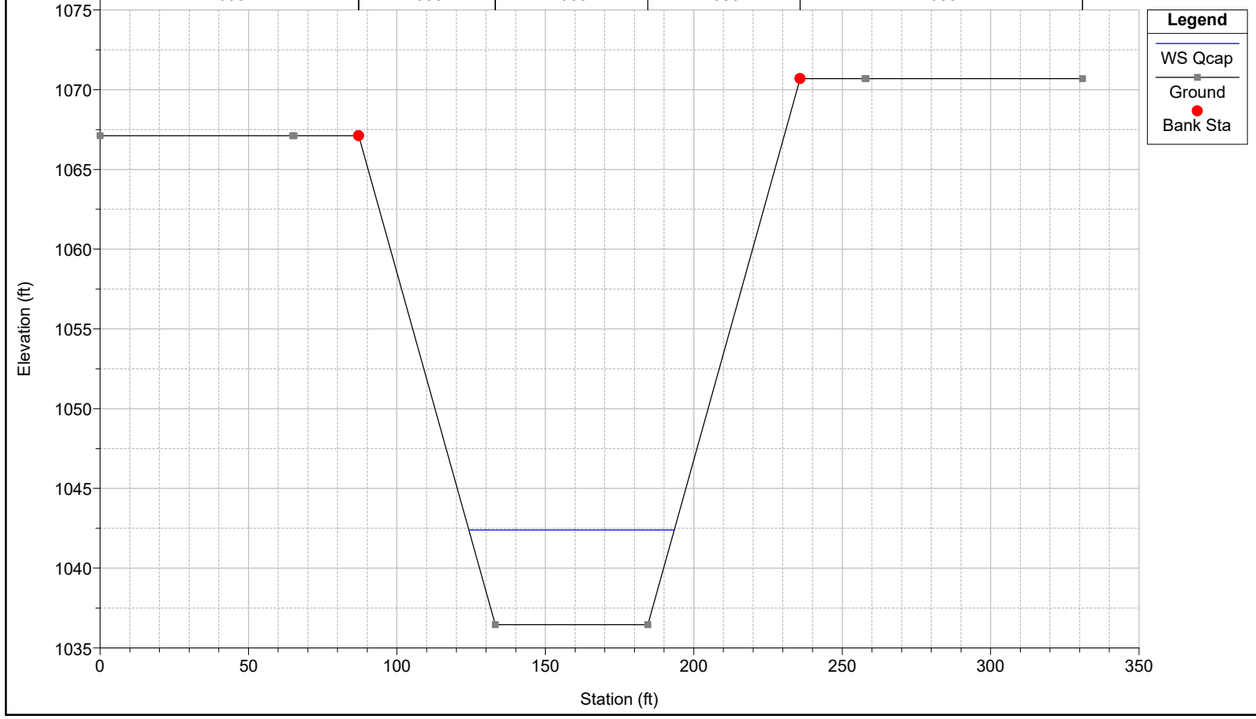
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4300



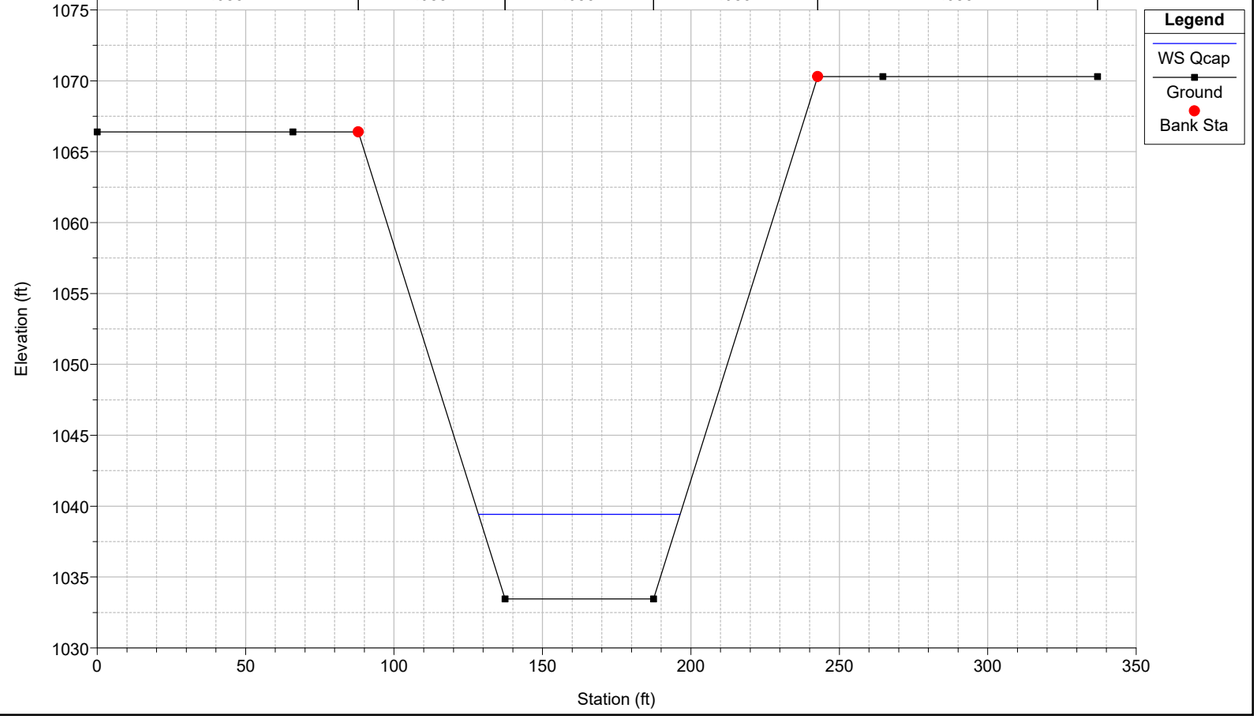
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4291.00*



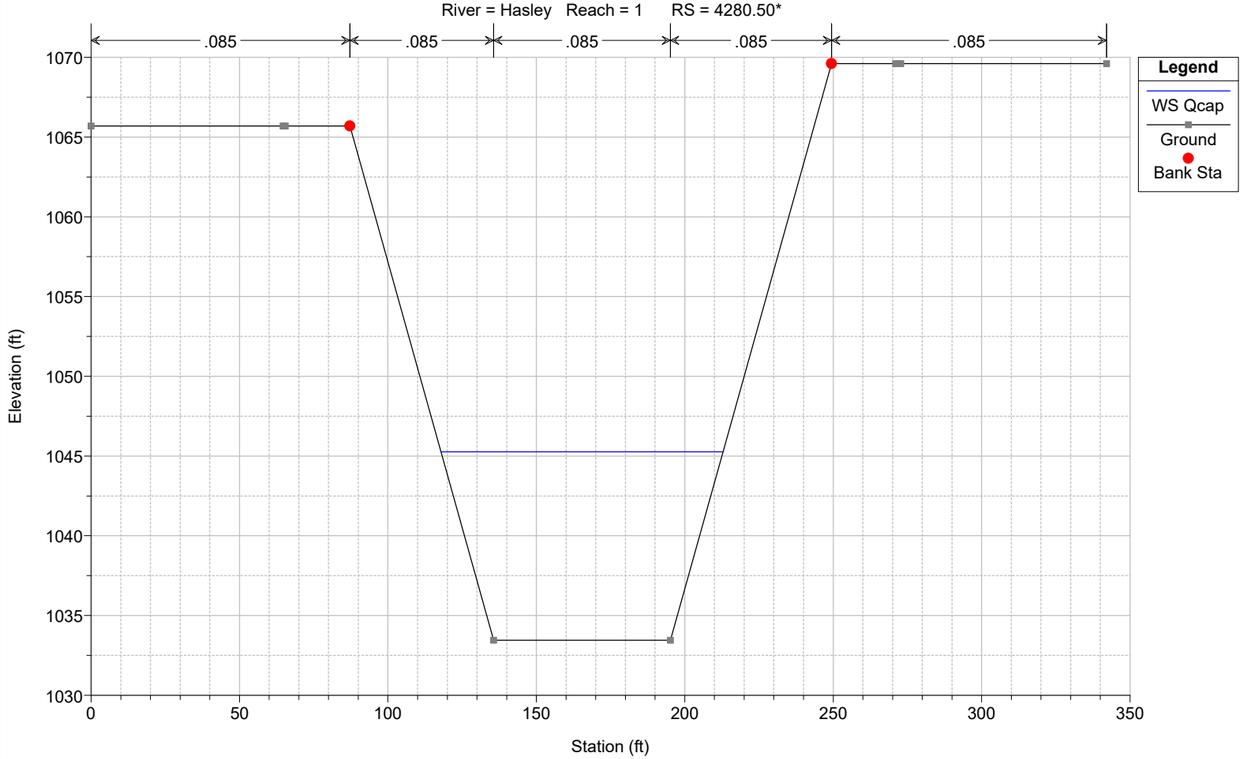
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4282



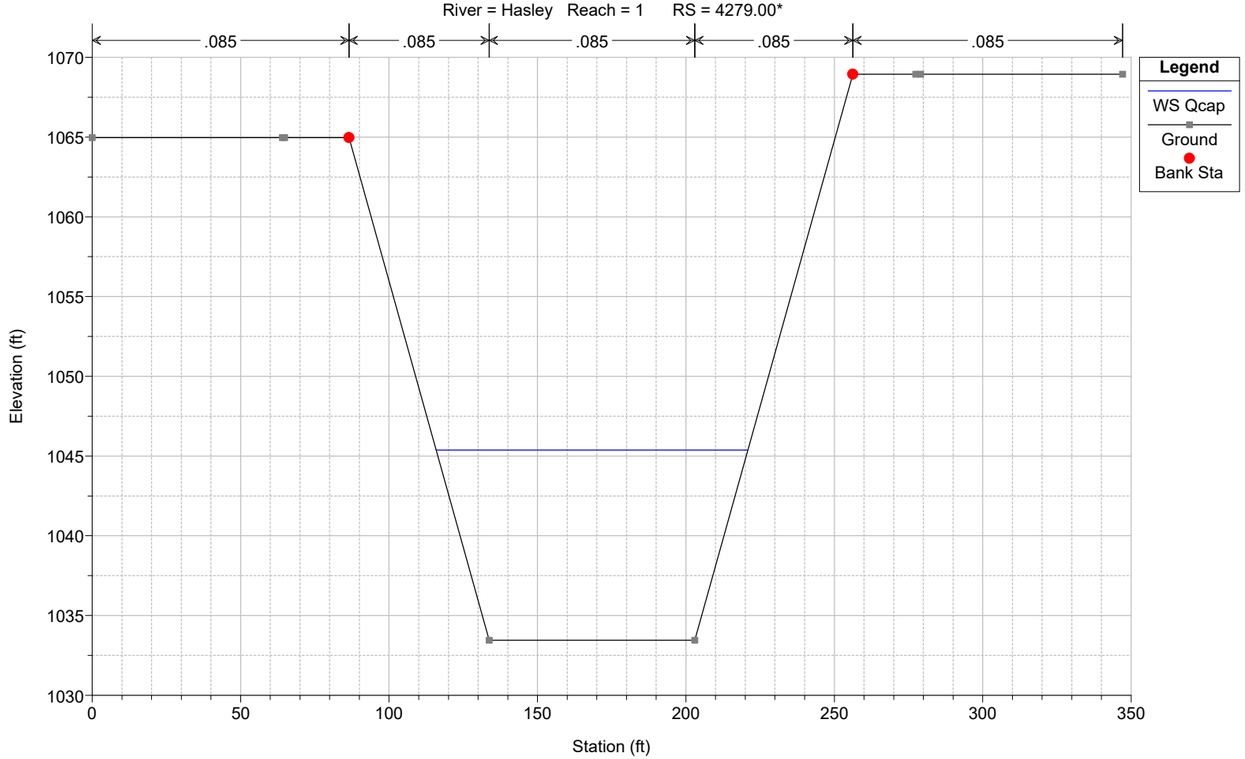
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4280.50*



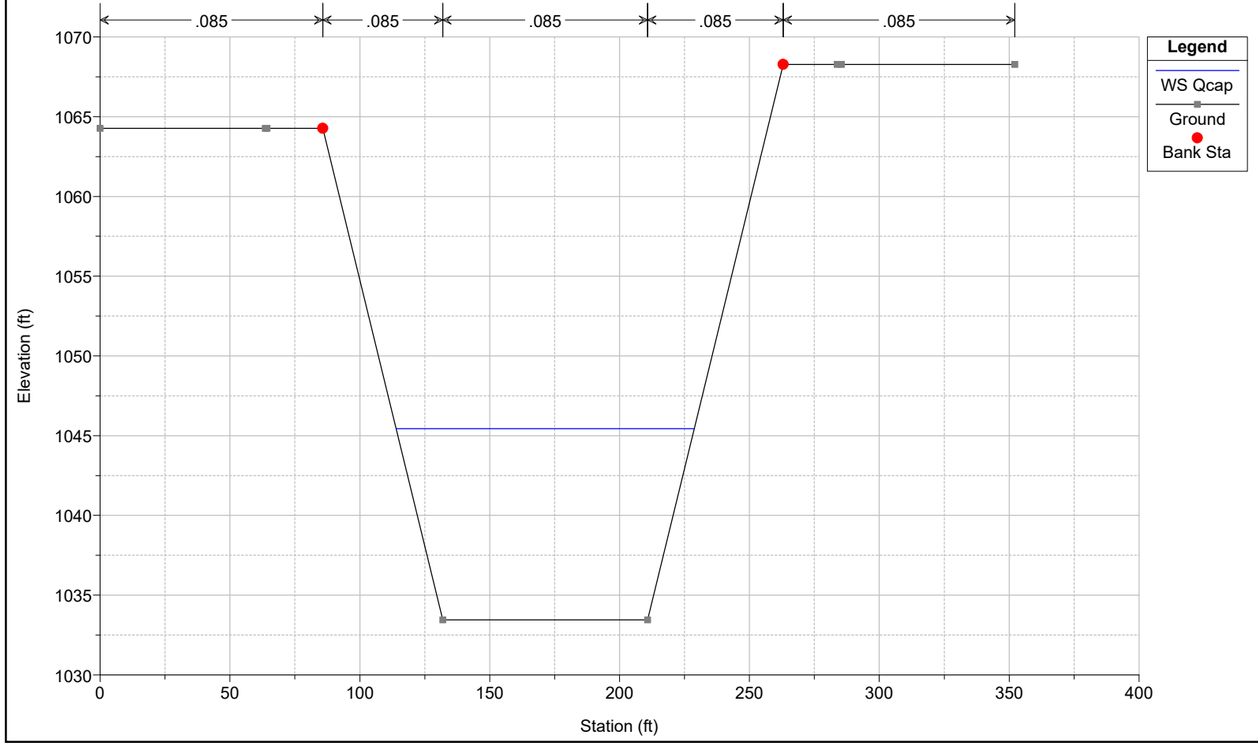
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4279.00*



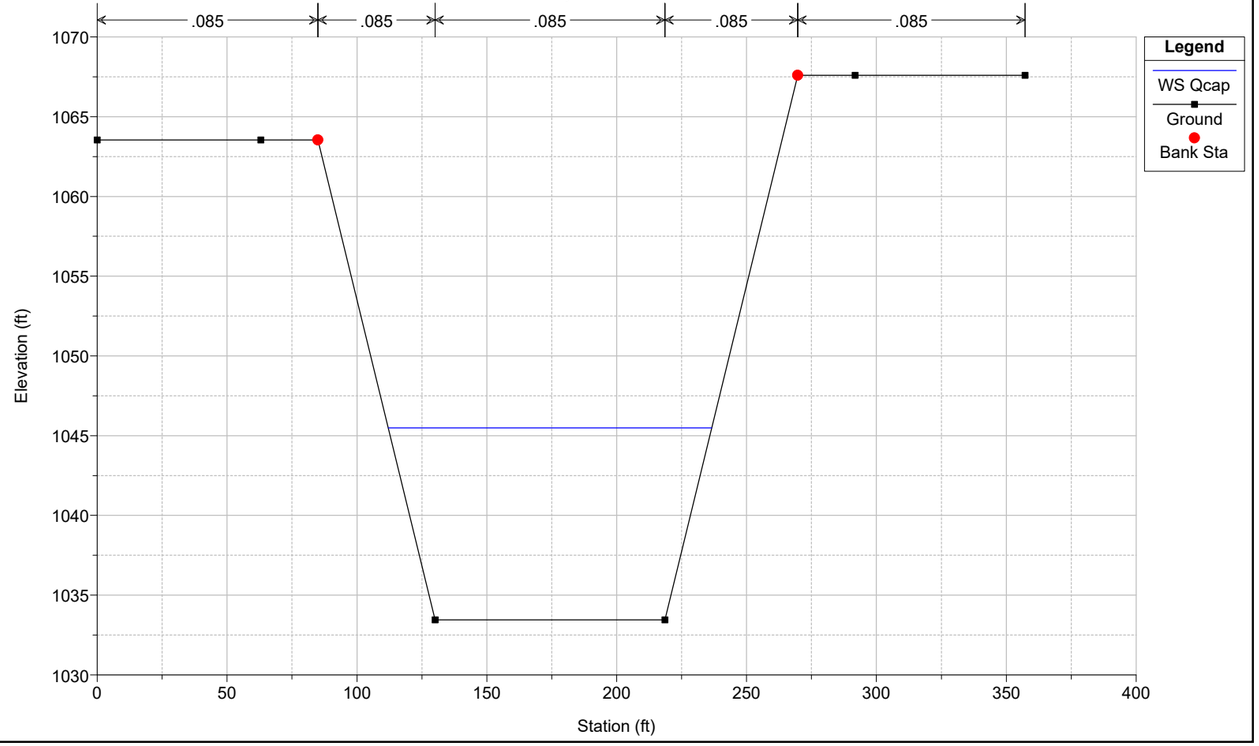
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4277.50*



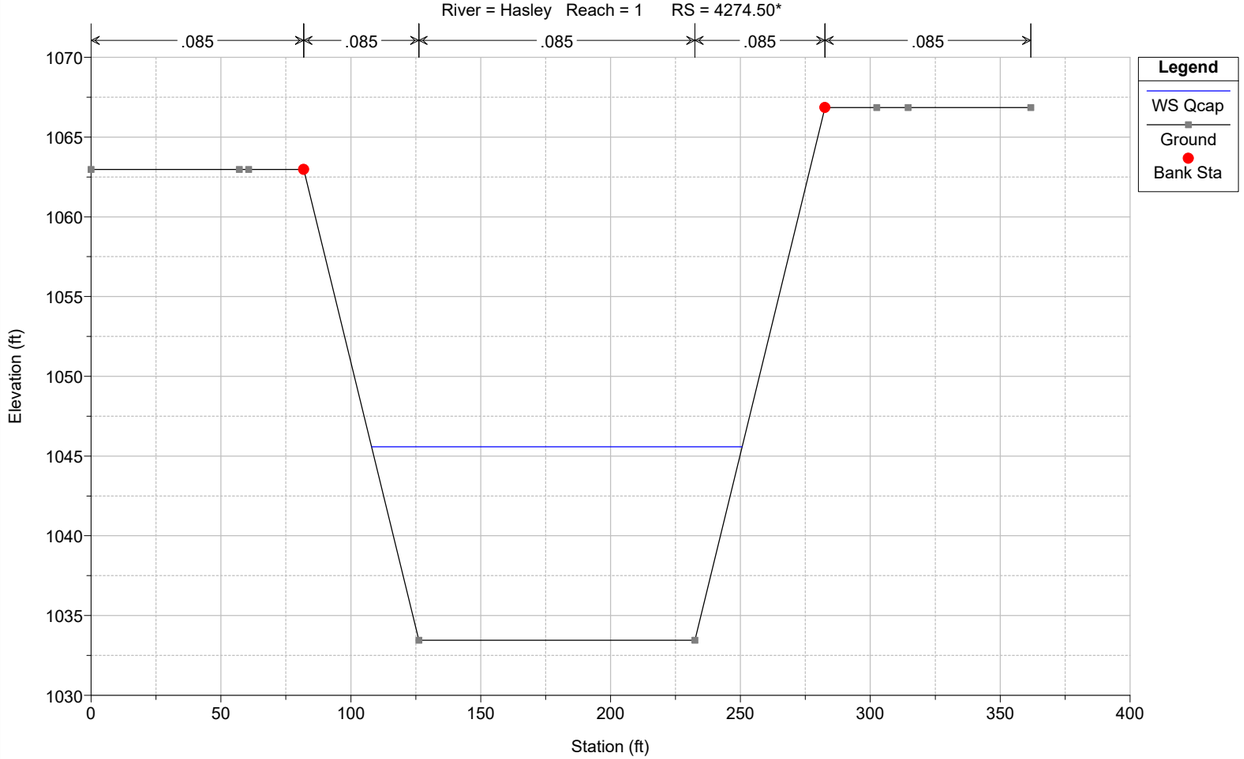
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4276



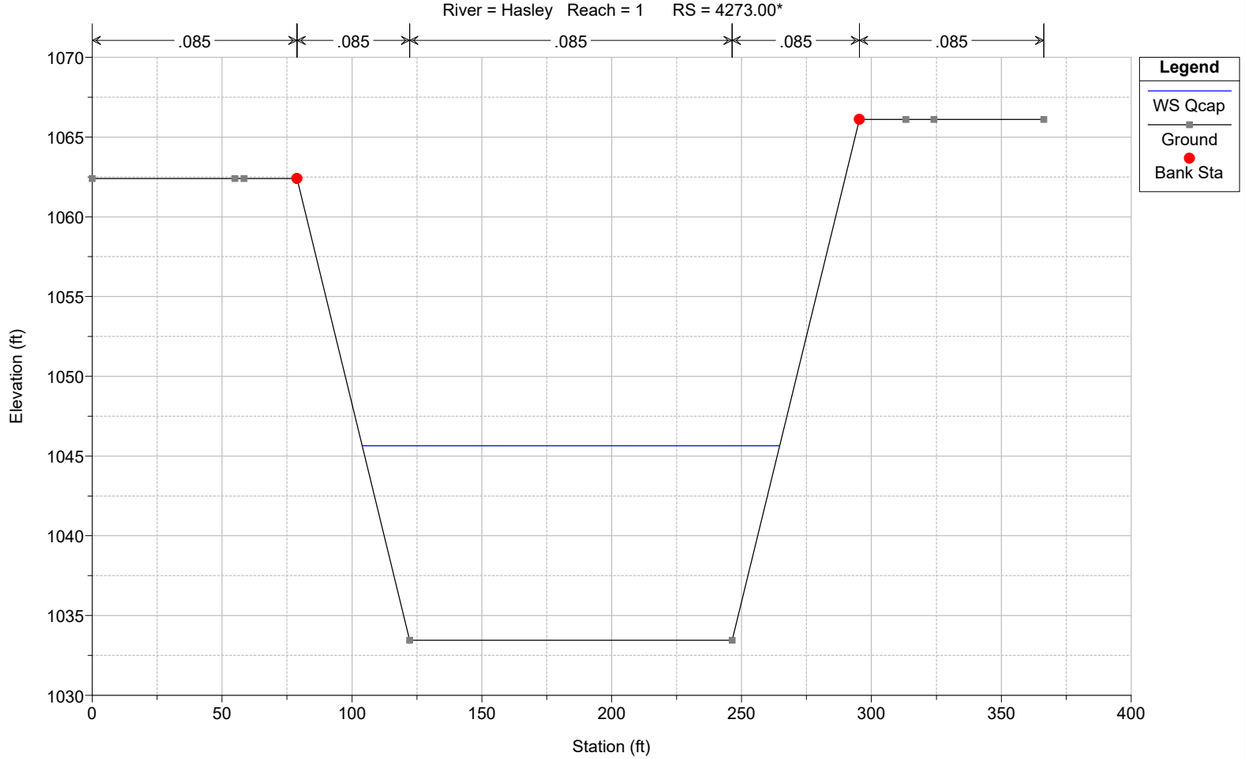
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4274.50*



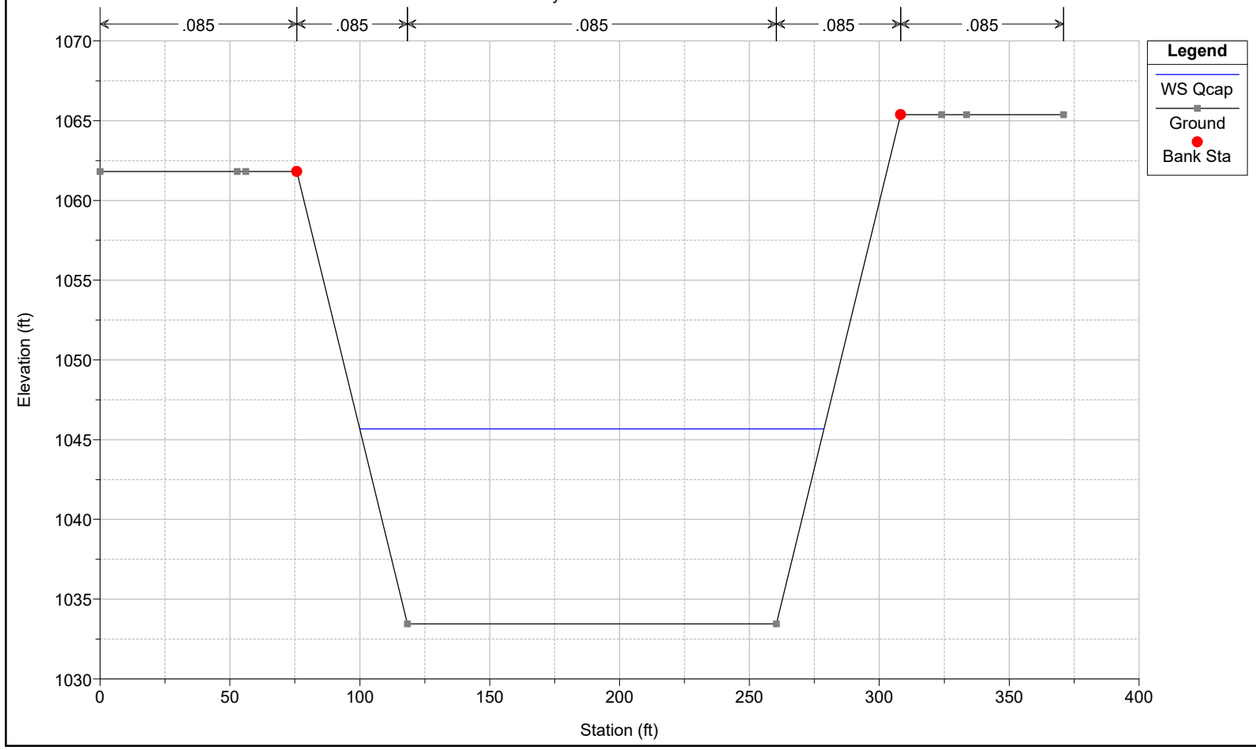
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4273.00*



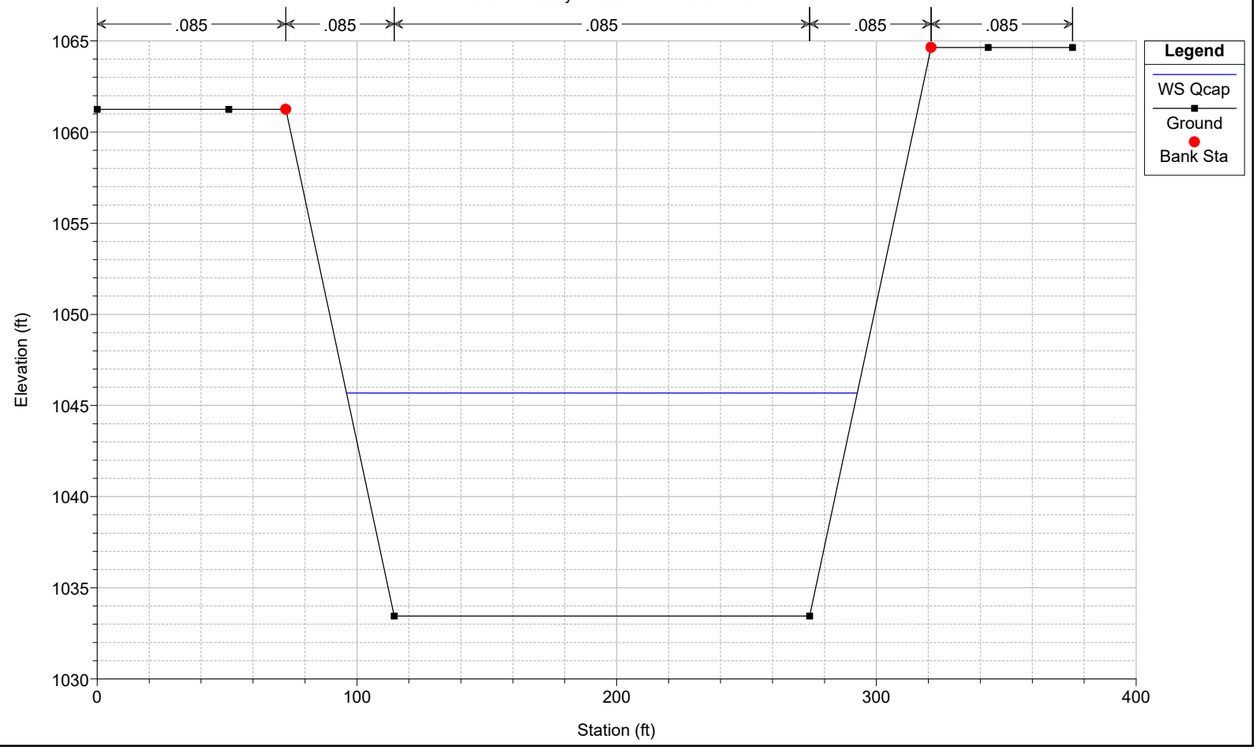
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4271.50*



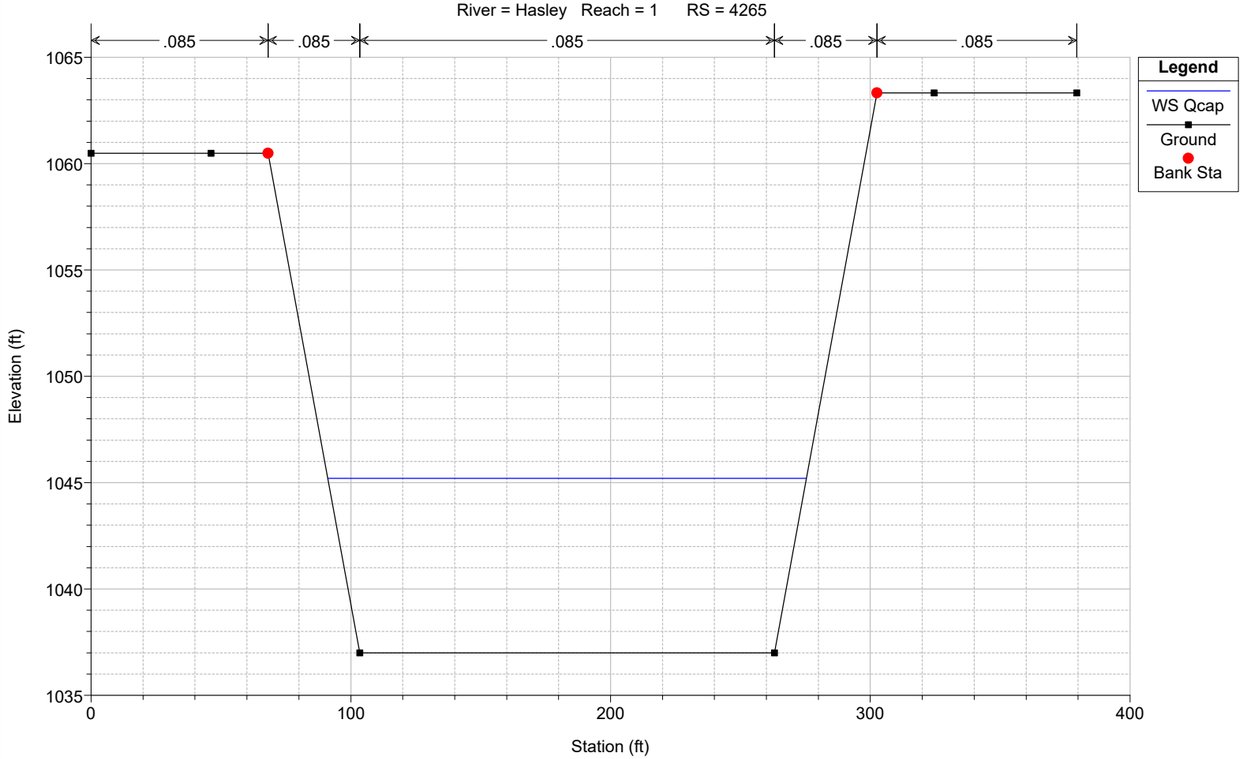
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4270



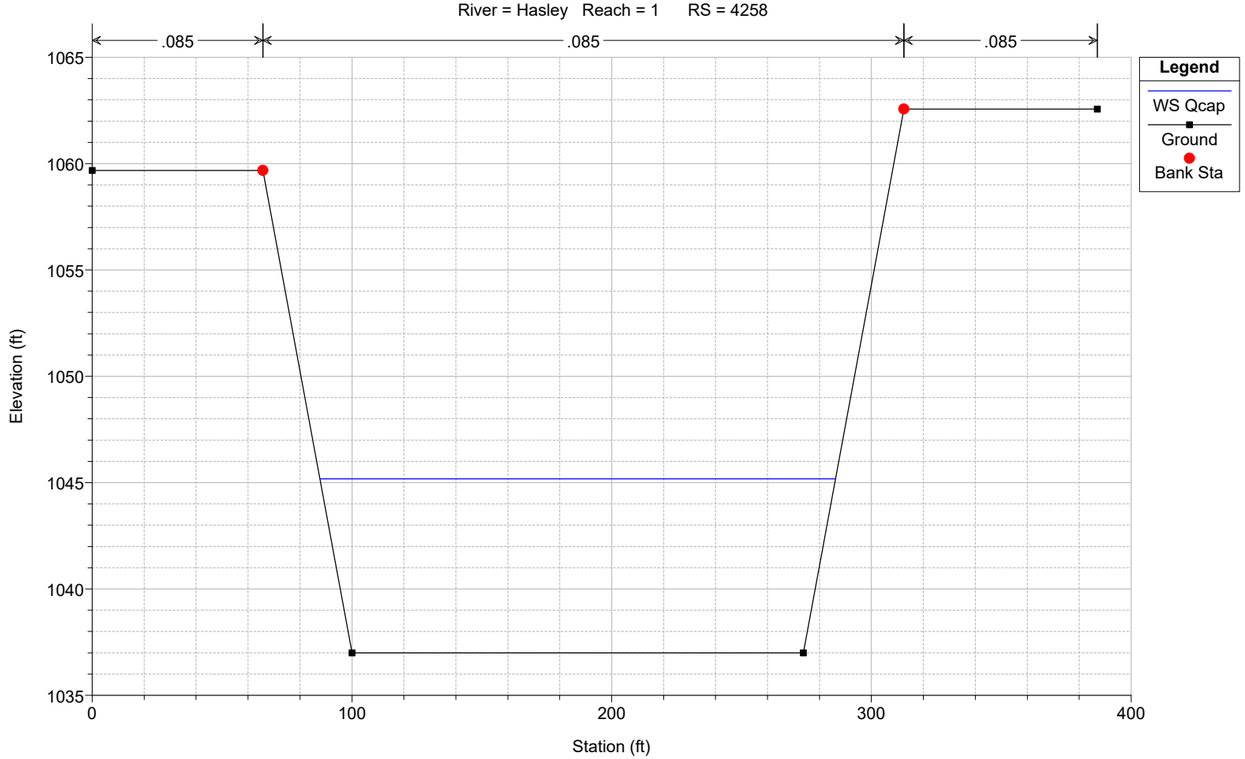
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4265



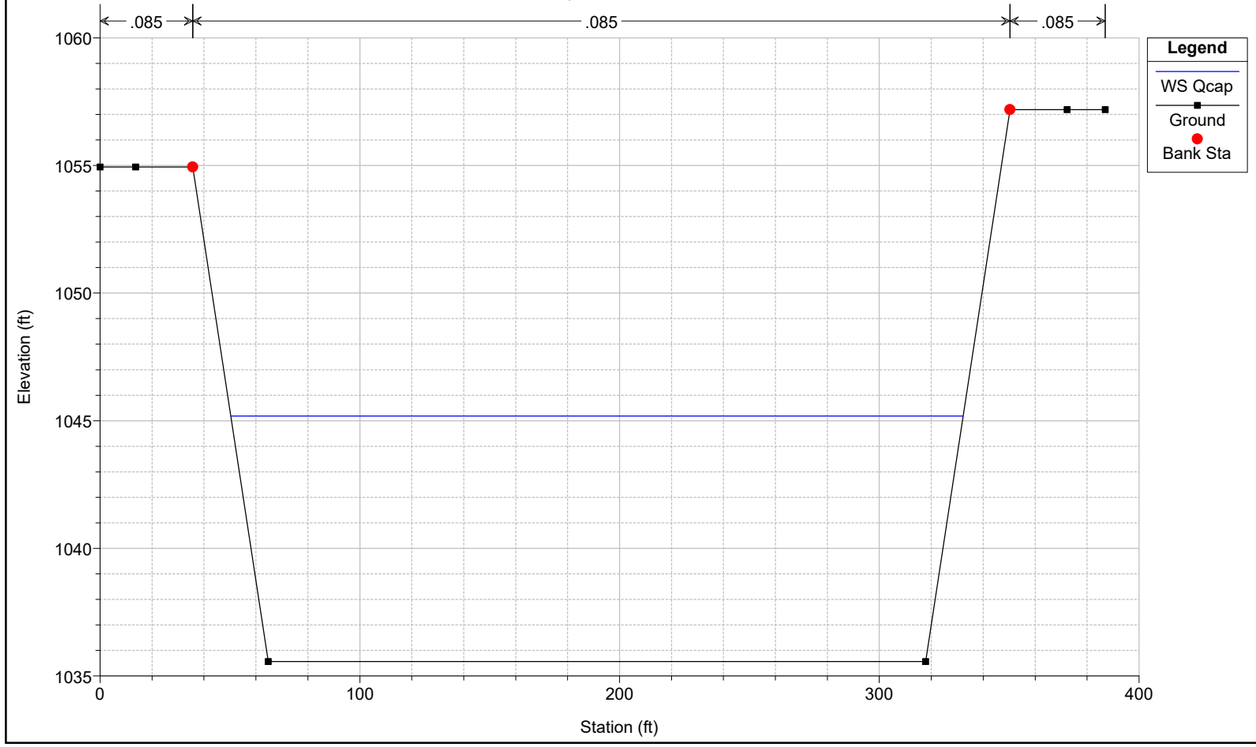
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 4258



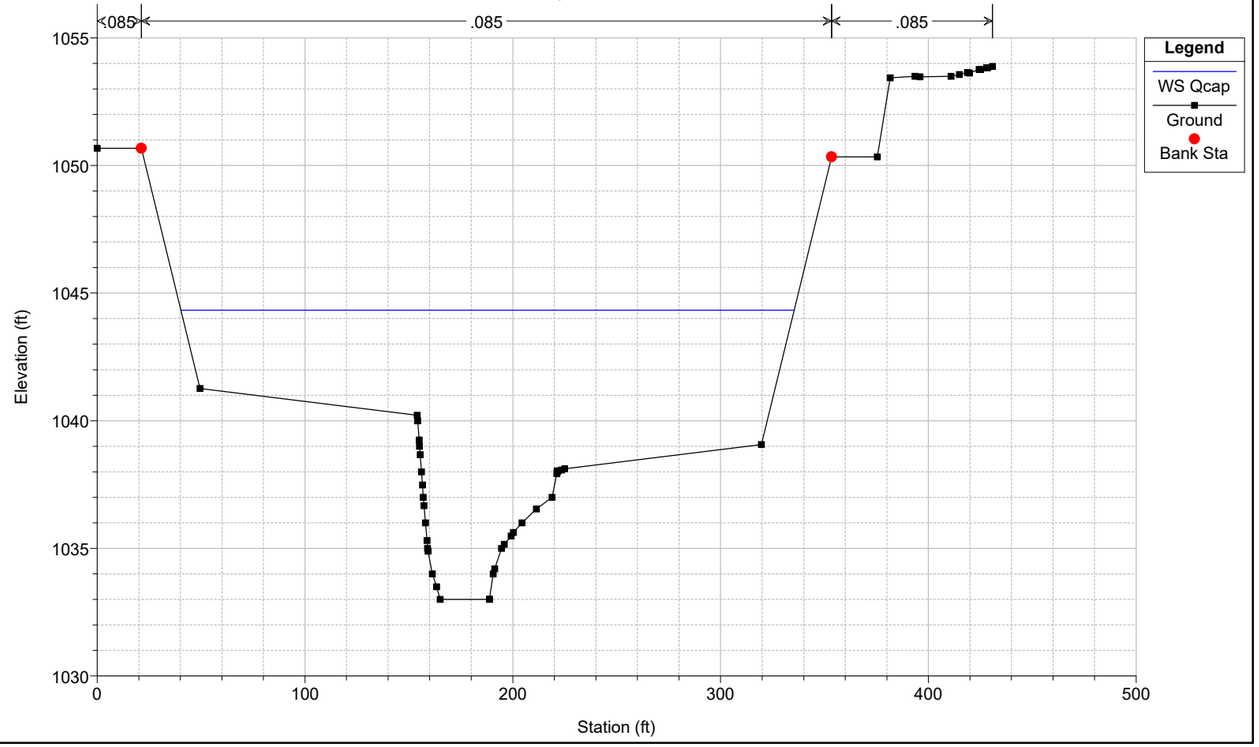
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

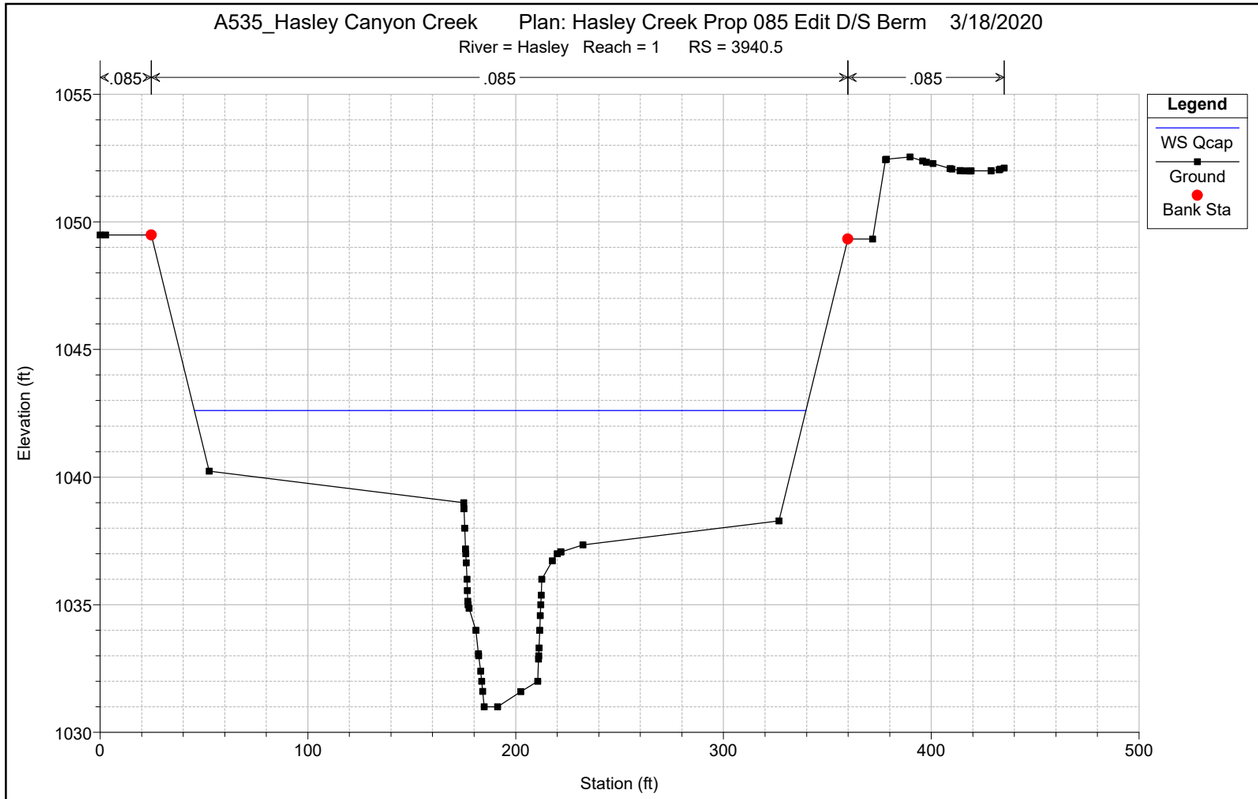
River = Hasley Reach = 1 RS = 4157

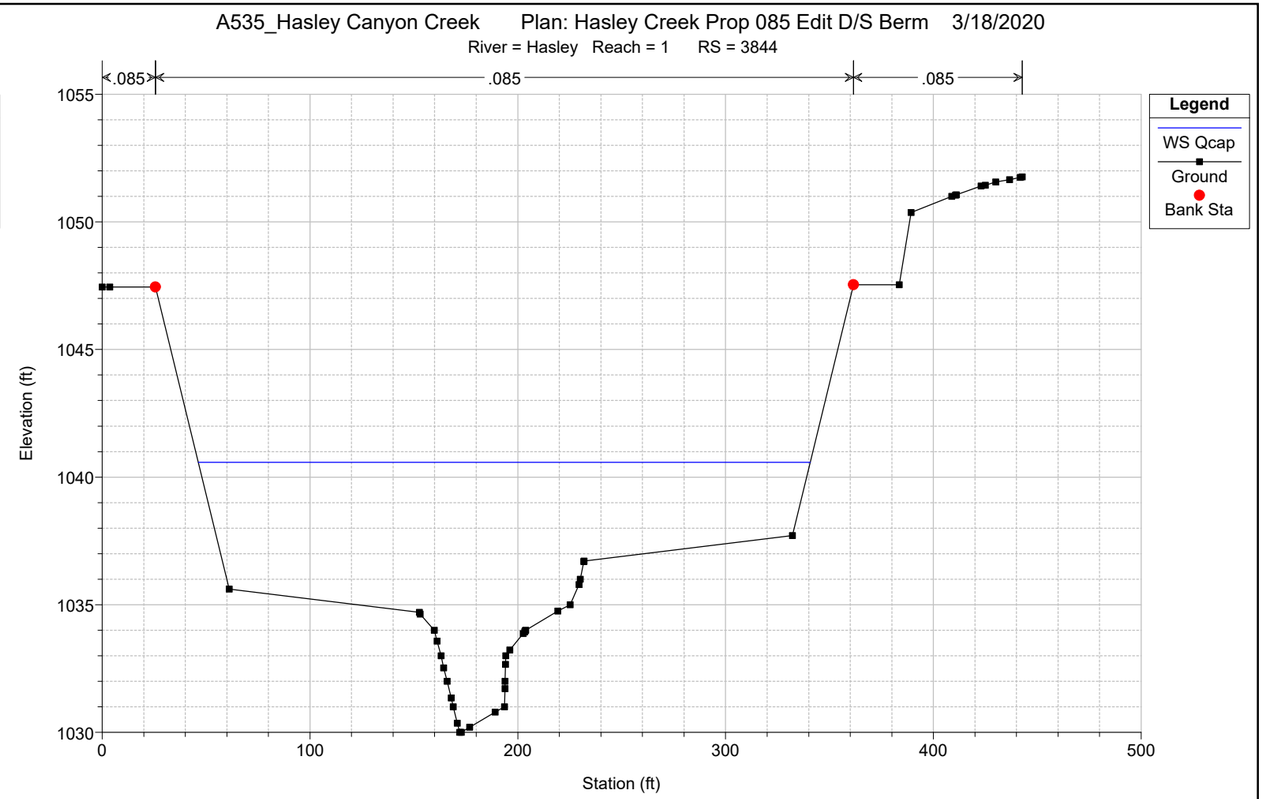


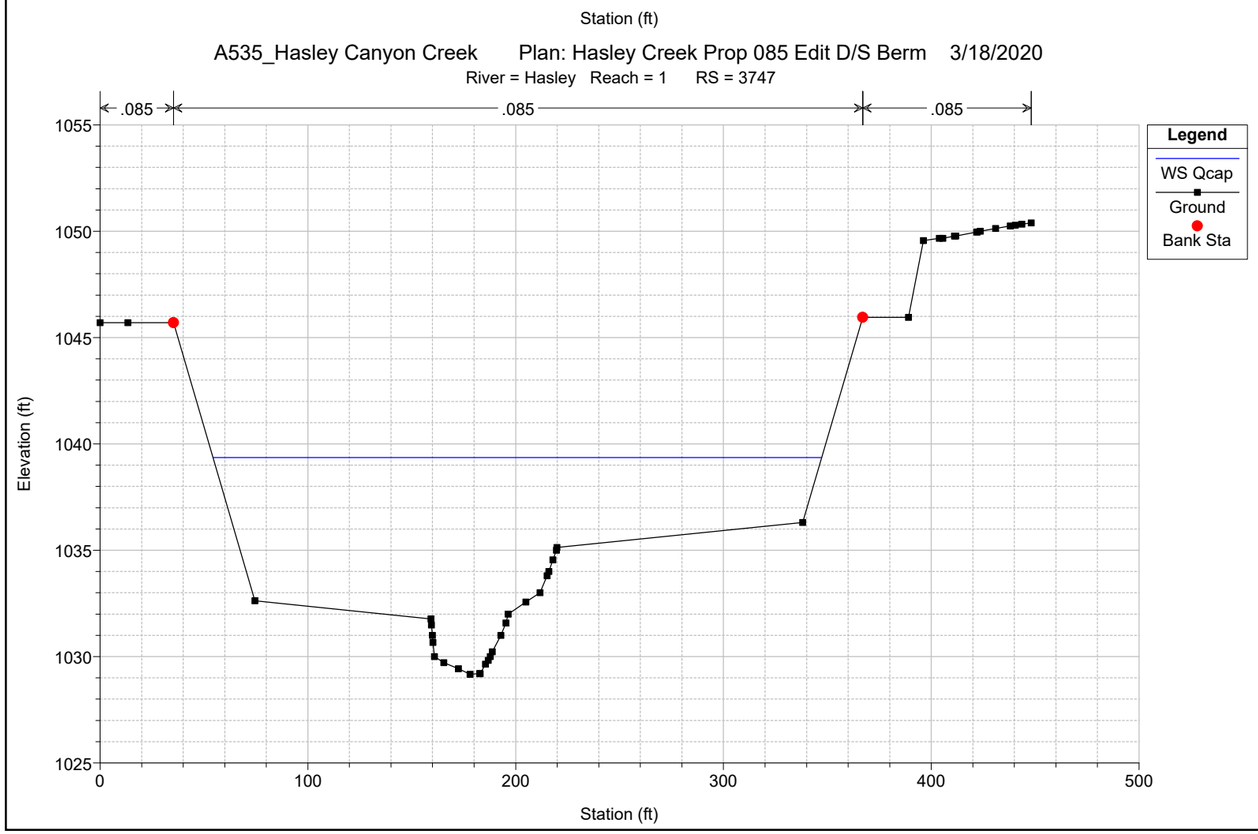
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

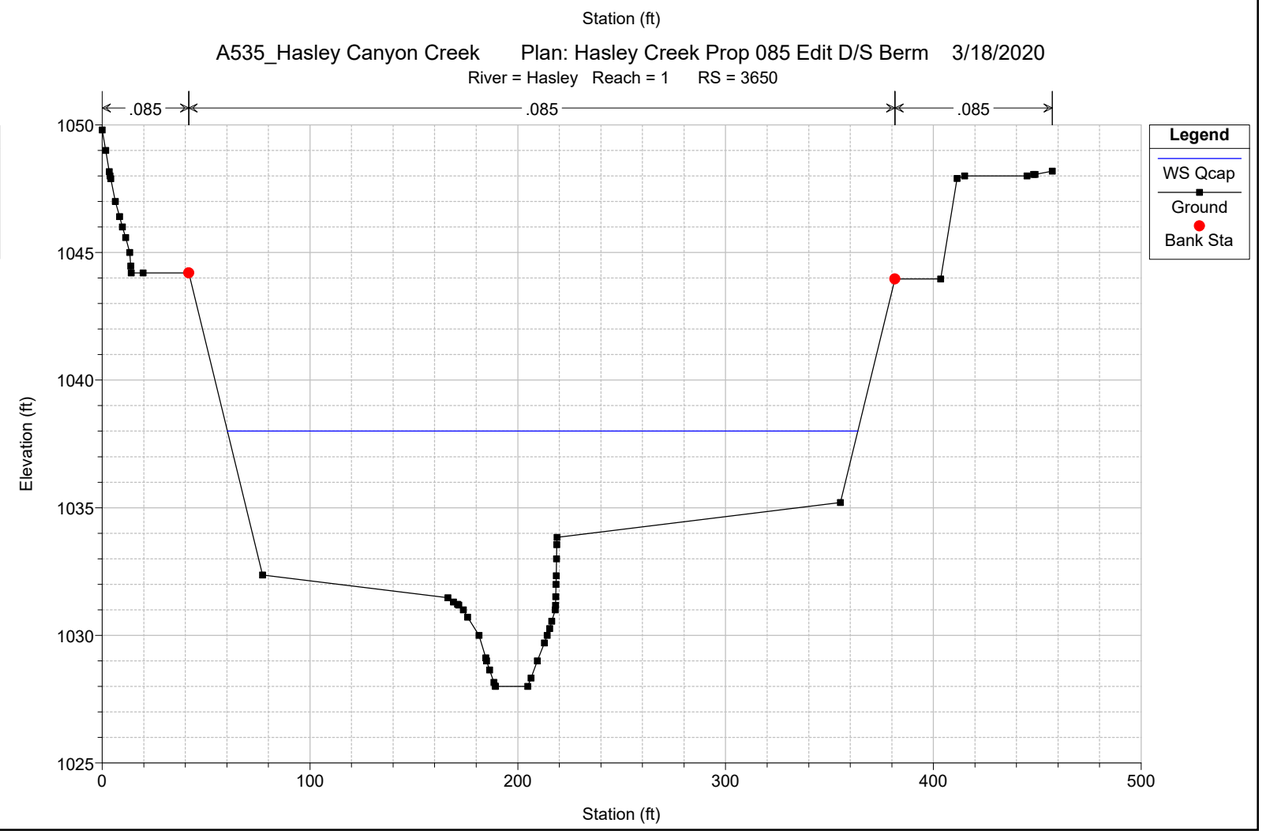
River = Hasley Reach = 1 RS = 4055.5

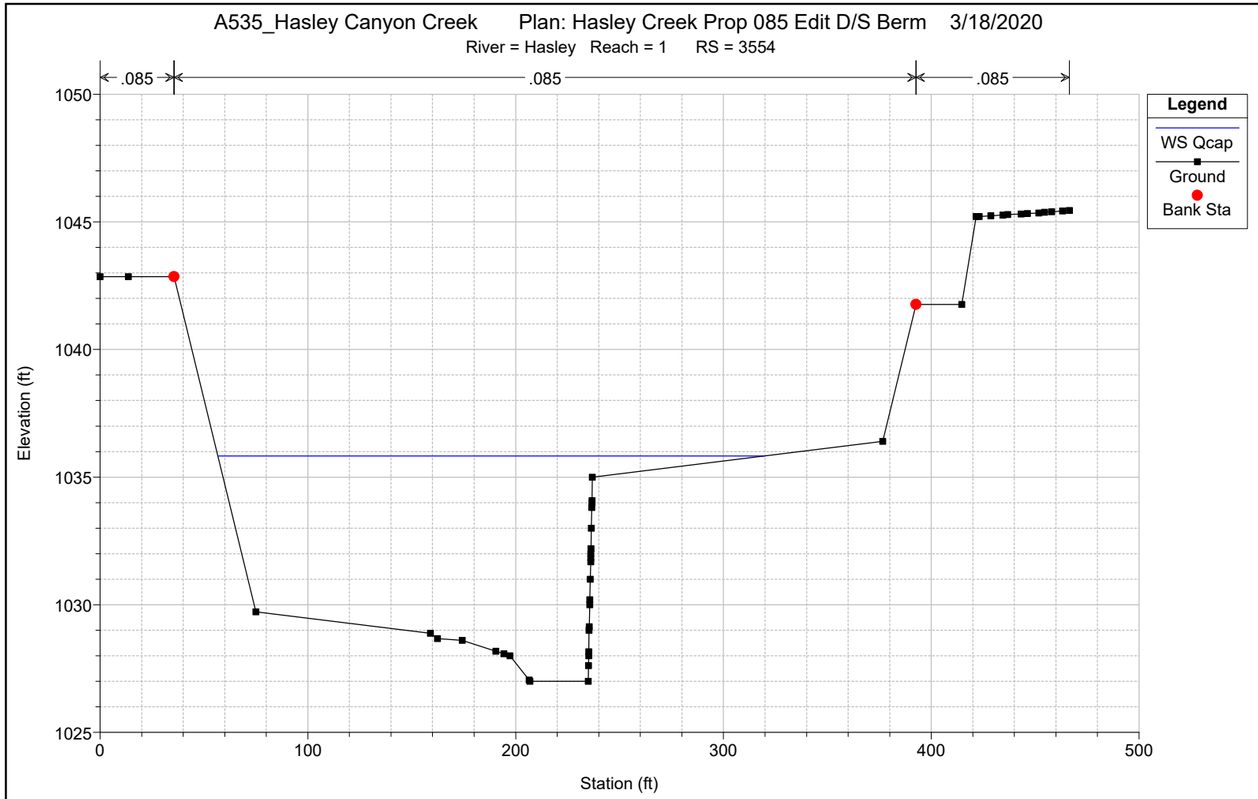


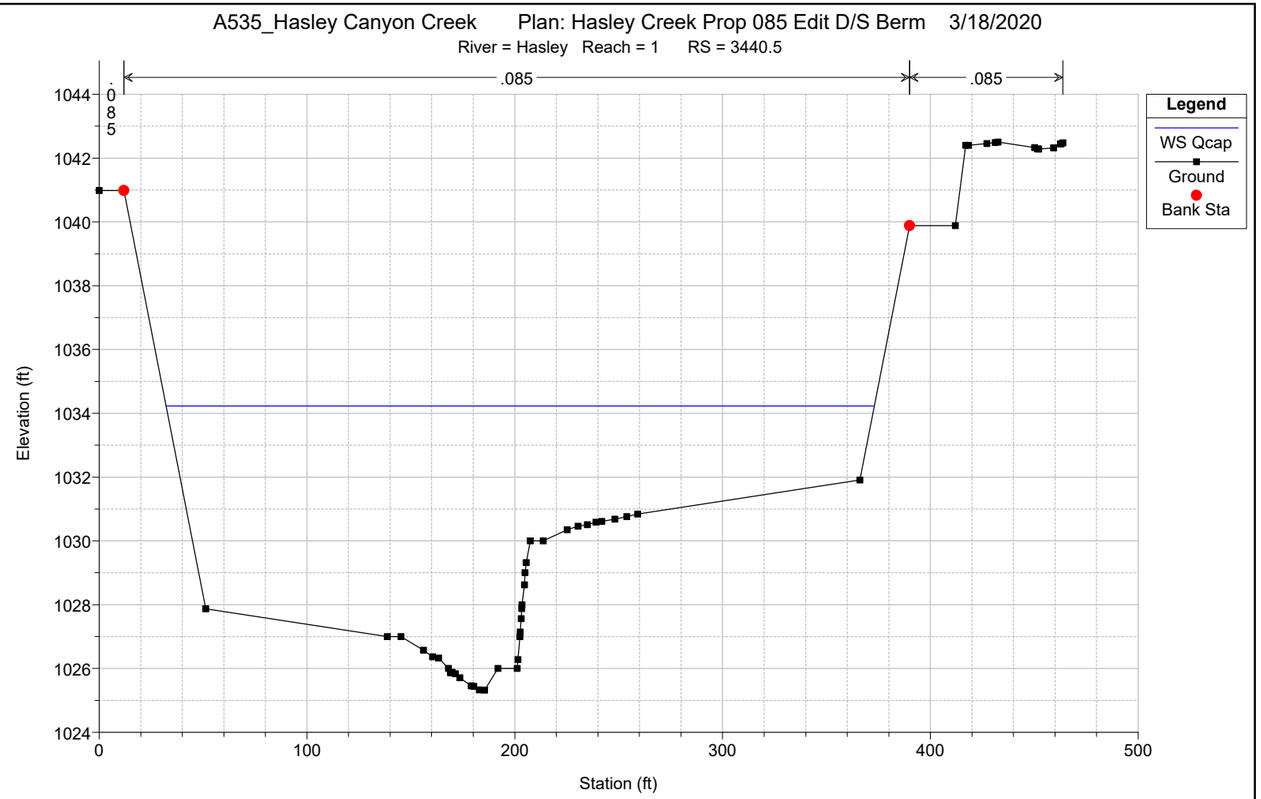

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 3940.5
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 3844
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 3747
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 3650
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 3554
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 3440.5
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1044
1042
1040
1038
1036
1034
1032
1030
1028
1026
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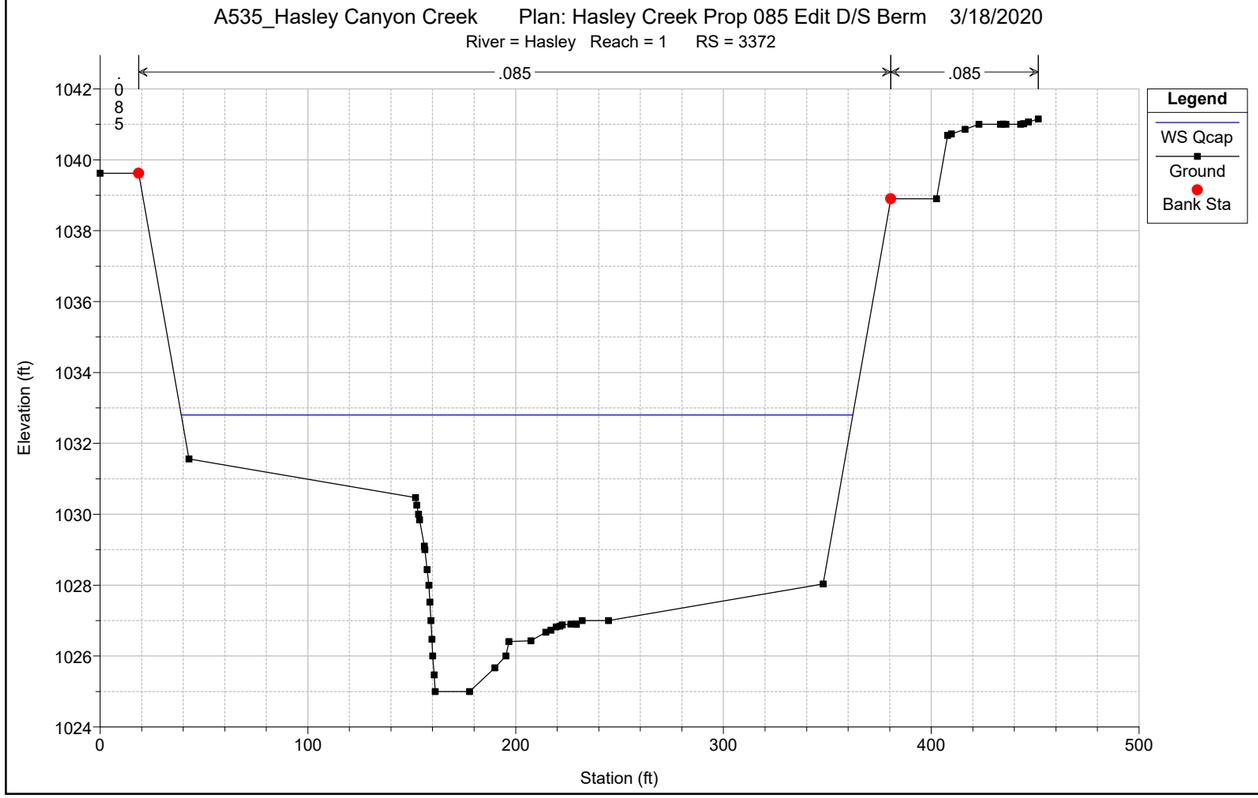
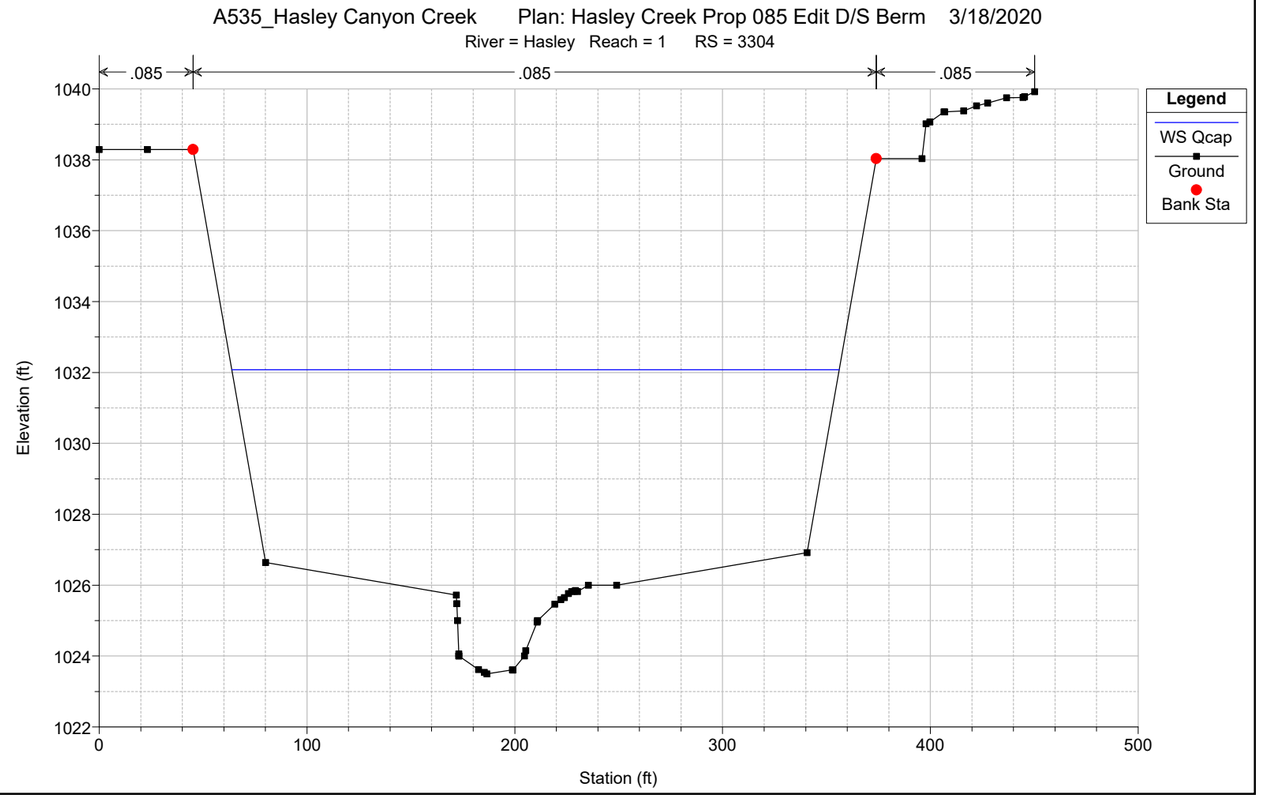
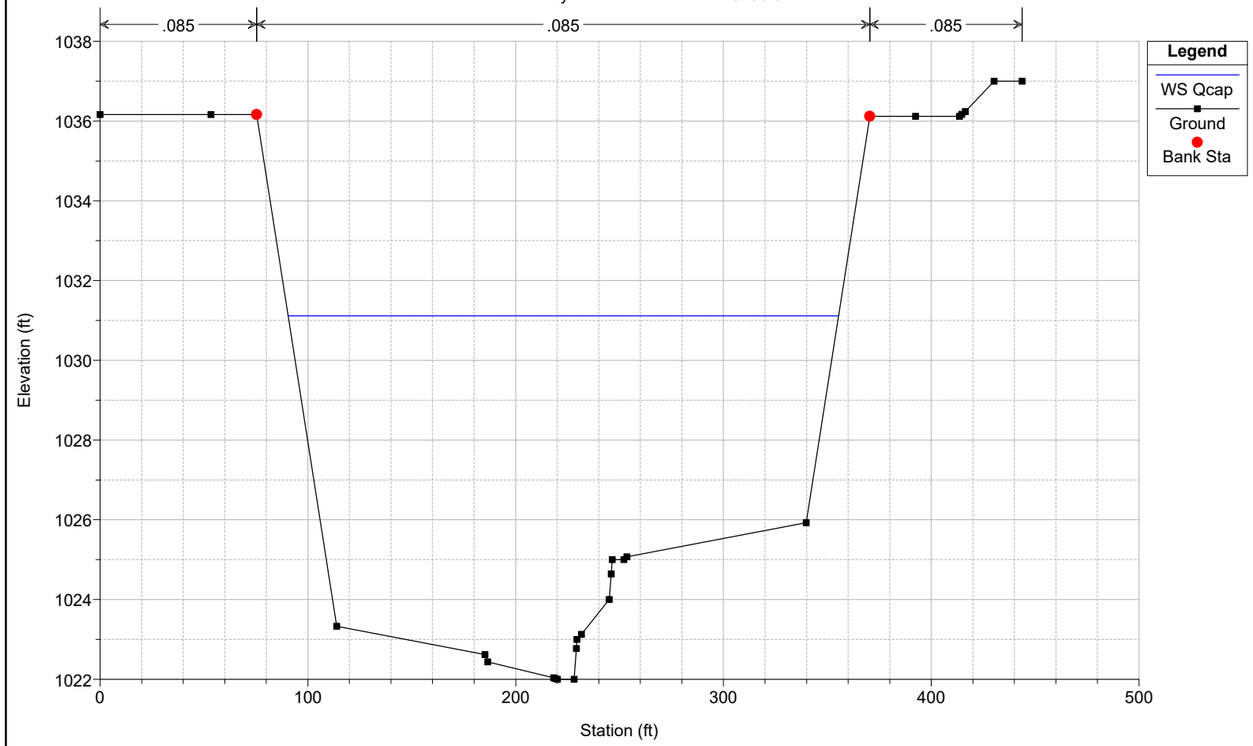
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 3372
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1042
1040
1038
1036
1034
1032
1030
1028
1026
1024
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020
River = Hasley Reach = 1 RS = 3304
.085
.085
.085
Legend
WS Qcap
Ground
Bank Sta
Elevation (ft)
Station (ft)
1040
1038
1036
1034
1032
1030
1028
1026
1024
1022
0
100
200
300
400
500

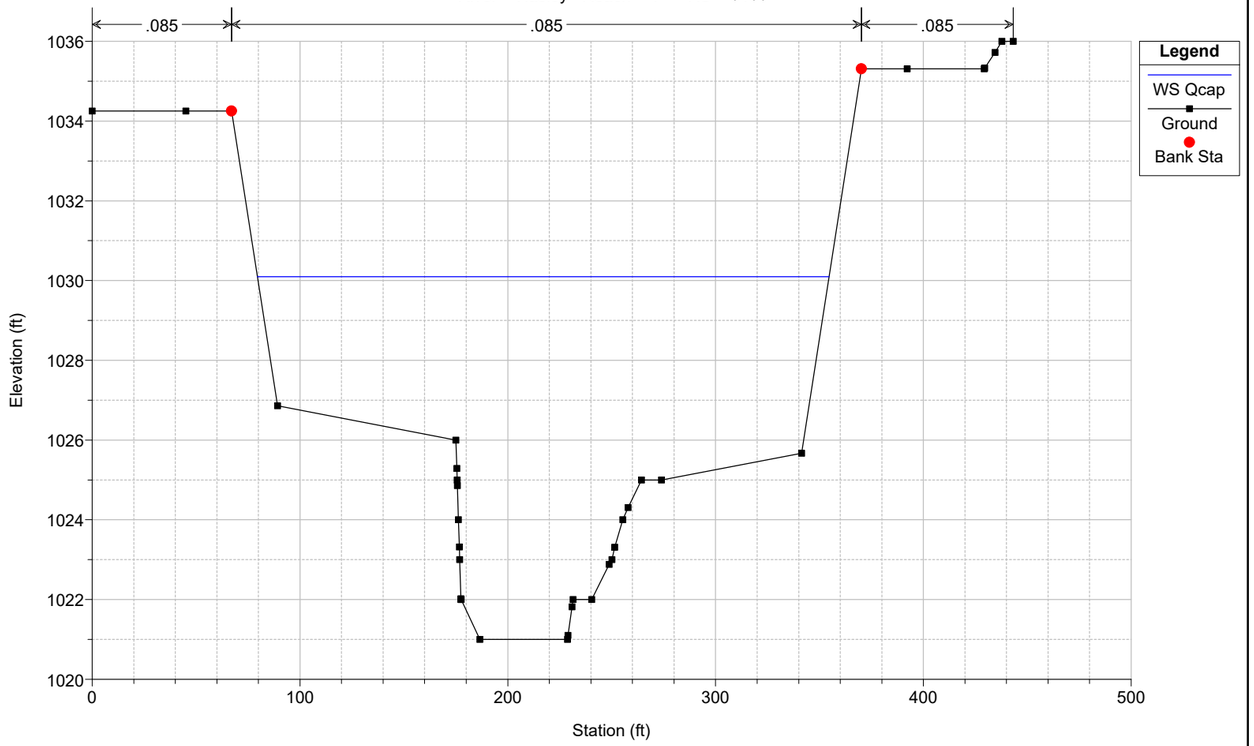
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 3190.5



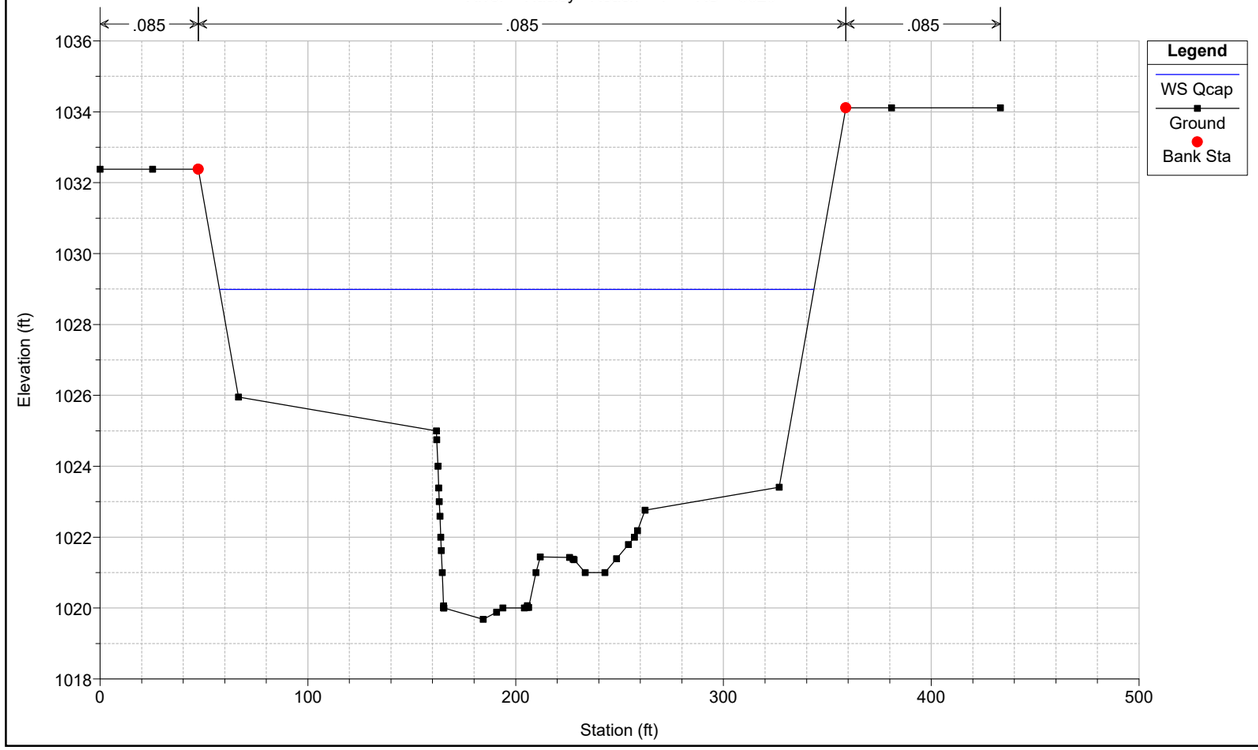
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 3105



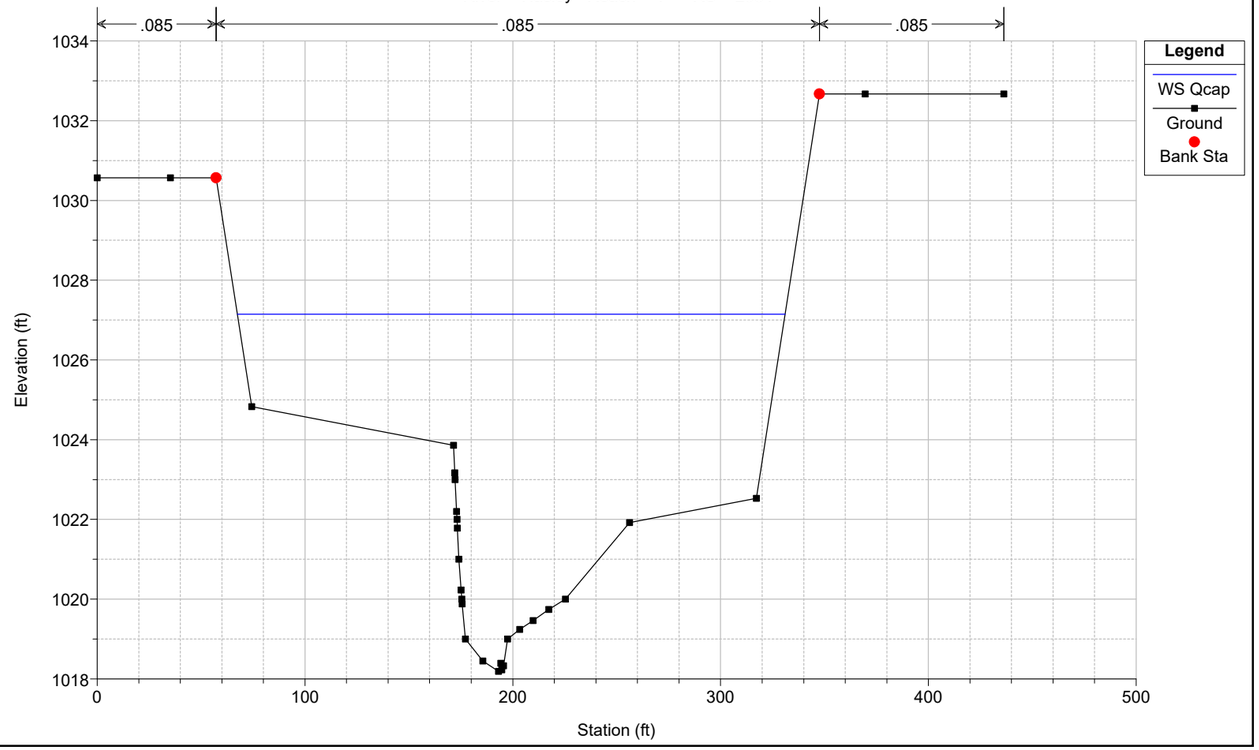
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 3020



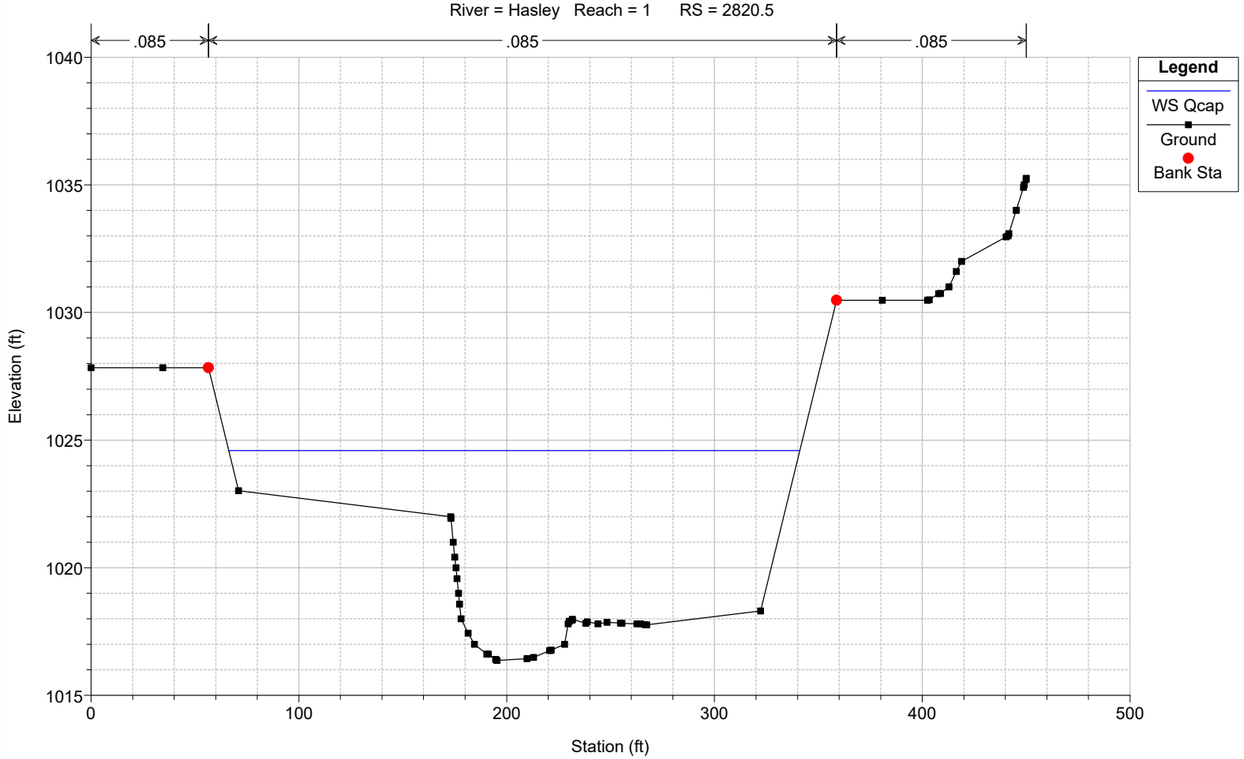
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2934



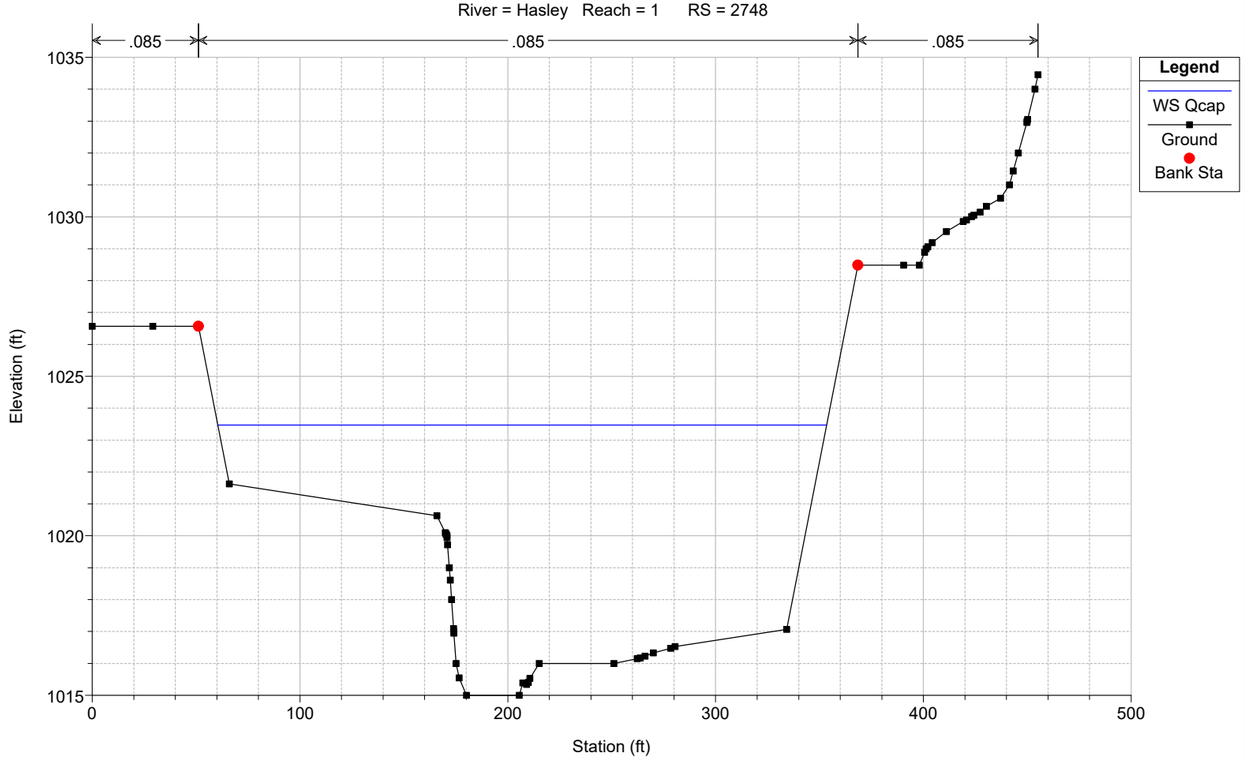
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2820.5



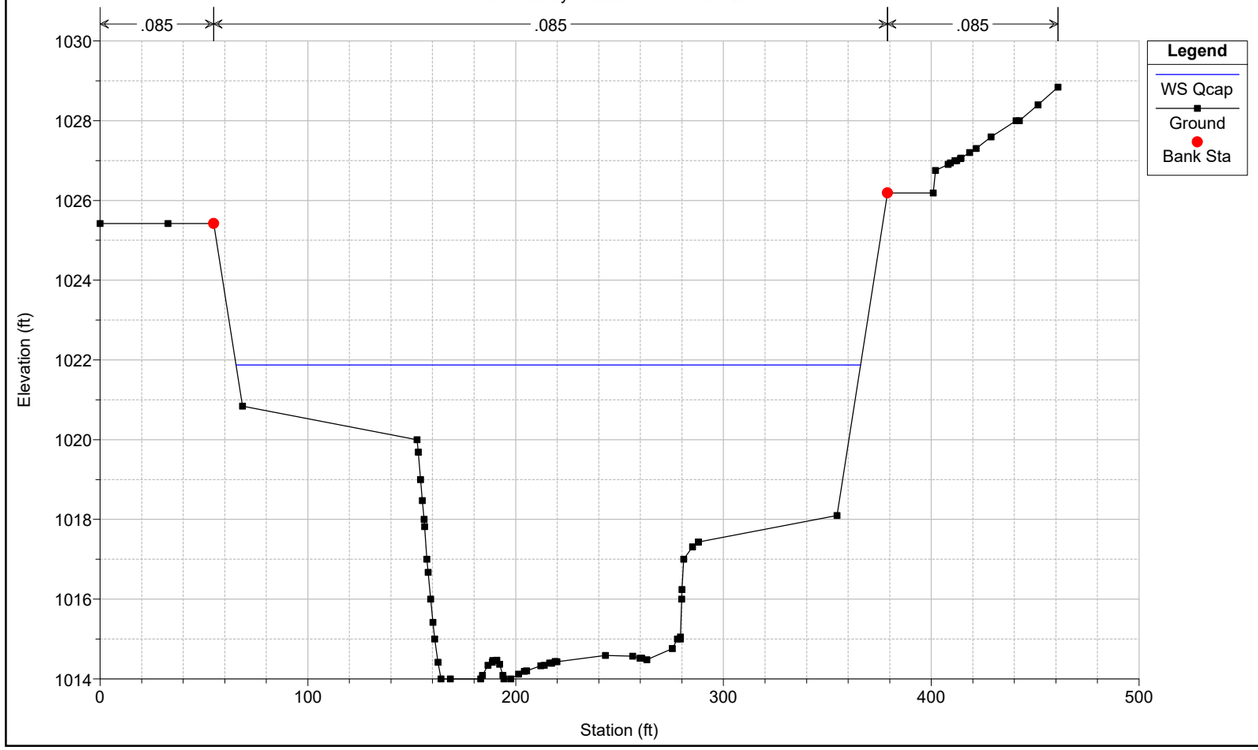
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2748



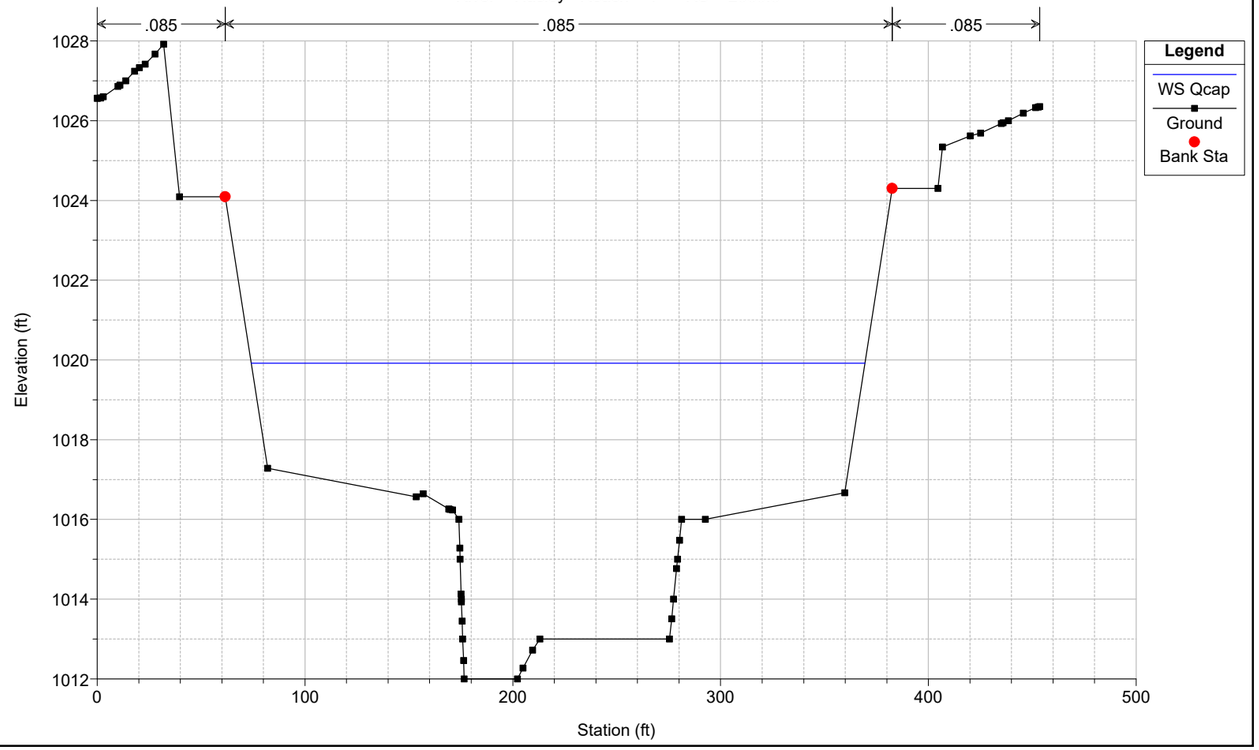
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2675.5



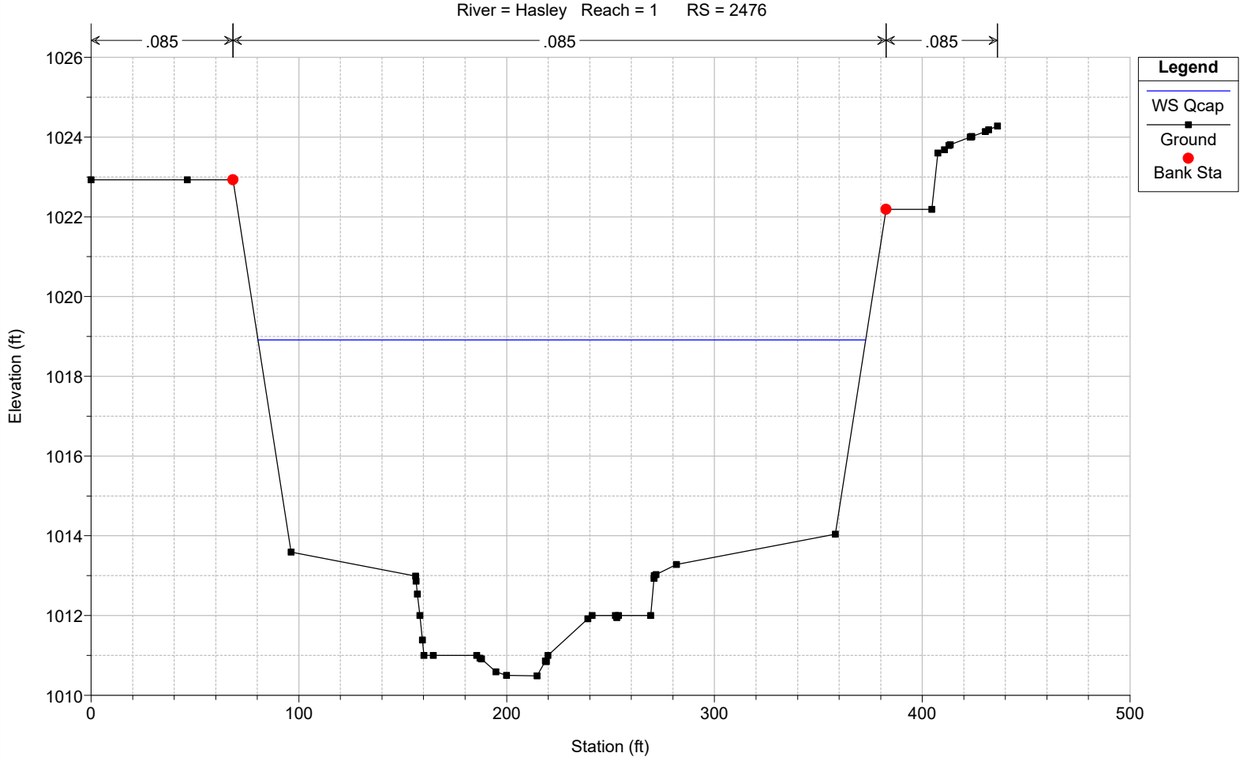
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2560.5



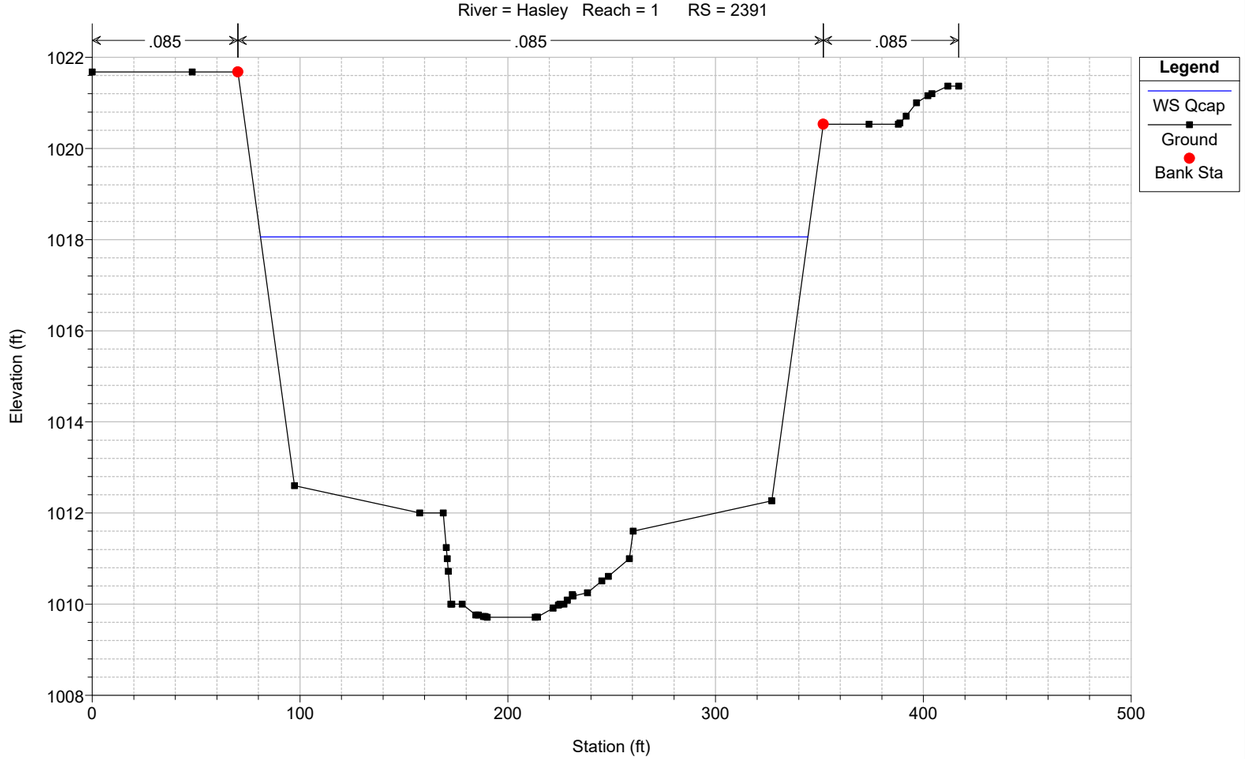
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2476



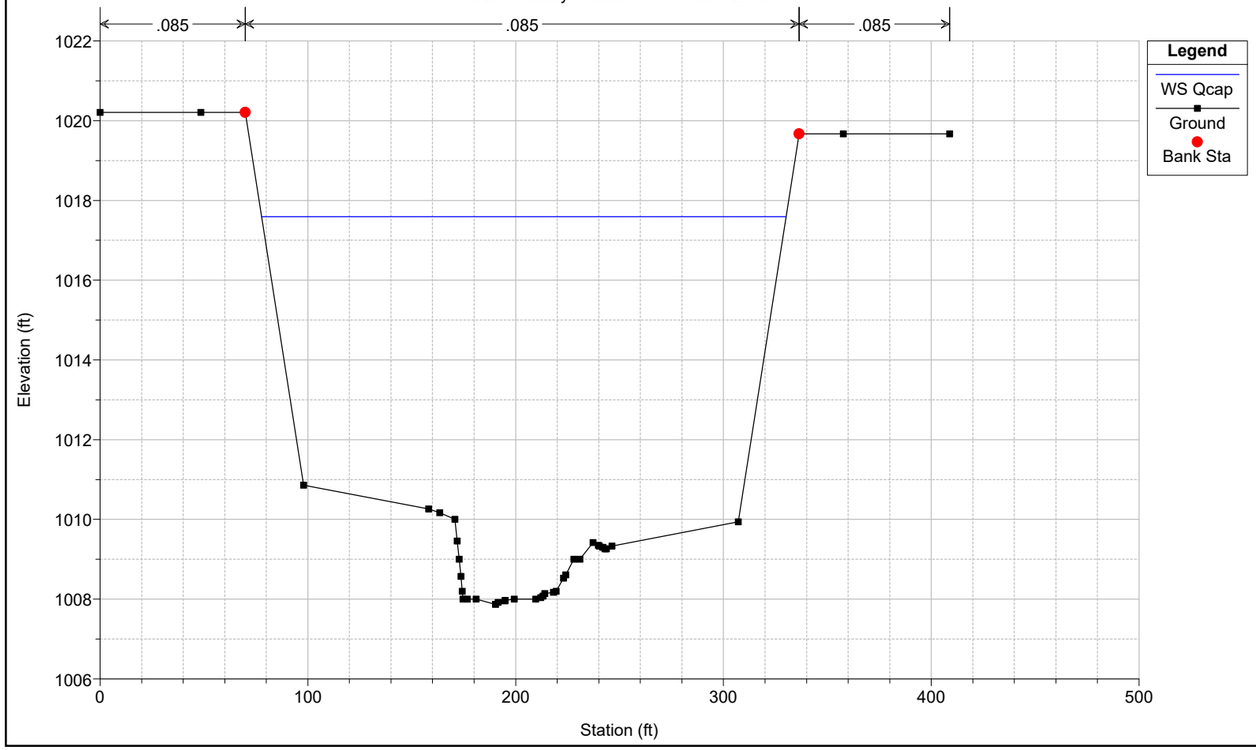
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2391



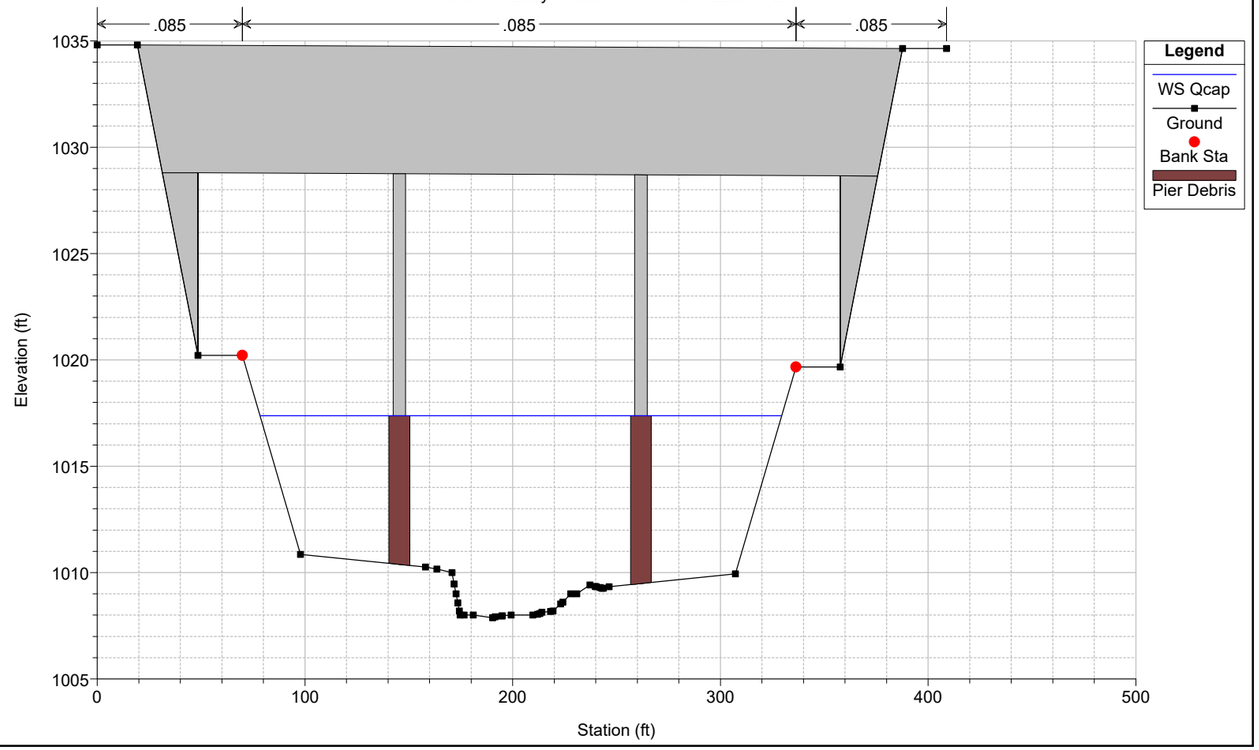
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2305.5



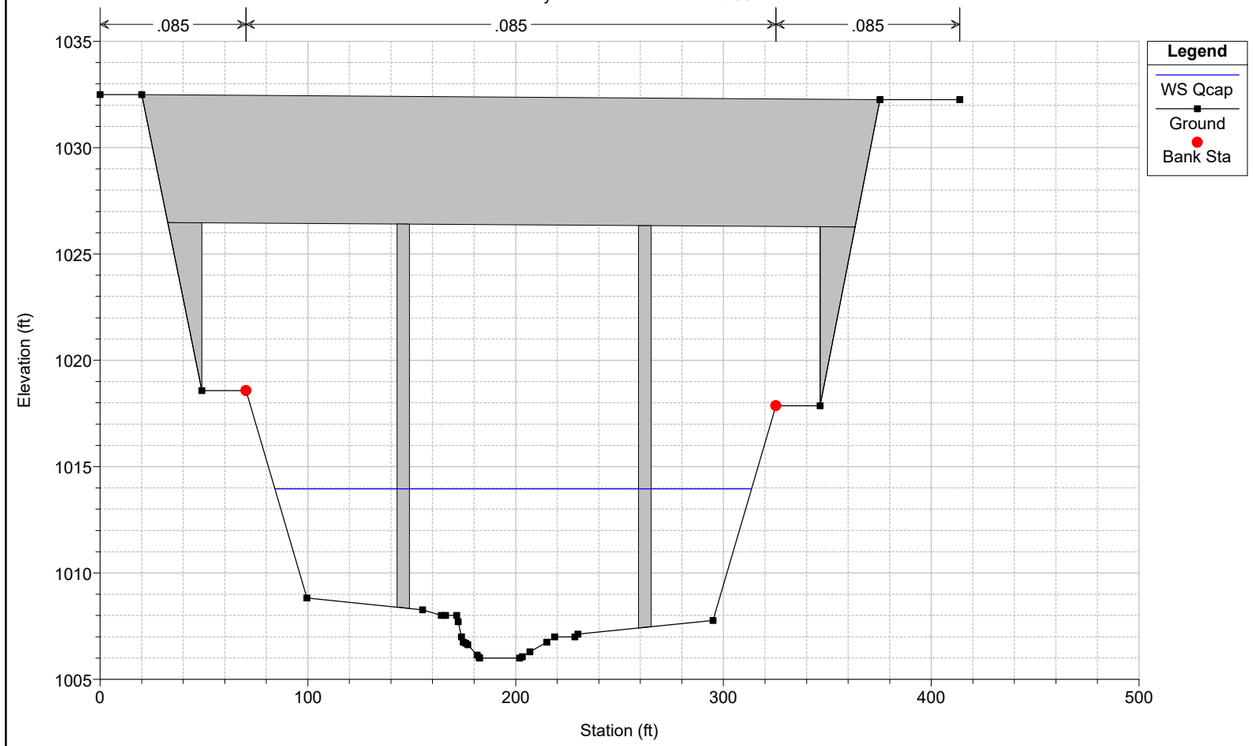
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2250 BR



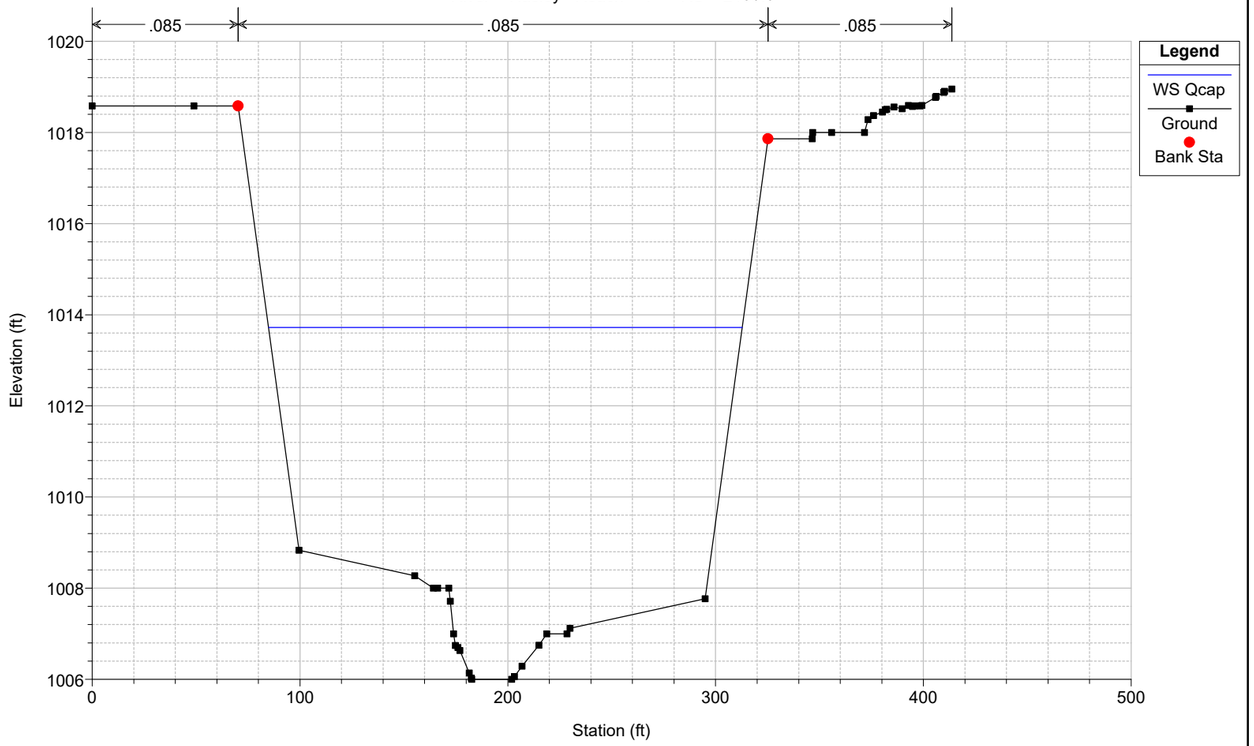
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2250 BR



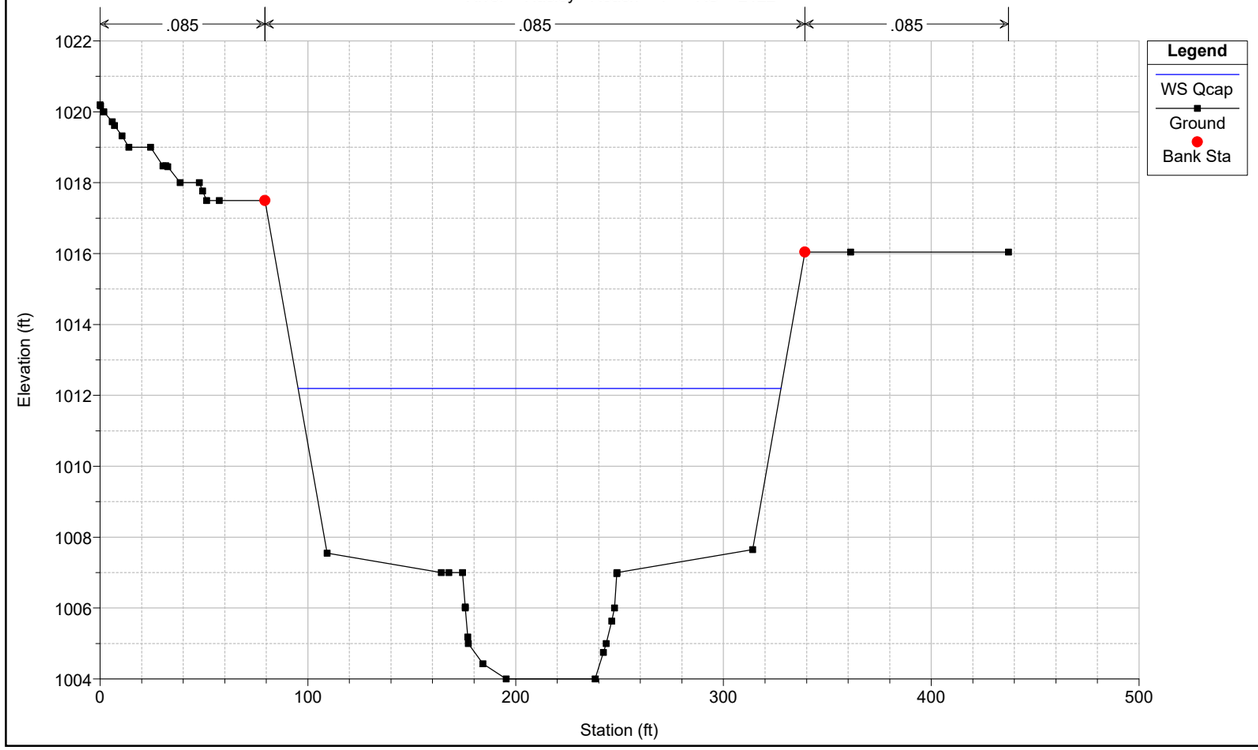
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2190.5



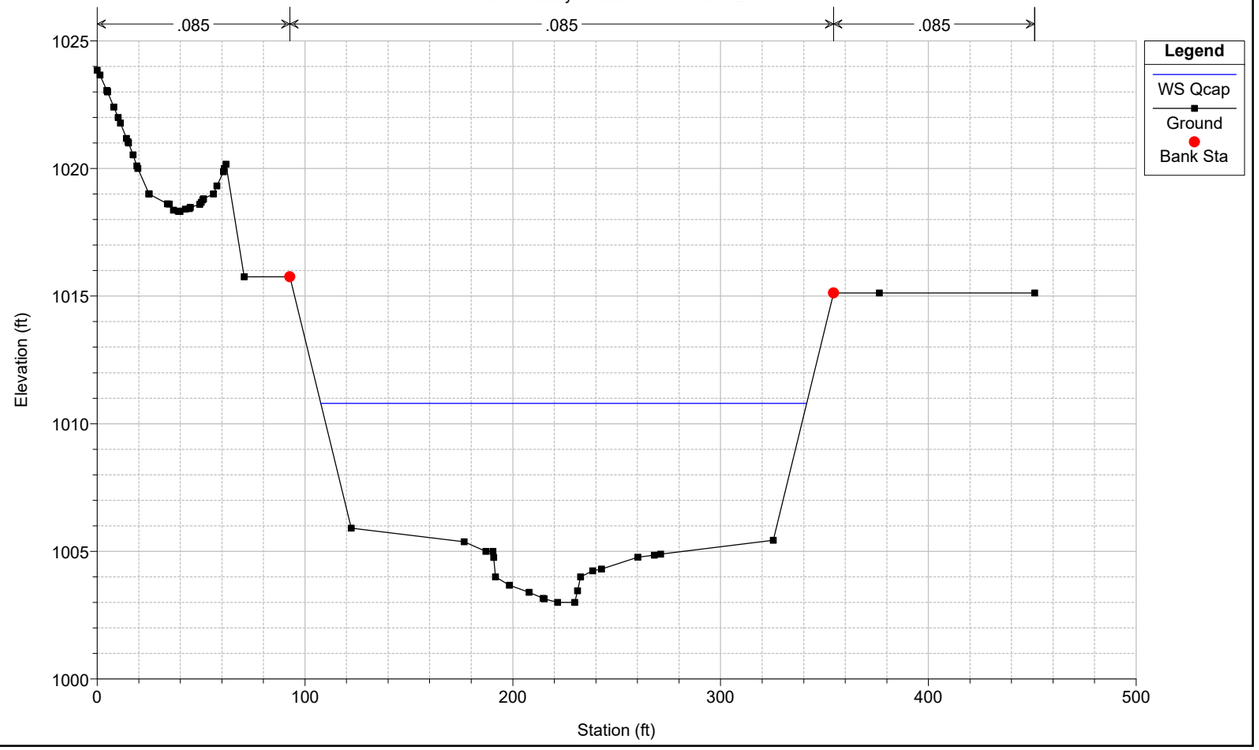
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2122



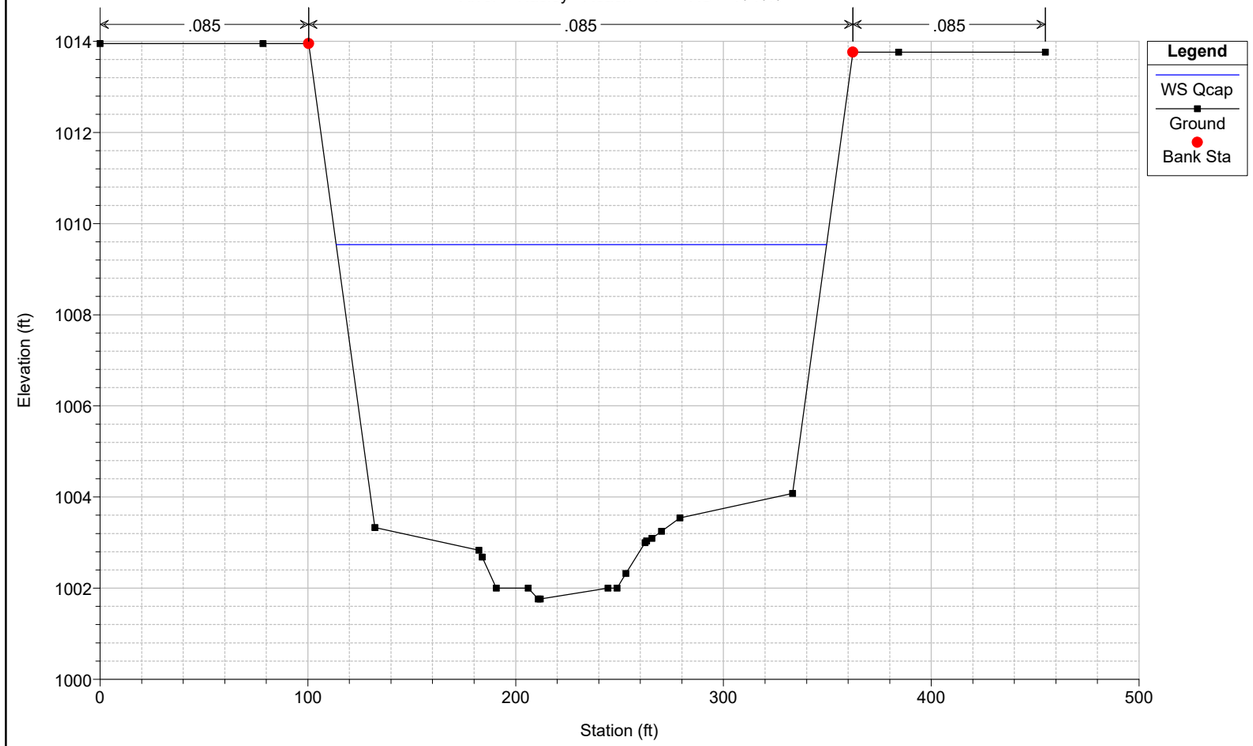
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 2054



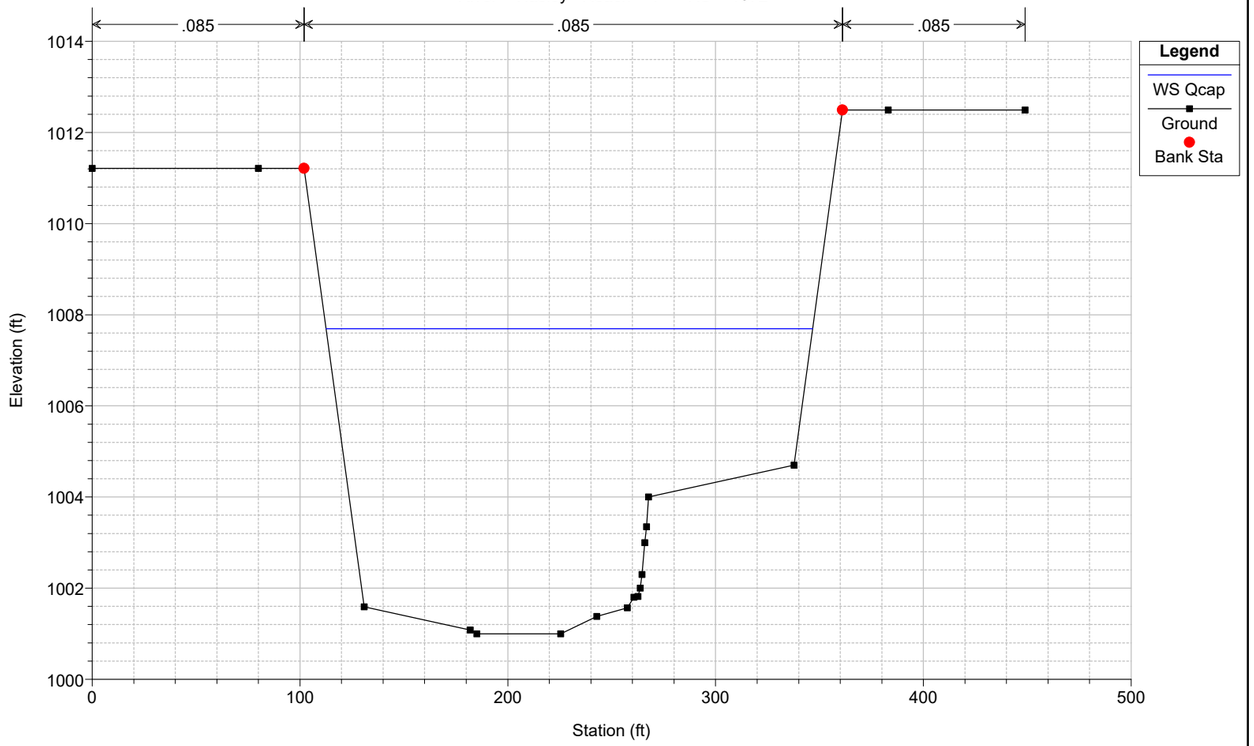
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1940.5



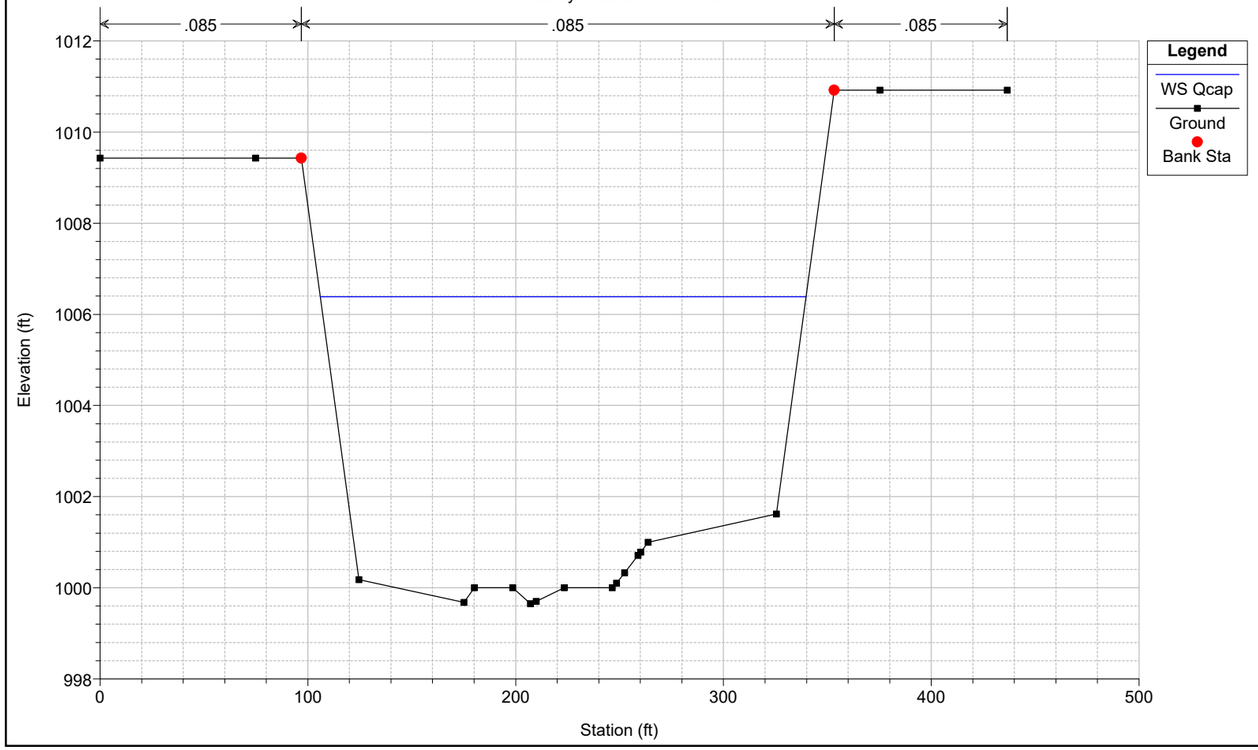
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1872



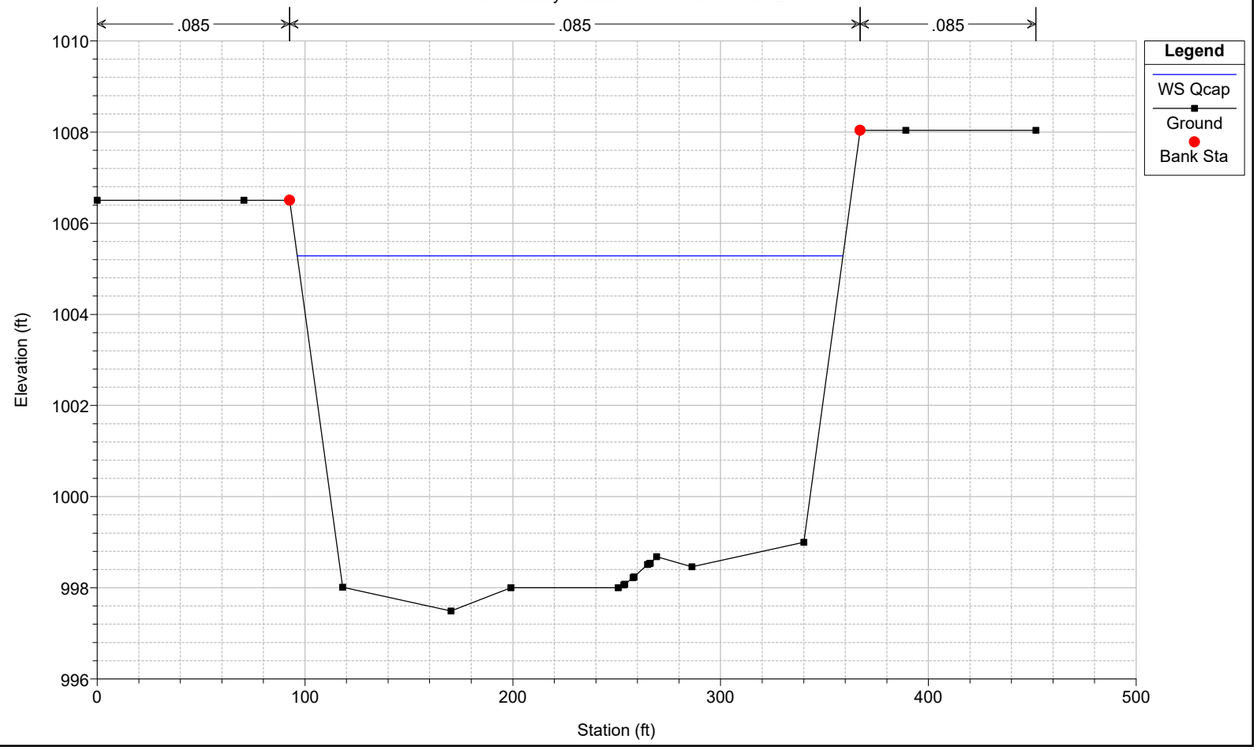
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1804



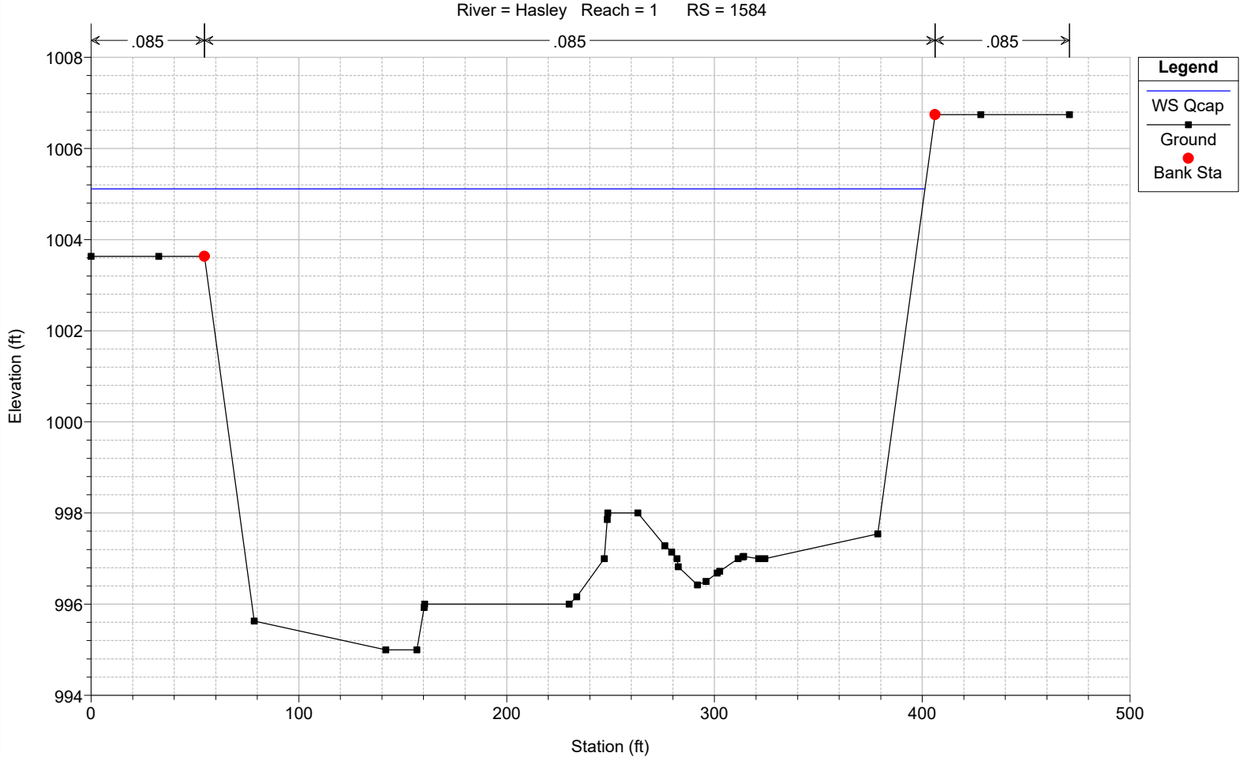
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1688.62



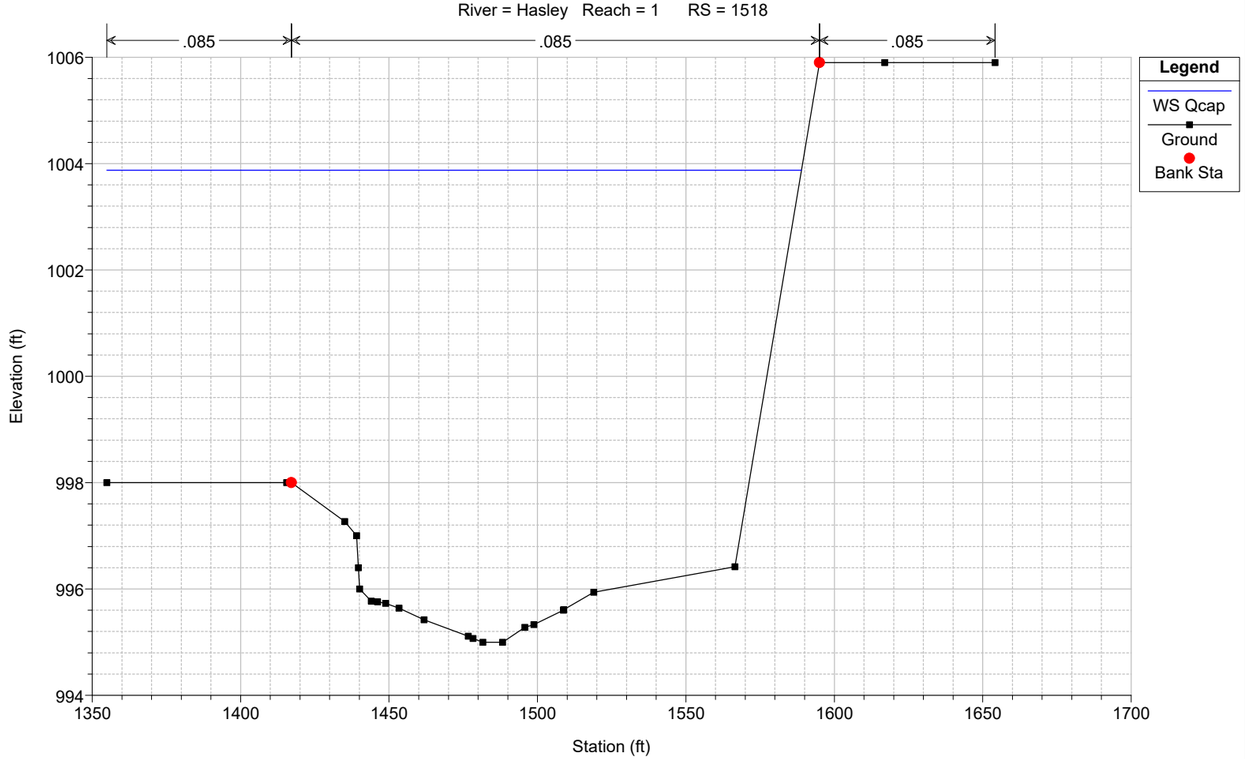
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1584



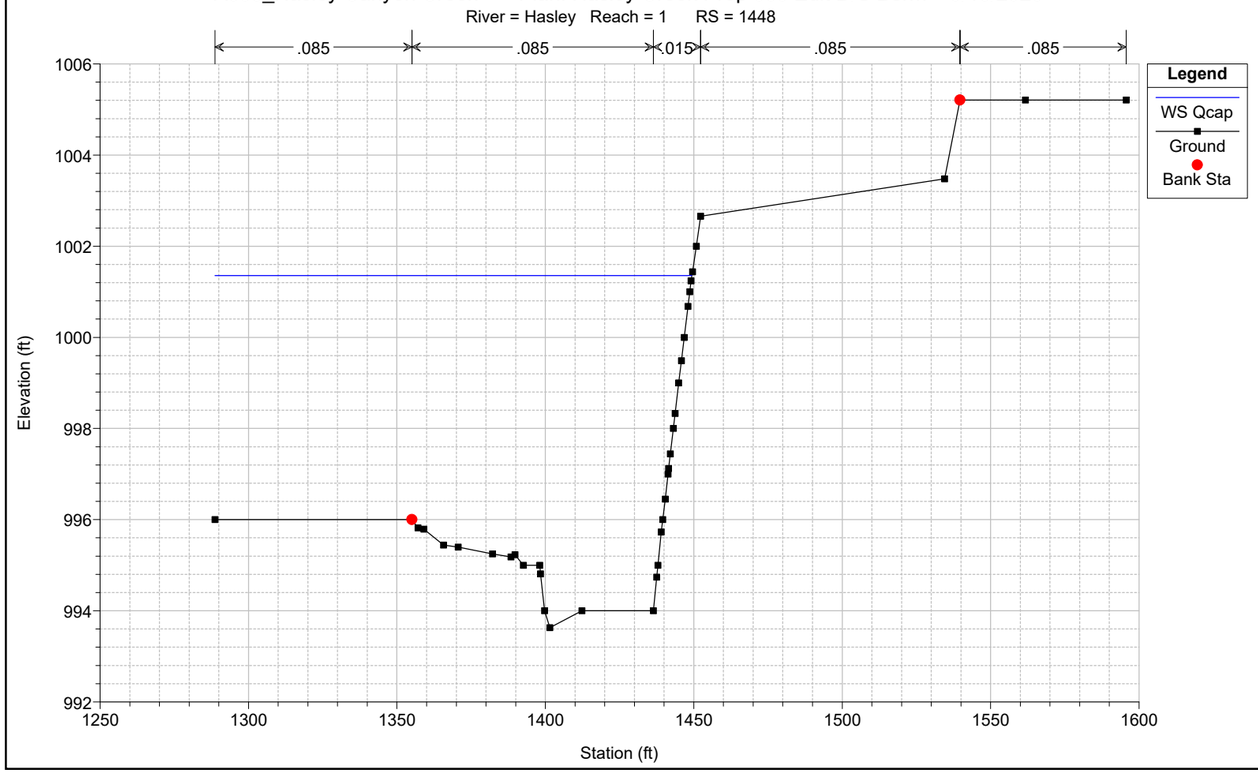
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1518



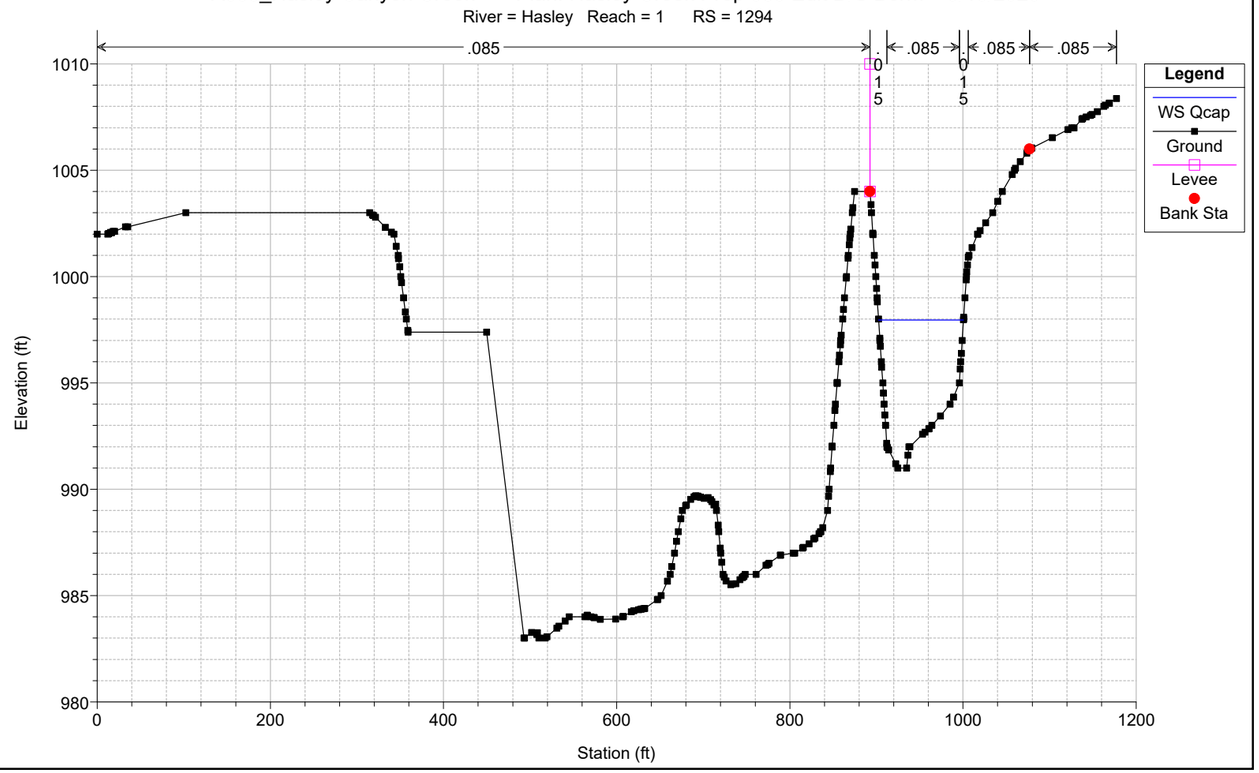
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1448



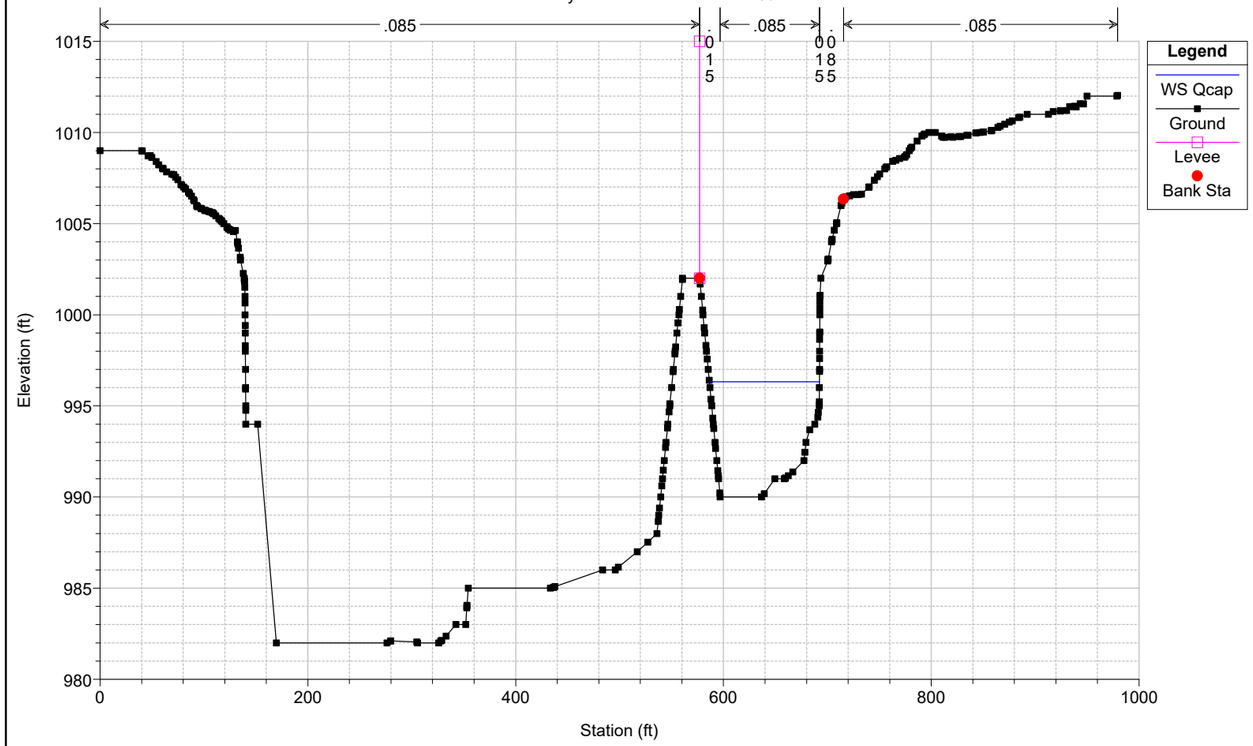
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1294



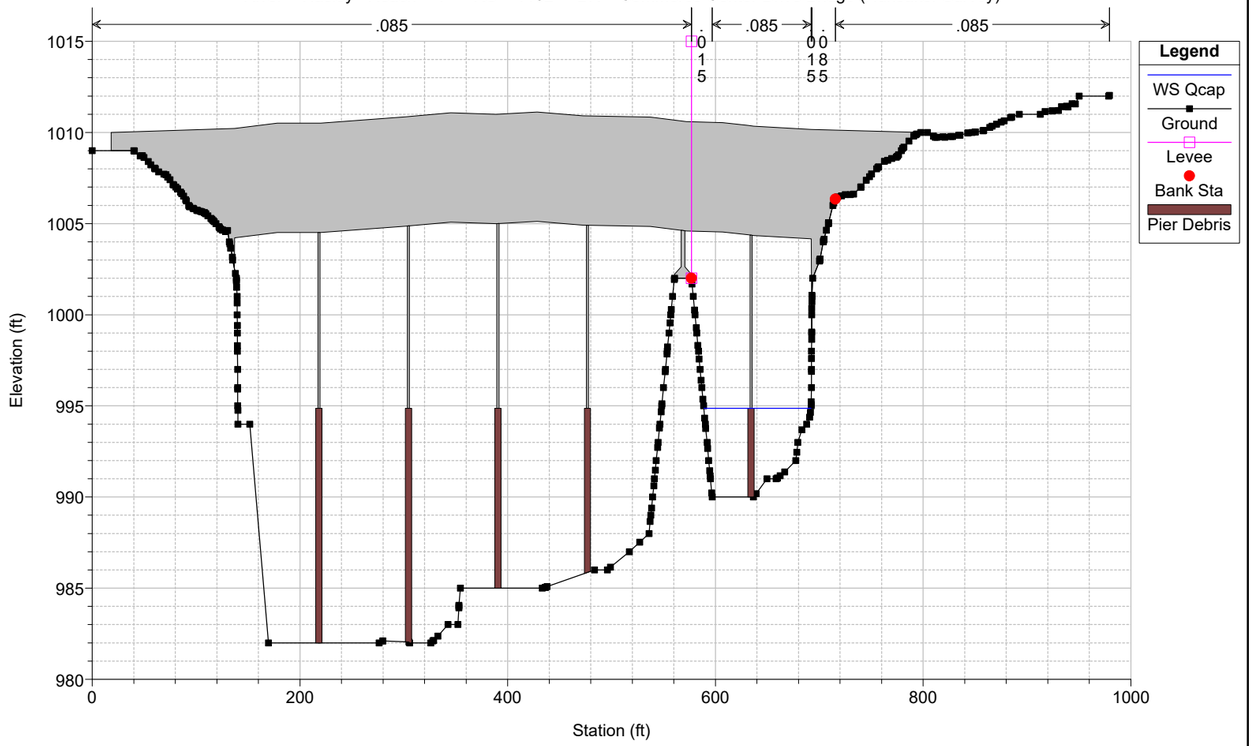
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1189



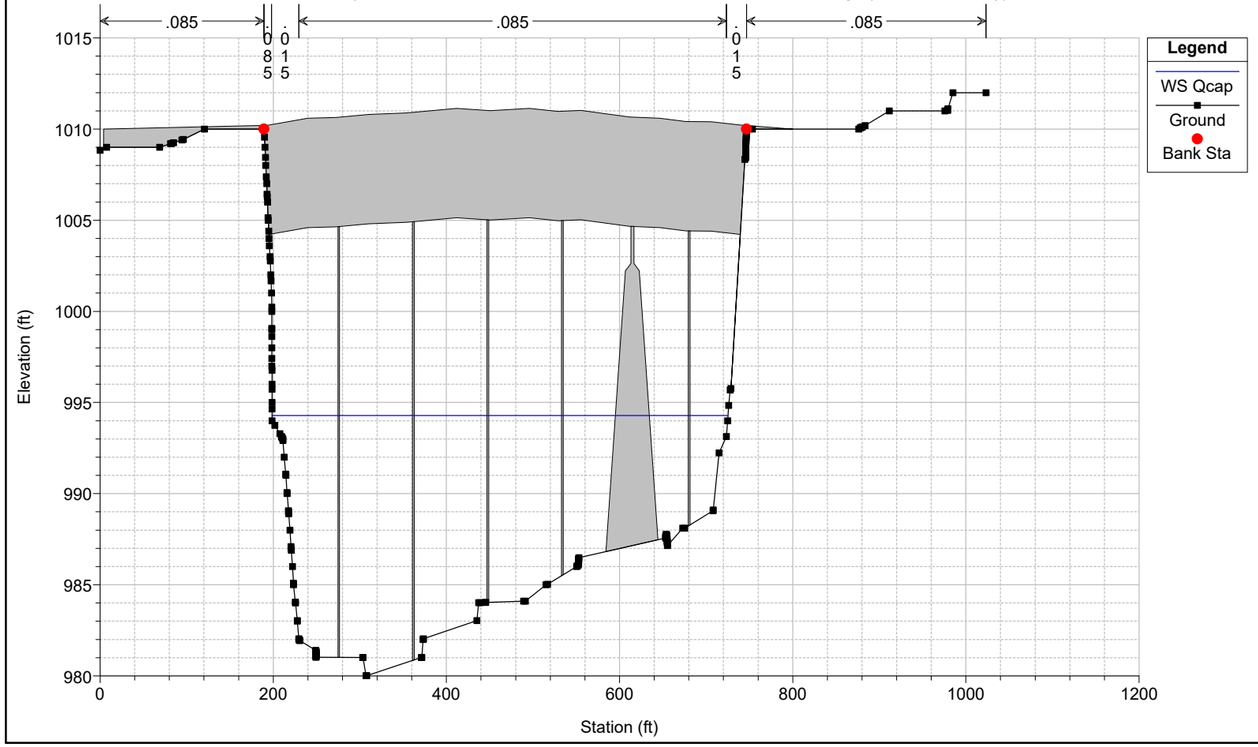
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)



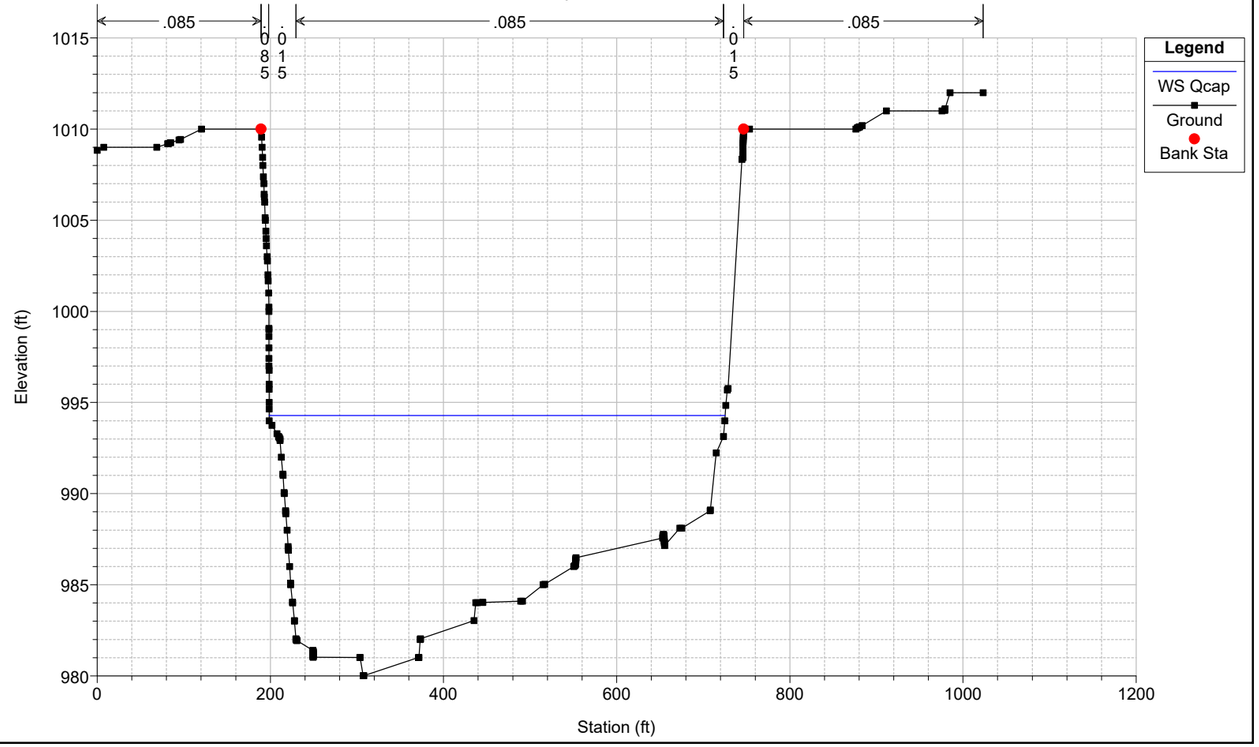
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)



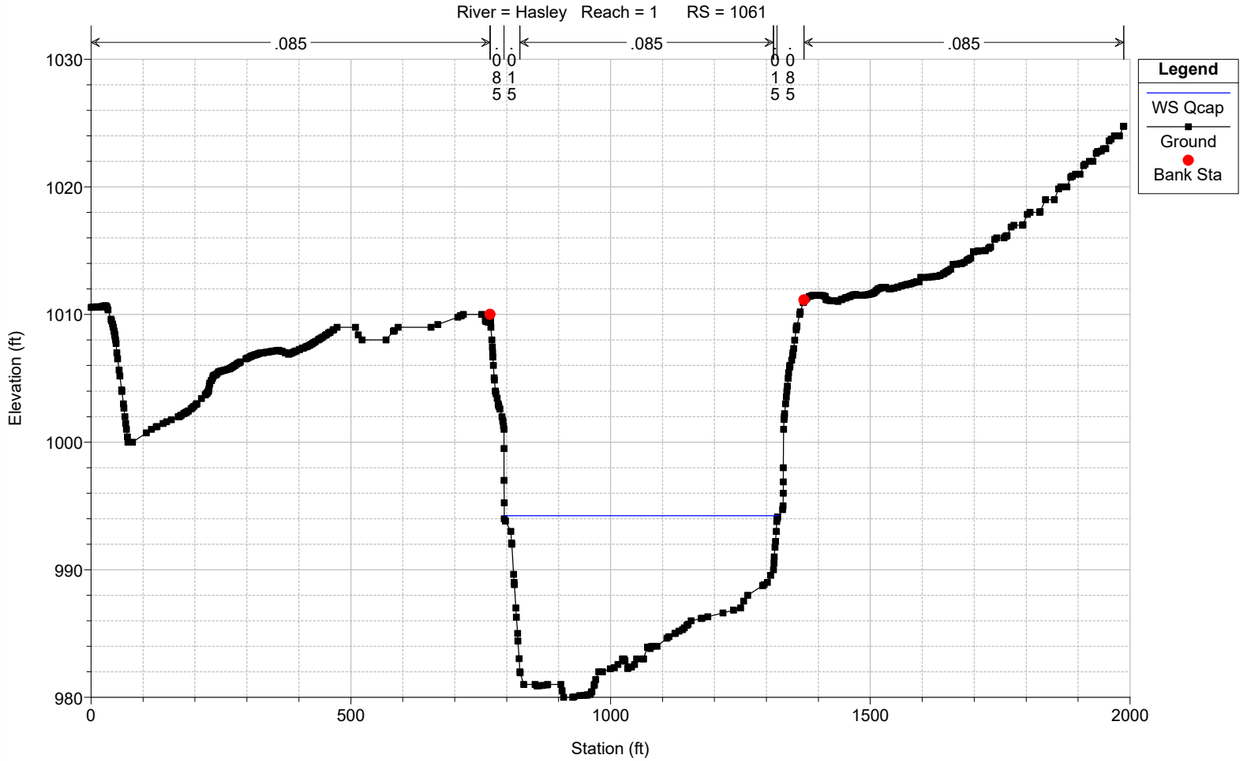
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1080



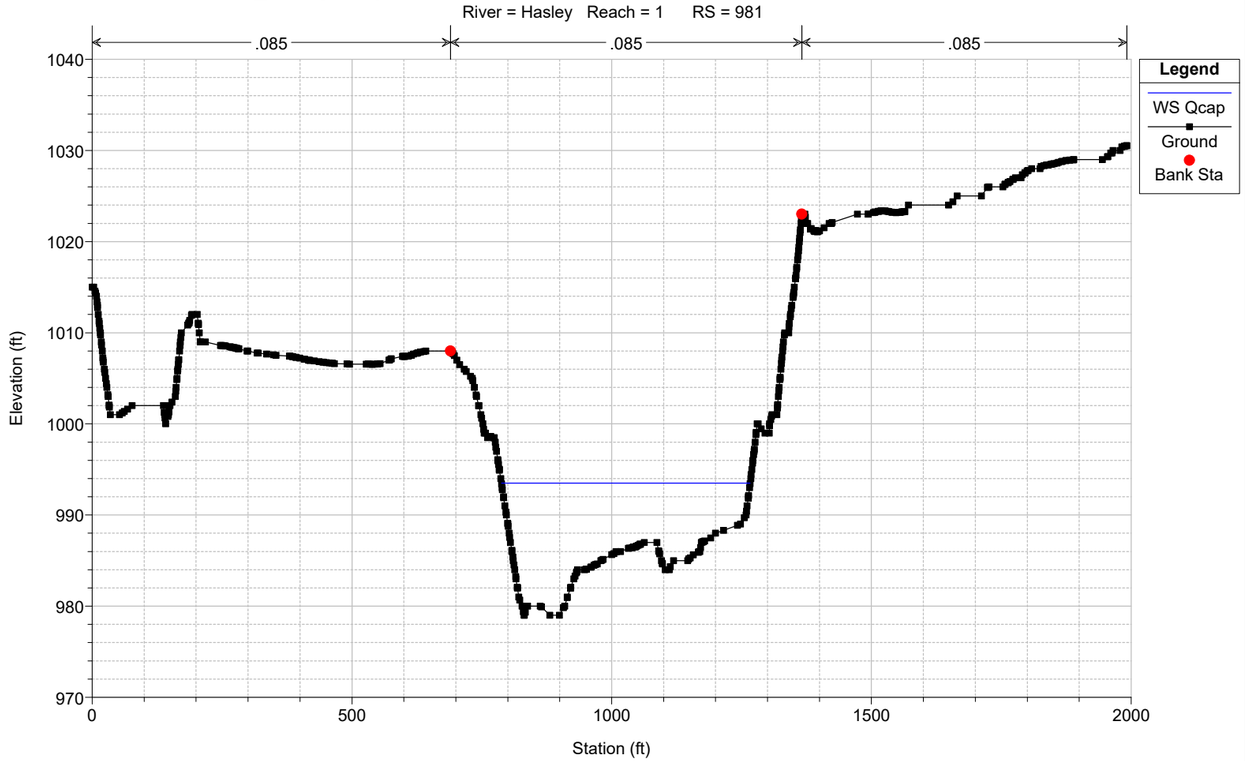
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 1061



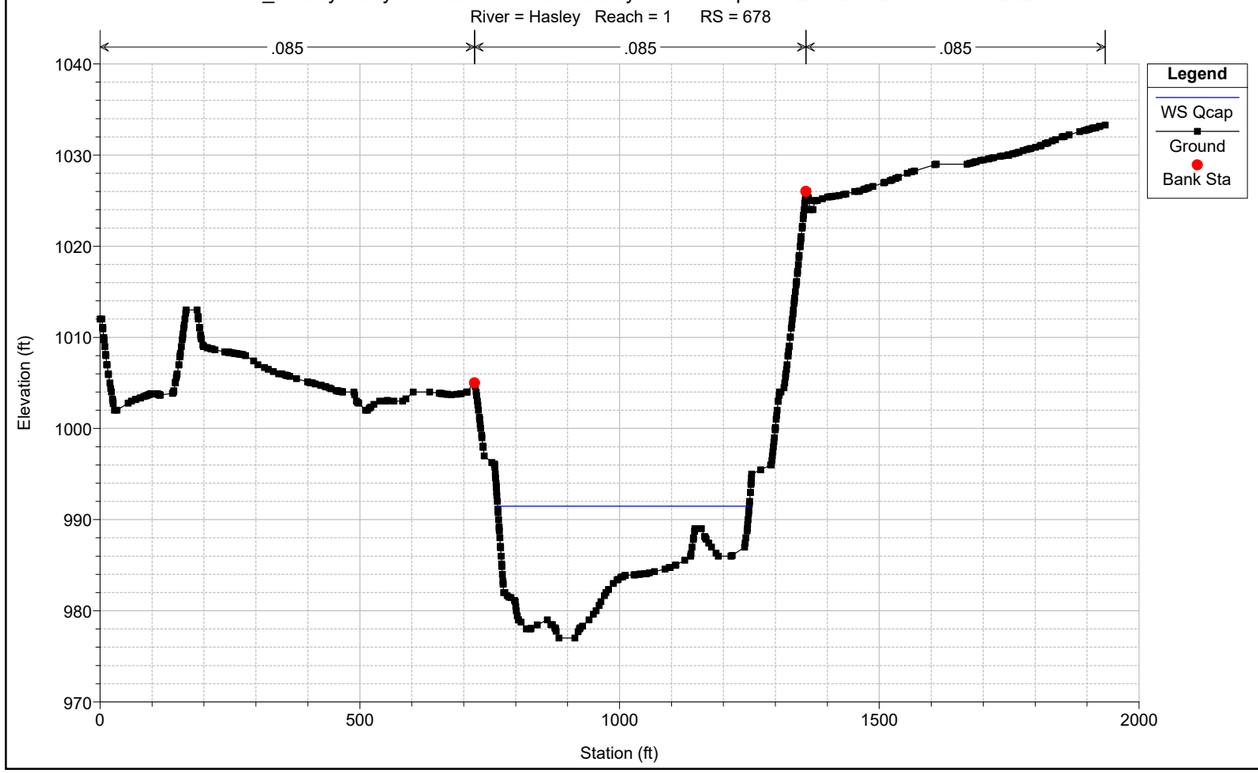
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 981



A535_Hasley Canyon Creek Plan: Hasley Creek Prop 085 Edit D/S Berm 3/18/2020

River = Hasley Reach = 1 RS = 678

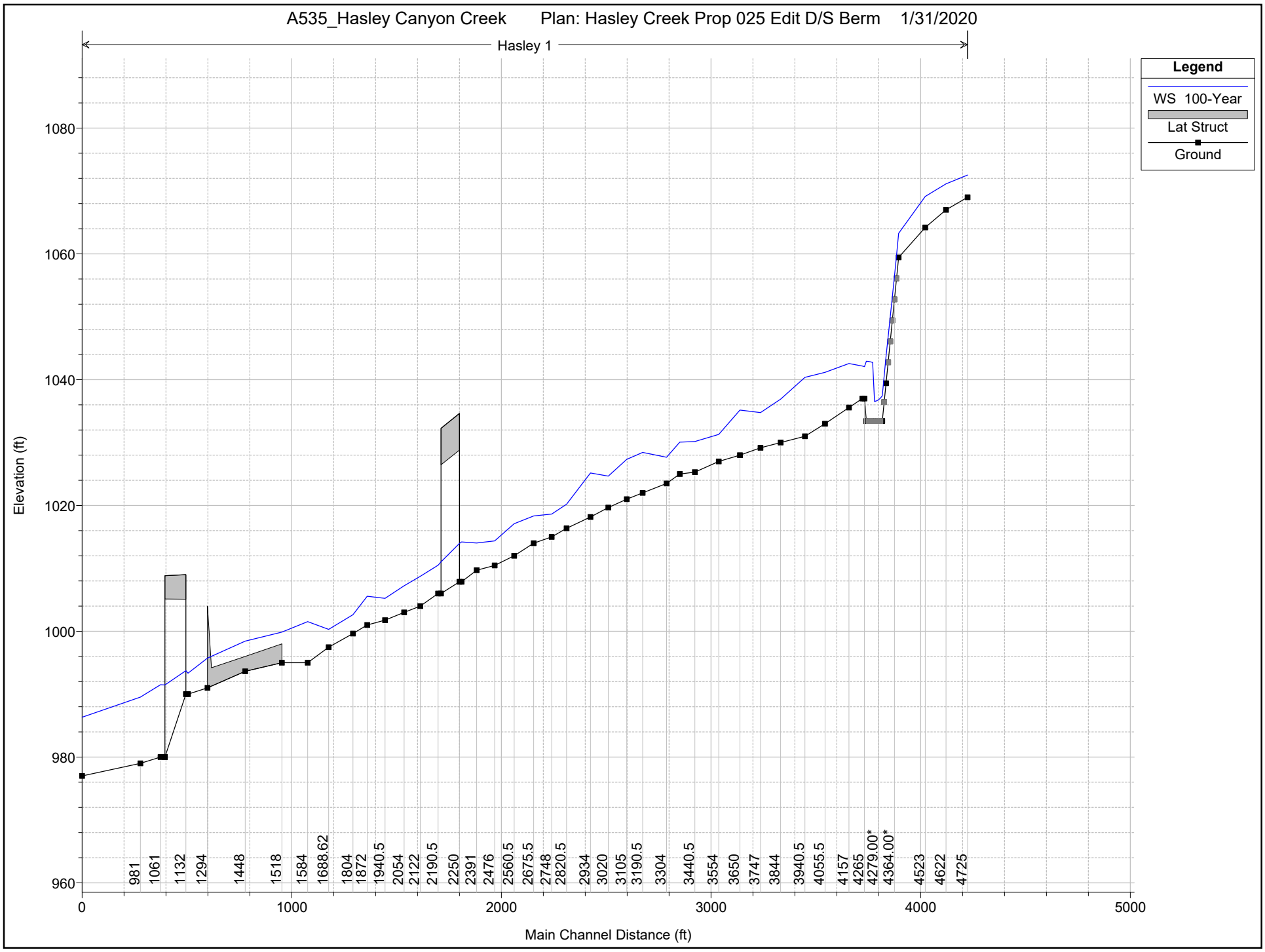


PACE
Advanced Water Engineering

Appendix D: Proposed Condition (n = 0.025) HEC-RAS Model Results

Appendix D: Proposed Condition HEC-RAS Model Results (n=0.025)

Water Surface Profile - Design Slope



1 in Horiz. = 600 ft 1 in Vert. = 20 ft

Appendix D: Proposed Condition HEC-RAS Model Results (n=0.025)

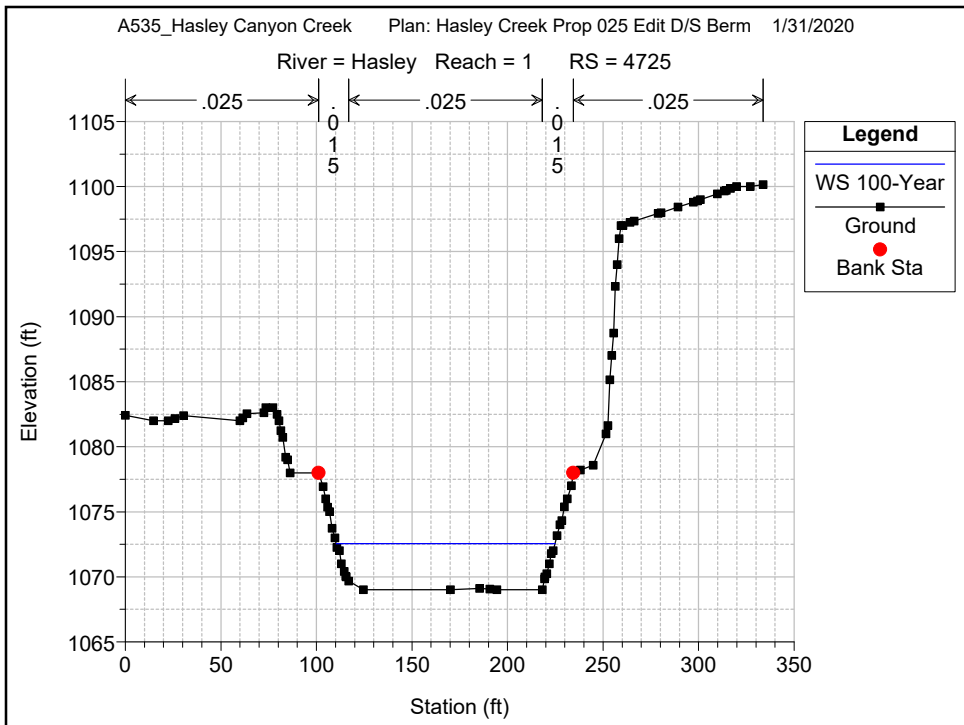
Output Summary Table - Design Slope

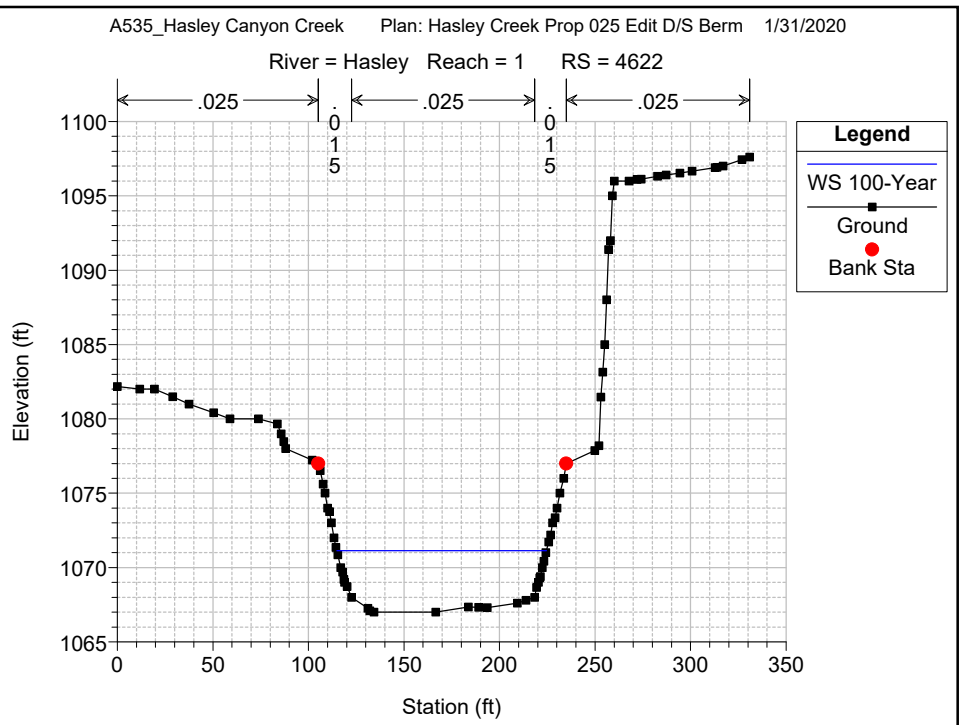
HEC-RAS Plan: Hasley Creek River: Hasley Reach: 1 Profile: 100-Year

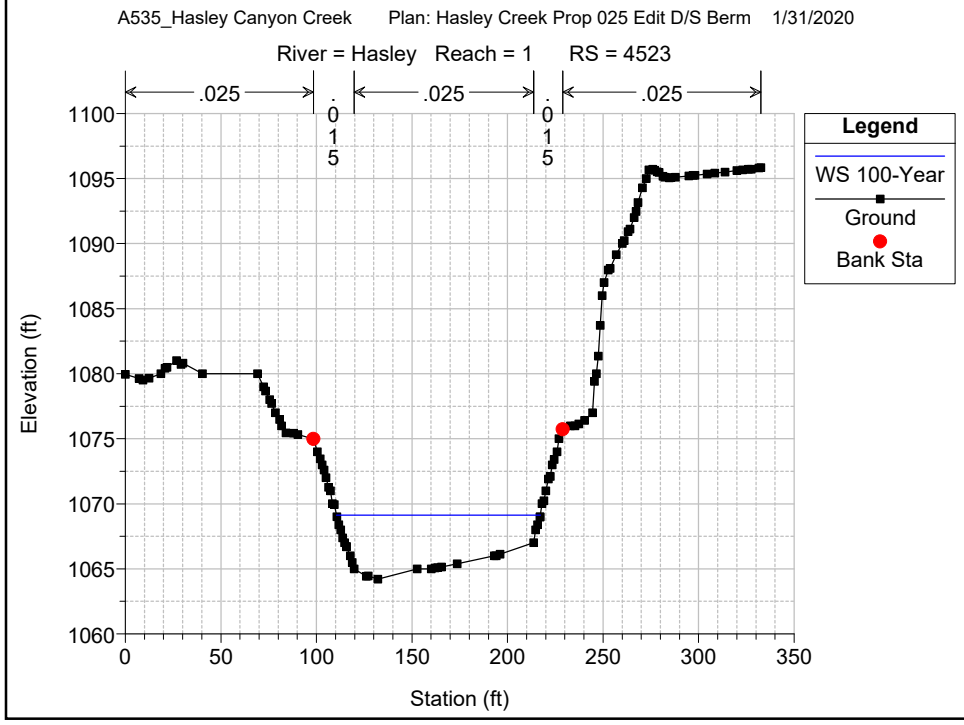
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	4725	100-Year	7000.00	1069.00	1072.55	1074.16	1077.91	0.018509	18.57	376.93	114.63	1.81
1	4622	100-Year	7000.00	1067.00	1071.14	1072.59	1076.05	0.015004	17.79	393.45	109.67	1.66
1	4523	100-Year	7000.00	1064.20	1069.13	1070.73	1074.45	0.016584	18.51	378.26	106.60	1.73
1	4396	100-Year	7000.00	1059.45	1063.27	1065.17	1069.58	0.153325	20.16	347.17	96.72	1.88
1	4380.00*	100-Year	7000.00	1056.12	1059.76	1062.09	1067.66	0.204210	22.55	310.38	90.77	2.15
1	4364.00*	100-Year	7000.00	1052.78	1056.43	1059.01	1065.39	0.229960	24.01	291.50	85.37	2.29
1	4348.00*	100-Year	7000.00	1049.45	1053.19	1055.96	1062.95	0.240656	25.05	279.40	80.24	2.37
1	4332.00*	100-Year	7000.00	1046.12	1050.01	1052.95	1060.46	0.243502	25.93	269.96	75.25	2.41
1	4316.00*	100-Year	7000.00	1042.78	1046.85	1049.96	1057.96	0.241564	26.74	261.79	70.38	2.44
1	4300	100-Year	7000.00	1039.45	1043.75	1047.03	1055.51	0.235734	27.51	254.41	65.64	2.46
1	4291.00*	100-Year	7000.00	1036.45	1040.60	1044.12	1053.91	0.117518	29.26	239.26	63.84	2.66
1	4282	100-Year	7000.00	1033.45	1037.46	1041.24	1052.57	0.140114	31.19	224.45	62.04	2.89
1	4280.50*	100-Year	7000.00	1033.45	1037.06	1040.53	1050.85	0.146715	29.79	234.99	70.46	2.88
1	4279.00*	100-Year	7000.00	1033.45	1036.81	1039.95	1049.05	0.143631	28.07	249.38	79.29	2.79
1	4277.50*	100-Year	7000.00	1033.45	1036.65	1039.47	1047.30	0.133271	26.17	267.44	88.40	2.65
1	4276	100-Year	7000.00	1033.45	1036.55	1039.05	1045.68	0.118946	24.23	288.84	97.72	2.49
1	4274.50*	100-Year	7000.00	1033.45	1042.74	1038.44	1043.35	0.001841	6.26	1117.42	134.17	0.38
1	4273.00*	100-Year	7000.00	1033.45	1042.84	1037.99	1043.29	0.001346	5.39	1298.10	152.34	0.33
1	4271.50*	100-Year	7000.00	1033.45	1042.90	1037.61	1043.25	0.001031	4.74	1476.34	170.41	0.28
1	4270	100-Year	7000.00	1033.45	1042.94	1037.30	1043.22	0.000818	4.23	1652.93	188.41	0.25
1	4265	100-Year	7000.00	1037.00	1042.06	1040.85	1043.12	0.007220	8.27	846.31	174.83	0.66
1	4258	100-Year	7000.00	1037.00	1042.17	1040.64	1043.03	0.001909	7.46	938.01	189.42	0.59
1	4157	100-Year	7000.00	1035.56	1042.57	1038.41	1042.80	0.000325	3.79	1848.02	274.06	0.26
1	4055.5	100-Year	7000.00	1033.00	1041.16	1041.16	1042.58	0.006804	9.54	733.69	266.68	1.01
1	3940.5	100-Year	7000.00	1031.00	1040.37	1040.49	1041.87	0.008132	9.82	712.78	280.88	1.09
1	3844	100-Year	7000.00	1030.00	1036.89	1038.02	1040.29	0.019028	14.78	473.61	193.00	1.66
1	3747	100-Year	7000.00	1029.17	1034.78	1036.26	1038.56	0.016312	15.60	448.82	150.69	1.59
1	3650	100-Year	7000.00	1028.00	1035.17	1035.37	1036.75	0.008837	10.07	694.80	283.70	1.13
1	3554	100-Year	7000.00	1027.00	1031.30	1032.47	1035.23	0.020006	15.89	440.42	165.76	1.72
1	3440.5	100-Year	7000.00	1025.32	1030.16	1031.21	1033.09	0.012991	13.74	509.40	174.59	1.42
1	3372	100-Year	7000.00	1025.00	1030.08	1030.37	1032.08	0.008305	11.35	616.57	201.09	1.14
1	3304	100-Year	7000.00	1023.50	1027.68	1028.68	1031.06	0.028666	14.75	474.43	265.89	1.95
1	3190.5	100-Year	7000.00	1022.00	1028.44	1026.96	1029.10	0.001729	6.52	1073.82	248.78	0.55
1	3105	100-Year	7000.00	1021.00	1027.35	1027.35	1028.79	0.006674	9.61	728.45	258.62	1.01
1	3020	100-Year	7000.00	1019.68	1024.68	1025.85	1027.80	0.013833	14.16	494.33	168.51	1.46
1	2934	100-Year	7000.00	1018.19	1025.18	1025.19	1026.65	0.006703	9.73	719.39	251.82	1.01
1	2820.5	100-Year	7000.00	1016.37	1020.22	1021.66	1025.02	0.024593	17.56	398.53	152.67	1.92
1	2748	100-Year	7000.00	1015.00	1018.64	1019.98	1023.16	0.025044	17.05	410.50	166.69	1.92
1	2675.5	100-Year	7000.00	1014.00	1018.35	1019.07	1021.06	0.013731	13.22	529.37	200.13	1.43
1	2560.5	100-Year	7000.00	1012.00	1017.12	1017.82	1019.58	0.016781	12.60	555.72	262.51	1.53
1	2476	100-Year	7000.00	1010.49	1014.36	1015.33	1017.59	0.026277	14.40	486.22	265.21	1.87
1	2391	100-Year	7000.00	1009.71	1014.04	1014.37	1015.93	0.009411	11.02	635.33	239.36	1.19
1	2305.5	100-Year	7000.00	1007.87	1014.20	1012.75	1014.92	0.001821	6.81	1028.30	232.05	0.57
1	2250		Bridge									
1	2190.5	100-Year	7000.00	1006.00	1010.52	1010.90	1012.62	0.009374	11.62	602.18	208.70	1.21
1	2122	100-Year	7000.00	1004.00	1008.73	1009.51	1011.54	0.015629	13.46	520.00	211.63	1.51
1	2054	100-Year	7000.00	1003.00	1007.24	1008.12	1010.25	0.017573	13.94	502.26	212.41	1.60
1	1940.5	100-Year	7000.00	1001.76	1005.25	1006.23	1008.54	0.019934	14.55	481.19	210.23	1.70
1	1872	100-Year	7000.00	1001.00	1005.56	1005.56	1007.14	0.006325	10.09	694.07	221.41	1.00
1	1804	100-Year	7000.00	999.65	1002.65	1003.71	1006.21	0.022833	15.12	462.99	211.35	1.80
1	1688.62	100-Year	7000.00	997.49	1000.30	1001.26	1003.51	0.021874	14.36	487.39	232.77	1.75
1	1584	100-Year	7000.00	995.00	1001.53	998.91	1001.82	0.000629	4.30	1626.57	329.66	0.34
1	1518	100-Year	7000.00	995.00	999.88	999.88	1001.45	0.005296	10.41	717.02	221.99	0.95
1	1500		Lat Struct									
1	1448	100-Year	5226.81	993.63	998.43	998.70	1000.37	0.006960	11.92	481.22	155.17	1.11
1	1294	100-Year	3743.80	991.00	995.73	996.53	998.71	0.012140	13.86	270.20	90.77	1.42
1	1189	100-Year	3743.80	990.00	993.33	994.55	997.23	0.018883	15.83	236.48	89.79	1.72
1	1132		Bridge									
1	1080	100-Year	3743.80	980.01	991.46	983.55	991.48	0.000022	1.04	3588.07	499.56	0.07
1	1061	100-Year	28143.80	980.00	991.51	988.37	992.37	0.001041	7.42	3791.35	505.57	0.48
1	981	100-Year	28143.80	979.00	989.53	989.53	992.01	0.005485	12.64	2226.95	454.87	1.01
1	678	100-Year	28143.80	977.00	986.35	987.19	989.98	0.008855	15.30	1839.83	404.31	1.26

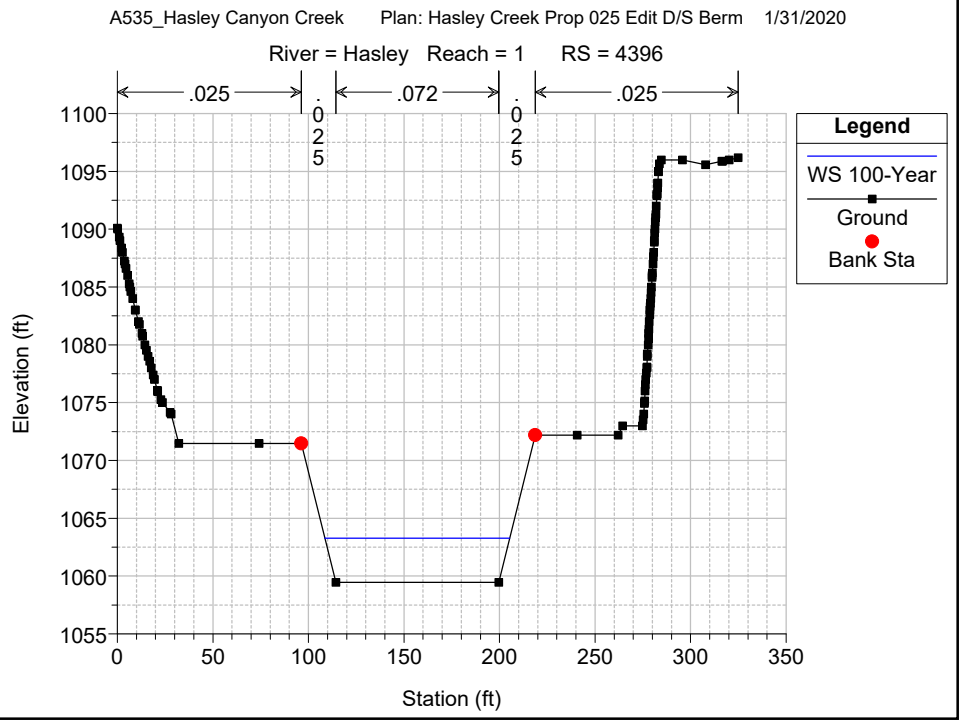
Appendix D: Proposed Condition HEC-RAS Model Results (n=0.025)

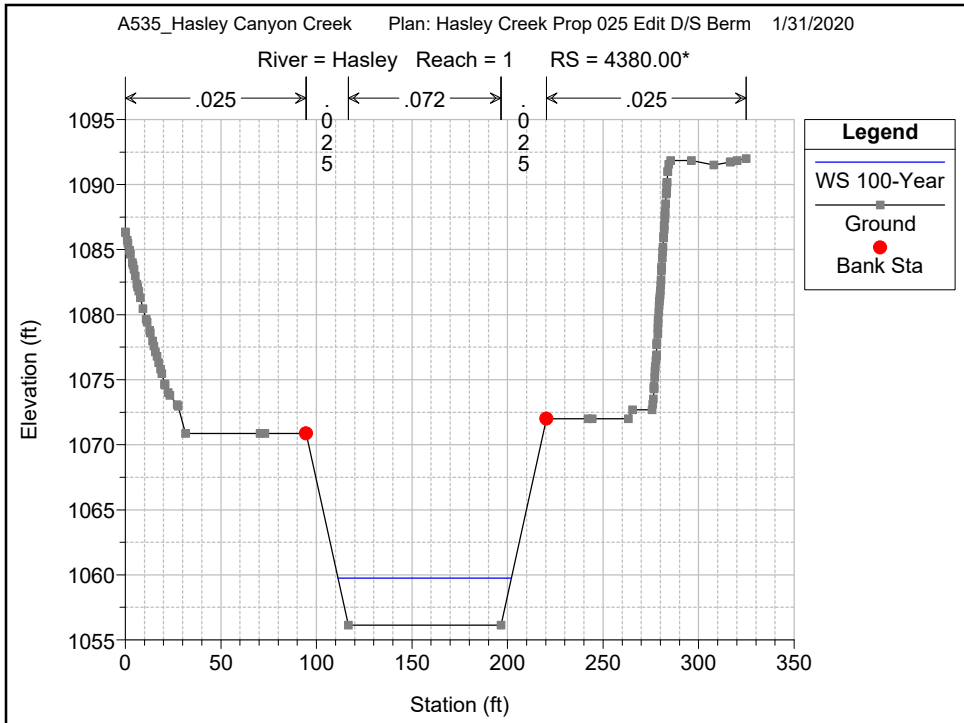
Cross Section Plots - Design Slope

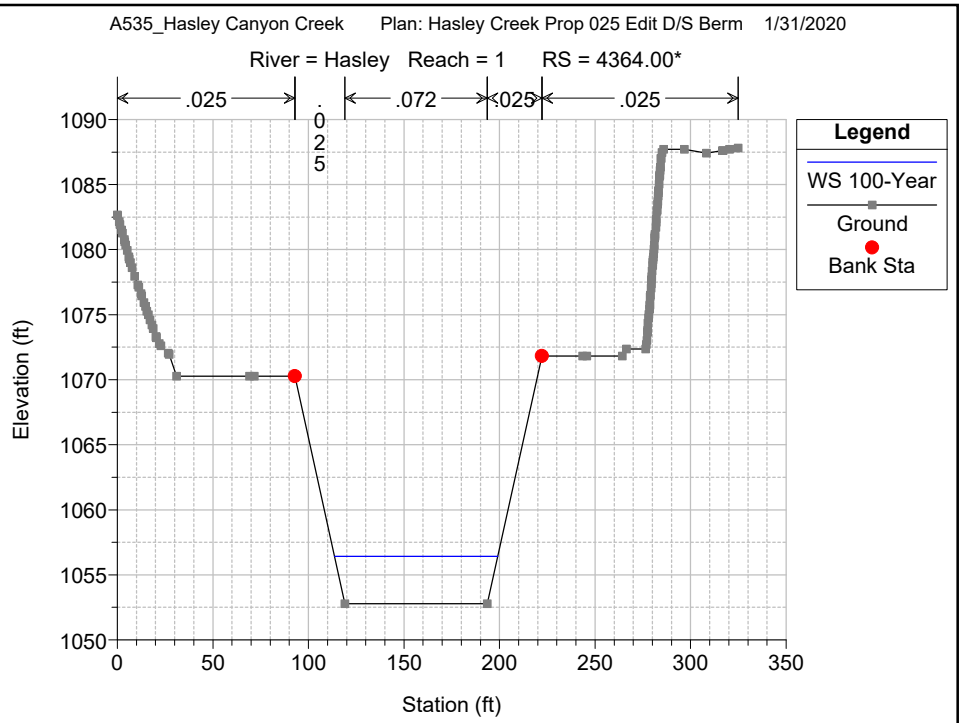

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4725
.025
.015
.025
.015
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

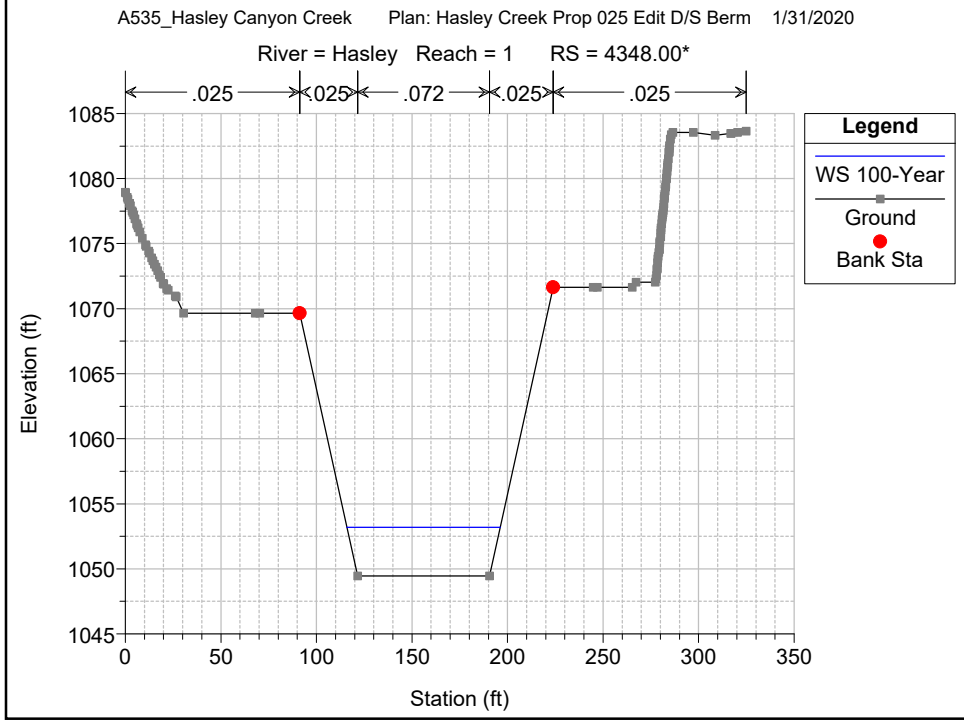

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4622
.025
.015
.025
.015
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

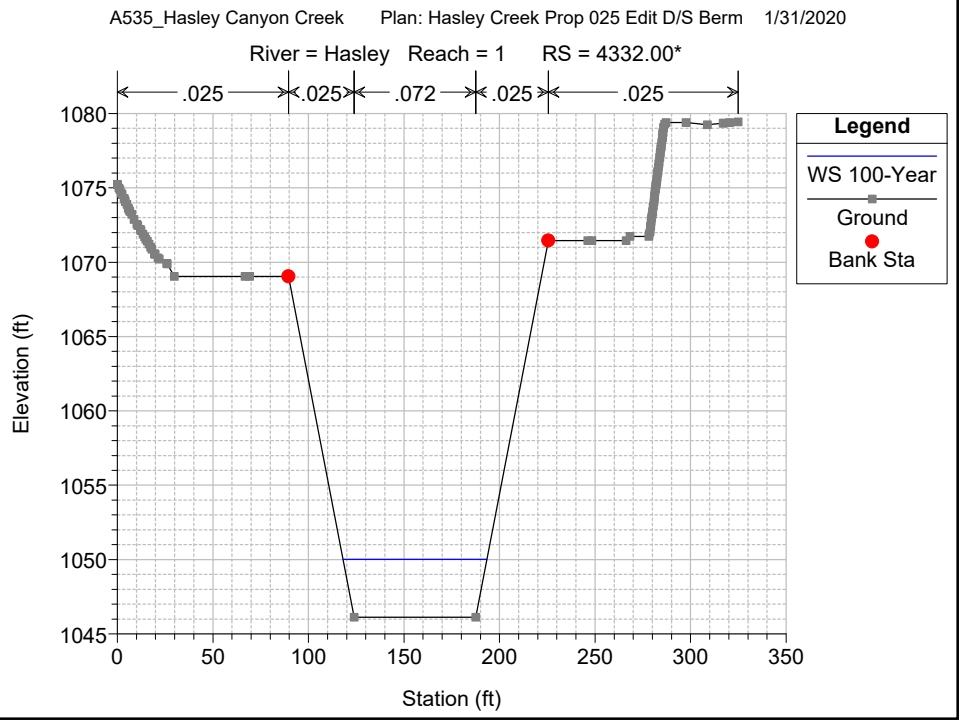

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4523
.025
.015
.025
.015
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4396
.025
.025
.072
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4380.00*
.025
.025
.072
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4364.00*
.025
.025
.072
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4348.00*
.025
.025
.072
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4332.00*
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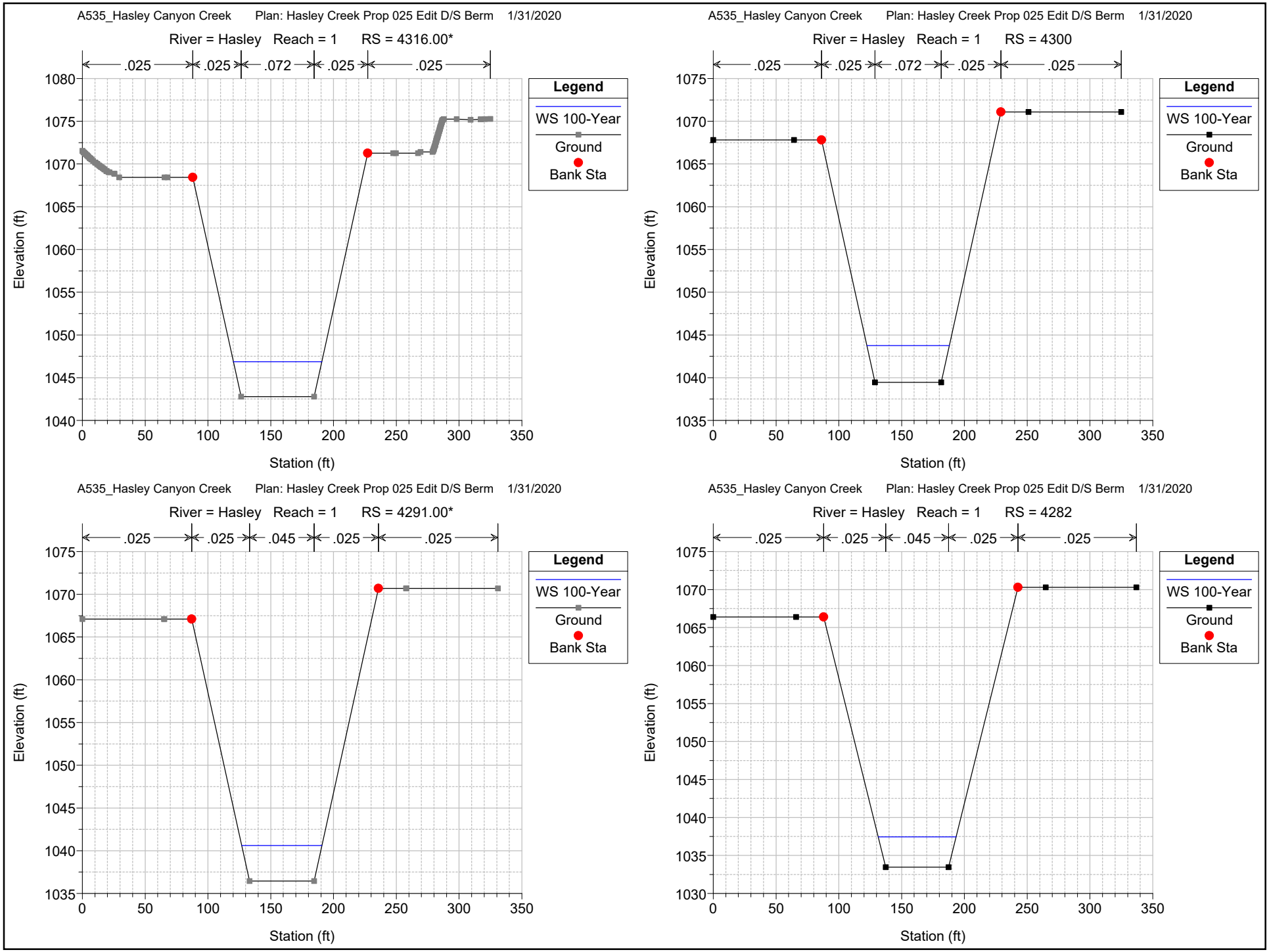
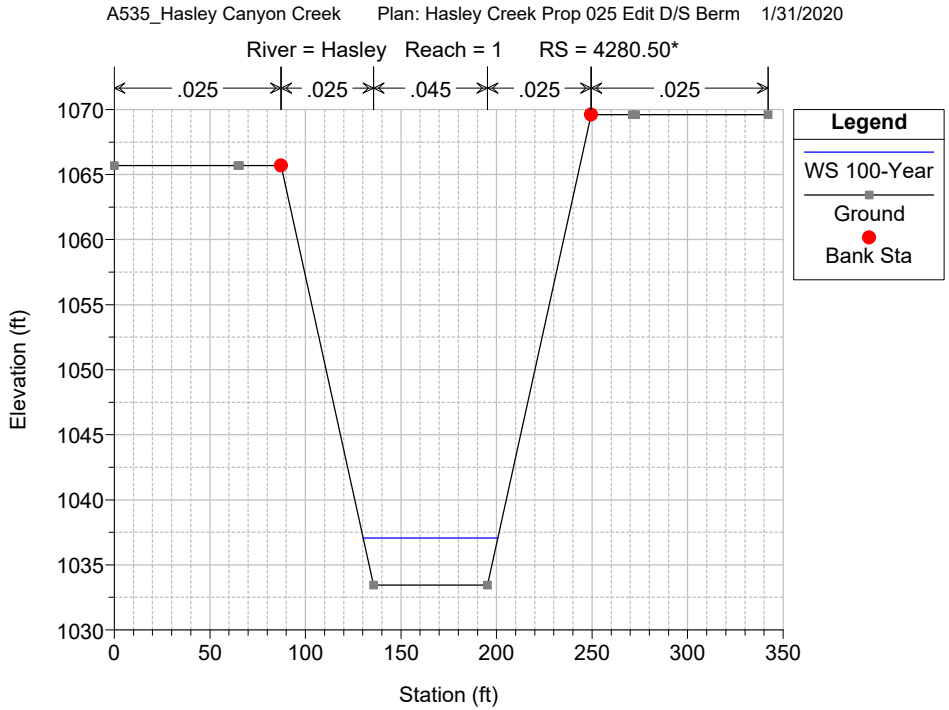
.025
.072
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4316.00*
.025 .025 .072 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4300
.025 .025 .072 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4291.00*
.025 .025 .045 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4282
.025 .025 .045 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4280.50*
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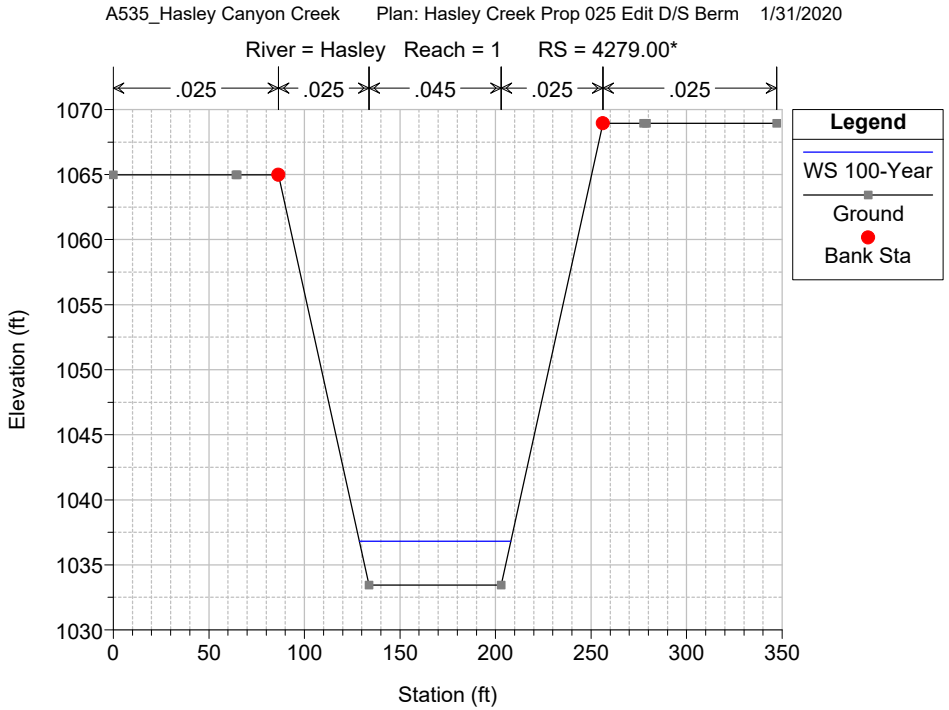
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4279.00*
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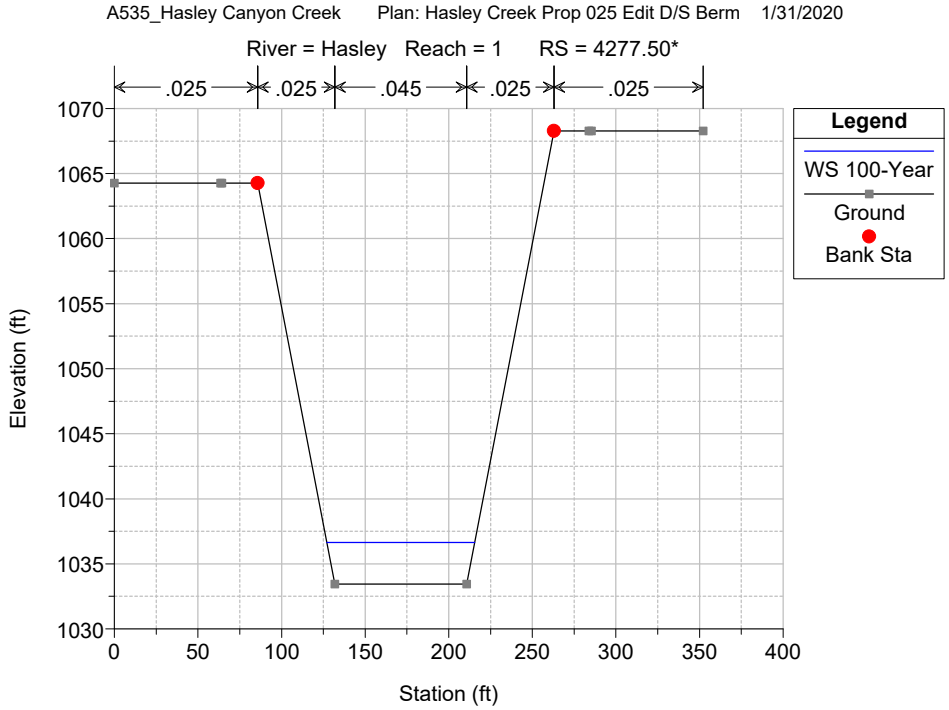
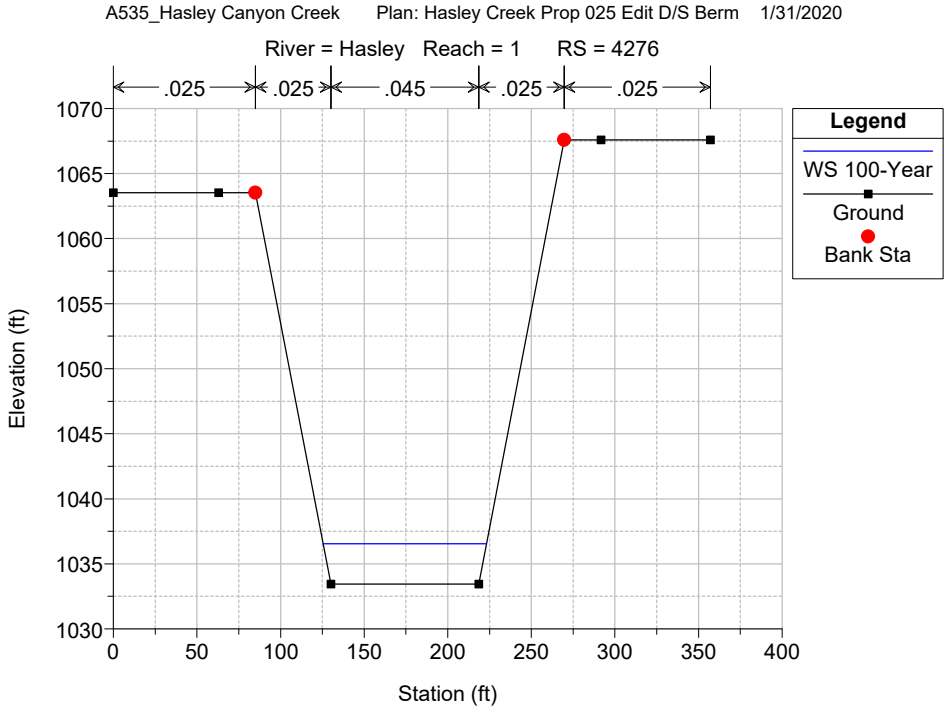
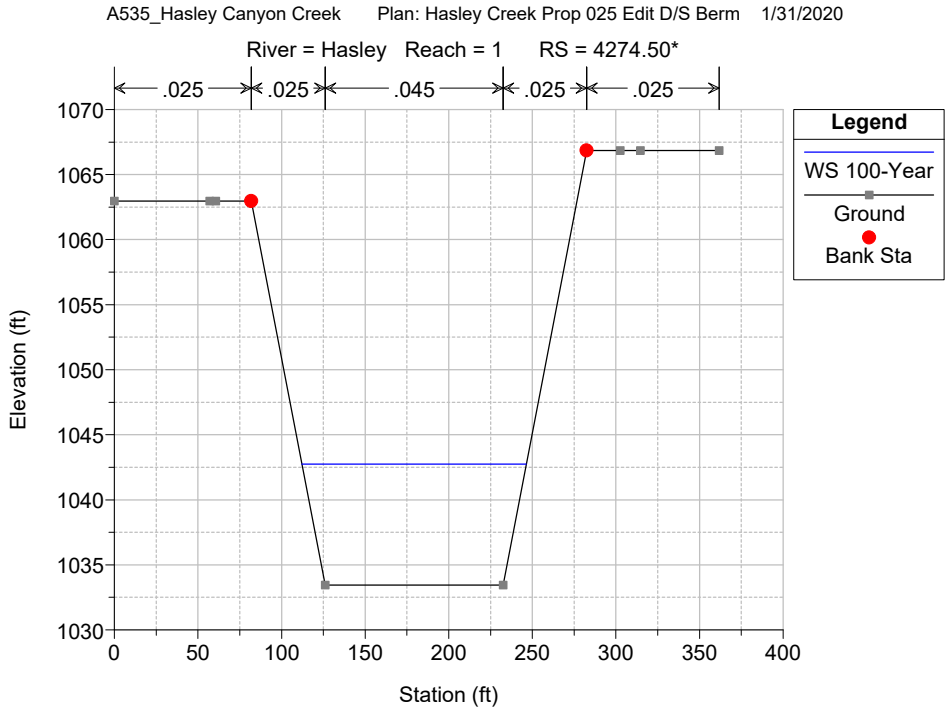
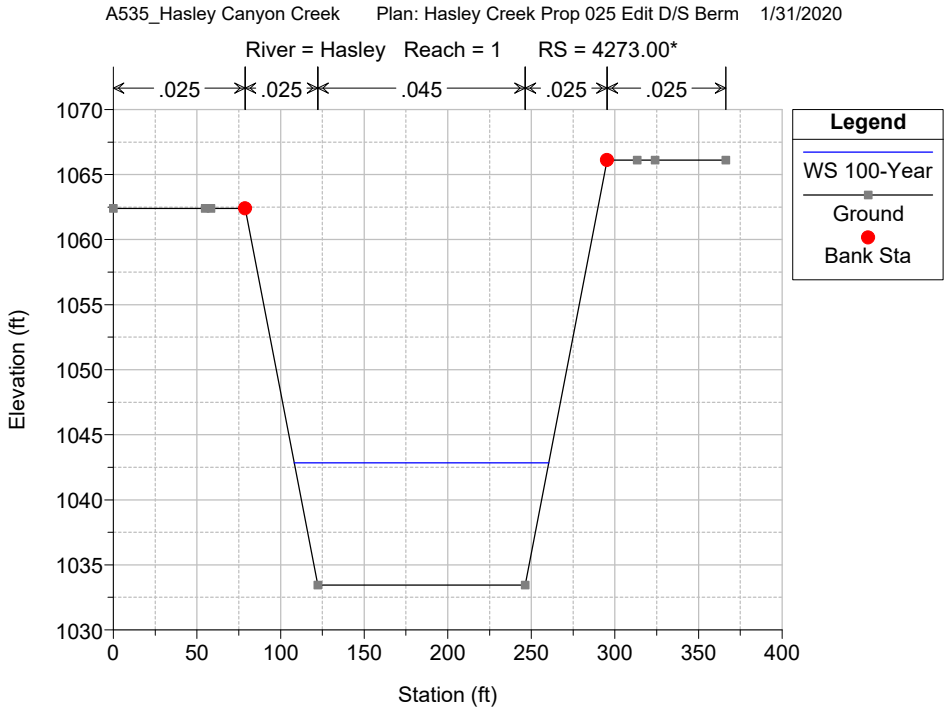
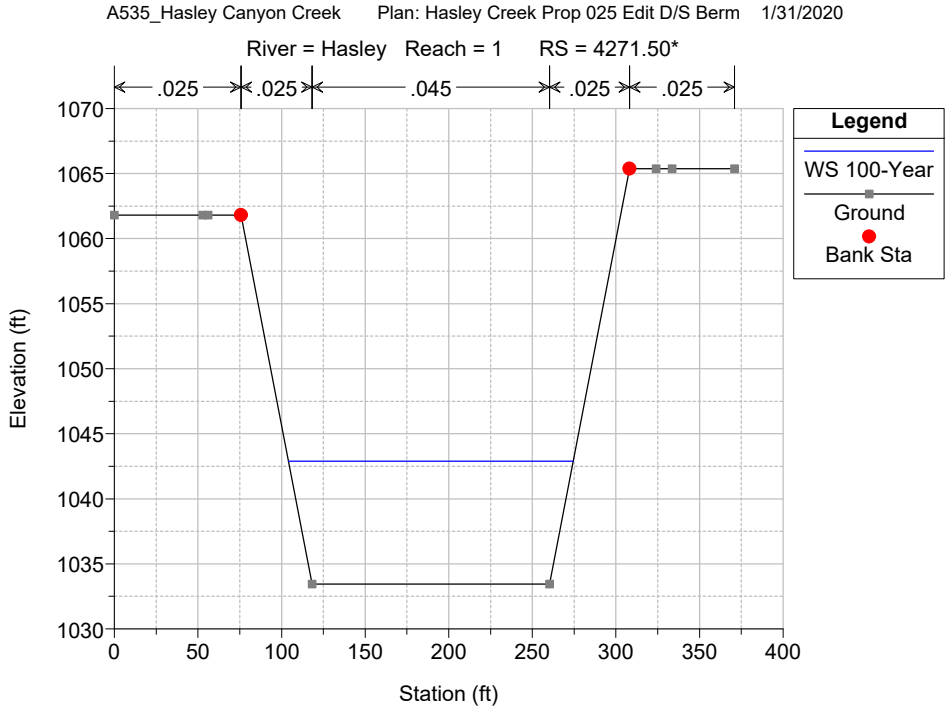
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

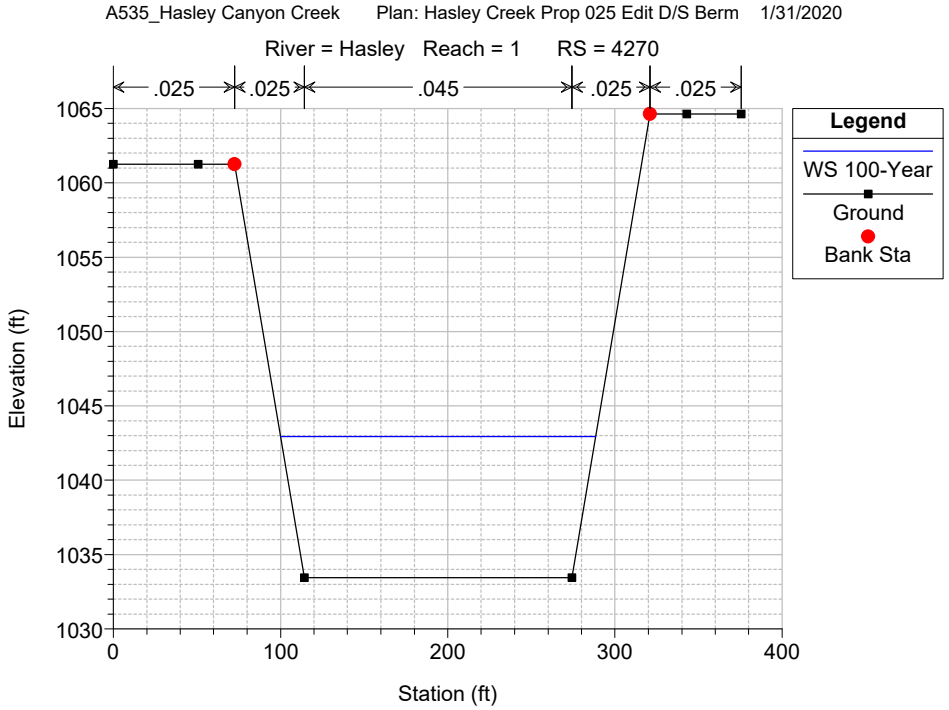

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4277.50*
.025 .025 .045 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4276
.025 .025 .045 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4274.50*
.025 .025 .045 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

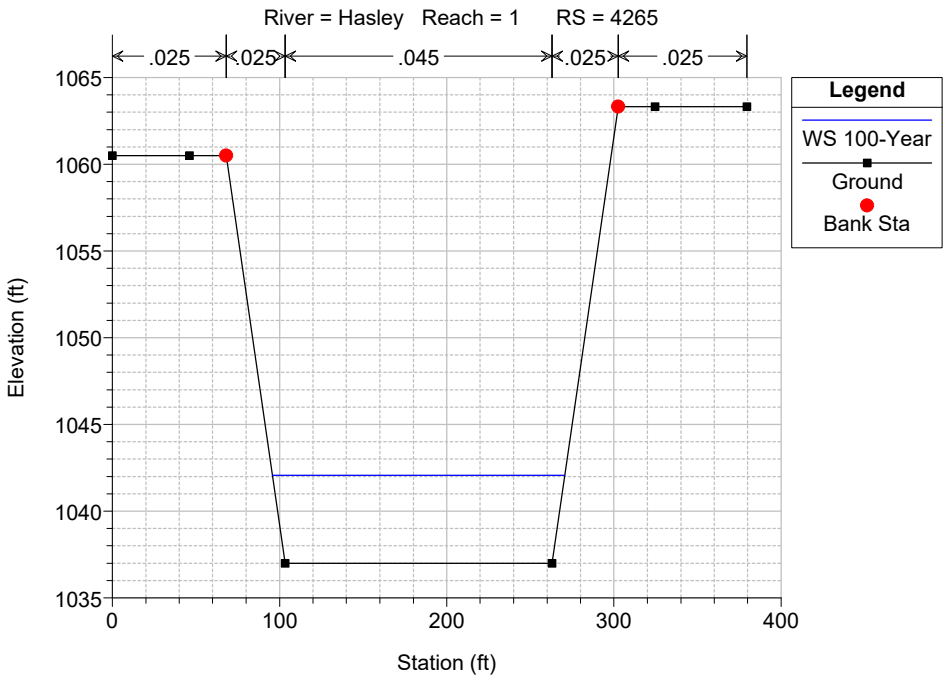

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4273.00*
.025 .025 .045 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4271.50*
.025 .025 .045 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 4270
.025 .025 .045 .025 .025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

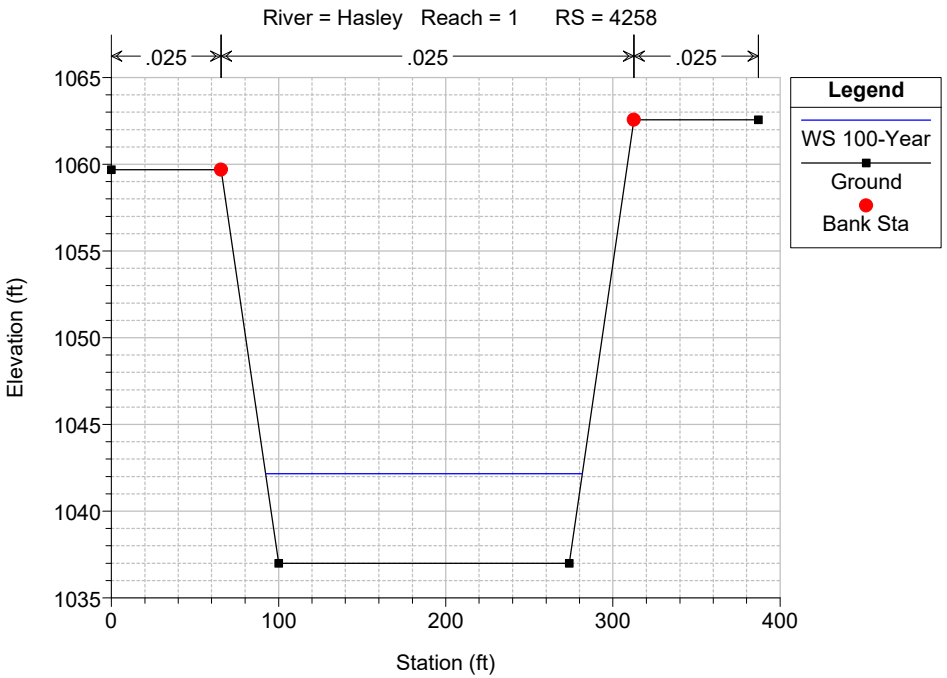
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 4265



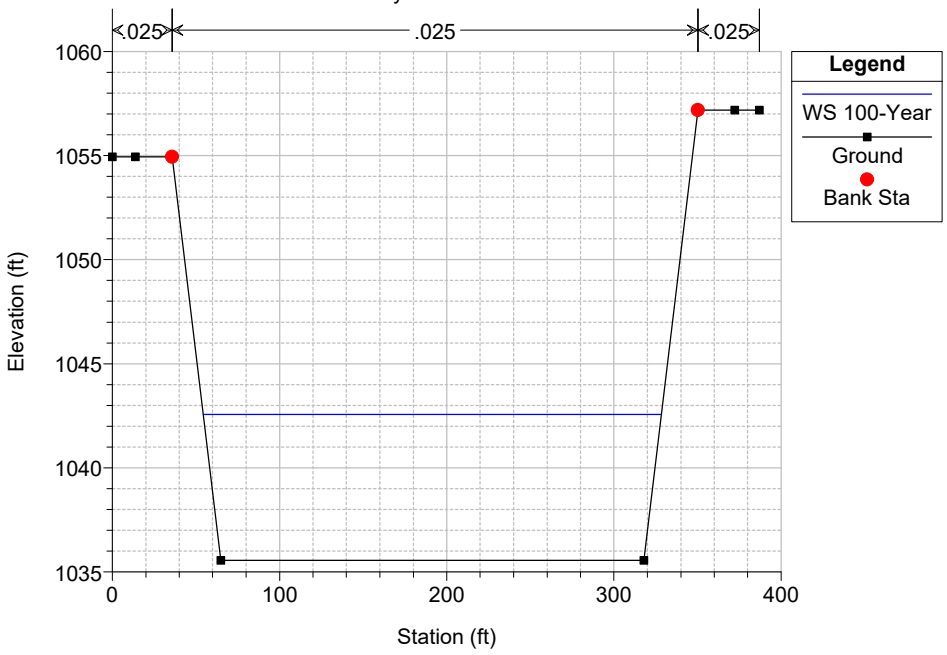
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 4258



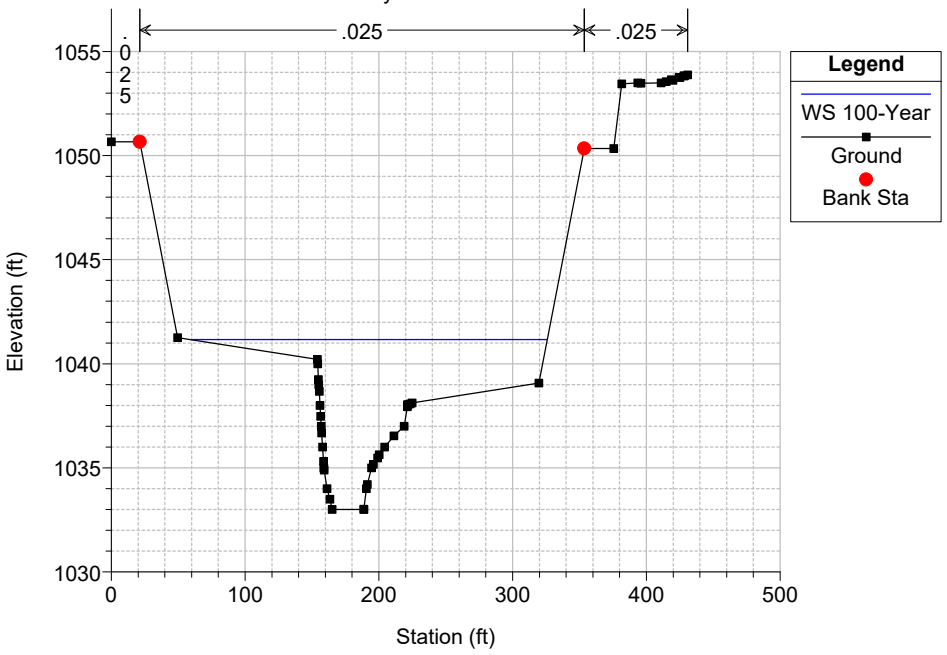
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 4157



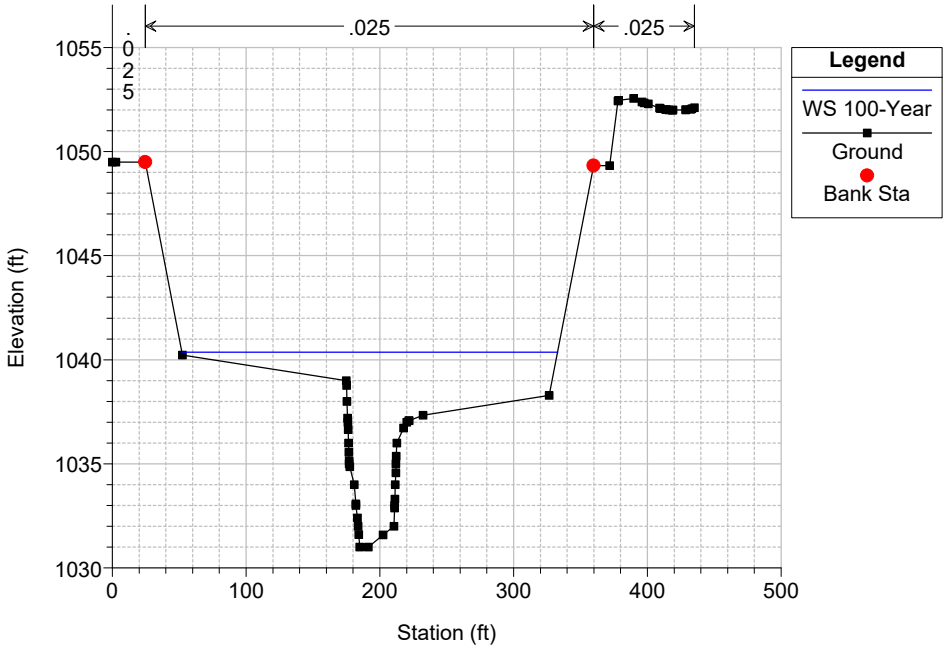
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 4055.5



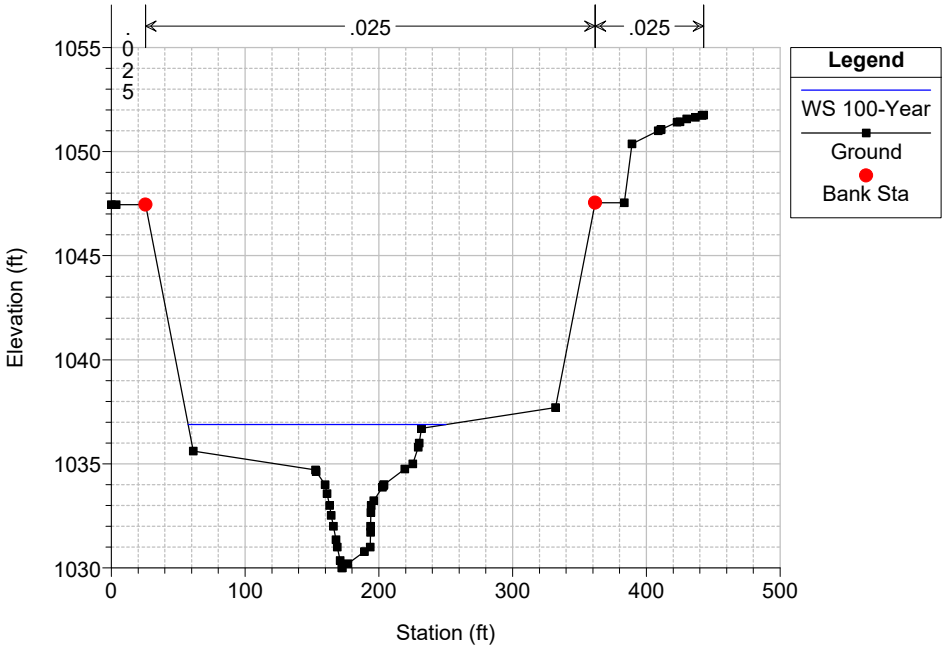
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 3940.5



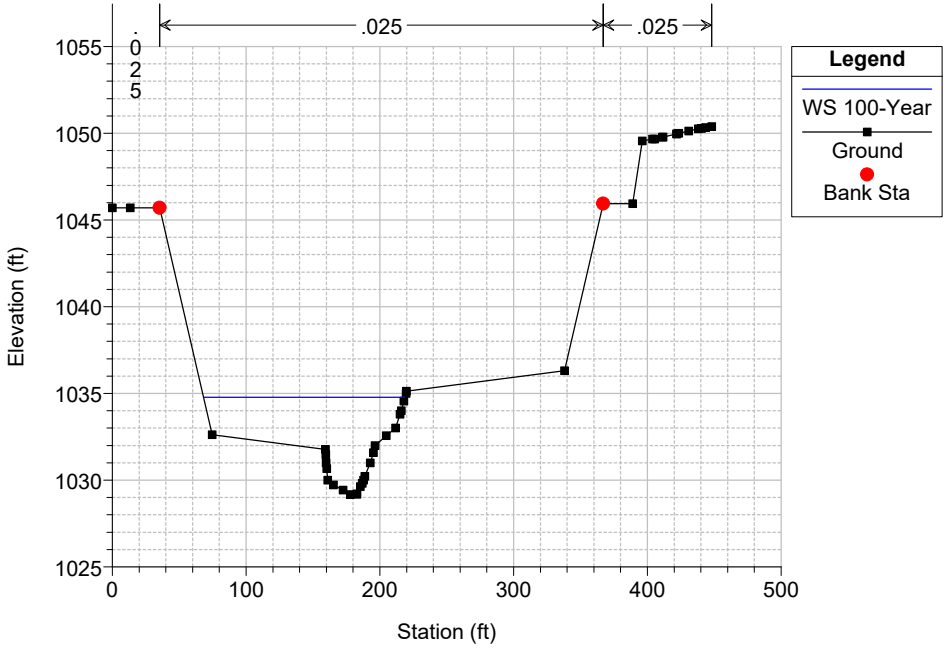
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 3844



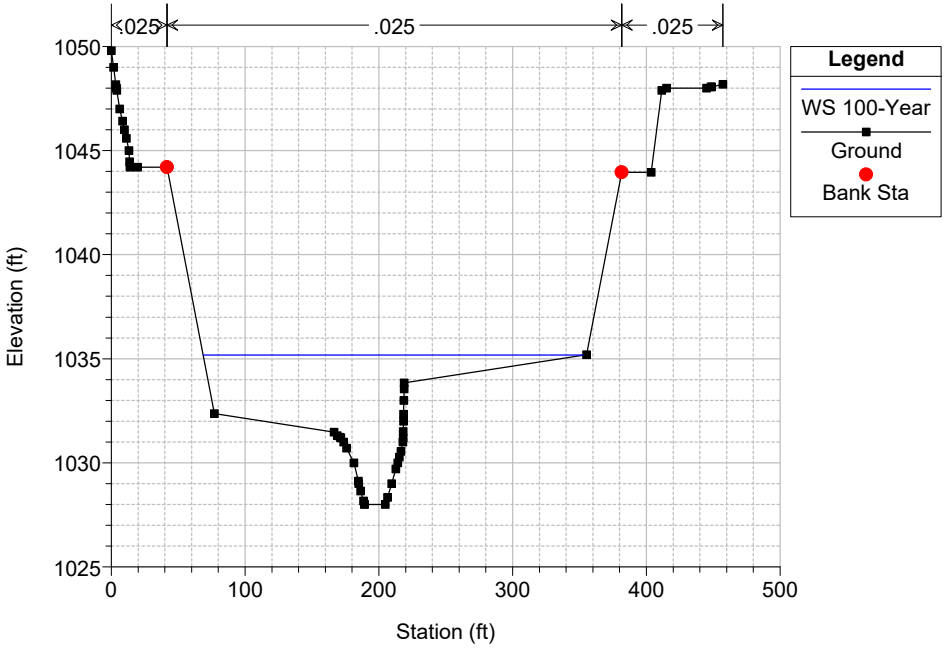
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 3747



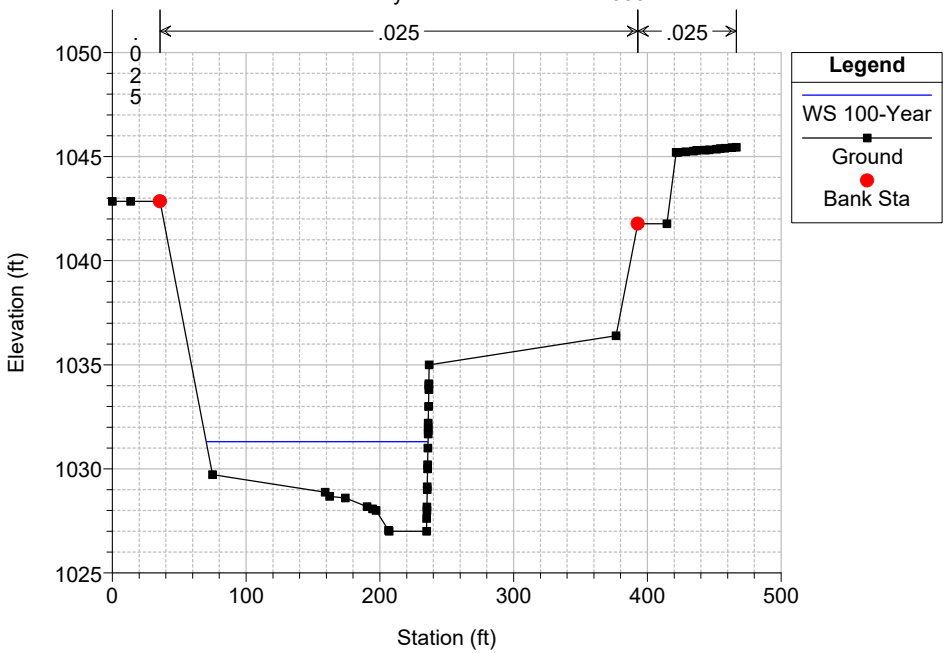
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 3650



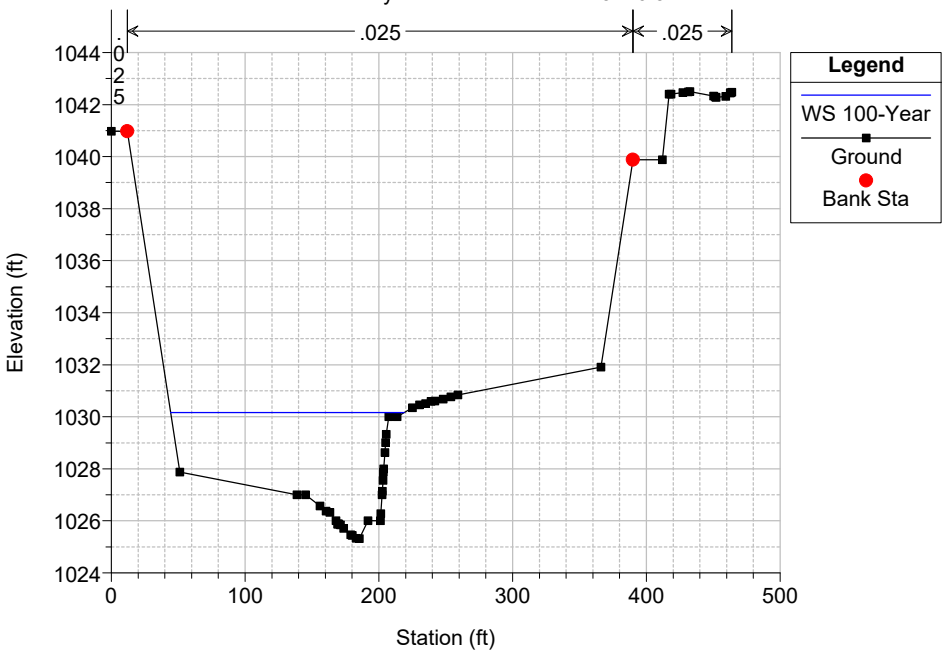
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 3554



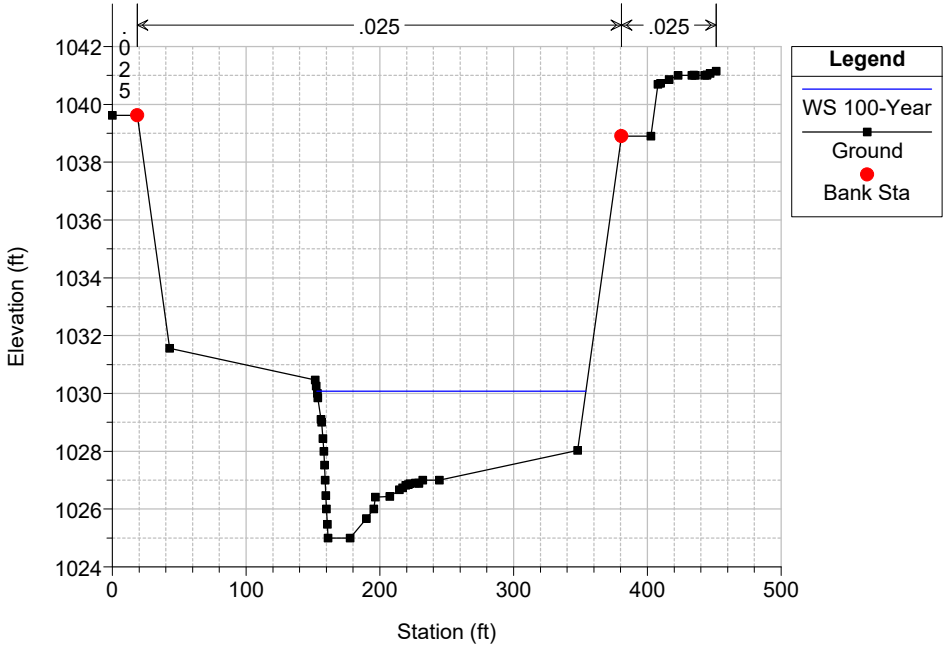
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 3440.5



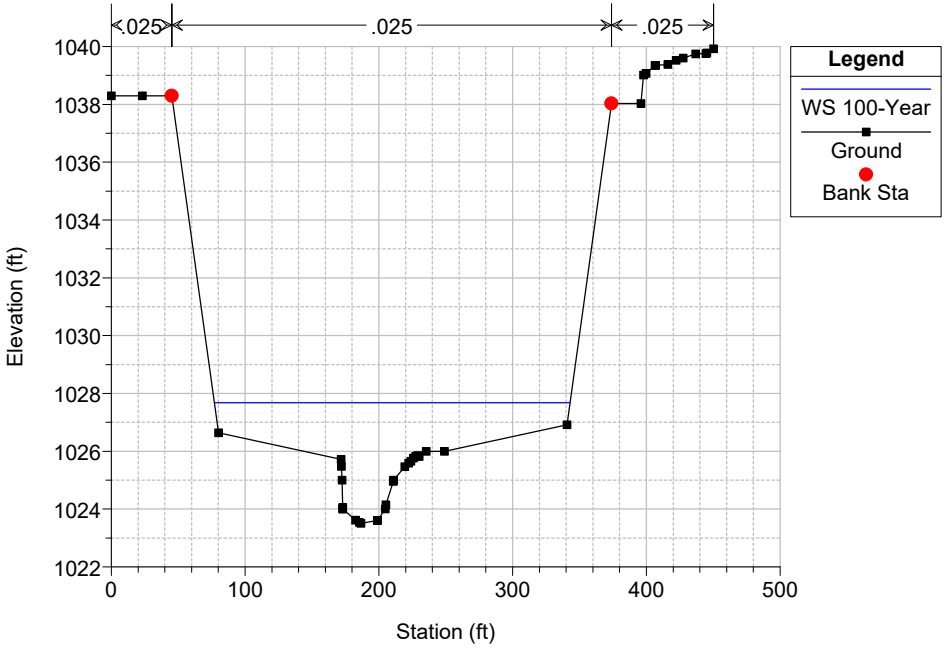
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

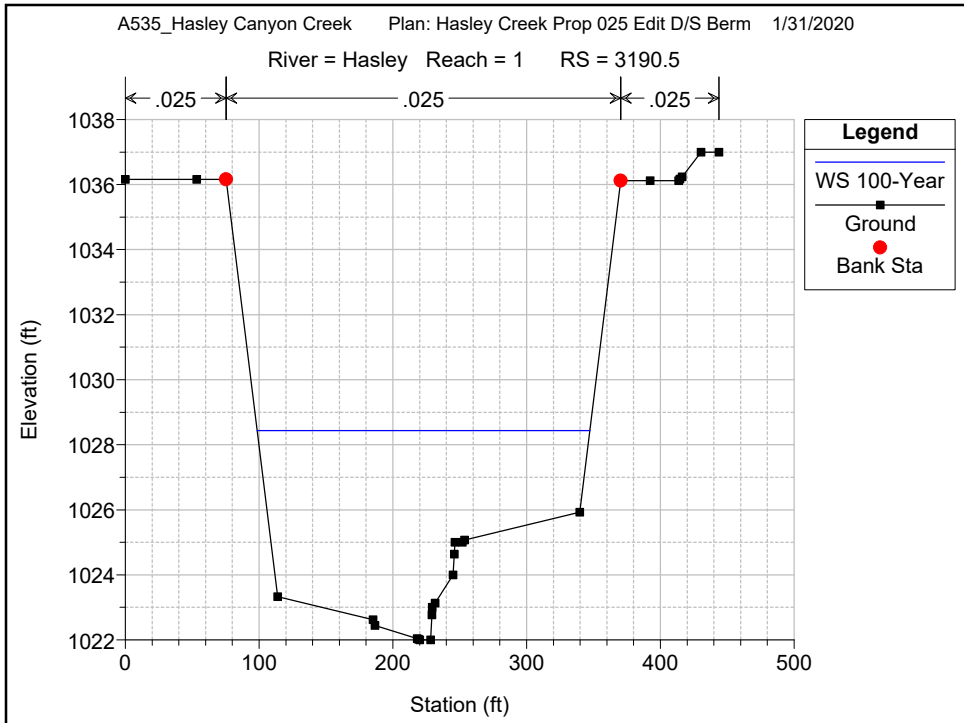
River = Hasley Reach = 1 RS = 3372

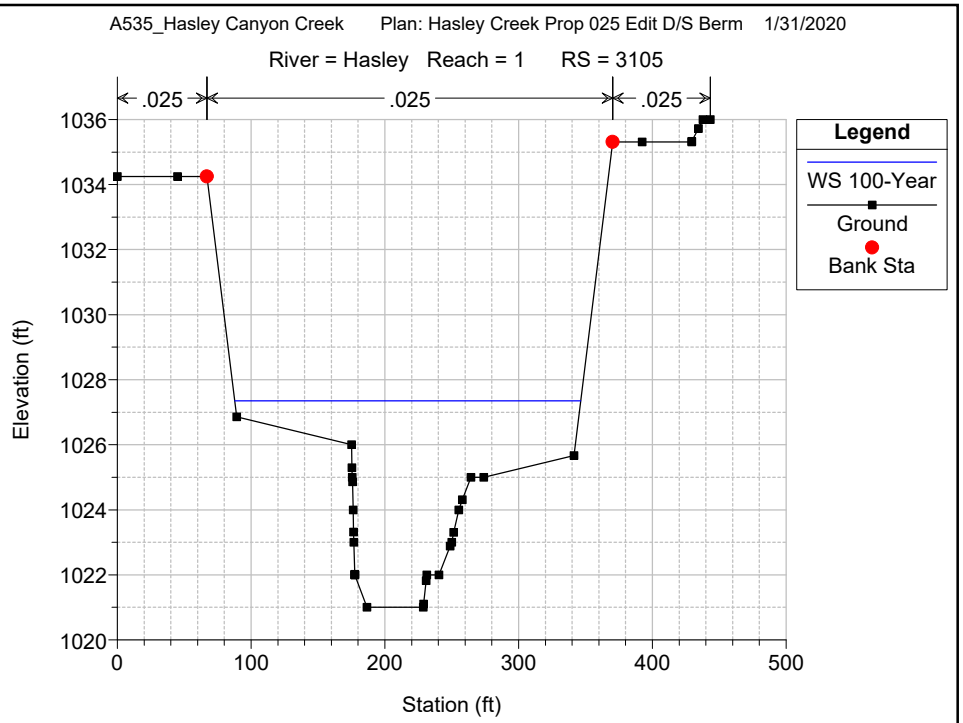


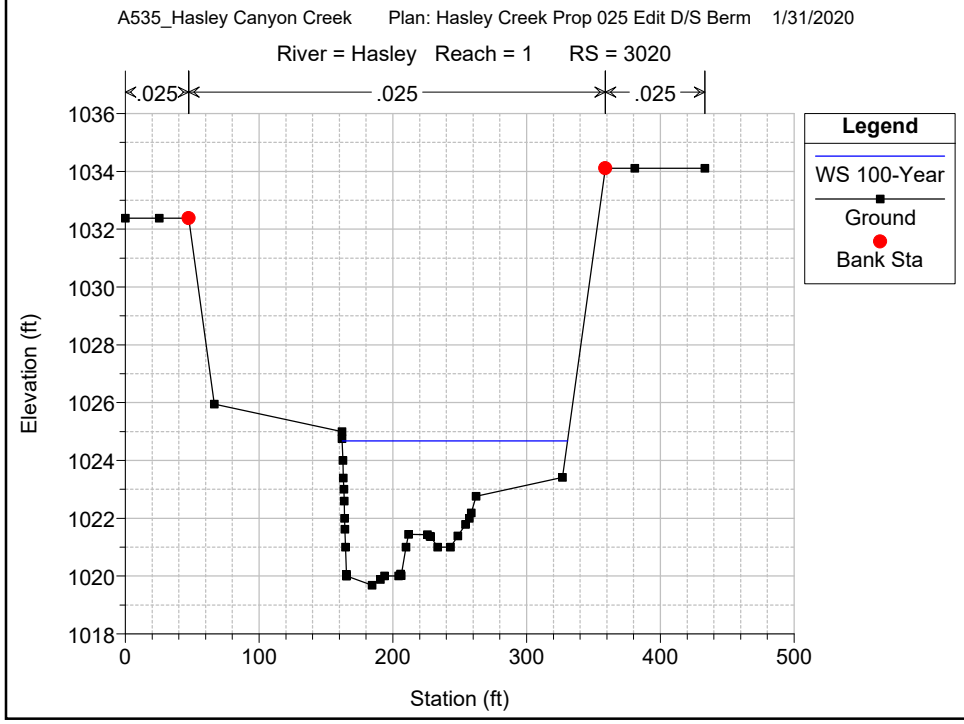
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

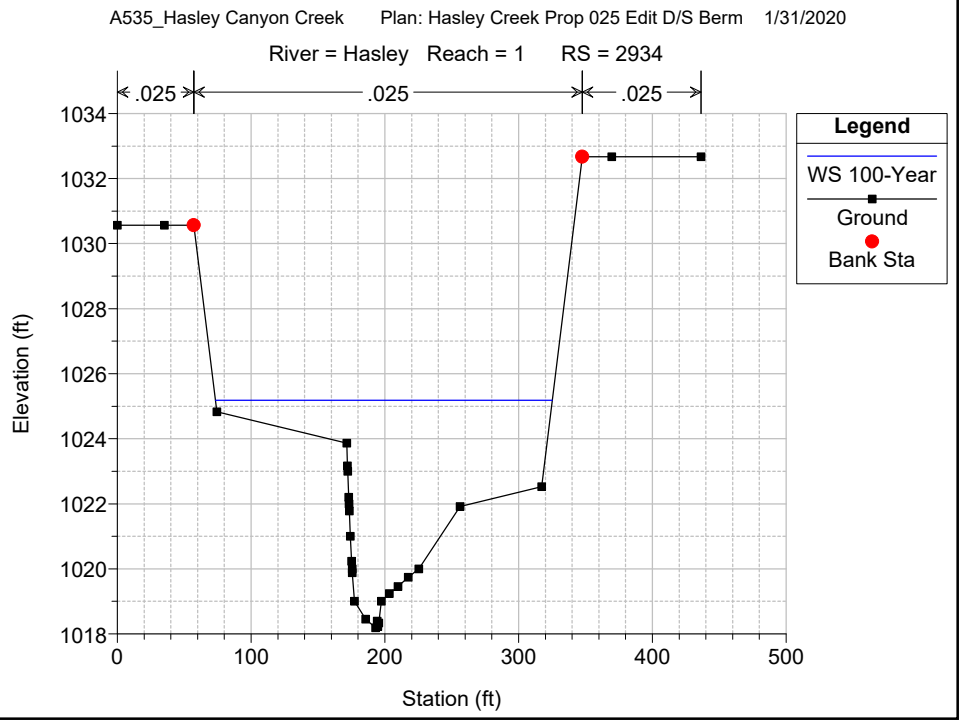
River = Hasley Reach = 1 RS = 3304




A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 3190.5
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

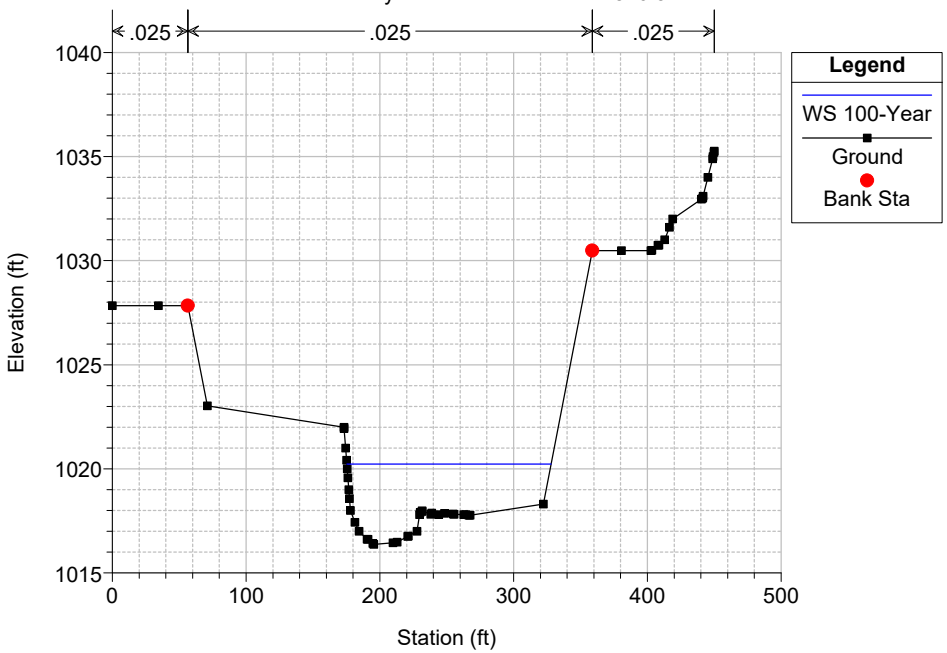

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 3105
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 3020
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 2934
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

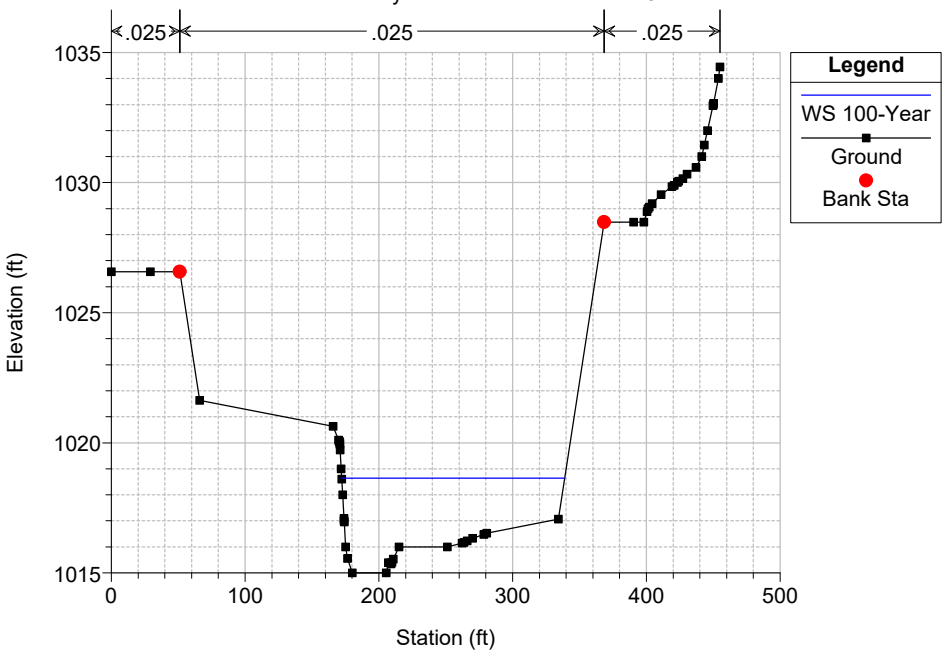
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 2820.5



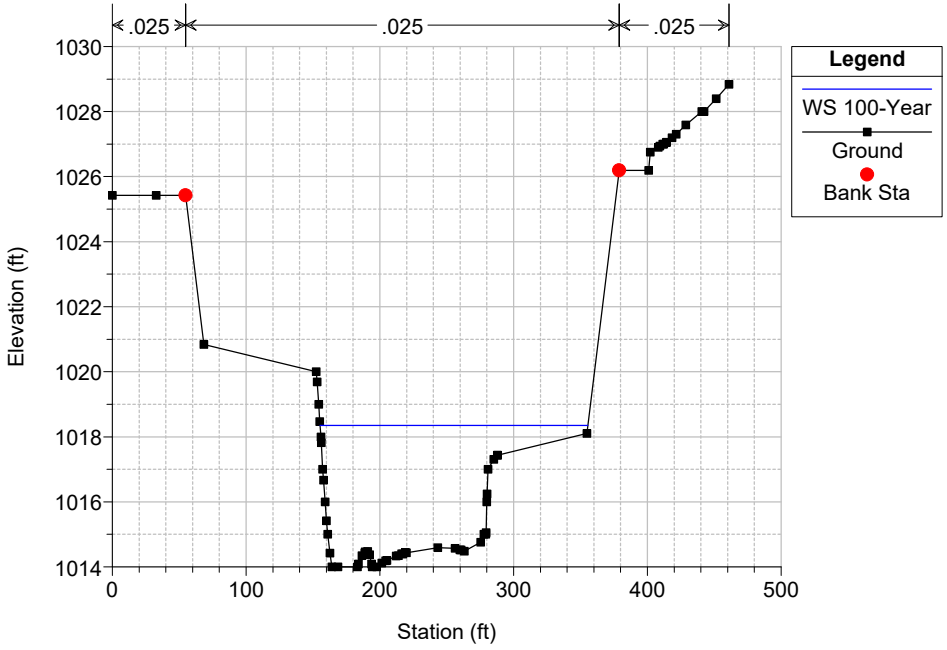
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 2748



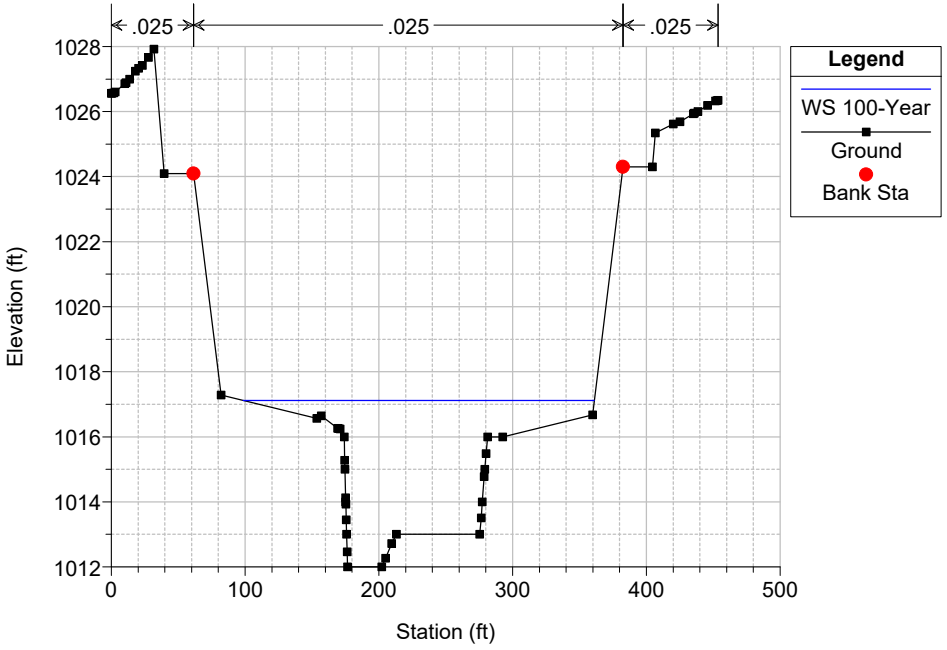
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 2675.5



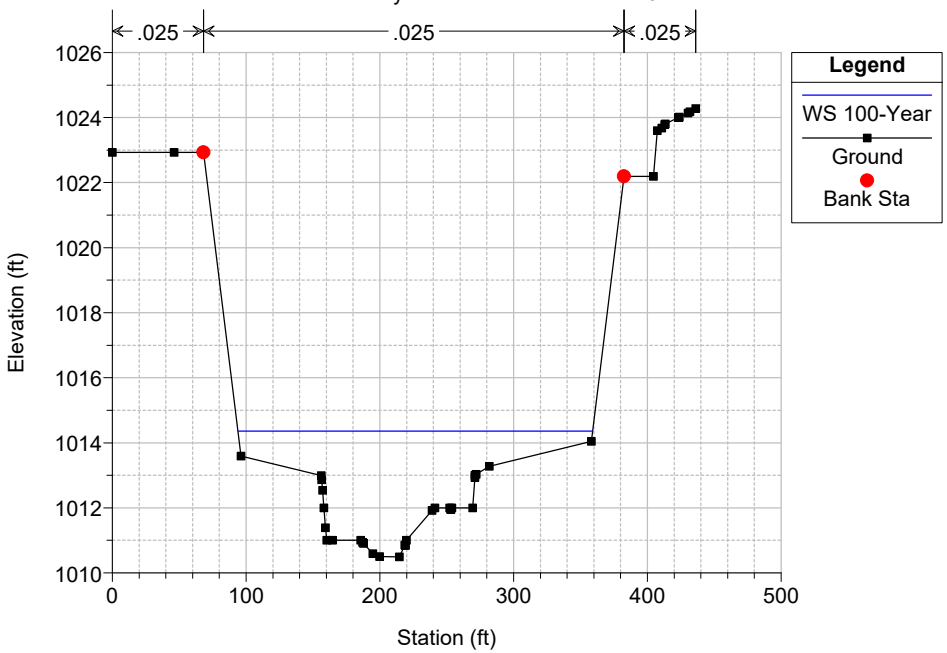
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 2560.5



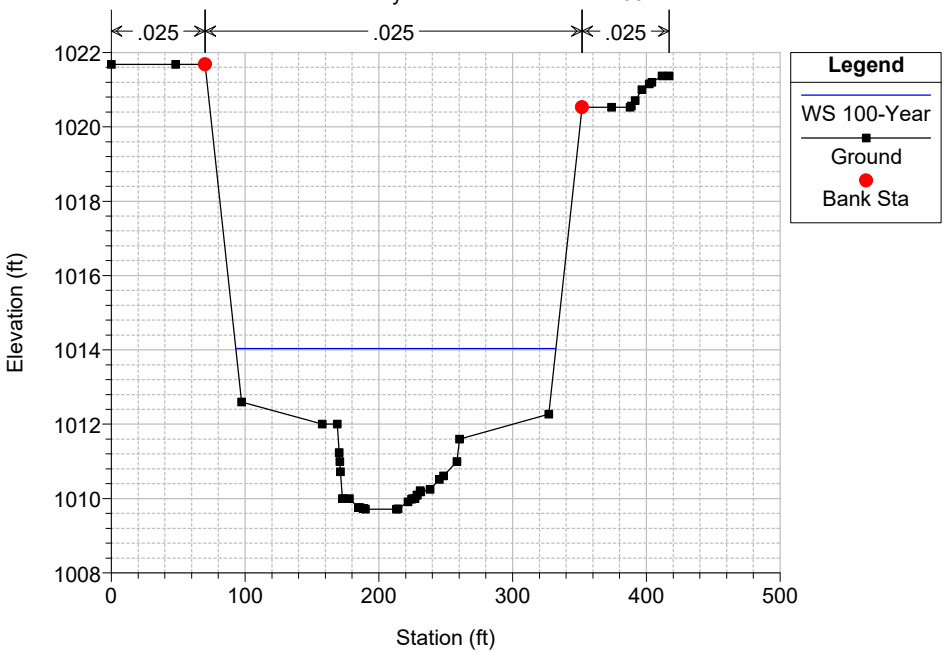
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 2476



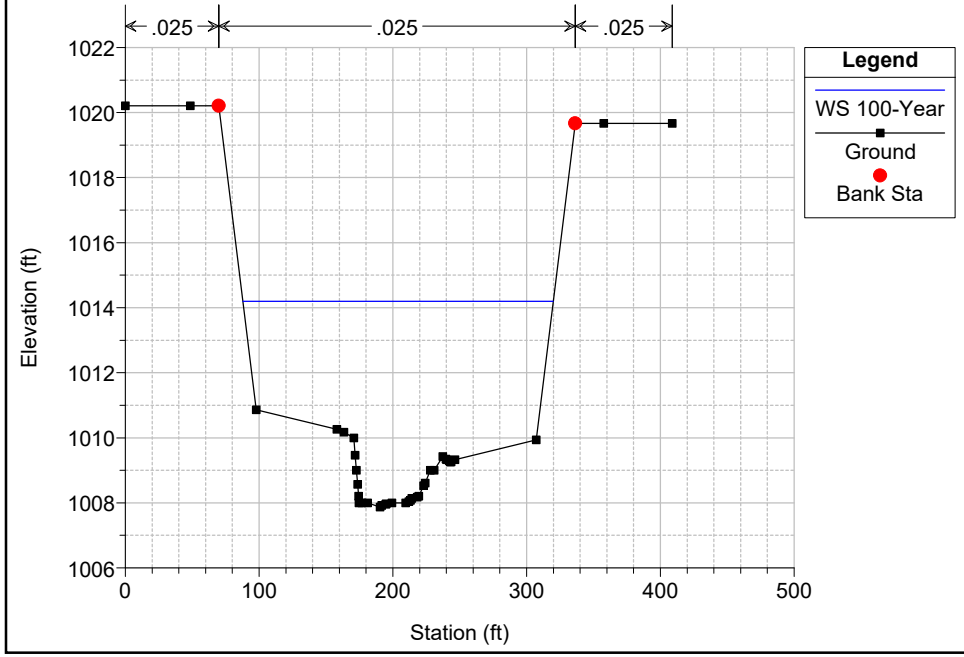
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 2391



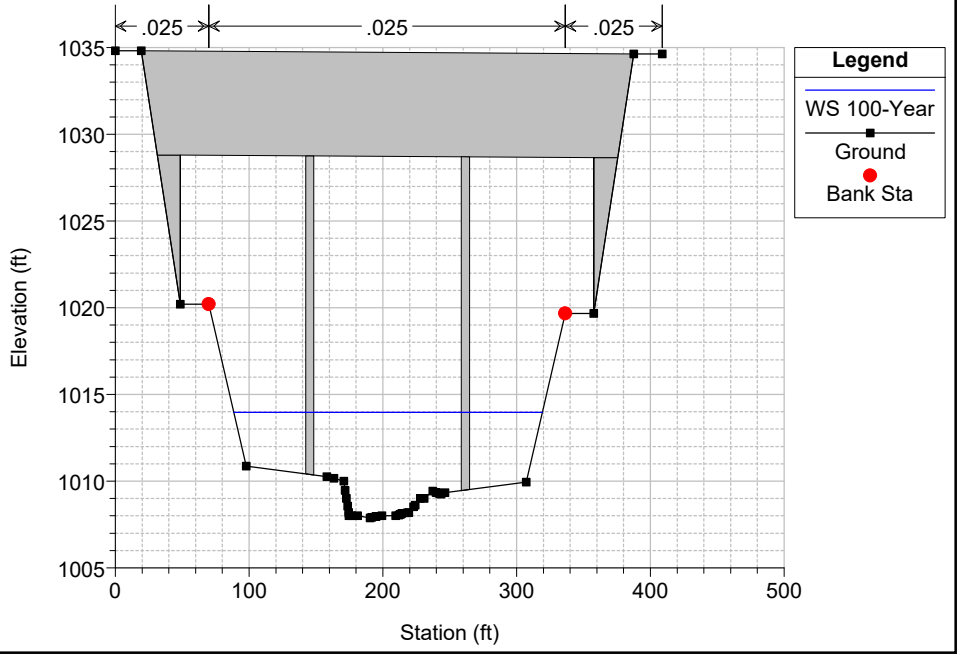
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

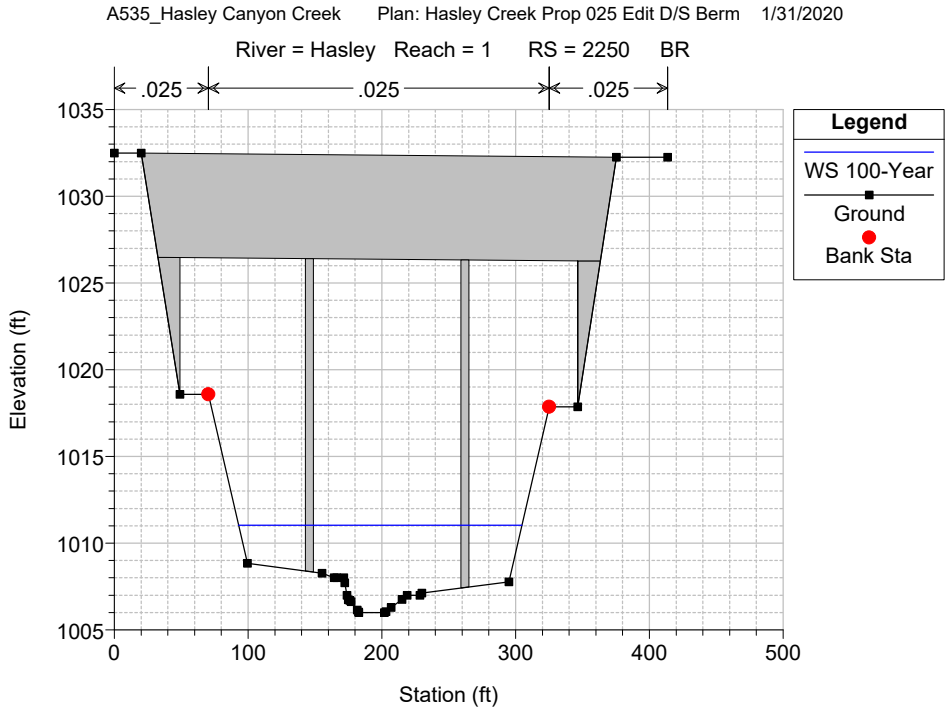
River = Hasley Reach = 1 RS = 2305.5

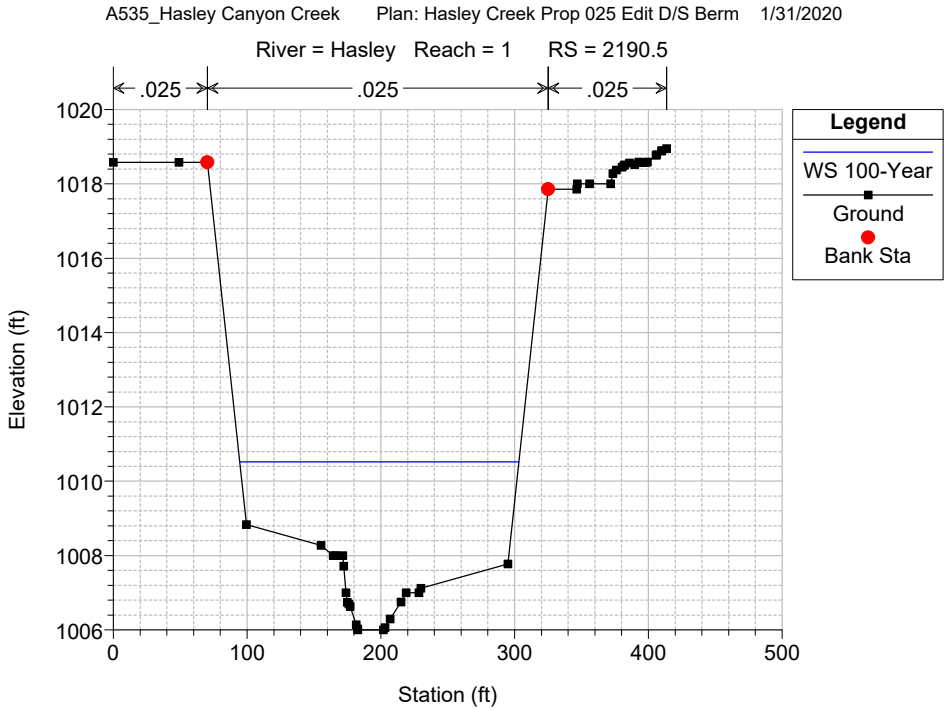


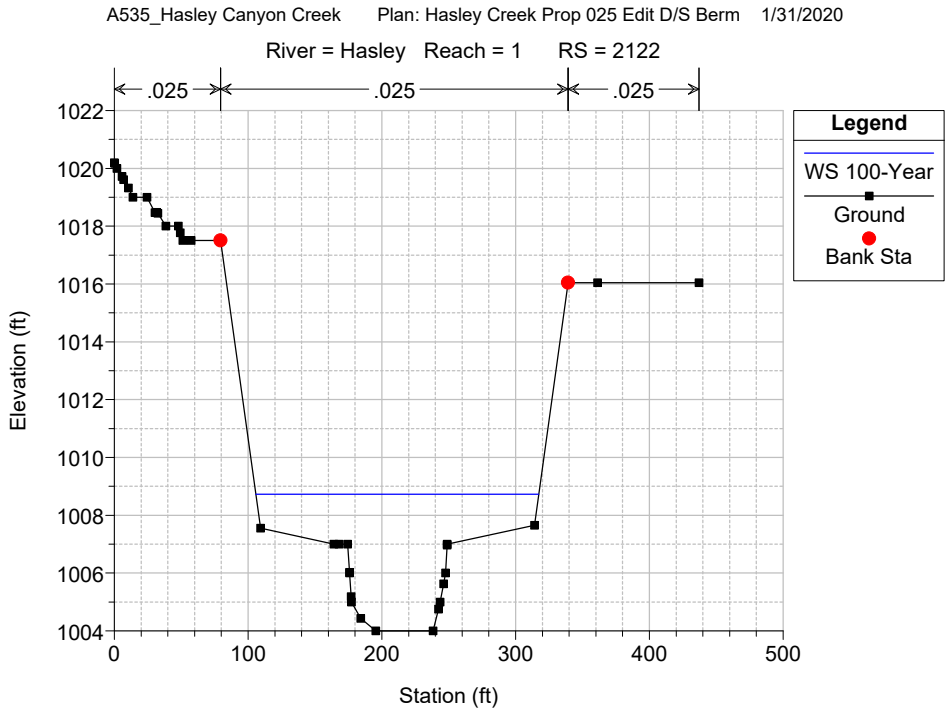
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

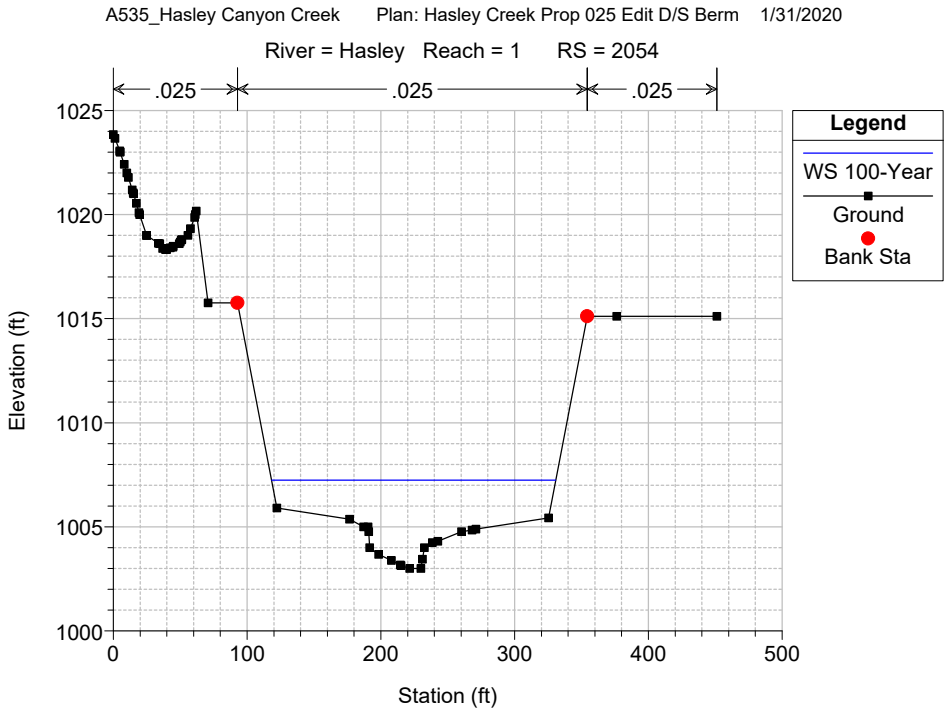
River = Hasley Reach = 1 RS = 2250 BR




A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 2250 BR
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1035
1030
1025
1020
1015
1010
1005
0
100
200
300
400
500

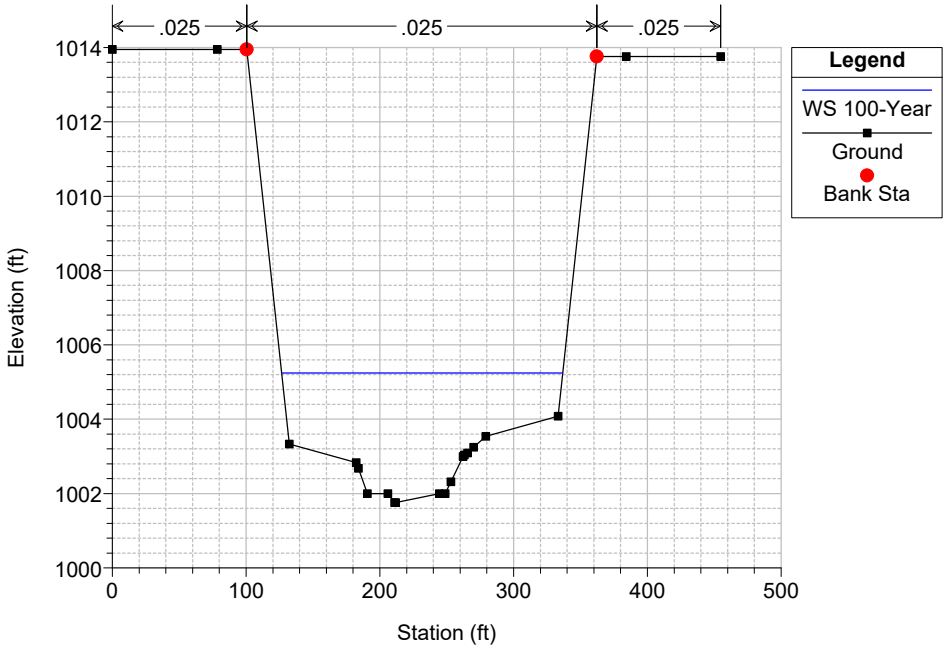

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 2190.5
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1020
1018
1016
1014
1012
1010
1008
1006
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 2122
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1022
1020
1018
1016
1014
1012
1010
1008
1006
1004
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 2054
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1025
1020
1015
1010
1005
1000
0
100
200
300
400
500

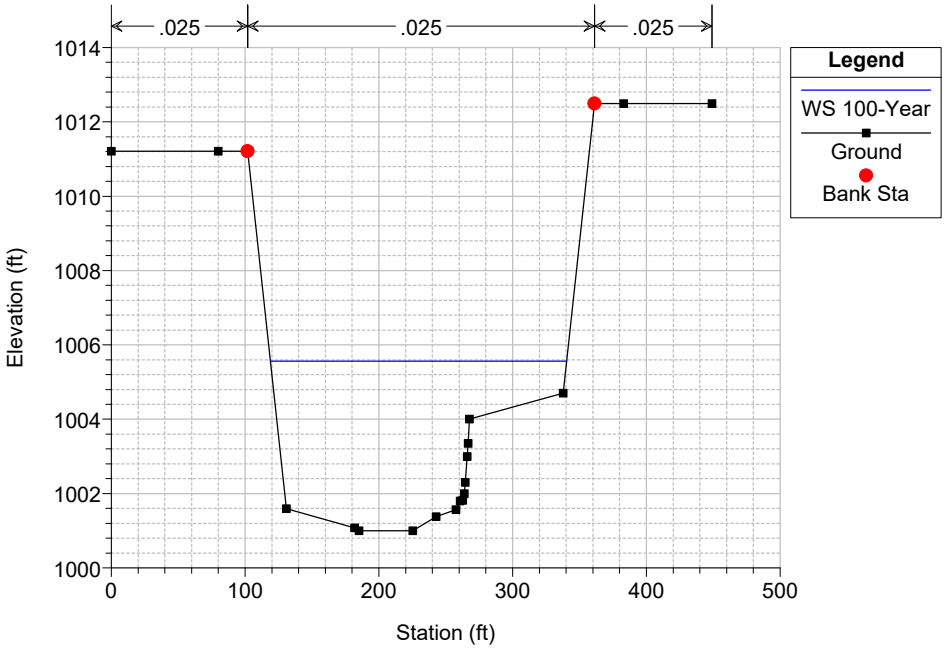
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 1940.5



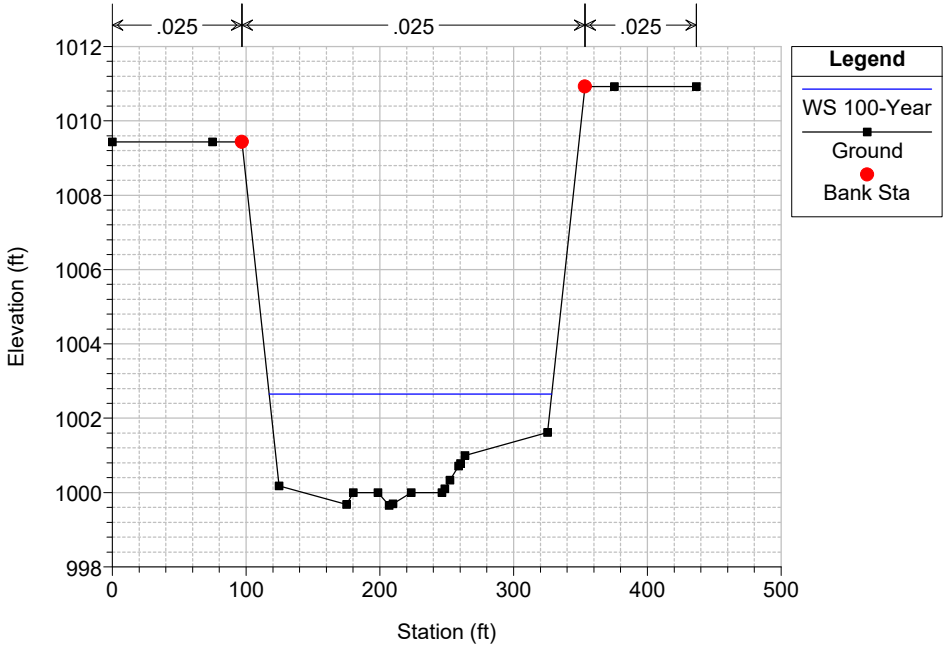
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

River = Hasley Reach = 1 RS = 1872



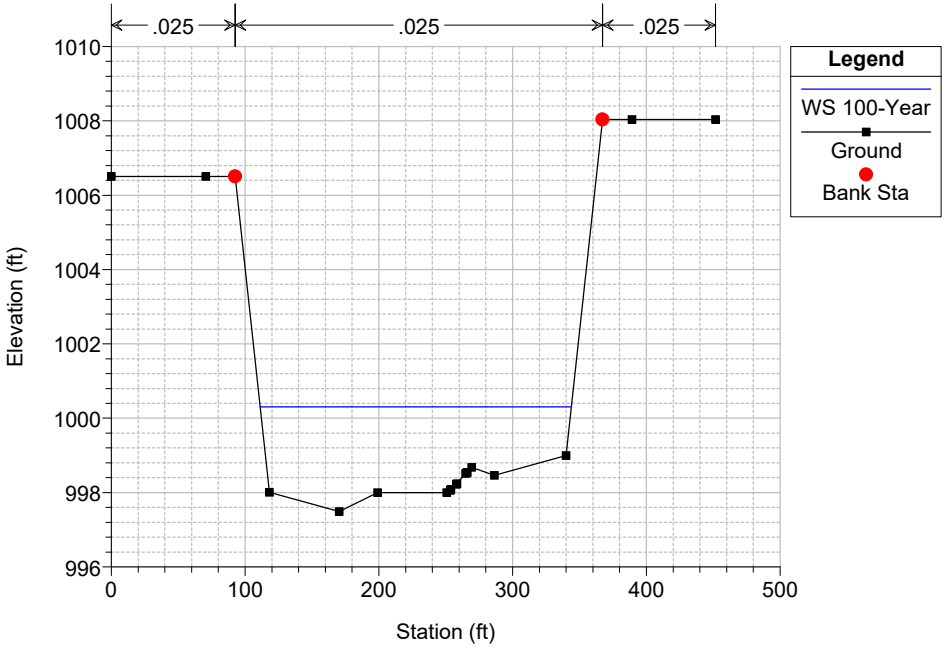
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

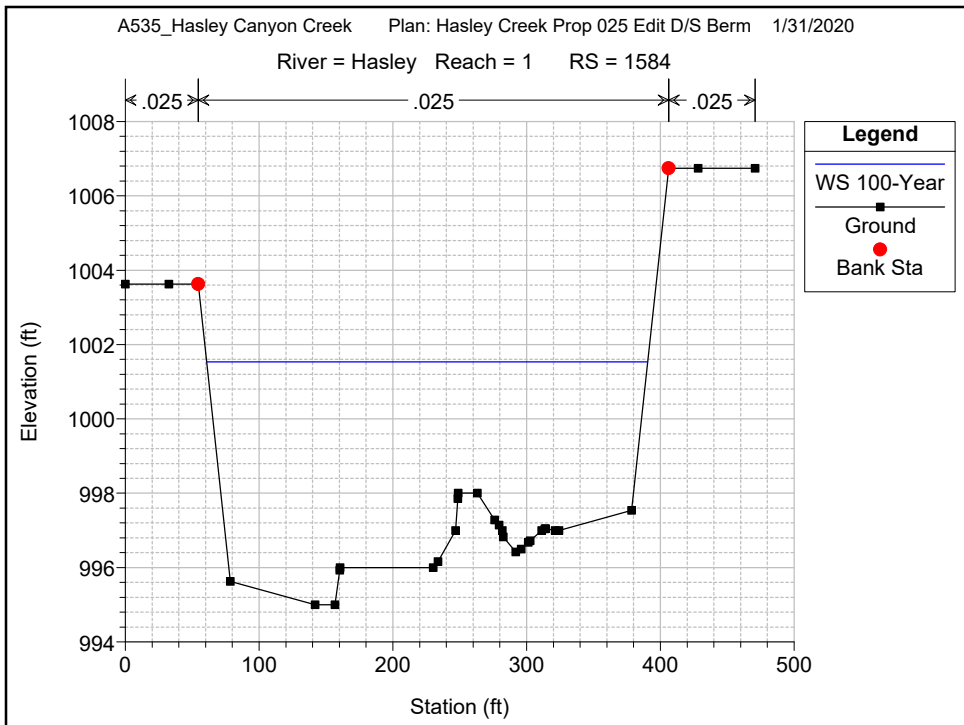
River = Hasley Reach = 1 RS = 1804

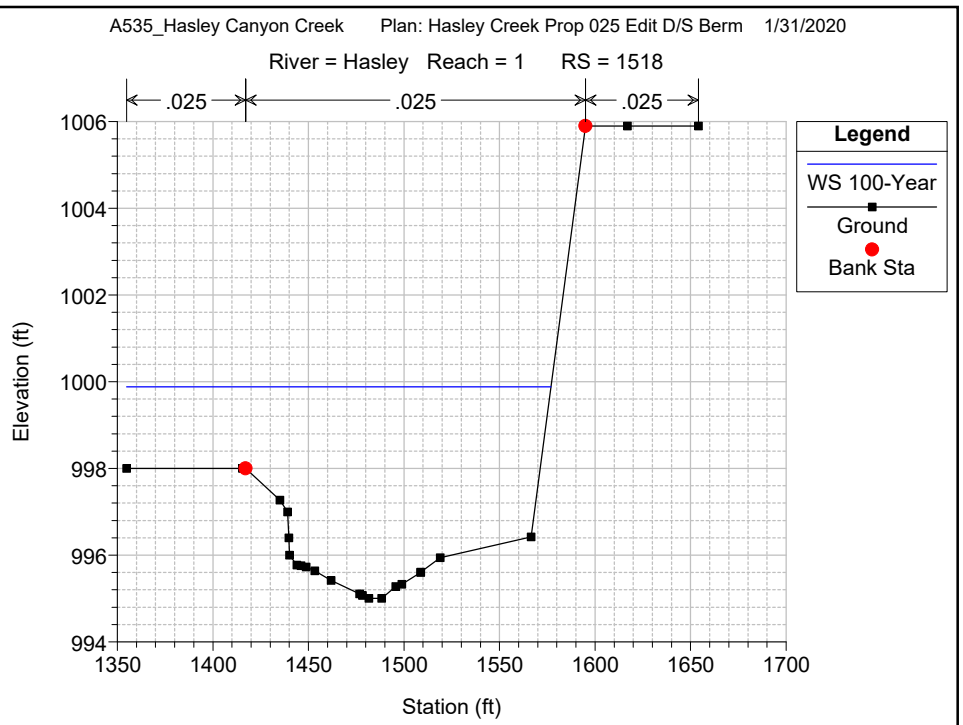


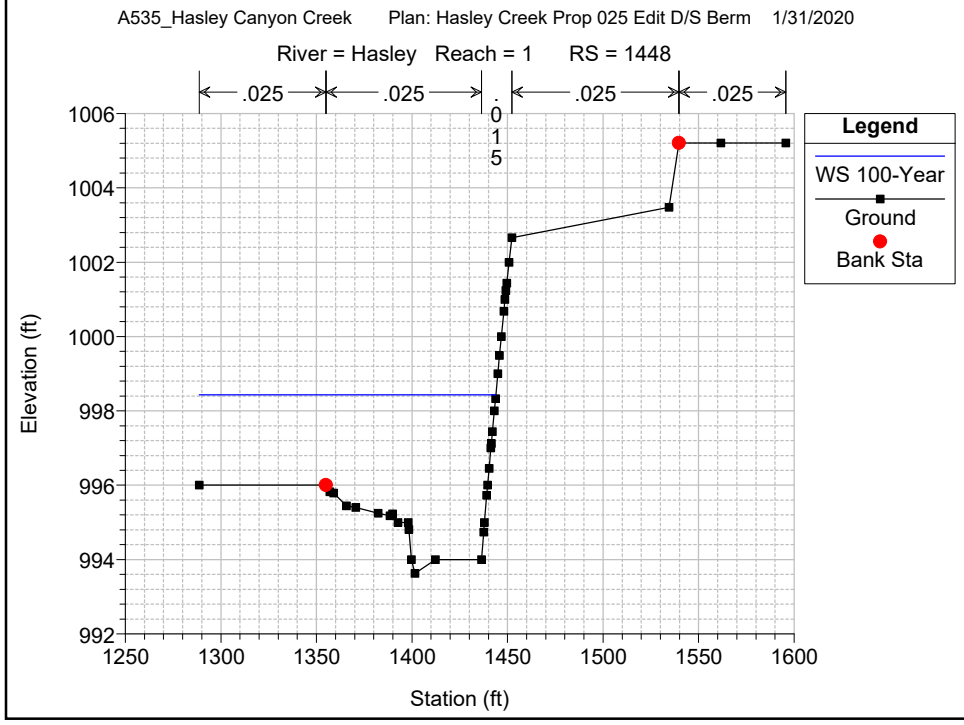
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020

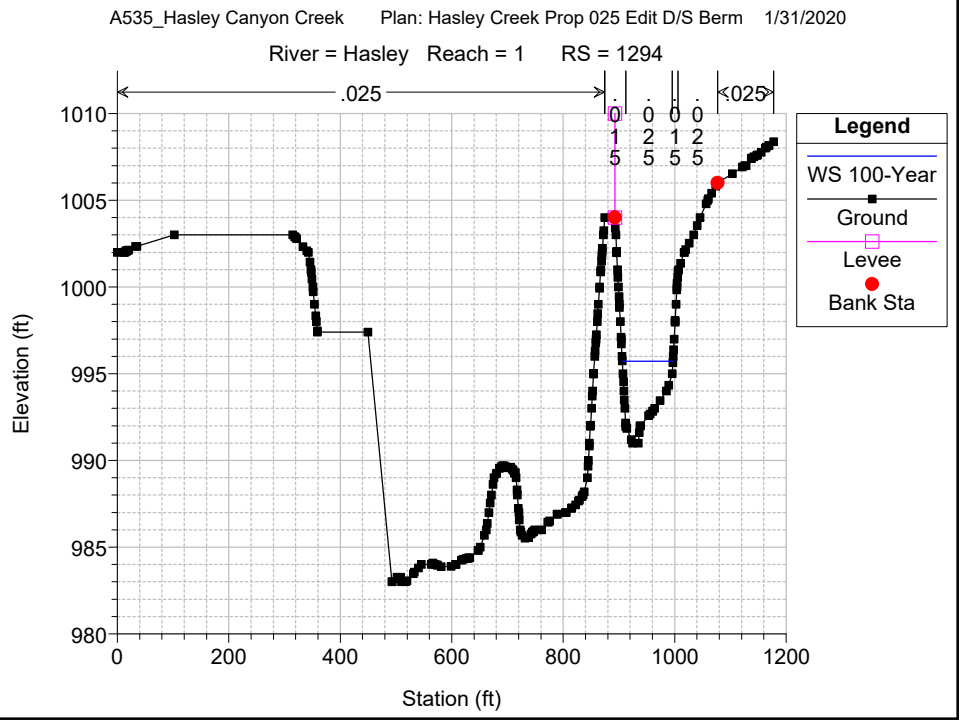
River = Hasley Reach = 1 RS = 1688.62

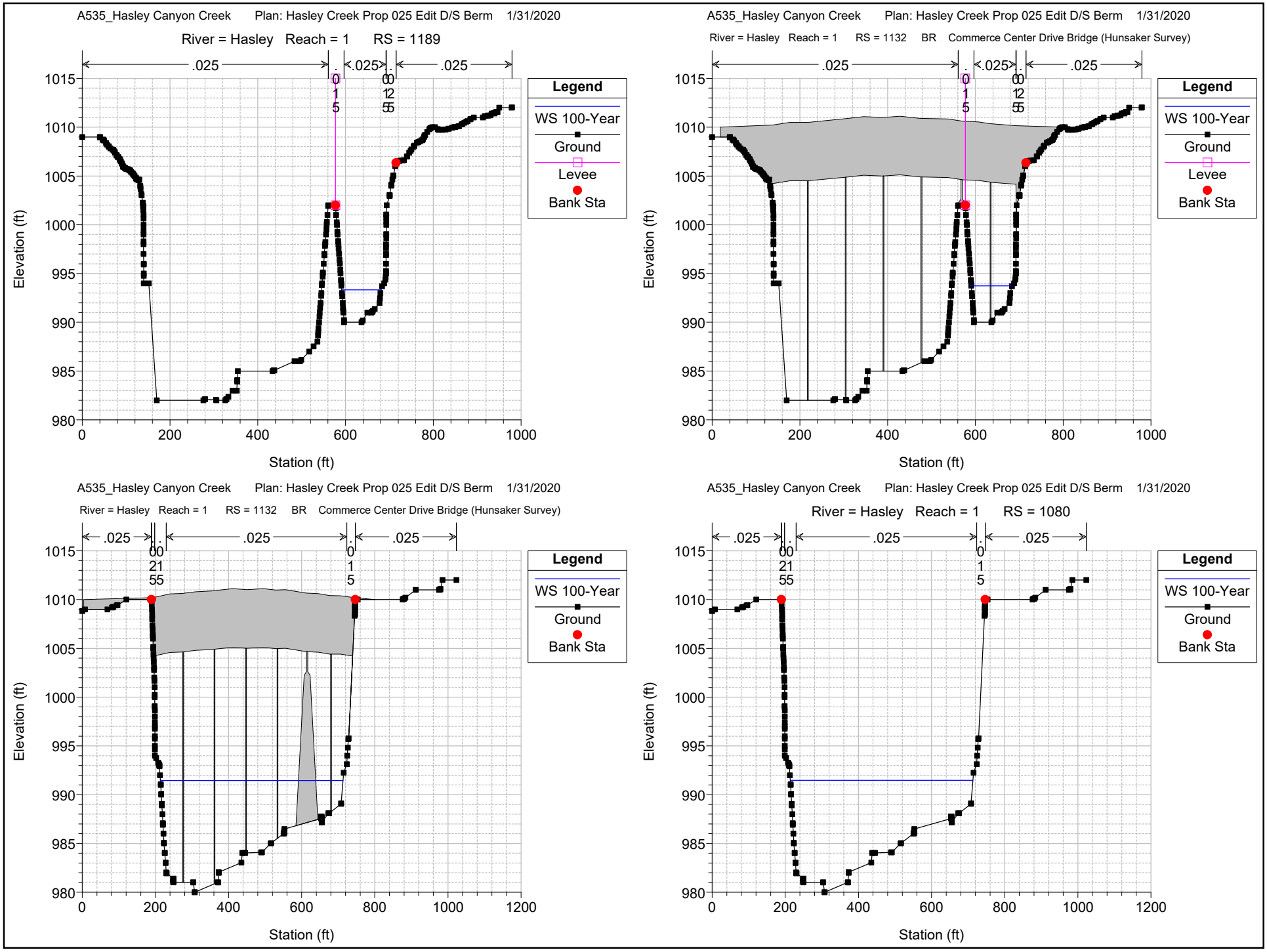


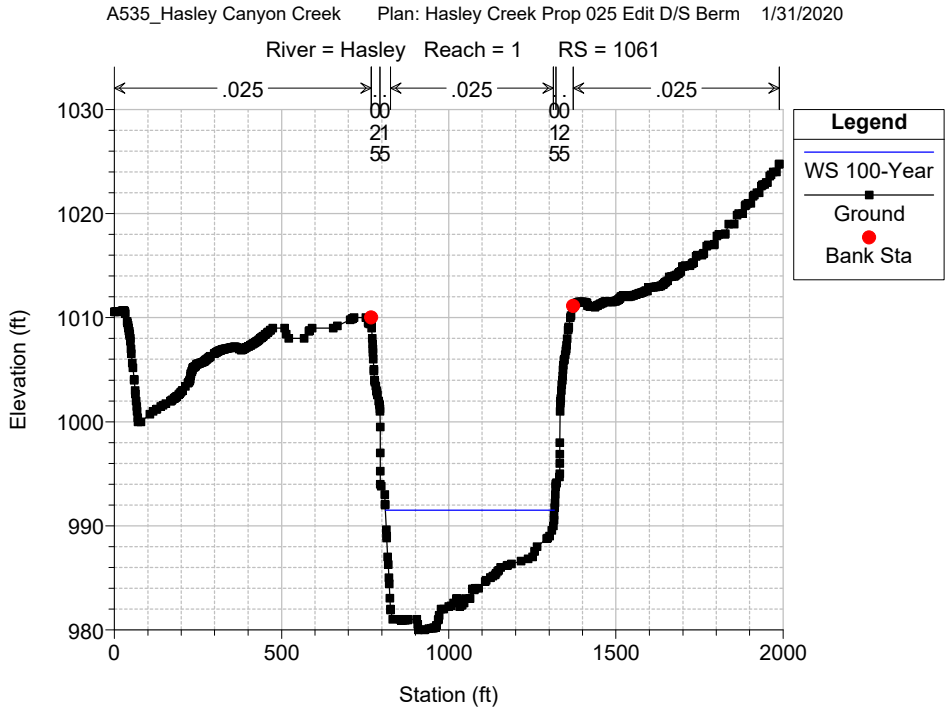

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1584
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

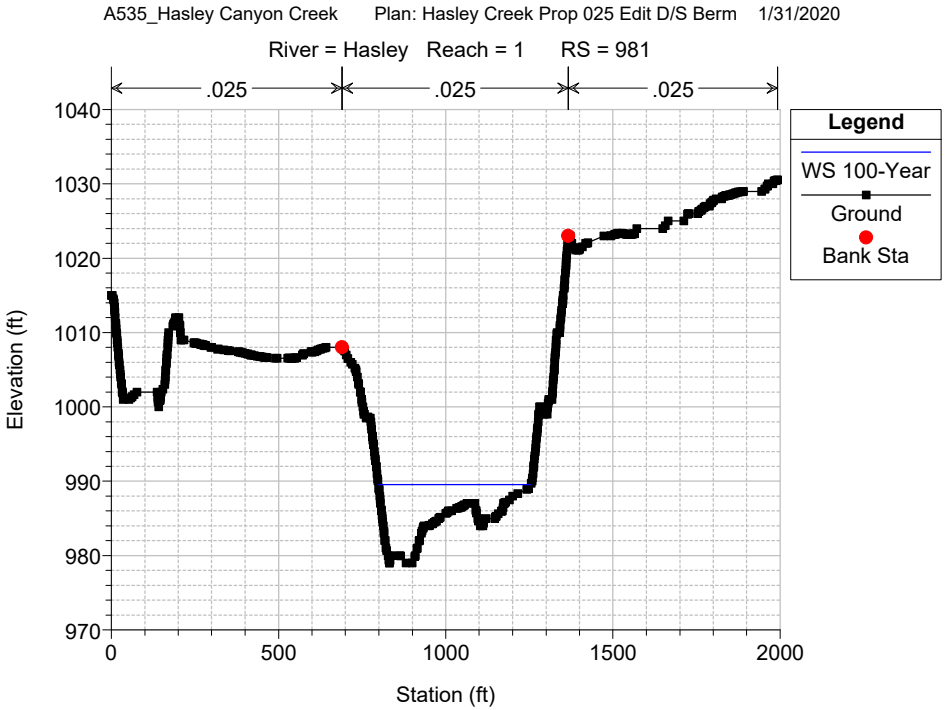

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1518
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

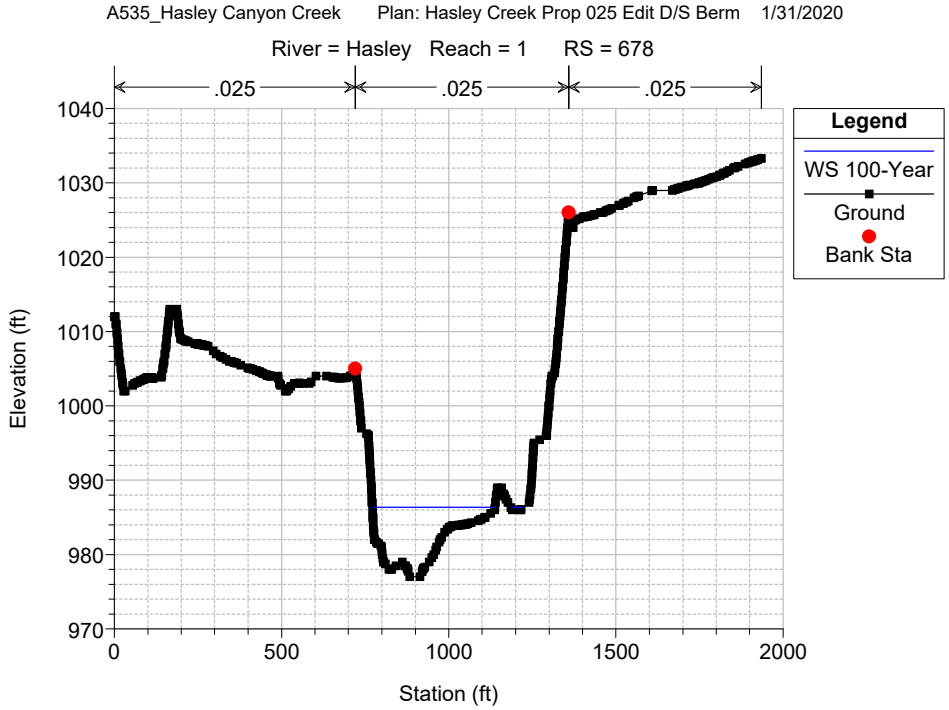

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1448
.025
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1294
.025
.025
Legend
WS 100-Year
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1189
.025
.025
.025
Legend
WS 100-Year
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)
.025
.025
.025
Legend
WS 100-Year
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1080
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 1061
.025
.025
.025
00
21
55
00
12
55
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1030
1020
1010
1000
990
980
0
500
1000
1500
2000

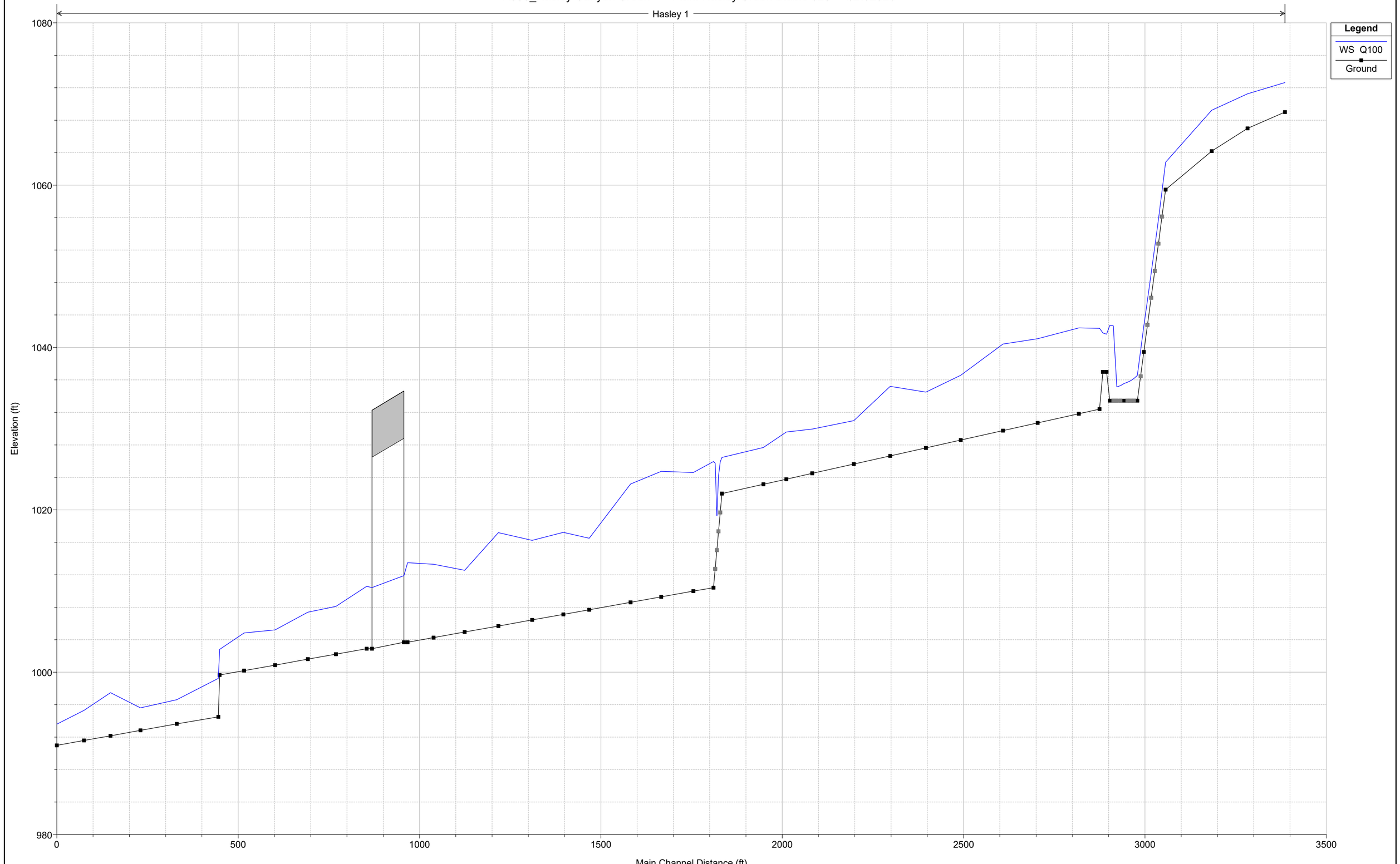

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 981
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1040
1030
1020
1010
1000
990
980
970
0
500
1000
1500
2000


A535_Hasley Canyon Creek Plan: Hasley Creek Prop 025 Edit D/S Berm 1/31/2020
River = Hasley Reach = 1 RS = 678
.025
.025
.025
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
1040
1030
1020
1010
1000
990
980
970
0
500
1000
1500
2000

Appendix D: Proposed Condition HEC-RAS Model Results (n=0.025)

Water Surface Profile- Stable Slope

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020



Appendix D: Proposed Condition HEC-RAS Model Results (n=0.025)

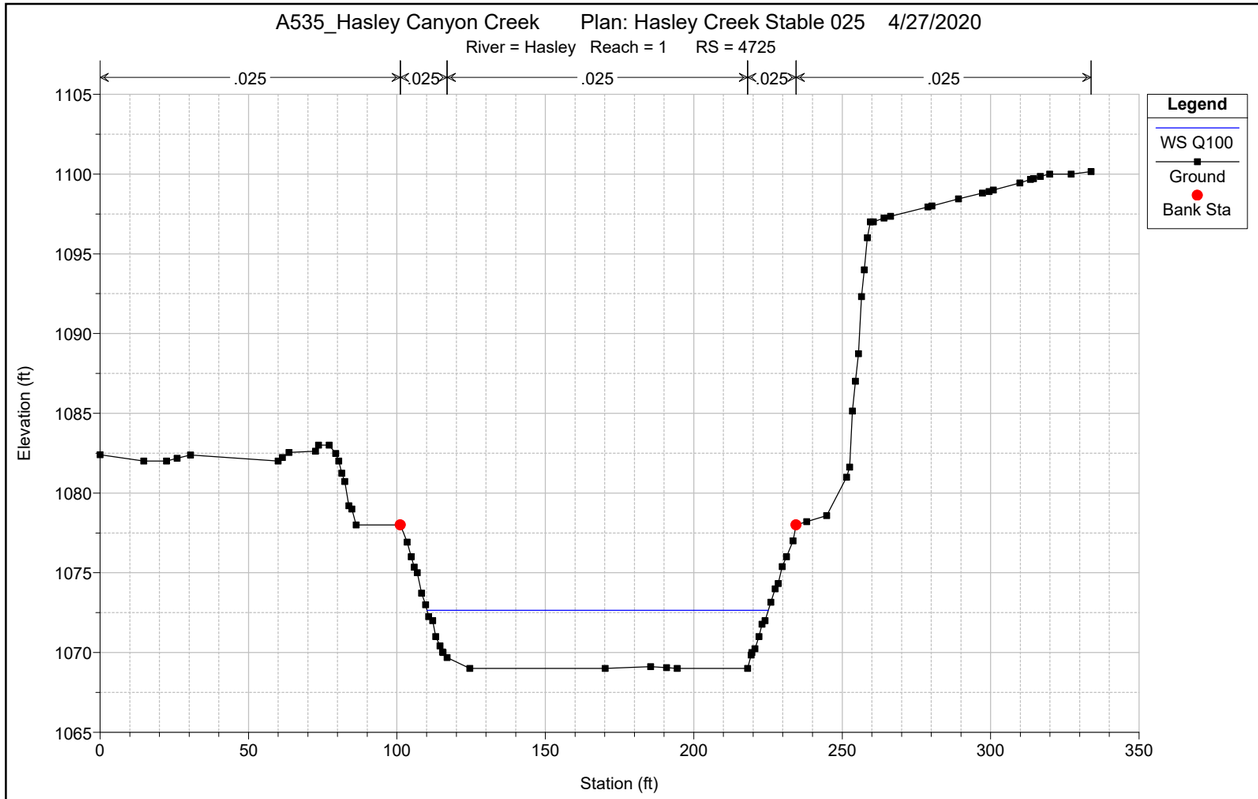
Output Summary Table - Stable Slope

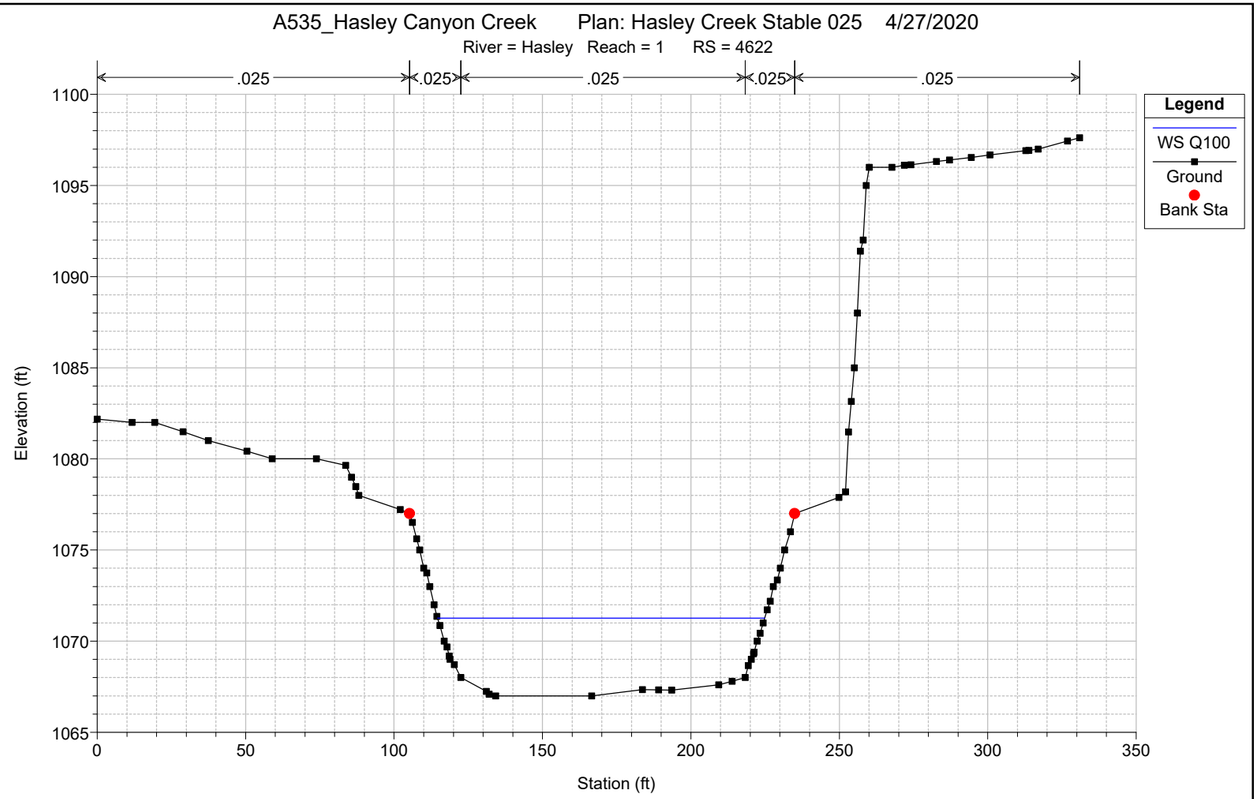
HEC-RAS Plan: Stable_025 River: Hasley Reach: 1 Profile: Q100

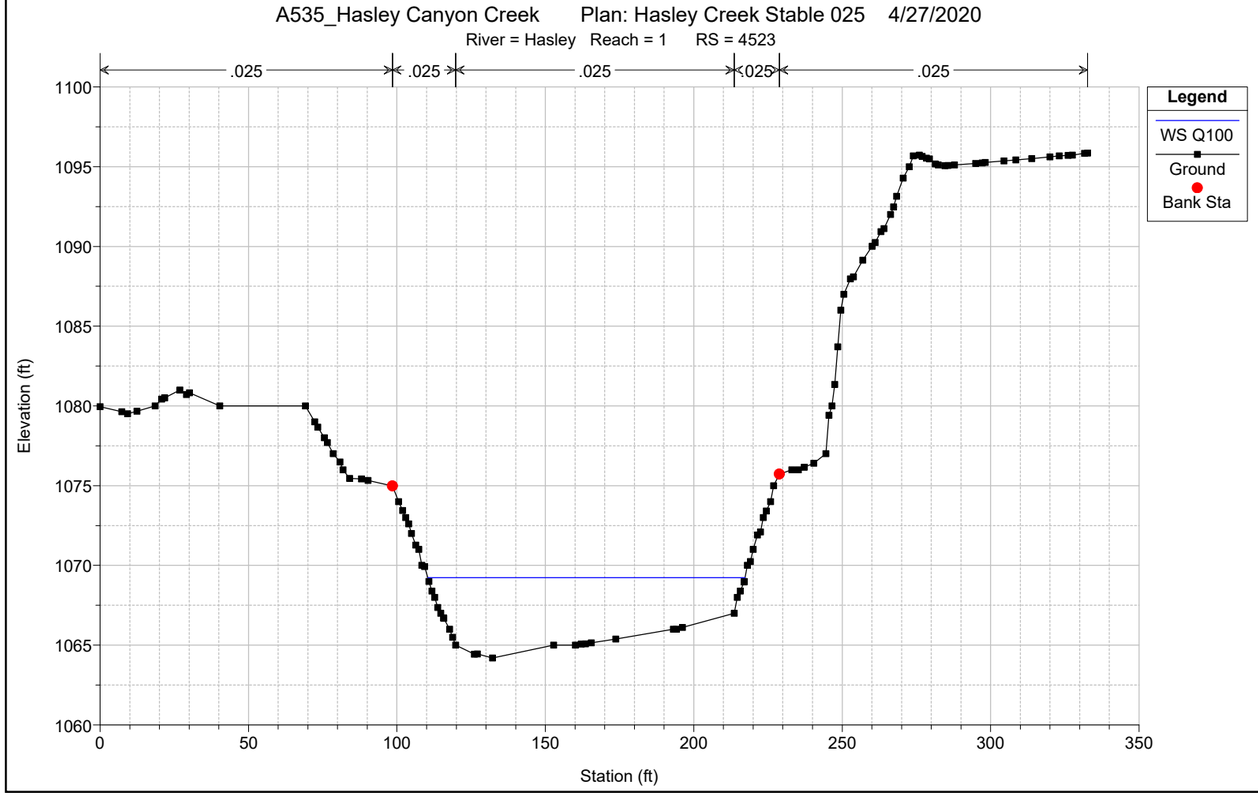
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	4725	Q100	7000.00	1069.00	1072.65	1074.18	1077.69	0.018505	18.02	388.49	114.94	1.73
1	4622	Q100	7000.00	1067.00	1071.26	1072.62	1075.86	0.014973	17.21	406.76	110.15	1.58
1	4523	Q100	7000.00	1064.20	1069.23	1070.76	1074.25	0.016649	17.97	389.57	106.87	1.66
1	4396	Q100	7000.00	1059.45	1062.82	1065.18	1071.05	0.032855	23.01	304.15	95.37	2.27
1	4300	Q100	7000.00	1039.45	1042.64	1047.04	1065.21	0.101320	38.11	183.68	62.32	3.91
1	4282	Q100	7000.00	1033.45	1036.56	1041.22	1062.83	0.122410	41.11	170.26	59.36	4.28
1	4276	Q100	7000.00	1033.45	1035.56	1039.08	1055.93	0.145947	36.21	193.34	94.74	4.47
1	4270	Q100	7000.00	1033.45	1042.73	1037.30	1043.02	0.000315	4.34	1612.59	187.77	0.26
1	4265	Q100	7000.00	1037.00	1041.64	1040.87	1042.91	0.003242	9.06	772.57	173.56	0.76
1	4258	Q100	7000.00	1037.00	1041.79	1040.67	1042.81	0.002450	8.07	867.81	188.29	0.66
1	4248.79	Q100	7000.00	1032.40	1042.37	1035.95	1042.55	0.000186	3.48	2012.08	221.45	0.20
1	4157	Q100	7000.00	1031.84	1042.42	1034.79	1042.52	0.000090	2.57	2726.24	273.60	0.14
1	4055.5	Q100	7000.00	1030.71	1041.07	1040.84	1042.37	0.005717	9.13	766.92	257.66	0.93
1	3940.5	Q100	7000.00	1029.75	1040.43	1040.43	1041.76	0.006783	9.26	756.04	281.25	1.00
1	3844	Q100	7000.00	1028.59	1036.58	1037.90	1040.29	0.019390	15.46	452.76	173.26	1.69
1	3747	Q100	7000.00	1027.62	1034.51	1036.11	1038.48	0.017683	15.99	437.67	148.90	1.64
1	3650	Q100	7000.00	1026.64	1035.22	1035.32	1036.64	0.007545	9.55	733.10	286.78	1.05
1	3554	Q100	7000.00	1025.64	1030.99	1032.25	1035.15	0.022246	16.36	427.77	164.74	1.79
1	3440.5	Q100	7000.00	1024.49	1029.95	1031.02	1032.95	0.012328	13.88	504.50	162.37	1.39
1	3372	Q100	7000.00	1023.77	1029.58	1030.12	1031.93	0.010821	12.31	568.84	198.05	1.28
1	3304	Q100	7000.00	1023.14	1027.68	1028.63	1030.84	0.025632	14.26	490.79	265.89	1.85
1	3190.5	Q100	7000.00	1022.00	1026.45	1026.98	1028.63	0.011798	11.84	591.30	236.86	1.32
1	3167.29	Q100	7000.00	1010.40	1025.94	1015.12	1026.06	0.000088	2.72	2570.87	234.40	0.14
1	3105	Q100	7000.00	1009.98	1024.59	1019.21	1025.92	0.001703	9.25	756.74	84.69	0.55
1	3020	Q100	7000.00	1009.27	1024.73	1019.26	1025.63	0.002012	7.59	922.45	168.71	0.57
1	2934	Q100	7000.00	1008.60	1023.18	1023.18	1025.23	0.006452	11.51	608.30	147.11	1.00
1	2820.5	Q100	7000.00	1007.69	1016.50	1019.46	1023.75	0.011537	21.60	324.13	42.64	1.38
1	2748	Q100	7000.00	1007.11	1017.22	1018.57	1021.72	0.026715	17.03	411.14	160.86	1.88
1	2675.5	Q100	7000.00	1006.43	1016.23	1017.19	1019.81	0.014121	15.16	461.64	121.36	1.37
1	2560.5	Q100	7000.00	1005.68	1017.19	1017.19	1018.56	0.006870	9.39	745.86	269.93	1.00
1	2476	Q100	7000.00	1004.94	1012.55	1014.36	1017.26	0.017130	17.41	401.96	113.25	1.63
1	2391	Q100	7000.00	1004.26	1013.29	1013.72	1015.32	0.010679	11.43	612.59	234.88	1.25
1	2305.5	Q100	7000.00	1003.68	1013.49	1012.24	1014.29	0.002153	7.18	974.76	227.79	0.61
1	2250		Bridge									
1	2190.5	Q100	7000.00	1002.89	1010.58	1010.58	1012.21	0.006281	10.24	683.79	209.05	1.00
1	2122	Q100	7000.00	1002.22	1008.11	1009.00	1011.15	0.017432	13.98	500.55	207.90	1.59
1	2054	Q100	7000.00	1001.60	1007.39	1008.02	1009.83	0.012529	12.52	558.91	213.35	1.36
1	1940.5	Q100	7000.00	1000.87	1005.20	1006.14	1008.38	0.018786	14.29	489.72	209.97	1.65
1	1872	Q100	7000.00	1000.19	1004.83	1005.24	1006.92	0.009796	11.60	603.66	217.02	1.23
1	1804	Q100	7000.00	999.65	1002.79	1003.72	1005.93	0.018661	14.21	492.71	212.19	1.64
1	1801.25	Q100	7000.00	994.49	999.24	1001.82	1005.55	0.016938	20.15	347.44	73.16	1.63
1	1688.62	Q100	7000.00	993.63	996.60	998.85	1003.03	0.029278	20.33	344.25	115.98	2.08
1	1584	Q100	7000.00	992.83	995.61	997.34	999.92	0.021067	16.65	420.42	151.48	1.76
1	1501	Q100	7000.00	992.16	997.47	997.47	998.80	0.006667	9.25	757.08	285.29	1.00
1	1428	Q100	7000.00	991.58	995.29	996.20	997.90	0.018825	12.96	540.03	267.16	1.61
1	1353	Q100	7000.00	990.98	993.60	994.31	995.97	0.034479	12.36	566.14	475.47	2.00

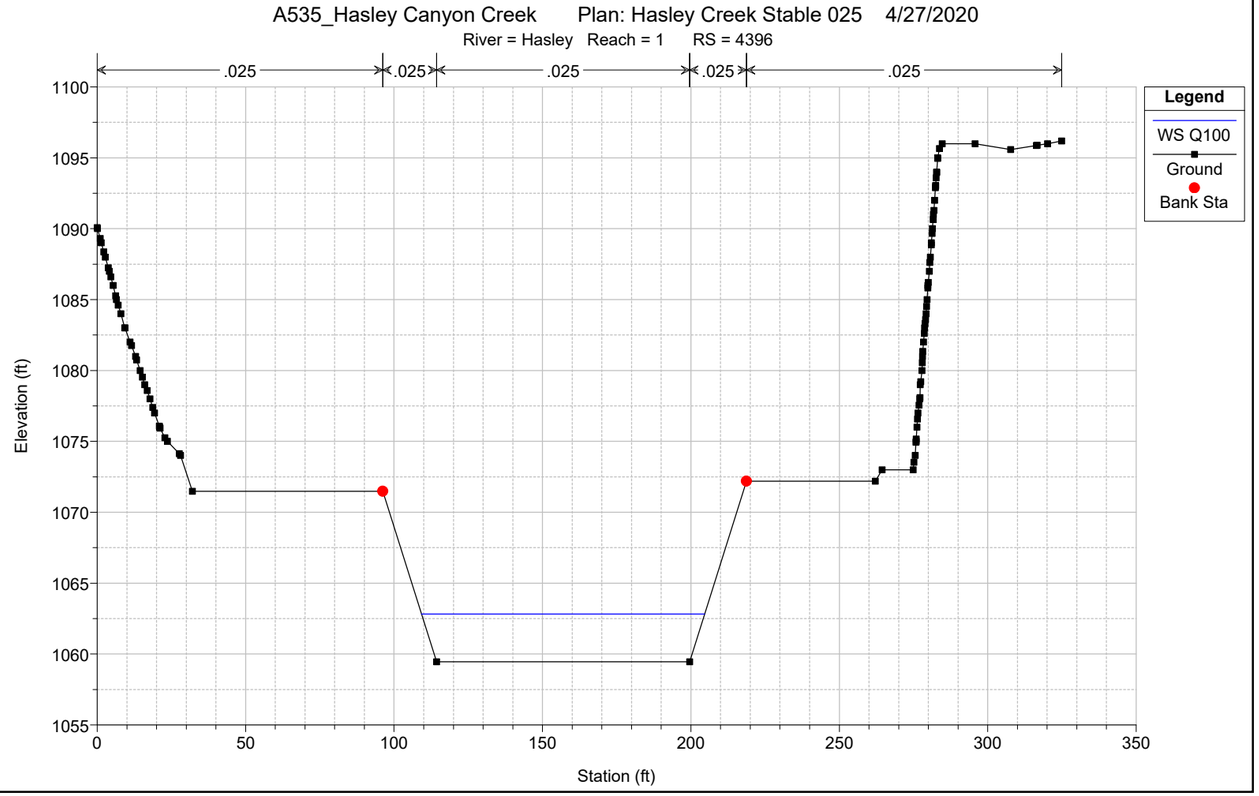
Appendix D: Proposed Condition HEC-RAS Model Results (n=0.025)

Cross Section Plots - Stable Slope


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4725
.025
.025
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1105
1100
1095
1090
1085
1080
1075
1070
1065
0
50
100
150
200
250
300
350

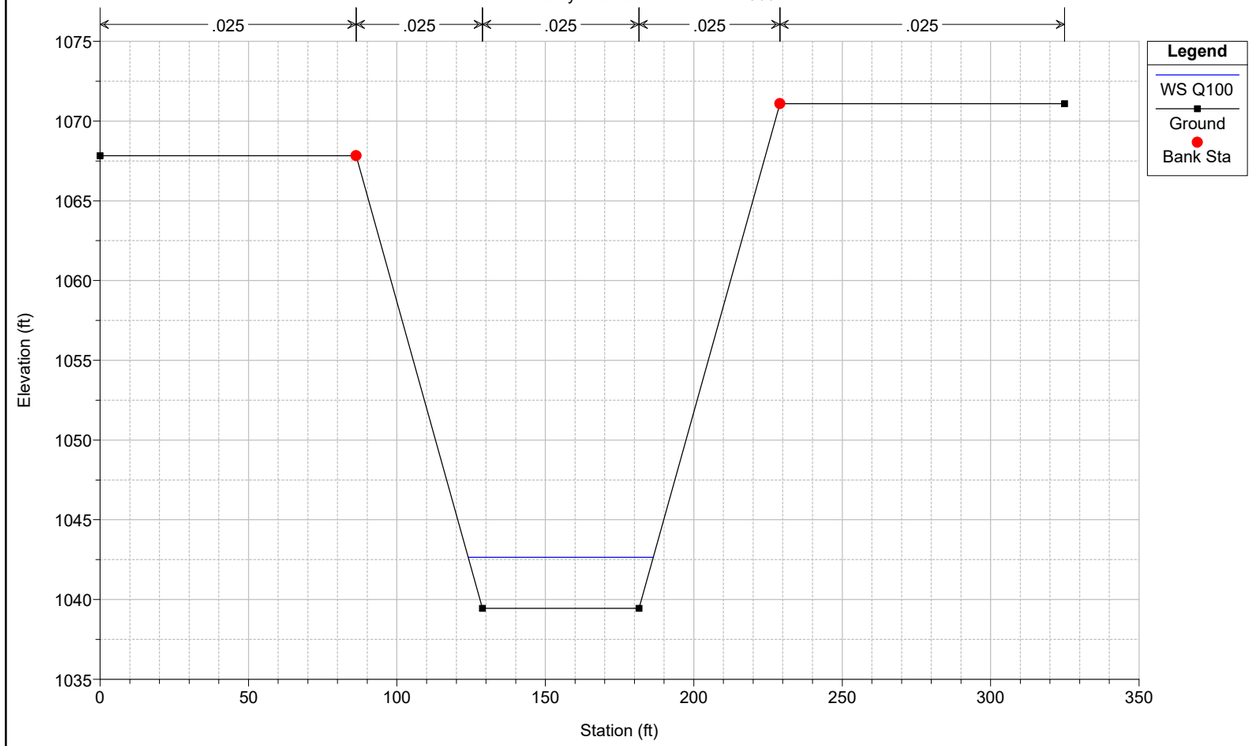

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4622
.025
.025
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1100
1095
1090
1085
1080
1075
1070
1065
0
50
100
150
200
250
300
350


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4523
.025
.025
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1100
1095
1090
1085
1080
1075
1070
1065
1060
0
50
100
150
200
250
300
350


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4396
.025
.025
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1100
1095
1090
1085
1080
1075
1070
1065
1060
1055
0
50
100
150
200
250
300
350

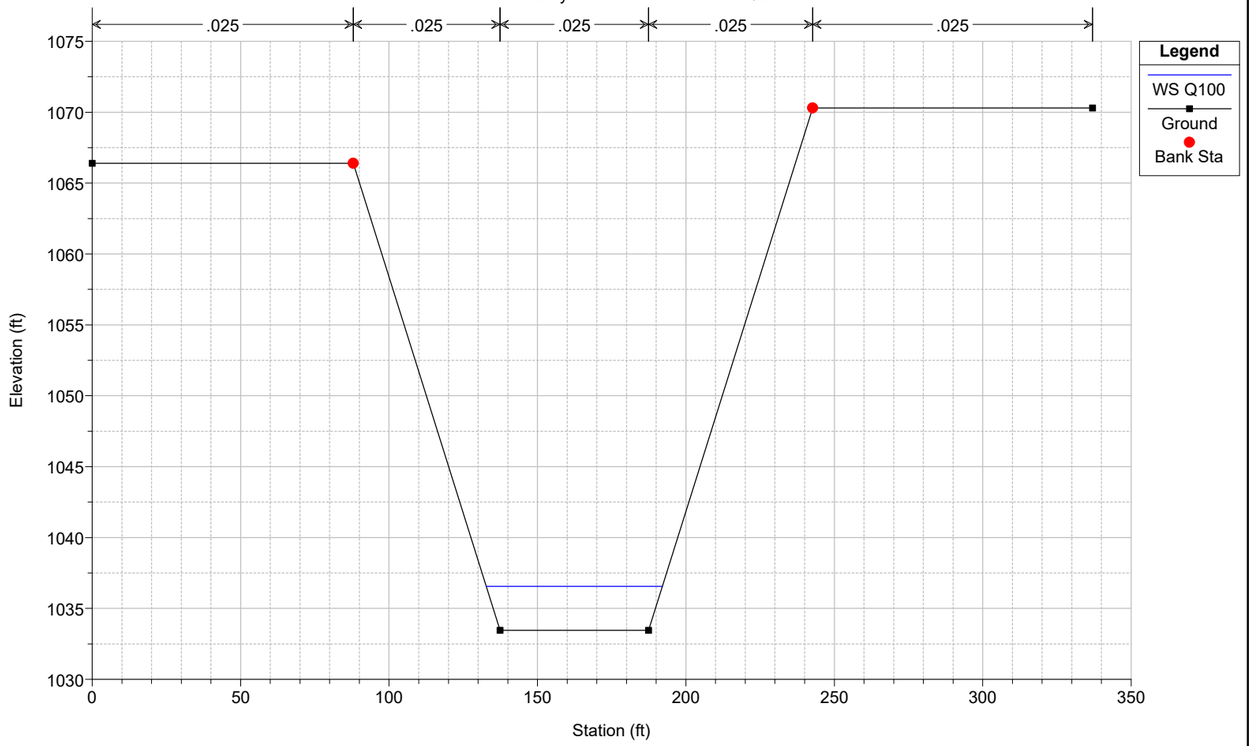
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 4300



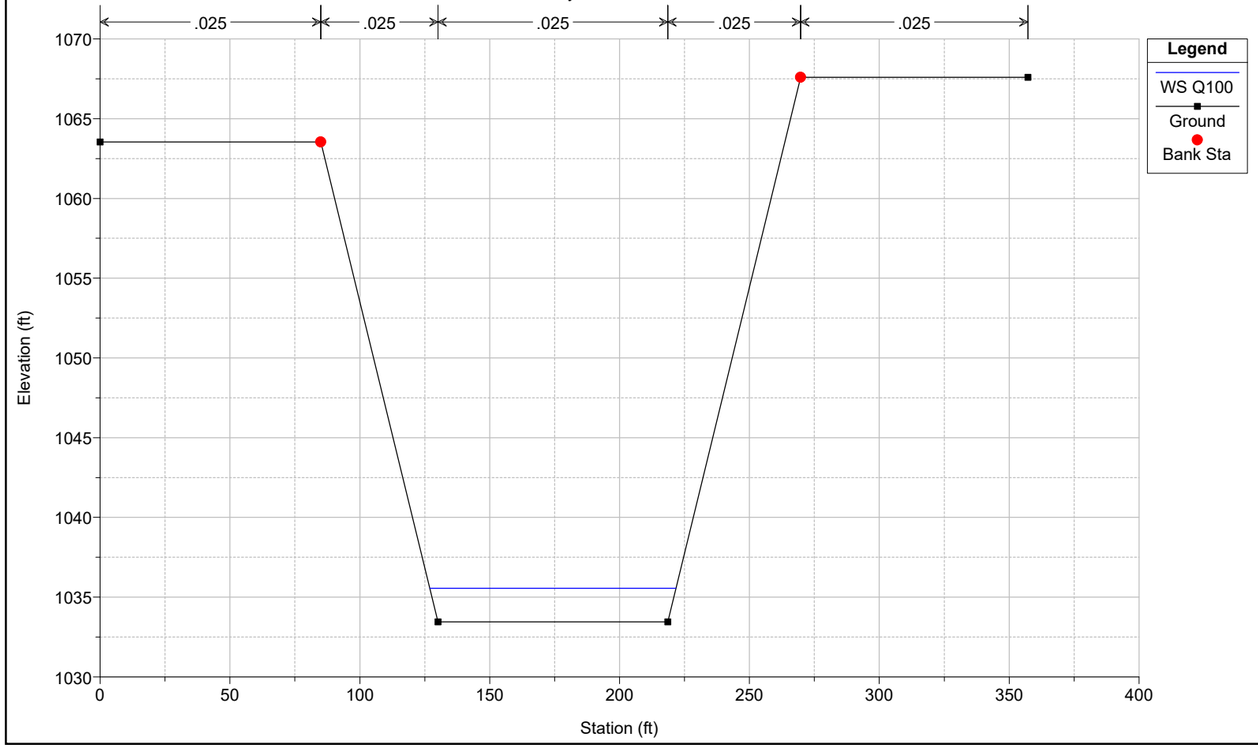
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 4282



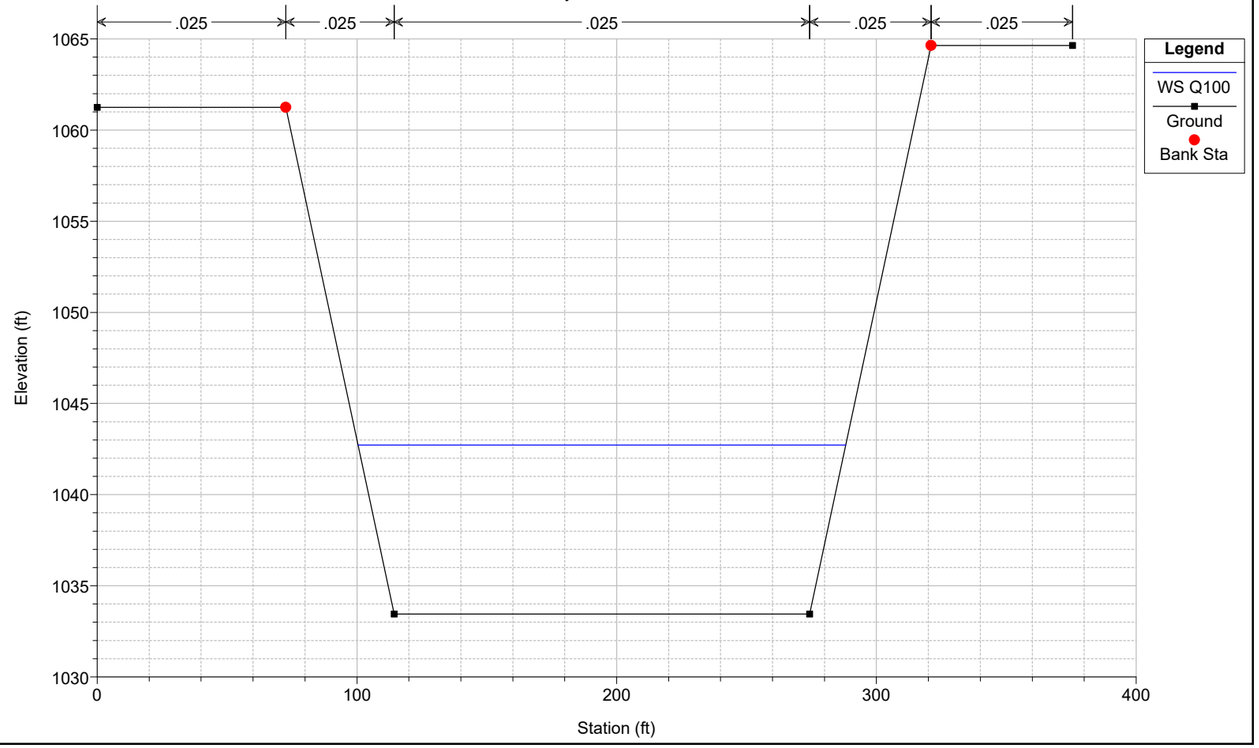
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

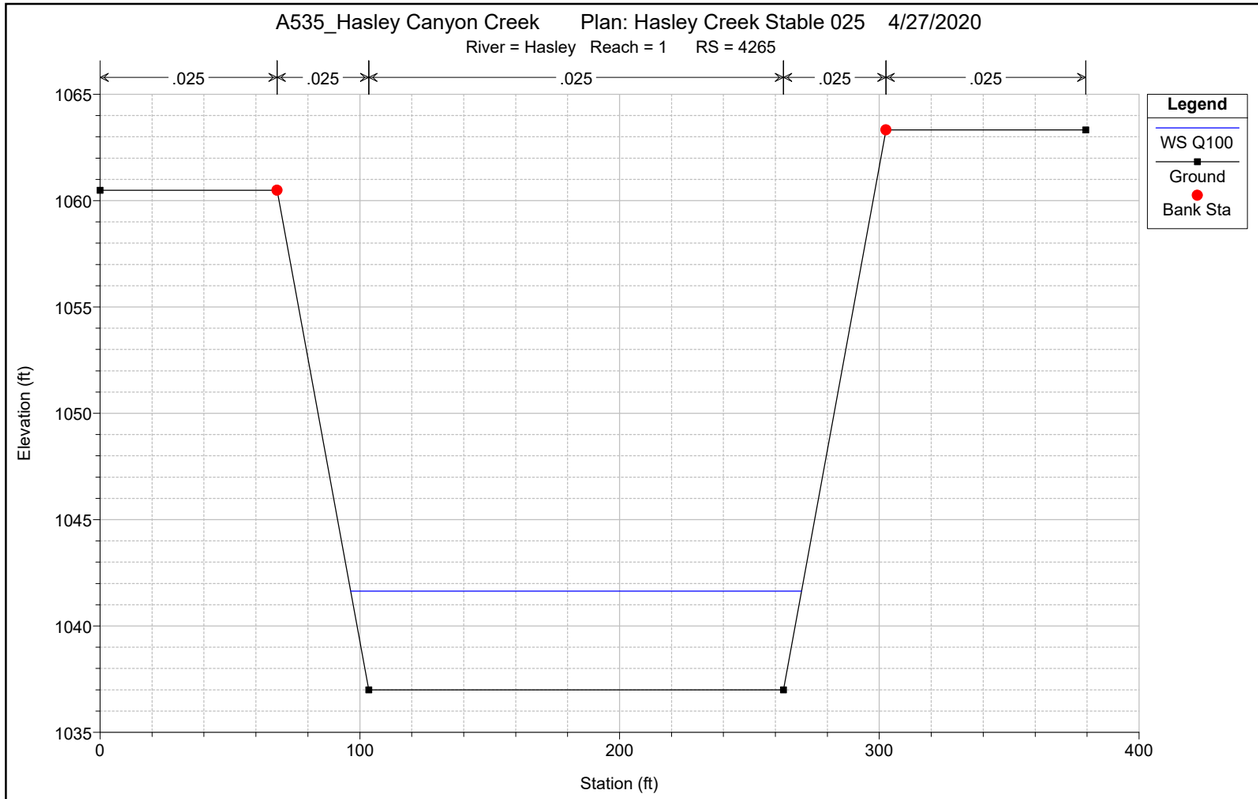
River = Hasley Reach = 1 RS = 4276

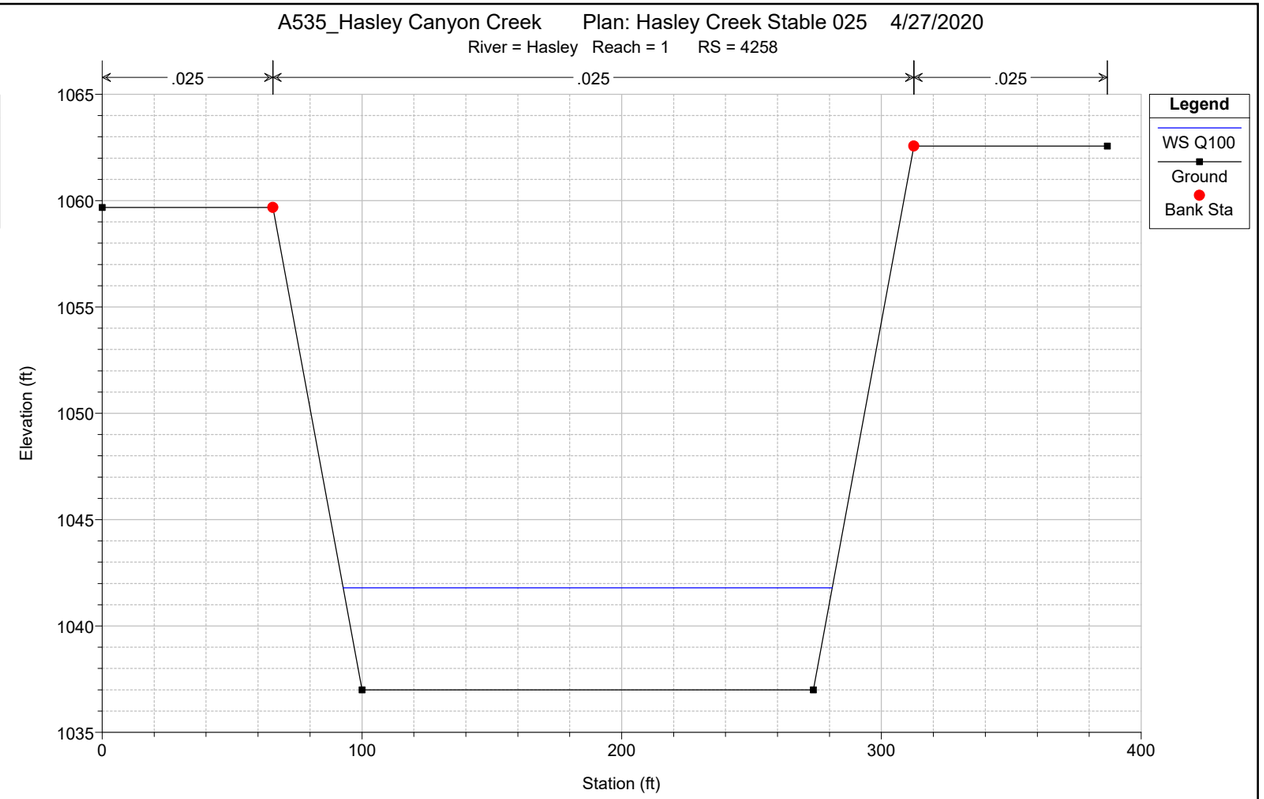


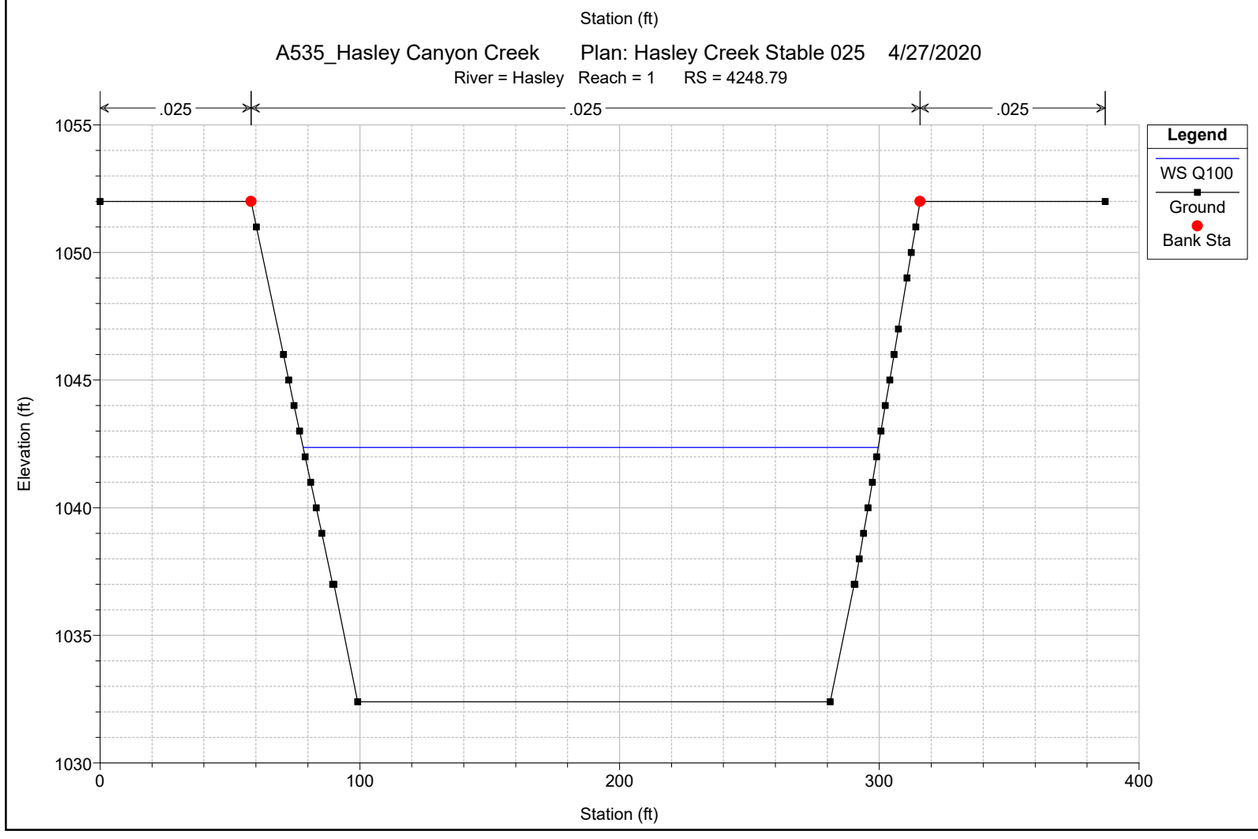
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

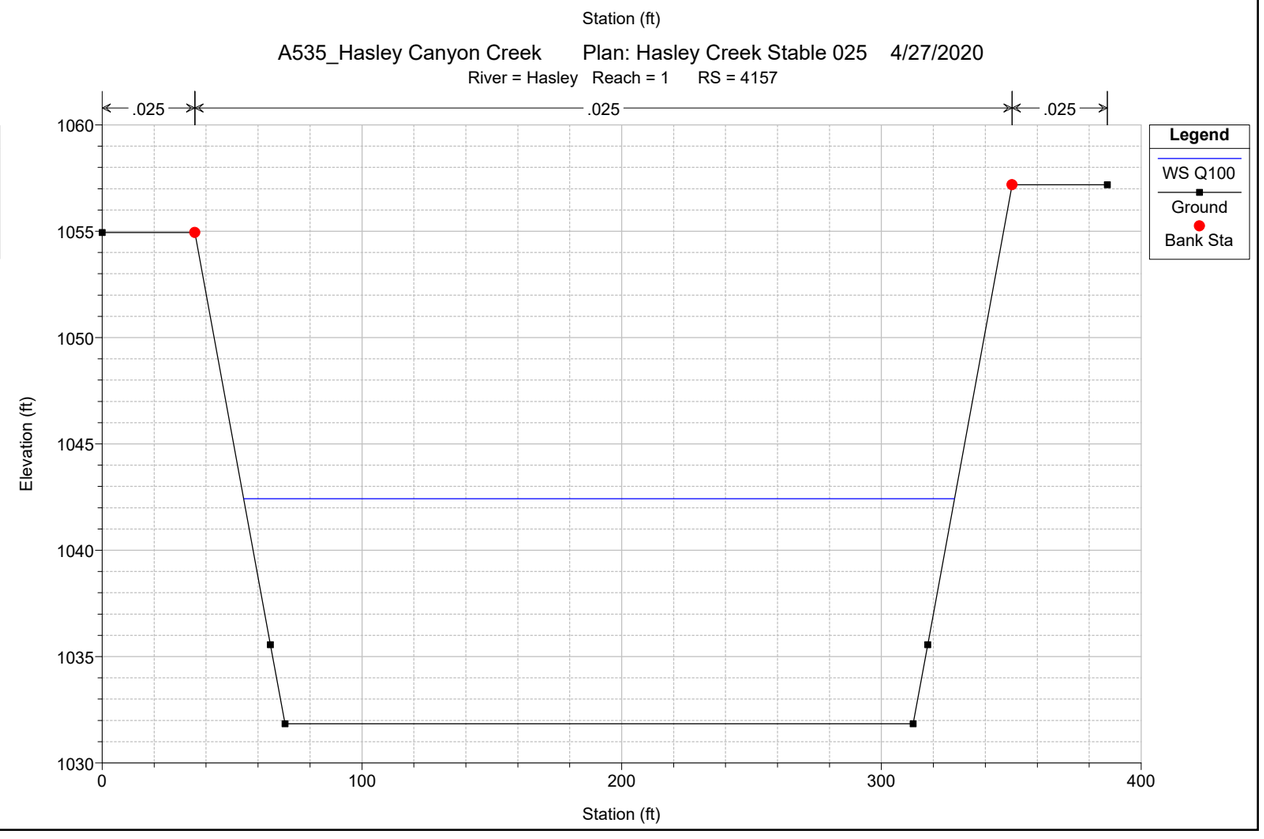
River = Hasley Reach = 1 RS = 4270

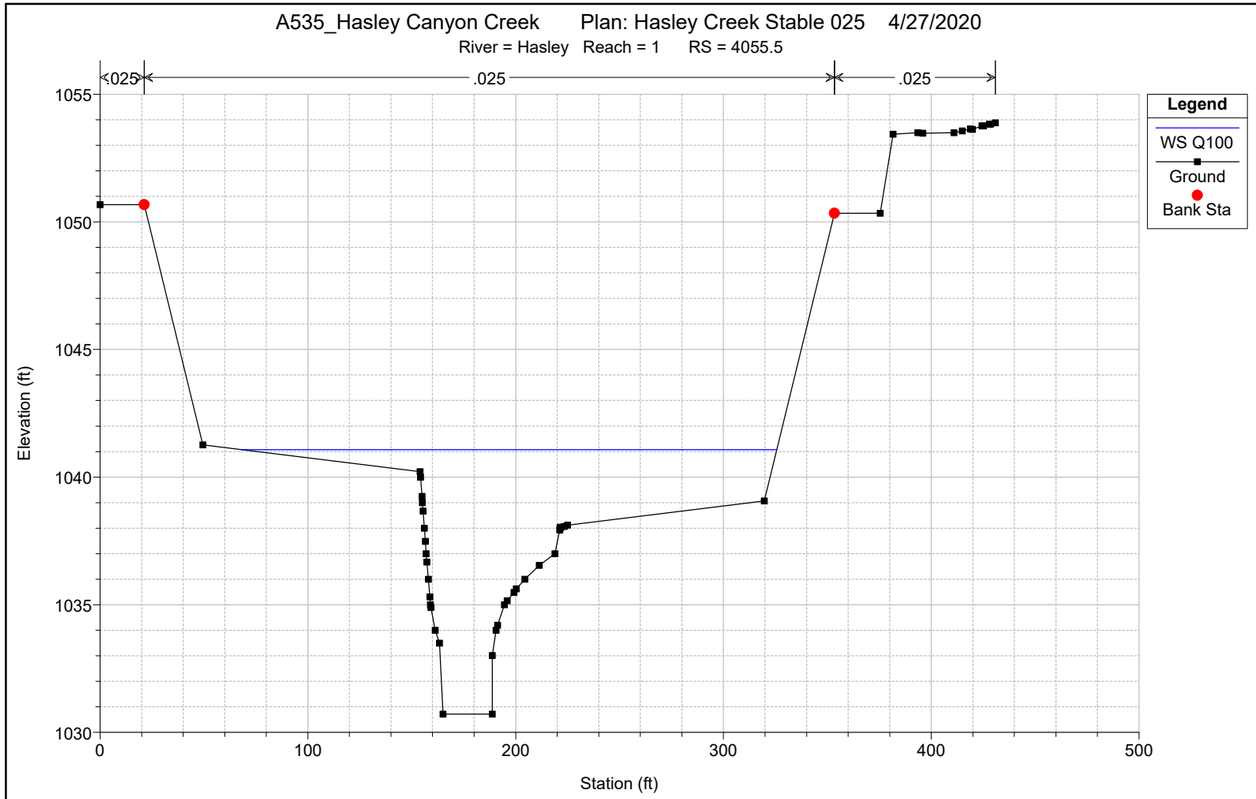


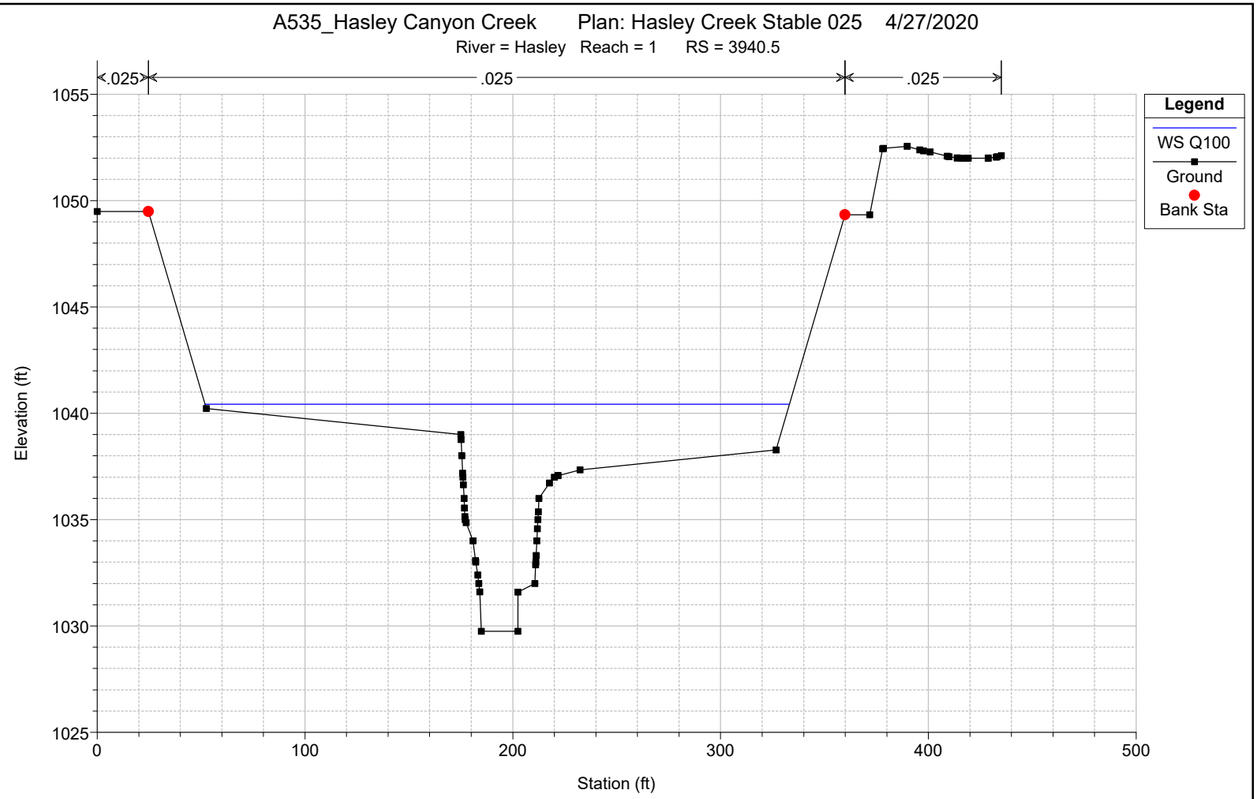

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4265
.025
.025
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1065
1060
1055
1050
1045
1040
1035
0
100
200
300
400

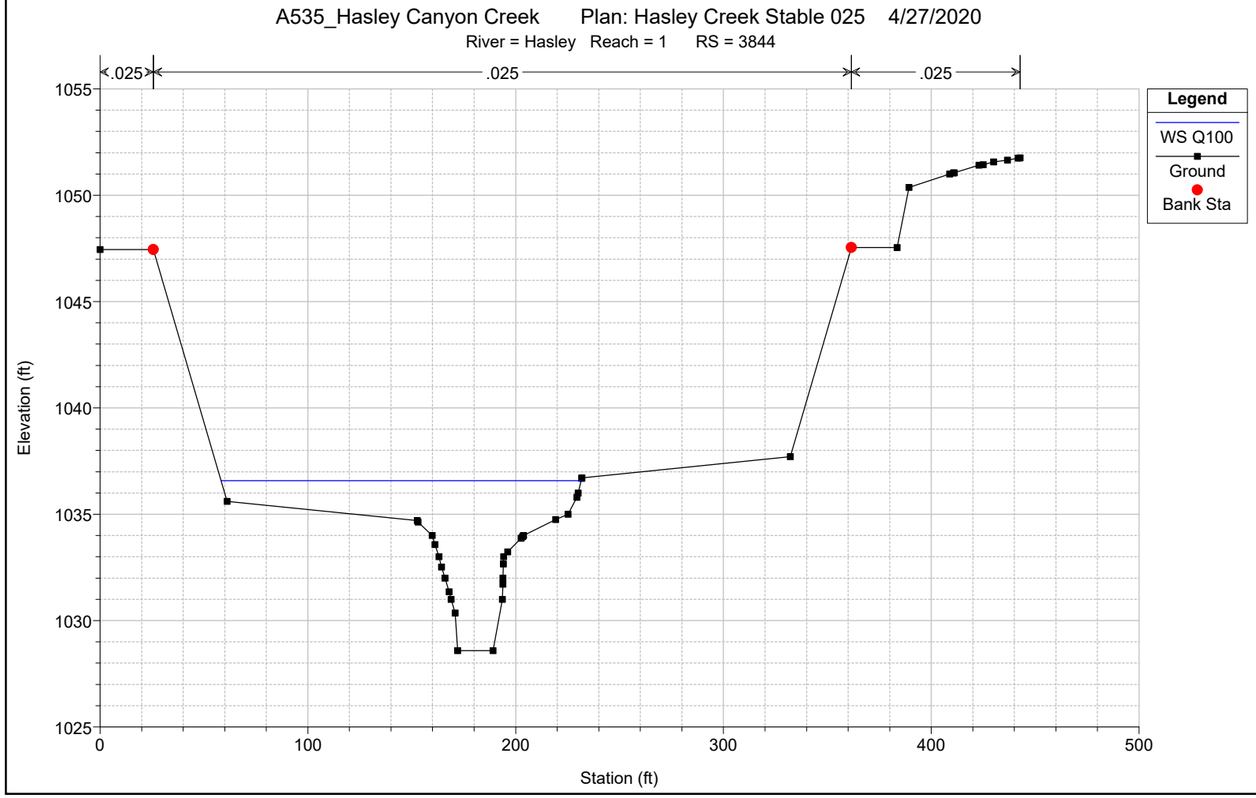

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4258
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1065
1060
1055
1050
1045
1040
1035
0
100
200
300
400

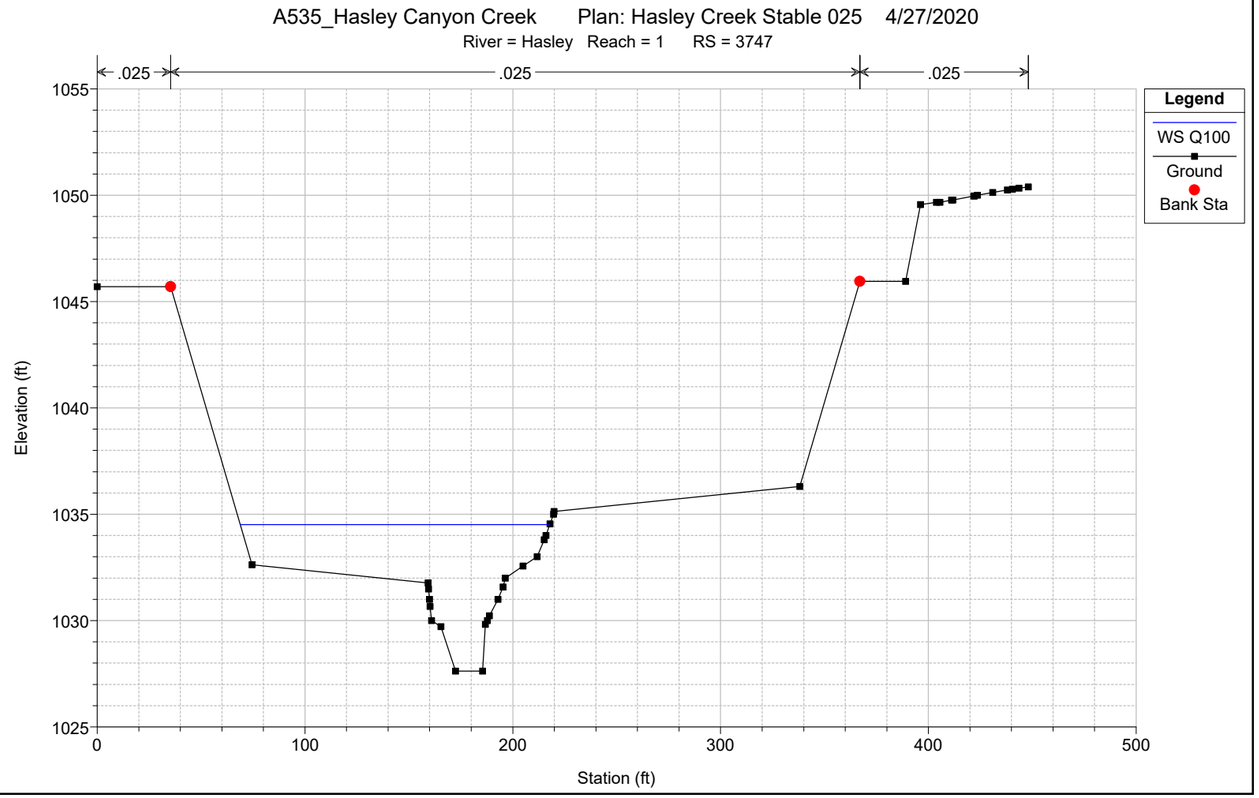

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4248.79
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
0
100
200
300
400

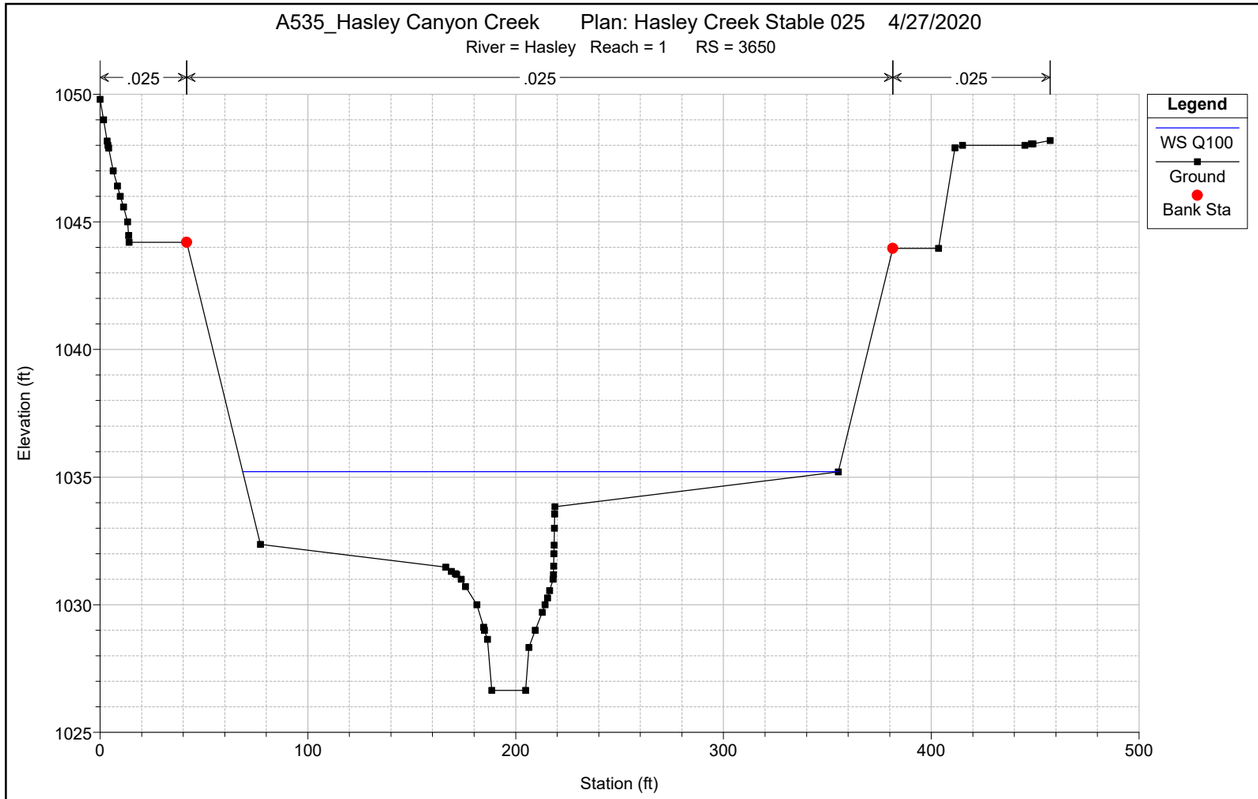

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4157
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1060
1055
1050
1045
1040
1035
1030
0
100
200
300
400

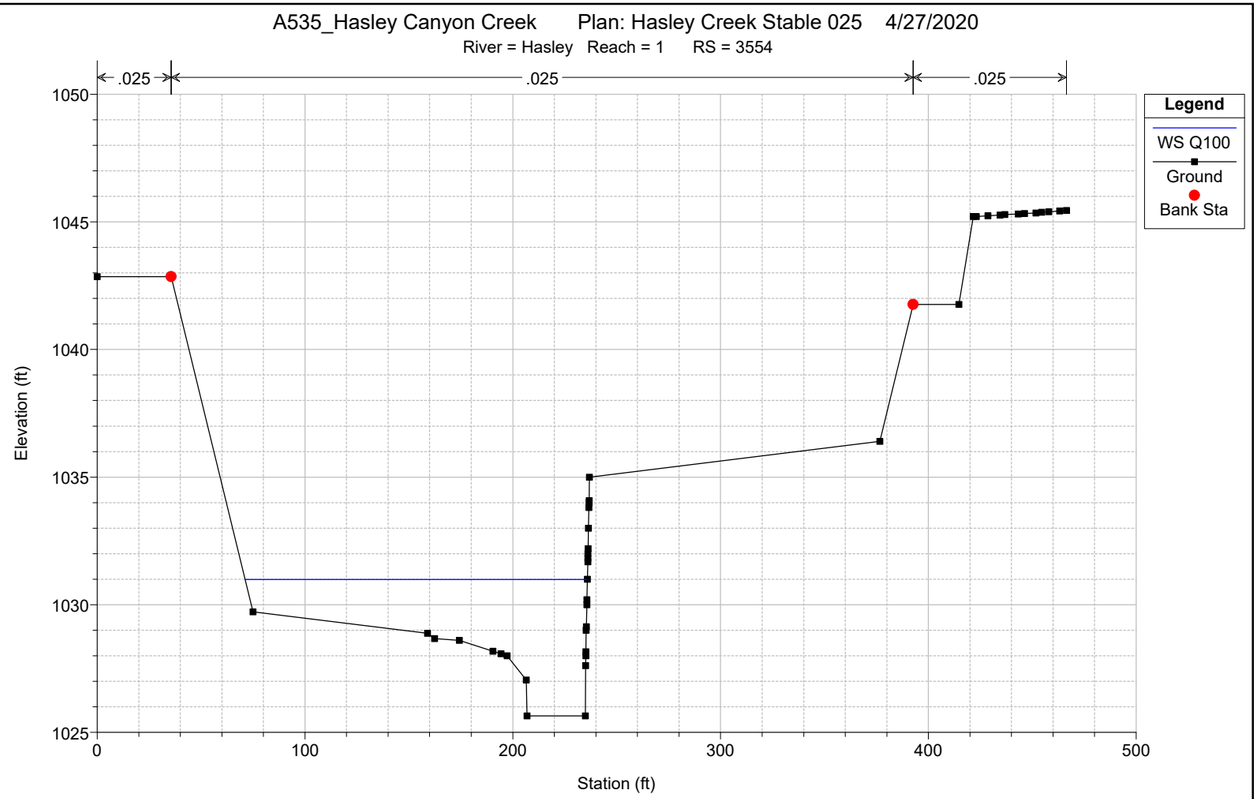

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 4055.5
<.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
0
100
200
300
400
500

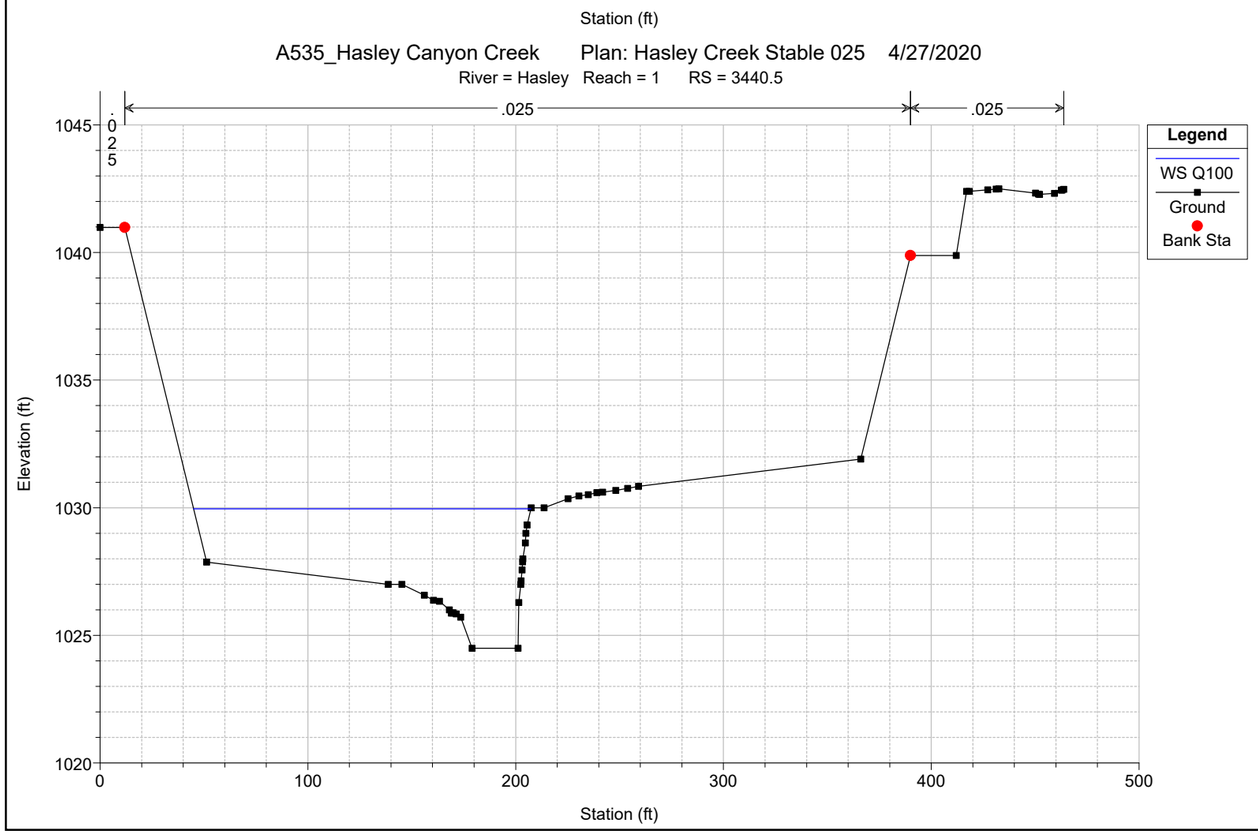

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3940.5
<.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500

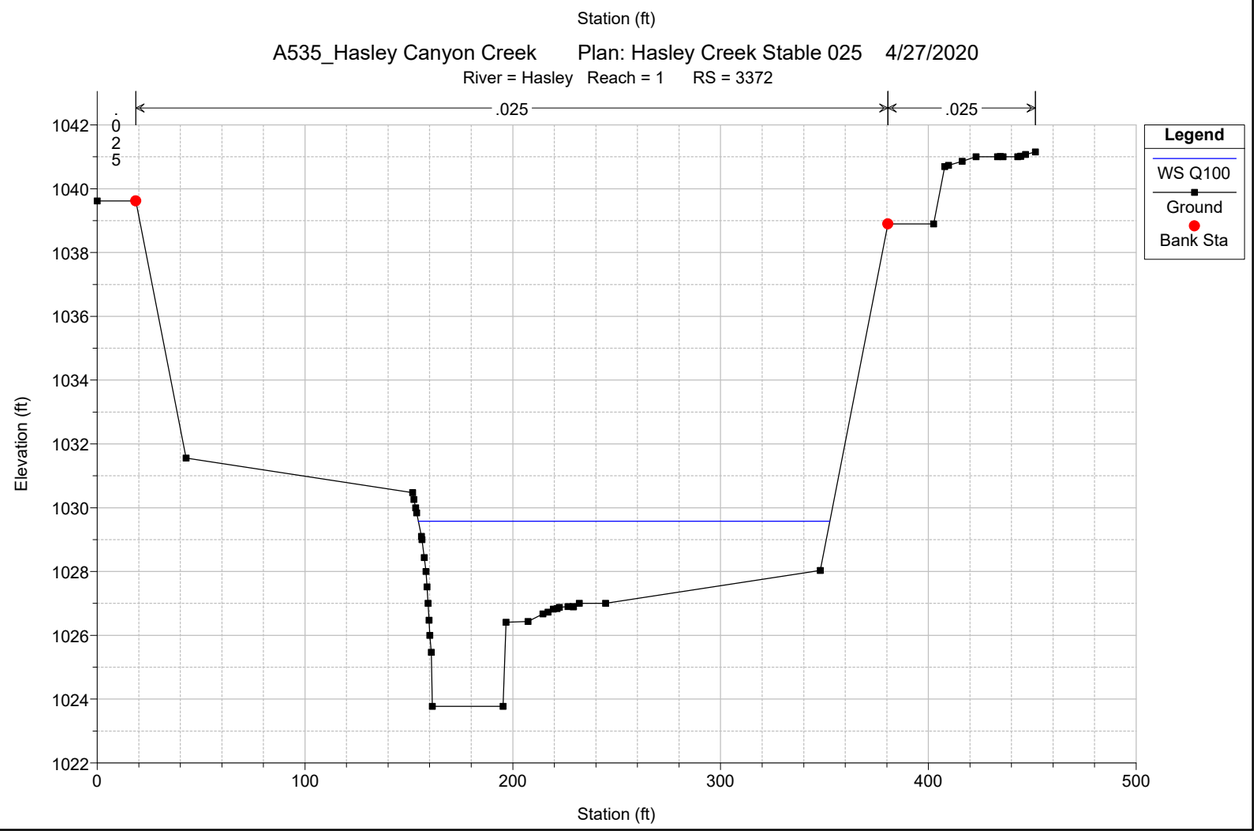

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3844
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3747
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1055
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500

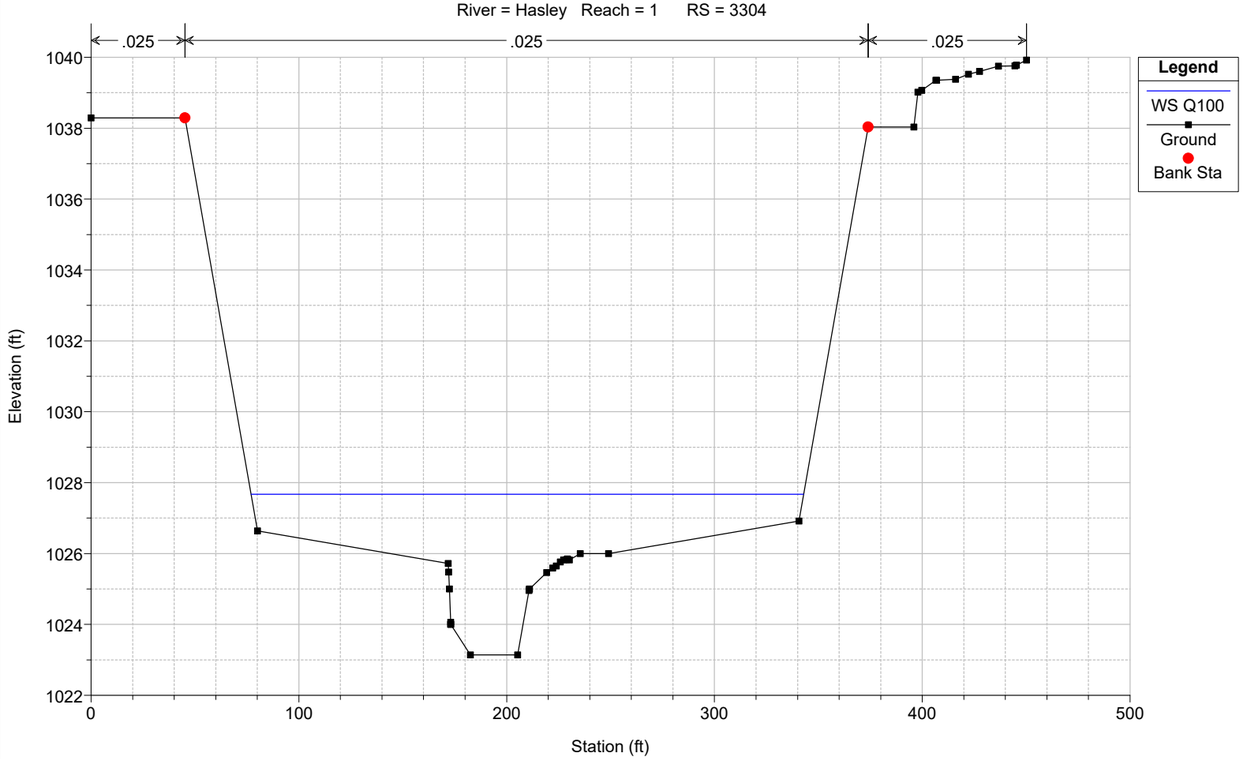

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3650
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3554
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1050
1045
1040
1035
1030
1025
0
100
200
300
400
500

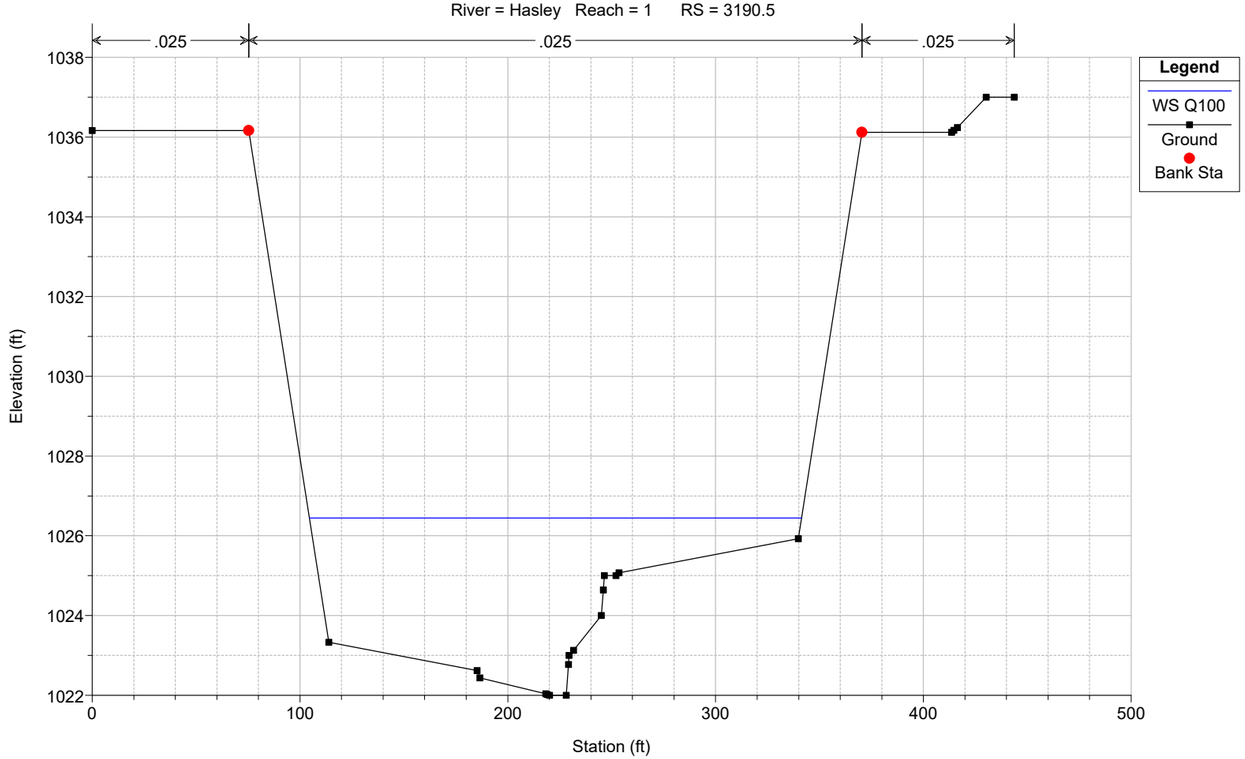

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3440.5
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1045
1040
1035
1030
1025
1020
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3372
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1042
1040
1038
1036
1034
1032
1030
1028
1026
1024
1022
0
100
200
300
400
500

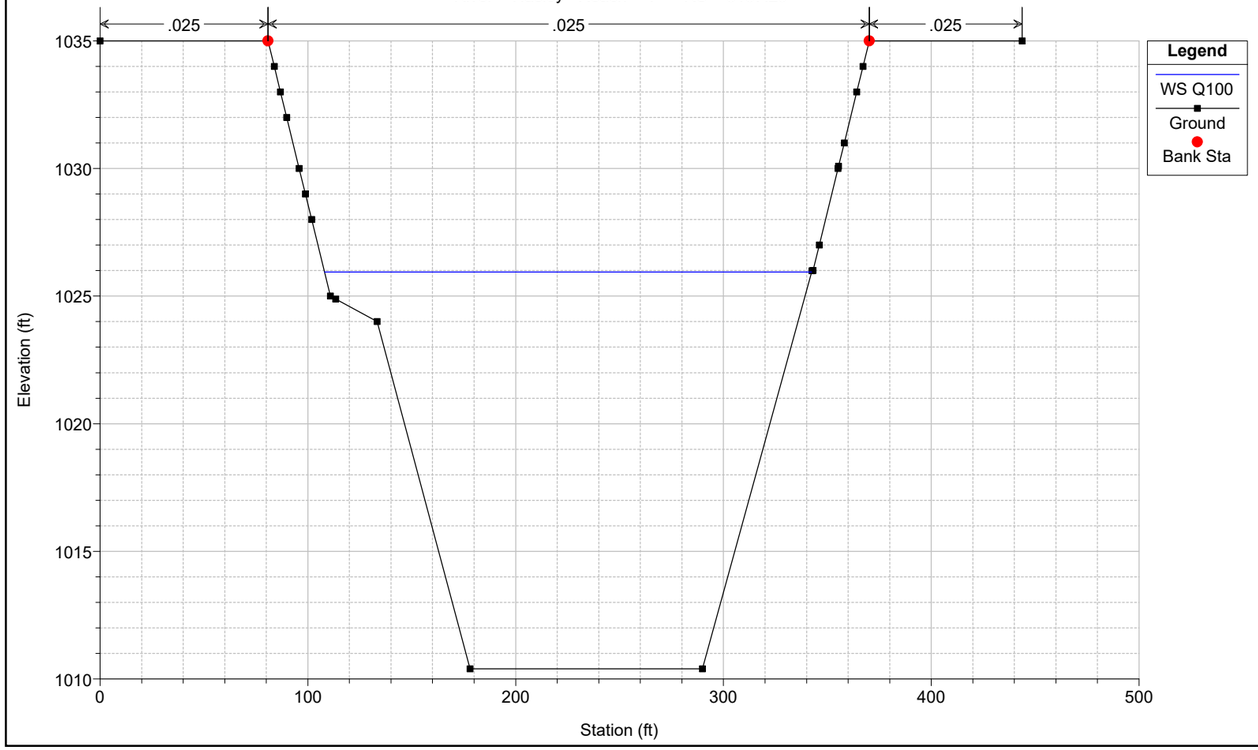
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3304



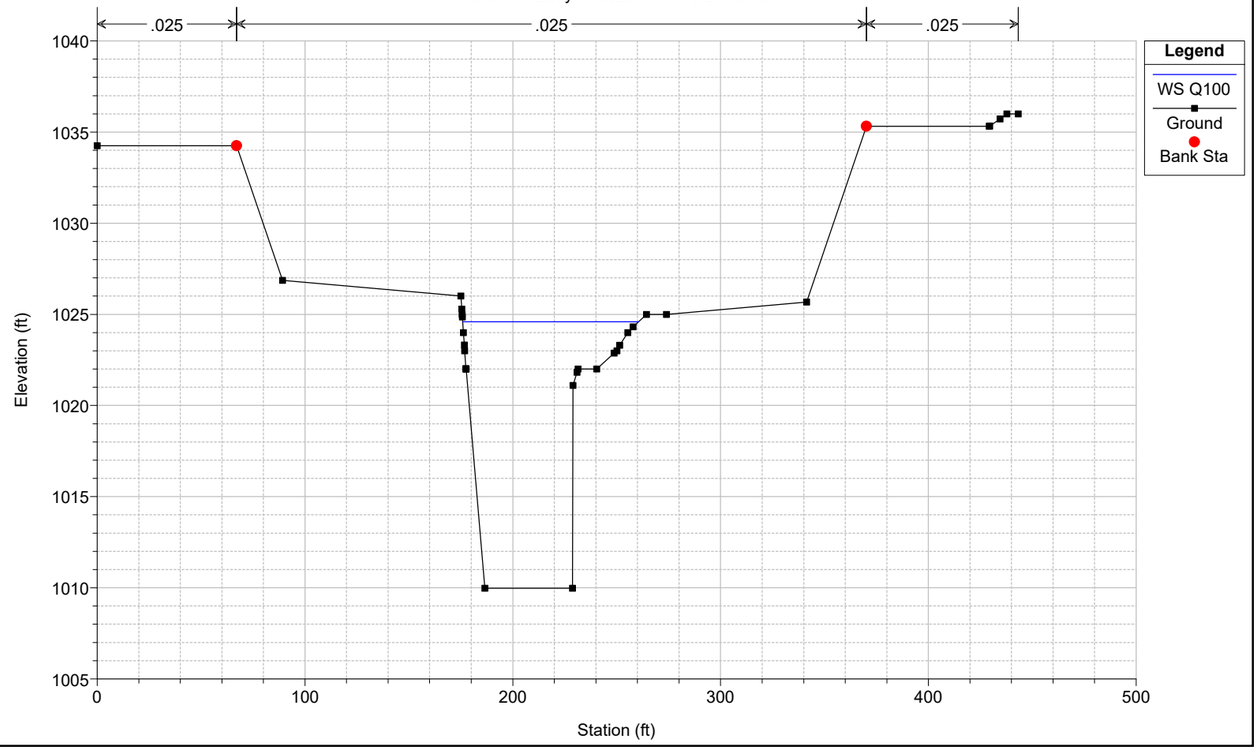
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3190.5

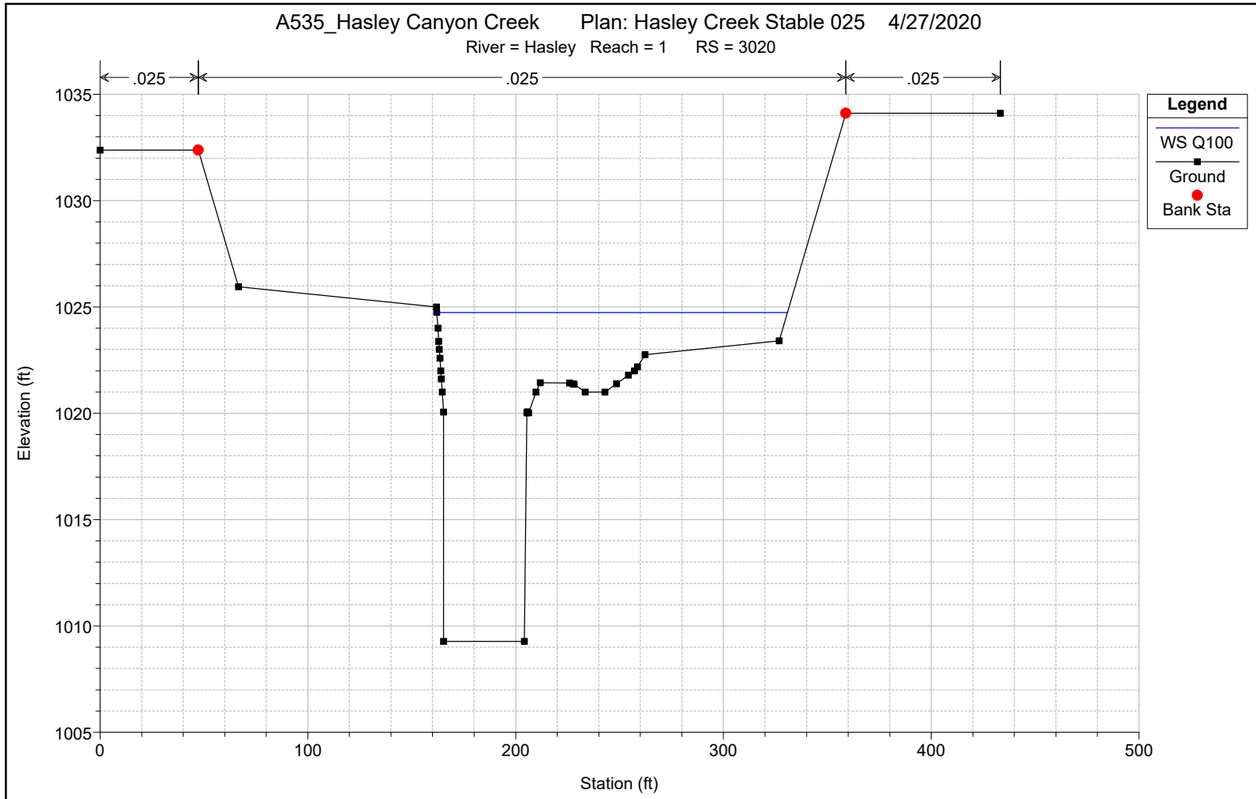


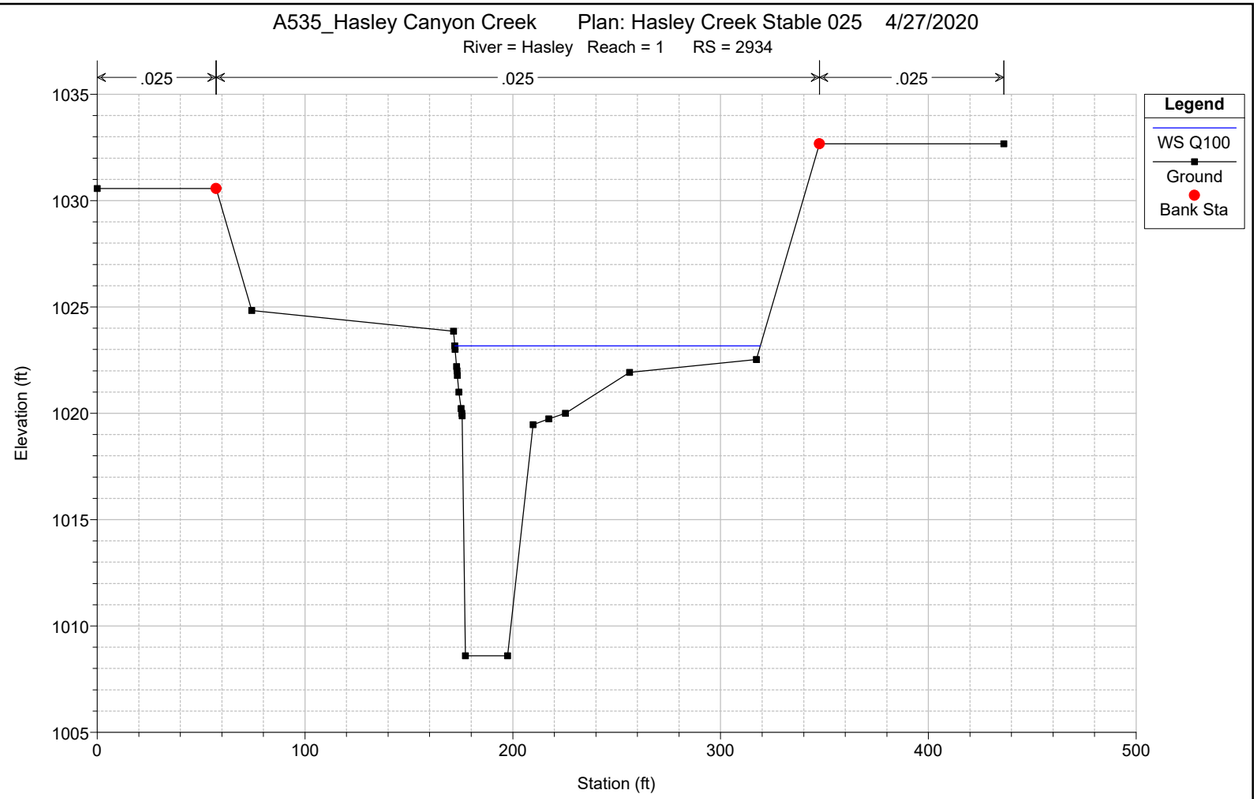
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3167.29

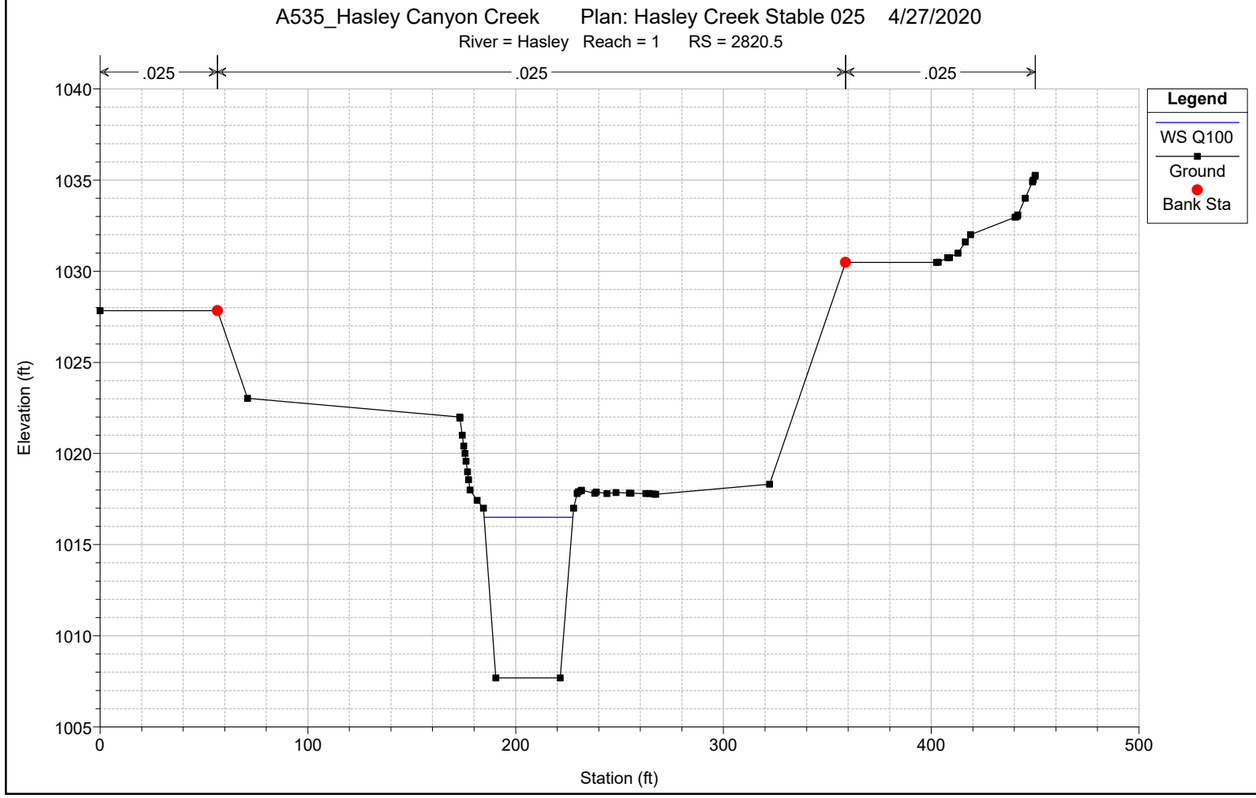


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3105




A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 3020
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1035
1030
1025
1020
1015
1010
1005
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2934
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1035
1030
1025
1020
1015
1010
1005
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2820.5
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
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1035
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1015
1010
1005
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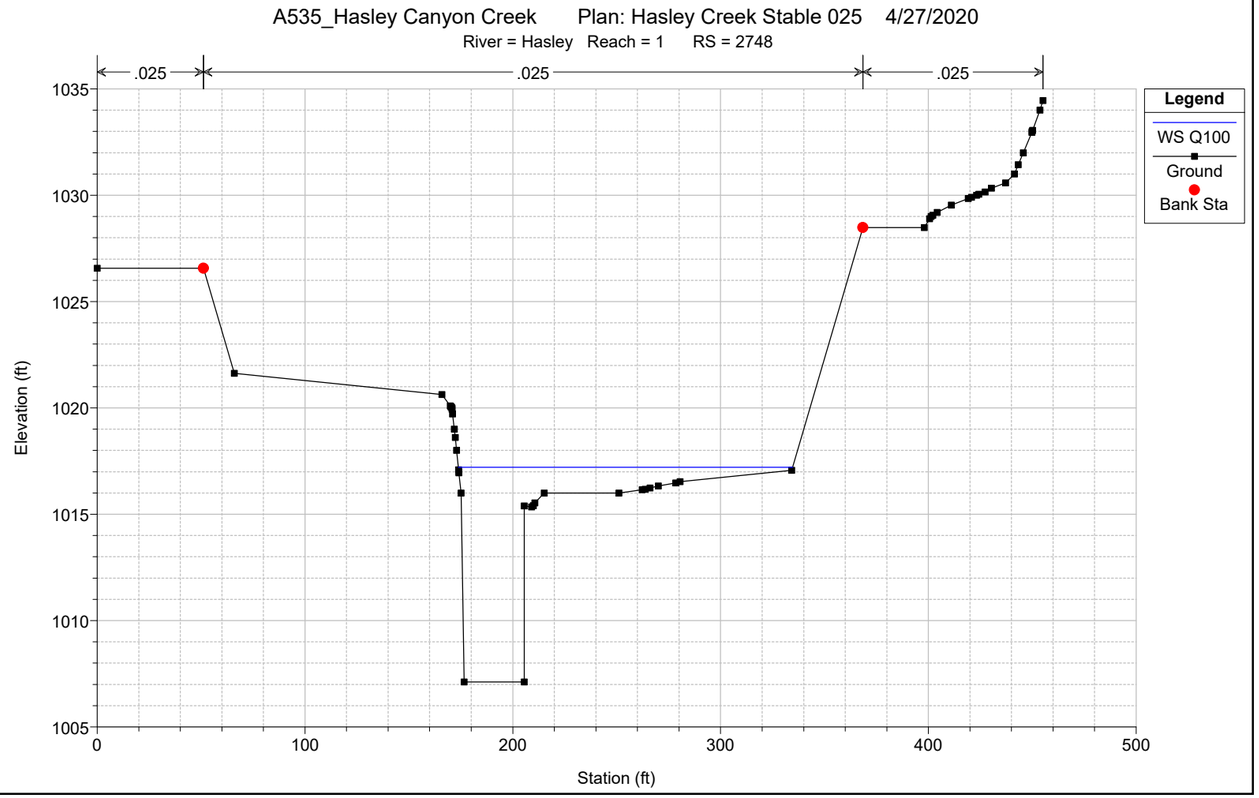
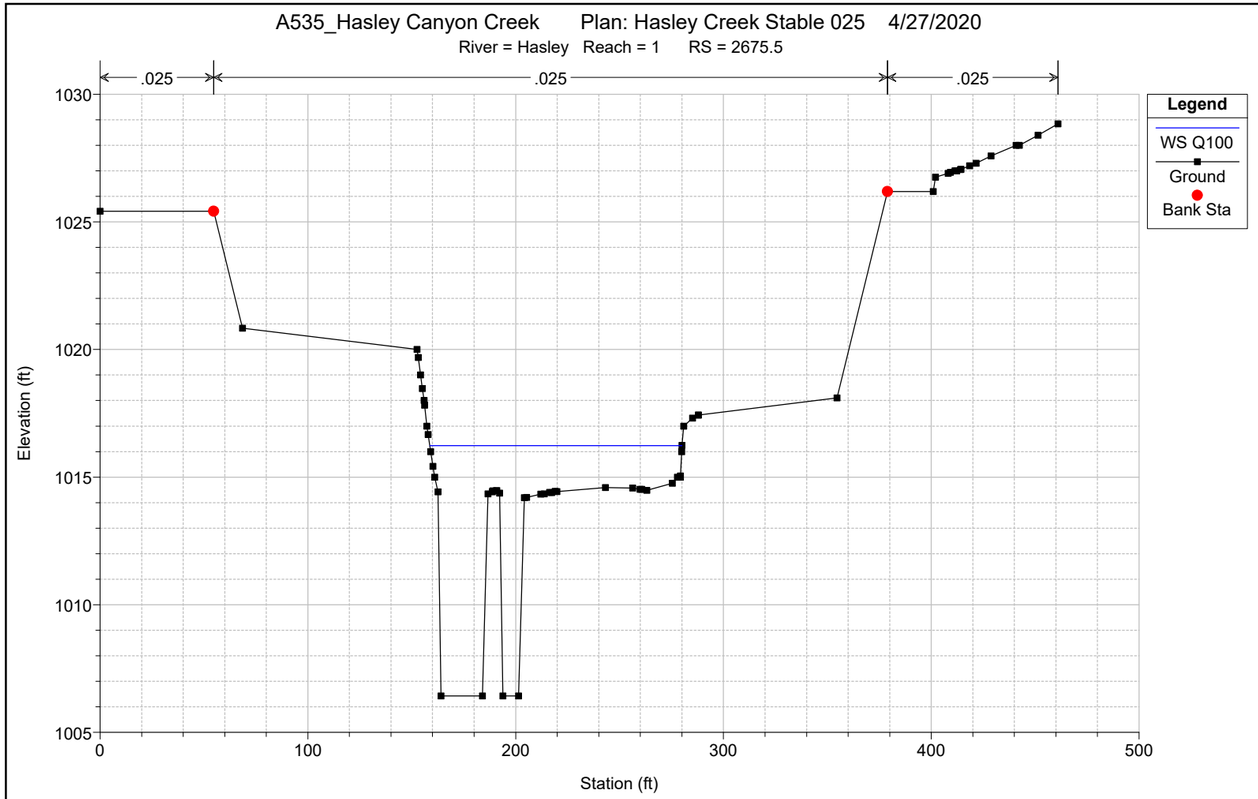
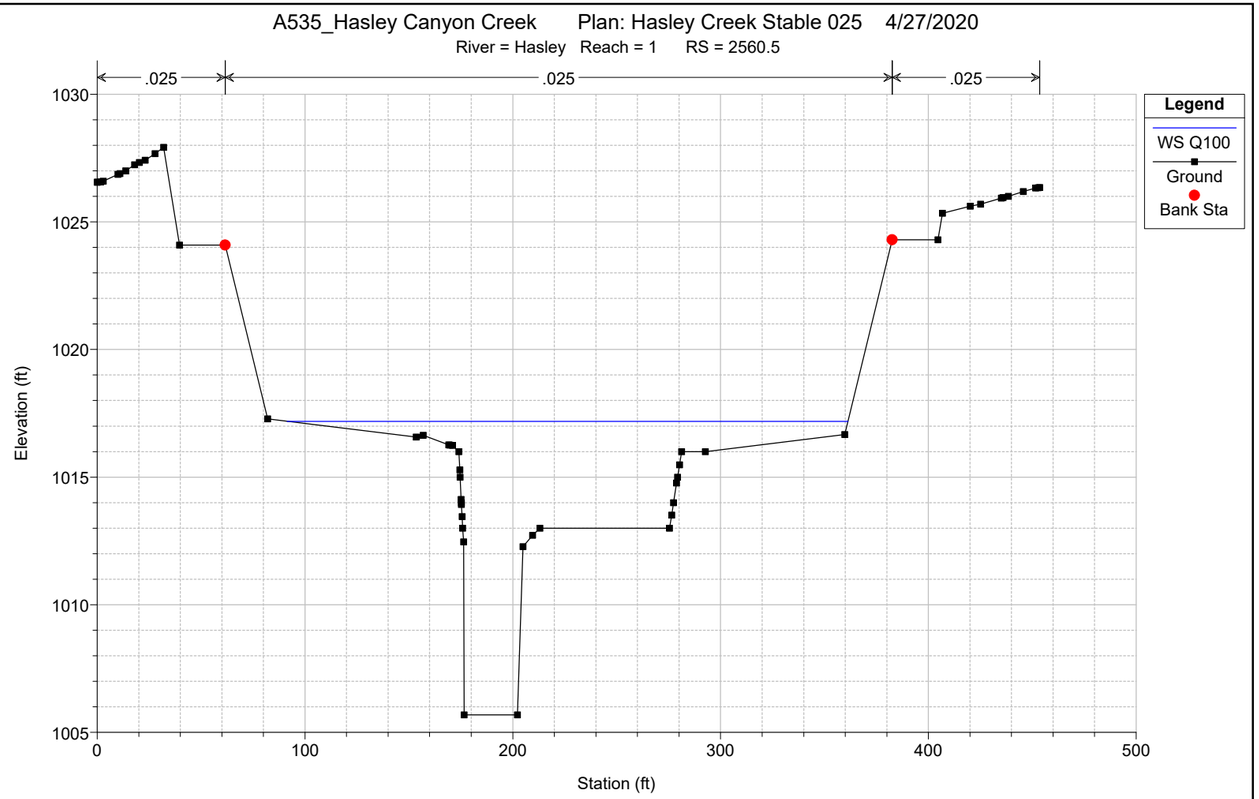
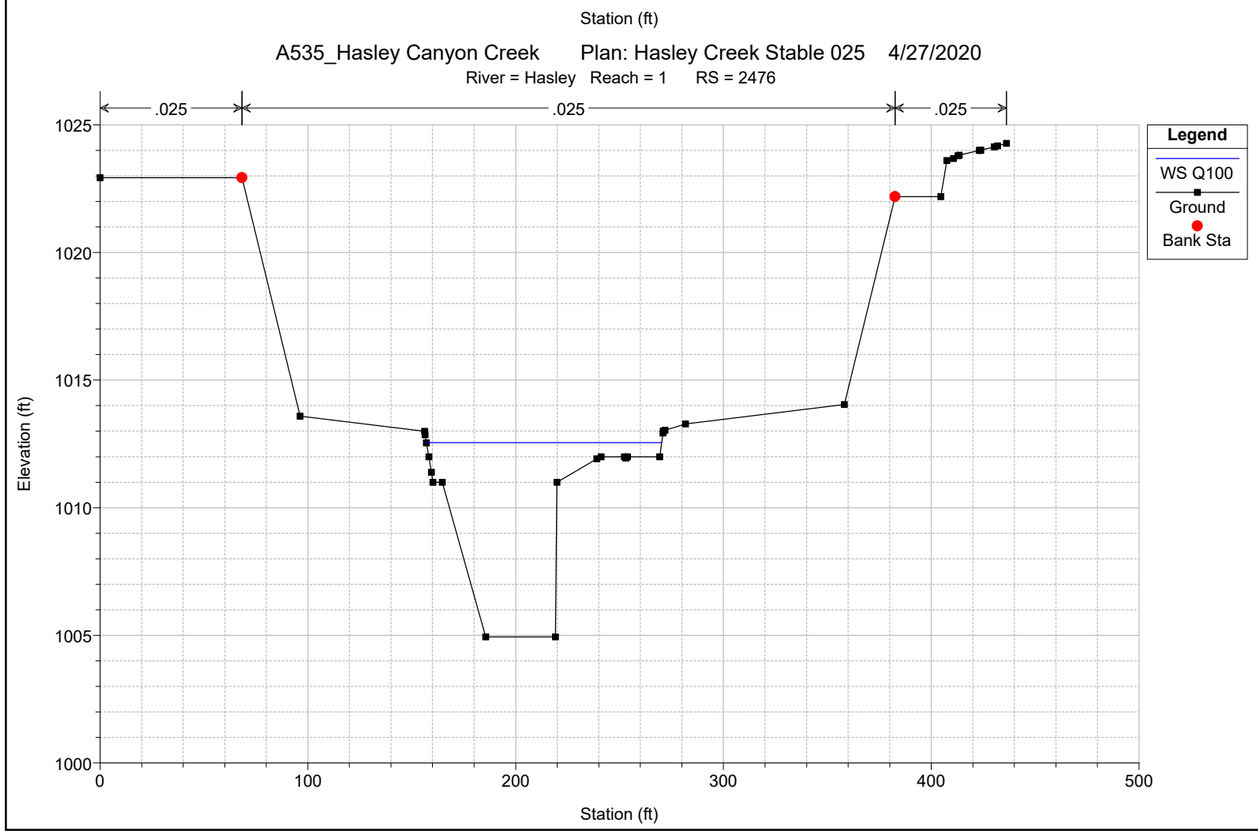
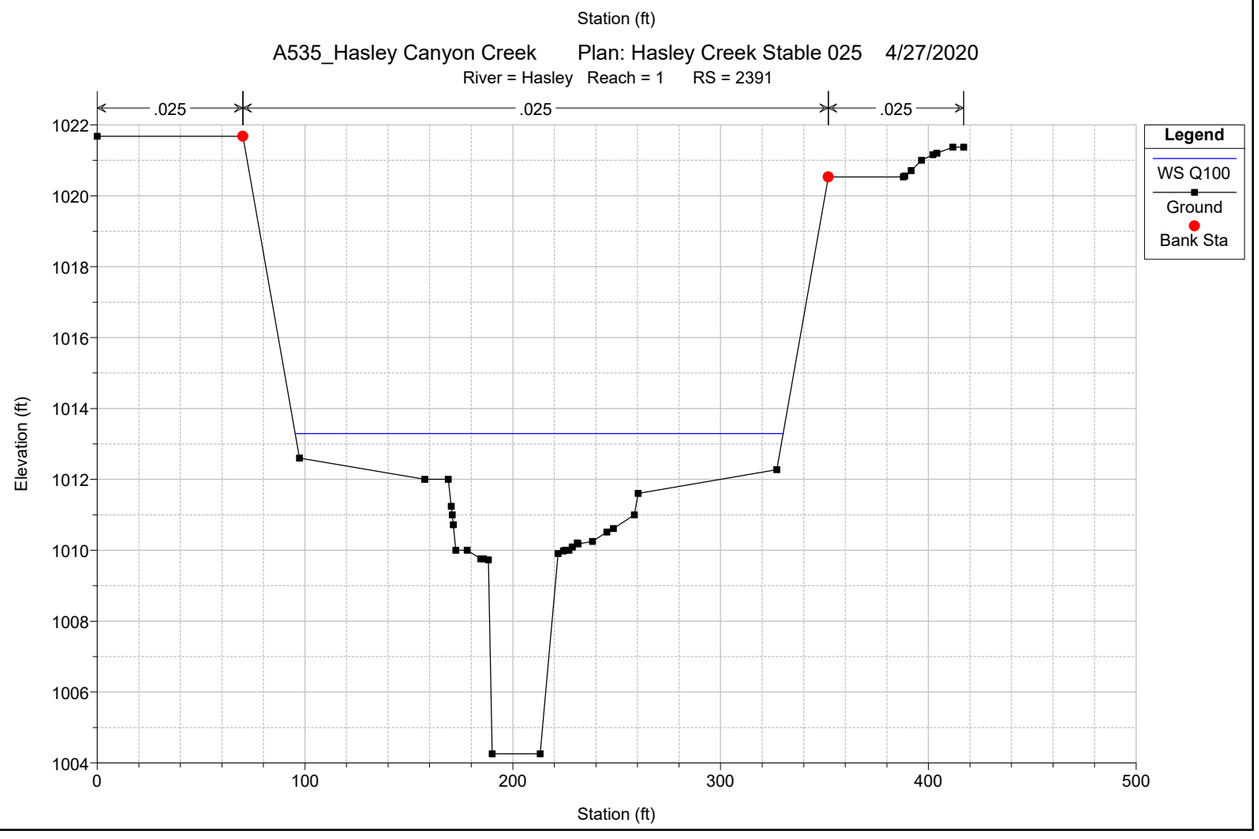
100
200
300
400
500

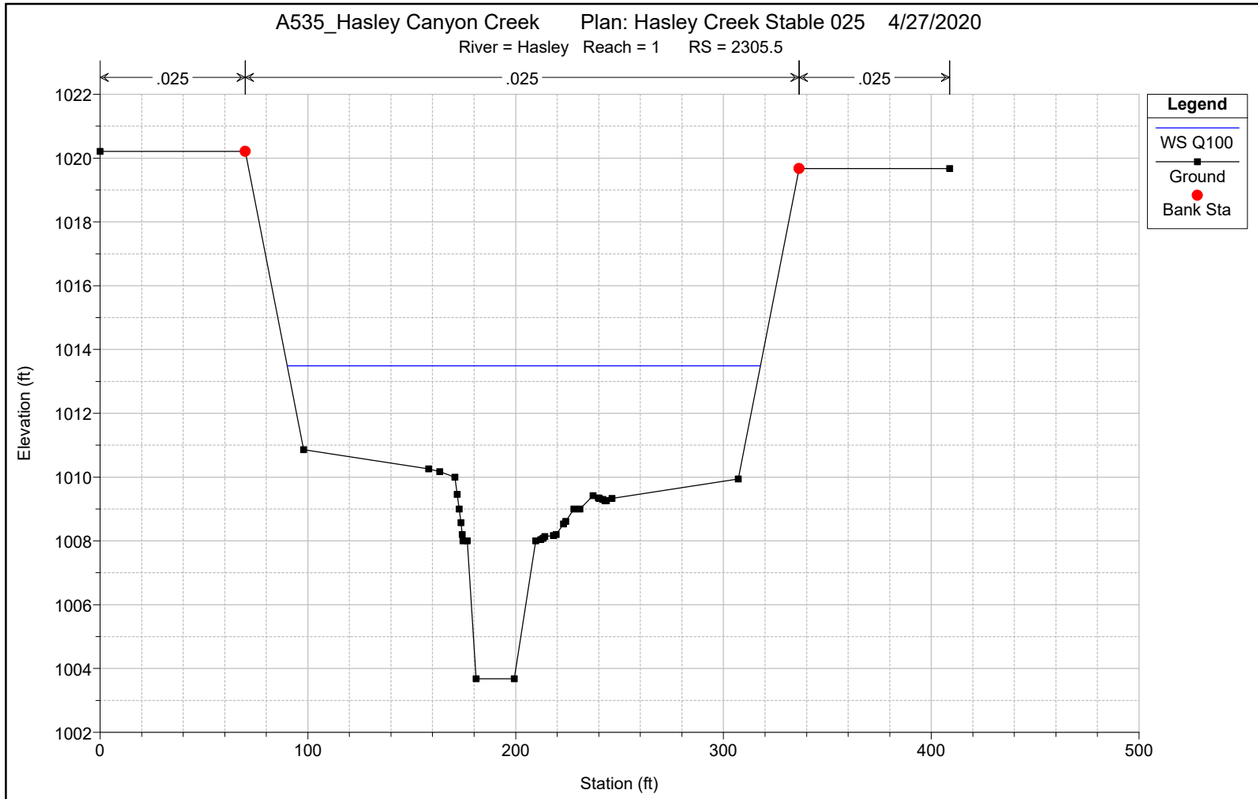

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2748
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1035
1030
1025
1020
1015
1010
1005
0
100
200
300
400
500

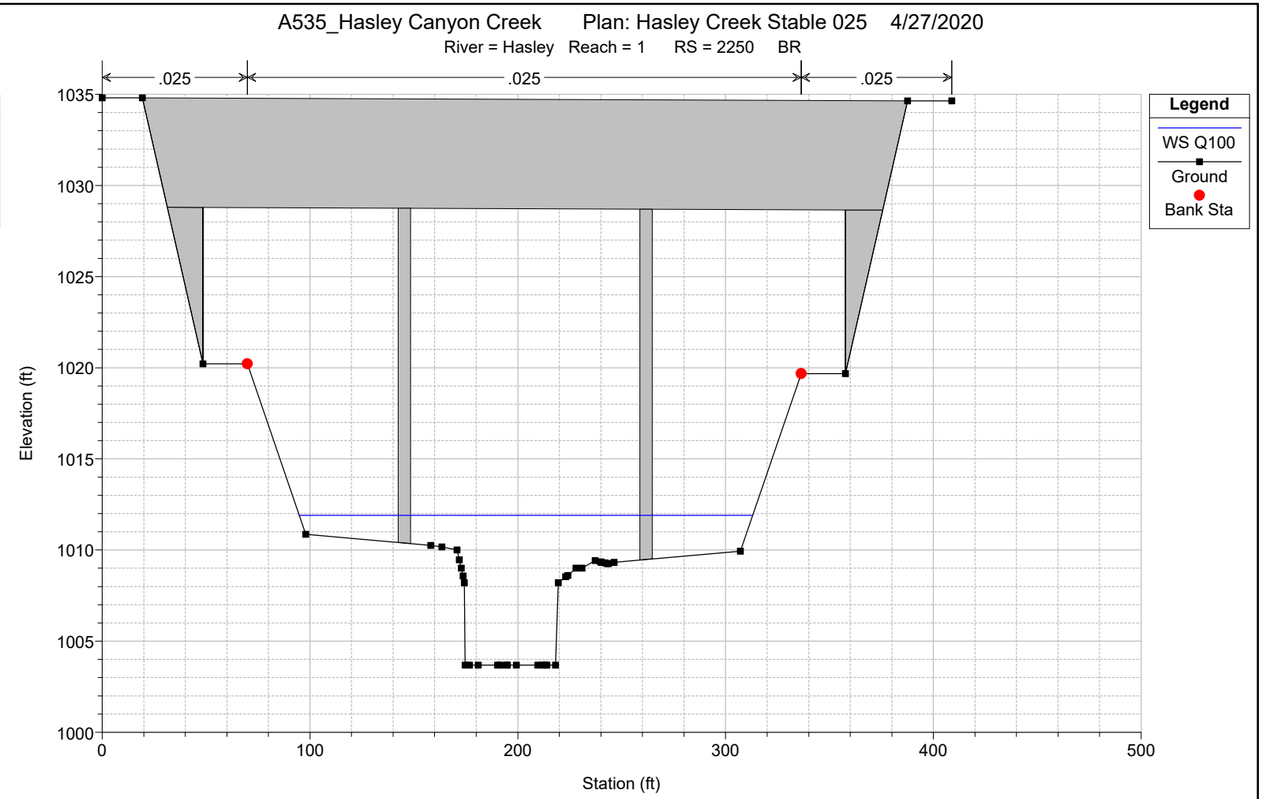

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2675.5
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1030
1025
1020
1015
1010
1005
0
100
200
300
400
500

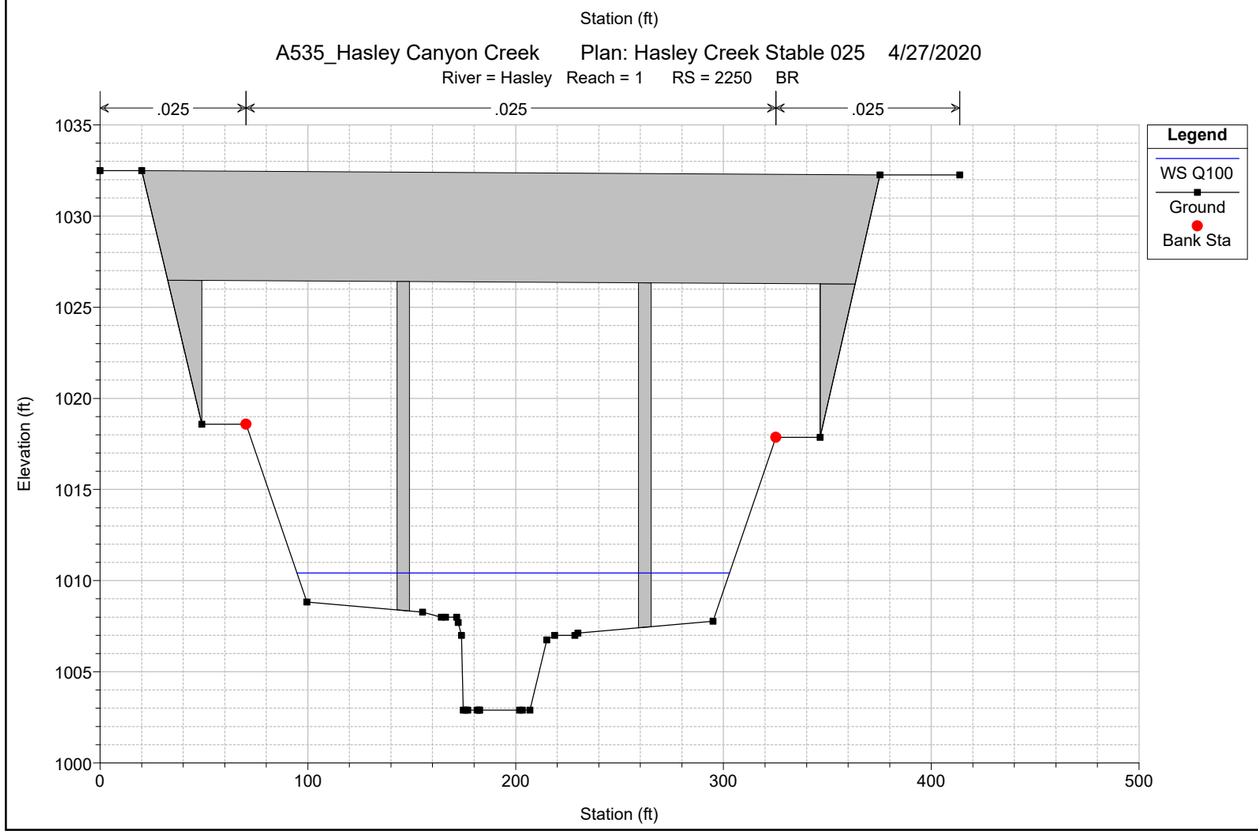

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2560.5
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1030
1025
1020
1015
1010
1005
0
100
200
300
400
500

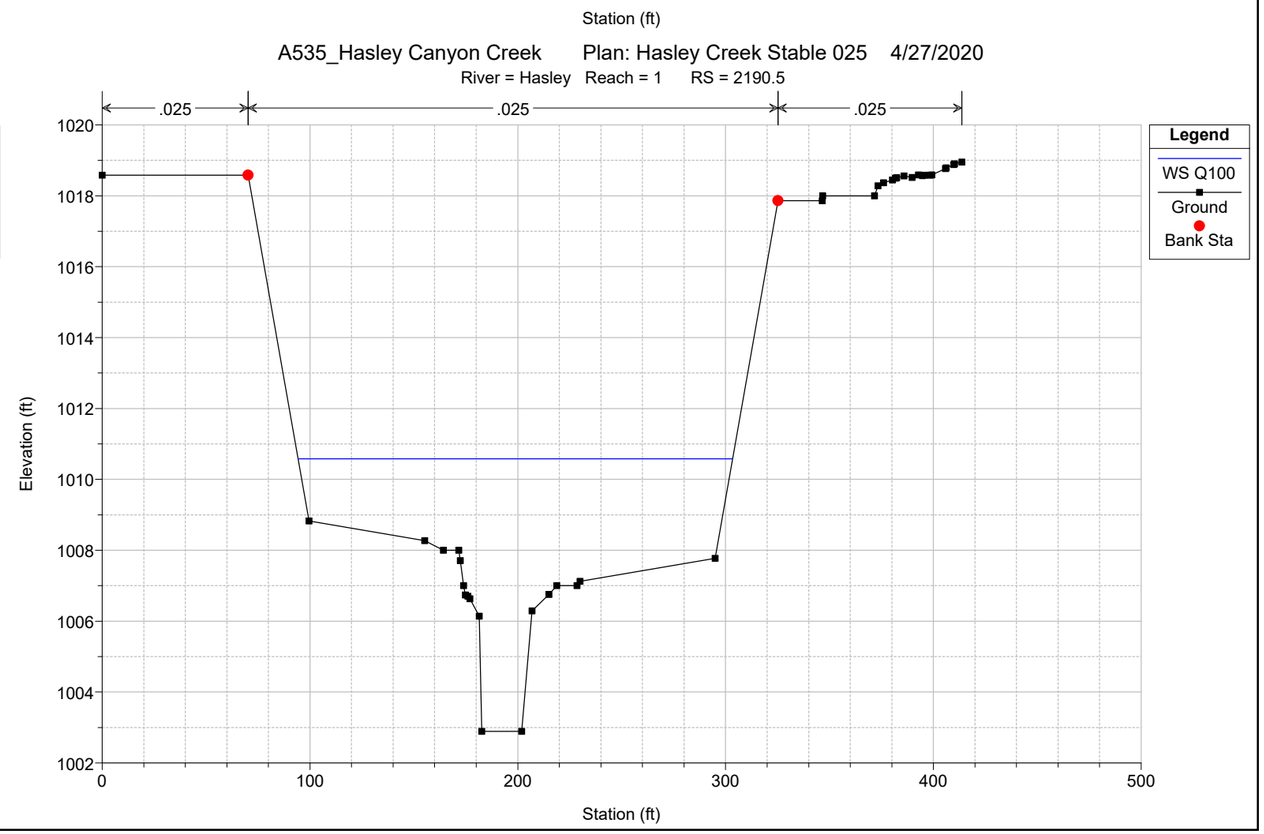

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2476
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1025
1020
1015
1010
1005
1000
0
100
200
300
400
500

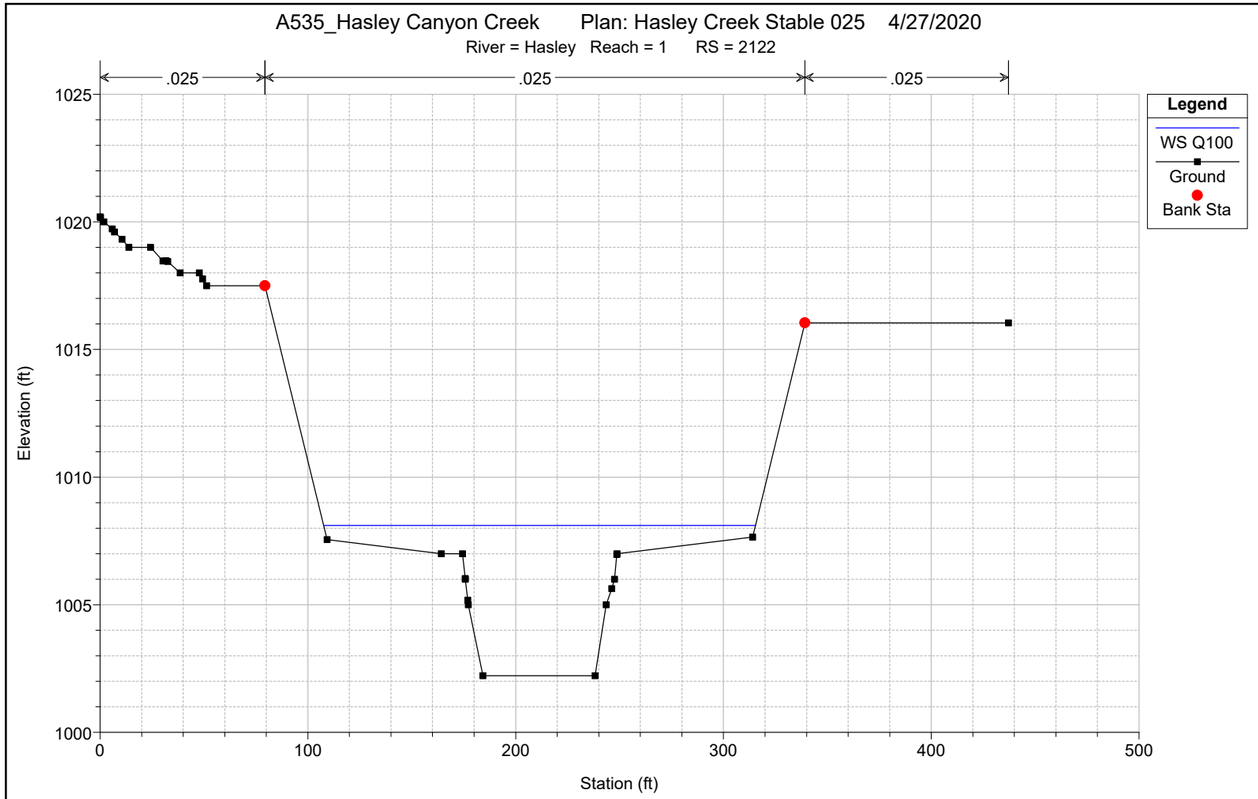

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2391
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1022
1020
1018
1016
1014
1012
1010
1008
1006
1004
0
100
200
300
400
500

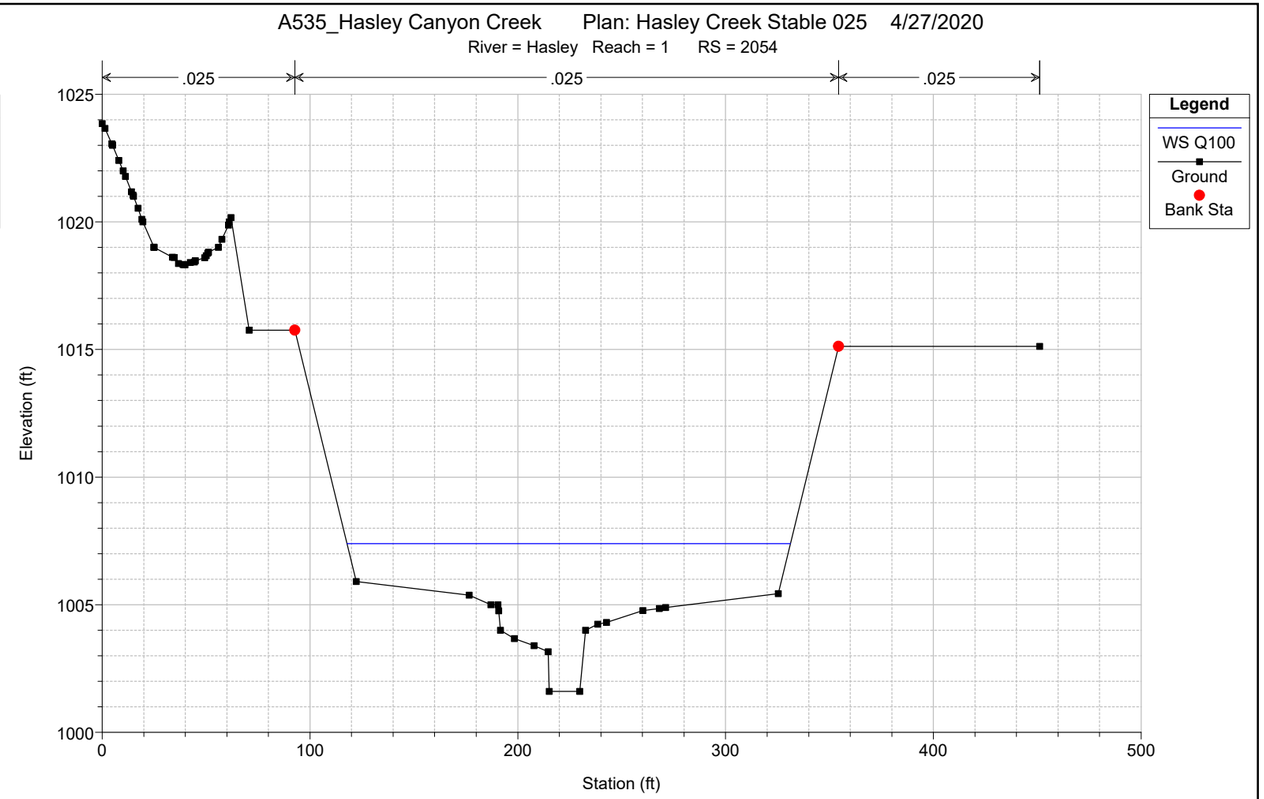

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2305.5
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1002
1004
1006
1008
1010
1012
1014
1016
1018
1020
1022
0
100
200
300
400
500

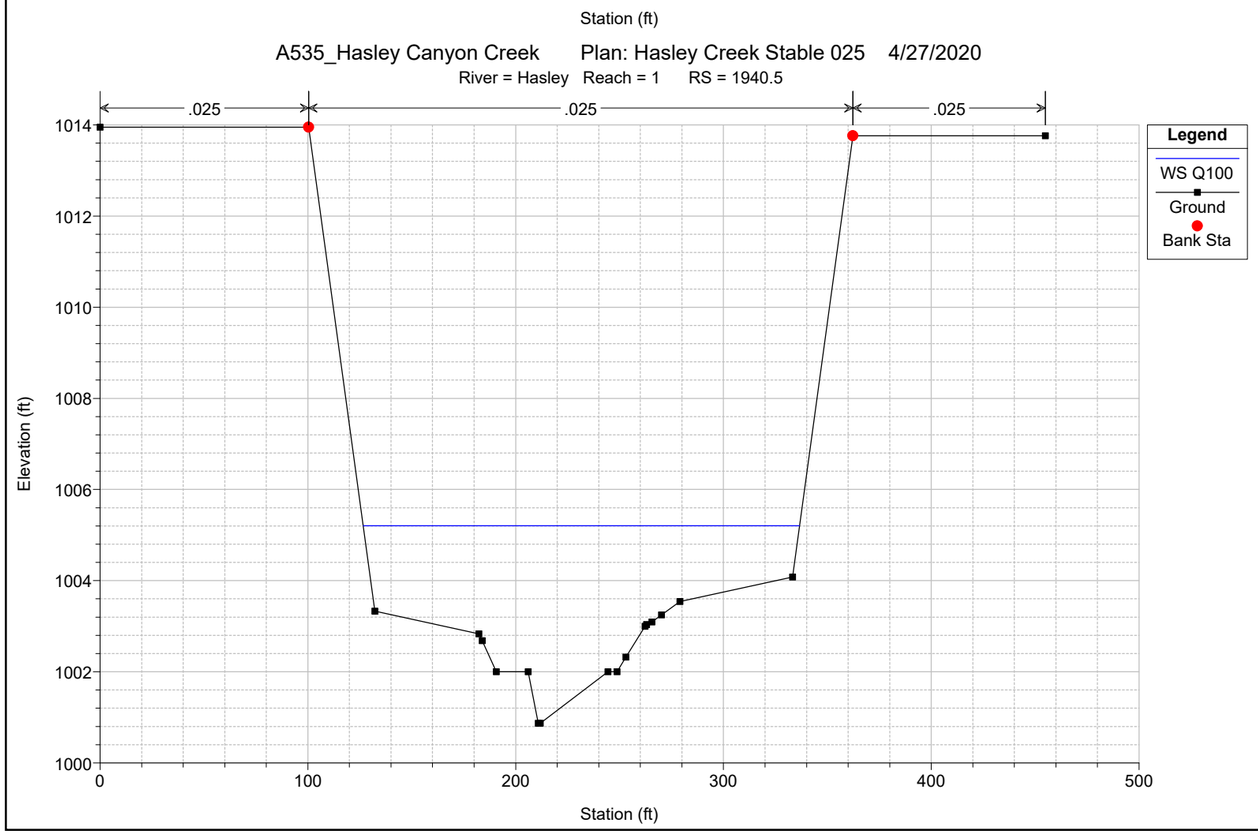

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2250 BR
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1000
1005
1010
1015
1020
1025
1030
1035
0
100
200
300
400
500

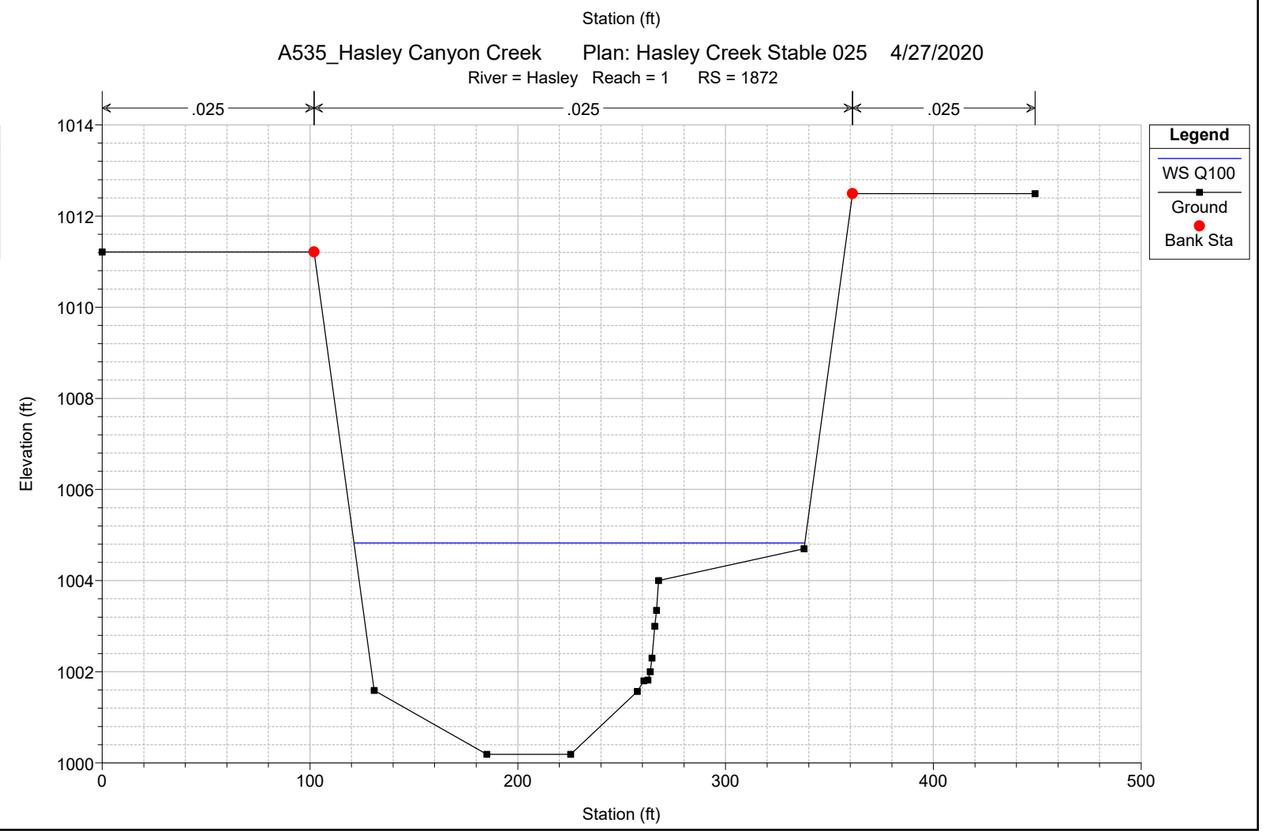

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2250 BR
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1000
1005
1010
1015
1020
1025
1030
1035
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2190.5
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1002
1004
1006
1008
1010
1012
1014
1016
1018
1020
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2122
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1025
1020
1015
1010
1005
1000
0
100
200
300
400
500

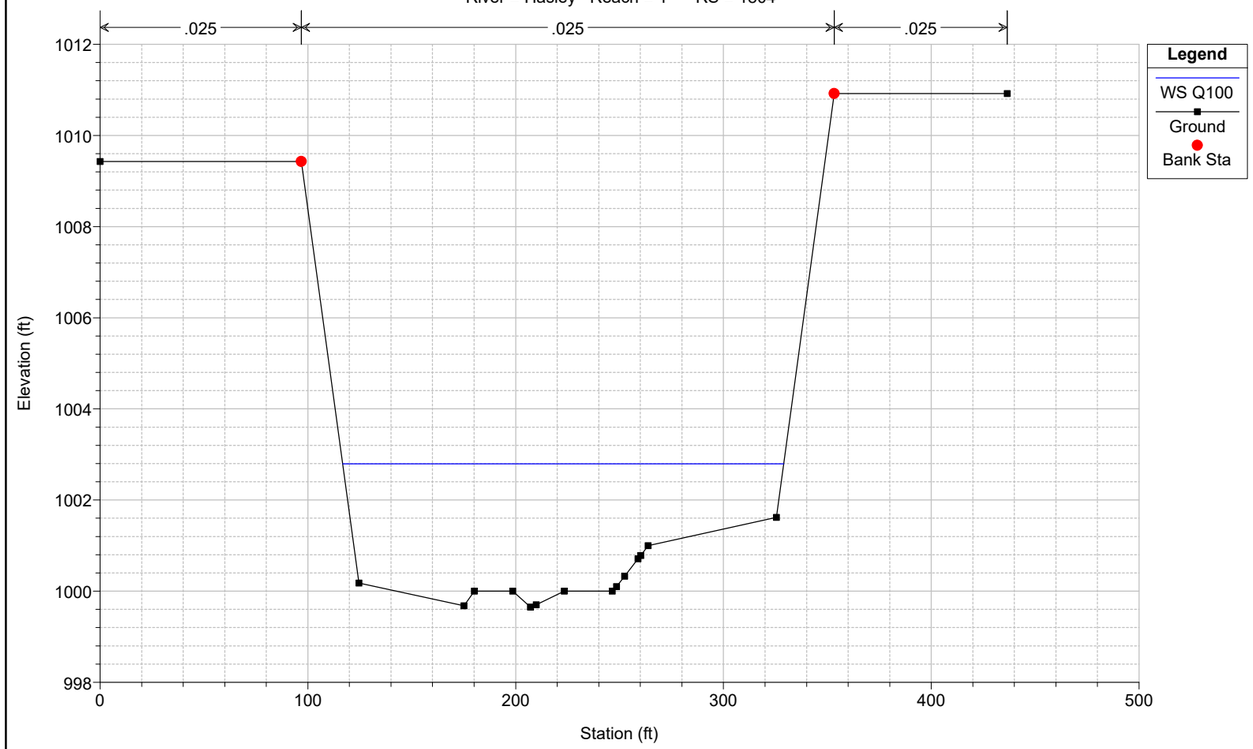

A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 2054
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1025
1020
1015
1010
1005
1000
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 1940.5
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1014
1012
1010
1008
1006
1004
1002
1000
0
100
200
300
400
500


A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020
River = Hasley Reach = 1 RS = 1872
.025
.025
.025
Legend
WS Q100
Ground
Bank Sta
Elevation (ft)
Station (ft)
1014
1012
1010
1008
1006
1004
1002
1000
0
100
200
300
400
500

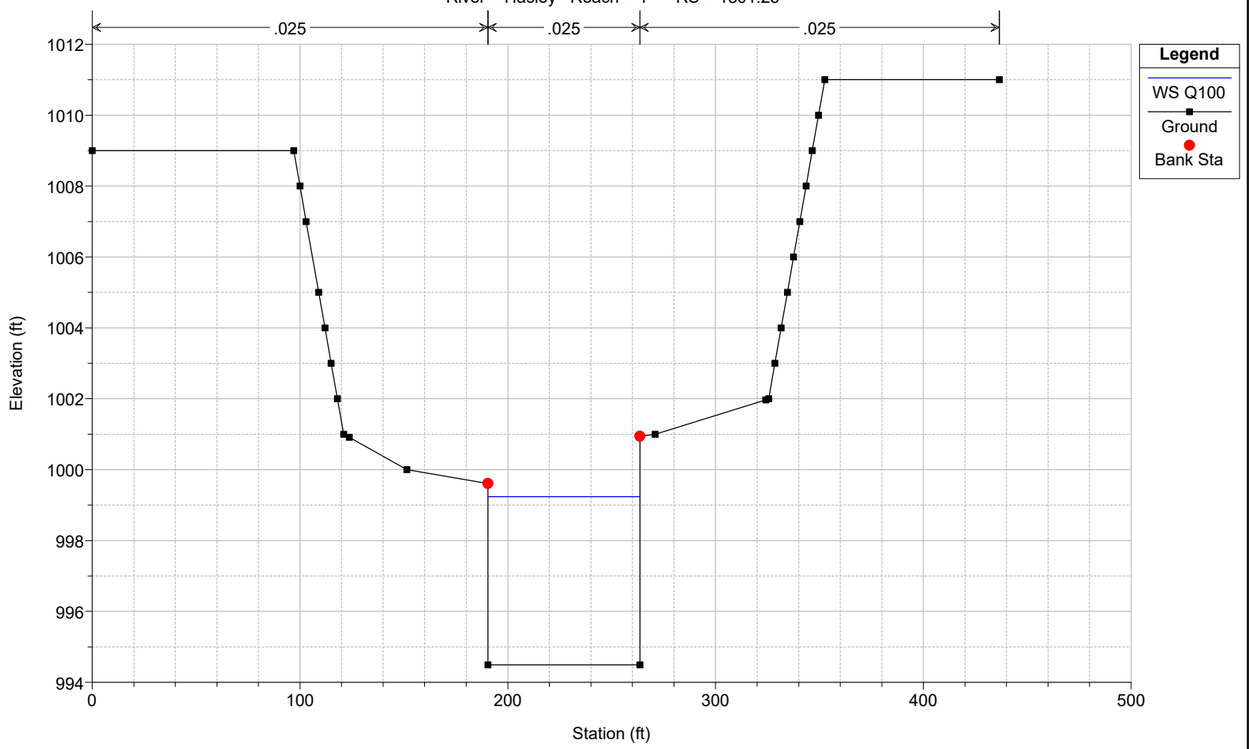
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 1804



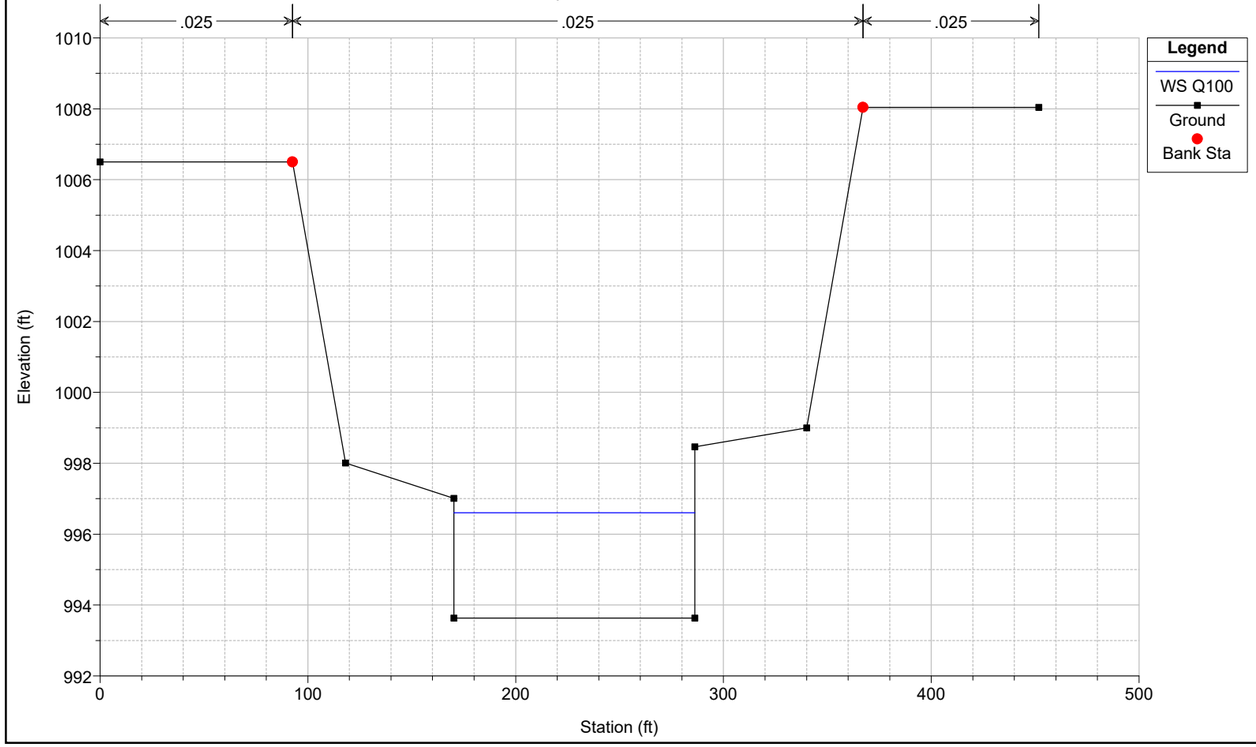
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 1801.25



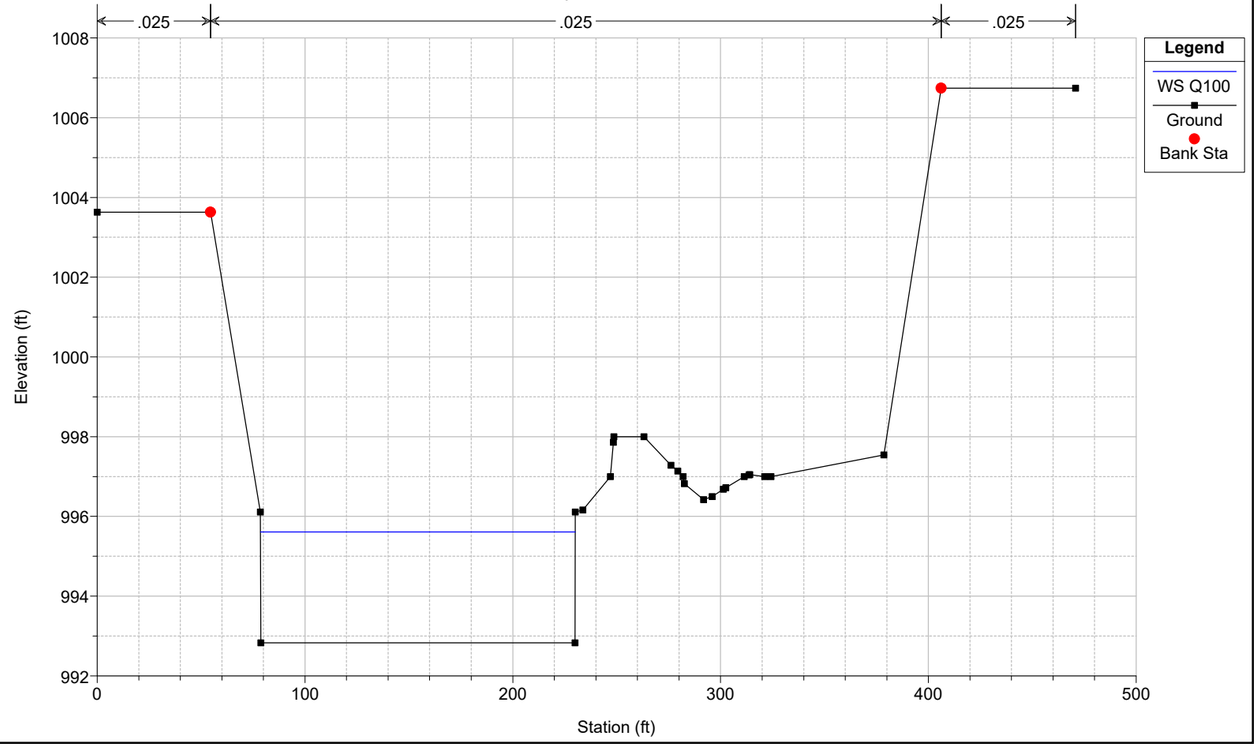
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 1688.62



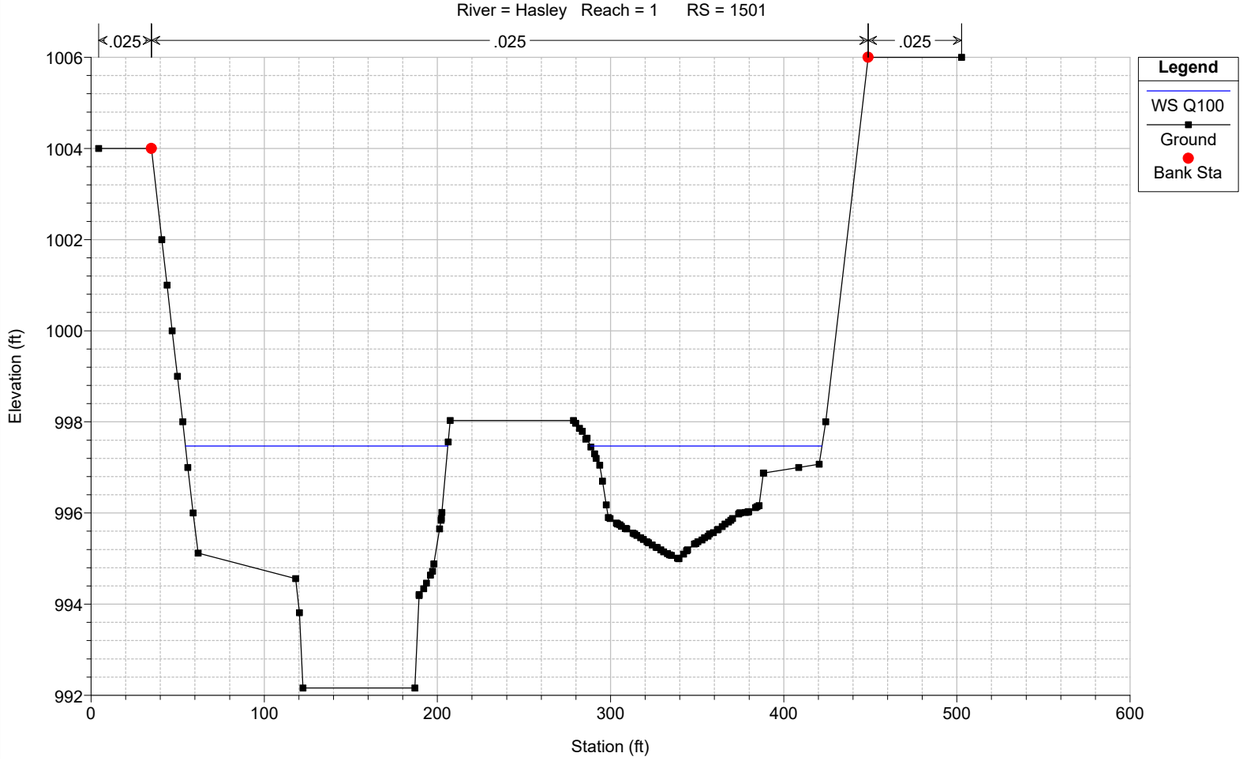
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 1584



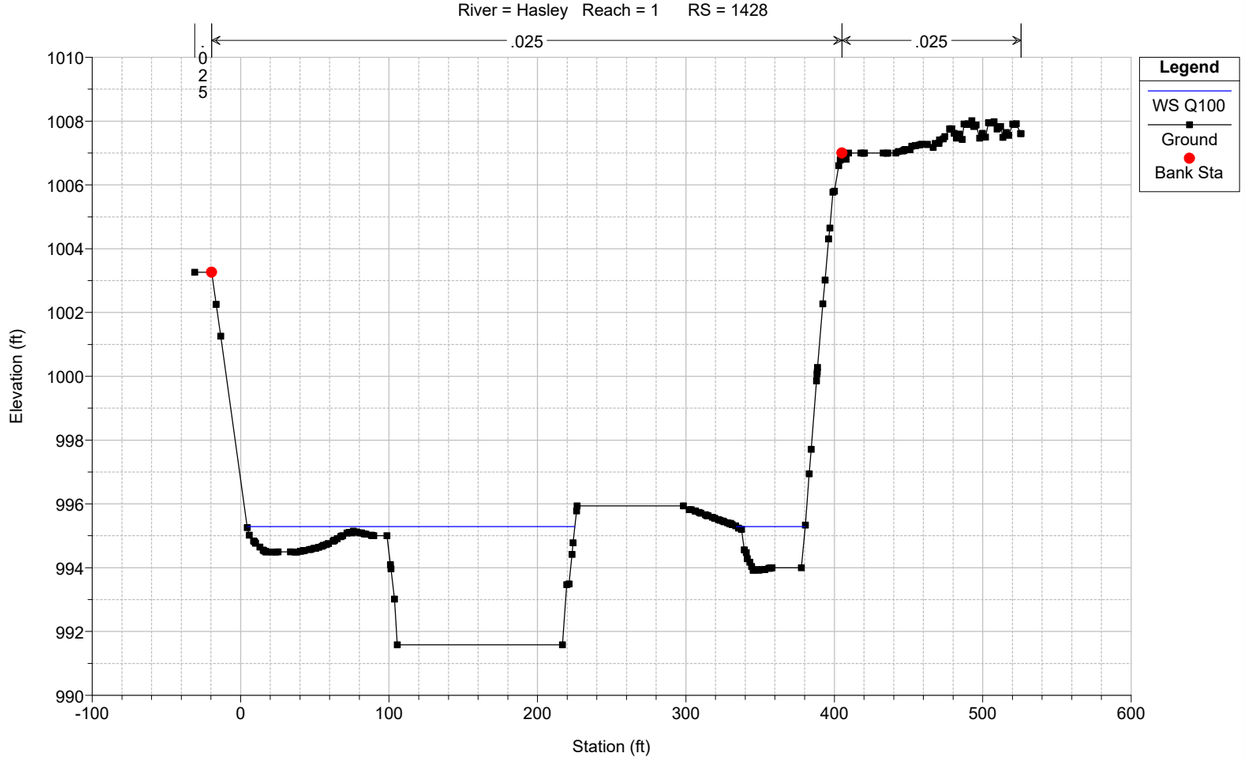
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 1501



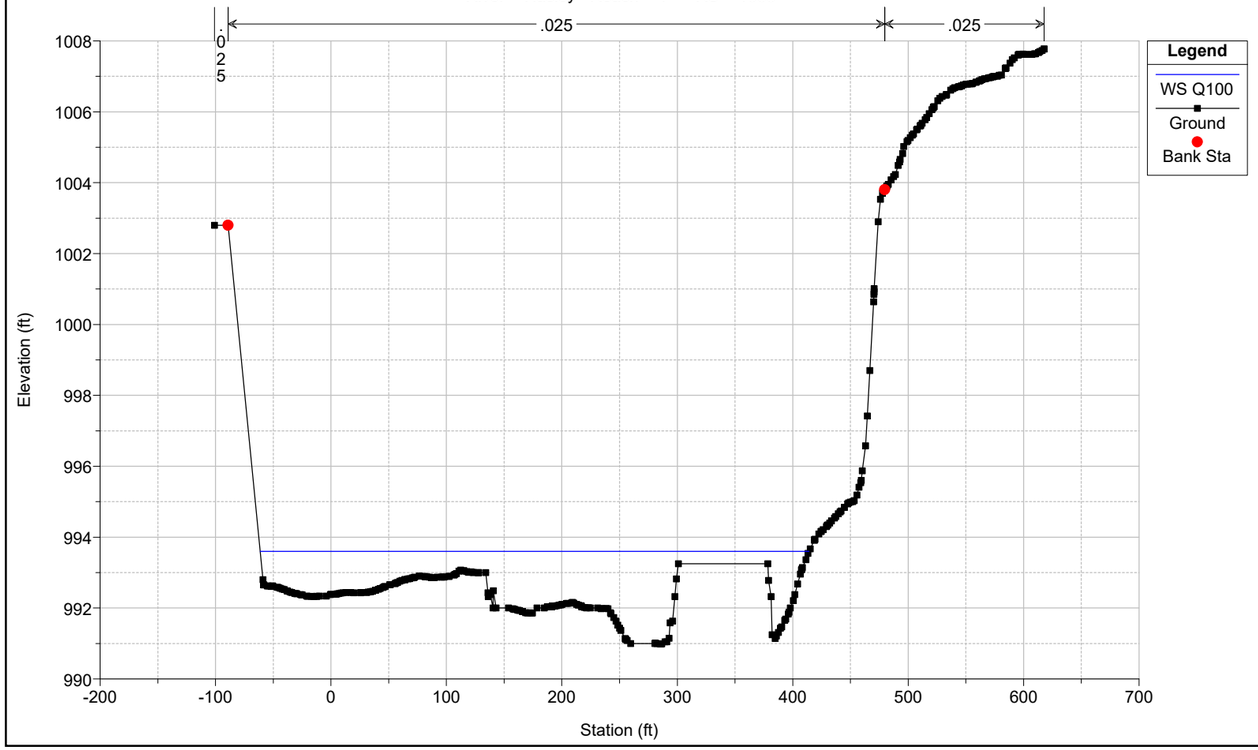
A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 1428



A535_Hasley Canyon Creek Plan: Hasley Creek Stable 025 4/27/2020

River = Hasley Reach = 1 RS = 1353



Appendix E: LACDPW Sedimentation Manual Freeboard and Toe-Down Calculation Spreadsheets

TABLE E.1 - HASLEY CANYON EAST BANK PROTECTION PROJECT FOR DESIGN SLOPE WITH Qcap AND n = 0.085
CALCULATIONS FOR FREEBOARD BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Y_{MAX}	Y_{TOT}	V (FPS)	FLOW DEPTH (FT)	Y_{AGG}+	Y_{GA}+	FROUDE NUMBER	CHANNEL TYPE	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	Y_{SE}+	BEND COEFF	SIDE SLOPE	RADIUS	H/2	Y_{DM}
4396	9.44	3.7	14.3	6.9	0.0	0.0	1.0	3.0	87.4	106.1	1.0	1	1.5	900	2.7	9.4
4300	14.02	3.0	25.7	6.0	0.0	0.0	2.0	3.0	55.0	70.7	0.0	0	1.5	0	3.0	14.0
4282	14.91	3.0	26.9	6.0	0.0	0.0	2.1	3.0	63.5	67.9	0.0	0	1.5	0	3.0	14.9
4276	2.50	0.7	7.4	12.0	0.0	0.0	0.4	2.0	101.8	124.5	0.0	0	1.5	0	0.7	2.5
4270	2.50	0.3	4.4	12.2	0.0	0.0	0.2	2.0	173.4	196.6	0.0	0	1.5	0	0.3	2.5
4265	2.50	0.6	6.7	8.2	0.0	0.0	0.4	2.0	162.2	184.2	0.0	0	1.5	0	0.6	2.5
4258	2.50	0.5	6.1	8.4	0.0	0.0	0.4	2.0	175.1	199.0	0.0	0	1.5	0	0.5	2.5
4157	2.50	1.7	3.7	9.6	0.0	1.5	0.2	2.0	256.3	281.9	0.0	0	1.5	0	0.2	2.5
4055.5	2.50	1.9	5.8	11.3	0.0	1.5	0.4	2.0	43.8	295.2	0.0	0	3.0	300	0.5	2.5
3940.5	2.50	2.1	7.0	11.6	0.0	1.5	0.6	2.0	34.3	294.3	0.0	0	3.0	300	0.7	2.5
3844	2.50	2.0	6.4	10.6	0.0	1.5	0.5	2.0	40.8	294.5	0.0	0	3.0	0	0.5	2.5
3747	2.50	1.9	5.9	10.2	0.0	1.5	0.4	2.0	129.0	292.9	0.0	0	3.0	0	0.5	2.5
3650	2.50	2.0	6.2	10.0	0.0	1.5	0.5	2.0	44.3	303.5	0.0	0	3.0	0	0.5	2.5
3554	2.50	2.2	7.5	8.8	0.0	1.5	0.6	2.0	112.8	263.2	0.0	0	3.0	0	0.8	2.5
3440.5	2.50	1.9	5.6	8.9	0.0	1.5	0.4	2.0	153.6	340.9	0.0	0	3.0	0	0.4	2.5
3372	2.50	2.1	6.9	7.8	0.0	1.5	0.6	2.0	133.0	323.2	0.0	0	3.0	0	0.6	2.5
3304	2.50	1.9	5.6	8.6	0.0	1.5	0.4	2.0	60.8	292.3	0.0	0	3.0	0	0.4	2.5
3190.5	2.50	2.1	5.4	9.1	0.0	1.5	0.4	2.0	131.5	264.9	0.2	1	3.0	500	0.4	2.5
3105	2.50	1.4	6.5	9.1	0.0	0.7	0.5	2.0	73.4	275.1	0.2	1	3.0	500	0.6	2.5
3020	2.50	1.3	5.9	9.3	0.0	0.7	0.4	2.0	94.3	286.1	0.2	1	3.0	500	0.5	2.5
2934	2.50	1.5	7.7	9.0	0.0	0.7	0.6	2.0	64.4	263.6	0.0	0	3.0	0	0.8	2.5
2820.5	2.50	1.4	7.2	8.2	0.0	0.7	0.6	2.0	144.9	274.8	0.0	0	3.0	0	0.7	2.5
2748	2.50	1.2	6.3	8.5	0.0	0.7	0.5	2.0	146.8	293.0	0.0	0	3.0	0	0.5	2.5
2675.5	2.50	1.3	6.8	7.9	0.0	0.7	0.6	2.0	119.5	300.7	0.0	0	3.0	0	0.6	2.5
2560.5	2.50	1.3	7.0	7.9	0.0	0.7	0.6	2.0	101.7	295.4	0.0	0	3.0	0	0.7	2.5
2476	2.50	1.1	5.4	8.4	0.0	0.7	0.4	2.0	113.3	292.5	0.0	0	3.0	0	0.4	2.5
2391	2.50	1.1	5.8	8.4	0.0	0.7	0.4	2.0	88.3	263.5	0.0	0	3.0	0	0.4	2.5
2305.5	2.50	1.0	5.1	9.7	0.0	0.7	0.3	2.0	192.8	252.4	0.0	0	3.0	0	0.4	2.5
2190.5	2.50	1.4	7.3	7.7	0.0	0.7	0.5	2.0	89.5	227.9	0.0	0	3.0	0	0.7	2.5
2122	2.50	1.7	7.4	8.2	0.0	0.7	0.6	2.0	72.2	232.4	0.3	1	3.0	400	0.7	2.5
2054	2.50	1.8	7.3	7.8	0.0	0.7	0.6	2.0	119.8	233.8	0.4	1	3.0	400	0.7	2.5
1940.5	2.50	1.6	6.6	7.8	0.0	0.7	0.5	2.0	154.6	235.9	0.4	1	3.0	400	0.6	2.5
1872	2.50	1.6	8.1	6.6	0.0	0.7	0.6	2.0	134.9	233.9	0.0	0	3.0	0	0.9	2.5
1804	2.50	1.5	7.6	6.5	0.0	0.7	0.6	2.0	164.6	232.5	0.0	0	3.0	0	0.8	2.5
1688.62	2.50	1.2	6.0	7.3	0.0	0.7	0.4	2.0	144.9	259.4	0.0	0	3.0	0	0.5	2.5
1584	2.50	0.9	3.6	9.5	0.0	0.7	0.2	2.0	283.6	399.4	0.0	0	3.0	0	0.2	2.5
MAX=	14.9	3.7									1.0				3.0	14.9
MIN=	2.5	0.3									0.0				0.2	2.5

Y_{AGG} was assigned a value of 0.0 for each section because the sediment transport modeling indicated that Hasley Canyon Creek is degradational.

Y_{GA+} values were obtained from Table 5.3 in the main body of the report. These values represent the maximum general aggradation for each reach based on sediment transport modeling.

DEFINITIONS

Y_{MAX} = MAXIMUM EMBANKMENT PROTECTION (FREEBOARD) VALUE IN FEET BETWEEN LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL
Y_{TOT} = TOTAL EMBANKMENT PROTECTION (FREEBOARD) IN FEET BASED ON THE LACDPW SEDIMENTATION MANUAL
V(FPS) = VELOCITY IN FEET PER SECOND
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
Y_{AGG} = LONG TERM AGGRADATION IN FEET
Y_{GA} = GENERAL AGGRADATION IN FEET
CHANNEL TYPE = CHANNEL SHAPE/FLOW FACTOR:
IF Fr < 1, RECTANGULAR = **0**; IF Fr > 1, RECTANGULAR = **1**;
IF Fr < 1, TRAPEZOIDAL = **2**; IF Fr > 1, TRAPEZOIDAL = **3**.
BOTTOM WIDTH = CHANNEL BOTTOM WIDTH IN FEET, LOW FLOW WATER SURFACE WIDTH
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
Y_{SE} = SUPER ELEVATION IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND=**0**, BEND=**1**
SIDE SLOPE = CHANNEL SIDE SLOPE (H:V), UNITLESS
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
H/2 = HALF BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH, AFTER KENNEDY (1963)
Y_{DM} = EMBANKMENT PROTECTION (FREEBOARD) IN FEET REQUIRED BY THE LACFCD HYDRAULIC DESIGN MANUAL

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE EMBANKMENT PROTECTION (FREEBOARD) BASED ON THE LACDPW SEDIMENTATION MANUAL (2006), PAGES 59-60 AND ASSOCIATED APPENDICES. FREEBOARD VALUES BASED ON LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF FREEBOARD BETWEEN THE TWO METHODOLOGIES (Y_{MAX}). ALL VELOCITIES ARE IN FEET PER SECOND (FPS), WITH NO MAXIMUM VALUE. THE USER SHOULD CONSIDER A PRACTICAL MAXIMUM VELOCITY OF APPROXIMATELY 20 TO 30 FPS. LONG TERM AGGRADATION IS USER SUPPLIED. GENERAL AGGRADATION IS ALSO USER SUPPLIED. SUPER ELEVATION AT BENDS IS BASED ON EQUATIONS IN SECTION C-3.1 (PAGE C-10) OF THE LACFCD HYDRAULIC DESIGN MANUAL. BEDFORM HEIGHT, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963), IS BASED ON EQUATIONS IN APPENDIX C OF THE LACDPW SEDIMENTATION MANUAL. IF FLOW IS SUPERCRITICAL, SPREADSHEET REPORTS LACFCD HYDRAULIC DESIGN MANUAL TOTAL WALL HEIGHT INSTEAD OF FREEBOARD. BOTTOM WIDTH IS BASED ON THE 2-YEAR WATER SURFACE WIDTH AFTER U.S. ARMY CORPS OF ENGINEERS PROCEDURES.

LACDPW = LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
AUGUST, 2005
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

TABLE E.2 - HASLEY CANYON WEST BANK PROTECTION PROJECT FOR DESIGN SLOPE WITH Qcap AND n = 0.085
CALCULATIONS FOR FREEBOARD BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Y_{MAX}	Y_{TOT}	V (FPS)	FLOW DEPTH (FT)	Y_{AGG}+	Y_{GA}+	FROUDE NUMBER	CHANNEL TYPE	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	Y_{SE}+	BEND COEFF	SIDE SLOPE	RADIUS	H/2	Y_{DM}
4396	9.44	2.7	14.3	6.9	0.0	0.0	1.0	3.0	87.4	106.1	0.0	0	1.5	0	2.7	9.4
4300	14.02	9.5	25.7	6.0	0.0	0.0	2.0	3.0	55.0	70.7	6.5	1	1.5	300	3.0	14.0
4282	14.92	10.9	26.9	6.0	0.0	0.0	2.1	3.0	63.5	67.9	7.9	1	1.5	300	3.0	14.9
4276	2.50	1.2	7.4	12.0	0.0	0.0	0.4	2.0	101.8	124.5	0.5	1	1.5	300	0.7	2.5
4270	2.50	0.5	4.4	12.2	0.0	0.0	0.2	2.0	173.4	196.6	0.2	1	1.5	300	0.3	2.5
4265	2.50	1.1	6.7	8.2	0.0	0.0	0.4	2.0	162.2	184.2	0.5	1	1.5	300	0.6	2.5
4258	2.50	0.9	6.1	8.4	0.0	0.0	0.4	2.0	175.1	199.0	0.4	1	1.5	300	0.5	2.5
4157	2.50	1.9	3.7	9.6	0.0	1.5	0.2	2.0	256.3	281.9	0.2	1	1.5	300	0.2	2.5
4055.5	2.50	1.9	5.8	11.3	0.0	1.5	0.4	2.0	43.8	295.2	0.0	0	3.0	0	0.5	2.5
3940.5	2.50	2.1	7.0	11.6	0.0	1.5	0.6	2.0	34.3	294.3	0.0	0	3.0	0	0.7	2.5
3844	2.50	2.0	6.4	10.6	0.0	1.5	0.5	2.0	40.8	294.5	0.0	0	3.0	0	0.5	2.5
3747	2.50	1.9	5.9	10.2	0.0	1.5	0.4	2.0	129.0	292.9	0.0	0	3.0	0	0.5	2.5
3650	2.50	2.1	6.2	10.0	0.0	1.5	0.5	2.0	44.3	303.5	0.1	1	3.0	1000	0.5	2.5
3554	2.50	2.4	7.5	8.8	0.0	1.5	0.6	2.0	112.8	263.2	0.2	1	3.0	1000	0.8	2.5
3440.5	2.50	1.9	5.6	8.9	0.0	1.5	0.4	2.0	153.6	340.9	0.0	0	3.0	0	0.4	2.5
3372	2.50	2.1	6.9	7.8	0.0	1.5	0.6	2.0	133.0	323.2	0.0	0	3.0	0	0.6	2.5
3304	2.50	1.9	5.6	8.6	0.0	1.5	0.4	2.0	60.8	292.3	0.0	0	3.0	0	0.4	2.5
3190.5	2.50	1.9	5.4	9.1	0.0	1.5	0.4	2.0	131.5	264.9	0.0	0	3.0	0	0.4	2.5
3105	2.50	1.2	6.5	9.1	0.0	0.7	0.5	2.0	73.4	275.1	0.0	0	3.0	0	0.6	2.5
3020	2.50	1.1	5.9	9.3	0.0	0.7	0.4	2.0	94.3	286.1	0.0	0	3.0	0	0.5	2.5
2934	2.50	1.5	7.7	9.0	0.0	0.7	0.6	2.0	64.4	263.6	0.0	0	3.0	0	0.8	2.5
2820.5	2.50	1.4	7.2	8.2	0.0	0.7	0.6	2.0	144.9	274.8	0.0	0	3.0	0	0.7	2.5
2748	2.50	1.2	6.3	8.5	0.0	0.7	0.5	2.0	146.8	293.0	0.0	0	3.0	0	0.5	2.5
2675.5	2.50	1.6	6.8	7.9	0.0	0.7	0.6	2.0	119.5	300.7	0.3	1	3.0	500	0.6	2.5
2560.5	2.50	1.6	7.0	7.9	0.0	0.7	0.6	2.0	101.7	295.4	0.3	1	3.0	500	0.7	2.5
2476	2.50	1.2	5.4	8.4	0.0	0.7	0.4	2.0	113.3	292.5	0.2	1	3.0	500	0.4	2.5
2391	2.50	1.3	5.8	8.4	0.0	0.7	0.4	2.0	88.3	263.5	0.2	1	3.0	500	0.4	2.5
2305.5	2.50	1.0	5.1	9.7	0.0	0.7	0.3	2.0	192.8	252.4	0.0	0	3.0	0	0.4	2.5
2190.5	2.50	1.4	7.3	7.7	0.0	0.7	0.5	2.0	89.5	227.9	0.0	0	3.0	0	0.7	2.5
2122	2.50	1.4	7.4	8.2	0.0	0.7	0.6	2.0	72.2	232.4	0.0	0	3.0	0	0.7	2.5
2054	2.50	1.4	7.3	7.8	0.0	0.7	0.6	2.0	119.8	233.8	0.0	0	3.0	0	0.7	2.5
1940.5	2.50	1.3	6.6	7.8	0.0	0.7	0.5	2.0	154.6	235.9	0.0	0	3.0	0	0.6	2.5
1872	2.50	1.6	8.1	6.6	0.0	0.7	0.6	2.0	134.9	233.9	0.0	0	3.0	0	0.9	2.5
1804	2.50	1.5	7.6	6.5	0.0	0.7	0.6	2.0	164.6	232.5	0.0	0	3.0	0	0.8	2.5
1688.62	2.50	1.2	6.0	7.3	0.0	0.7	0.4	2.0	144.9	259.4	0.0	0	3.0	0	0.5	2.5
1584	2.50	0.9	3.6	9.5	0.0	0.7	0.2	2.0	283.6	399.4	0.0	0	3.0	0	0.2	2.5
MAX=	14.9	10.9									7.9				3.0	14.9
MIN=	2.5	0.5									0.0				0.2	2.5

Y_{AGG} was assigned a value of 0.0 for each section because the sediment transport modeling indicated that Hasley Canyon Creek is degradational.

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IF Fr < 1, TRAPEZOIDAL = **2**; IF Fr > 1, TRAPEZOIDAL = **3**.
BOTTOM WIDTH = CHANNEL BOTTOM WIDTH IN FEET, LOW FLOW WATER SURFACE WIDTH
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
Y_{SE} = SUPER ELEVATION IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND=**0**, BEND=**1**
SIDE SLOPE = CHANNEL SIDE SLOPE (H:V), UNITLESS
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
H/2 = HALF BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH, AFTER KENNEDY (1963)
Y_{DM} = EMBANKMENT PROTECTION (FREEBOARD) IN FEET REQUIRED BY THE LACFCD HYDRAULIC DESIGN MANUAL

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LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
AUGUST, 2005
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

PACE
Advanced Water Engineering

TABLE E.3 - HASLEY CANYON EAST BANK PROTECTION PROJECT FOR DESIGN SLOPE WITH Q_{100} AND n = 0.025
CALCULATIONS FOR TOE-DOWN BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Z_{TOT}	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	BANK PROT	Z_{LS}+ BANK	Z_{LS}+ BRIDGE	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_I+	H/2
4396	5.96	20.2	3.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.6	0.153	96.7	900	0.1	2.0	1.9
4300	6.15	27.5	4.3	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.9	0.236	65.6	900	0.0	2.0	2.2
4282	6.01	31.2	4.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.6	0.140	62.0	900	0.0	2.0	2.0
4276	5.55	24.2	3.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.119	97.7	0	0.0	2.0	1.6
4270	4.24	4.2	9.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	8.8	0.001	188.4	0	0.0	2.0	0.2
4265	4.93	8.3	5.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.8	0.007	174.8	0	0.0	2.0	0.9
4258	4.67	7.1	5.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	5.2	0.002	190.1	0	0.0	2.0	0.7
4157	9.89	3.8	7.0	3.7	2.0	0	0.0	1	0.0	0	2.0	0.0	0	6.7	0.000	274.1	0	0.0	2.0	0.2
4055.5	15.15	9.5	8.2	2.3	2.0	0	0.0	1	0.0	0	2.0	0.0	1	2.8	0.007	266.7	300	5.6	2.0	1.2
3940.5	15.21	9.8	9.4	1.3	2.0	0	0.0	1	0.0	0	2.0	0.0	1	2.5	0.008	280.9	300	6.6	2.0	1.3
3844	10.53	14.8	6.9	1.4	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.019	193.0	0	0.0	2.1	2.9
3747	10.38	15.6	5.6	1.5	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.016	150.7	0	0.0	2.0	2.8
3650	8.76	10.1	7.2	1.4	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.009	283.7	0	0.0	2.0	1.4
3554	9.54	15.9	4.3	1.4	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.7	0.020	165.8	0	0.0	2.0	2.2
3440.5	9.39	13.7	4.8	0.8	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.013	174.6	0	0.0	2.1	2.4
3372	9.00	11.4	5.1	1.2	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.008	201.1	0	0.0	2.0	1.7
3304	8.47	14.8	4.2	0.4	2.0	0	0.0	1	0.0	0	2.0	0.0	0	1.8	0.029	265.9	0	0.0	2.0	2.1
3190.5	7.41	6.5	6.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.3	0.002	248.8	500	2.8	2.0	0.6
3105	20.15	9.6	6.4	11.0	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.8	0.007	258.6	500	3.1	2.0	1.2
3020	19.56	14.2	5.0	10.4	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.9	0.014	168.5	500	1.9	2.0	2.5
2934	15.65	9.7	7.0	9.6	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.007	251.8	0	0.0	2.0	1.3
2820.5	15.39	17.6	3.9	8.7	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.025	152.7	0	0.0	2.0	1.9
2748	14.49	17.1	3.6	7.9	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.025	166.7	0	0.0	2.0	1.8
2675.5	14.53	13.2	4.4	7.6	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.7	0.014	200.1	0	0.0	2.0	2.2
2560.5	13.24	12.6	5.1	6.3	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.1	0.017	262.5	0	0.0	2.0	2.1
2476	12.27	14.4	3.9	5.6	0.8	0	0.0	1	0.0	0	2.0	0.0	0	1.8	0.026	265.2	0	0.0	2.0	1.9
2391	11.87	11.0	4.3	5.5	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.7	0.009	239.4	0	0.0	2.0	1.6
2305.5	19.84	6.8	6.3	4.2	0.8	0.9	6.0	1	0.0	1	0.0	12.2	0	4.4	0.002	232.1	0	0.0	2.0	0.6
2190.5	22.42	11.6	4.5	3.1	0.8	0.9	6.0	1	0.0	1	0.0	14.7	0	2.9	0.009	208.7	0	0.0	2.0	1.8
2122	11.45	13.5	4.7	1.8	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.5	0.016	211.6	400	2.5	2.0	2.4
2054	10.59	13.9	4.2	1.4	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.4	0.018	212.4	400	2.3	2.0	2.1
1940.5	9.29	14.6	3.5	0.9	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.3	0.020	210.2	400	1.9	2.0	1.7
1872	6.96	10.1	4.6	0.8	0.8	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.006	221.4	0	0.0	2.0	1.4
1804	5.50	15.1	3.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.2	0.023	211.4	0	0.0	2.0	1.5
1688.62	10.07	14.4	2.8	3.9	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.1	0.022	232.8	0	0.0	2.0	1.4
1584	7.22	4.3	6.5	2.2	0.8	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.001	329.7	0	0.0	2.0	0.2
MAXIMUM=	22.4			11.0	2.0							14.7						6.6		2.9
MINIMUM=	4.2			0.0	0.0							0.0						0.0		0.2

- No long-term scour (Z_{DEG}) or General Scour (Z_{GS}) was applied at the grade control structures.
- Z_{DEG} values were determined by subtracting the minimum channel elevation for the stable slope geometry from the minimum channel elevation for the design slope geometry.
- Z_{GS} values were obtained from Table 5.6 in the main body of the report.

DEFINITIONS

Z_{TOT} = TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG} = LONG TERM DEGRADATION IN FEET
Z_{GS} = GENERAL SCOUR IN FEET
Z_{LS} = LOCAL SCOUR IN FEET [**Z_{LS} BANK + Z_{LS} BRIDGE**]
Z_{LS} BRIDGE = BRIDGE LOCAL SCOUR IN FEET [PIER (APP C-4) + ABUTMENT (APP C-6)]
Z_{LS} BANK = LEVEE/BANK LOCAL SCOUR = **2.0'** IF BANK PROTECTION PRESENT
BANK PROT = BANK PROTECTION ON CHANNEL BANK
0 = YES; **1** = NO
PIER TYPE = PIER SHAPE FACTOR; IF NO PIERS = **0**
1.0 = SQUARE NOSE; **0.9** = ROUND NOSE; **0.9** = CYLINDER;
0.8 = SHARP NOSE; **0.9** = GROUP OF CYLINDERS
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
B = WIDTH OF PIERS IN FEET; NO PIER = **0**
ABUT TYPE = VERT WALL FACTOR; IF VERT = **2**; NON VERT = **1**
A = ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
Z_{BS} = BEND SCOUR IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND = **0**, BEND = **1**
HYD DEPTH = HYDRAULIC DEPTH IN FEET
E SLOPE = ENERGY SLOPE, UNITLESS
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I = LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H = BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-59 AND ASSOCIATED APPENDICES (APPENDIX C). VALUES FOR TOE-DOWN BASED ON THE CUT-OFF DEPTHS TABLE (PAGE F-31) IN THE LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF TOE-DOWN BETWEEN THE TWO METHODOLOGIES (Z_{MAX}). THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT-OFF DEPTH BASED ON FIGURE F-06 (PAGE F-37). LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR VALUES ARE INTERPOLATED FROM THE GENERAL DEGRADATION GRAPH IN APPENDIX C (PAGE C-3) OF THE LACDPW SEDIMENTATION MANUAL. BEND SCOUR AND LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON APPENDIX C (PAGES C-6 TO C-8) OF THE LACDPW SEDIMENTATION MANUAL. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON APPENDIX C-9 OF THE SEDIMENTATION MANUAL. THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY REVISION INCLUDES THE Z_{MAX} CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

LACDPW = LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES
OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

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TABLE E.4 - HASLEY CANYON WEST BANK PROTECTION PROJECT FOR DESIGN SLOPE WITH Q_{100} AND n = 0.025
CALCULATIONS FOR TOE-DOWN BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Z_{TOT}	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	BANK PROT	Z_{LS}+ BANK	Z_{LS}+ BRIDGE	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_I+	H/2
4396	5.91	20.2	3.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.6	0.153	96.7	0	0.0	2.0	1.9
4300	6.15	27.5	4.3	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.9	0.236	65.6	0	0.0	2.0	2.2
4282	6.01	31.2	4.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.6	0.140	62.0	0	0.0	2.0	2.0
4276	6.45	24.2	3.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.0	0.119	97.7	300	0.9	2.0	1.6
4270	7.52	4.2	9.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	8.8	0.001	188.4	300	3.3	2.0	0.2
4265	6.80	8.3	5.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.8	0.007	174.8	300	1.9	2.0	0.9
4258	7.55	7.1	5.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	5.2	0.002	190.1	300	2.9	2.0	0.7
4157	13.97	3.8	7.0	3.7	2.0	0	0.0	1	0.0	0	2.0	0.0	1	6.7	0.000	274.1	300	4.1	2.0	0.2
4055.5	9.55	9.5	8.2	2.3	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.8	0.007	266.7	0	0.0	2.0	1.2
3940.5	8.59	9.8	9.4	1.3	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.008	280.9	0	0.0	2.0	1.3
3844	10.53	14.8	6.9	1.4	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.019	193.0	0	0.0	2.1	2.9
3747	10.38	15.6	5.6	1.5	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.016	150.7	0	0.0	2.0	2.8
3650	10.88	10.1	7.2	1.4	2.0	0	0.0	1	0.0	0	2.0	0.0	1	2.5	0.009	283.7	1000	2.1	2.0	1.4
3554	10.19	15.9	4.3	1.4	2.0	0	0.0	1	0.0	0	2.0	0.0	1	2.7	0.020	165.8	1000	0.6	2.0	2.2
3440.5	9.39	13.7	4.8	0.8	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.013	174.6	0	0.0	2.1	2.4
3372	9.00	11.4	5.1	1.2	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.008	201.1	0	0.0	2.0	1.7
3304	8.47	14.8	4.2	0.4	2.0	0	0.0	1	0.0	0	2.0	0.0	0	1.8	0.029	265.9	0	0.0	2.0	2.1
3190.5	4.57	6.5	6.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.3	0.002	248.8	0	0.0	2.0	0.6
3105	17.04	9.6	6.4	11.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.8	0.007	258.6	0	0.0	2.0	1.2
3020	17.69	14.2	5.0	10.4	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.014	168.5	0	0.0	2.0	2.5
2934	15.65	9.7	7.0	9.6	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.007	251.8	0	0.0	2.0	1.3
2820.5	15.39	17.6	3.9	8.7	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.025	152.7	0	0.0	2.0	1.9
2748	14.49	17.1	3.6	7.9	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.025	166.7	0	0.0	2.0	1.8
2675.5	16.39	13.2	4.4	7.6	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.7	0.014	200.1	500	1.9	2.0	2.2
2560.5	15.91	12.6	5.1	6.3	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.1	0.017	262.5	500	2.7	2.0	2.1
2476	14.36	14.4	3.9	5.6	0.8	0	0.0	1	0.0	0	2.0	0.0	1	1.8	0.026	265.2	500	2.1	2.0	1.9
2391	13.94	11.0	4.3	5.5	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.7	0.009	239.4	500	2.1	2.0	1.6
2305.5	19.84	6.8	6.3	4.2	0.8	0.9	6.0	1	0.0	1	0.0	12.2	0	4.4	0.002	232.1	0	0.0	2.0	0.6
2190.5	22.42	11.6	4.5	3.1	0.8	0.9	6.0	1	0.0	1	0.0	14.7	0	2.9	0.009	208.7	0	0.0	2.0	1.8
2122	8.93	13.5	4.7	1.8	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.016	211.6	0	0.0	2.0	2.4
2054	8.30	13.9	4.2	1.4	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.4	0.018	212.4	0	0.0	2.0	2.1
1940.5	7.41	14.6	3.5	0.9	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.3	0.020	210.2	0	0.0	2.0	1.7
1872	6.96	10.1	4.6	0.8	0.8	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.006	221.4	0	0.0	2.0	1.4
1804	5.50	15.1	3.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.2	0.023	211.4	0	0.0	2.0	1.5
1688.62	10.07	14.4	2.8	3.9	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.1	0.022	232.8	0	0.0	2.0	1.4
1584	7.22	4.3	6.5	2.2	0.8	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.001	329.7	0	0.0	2.0	0.2
1518	8.89	10.4	4.9	2.2	0.8	0	0.0	1	0.0	0	2.0	0.0	0	3.2	0.005	222.0	0	0.0	2.0	1.9
1448	9.56	11.9	4.8	2.8	0.8	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.007	155.2	0	0.0	2.0	1.9
MAXIMUM=	22.4			11.0	2.0							14.7						4.1		2.9
MINIMUM=	4.6			0.0	0.0							0.0						0.0		0.2

- No long-term scour (Z_{DEG}) or General Scour (Z_{GS}) was applied at the grade control structures.
- Z_{DEG} values were determined by subtracting the minimum channel elevation for the stable slope geometry from the minimum channel elevation for the design slope geometry.
- Z_{GS} values were obtained from Table 5.6 in the main body of the report.

DEFINITIONS

Z_{TOT} = TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG} = LONG TERM DEGRADATION IN FEET
Z_{GS} = GENERAL SCOUR IN FEET
Z_{LS} = LOCAL SCOUR IN FEET [**Z_{LS} BANK + Z_{LS} BRIDGE**]
Z_{LS} BRIDGE = BRIDGE LOCAL SCOUR IN FEET [PIER (APP C-4) + ABUTMENT (APP C-6)]
Z_{LS} BANK = LEVEE/BANK LOCAL SCOUR = **2.0'** IF BANK PROTECTION PRESENT
BANK PROT = BANK PROTECTION ON CHANNEL BANK
0 = YES; **1** = NO
PIER TYPE = PIER SHAPE FACTOR; IF NO PIERS = **0**
1.0 = SQUARE NOSE; **0.9** = ROUND NOSE; **0.9** = CYLINDER;
0.8 = SHARP NOSE; **0.9** = GROUP OF CYLINDERS
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
B = WIDTH OF PIERS IN FEET; NO PIER = **0**
ABUT TYPE = VERT WALL FACTOR; IF VERT = **2**; NON VERT = **1**
A = ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
Z_{BS} = BEND SCOUR IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND = **0**, BEND = **1**
HYD DEPTH = HYDRAULIC DEPTH IN FEET
E SLOPE = ENERGY SLOPE, UNITLESS
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I = LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H = BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-59 AND ASSOCIATED APPENDICES (APPENDIX C). VALUES FOR TOE-DOWN BASED ON THE CUT-OFF DEPTHS TABLE (PAGE F-31) IN THE LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF TOE-DOWN BETWEEN THE TWO METHODOLOGIES (Z_{MAX}). THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT-OFF DEPTH BASED ON FIGURE F-06 (PAGE F-37). LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR VALUES ARE INTERPOLATED FROM THE GENERAL DEGRADATION GRAPH IN APPENDIX C (PAGE C-3) OF THE LACDPW SEDIMENTATION MANUAL. BEND SCOUR AND LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON APPENDIX C (PAGES C-6 TO C-8) OF THE LACDPW SEDIMENTATION MANUAL. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON APPENDIX C-9 OF THE SEDIMENTATION MANUAL. THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY REVISION INCLUDES THE Z_{MAX} CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

LACDPW = LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES
OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

PACE
Advanced Water Engineering

TABLE E.5 - HASLEY CANYON EAST BANK PROTECTION PROJECT FOR STABLE SLOPE, Q_{100} AND n = 0.025
CALCULATIONS FOR TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Z_{TOT}	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	BANK PROT	Z_{LS}+ BANK	Z_{LS}+ BRIDGE	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_I+	H/2
4396.0	5.76	23.0	3.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.2	0.033	95.4	900	0.1	2.0	1.7
4300.0	5.60	38.1	3.2	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.0	0.101	62.3	900	0.0	2.0	1.6
4282.0	5.56	41.1	3.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.9	0.122	59.4	900	0.0	2.0	1.6
4276.0	5.06	36.2	2.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.0	0.146	94.7	0	0.0	2.0	1.1
4270.0	4.25	4.3	9.3	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	8.6	0.000	187.8	0	0.0	2.0	0.3
4265.0	5.11	9.1	4.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.5	0.003	173.6	0	0.0	2.0	1.1
4258.0	4.88	8.1	4.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.6	0.002	188.3	0	0.0	2.0	0.9
4248.8	4.16	3.5	10.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	9.1	0.000	221.5	0	0.0	2.0	0.2
4157.0	4.09	2.6	10.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	10.0	0.000	273.6	0	0.0	2.0	0.1
4055.5	12.15	9.1	10.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.0	0.006	257.7	300	6.9	2.2	1.1
3940.5	12.84	9.3	10.7	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.7	0.007	281.3	300	7.4	2.2	1.2
3844.0	7.23	15.5	8.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.019	173.3	0	0.0	2.0	3.2
3747.0	7.80	16.0	6.9	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.018	148.9	0	0.0	2.4	3.4
3650.0	5.23	9.6	8.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.008	286.8	0	0.0	2.0	1.2
3554.0	6.68	16.4	5.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.022	164.7	0	0.0	2.0	2.7
3440.5	6.60	13.9	5.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.012	162.4	0	0.0	2.0	2.6
3372.0	6.05	12.3	5.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.011	198.1	0	0.0	2.0	2.0
3304.0	6.27	14.3	4.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	1.9	0.026	265.9	0	0.0	2.0	2.3
3190.5	8.03	11.8	4.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.5	0.012	236.9	500	2.1	2.0	1.9
3167.3	9.59	2.7	15.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	11.0	0.000	234.4	500	5.5	2.0	0.1
3105.0	7.07	9.3	14.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	8.9	0.002	84.7	500	1.9	2.0	1.2
3020.0	9.86	7.6	15.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	5.5	0.002	168.7	500	4.9	2.2	0.8
2934.0	5.79	11.5	14.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.1	0.006	147.1	0	0.0	2.0	1.8
2820.5	8.41	21.6	8.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	7.6	0.012	42.6	0	0.0	2.0	4.4
2748.0	7.92	17.0	10.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.027	160.9	0	0.0	2.0	3.9
2675.5	7.10	15.2	9.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.8	0.014	121.4	0	0.0	2.0	3.1
2560.5	5.19	9.4	11.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.8	0.007	269.9	0	0.0	2.0	1.2
2476.0	7.83	17.4	7.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.6	0.017	113.3	0	0.0	2.0	3.8
2391.0	6.06	11.4	9.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.011	234.9	0	0.0	2.3	1.8
2305.5	16.70	7.2	9.8	0.0	0.0	0.9	6.0	1	0.0	1	0.0	13.3	0	4.3	0.002	227.8	0	0.0	2.7	0.7
2190.5	18.39	10.2	7.7	0.0	0.0	0.9	6.0	1	0.0	1	0.0	15.0	0	3.3	0.006	209.1	0	0.0	2.0	1.4
2122.0	9.75	14.0	5.9	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.4	0.017	207.9	400	3.1	2.0	2.6
2054.0	9.17	12.5	5.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.6	0.013	213.4	400	3.0	2.0	2.1
1940.5	8.49	14.3	4.3	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.3	0.019	210.0	400	2.3	2.0	2.2
1872.0	5.82	11.6	4.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.8	0.010	217.0	0	0.0	2.0	1.8
1804.0	5.57	14.2	3.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.3	0.019	212.2	0	0.0	2.0	1.6
1801.3	6.38	20.2	4.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.8	0.017	73.2	0	0.0	2.0	2.4
1688.6	5.49	20.3	3.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.029	116.0	0	0.0	2.0	1.5
1584.0	5.39	16.7	2.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.8	0.021	151.5	0	0.0	2.0	1.4
MAXIMUM=	18.4			0.0	0.0							15.0						7.4		4.4
MINIMUM=	4.1			0.0	0.0							0.0						0.0		0.1

- Z_{DEG} is zero for the stable slope condition because it represents the equilibrium slope.
- Z_{GS} values were obtained from Table 5.6 in the main body of the report.

DEFINITIONS

V(FPS) = VELOCITY IN FEET PER SECOND
Z_{TOT} = TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG} = LONG TERM DEGRADATION IN FEET
Z_{GS} = GENERAL SCOUR IN FEET
Z_{LS} = LOCAL SCOUR IN FEET [Z_{LS} **BANK** + Z_{LS} **BRIDGE**]
Z_{LS} **BRIDGE** = BRIDGE LOCAL SCOUR IN FEET [PIER (APP C-4) + ABUTMENT (APP C-6)]
Z_{LS} **BANK** = LEVEE/BANK LOCAL SCOUR = **2.0'** IF BANK PROTECTION PRESENT
BANK PROT = BANK PROTECTION ON CHANNEL BANK
0 = YES; **1** = NO
PIER TYPE = PIER SHAPE FACTOR; IF NO PIERS = **0**
1.0 = SQUARE NOSE; **0.9** = ROUND NOSE; **0.9** = CYLINDER;
0.8 = SHARP NOSE; **0.9** = GROUP OF CYLINDERS
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
B = WIDTH OF PIERS IN FEET; NO PIER = **0**
ABUT TYPE = VERT WALL FACTOR; IF VERT = **2**; NON VERT = **1**
A = ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
Z_{BS} = BEND SCOUR IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND = **0**, BEND = **1**
HYD DEPTH = HYDRAULIC DEPTH IN FEET
E SLOPE = ENERGY SLOPE, UNITLESS
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I = LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H = BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-59 AND ASSOCIATED APPENDICES (APPENDIX C). VALUES FOR TOE-DOWN BASED ON THE CUT-OFF DEPTHS TABLE (PAGE F-31) IN THE LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF TOE-DOWN BETWEEN THE TWO METHODOLOGIES (Z_{MAX}). THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT-OFF DEPTH BASED ON FIGURE F-06 (PAGE F-37). LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR VALUES ARE INTERPOLATED FROM THE GENERAL DEGRADATION GRAPH IN APPENDIX C (PAGE C-3) OF THE LACDPW SEDIMENTATION MANUAL. BEND SCOUR AND LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON APPENDIX C (PAGES C-6 TO C-8) OF THE LACDPW SEDIMENTATION MANUAL. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON APPENDIX C-9 OF THE SEDIMENTATION MANUAL. THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY REVISION INCLUDES THE Z_{MAX} CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

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INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

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PACIFIC ADVANCED CIVIL ENGINEERING, INC
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TABLE E.6 - HASLEY CANYON WEST BANK PROTECTION PROJECT FOR STABLE SLOPE, Q_{100} AND n = 0.025
CALCULATIONS FOR TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Z_{TOT}	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	BANK PROT	Z_{LS}+ BANK	Z_{LS}+ BRIDGE	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_I+	H/2
4396.0	5.69	23.0	3.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.2	0.033	95.4	0	0.0	2.0	1.7
4300.0	5.60	38.1	3.2	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.101	62.3	0	0.0	2.0	1.6
4282.0	5.56	41.1	3.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.122	59.4	0	0.0	2.0	1.6
4276.0	5.95	36.2	2.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.0	0.146	94.7	300	0.9	2.0	1.1
4270.0	8.63	4.3	9.3	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	8.6	0.000	187.8	300	4.4	2.0	0.3
4265.0	7.53	9.1	4.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.5	0.003	173.6	300	2.4	2.0	1.1
4258.0	7.46	8.1	4.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.6	0.002	188.3	300	2.6	2.0	0.9
4248.8	9.16	3.5	10.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	9.1	0.000	221.5	300	5.0	2.0	0.2
4157.0	9.73	2.6	10.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	10.0	0.000	273.6	300	5.6	2.0	0.1
4055.5	5.29	9.1	10.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.006	257.7	0	0.0	2.2	1.1
3940.5	5.40	9.3	10.7	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.7	0.007	281.3	0	0.0	2.2	1.2
3844.0	7.23	15.5	8.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.019	173.3	0	0.0	2.0	3.2
3747.0	7.80	16.0	6.9	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.018	148.9	0	0.0	2.4	3.4
3650.0	7.77	9.6	8.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.6	0.008	286.8	1,000	2.5	2.0	1.2
3554.0	7.47	16.4	5.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.6	0.022	164.7	1,000	0.8	2.0	2.7
3440.5	6.60	13.9	5.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.012	162.4	0	0.0	2.0	2.6
3372.0	6.05	12.3	5.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.011	198.1	0	0.0	2.0	2.0
3304.0	6.27	14.3	4.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	1.9	0.026	265.9	0	0.0	2.0	2.3
3190.5	5.89	11.8	4.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.012	236.9	0	0.0	2.0	1.9
3167.3	4.10	2.7	15.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	11.0	0.000	234.4	0	0.0	2.0	0.1
3105.0	5.16	9.3	14.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	8.9	0.002	84.7	0	0.0	2.0	1.2
3020.0	4.97	7.6	15.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	5.5	0.002	168.7	0	0.0	2.2	0.8
2934.0	5.79	11.5	14.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.1	0.006	147.1	0	0.0	2.0	1.8
2820.5	8.41	21.6	8.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	7.6	0.012	42.6	0	0.0	2.0	4.4
2748.0	7.92	17.0	10.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.027	160.9	0	0.0	2.0	3.9
2675.5	9.56	15.2	9.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.8	0.014	121.4	500	2.5	2.0	3.1
2560.5	10.89	9.4	11.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.8	0.007	269.9	500	5.7	2.0	1.2
2476.0	9.72	17.4	7.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.6	0.017	113.3	500	1.9	2.0	3.8
2391.0	10.30	11.4	9.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	2.6	0.011	234.9	500	4.2	2.3	1.8
2305.5	16.70	7.2	9.8	0.0	0.0	0.9	6.0	1	0.0	1	0.0	13.3	0	4.3	0.002	227.8	0	0.0	2.7	0.7
2190.5	18.39	10.2	7.7	0.0	0.0	0.9	6.0	1	0.0	1	0.0	15.0	0	3.3	0.006	209.1	0	0.0	2.0	1.4
2122.0	6.64	14.0	5.9	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.4	0.017	207.9	0	0.0	2.0	2.6
2054.0	6.12	12.5	5.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.013	213.4	0	0.0	2.0	2.1
1940.5	6.17	14.3	4.3	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.3	0.019	210.0	0	0.0	2.0	2.2
1872.0	5.82	11.6	4.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.8	0.010	217.0	0	0.0	2.0	1.8
1804.0	5.57	14.2	3.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	2.3	0.019	212.2	0	0.0	2.0	1.6
1801.3	6.38	20.2	4.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.8	0.017	73.2	0	0.0	2.0	2.4
1688.6	5.49	20.3	3.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.029	116.0	0	0.0	2.0	1.5
1584.0	5.39	16.7	2.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0		2.8	0.021	151.5	0	0.0	2.0	1.4
MAXIMUM=	18.4			0.0	0.0							15.0						5.7		4.4
MINIMUM=	4.1			0.0	0.0							0.0						0.0		0.1

- Z_{DEG} is zero for the stable slope condition because it represents the equilibrium slope.
- Z_{GS} values were obtained from Table 5.6 in the main body of the report.

DEFINITIONS

V(FPS) = VELOCITY IN FEET PER SECOND
Z_{TOT} = TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG} = LONG TERM DEGRADATION IN FEET
Z_{GS} = GENERAL SCOUR IN FEET
Z_{LS} = LOCAL SCOUR IN FEET [**Z_{LS} BANK + Z_{LS} BRIDGE**]
Z_{LS} BRIDGE = BRIDGE LOCAL SCOUR IN FEET [PIER (APP C-4) + ABUTMENT (APP C-6)]
Z_{LS} BANK = LEVEE/BANK LOCAL SCOUR = **2.0'** IF BANK PROTECTION PRESENT
BANK PROT = BANK PROTECTION ON CHANNEL BANK
0 = YES; **1** = NO
PIER TYPE = PIER SHAPE FACTOR; IF NO PIERS = **0**
1.0 = SQUARE NOSE; **0.9** = ROUND NOSE; **0.9** = CYLINDER;
0.8 = SHARP NOSE; **0.9** = GROUP OF CYLINDERS
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
B = WIDTH OF PIERS IN FEET; NO PIER = **0**
ABUT TYPE = VERT WALL FACTOR; IF VERT = **2**; NON VERT = **1**
A = ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
Z_{BS} = BEND SCOUR IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND = **0**, BEND = **1**
HYD DEPTH = HYDRAULIC DEPTH IN FEET
E SLOPE = ENERGY SLOPE, UNITLESS
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I = LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H = BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-59 AND ASSOCIATED APPENDICES (APPENDIX C). VALUES FOR TOE-DOWN BASED ON THE CUT-OFF DEPTHS TABLE (PAGE F-31) IN THE LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF TOE-DOWN BETWEEN THE TWO METHODOLOGIES (Z_{MAX}). THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT-OFF DEPTH BASED ON FIGURE F-06 (PAGE F-37). LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR VALUES ARE INTERPOLATED FROM THE GENERAL DEGRADATION GRAPH IN APPENDIX C (PAGE C-3) OF THE LACDPW SEDIMENTATION MANUAL. BEND SCOUR AND LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON APPENDIX C (PAGES C-6 TO C-8) OF THE LACDPW SEDIMENTATION MANUAL. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON APPENDIX C-9 OF THE SEDIMENTATION MANUAL. THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY REVISION INCLUDES THE Z_{MAX} CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

LACDPW = LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES
OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

PACE
Advanced Water Engineering

PACE
Advanced Water Engineering

Appendix F: Fluvial Study Calculations and Supporting Documents

Appendix F – Fluvial Study Calculations and Supporting Documentation

Excerpt of "Hydraulic Analysis Technical Assessment Report for Engineered Earthen-Bottom Flood Control Channels Located Within the Santa Clara River Watershed and Antelope Valley Watershed"

PACE

HYDRAULIC ANALYSIS
TECHNICAL ASSESSMENT REPORT

FOR
ENGINEERED EARTHEN-BOTTOM FLOOD CONTROL CHANNELS LOCATED WITHIN THE SANTA CLARA RIVER WATERSHED & ANTELOPE VALLEY WATERSHED

MAINTAINED AND OPERATED BY THE
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

IN COMPLIANCE WITH THE

WASTE DISCHARGE REQUIREMENTS
NUMBER R4-2015-0032-A1

PREPARED FOR:

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August 2017

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Appendices

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Appendix B – Manning's Assessment Worksheets

Appendix C – Summary Results by Reach

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Appendix H – Additional Analysis Data for SBC Reach 103

Acronyms and Abbreviations

AB: As-Built Plan

Dwg: Drawing

FEMA: Federal Emergency Management Agency

FMD: Flood Maintenance Division

HEC-RAS: Hydrologic Engineering Center's River Analysis System

LACDPW: Los Angeles County Department of Public Works

LACFCD: Los Angeles County Flood Control District

LiDAR: Light Detection and Ranging

MCI: Maintenance Channel Inlet

MCO: Maintenance Channel Outlet

PD: Private Drain

RDD: Road Drainage Design

SBC: Soft-Bottom Channel

SCR: Santa Clara River

TIN: Triangulated Irregular Network

USACE: United States Army Corps of Engineers

WDR: Waste Discharge Requirements

1 Introduction

The Los Angeles County Flood Control District (LACFCD) operates and maintains numerous engineered soft-bottom flood control channels within the County of Los Angeles. These channels convey storm flows from the canyons and surrounding areas. The LACFCD conducts annual maintenance to provide efficient and effective operation of these facilities to protect life and property from potential flooding, reduce fire hazards, and control vector nuisances.

On February 4, 2010, the Los Angeles Regional Water Quality Control Board (Regional Board) adopted Waste Discharge Requirements (WDR) for the maintenance of soft-bottomed flood control channels, Order No. R4-2010-0021. The adopted WDR required a Feasibility Study to be conducted within six years for all the earth-bottomed channels, authorized in the WDR, in each watershed within Los Angeles County. The Feasibility Study included a hydraulic analysis for the engineered earthen-bottom flood control channels located within the Santa Clara River and Antelope Valley Watersheds. The hydraulic analysis will determine the existing flood control capacity of the soft-bottom channel reaches and whether the potential may exist for native vegetation to remain within the soft-bottom portion of the channel or if additional hydraulic capacity is needed. The WDR was extended on February 12, 2015 (Order No. R4-2015-0032) and amended on February 11, 2016 (Order No. R4-2015-0032-A1).

This report presents the results of a technical assessment of the hydraulic conditions for 51 soft-bottom channel reaches in the Santa Clara River Watershed and one soft-bottom channel reach in the Antelope Valley Watershed included in the WDR. Detailed reach characteristics and hydraulic modeling assumptions are presented in the respective sections for the reaches examined in this report. The report addresses capacity requirements for flood control and analyzes, from a hydraulic perspective, reaches with the potential for restoration or addition of native vegetation or where existing vegetation must be removed. Reaches have been identified where vegetation can remain in the channel and where native vegetation can be reintroduced.

1.1 Study Reaches

Within the Santa Clara River and Antelope Valley Watersheds, there are 52 defined soft-bottom reaches in the Regional Board's WDR. Locations of the 52 soft-bottom channel (SBC) reaches are presented in Figure 1-1. Reach lengths are summarized in Table 1-1.

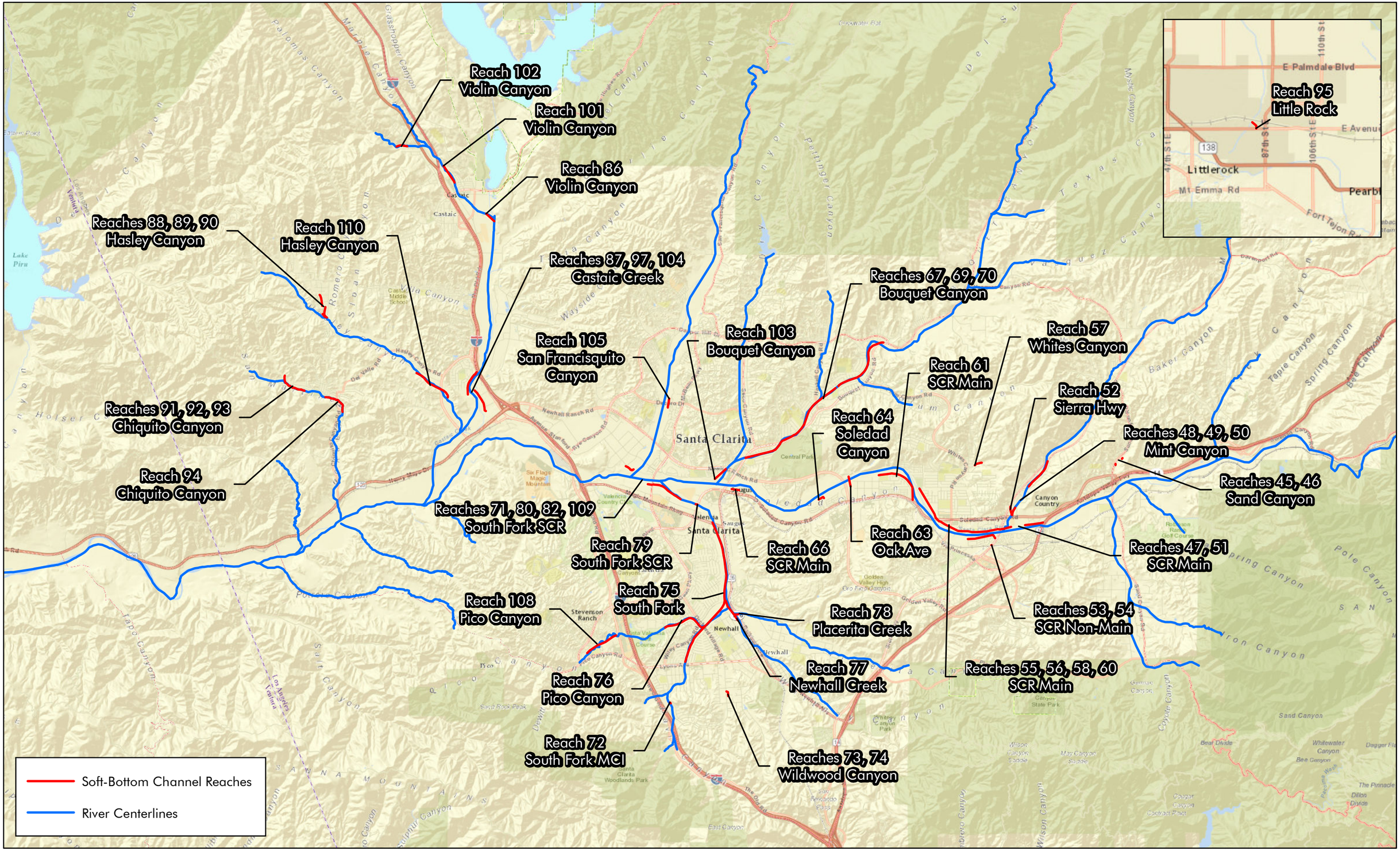
The study reaches include main channels and creeks, as well as their main and secondary tributaries. In the Santa Clara River Watershed, the SBC reaches include portions of the Santa Clara River, South Fork, Hasley Canyon, Violin Canyon, San Martinez Chiquito Canyon, Castaic Creek, Pico Canyon, Bouquet Canyon, Mint Canyon, Sand Canyon, Whites Canyon, Wildwood Canyon, and San Francisquito Canyon. In the Antelope Valley Watershed, the SBC reach includes a portion of Little Rock Wash.

Table 1-1: List of Soft-Bottom Channel Reaches

Report Section	Reach No.	Reach Name	Length (ft)
2	71	Santa Clara River Main Channel	242
	80	South Fork SCR (Main River Channel)	2,686
	82	Santa Clara River Main Channel	849
	109	Santa Clara River (MTD 1510) South Bank West of McBean Pkwy	372
3	76	Pico Canyon	4,116
4	86	Violin Canyon MCO	1,006
	101	Violin Canyon	1,818
	102	Violin Canyon	975

Report Section	Reach No.	Reach Name	Length (ft)
5	88	Hasley Canyon Upper	1,051
	89	Hasley Canyon South Fork	341
	90	Hasley Canyon Lower	1,051
6	97	Castaic Creek (Live Oak)	2,002
	104	Castaic Creek (Handcock)	2,223
7	105	San Francisquito Canyon Channel	833
8	110	Hasley Canyon Channel	3,737
9	47	Santa Clara River Main Channel	1,658
	51	Santa Clara River	931
	55	Santa Clara River Main Channel – Right Bank	3,518
	56	Santa Clara River Main Channel – Left Bank	2,346
	58	Santa Clara River Main Channel	2,644
	60	Santa Clara River Main Channel	3,166
	61	Santa Clara River	4,715
10	63	Oak Ave Road Drainage	914
11	66	Santa Clara River Main Channel	710
12	67	Bouquet Canyon Upper	6,344
	69	Bouquet Canyon Middle	7,326
	70	Bouquet Canyon Lower	3,505
	103	Bouquet Canyon Channel	1,348
13	75	South Fork SCR	14,075
14	79	South Fork SCR (Valencia Blvd Bridge Stabilizer)	168
15	87	Castaic Old Road Drain Outlet	225
16	108	Pico Canyon	3,100
17	45	Sand Canyon Main Channel Inlet	102
	46	Sand Canyon Main Channel Outlet	84
18	48	Mint Canyon Mint Canyon Channel b/w Sierra Hwy & Adon Ave	2,505
	49	Mint Canyon Channel b/w Adon Ave & Scherzinger	385
	50	Mint Canyon Channel b/w Solomint & Soledad	735
	52	Sierra Hwy Road Drainage	722
19	53	Santa Clara River Non/main Channel MCI	35
	54	Santa Clara River Non/main Channel MCO	316
20	57	Whites Canyon MCI	695
21	64	Soledad Canyon Road Drain	574
22	72	South Fork Santa Clara River (Smizer Ranch MCI)	101
23	73	Wildwood Canyon Channel MCI	83
	74	Wildwood Canyon Channel	365
24	77	Newhall Creek Outlet	2,092
25	78	Placerita Creek	376
26	91	San Martinez Chiquito Canyon u/s Kensington Road	599
	92	San Martinez Chiquito Canyon (N. Fork) unnamed	768
	93	San Martinez Chiquito Canyon b/w Kensington/Val Verde Park	1,072
	94	San Martinez Chiquito Canyon b/w Val Verde Park/ d/s of Madison St.	2,446
27 [1]	95	Little Rock Wash	1,823

Notes:
[1] *Reach 95 is the only SBC reach located within the Antelope Valley Watershed.*



PACE Advanced Water Engineering

LACDPW
SANTA CLARA RIVER WATERSHED
SOFT BOTTOM CHANNEL ANALYSIS

TITLE: SOFT-BOTTOM CHANNEL REACH LOCATION MAP

FIGURE: 1-1

1.2 Report Organization

This report is organized into individual sections identifying and describing each SBC reach analyzed for the Santa Clara River and Antelope Valley Watersheds. The sections present the reaches in the same order as listed in Table 1-1. Reaches that are modeled hydraulically as a single reach are summarized together in one section.

Supplementary information is provided in the Appendices A - E regarding notes and photographs from field investigations, existing condition Manning's value assessments, super-elevation calculations and freeboard capacity results.

1.3 Hydrologic Data

Design flow rates were used for the hydraulic analysis of the soft-bottom channel reaches. The flow data used in this study were obtained from various sources. A discussion of the source of the flow data is provided in each reach's section.

1.4 Hydraulic Modeling

Hydraulic models were developed for the 52 SBC reaches using the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) computer program, Version 5.0.3. Several iterations of the models were conducted for each channel reach.

Initially, a model of the existing conditions was developed. The model of the existing conditions uses design flow rates and vegetation levels in the channel reach representing the typical vegetation levels existing immediately prior to annual maintenance activities (i.e. vegetation levels typical in August-October). A second model was also developed for a "design conditions" (or estimated design conditions) scenario for those cases when existing condition did not have excess capacity or partial excess capacity. The design conditions model uses design flow rates and design roughness conditions in the channel reach.

For the reaches not having excess capacity (to convey the design flow rate) under the existing conditions scenario, the design conditions model was reviewed to determine whether the reach might have excess capacity under a "design conditions" (or estimated design conditions) scenario. If there was excess capacity under the design conditions scenario, development of a model with added native vegetation in a quantity that would not result in the design channel capacity being exceeded was considered. The type and species of the additional vegetation was determined in consultation with BonTerra Psomas, the LACFCD biological consultant.

For reaches that were found to have excess channel capacity under the existing conditions scenario, a model was developed to determine the amount and type of additional vegetation that might be allowed to remain in the channel reach without affecting the design channel capacity. Selection of the vegetation was accomplished with recommendations from BonTerra Psomas.

The hydraulic models follow standard orientation conventions used by the USACE. Cross sections defining channel geometry are described by station and elevation data from left to right, looking in the downstream direction. River stationing begins downstream and increases upstream. Input and output files for the hydraulic models discussed in this report are provided in Appendix E.

1.4.1 *Field Investigations*

Field investigations were conducted for all 52 SBC reaches to verify channel geometry, obstructions, structures, and vegetation. The field investigations were completed by PACE between August and October of 2015. Field notes and photographs were taken of all reaches to document the type, density, and size of vegetation. These items are provided in Appendix A.

1.4.2 *Manning's Roughness Coefficients*

Manning's roughness coefficients were determined from field observations, published values of Manning's roughness coefficients, and engineering judgement. The references used in estimating the Manning's roughness coefficients were "Open-Channel Hydraulics" by Ven T. Chow and "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains", United States Geological Survey Water-supply Paper 2339.

Six variables were quantified for the observed channel features: (1) river bed material, (2) surface irregularities, (3) variation in channel width, (4) channel obstructions, (5) vegetation, and (6) channel meandering. Each variable has a range of sub-type characterizations that range from smallest to largest roughness contribution. The soft-bottom channel roughness values were estimated using the following formula, developed by Cowan (1956):

$$n = (n_b + n_1 + n_2 + n_3 + n_4)m$$

where:

n_b = a base value of n for a straight, uniform, smooth channel in natural materials

n_1 = a correction factor for the effect of surface irregularities

n_2 = a value for variation in the shape and size of the channel cross section

n_3 = a value for obstructions

n_4 = a value for vegetation and flow conditions

m = a correction factor for meandering of the channel

The Manning's roughness values were estimated on a reach by reach basis. Depending on the native bed material, Figure 1-2 was used to determine the base roughness, n_b.

Bed material	Median size of bed material (in millimeters)	Base *n* value	
		Straight uniform channel[1]	Smooth channel[2]
Sand channels			
Sand[3]	0.2	0.012	—
	.3	.017	—
	.4	.020	—
	.5	.022	—
	.6	.023	—
	.8	.025	—
	1.0	.026	—
Stable channels and flood plains			
Concrete	—	0.012–0.018	0.011
Rock cut	—	—	.025
Firm soil	—	0.025–0.032	.020
Coarse sand	1–2	0.026–0.035	—
Fine gravel	—	—	.024
Gravel	2–64	0.028–0.035	—
Coarse gravel	—	—	.026
Cobble	64–256	0.030–0.050	—
Boulder	>256	0.040–0.070	—

[1] Benson and Dalrymple (1967).
[2] For indicated material; Chow (1959).
[3] Only for upper regime flow where grain roughness is predominant.

Figure 1-2: Base Roughness Value (USGS Water Supply Paper 2339)

The basis for design condition Manning's roughness coefficients comes from values identified in the as-built plans and design reports. For reaches where the roughness coefficient could not be identified, either the n-value was calculated based on hydraulic data from the plans and reports – such as the channel geometry, flow rate, bed slope, and flow depth – or an assumption for the n-value was made based on bare-earth soil conditions.

Each section specifies the existing and design conditions Manning's roughness coefficients for each of the SBC reaches. Appendix B provides the assessment for existing conditions Manning's roughness coefficients for each reach.

1.4.3 *Geometric Data and Cross Sections*

The hydraulic models were developed using 2006 LiDAR topographic point data for each reach, extending both upstream and downstream of the reach of interest to avoid influence of the user defined boundary conditions on the results. The LiDAR data was processed using GIS tools and imported into HEC-RAS to develop the hydraulic models. The vertical datum for all models is NAVD 88.

Cross-sections cut lines were drawn using HEC-GeoRAS and initially placed using cross section locations from the FEMA and USACE models as a guide. For most reaches, additional cross sections were added to the model to incorporate structures, obstructions, bends in the channel, and channel transitions. As-built plans and field measurements were used as necessary to refine channel features such as bridges, culverts, drop structures, and hard surfaces.

1.4.4 *Bridges and Culverts*

Bridges and culverts included in each model use the bridge and culvert data from the FEMA and USACE models. Where structure data was not available from FEMA or USACE models, the structures were modeled based on as-built plans and field measurements.

For low flows through bridges, HEC-RAS can compute the flow through a bridge using three low flow methods: (1) the energy equation method, (2) the momentum balance method, and (3) the Yarnell equation method. Based on the type of bridge pier, a drag coefficient (*Cd*) is selected for the momentum balance equation and a pier shape coefficient (*K*) is selected for the Yarnell equation. The recommended values of *Cd* and *K* are provided in the HEC-RAS 5.0.3 User's Manual. For this analysis, HEC-RAS compared the results for all three methods and selected the method with the greatest energy loss for the solution.

For high flows through bridges, HEC-RAS can calculate high flows through bridges using two methods: (1) the standard step method, and (2) pressure and/or weir flow. The pressure and/or weir flow method is assumed for all bridges and culverts in all models, with the exception of the culvert at Soledad Canyon Road along Mint Canyon (downstream end of Reach 50). For the bridges and culverts using this method, the submerged inlet and outlet coefficient is set to the default value of 0.80.

As flow in the channel approaches the opening of a bridge or culvert, areas develop on either side of the opening where the flow will pond and no longer contribute to the active flow in the channel. Additional areas of ponding occur on either side of the bridge or culvert exit. To model this behavior, ineffective flow markers are applied to cross sections located upstream and downstream of the bridges and culverts. The placement of ineffective flow markers are based on recommendations provided in the HEC-RAS User's Manual. Ineffective flow markers are placed assuming a 1:1 contraction ratio for the upstream side and a 2:1 expansion ratio for the downstream side of the bridge or culvert. The height of the ineffective flow markers are set to the top of deck elevation for the upstream side and to an elevation between the top and the soffit of the deck for the downstream side.

Following USACE Hydrology and Hydraulics Policy Memorandum No. 4, two feet of debris accumulation is applied for debris loading on each side of each bridge pier or interior culvert wall for its entire height that is below the water surface. For piers with sloping extensions, two feet of debris accumulation is applied on each side of each pier for a distance up to six feet below the water surface.

1.4.5 *Contraction and Expansion Coefficients*

The recommended contraction and expansion coefficients of 0.1 and 0.3 from the HEC-RAS User's Manual are used to compute energy losses between cross sections. Since changes in the shape of river cross sections are more abrupt upstream and downstream of bridges, contraction and expansion coefficients were adjusted to 0.3 and 0.5 for the cross sections located immediately upstream and downstream of all bridges, culverts, and weirs.

1.4.6 *Boundary Conditions and Flow Regime*

All HEC-RAS model simulations use steady state conditions with the mixed flow regime option. The mixed flow regime was chosen to allow subcritical and supercritical flow regimes. This option requires boundary conditions at the upstream and downstream ends of the model. Most models use normal depth for the upstream and downstream boundary conditions. Boundary conditions for normal depth are based on the channel bed slope as measured from the HEC-RAS models or as-built plans. For reaches where the water surface elevations were available from as-built plans or previous hydraulic models, the hydraulic grade line was used as the boundary condition. The upstream and downstream limits of the study reach were extended a distance beyond the maintenance limits such that any user-defined boundary condition would not affect the results within the study reach. A discussion of the boundary conditions used is provided in each reach's section.

1.4.7 *Freeboard Requirement*

Freeboard is the vertical distance measured from the design water surface to the top of the channel wall or levee. Freeboard is provided to ensure that the desired degree of protection will not be reduced by unaccounted factors such as embankment settlement, accumulation of silt, trash and debris, and wave action. The freeboard requirement for each SBC reach was determined using the standard in the Los Angeles County Hydraulic Design Manual published in March 1982. The minimum required freeboard is 2.5 feet for trapezoidal channels. The minimum required freeboard increases for reaches where super-elevation may occur. Appendix C identifies the freeboard requirements for each reach, and Appendix D shows the calculation for additional freeboard required due to super-elevation.

1.5 Changes in Streamflow

Condition 21 of the 2015 WDR required that the hydraulic analysis discuss expected changes in stream flow in response to requirements of the Los Angeles County Municipal Separate Storm Sewer (MS4) NPDES Permit, Standard Urban Stormwater Mitigation Plans (SUSMPs), Total Maximum Daily Loads (TMDLs) and other pertinent local plans including, but not limited to the Integrated Regional Water Management Plan (IRWMP) (including implementation of, and plans for, increased stormwater infiltration), the City of Los Angeles' Integrated Resources Plan, the relevant watershed master plan and the LACFCD's Drought Management Plan.

While such infiltration requirements are expected to be effective in reducing stream flows during smaller storm events, which may occur potentially multiple times during a single year, the purpose of such requirements is to improve water quality and conserve water, not to significantly reduce the risk of flooding during major storm events. Flood control channels are typically designed to handle much higher stream flows which occur during large storm events. Such storm events (Flood Control Storms) will produce large volumes of runoff, quickly overwhelming these water quality infiltration facilities and rendering them insignificant in their ability to effectively reduce flow rates during the most intense part of a storm.

1.6 Summary of Results

Of the 52 soft-bottom reaches defined in the Regional Board's WDR, 8 were identified with excess capacity based on analysis of the design conditions, out of which 6 were assumed to have excess capacity since the existing conditions scenario showed excess hydraulic capacity. Under design conditions, 16 reaches had partial excess capacity and under the existing conditions 9 reaches had partial excess capacity. Although these reaches have portions within the channels that have sufficient hydraulic capacity to accommodate vegetation, not all of them are recommended for additional vegetation for one or more of the following reasons: (1) minimal maintenance practices are already being implemented, (2) short and sporadic segments of hydraulic capacity, (3) excess sediment accumulation, (4) a need for removal of most vegetation, (5) a lack of right-of-way or easement for maintenance, (6) additional vegetation would impact structures within the channel reach, and (7) the portion identified with excess capacity is hardscaped. Of the reaches identified with excess or partial excess hydraulic capacity, 7 reaches can accommodate additional vegetation, 3 of which will incorporate new biological recommendations to allow for additional vegetation growth. Detailed modeling results for the individual reaches are presented in each section and in Appendix C. Table 1-2 summarizes the hydraulic modeling results for all of the SBC reaches for the existing and design conditions scenarios.

Table 1-2: Hydraulic Assessment Summary

Reach Number	Reach Name	Hydraulic Modeling Results		
		Existing Condition	Design Condition	Additional Vegetation
71	Santa Clara River Main Channel	No Excess Capacity	No Excess Capacity	No
80	South Fork SCR (Main River Channel)	No Excess Capacity	No Excess Capacity	No
82	Santa Clara River Main Channel	Excess Capacity [1,2]	Excess Capacity [1,2]	Yes
109	Santa Clara River (MTD 1510) South Bank	No Excess Capacity	No Excess Capacity	No
76	Pico Canyon	Partial Excess Capacity [1,3,6]	Partial Excess Capacity [1,3,6]	No
86	Violin Canyon M.C.O	No Excess Capacity	No Excess Capacity	No
101	Violin Canyon	Partial Excess Capacity [1]	Partial Excess Capacity [1]	Yes[12]
102	Violin Canyon	Excess Capacity	Excess Capacity[13]	Yes
88	Hasley Canyon Upper	Partial Excess Capacity	Partial Excess Capacity	Yes
89	Hasley Canyon South Fork	No Excess Capacity	No Excess Capacity	No
90	Hasley Canyon Lower	Partial Excess Capacity [3, 7]	Partial Excess Capacity [3, 7]	No
97	Castaic Creek (Live Oak)	No Excess Capacity [10]	No Excess Capacity [10]	No
104	Castaic Creek (Hancock)	Excess Capacity[1,2]	Excess Capacity [1,2,13]	Yes
105	San Francisquito Canyon Channel	Excess Capacity [1,4]	Excess Capacity [1,4,13]	Yes
110	Hasley Canyon Channel	No Excess Capacity [9]	Excess Capacity [9]	No
47	Santa Clara River Main Channel	No Excess Capacity [1]	Partial Excess Capacity [1]	No
51	Santa Clara River	No Excess Capacity [1]	Partial Excess Capacity [1]	No
55	Santa Clara River Main Channel – Right Bank	No Excess Capacity	No Excess Capacity	No
56	Santa Clara River Main Channel – Left Bank	No Excess Capacity	No Excess Capacity	No
58	Santa Clara River Main Channel	Partial Excess Capacity [7]	Partial Excess Capacity [7]	No
60	Santa Clara River Main Channel	No Excess Capacity	No Excess Capacity	No
61	Santa Clara River	No Excess Capacity	No Excess Capacity	No

Reach Number	Reach Name	Hydraulic Modeling Results		
		Existing Condition	Design Condition	Additional Vegetation
63	Oak Ave Road Drainage	No Excess Capacity [10]	No Excess Capacity [10]	No
66	Santa Clara River Main Channel	No Excess Capacity	No Excess Capacity	No
67	Bouquet Canyon Upper	No Excess Capacity	Partial Excess Capacity [3]	No
69	Bouquet Canyon Middle	No Excess Capacity	Partial Excess Capacity [3]	No
70	Bouquet Canyon Lower	Partial Excess Capacity [3, 8]	Partial Excess Capacity [3, 8]	No
103	Bouquet Canyon Channel	Excess Capacity	Excess Capacity [13]	Yes
75	South Fork SCR	No Excess Capacity	Partial Excess Capacity [3]	No
79	South Fork SCR (Valencia Blvd Bridge Stabilizer)	Partial Excess Capacity [5]	Partial Excess Capacity [5]	No
87	Castaic Old Road Drain Outlet	No Excess Capacity [10]	No Excess Capacity [10]	No
108	Pico Canyon	No Excess Capacity	Excess Capacity [1]	No
45	Sand Canyon M.C.I.	Excess Capacity [10]	Excess Capacity [10, 13]	No
46	Sand Canyon M.C.O.	No Excess Capacity	No Excess Capacity	No
48	Mint Canyon Mint Canyon Channel	No Excess Capacity	No Excess Capacity	No
49	Mint Canyon Channel	No Excess Capacity	No Excess Capacity	No
50	Mint Canyon Channel	No Excess Capacity	No Excess Capacity	No
52	Sierra Hwy Road Drainage[11]	–	–	No
53	Santa Clara River Tributary Channel M.C.I	No Excess Capacity	No Excess Capacity	No
54	Santa Clara River Tributary Channel M.C.O	No Excess Capacity	No Excess Capacity	No
57	Whites Canyon M.C.I	No Excess Capacity	No Excess Capacity	No
64	Soledad Canyon Road Drainage	No Excess Capacity [10]	No Excess Capacity [10]	No
72	South Fork Santa Clara River (Smizer Ranch M.C.I)	No Excess Capacity	No Excess Capacity	No
73	Wildwood Canyon Channel M.C.I.	No Excess Capacity [10]	No Excess Capacity [10]	No
74	Wildwood Canyon Channel	Partial Excess Capacity [6, 10]	Partial Excess Capacity [6, 10]	No

Reach Number	Reach Name	Hydraulic Modeling Results		
		Existing Condition	Design Condition	Additional Vegetation
77	Newhall Creek Outlet	No Excess Capacity [10]	Partial Excess Capacity [3, 8,10]	No
78	Placerita Creek	No Excess Capacity [10]	No Excess Capacity [10]	No
91	San Martinez Chiquito Canyon	No Excess Capacity	No Excess Capacity	No
92	San Martinez Chiquito Canyon	Partial Excess Capacity [1, 7]	Partial Excess Capacity [1, 7]	No
93	San Martinez Chiquito Canyon	No Excess Capacity	Partial Excess Capacity [1, 8]	No
94	San Martinez Chiquito Canyon	No Excess Capacity	No Excess Capacity	No
95	Little Rock Wash	No Excess Capacity	No Excess Capacity	No

Notes:

[1] *Minimal maintenance practice in place (approximately 15' along levee toe), allowing existing vegetation growth to full potential across width of channel in cases where channel width is wider than minimal clearance.*
[2] *Segments identified with capacity have mature existing vegetation in place.*
[3] *Portions identified with excess capacity were predominately segmented and sporadic. No additional vegetation recommendation proposed.*
[4] *Channel design accommodates and allows for mature vegetation.*
[5] *Segment of the channel is in the location of the bridge stabilizer structure where vegetation cannot be planted.*
[6] *Portion identified with excess capacity is hard-bottom (concrete, rip-rap)*
[7] *Limited easement. No additional vegetation recommended within LACFCD right-of-way. Remaining width of channel outside of right-of-way remains natural.*
[8] *Easement does not exist in portions with excess capacity. No additional vegetation recommended.*
[9] *Excess sediment accumulation*
[10] *LACFCD does not have an easement for the reach*
[11] *This reach is part of Reach 50 – Mint Canyon Channel*
[12] *This reach can accommodate additional vegetation then originally designed, however vegetation levels should not exceed existing conditions*
[13] *Design condition scenario not analyzed, assumed to have excess capacity based on results of existing condition analysis*

8 Hasley Canyon Channel Reach 110

8.1 General Description

Hasley Canyon is a tributary to Castaic Creek located within the Santa Clara River Watershed. Hasley Canyon Channel originates in the mountains north of the Santa Clara River and joins with Castaic Creek at Commerce Center Drive. The study reach is nearly 4,000 feet in length, extending approximately 3,000 feet upstream and 1,000 feet downstream of Commerce Center Drive. The surrounding land consists of mostly commercial property with some brushy open space located at the upstream and downstream boundaries. The soft-bottom reach of interest along Hasley Canyon Channel measures 3,737 feet in length. The limits of the SBC reach are illustrated in Figure 8-1.

Figure 8-1: Reach 110 – Hasley Canyon Channel

8.2 Structures

The reach of interest for Hasley Canyon Channel is an engineered, concrete slope-lined channel with an earthen bottom and 12 drop structures. One bridge crosses Hasley Canyon Channel along the study reach, as summarized in Table 8-1.

Table 8-1: Reach 110 – Hasley Canyon Channel Structures

Structure Number	HEC-RAS Station	Road Name	Type	Description	Structure Model Data Origin
1	4500	Commerce Center Dr.	Bridge	1 – 12" wide square-nosed pier wall	USACE model

8.3 Manning's Roughness Coefficient

8.3.1 *Existing Conditions Manning's Coefficient*

Photographs documenting the existing channel conditions are provided in Appendix A. The existing conditions Manning's roughness coefficients are summarized in Table 8-2 with backup detail provided in Appendix B.

Table 8-2: Reach 110 – Hasley Canyon Channel Existing Conditions Manning's Roughness

HEC-RAS Station	Left Bank	Main Channel	Right Bank
7672.401	0.025	0.034	0.025
7367.926 to 7321.790	0.025	0.032	0.025
7261.271 to 7054.132	0.015	0.090	0.015
7027.804 to 6754.417	0.015	0.047	0.015
6716.515 to 6433.633	0.015	0.042	0.015
6407.497 to 6033.218	0.015	0.068	0.015
6015.436 to 5739.189	0.015	0.051	0.015
5713.722 to 5141.326	0.015	0.072	0.015
5117.463 to 4926.440	0.015	0.060	0.015
4892.486 to 4678.845	0.015	0.070	0.015
4639.804	0.015	0.052	0.015
4395.956 to 4107.706	0.015	0.121	0.015
4087.444 to 3743.888	0.015	0.095	0.015
3637.300 to 3614.738	0.015	0.085	0.015
3450.237	0.042	0.085	0.042

8.3.2 *Design Conditions Manning's Coefficient*

The Manning's roughness values for the design conditions HEC-RAS model are based on information provided in the as-built plans for the engineered channel. The Manning's roughness values used in the Design Conditions HEC-RAS model are summarized in Table 8-3.

Table 8-3: Reach 110 – Hasley Canyon Channel Design Conditions Manning's Roughness

HEC-RAS Station	Left Bank	Main Channel	Right Bank
7672.401 to 3450.237	0.030	0.030	0.030

8.4 Hydrology

The design flow rate was obtained from the PD 2262 as-built channel design documents available from the LACFCD website: http://dpw.lacounty.gov. The design document and discharge are summarized in Table 8-4.

Table 8-4: Reach 110 – Hasley Canyon Channel Design Flow Rates

Design Document No.	Year	Discharge (cfs)	HEC-RAS Station
PD 2262	1990	12,300	7672.401

8.5 Hydraulic Model

The study reach is modeled with 55 cross sections with a majority of cross sections spaced at roughly 60 foot intervals. The cross sections are cut using 2006 LIDAR topographic data provided by LACDPW. The cross section locations and SBC reach extents are presented in Figures 8-2 through 8-3.

Cross section spacing was chosen to ensure a gradually varied flow profile and to adequately represent the channel geometry and structures along the study reach. The spacing between cross sections was reduced to approximately 20 foot intervals near drop structures to better represent these portions of the channel. The hydraulic model was run under “mixed flow” conditions so that potential areas of supercritical flow were adequately modeled. HEC-RAS input and output files are provided in Appendix E.

8.6 Boundary Conditions

Normal depth is used as the boundary condition for the upstream and downstream extents of the model. The value of normal depth is estimated as the channel bed slope. The boundary conditions are summarized in Table 8-5.

Table 8-5: Reach 110 – Hasley Canyon Channel Boundary Conditions

Sub-reach	Upstream Boundary Condition	Downstream Boundary Condition
Hasley – 1	Normal Depth – S = 0.022	Normal Depth – S = 0.010

8.7 Results

The water surface elevation from the existing conditions model is used to calculate freeboard at each cross section within the SBC reaches. The existing conditions freeboard is compared to the required freeboard to determine whether there is excess freeboard (hydraulic capacity) at the cross section. Results of the freeboard calculations and capacity determination for each cross section are presented in Table 8-6, and in Figures 8-2 through 8-3. A detailed summary of these results is provided in Appendix C.

Table 8-6: Reach 110 – Hasley Canyon Channel Excess Capacity Determination

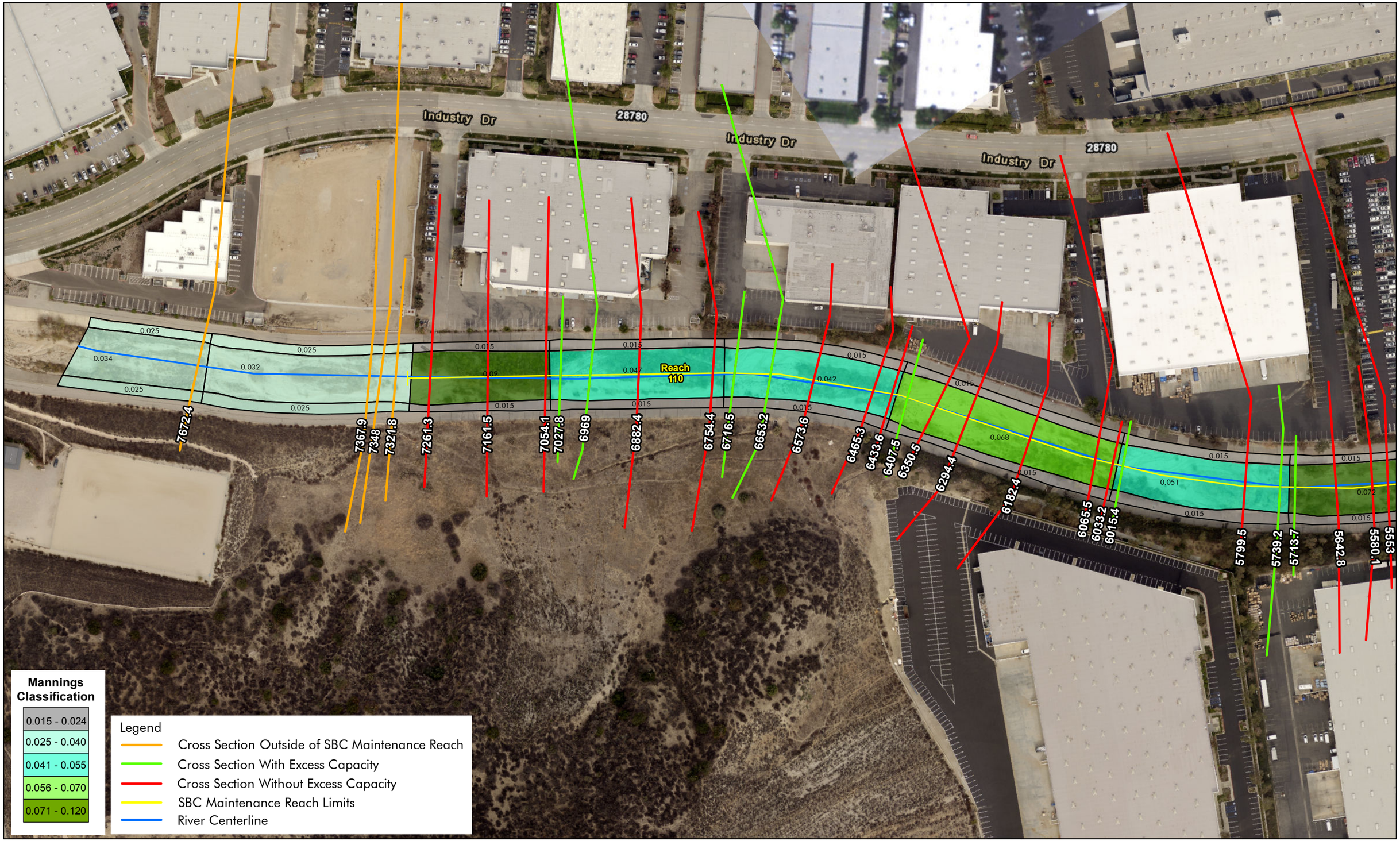
HEC-RAS Station	Required Freeboard (ft)	Existing Freeboard (ft)	Excess Freeboard (ft)	Capacity for Additional Vegetation (Yes/No)
7261.271	2.5	2.2	0.0	No
7161.515	2.5	-1.7	0.0	No
7054.132	2.5	2.3	0.0	No
7027.804	2.6	5.3	2.7	Yes
6969.027	2.7	4.0	1.3	Yes

HEC-RAS Station	Required Freeboard (ft)	Existing Freeboard (ft)	Excess Freeboard (ft)	Capacity for Additional Vegetation (Yes/No)
6882.363	2.9	1.3	0.0	No
6754.417	3.3	2.6	0.0	No
6716.515	3.3	4.8	1.5	Yes
6653.246	3.3	3.7	0.4	Yes
6573.628	3.3	2.0	0.0	No
6465.290	3.3	2.6	0.0	No
6433.633	3.3	3.0	0.0	No
6407.497	3.3	5.7	2.4	Yes
6350.499	3.3	-0.2	0.0	No
6294.441	3.3	0.4	0.0	No
6182.436	3.3	1.3	0.0	No
6065.472	3.3	2.0	0.0	No
6033.218	3.3	3.1	0.0	No
6015.436	3.3	7.4	4.1	Yes
5799.549	3.0	1.9	0.0	No
5739.189	2.8	3.5	0.7	Yes
5713.722	2.6	6.6	4.0	Yes
5642.817	2.6	-1.1	0.0	No
5580.129	2.5	-0.2	0.0	No
5552.958	2.5	-0.2	0.0	No
5439.993	2.6	3.0	0.4	Yes
5401.168	2.6	0.5	0.0	No
5352.139	2.6	-0.6	0.0	No
5295.071	2.6	-0.7	0.0	No
5141.326	2.5	2.3	0.0	No
5117.463	2.5	2.9	0.3	Yes
5097.181	2.5	4.4	1.9	Yes
5006.528	2.5	0.2	0.0	No
4946.520	2.5	1.0	0.0	No
4926.440	2.5	1.7	0.0	No
4892.486	2.5	4.0	1.5	Yes
4763.020	2.5	-2.1	0.0	No
4716.150	2.5	-1.9	0.0	No
4678.845	2.5	-1.9	0.0	No
4639.804	2.5	-5.3	0.0	No
4395.956	3.1	-3.7	0.0	No
4318.117	2.5	-4.0	0.0	No
4155.965	3.3	-1.0	0.0	No
4107.706	3.3	2.0	0.0	No
4087.444	3.3	0.8	0.0	No

HEC-RAS Station	Required Freeboard (ft)	Existing Freeboard (ft)	Excess Freeboard (ft)	Capacity for Additional Vegetation (Yes/No)
3911.677	3.3	-1.8	0.0	No
3829.697	3.3	-1.1	0.0	No
3743.888	3.3	-0.6	0.0	No
3637.300	3.3	3.4	0.1	Yes
3614.738	3.3	6.0	2.7	Yes

8.8 Additional Analysis

The majority of the reach does not have excess hydraulic capacity under the existing conditions scenario. The design conditions scenario was reviewed, and the reach showed excess capacity under design conditions. However, this reach has accumulated excess sediment which may reduce capacity. Therefore, no additional vegetation recommendation is proposed.



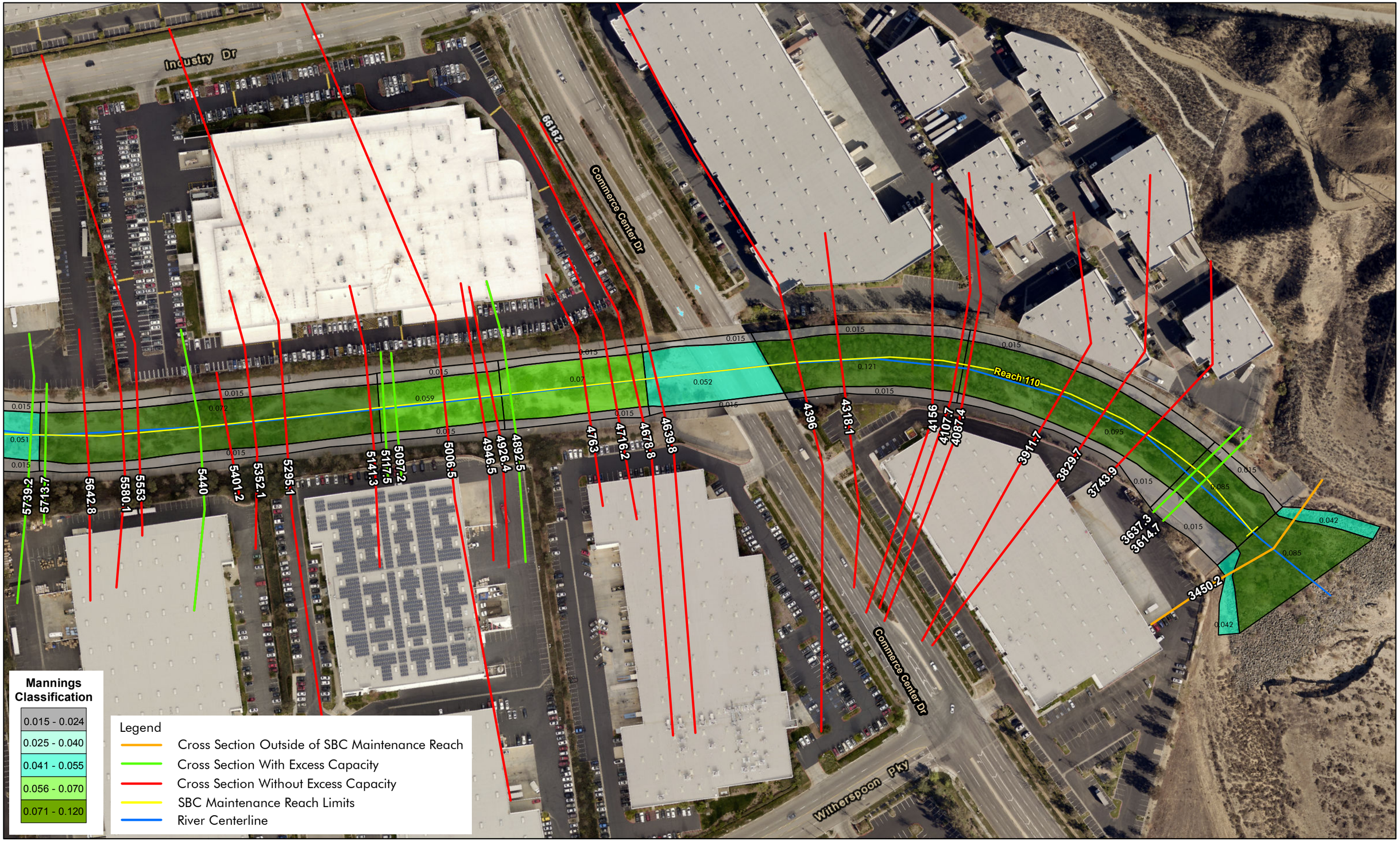
0 150 300 Feet

PACE Advanced Water Engineering

LACDPW
SANTA CLARA RIVER WATERSHED
SOFT BOTTOM CHANNEL ANALYSIS

TITLE
HASLEY CANYON 110
EXISTING CAPACITY RESULTS

FIGURE
8-2



0 150 300 Feet

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SOFT BOTTOM CHANNEL ANALYSIS

TITLE

HASLEY CANYON 110
EXISTING CAPACITY RESULTS

FIGURE

8-3

Appendix A: Maintenance Reach Annotated Photographs

Hasley Canyon Channel Reach 110

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Advanced Water Engineering

Reach No. 110 – Hasley River

Site Visit: 08/27/2015

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 7672.4 to STA 7672.4	Left Bank		0.025				0				0			0				0				1	0.025
	Right		0.025				0				0			0				0				1	0.025
	Channel		0.025					0.002			0			0				0.007				1	0.034

Standing on left bank, looking d/s (left) to u/s (right) from STA 76+72

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 7367.9 to STA 7321.8	Left Bank				0.015		0				0			0				0				1	0.015
	Right				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0			0				0.005				1	0.032

Standing on right bank, looking u/s (left) to d/s (right) from STA 73+48

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 7261.3 to STA 7054.1	Left Bank				0.015		0				0			0				0				1	0.015
	Right				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02				0.043		1	0.09

Standing on right bank, looking u/s (left) to d/s (right) from STA 72+61

Standing on right bank, looking u/s (left) to d/s (right) from STA 71+26

Standing on right bank, looking u/s (left) to d/s (right)
STA 70+54 u/s of drop structure
STA 70+27 d/s of drop structure

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 7027.8 to STA 6754.4	Left Bank				0.015		0				0			0				0				1	0.015
	Right				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.008			0			0					0.014			1	0.047

Standing on the left bank, looking upstream from STA 68+82

Standing on the left bank, looking downstream from STA 68+82

Looking along left bank, d/s (left) to u/s (right) from STA 67+54.42

Looking along left bank, d/s (left) to u/s (right), downstream from STA 67+54.42

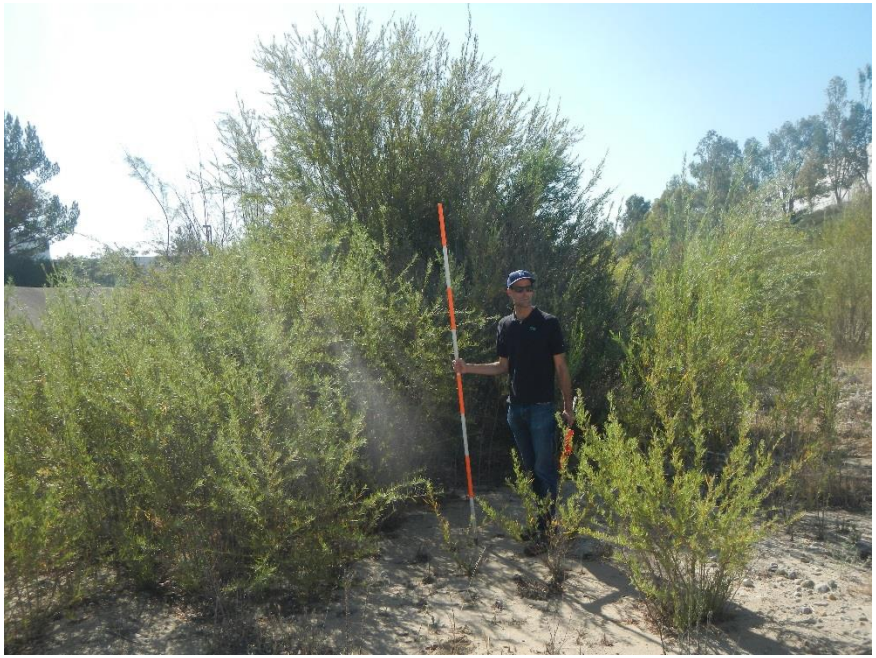
Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 6717.0 to STA 6434.0	Left Bank				0.015		0				0			0				0				1	0.015
	Right				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0			0					0.015			1	0.042

Looking in channel, facing downstream from STA 67+16.52

Looking in channel, facing upstream, downstream from STA 67+16.52

Looking in channel, facing downstream, downstream from STA 67+16.52

Looking in channel, facing downstream, downstream from STA 66+53.25



Standing on the left bank, looking upstream from STA 65+74

Standing on the left bank, looking downstream from STA 65+74

Looking along left toe, d/s (left) to u/s (right) from STA 65+73.63

Looking along left toe, facing downstream, downstream from STA 65+73.63

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 6407.5 to STA 6033.2	Left Bank				0.015		0				0			0				0				1	0.015
	Right				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02			0.021			1	0.068

Looking in channel, facing right bank, downstream from STA 64+07.50

Standing on the left bank, looking upstream from STA 62+94

Standing on the left bank, looking downstream from STA 62+94

Looking in channel, facing downstream toward right bank, upstream from STA 61+82.44 (Angle 1)

Looking in channel, facing downstream, upstream from STA 61+82.44 (Angle 2)

Looking along channel, facing right bank, upstream from STA 61+82.44

Looking in channel, facing upstream, downstream from STA 61+82.44

Looking along left bank, d/s (left) to u/s (right), upstream from STA 60+65.47

Looking in channel, facing upstream, upstream from STA 60+65.47 (Angle 1)

Looking in channel, facing upstream, upstream from STA 60+65.47 (Angle 2)

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 6015.4 to STA 5739.2	Left Bank				0.015		0				0			0				0				1	0.015
	Right				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0			0					0.024			1	0.051

Looking along left bank, d/s (left) to u/s (right), downstream from STA 60+15.44

Looking along channel, facing right bank, downstream from STA 60+15.44

Looking along channel, facing left bank, u/s (left) to d/s (right), downstream from STA 60+15.44

Looking along channel, facing right bank d/s (left) to u/s (right), downstream from STA 60+15.44

Looking along left toe, facing right bank, downstream from STA 60+15.44

Looking in channel, facing upstream, downstream from STA 60+15.44 (Angle 1)

0Reach No. 110 – Hasley River

Site Visit: 08/27/2015

Looking in channel, facing upstream, downstream from STA 60+15.44 (Angle 2)

Looking along left bank, d/s (left) to u/s (right), upstream from STA 57+99.55 (Angle 1)

Standing on the left bank, looking upstream from upstream of STA 58+00

Standing on the left bank, looking upstream from upstream of STA 58+00

Looking along left bank, d/s (left) to u/s (right), upstream from STA 57+99.55 (Angle 2)

Looking along channel, facing right bank, upstream from STA 57+99.55 (Height measurement)

Looking along channel, facing right bank, upstream from STA 57+99.55 (Width measurement)

Looking in channel, facing downstream, downstream from STA 57+99.55

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 5714.0 to STA 5141.0	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02				0.025		1	0.072

Looking along channel, facing right bank, d/s (left) to u/s (right), downstream from STA 57+13.72

Looking along left bank, d/s (left) to u/s (right) from STA 55+80.13

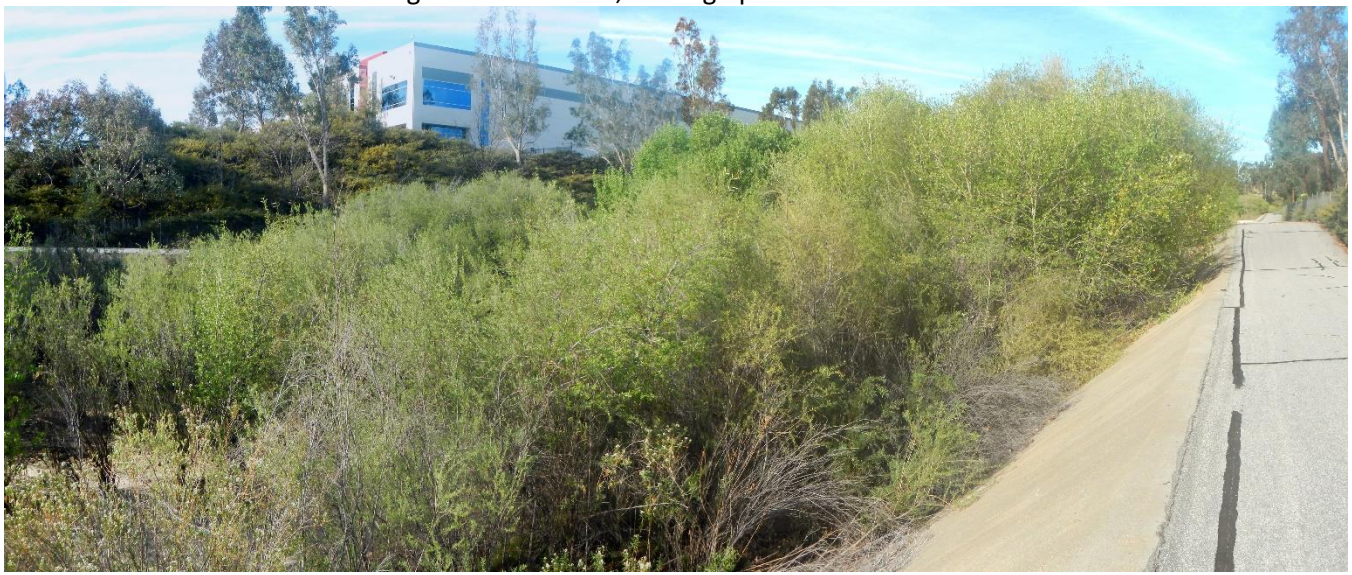
Standing on the left bank, looking upstream from STA 55+80

Standing on the left bank, looking downstream from STA 55+80

Looking at left bank, facing downstream, downstream of STA 55+52.96

Looking along left bank, facing right bank, d/s (left) to u/s (right), downstream from STA 55+52.96

Standing on the left bank, looking upstream from STA 52+95



Standing on the left bank, looking downstream from STA 52+95

Looking in channel, facing upstream, downstream from STA 52+95.07

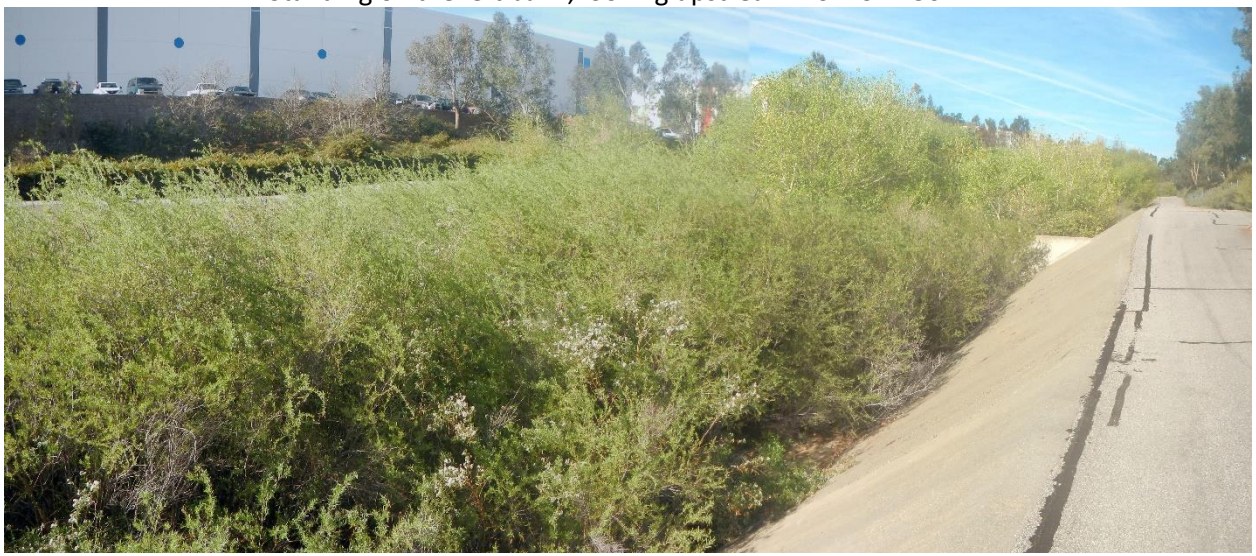
Looking along channel, facing right bank, downstream from STA 52+95.07

Looking along channel, facing right bank, downstream from STA 52+95.07

Looking in channel, facing downstream, downstream from STA 52+95.07

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 5117.5 to STA 4926.4	Left Bank				0.015		0				0			0				0				1	0.015
	Right				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0				0.005					0.028		1	0.059

Standing on the left bank, looking upstream from STA 50+77



Standing on the left bank, looking downstream from STA 50+77

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 4892.5 to STA 4678.8	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02			0.023			1	0.07

Looking along left bank, facing right bank, d/s (left) to u/s (right), upstream from STA 47+63.02

Standing on the left bank, looking upstream from STA 47+63

Standing on the left bank, looking downstream from STA 47+63

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 4639.8 to STA 4639.8	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0				0.005				0.02			1	0.052

Standing on the left bank, looking upstream from STA 46+40

Standing on the left bank, looking downstream from STA 46+40

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 4396.0 to STA 4107.7	Left Bank				0.015		0				0			0				0				1	0.015
	Right				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0						0.04				0.054	1	0.121

Standing on the left bank, looking upstream from STA 43+18

Standing on the left bank, looking downstream from STA 43+18

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 4087.4 to STA 3743.9	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02				0.048		1	0.095

Standing on the left bank, looking upstream from STA 39+12

Standing on the left bank, looking downstream from STA 39+12

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 3637.3 to STA 3614.7	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02				0.038		1	0.085

Standing on the left bank, looking upstream from downstream of STA 36+14

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 3450.2 to STA 3450.2	Left Bank					0.04		0.002			0			0				0				1	0.042
	Right Bank					0.04		0.002			0			0				0				1	0.042
	Channel		0.025					0.002			0					0.02				0.038		1	0.085

Standing on the left bank, looking downstream from upstream of STA 34+50

Reach No. 95 – Little Rock Wash

Site Visit: 11/05/2015

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 1850.0 to STA 1850.0	Left Bank		0.025						0.008		0			0				0				1	0.033
	Right		0.025						0.008		0			0				0				1	0.033
	Channel					0.04		0.002			0			0				0				1	0.042

Looking in channel, facing upstream from STA 18+50

Looking in channel, facing downstream from STA 18+50

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 1800.0 to STA 1300.0	Left Bank			0.03				0.002			0			0				0				1	0.032
	Right		0.025					0.002			0			0				0				1	0.027
	Channel		0.025					0.002			0			0				0				1	0.027

Looking in channel, facing downstream from STA 17+50

Looking in channel, facing downstream from STA 16+50

Looking in channel, facing downstream from STA 15+50

Looking in channel, facing downstream from STA 14+50

Looking in channel, facing upstream from STA 13+50

Looking in channel, facing downstream from STA 13+50

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 1250.0 to STA 1200.0	Left Bank					0.04		0.002			0			0				0				1	0.042
	Right					0.04		0.002			0			0				0				1	0.042
	Channel		0.025					0.002			0			0				0				1	0.027

Looking in channel, facing downstream from STA 12+50

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 1150.0 to STA 200.0	Left Bank			0.03				0.002			0			0				0				1	0.032
	Right		0.025					0.002			0			0				0				1	0.027
	Channel		0.025					0.002			0			0				0				1	0.027

Looking in channel, facing upstream from STA 11+50

Looking in channel, facing downstream from STA 11+50

Looking in channel, facing downstream from STA 10+50

Looking in channel, facing upstream from STA 9+50

Looking in channel, facing downstream from STA 9+50

Looking in channel, facing downstream from STA 8+50

Looking in channel, facing upstream from STA 7+50

Looking in channel, facing downstream from STA 7+50

Looking in channel, facing downstream from STA 6+50

Looking in channel, facing upstream from STA 5+50

Looking in channel, facing downstream from STA 5+50

Looking in channel, facing downstream from STA 4+50

Looking in channel, facing upstream from STA 3+50

Looking in channel, facing downstream from STA 3+50

Looking in channel, facing downstream from STA 2+50

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDER	TOTAL "n"
	Base Material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 150.0 to STA 100.0	Left Bank					0.04		0.002			0			0				0				1	0.042
	Right					0.04		0.002			0			0				0				1	0.042
	Channel					0.04		0.002			0			0				0				1	0.042

Looking in channel, facing downstream from STA 1+50

Looking in channel, facing downstream from STA 1+00

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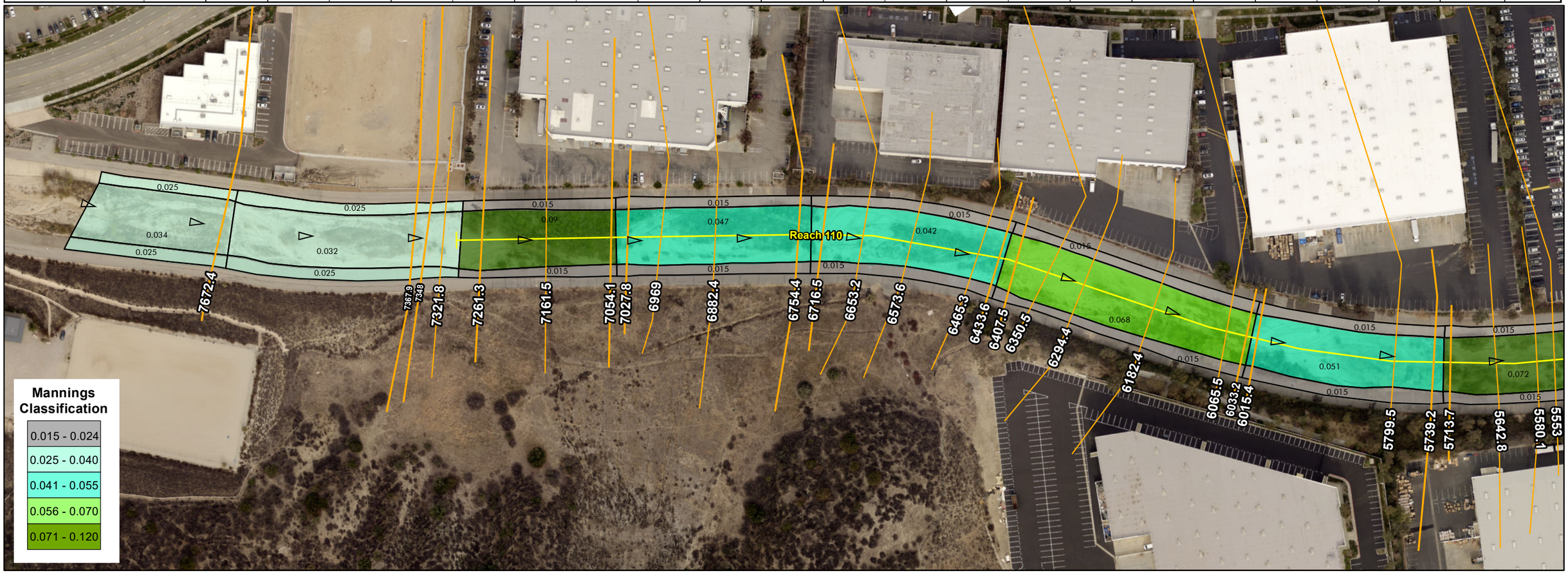
Appendix B – Manning's Assessment Worksheets

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CHANNEL CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDERING	TOTAL "n"
	Range	0.026 - 0.035	0.025 - 0.032	0.024 - 0.035	0.012 - 0.018	0.03 - 0.07	0	0.001 - 0.005	0.006 - 0.010	0.011 - 0.020	0	0.001 - 0.005	0.010 - 0.015	0.000 - 0.004	0.005 - 0.015	0.020 - 0.030	0.040 - 0.050	0.002 - 0.010	0.010 - 0.025	0.025 - 0.050	0.050 - 0.100	1	
	Base material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 76+72 to STA 76+72	Left Bank		0.025				0				0			0				0				1	0.025
	Right Bank		0.025				0				0			0				0				1	0.025
	Channel		0.025					0.002			0			0				0.007				1	0.034
STA 73+68 to STA 73+21	Left Bank		0.025				0				0			0				0				1	0.025
	Right Bank		0.025				0				0			0				0				1	0.025
	Channel		0.025					0.002			0			0				0.005				1	0.032
STA 72+61 to STA 70+54	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02				0.043		1	0.09
STA 70+28 to STA 67+54	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.008			0			0					0.014			1	0.047
STA 67+17 to STA 64+34	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0			0					0.015			1	0.042
STA 64+07 to STA 60+33	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02			0.021			1	0.068
STA 60+15 to STA 57+39	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0			0					0.024			1	0.051
	Left Bank																						
	Right Bank																						
	Channel																						



0 150 300 Feet

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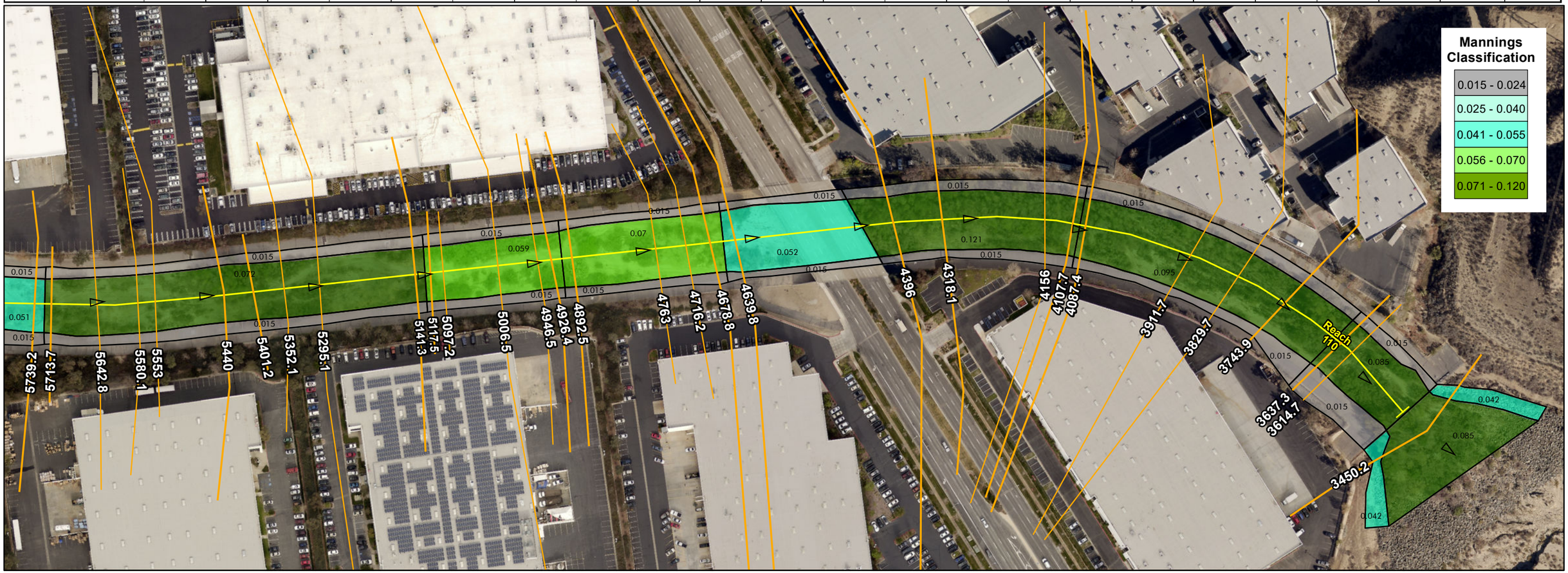
LACDPW
SANTA CLARA RIVER WATERSHED
SOFT BOTTOM CHANNEL ANALYSIS

TITLE
HASLEY CANYON 110
MANNINGS ASSESSMENT WORKSHEET

FIGURE
3-1a

Reach Stationing	Category	BASE "n"					SURFACE IRREGULARITY				VARIATION IN CHANNEL CROSS SECTION			OBSTRUCTIONS				VEGETATION				MEANDERING	TOTAL "n"
	Range	0.026 - 0.035	0.025 - 0.032	0.024 - 0.035	0.012 - 0.018	0.03 - 0.07	0	0.001 - 0.005	0.006 - 0.010	0.011 - 0.020	0	0.001 - 0.005	0.010 - 0.015	0.000 - 0.004	0.005 - 0.015	0.020 - 0.030	0.040 - 0.050	0.002 - 0.010	0.010 - 0.025	0.025 - 0.050	0.050 - 0.100	1	
	Base material	Sand	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
STA 57+14 to STA 51+41	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02				0.025		1	0.072
STA 51+17 to STA 49+26	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0				0.005					0.028		1	0.059
STA 48+92 to STA 46+79	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02			0.023			1	0.07
STA 46+40 to STA 46+40	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0				0.005				0.02			1	0.052
STA 43+96 to STA 41+08	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0						0.04				0.054	1	0.121
STA 40+87 to STA 37+44	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02				0.048		1	0.095
STA 36+37 to STA 36+15	Left Bank				0.015		0				0			0				0				1	0.015
	Right Bank				0.015		0				0			0				0				1	0.015
	Channel		0.025					0.002			0					0.02				0.038		1	0.085
STA 34+50 to STA 34+50	Left Bank					0.04		0.002			0			0				0				1	0.042
	Right Bank					0.04		0.002			0			0				0				1	0.042
	Channel		0.025					0.002			0					0.02				0.038		1	0.085



0 150 300 Feet

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LACDPW
SANTA CLARA RIVER WATERSHED
SOFT BOTTOM CHANNEL ANALYSIS

TITLE
HASLEY CANYON 110
MANNINGS ASSESSMENT WORKSHEET

FIGURE
3-1b

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Appendix C – Summary Results by Reach

DESIGN CONDITION AND EXISTING CONDITION
HEC-RAS RESULTS SUMMARY

SUMMARY BY REACH - FREEBOARD ACCORDING TO THE COUNTY'S 1982 HYDRAULIC DESIGN MANUAL

Reach number	Reach name	Reach Length (ft)	Current Maintenance Program	Required Freeboard Depth [1] (ft)	Design Condition Mannings Value	Existing Condition Weighted Mannings Value [2, 3]	Design Condition Freeboard [4] (ft)		Design Condition Capacity [4] (ft)		Existing Condition Freeboard [2, 4] (ft)		Existing Condition Capacity [2, 4] (ft)		Reach number
							Average	Minimum	Average	Minimum	Average	Minimum	Average	Minimum	
71	Santa Clara River Main Channel	242	2-Remove Toe Vegetation - 20 ft (Mechanical)	2.5	0.060	0.051	-1.4	-1.6	-3.9	-4.1	-1.8	-1.8	-4.3	-4.3	71
80	South Fork SCR (Main River Channel)	2,686	2-Remove Toe Vegetation - 20 ft (Mechanical)	2.5	0.060	0.064	0.7	-1.9	-1.8	-4.4	-0.4	-2.8	-2.9	-5.3	80
82	Santa Clara River Main Channel	849	2-Remove Toe Vegetation - 20 ft (Mechanical)	2.5	-	0.108	-	-	-	-	3.4	3.0	0.9	0.5	82
109	Santa Clara River (MTD 1510) South Bank West of McBean Pkwy	372	2-Remove Toe Vegetation - 20 ft (Mechanical) Left Bank 3-Remove Outlet Vegetation - 12 ft (Mechanical) (Max 30 ft from Toe)	2.5	0.060	0.063	2.7	2.3	0.2	-0.2	2.0	1.6	-0.5	-0.9	109
76	Pico Canyon	4,116	1-Remove All Vegetation (Mechanical)	2.5-4.2	0.025	0.023	4.1	1.5	1.2	-2.4	4.0	-1.3	1.1	-5.5	76
86	Violin Canyon M.C.O.	1,006	1-Remove All Vegetation (Mechanical)	2.5	0.032	0.040	-2.0	-4.4	-4.5	-6.9	-2.3	-4.8	-4.8	-7.3	86
101	Violin Canyon	1,818	2-Remove Toe Vegetation - 12 ft (Mechanical)	2.5-4.5	0.032	0.039	3.8	1.9	1.1	-0.6	3.4	1.8	0.6	-0.7	101
102	Violin Canyon	975	1-Remove All Vegetation (Mechanical) XS 11243 to 11047 2-Remove Toe Vegetation - 12 ft (Mechanical) 3-Remove Outlet Vegetation - 12 ft (including grading)	2.5	-	0.038	-	-	-	-	8.0	4.2	5.5	1.7	102
88	Hasley Canyon Upper	1,051	1-Remove All Vegetation (Mechanical) Sharp Rd to 755 u/s 1-Remove All Vegetation (Hand) 330' d/s to Sharp Rd	2.5-3.4	0.035	0.033	3.4	-1.7	0.7	-4.2	3.3	-1.6	0.7	-4.1	88
89	Hasley Canyon South Fork	341	5-Remove Alluvial Sage Scrub V (H)	2.5	0.035	0.037	1.0	-2.0	-1.5	-4.5	0.9	-2.0	-1.6	-4.5	89
90	Hasley Canyon Lower	1,051	1-Remove All Vegetation (Mechancial & Hand) Bed only, not embankment 5-Leave clusters of mature trees in bed per Nov. 1997 condition	2.5-4	0.035	0.037	2.4	-3.9	-0.8	-6.4	2.3	-3.9	-0.9	-6.4	90
97	Castaic Creek (Live Oak)	2,002	2-Remove Toe Vegetation - 20 ft (Mechanical & Hand) 3-Remove Outlet Vegetation - 12 ft (including grading)	2.5-3.3	0.023	0.048	-0.2	-1.0	-3.3	-4.3	-1.5	-2.3	-4.6	-5.6	97
104	Castaic Creek (Hancock)	2,223	2-Remove Toe Vegetation - 15 ft (M&H) Left Bank 3-Remove Outlet Vegetation - 10 ft (max 30 ft from Toe)	2.5	-	0.107	-	-	-	-	7.0	3.8	4.5	1.3	104
105	San Francisquito Canyon Channel	833	2-Remove Toe Vegetation - 15 ft (Mechanical) 5-NRMP Details	2.5	-	0.044	-	-	-	-	5.6	4.0	3.1	1.5	105
110	Hasley Canyon Channel	3,737	3-Remove Outlet. Vegetation - 10 ft (Mechanical+grading) 4-Remove 50% Vegetation (Mechanical+grading) 5-Any veg clearing w/in 100 ft of confluence w/ Castaic Creek will be hand	2.5-3.3	0.030	0.059	4.0	0.5	1.1	-2.2	1.4	-5.3	-1.5	-7.8	110
47	Santa Clara River Main Channel - Right Bank	1,658	2-Remove Toe Vegetation - 20 ft (Mechanical)	2.5	0.027	0.035	3.2	1.0	0.7	-1.5	2.0	0.9	-0.5	-1.6	47

DESIGN CONDITION AND EXISTING CONDITION
HEC-RAS RESULTS BY REACH

REACH NO:	110	Hasley Canyon Channel - 1982 Hydraulic Design Manual Required Freeboard Analysis
Current Maintenance Program		3-Remove Outlet. Vegetation - 10 ft (Mechanical+grading); 4-Remove 50% Vegetation (Mechanical+grading); 5-Any veg clearing w/in 100 ft of confluence w/ Castaic Creek will be by hand

	Design Conditions (As Built)					Existing Conditions (Aug. - Oct. 2015)			
	n=0.030	Q=12,300 cfs				n varies	Q=12,300		
A	B	C	B-C	E	(B-E)-C	H	B-H	(B-E)-H	K
HEC-RAS Station	HEC-RAS Controlling Top of Bank [1, 9] Elevation (ft)	Design Condition HEC-RAS Water Surface Elevation[2] (ft)	Design Condition Freeboard [3] **(ft)	Design Condition 1982 Hydraulic Design Manual Required Freeboard Depth[4] (ft)	Design Condition Freeboard "Capacity"[5] (ft)	Existing Condition HEC-RAS Water Surface Elevation[6] (ft)	Existing Condition Freeboard [7] **(ft)	Existing Condition Freeboard "Capacity"[8] (ft)	Existing Condition Weighted Mannings value
7261.271*	1144.48	1140.81	**3.7**	2.5	1.2	1142.28	**2.2**	-0.3	0.078
7161.515	1143.25	1140.21	**3.0**	2.5	0.5	1144.92	**-1.7**	-4.2	0.072
7054.132	1142.70	1138.60	**4.1**	2.5	1.6	1140.36	**2.3**	-0.2	0.075
7027.804	1140.37	1134.39	**6.0**	2.6	3.4	1135.06	**5.3**	2.7	0.042
6969.027	1137.52	1132.42	**5.1**	2.7	2.4	1133.47	**4.0**	1.3	0.042
6882.363	1136.89	1132.72	**4.2**	2.9	1.3	1135.60	**1.3**	-1.6	0.040
6754.417	1135.81	1133.02	**2.8**	3.3	-0.5	1133.25	**2.6**	-0.7	0.041
6716.515	1132.53	1127.58	**5.0**	3.3	1.7	1127.73	**4.8**	1.5	0.037
6653.246	1130.72	1126.40	**4.3**	3.3	1.0	1127.07	**3.7**	0.4	0.037
6573.628	1130.48	1126.42	**4.1**	3.3	0.8	1128.44	**2.0**	-1.3	0.036
6465.29	1129.86	1126.92	**2.9**	3.3	-0.4	1127.26	**2.6**	-0.7	0.036
6433.633	1129.58	1126.25	**3.3**	3.3	0.0	1126.62	**3.0**	-0.3	0.036
6407.497	1127.83	1122.00	**5.8**	3.3	2.5	1122.17	**5.7**	2.4	0.060
6350.499	1124.93	1120.87	**4.1**	3.3	0.8	1125.13	**-0.2**	-3.5	0.057
6294.441	1124.88	1120.44	**4.4**	3.3	1.1	1124.49	**0.4**	-2.9	0.057
6182.436	1124.25	1120.30	**4.0**	3.3	0.7	1123.00	**1.3**	-2.0	0.056
6065.472	1123.27	1118.70	**4.6**	3.3	1.3	1121.29	**2.0**	-1.3	0.055
6033.218	1122.51	1118.57	**3.9**	3.3	0.6	1119.41	**3.1**	-0.2	0.055
6015.436	1121.49	1113.85	**7.6**	3.3	4.3	1114.11	**7.4**	4.1	0.045
5799.549	1116.69	1112.78	**3.9**	3.0	0.9	1114.81	**1.9**	-1.1	0.041
5739.189	1116.64	1112.18	**4.5**	2.8	1.7	1113.14	**3.5**	0.7	0.043
5713.722*	1114.23	1107.31	**6.9**	2.6	4.3	1107.62	**6.6**	4.0	0.065
5642.817*	1110.41	1106.50	**3.9**	2.6	1.3	1111.49	**-1.1**	-3.7	0.060
5580.129	1110.57	1106.42	**4.1**	2.5	1.6	1110.81	**-0.2**	-2.7	0.059
5552.958	1110.26	1106.86	**3.4**	2.5	0.9	1110.42	**-0.2**	-2.7	0.060
5439.993*	1109.63	1105.63	**4.0**	2.6	1.4	1106.61	**3.0**	0.4	0.062
5401.168*	1106.02	1100.73	**5.3**	2.6	2.7	1105.55	**0.5**	-2.1	0.060
5352.139*	1104.66	1100.04	**4.6**	2.6	2.0	1105.26	**-0.6**	-3.2	0.059
5295.071*	1103.95	1100.28	**3.7**	2.6	1.1	1104.62	**-0.7**	-3.3	0.059
5141.326	1102.99	1100.13	**2.9**	2.5	0.4	1100.68	**2.3**	-0.2	0.059
5117.463	1102.56	1098.70	**3.9**	2.5	1.4	1099.71	**2.8**	0.3	0.051
5097.181	1100.87	1096.00	**4.9**	2.5	2.4	1096.43	**4.4**	1.9	0.052
5006.528	1097.58	1093.99	**3.6**	2.5	1.1	1097.34	**0.2**	-2.3	0.049
4946.52*	1097.37	1093.79	**3.6**	2.5	1.1	1096.33	**1.0**	-1.5	0.049
4926.44*	1096.84	1093.55	**3.3**	2.5	0.8	1095.13	**1.7**	-0.8	0.050
4892.486	1095.22	1090.46	**4.8**	2.5	2.3	1091.23	**4.0**	1.5	0.062
4763.02*	1091.23	1088.49	**2.7**	2.5	0.2	1093.29	**-2.1**	-4.6	0.059
4716.15*	1091.09	1088.23	**2.9**	2.5	0.4	1092.94	**-1.9**	-4.4	0.059
4678.845*	1090.78	1088.21	**2.6**	2.5	0.1	1092.67	**-1.9**	-4.4	0.058

PACE

DESIGN CONDITION AND EXISTING CONDITION
HEC-RAS RESULTS BY REACH

PACE Job # A844
7/5/2017

4639.804*	1087.79	1084.32	**3.5**	2.5	1.0	1093.09	**-5.3**	-7.8	0.046
4395.956	1084.95	1084.02	**0.9**	3.1	-2.2	1088.60	**-3.6**	-6.7	0.098
4318.117*	1083.49	1082.99	**0.5**	2.5	-2.0	1087.44	**-4.0**	-6.5	0.100
4155.965	1083.29	1079.62	**3.7**	3.3	0.4	1084.33	**-1.0**	-4.3	0.095
4107.706	1083.20	1079.96	**3.2**	3.3	-0.1	1081.21	**2.0**	-1.3	0.099
4087.444	1082.30	1076.02	**6.3**	3.3	3.0	1081.53	**0.8**	-2.5	0.077
3911.677	1077.84	1074.46	**3.4**	3.3	0.1	1079.65	**-1.8**	-5.1	0.078
3829.697	1077.48	1074.45	**3.0**	3.3	-0.3	1078.62	**-1.1**	-4.4	0.077
3743.888	1076.85	1073.28	**3.6**	3.3	0.3	1077.42	**-0.6**	-3.9	0.076
3637.3	1076.25	1072.72	**3.5**	3.3	0.2	1072.85	**3.4**	0.1	0.072
3614.738	1074.53	1067.89	**6.6**	3.3	3.3	1068.57	**6.0**	2.7	0.077
Average:			**4.0**		1.1		**1.4**	-1.5	0.059
Minimum:			**0.5**		-2.2		**-5.3**	-7.8	

[1] HEC-RAS model developed based on 2006 LIDAR data and validated with As Built Plans.
[2] HEC-RAS generated Water Surface Elevation: Design Condition Manning's values.
[3] Design Condition freeboard depth: (HEC-RAS Controlling Top of Bank) - (Design Condition HEC-RAS Water Surface Elevation).
[4] Required Freeboard depth according to the County's 1982 Hydraulic Design Manual.
[5] In this context, the term "Capacity" identifies the amount of additional or excess freeboard that exists beyond the required freeboard per the County's 1982 Hydraulic Design Manual. Design Condition Freeboard Capacity: (HEC-RAS Controlling Top of Bank) - (Required 1982 Hydraulic Manual Freeboard) - (Design Condition HEC-RAS Water Surface Elevation).
[6] HEC-RAS generated Water Surface Elevation: Existing Condition Manning's values as determined at the time of the field visit Aug-Oct 2015.
[7] Existing Condition freeboard depth: (HEC-RAS Controlling Top of Bank) - (Existing Condition HEC-RAS Water Surface Elevation).
[8] In this context, the term "Capacity" identifies the amount of additional or excess freeboard that exists beyond the required freeboard per the County's 1982 Hydraulic Design Manual. Existing Condition Freeboard capacity: (HEC-RAS Controlling Top of Bank) - (Required 1982 Hydraulic Manual Freeboard) - (Existing Condition HEC-RAS Water Surface Elevation).
[9] The "Top of Bank Elevation" in column B and The "1982 Hydraulic Design Manual Requried Freeboard Depth" in column E refers to the side of the channel that together gives the lowest "Design Condition Freeboard Capacity" in column (B-E)-C. For reach 110 this was the Left Bank for all cross sections except the fifteen (15) cross sections marked with an asterix (*) in column A.

** *Sufficient Freeboard Capacity, Freeboard ≥ 1982 Hydraulic Design Manual Required Freeboard*
Deficient Freeboard Capacity, Freeboard < 1982 Hydraulic Design Manual Required Freeboard

PACE

Appendix E: HEC-RAS Model Output Data

Hasley Canyon Channel Reach 110
Existing Conditions

PACE
Advanced Water Engineering

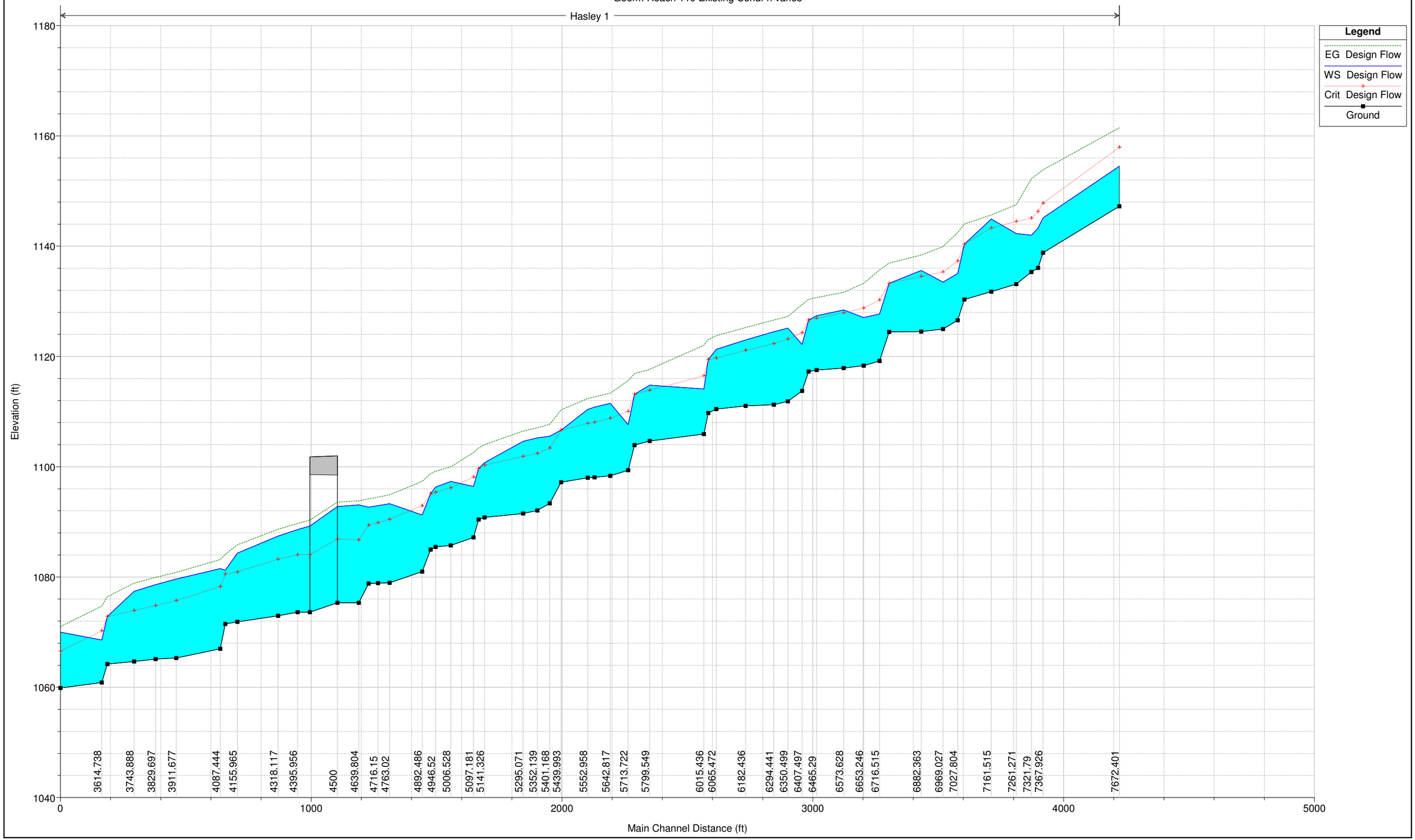
HEC-RAS Plan: 110 River: Hasley Reach: 1 Profile: Design Flow

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)	
1	7672.401	Design Flow	12300.00	1147.24	1154.50	1157.93	1161.46	0.022013	21.17	581.05	99.02	1.54
1	7367.926	Design Flow	12300.00	1138.80	1145.13	1147.81	1153.84	0.027278	23.67	519.56	96.68	1.80
1	7348.048	Design Flow	12300.00	1136.05	1143.29	1146.29	1153.15	0.031960	25.19	488.27	91.76	1.93
1	7321.79	Design Flow	12300.00	1135.31	1141.98	1145.08	1152.23	0.034265	25.69	478.83	92.34	1.99
1	7261.271	Design Flow	12300.00	1133.12	1142.28	1144.49	1147.54	0.092119	18.38	669.04	111.44	1.32
1	7161.515	Design Flow	12300.00	1131.74	1144.92	1143.32	1145.66	0.005904	6.85	1782.67	380.55	0.39
1	7054.132	Design Flow	12300.00	1130.31	1140.36	1140.36	1144.02	0.044815	15.36	800.70	109.37	1.00
1	7027.804	Design Flow	12300.00	1126.56	1135.06	1137.31	1142.49	0.042472	21.87	562.37	99.48	1.62
1	6969.027	Design Flow	12300.00	1124.96	1133.47	1135.33	1139.93	0.035206	20.40	603.03	105.03	1.50
1	6882.363	Design Flow	12300.00	1124.51	1135.60	1134.52	1138.39	0.008717	13.39	918.48	112.84	0.83
1	6754.417	Design Flow	12300.00	1124.44	1133.25	1133.25	1136.93	0.013482	15.38	799.75	108.17	1.00
1	6716.515	Design Flow	12300.00	1119.18	1127.73	1130.23	1135.70	0.036259	22.65	542.96	99.63	1.71
1	6653.246	Design Flow	12300.00	1118.33	1127.07	1128.79	1133.26	0.025531	19.97	616.05	105.24	1.45
1	6573.628	Design Flow	12300.00	1117.90	1128.42	1127.93	1131.63	0.008538	14.38	855.58	111.43	0.91
1	6465.29	Design Flow	12300.00	1117.54	1127.38	1126.92	1130.69	0.008572	14.59	843.10	108.96	0.92
1	6433.633	Design Flow	12300.00	1117.27	1126.62	1126.62	1130.34	0.010480	15.48	794.75	107.35	1.00
1	6407.497	Design Flow	12300.00	1113.75	1122.17	1124.30	1129.39	0.083304	21.56	570.59	102.00	1.61
1	6350.499	Design Flow	12300.00	1111.84	1125.13	1123.16	1127.29	0.012443	11.78	1047.69	142.57	0.70
1	6294.441	Design Flow	12300.00	1111.26	1124.49	1122.33	1126.60	0.011502	11.66	1057.63	128.79	0.69
1	6182.436	Design Flow	12300.00	1111.04	1123.00	1121.10	1125.26	0.012234	12.06	1020.07	116.16	0.72
1	6065.472	Design Flow	12300.00	1110.46	1121.29	1119.70	1123.76	0.013045	12.60	976.30	113.46	0.76
1	6033.218	Design Flow	12300.00	1109.74	1119.41	1119.41	1123.08	0.024623	15.35	801.21	109.50	1.00
1	6015.436	Design Flow	12300.00	1105.93	1114.11	1116.50	1122.03	0.052761	22.58	544.84	96.51	1.68
1	5799.549	Design Flow	12300.00	1104.66	1114.79	1113.84	1117.66	0.009677	13.60	904.31	113.16	0.85
1	5739.189	Design Flow	12300.00	1103.93	1113.15	1113.15	1116.86	0.015104	15.45	796.32	108.02	1.00
1	5713.722	Design Flow	12300.00	1099.36	1107.62	1110.05	1115.62	0.107408	22.68	542.30	96.38	1.69
1	5642.817	Design Flow	12300.00	1098.36	1111.49	1108.80	1113.34	0.010542	10.94	1135.99	152.88	0.63
1	5580.129	Design Flow	12300.00	1098.08	1110.80	1108.07	1112.67	0.010579	10.99	1126.58	151.98	0.63
1	5552.958	Design Flow	12300.00	1098.00	1110.40	1107.88	1112.37	0.011375	11.24	1095.12	126.21	0.65
1	5439.993	Design Flow	12300.00	1097.21	1106.64	1106.64	1110.32	0.031296	15.39	799.18	108.70	1.00
1	5401.168	Design Flow	12300.00	1093.35	1105.54	1103.39	1107.72	0.013257	11.84	1039.22	115.65	0.70
1	5352.139	Design Flow	12300.00	1092.06	1105.25	1102.42	1107.05	0.009903	10.80	1151.71	151.75	0.62
1	5295.071	Design Flow	12300.00	1091.52	1104.60	1101.88	1106.46	0.010496	10.97	1133.07	152.17	0.63
1	5141.326	Design Flow	12300.00	1090.80	1100.73	1100.30	1103.99	0.023881	14.48	849.37	111.27	0.92
1	5117.463	Design Flow	12300.00	1090.43	1099.71	1099.71	1103.41	0.020479	15.44	796.81	107.62	1.00
1	5097.181	Design Flow	12300.00	1087.18	1096.43	1098.14	1102.57	0.047655	19.87	619.12	104.26	1.44
1	5006.528	Design Flow	12300.00	1085.73	1097.33	1096.17	1099.99	0.012544	13.08	940.27	117.31	0.81
1	4946.52	Design Flow	12300.00	1085.46	1096.32	1095.40	1099.17	0.013949	13.55	907.62	114.89	0.85

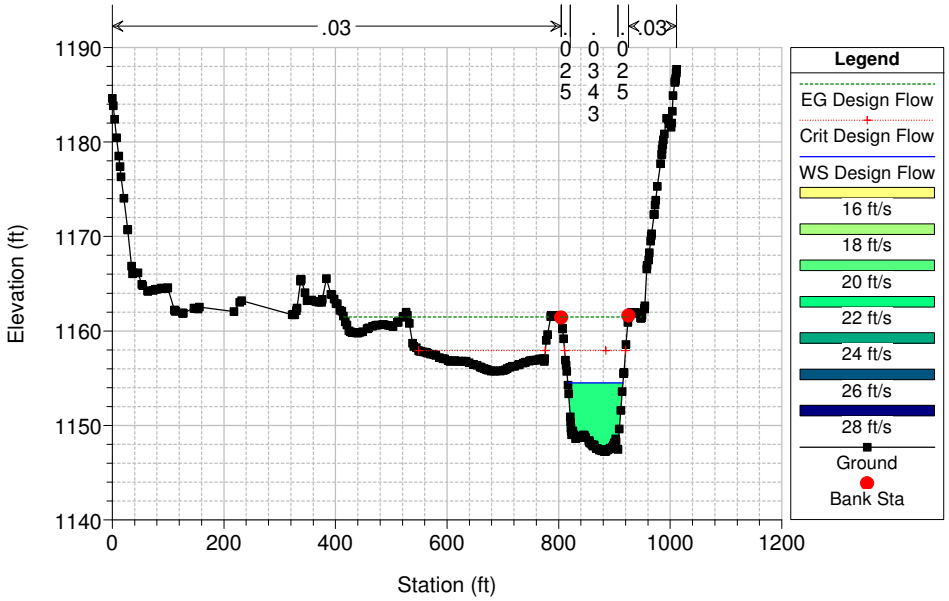
HEC-RAS Plan: 110 River: Hasley Reach: 1 Profile: Design Flow (Continued)

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)	
1	4926.44	Design Flow	12300.00	1084.99	1095.13	1095.13	1098.76	0.020649	15.30	804.09	110.92	1.00
1	4892.486	Design Flow	12300.00	1080.97	1091.23	1092.91	1097.33	0.071160	19.81	620.93	106.30	1.44
1	4763.02	Design Flow	12300.00	1078.95	1093.29	1090.47	1094.92	0.009311	10.32	1214.36	157.09	0.59
1	4716.15	Design Flow	12300.00	1078.90	1092.94	1089.83	1094.48	0.008187	10.07	1245.29	156.68	0.56
1	4678.845	Design Flow	12300.00	1078.82	1092.67	1089.39	1094.17	0.007786	9.90	1257.17	156.35	0.55
1	4639.804	Design Flow	12300.00	1075.31	1093.09	1086.72	1093.81	0.001764	7.01	1844.71	206.97	0.34
1	4500		Bridge									
1	4395.956	Design Flow	12300.00	1073.63	1088.59	1084.03	1089.69	0.011584	7.90	1499.38	158.55	0.41
1	4318.117	Design Flow	12300.00	1072.96	1087.44	1083.25	1088.65	0.014548	8.55	1406.56	153.69	0.45
1	4155.965	Design Flow	12300.00	1071.86	1084.33	1080.93	1085.83	0.020851	9.85	1258.49	160.57	0.56
1	4107.706	Design Flow	12300.00	1071.48	1081.21	1080.51	1084.10	0.059834	13.63	902.69	119.06	0.87
1	4087.444	Design Flow	12300.00	1066.99	1081.53	1078.26	1083.17	0.015377	10.27	1197.29	124.07	0.58
1	3911.677	Design Flow	12300.00	1065.31	1079.64	1075.75	1080.84	0.010428	8.85	1413.00	189.65	0.49
1	3829.697	Design Flow	12300.00	1065.10	1078.61	1074.83	1079.93	0.011488	9.26	1345.24	168.89	0.51
1	3743.888	Design Flow	12300.00	1064.67	1077.42	1073.92	1078.88	0.012754	9.72	1275.35	165.76	0.55
1	3637.3	Design Flow	12300.00	1064.21	1072.86	1072.86	1076.41	0.042032	15.11	813.84	114.65	1.00
1	3614.738	Design Flow	12300.00	1060.85	1068.57	1070.26	1074.73	0.104839	19.90	618.23	103.69	1.44
1	3450.237	Design Flow	12300.00	1059.88	1070.00	1066.57	1071.01	0.010013	8.03	1531.81	182.74	0.49

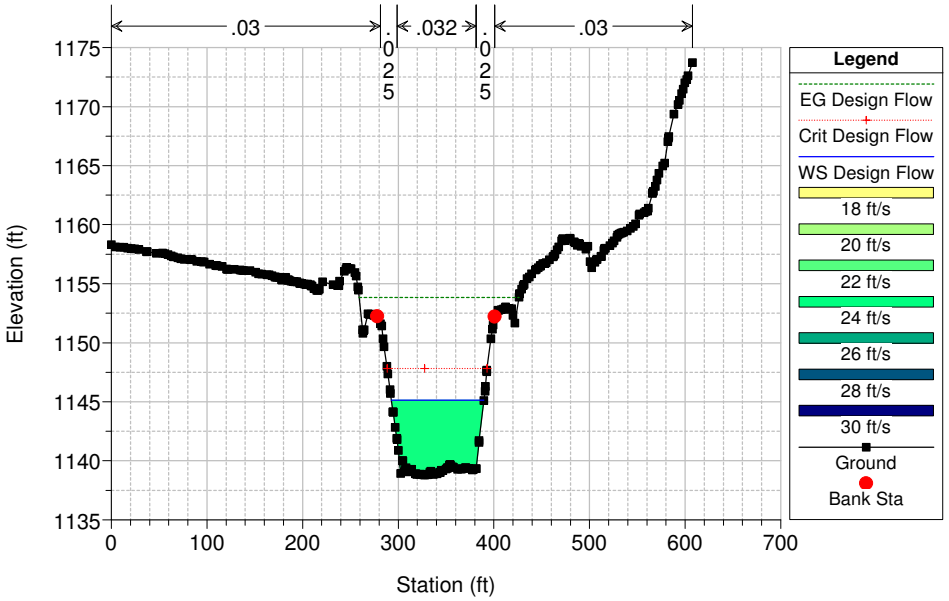
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies



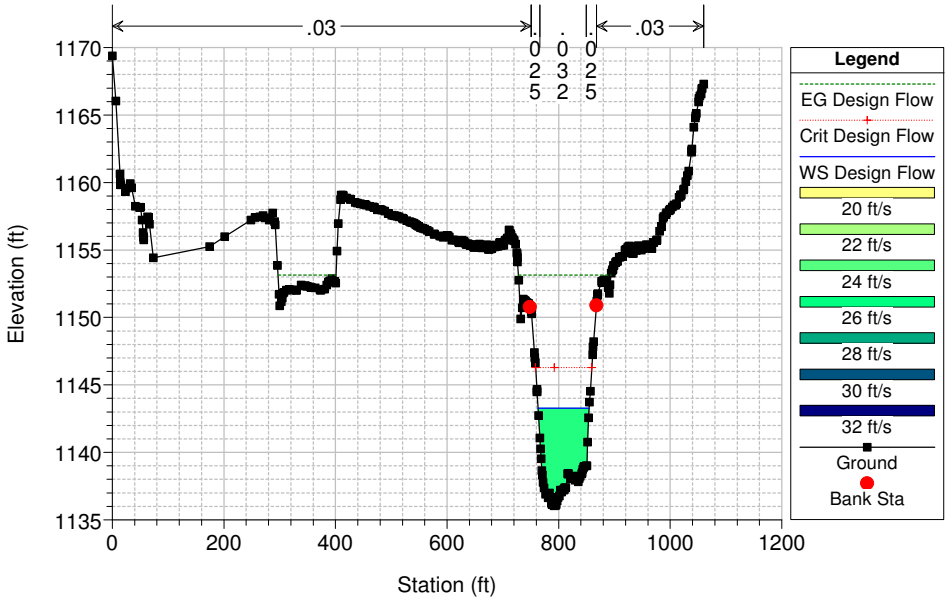
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 7672.401



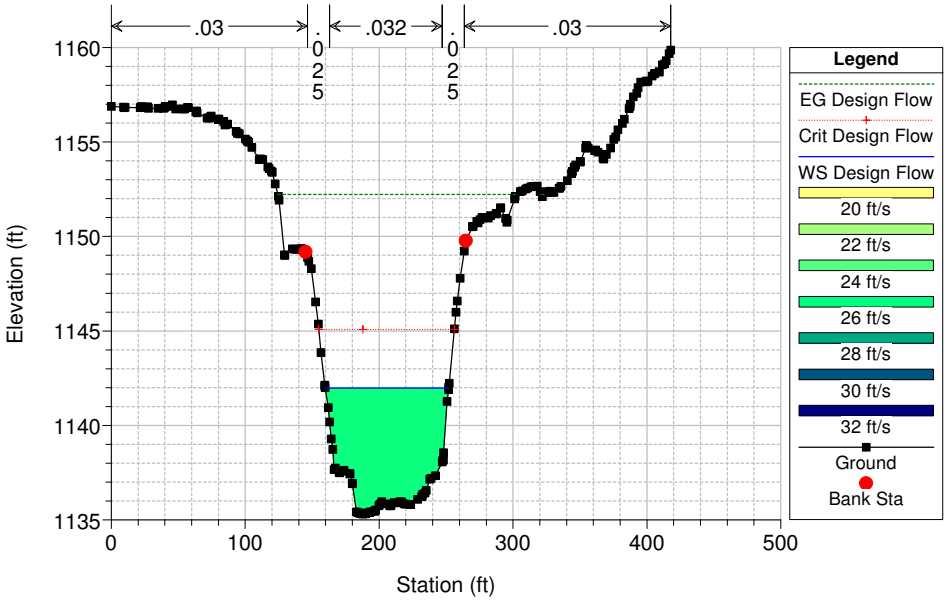
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 7367.926

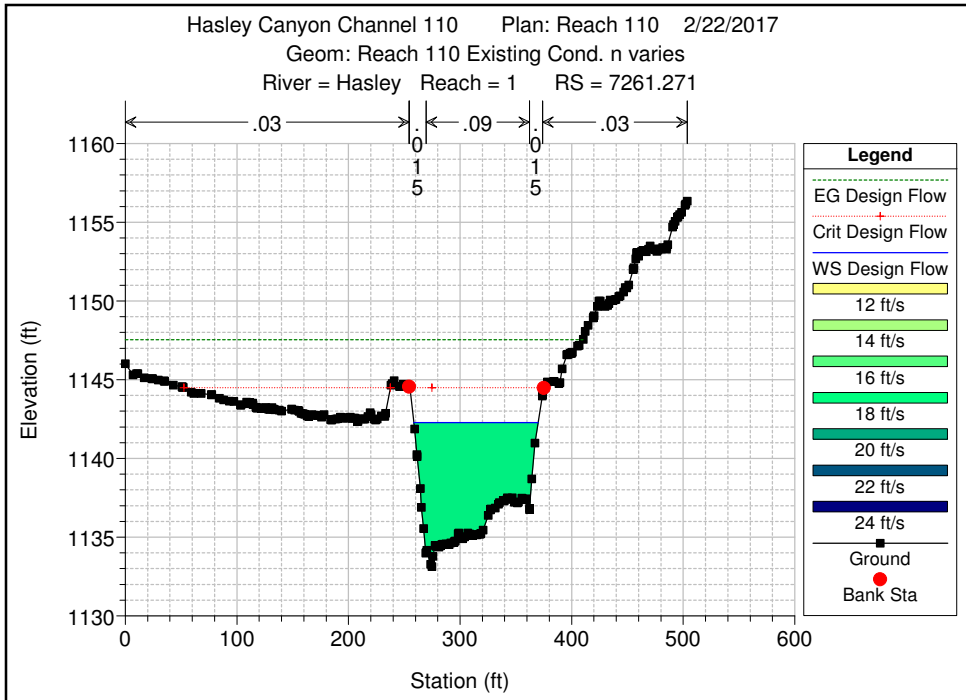


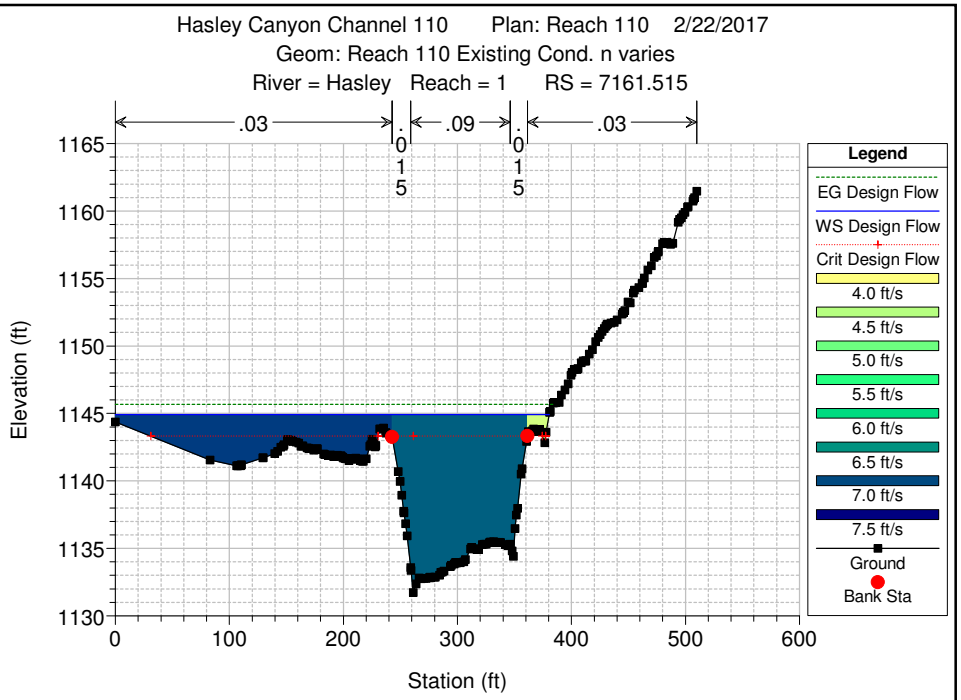
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 7348.048

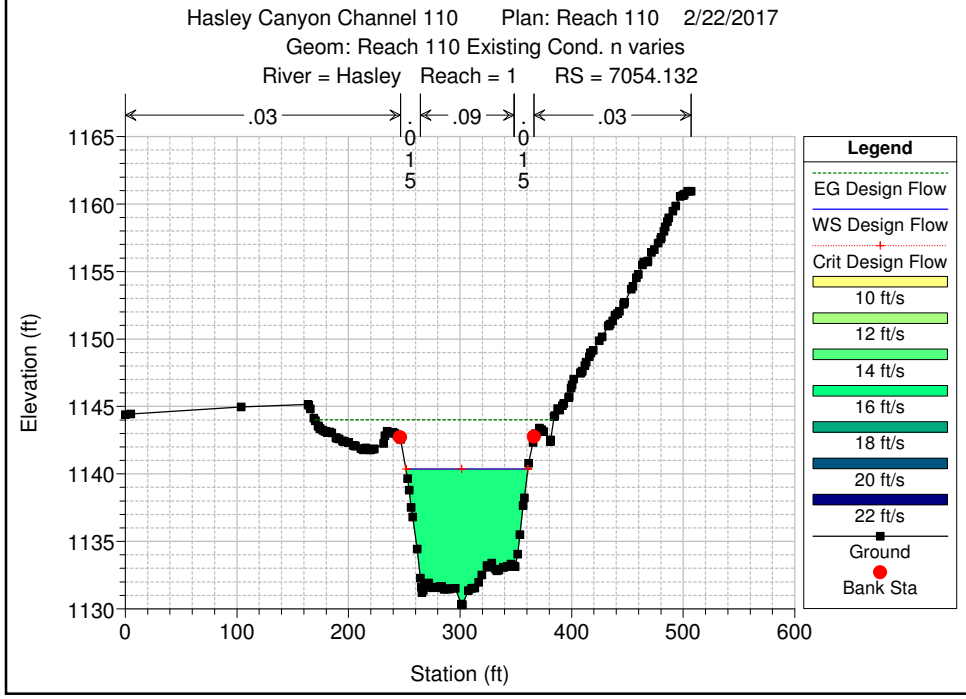


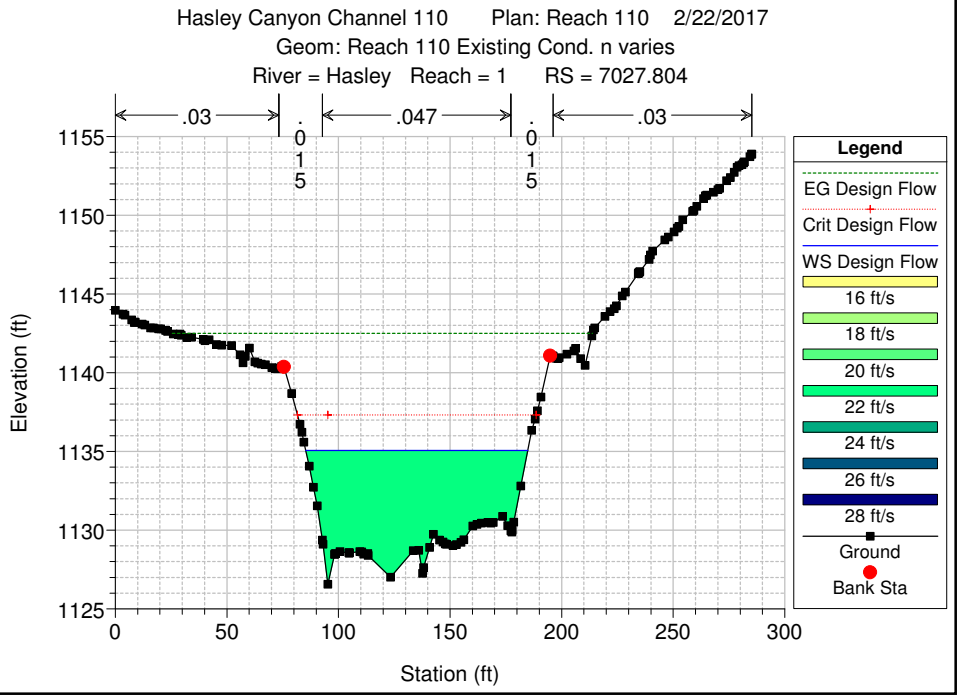
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 7321.79

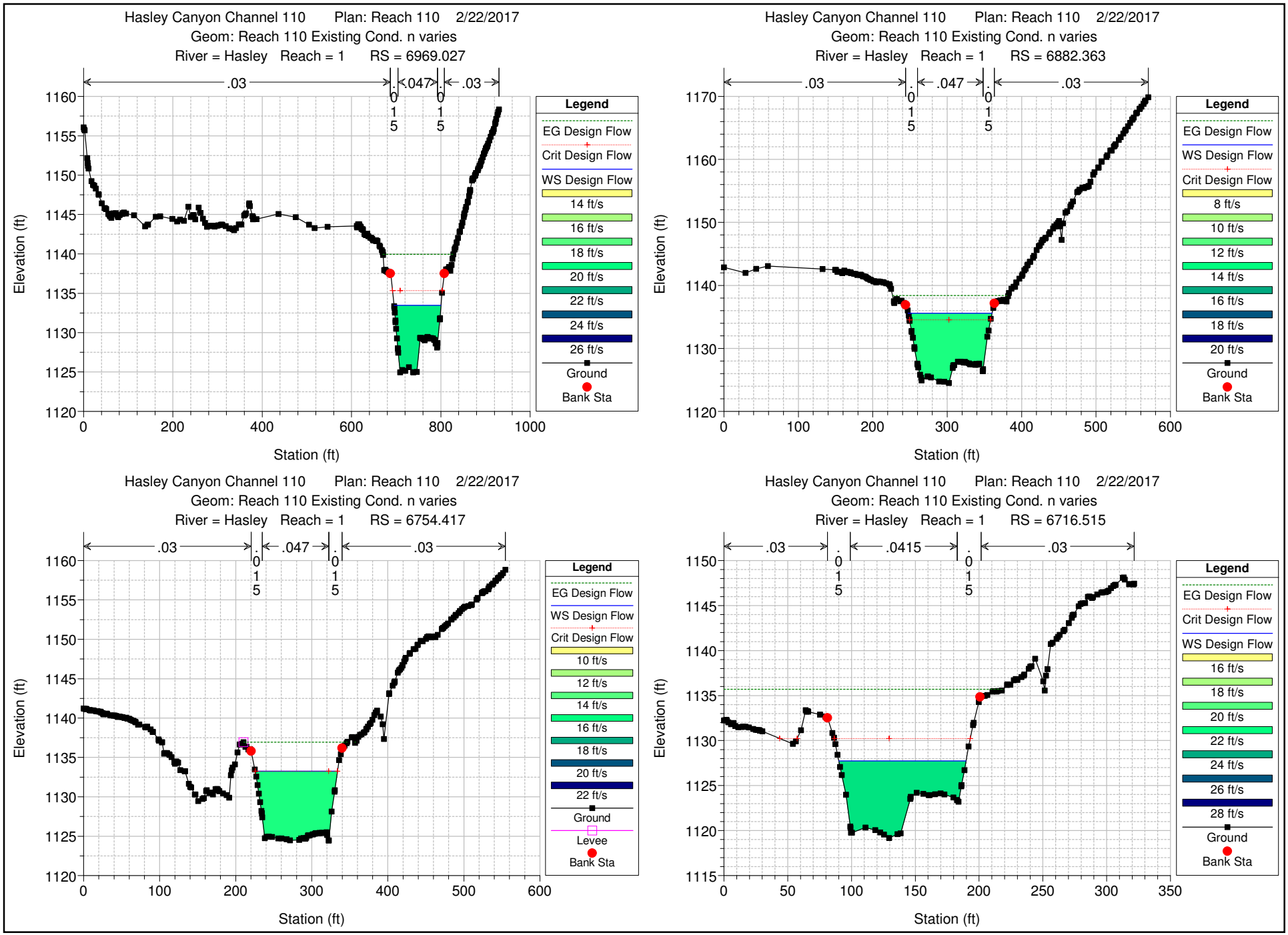


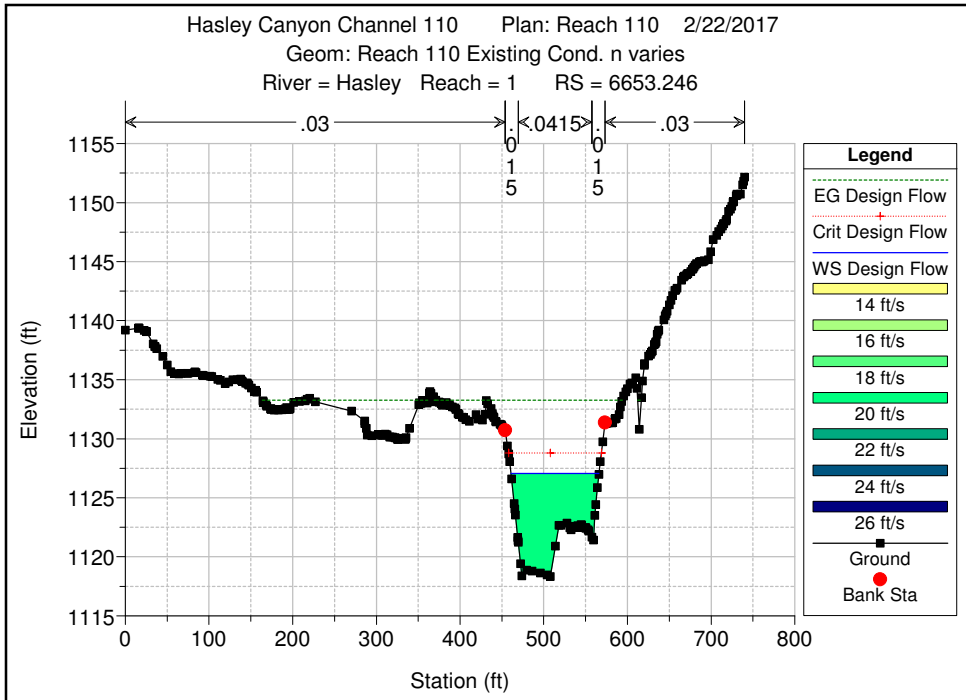

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 7261.271
.03
.09
.03
0.015
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Bank Sta

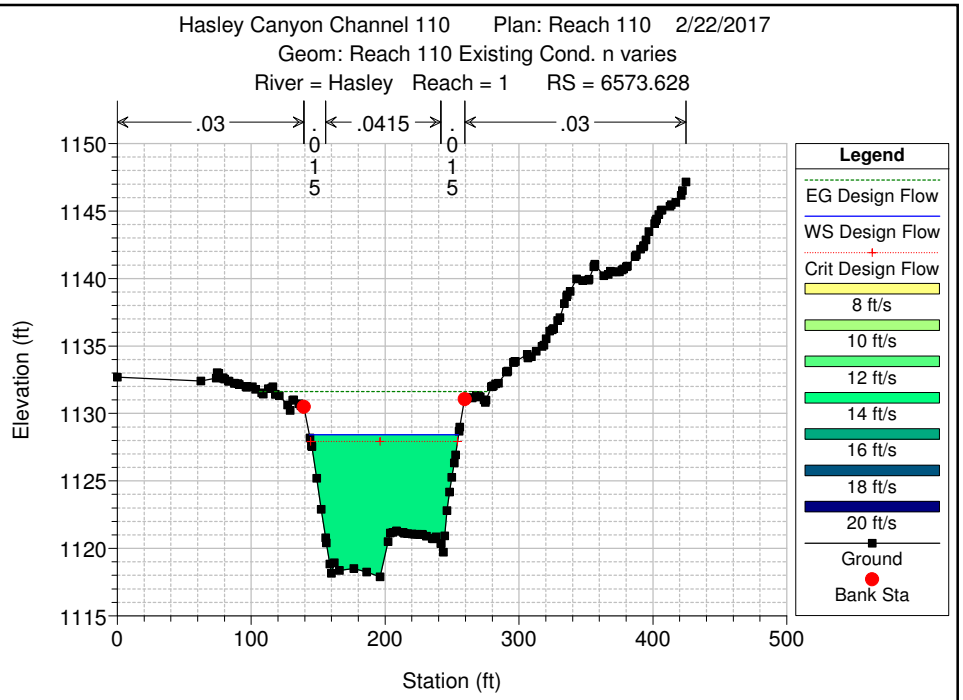

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 7161.515
.03
.09
.03
0.015
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
4.0 ft/s
4.5 ft/s
5.0 ft/s
5.5 ft/s
6.0 ft/s
6.5 ft/s
7.0 ft/s
7.5 ft/s
Ground
Bank Sta

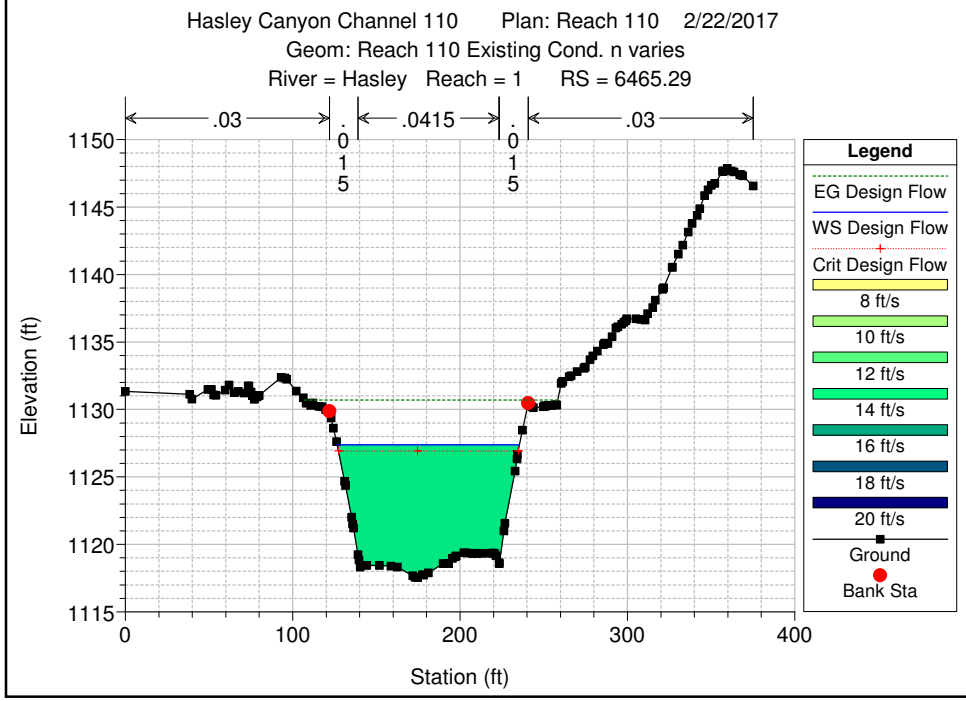

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 7054.132
.03
.09
.03
0.015
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta

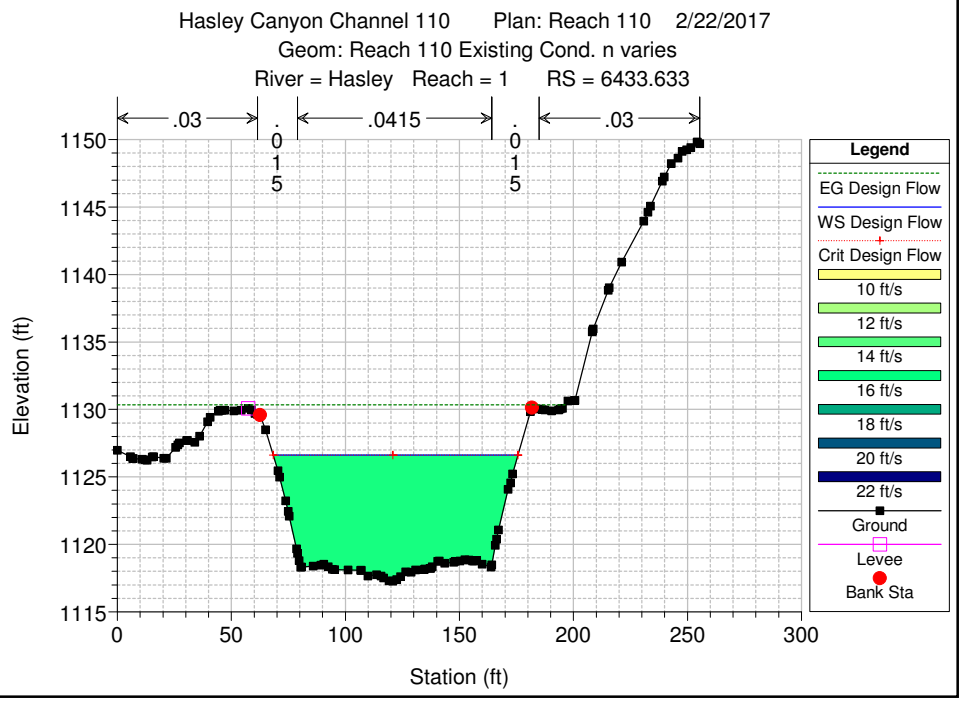

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 7027.804
.03
.047
.03
0.015
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta

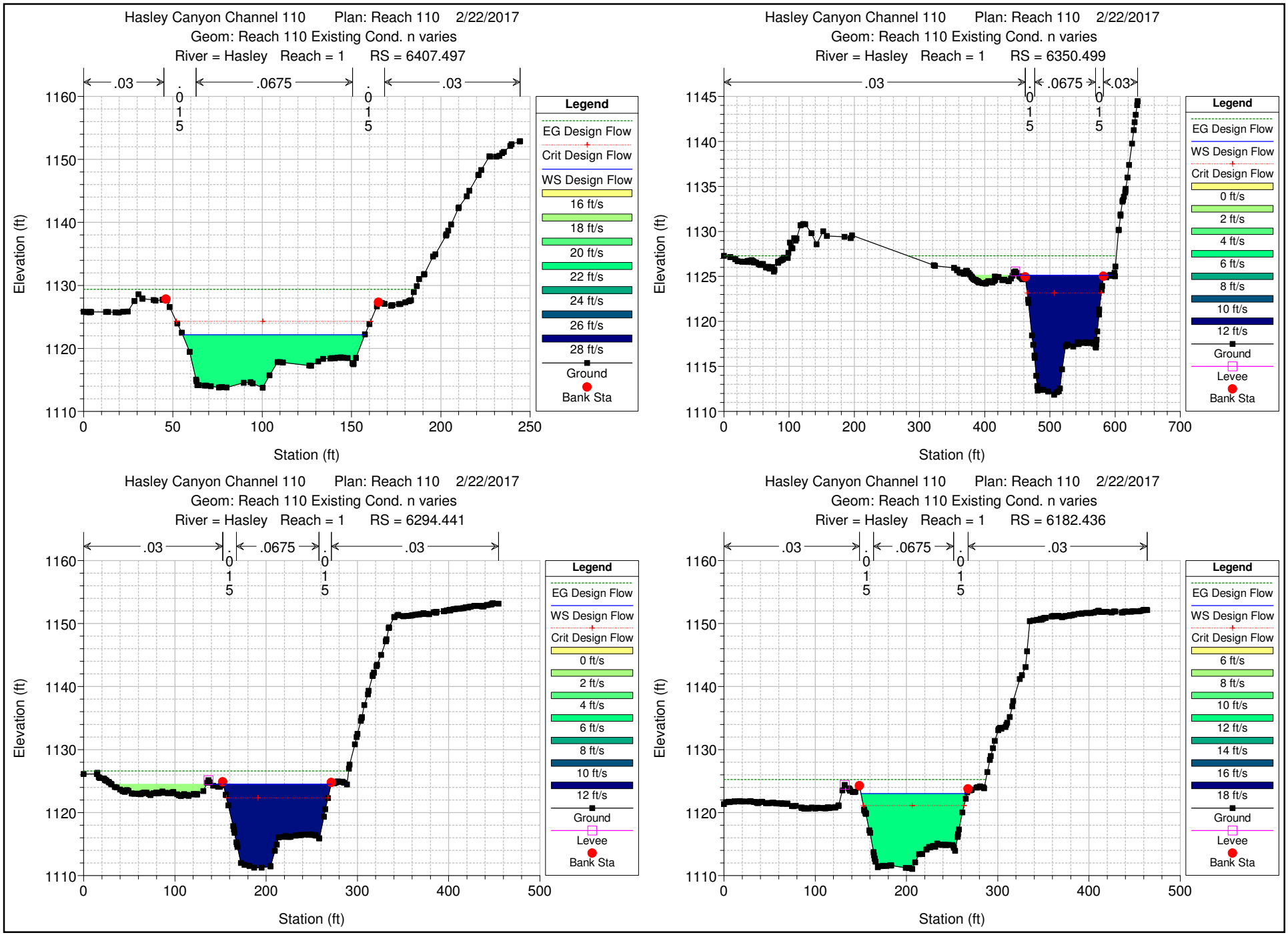

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6969.027
.03
.047
.03
.015
.015
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6882.363
.03
.047
.03
.015
.015
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6754.417
.03
.047
.03
.015
.015
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6716.515
.03
.0415
.03
.015
.015
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

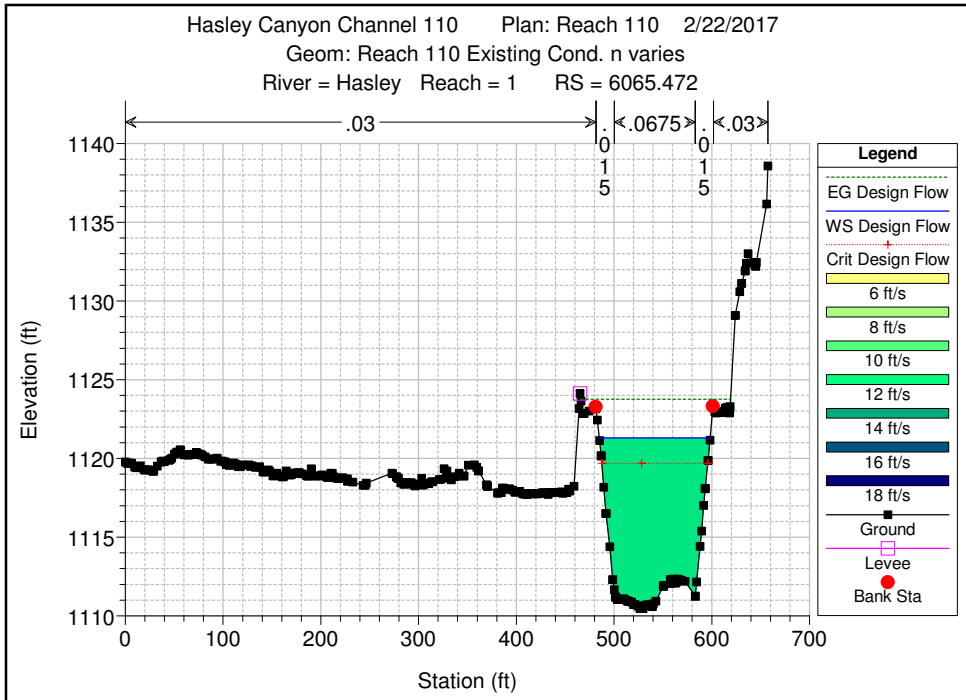

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6653.246
.03
.0415
.03
.015
.015
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

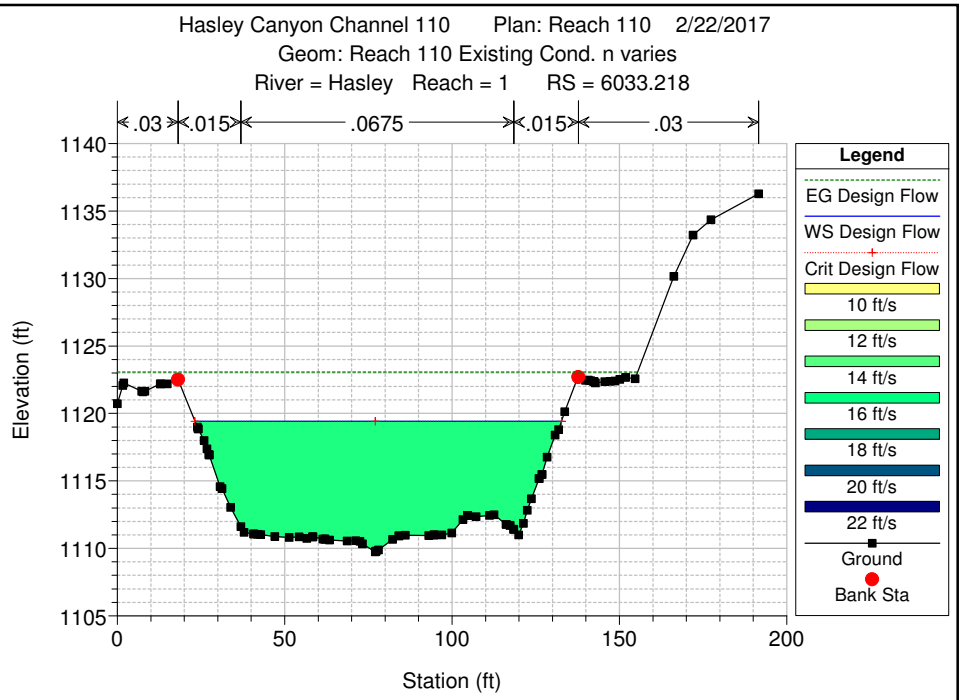

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6573.628
.03
.0415
.03
.015
.015
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

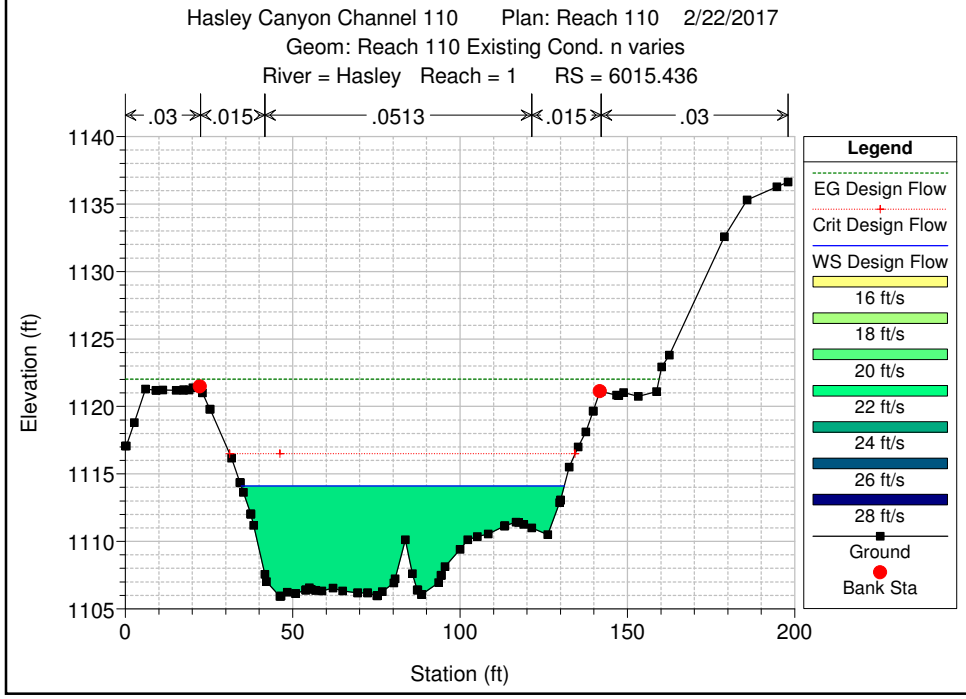

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6465.29
.03
.0415
.03
.015
.015
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

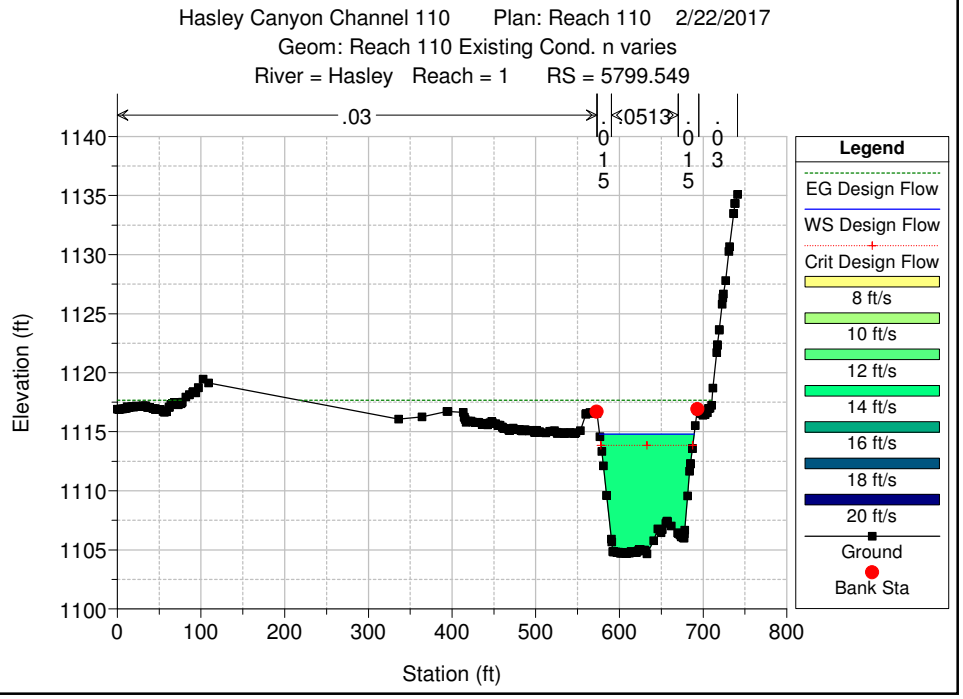

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6433.633
.03
.0415
.03
.015
.015
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

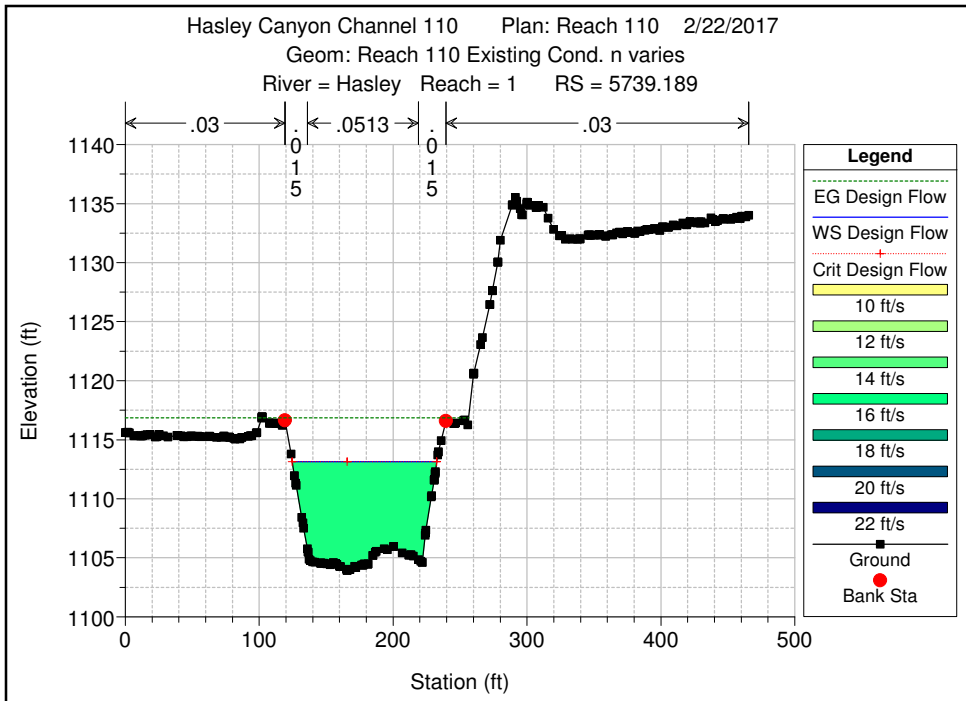

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6407.497
.03
.0675
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6350.499
.03
.0675
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Levee
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6294.441
.03
.0675
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Levee
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6182.436
.03
.0675
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
Ground
Levee
Bank Sta

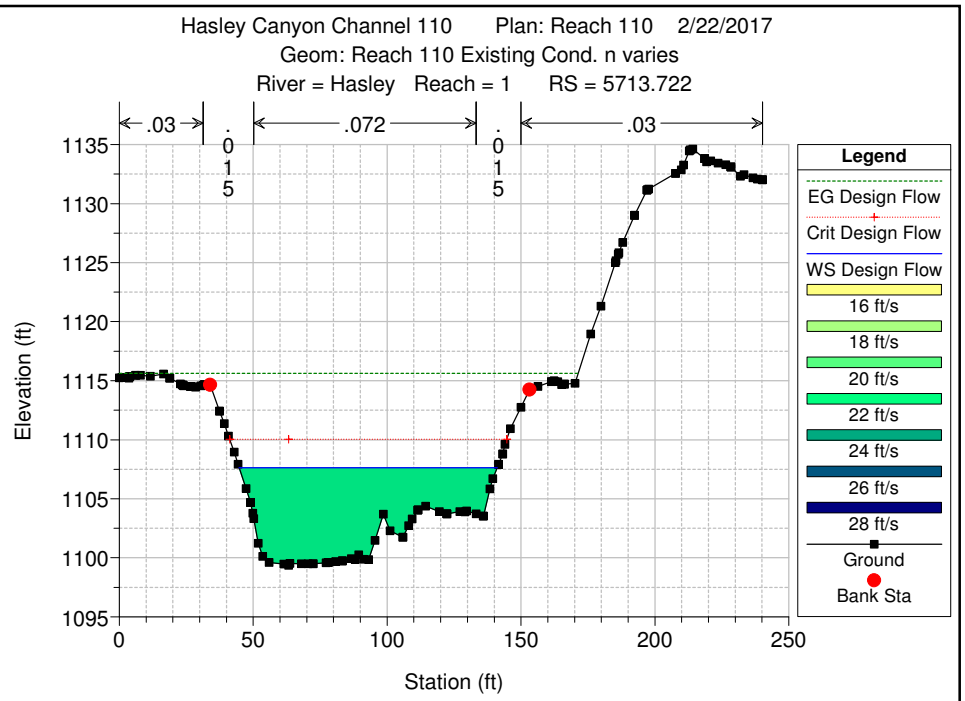

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6065.472
.03
.015
.0675
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
Ground
Levee
Bank Sta

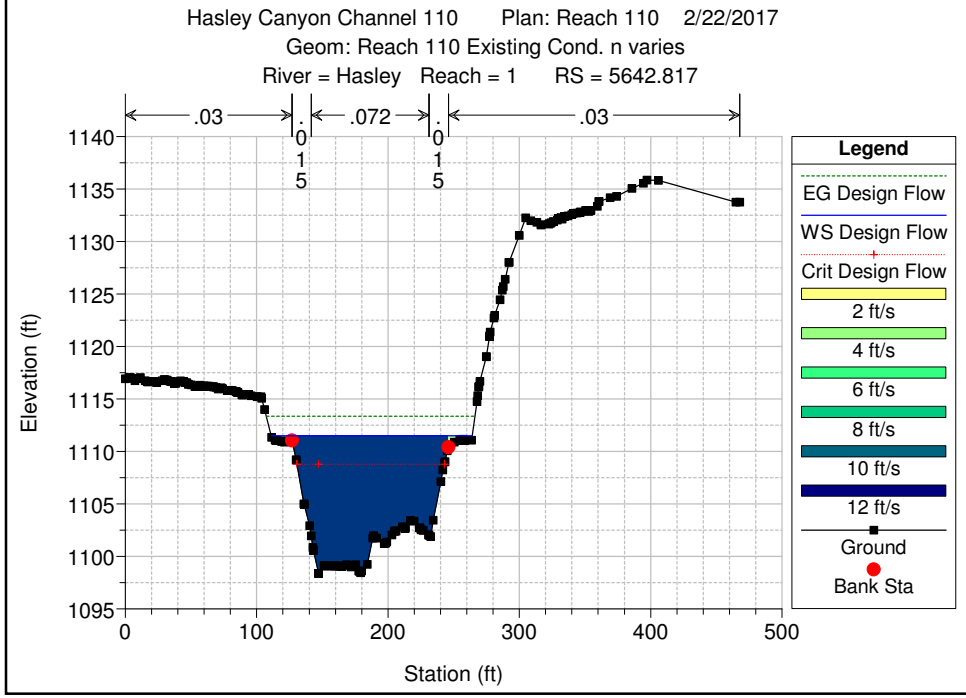

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6033.218
.03
.015
.0675
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta

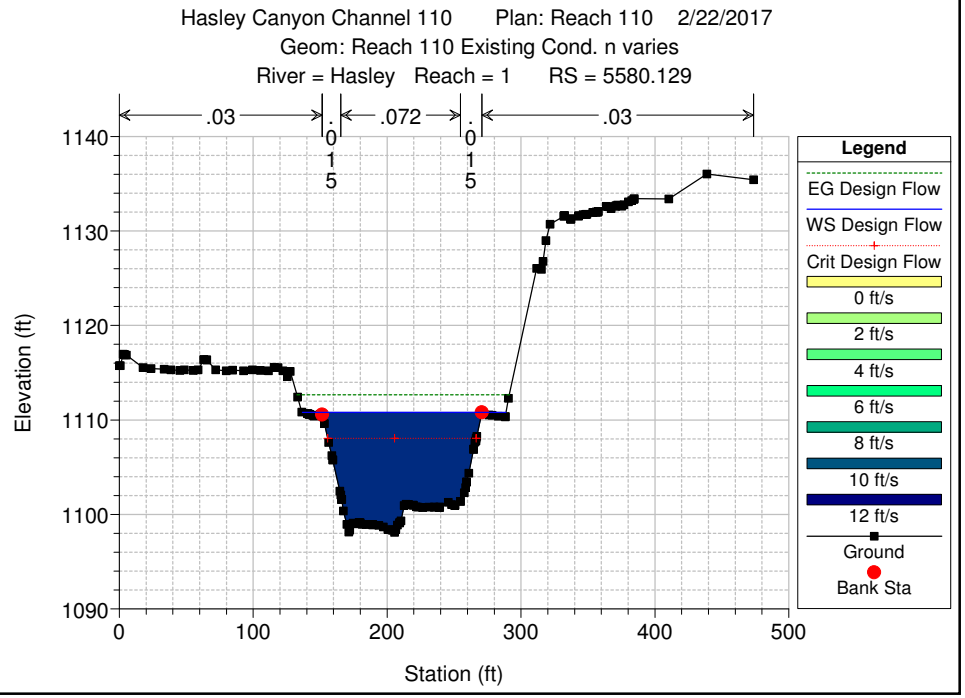

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 6015.436
.03
.015
.0513
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta

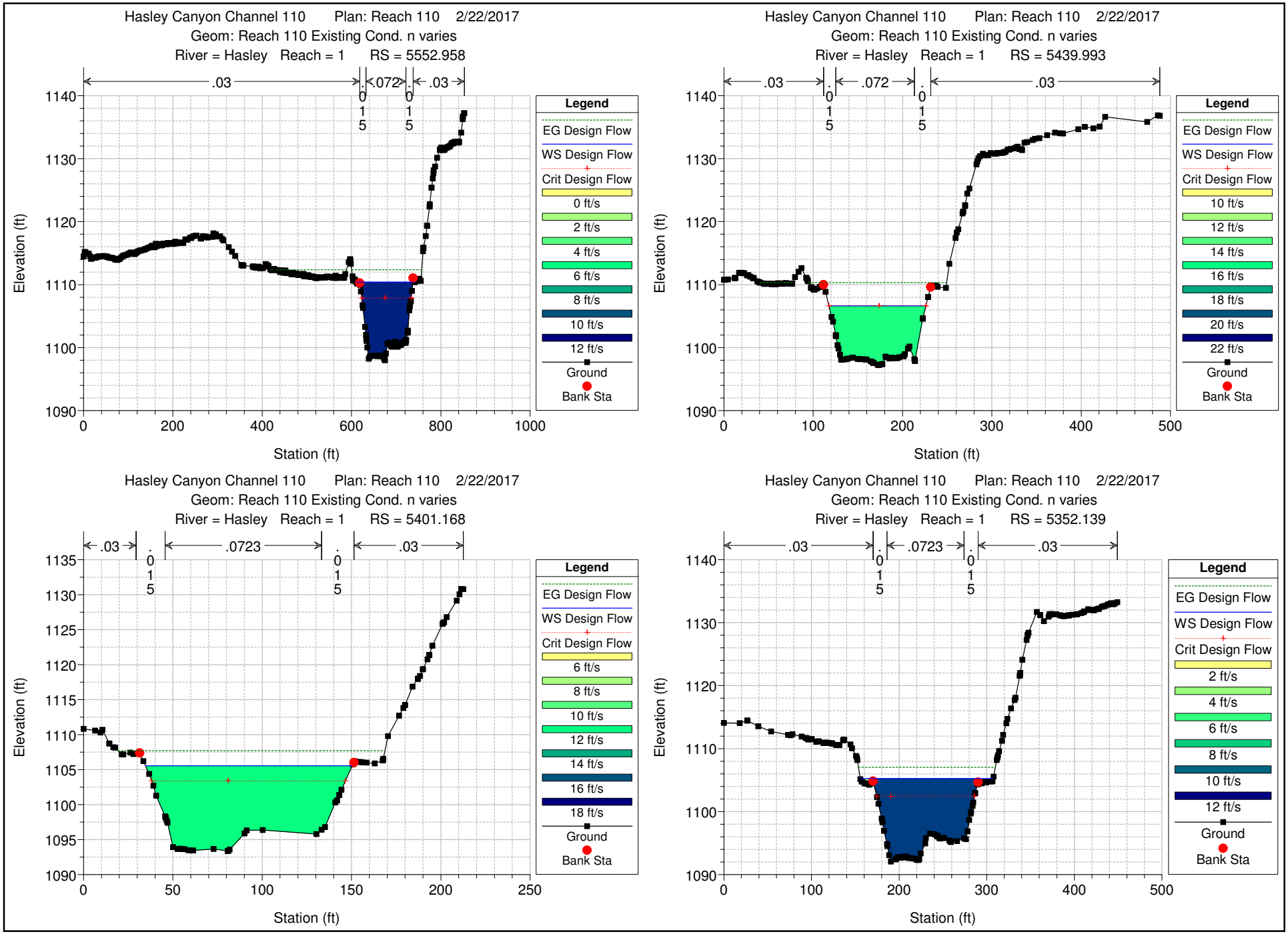

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5799.549
.03
.0513
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta

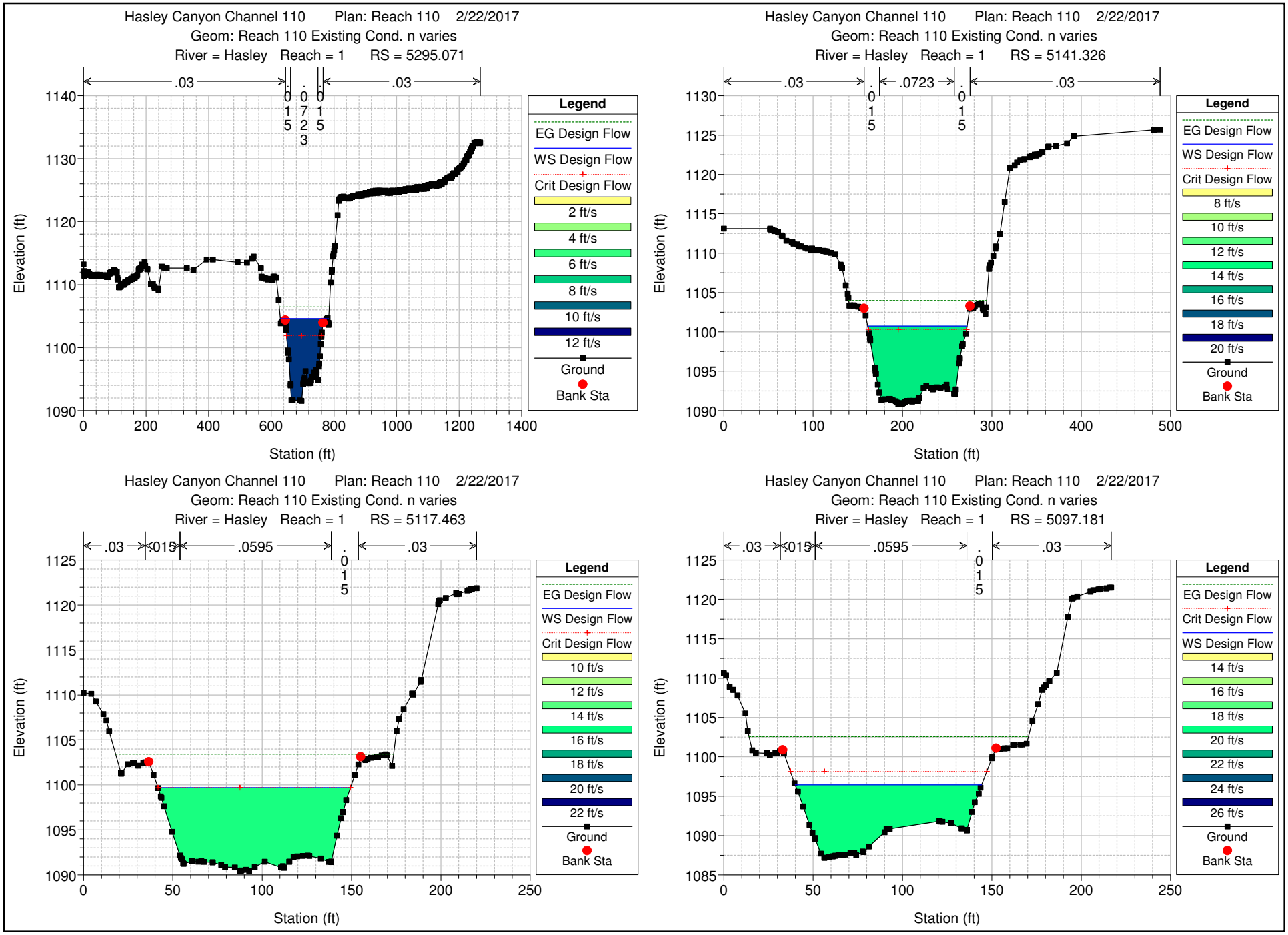

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5739.189
.03
.0513
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta

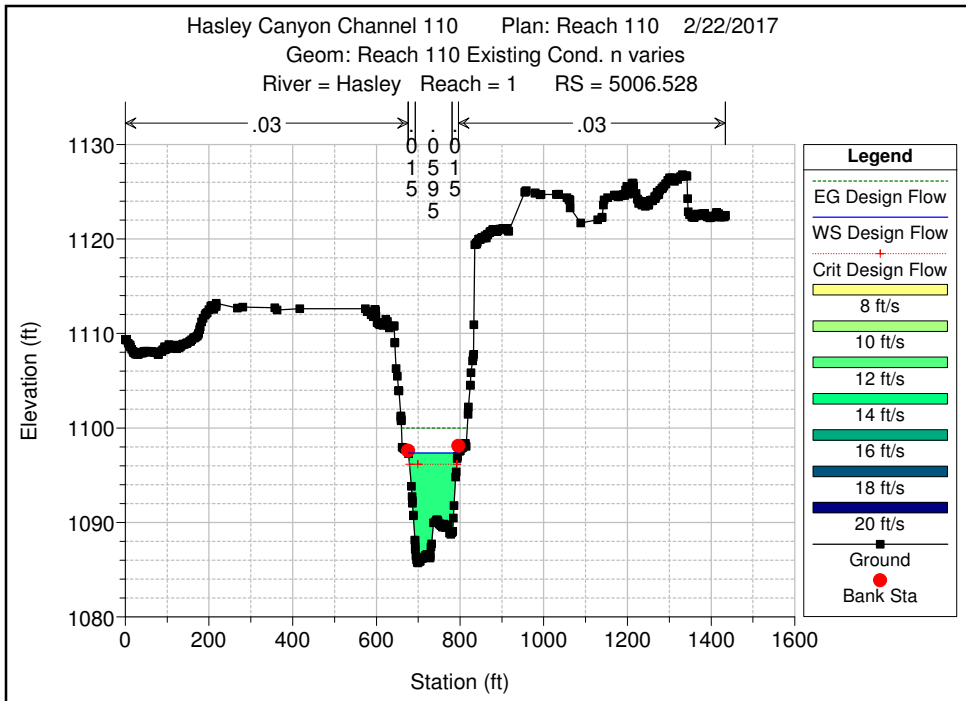

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5713.722
.03
.072
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta

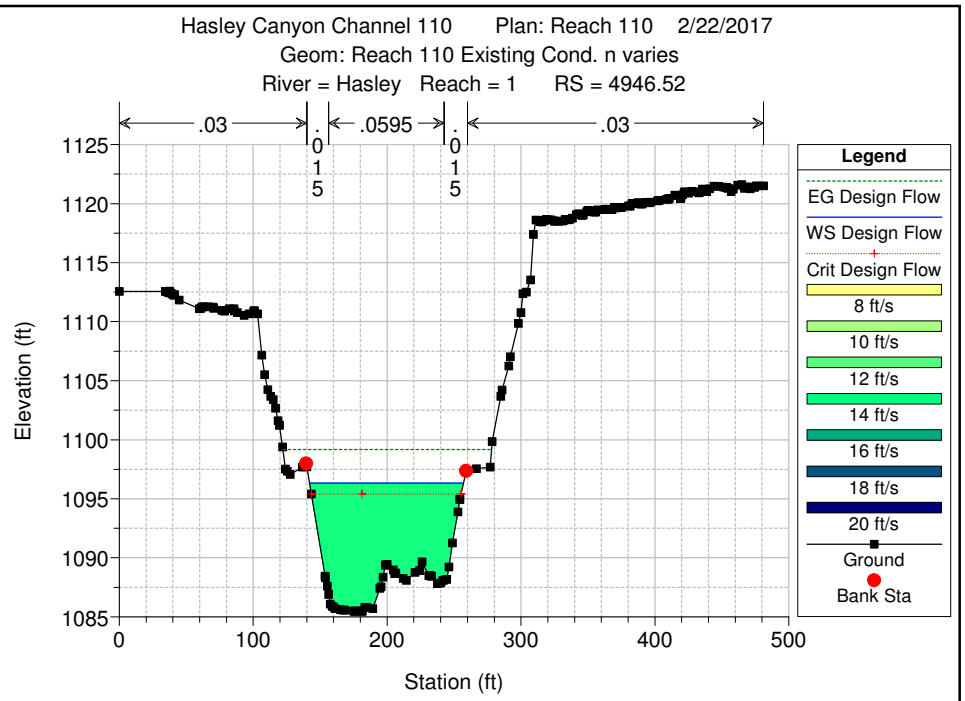

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5642.817
.03
.072
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

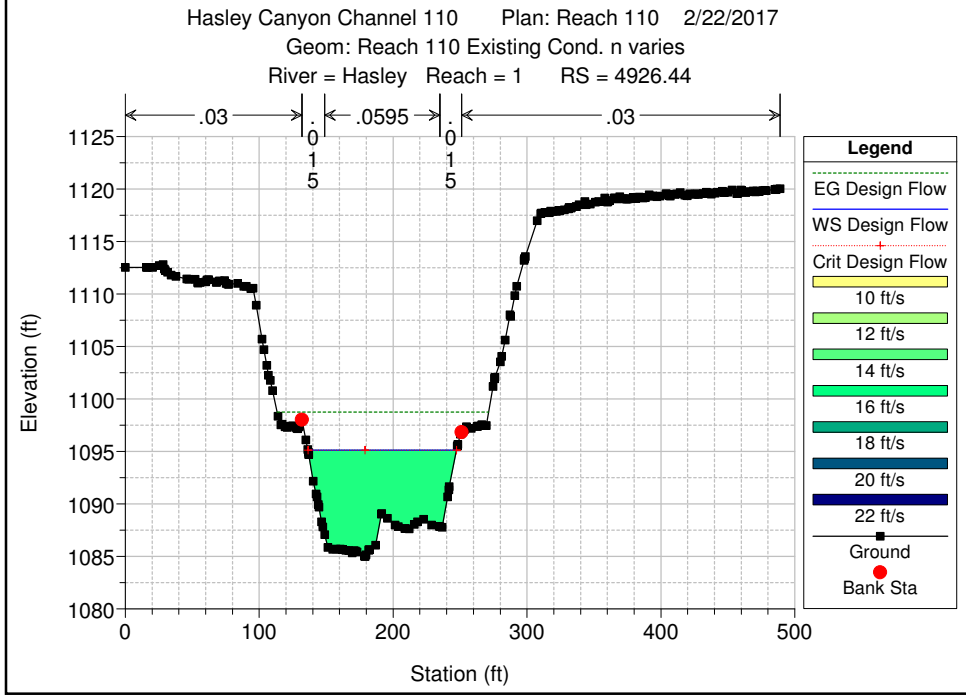

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5580.129
.03
.072
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

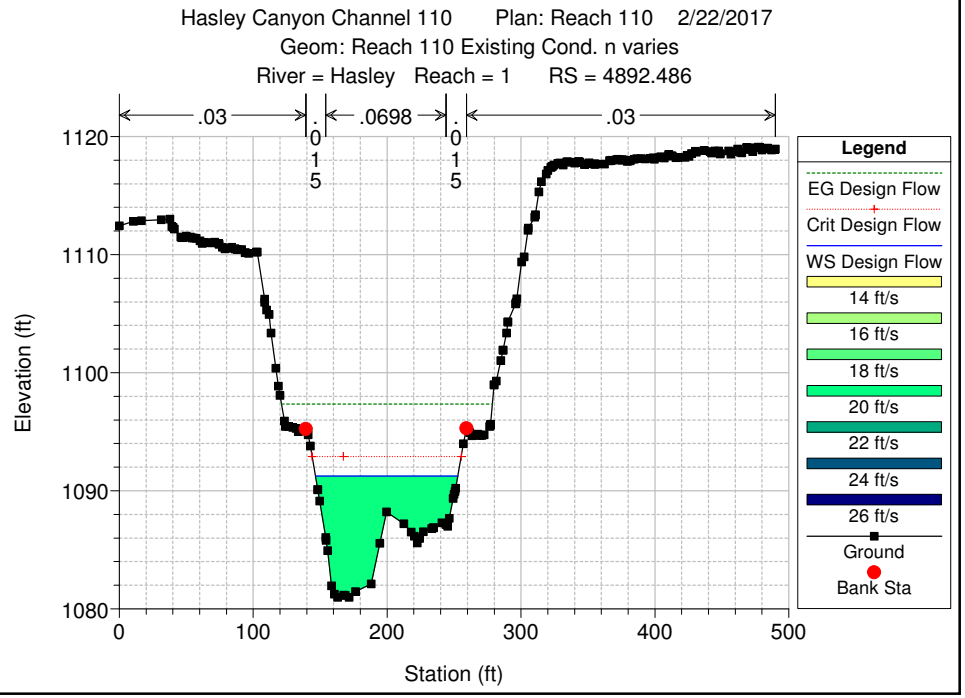

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5552.958
.03
.015
.072
.015
.03
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5439.993
.03
.015
.072
.015
.03
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5401.168
.03
.015
.0723
.015
.03
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5352.139
.03
.015
.0723
.015
.03
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

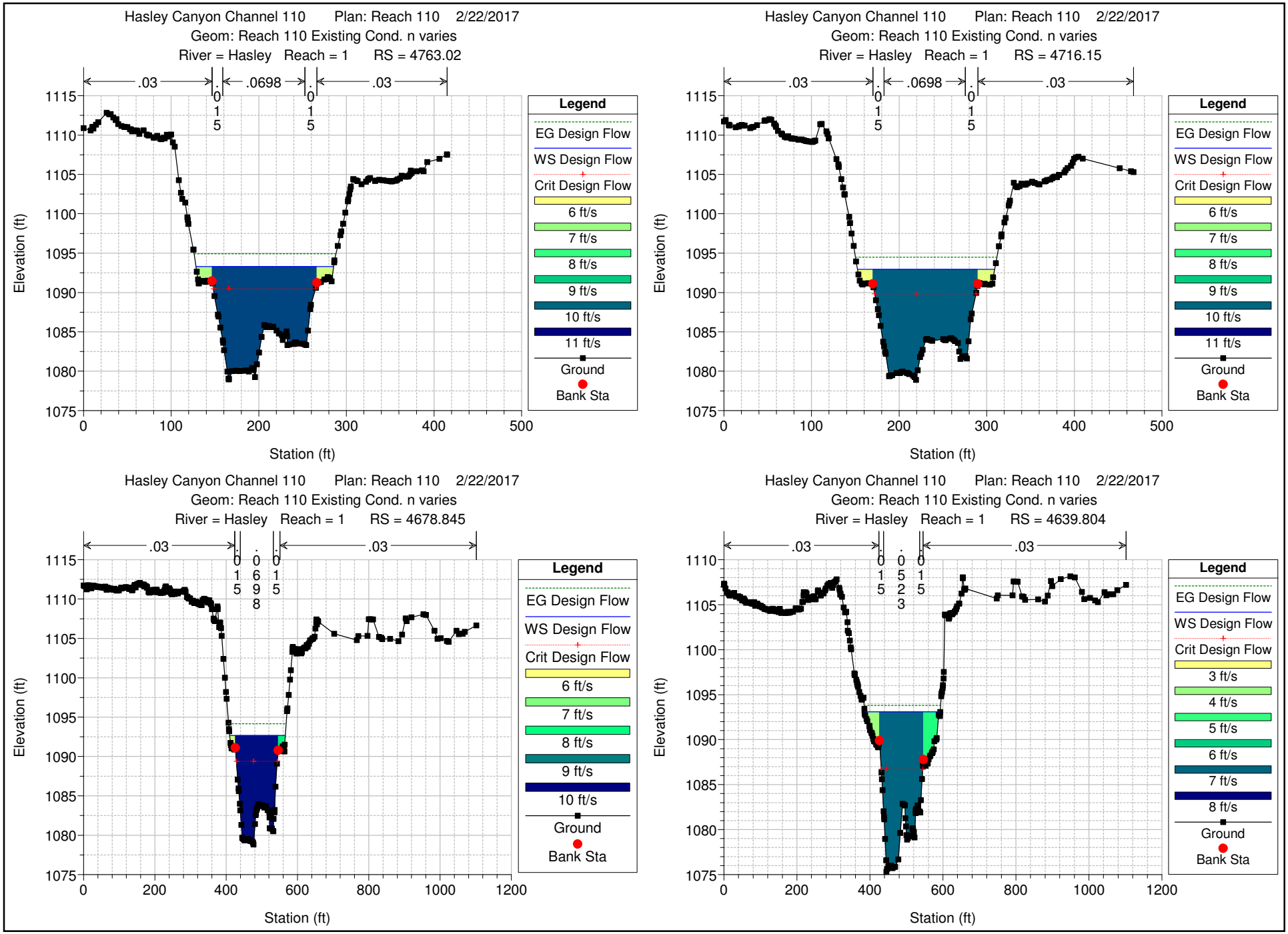

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5295.071
.03
.015
.0723
.015
.03
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5141.326
.03
.015
.0723
.015
.03
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5117.463
.03
.015
.0595
.015
.03
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5097.181
.03
.015
.0595
.015
.03
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

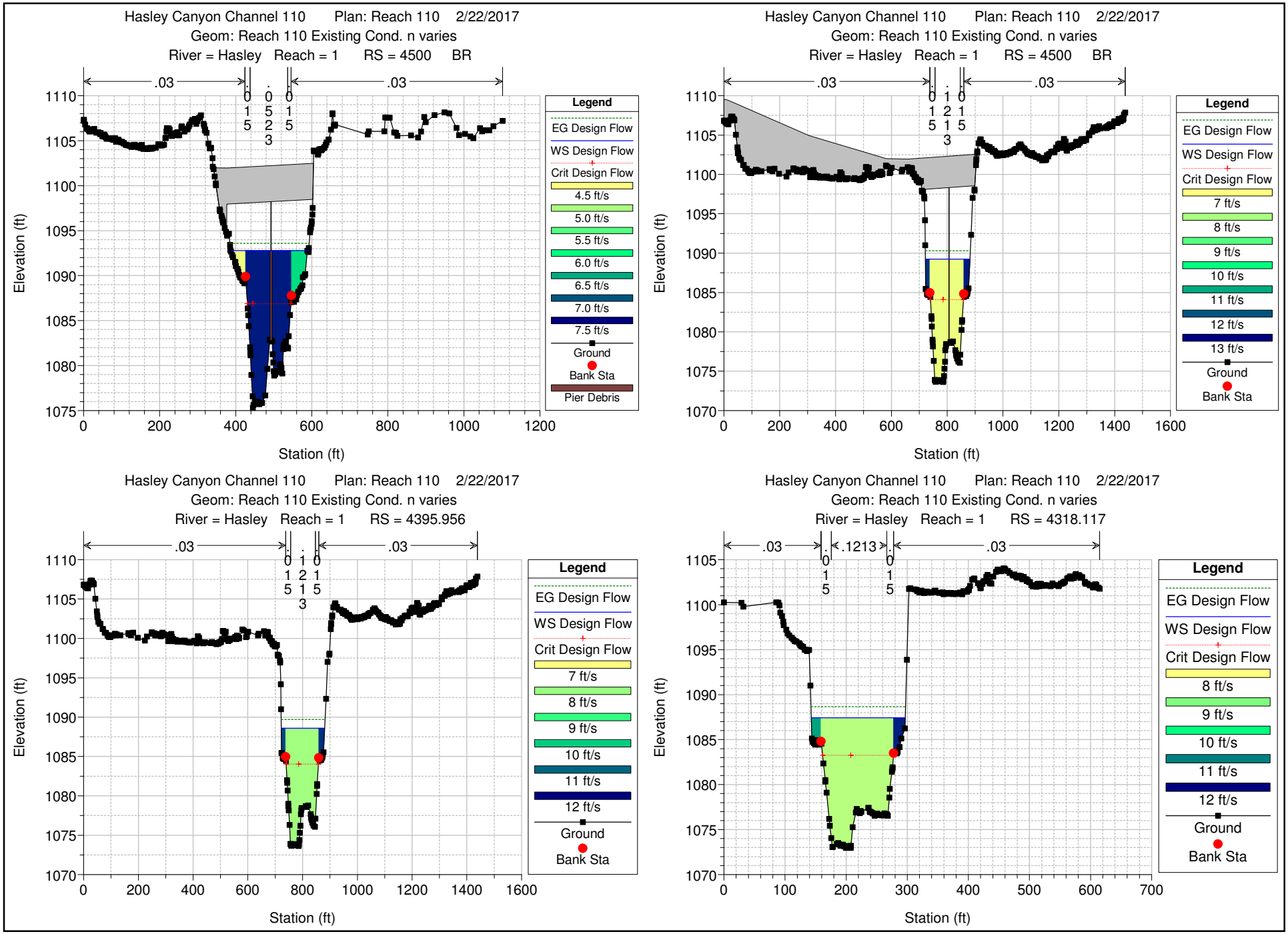

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 5006.528
.03
.015
.0595
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta

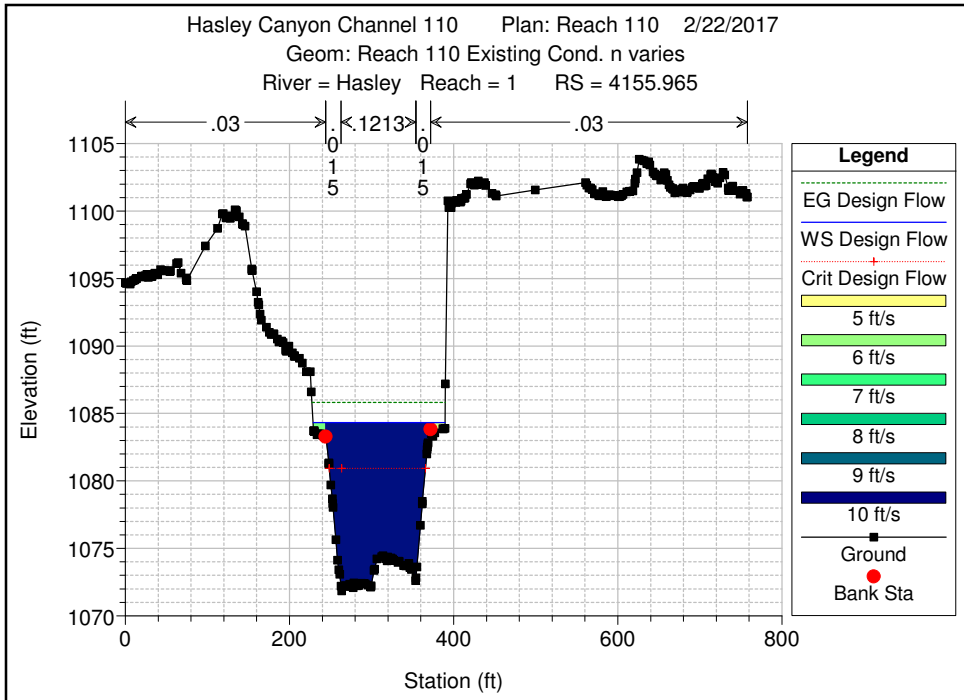

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4946.52
.03
.015
.0595
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta

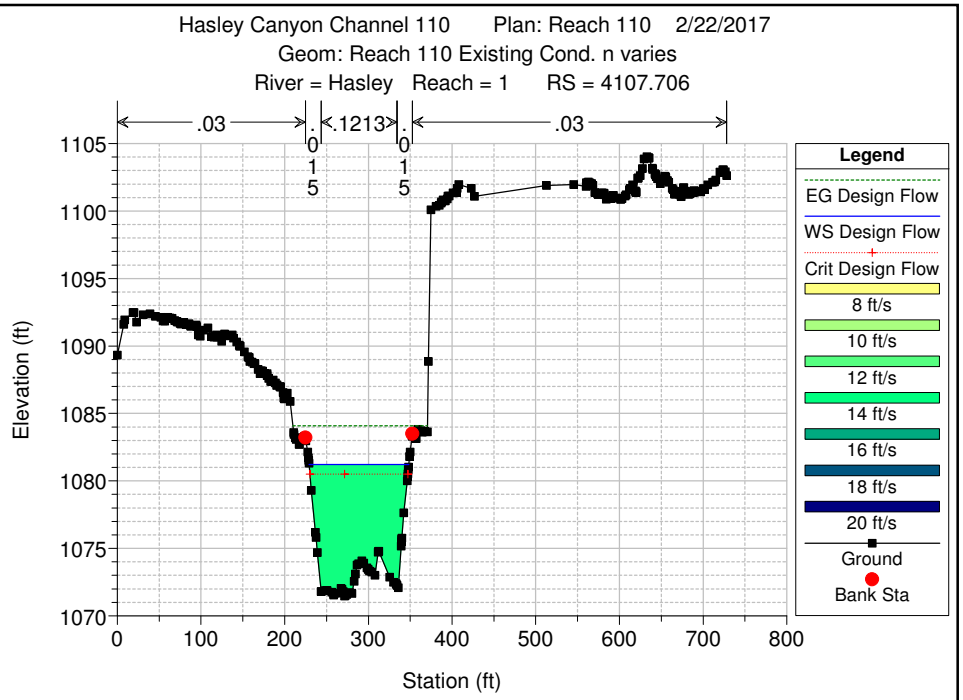

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4926.44
.03
.015
.0595
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta

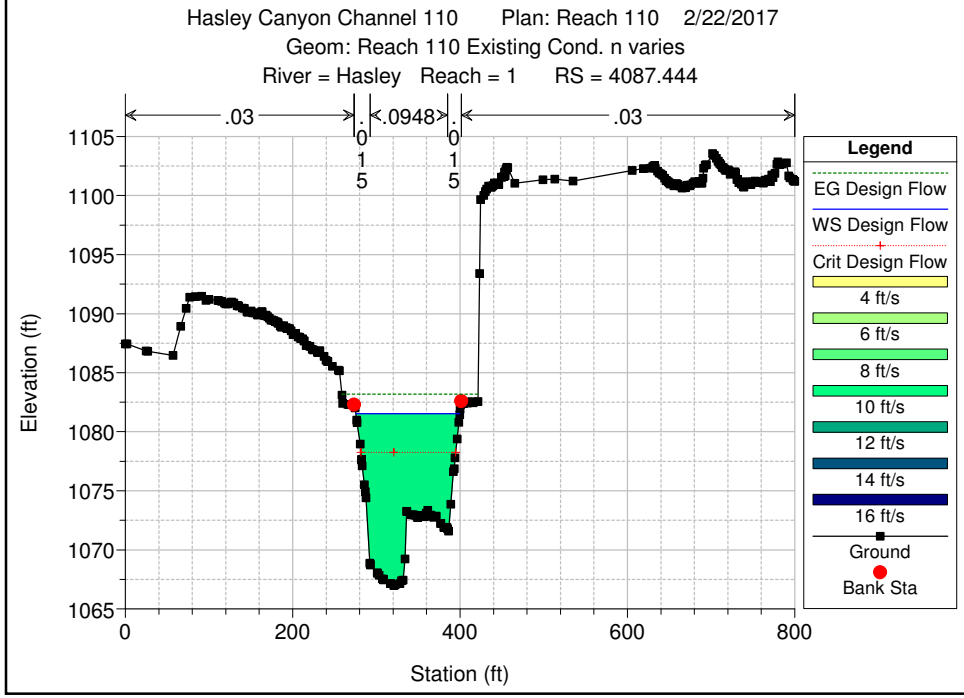

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4892.486
.03
.015
.0698
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta

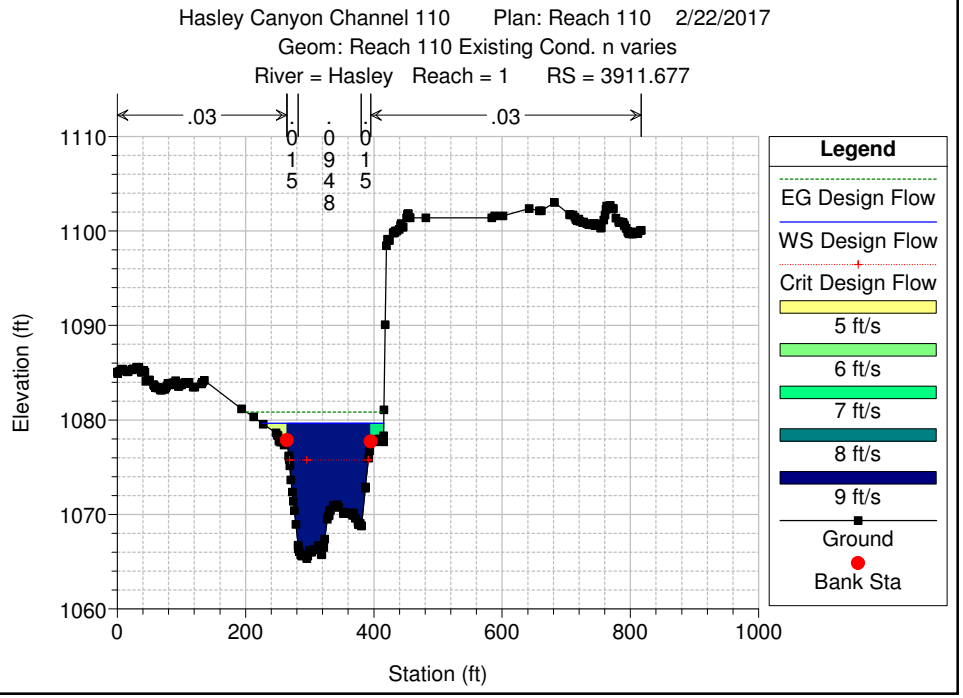

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4763.02
.03
.0698
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
11 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4716.15
.03
.0698
.03
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
11 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4678.845
.03
.03
.015
.0698
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4639.804
.03
.03
.015
.0523
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
Ground
Bank Sta

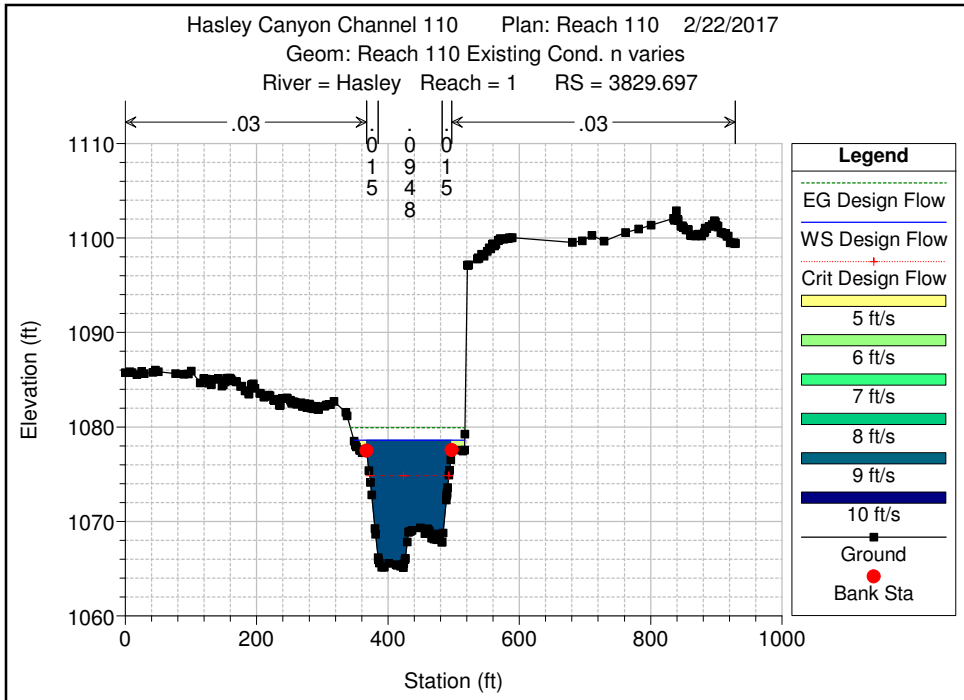

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4500 BR
.03
.03
.03
0.015
0.052
0.015
3
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
4.5 ft/s
5.0 ft/s
5.5 ft/s
6.0 ft/s
6.5 ft/s
7.0 ft/s
7.5 ft/s
Ground
Bank Sta
Pier Debris
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4500 BR
.03
.03
.03
0.015
0.121
0.015
3
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
7 ft/s
8 ft/s
9 ft/s
10 ft/s
11 ft/s
12 ft/s
13 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4395.956
.03
.03
.03
0.015
0.121
0.015
3
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
7 ft/s
8 ft/s
9 ft/s
10 ft/s
11 ft/s
12 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4318.117
.03
.1213
.03
0.015
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
9 ft/s
10 ft/s
11 ft/s
12 ft/s
Ground
Bank Sta

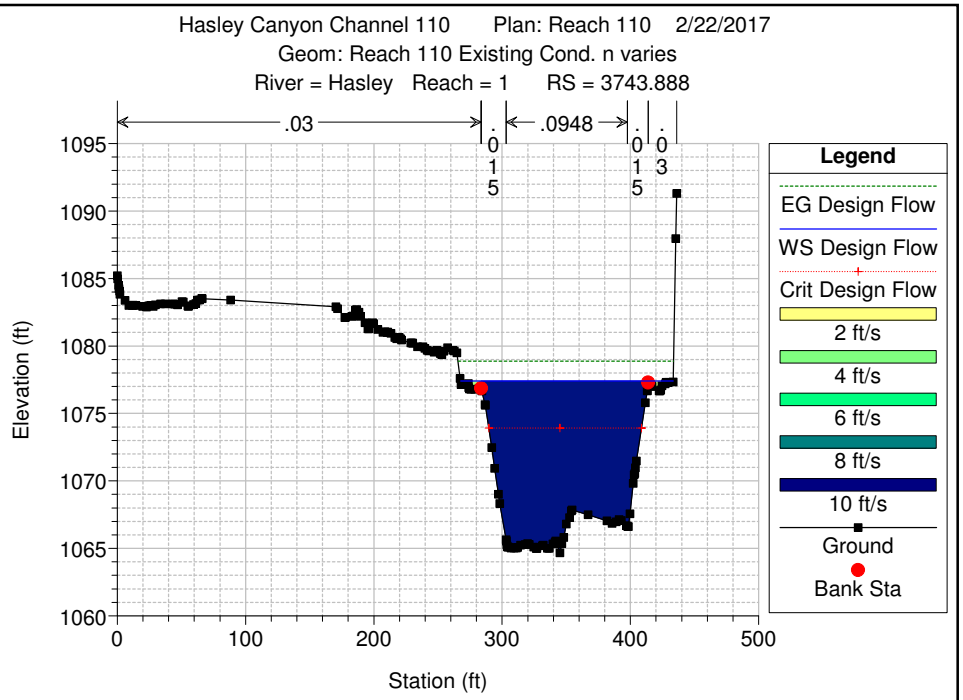

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4155.965
.03
.1213
.03
0.015
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
Ground
Bank Sta

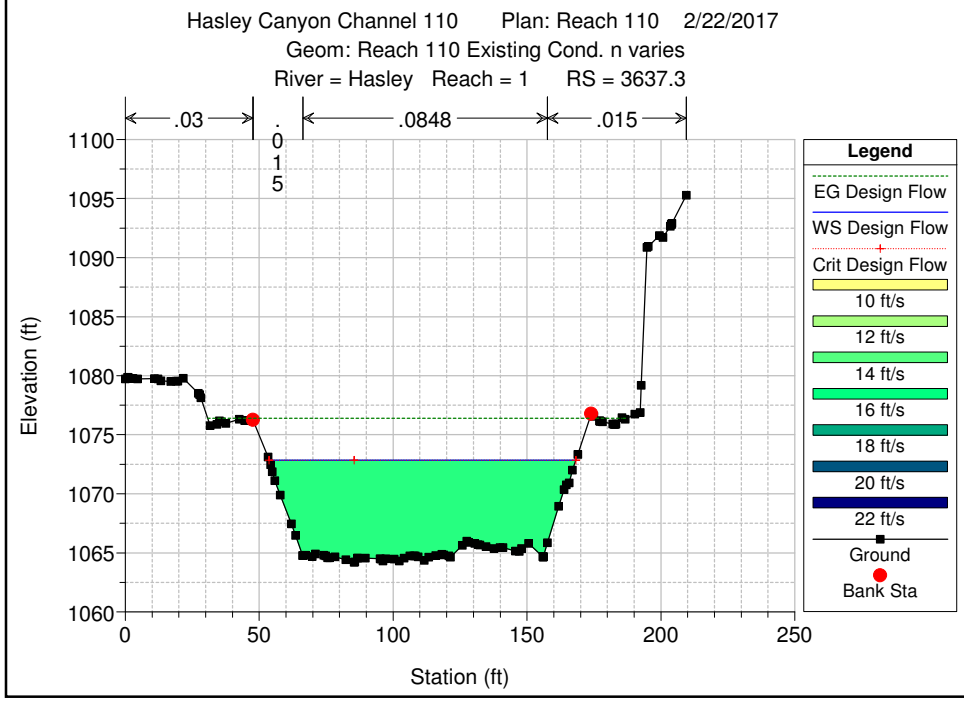

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4107.706
.03
.1213
.03
0.015
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta

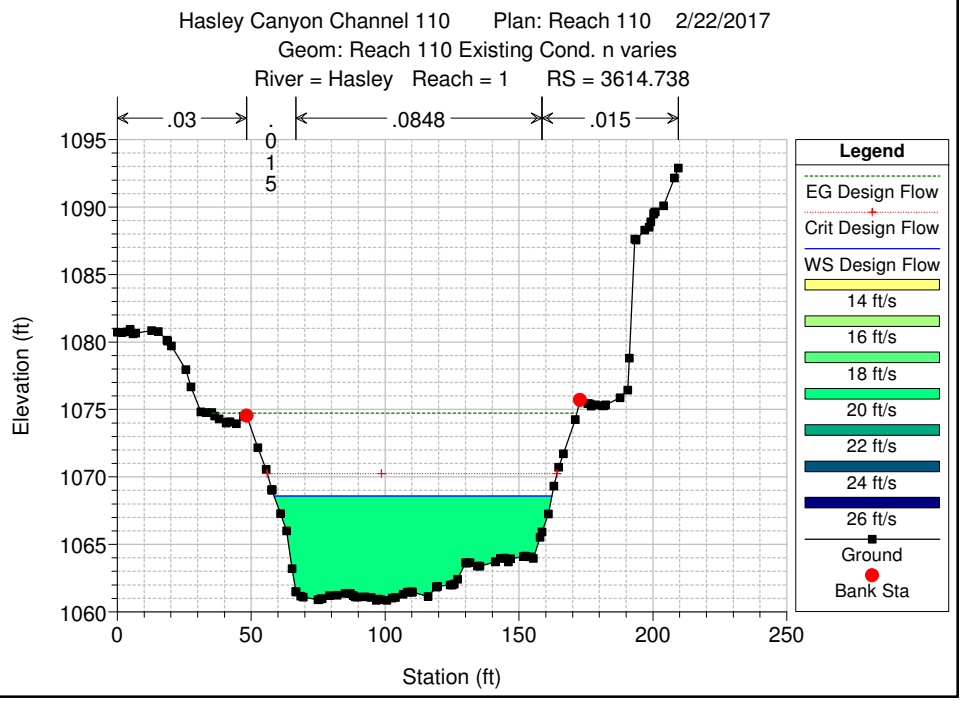

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 4087.444
.03
.0948
.03
0.015
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta

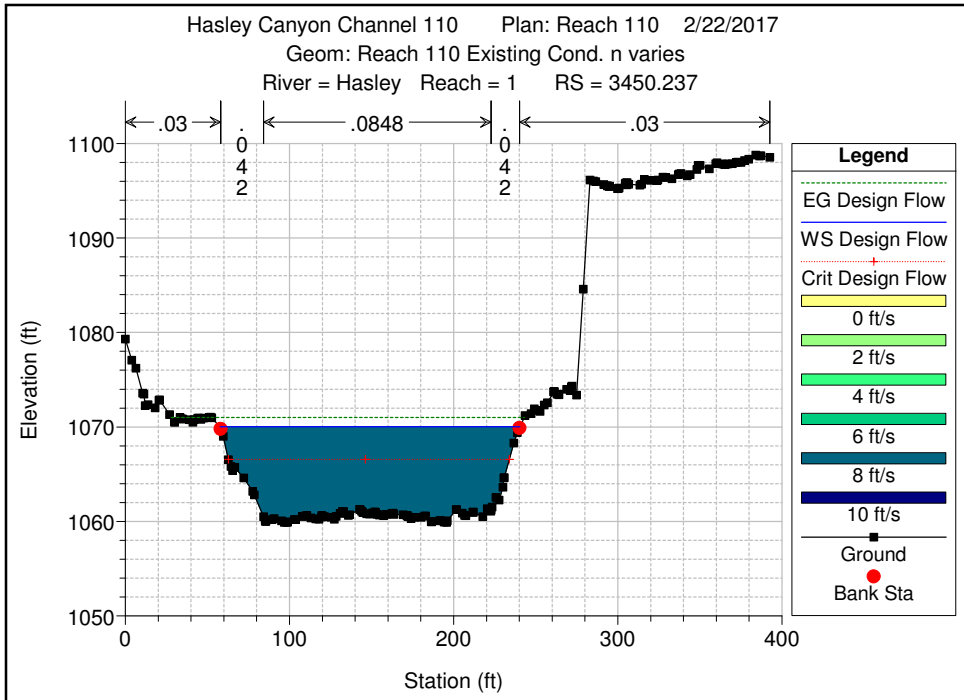

Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 3911.677
.03
.03
0.015
0.0948
0.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 3829.697
.03
.015
.0948
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 3743.888
.03
.015
.0948
.015
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 3637.3
.03
.015
.0848
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 3614.738
.03
.015
.0848
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 2/22/2017
Geom: Reach 110 Existing Cond. n varies
River = Hasley Reach = 1 RS = 3450.237
.03
.042
.0848
.042
.03
Elevation (ft)
1100
1090
1080
1070
1060
1050
0
100
200
300
400
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

Appendix E: HEC-RAS Model Output Data

Hasley Canyon Channel Reach 110
Design Conditions

PACE
Advanced Water Engineering

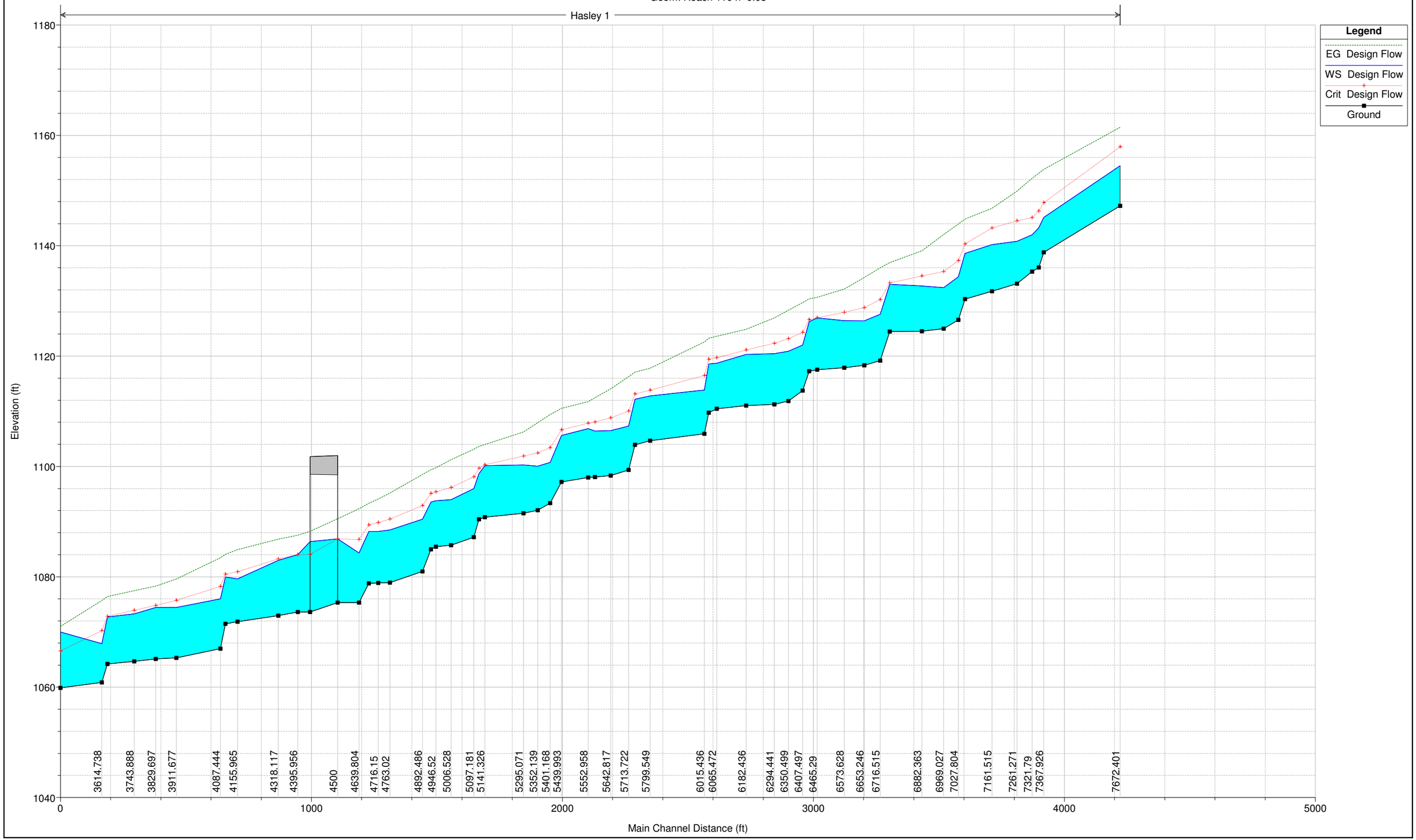
HEC-RAS Plan: Reach 110 River: Hasley Reach: 1 Profile: Design Flow

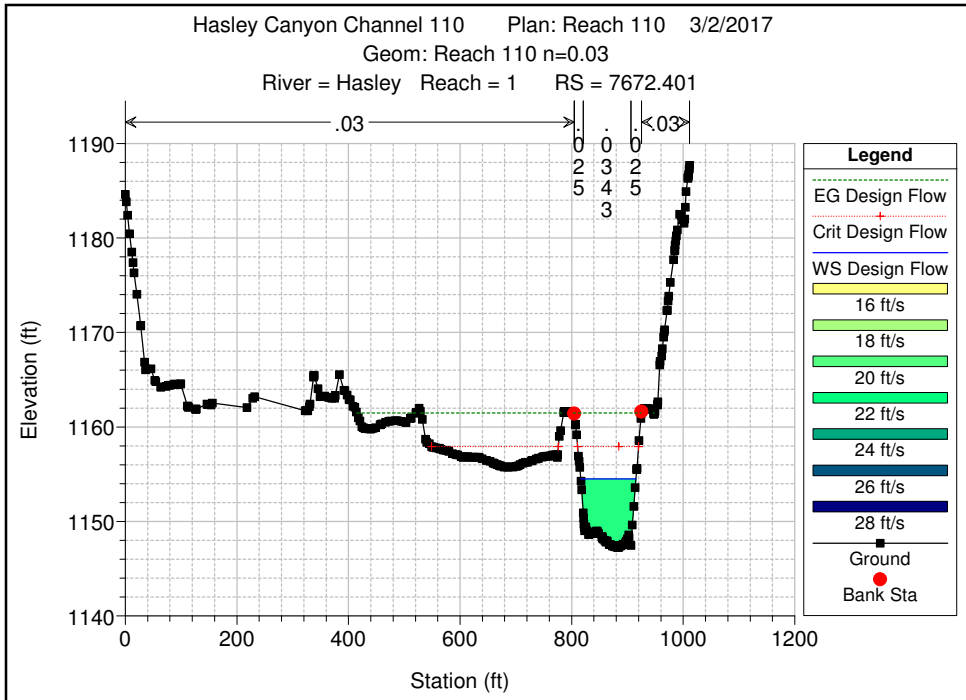
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	7672.401	Design Flow	12300.00	1147.24	1154.50	1157.93	1161.46	0.022013	21.17	581.05	99.02	1.54
1	7367.926	Design Flow	12300.00	1138.80	1145.13	1147.81	1153.84	0.027278	23.67	519.56	96.68	1.80
1	7348.048	Design Flow	12300.00	1136.05	1143.29	1146.29	1153.15	0.031960	25.19	488.27	91.76	1.93
1	7321.79	Design Flow	12300.00	1135.31	1141.98	1145.08	1152.23	0.034265	25.69	478.83	92.34	1.99
1	7261.271	Design Flow	12300.00	1133.12	1140.81	1144.51	1149.90	0.031372	24.19	508.41	106.27	1.95
1	7161.515	Design Flow	12300.00	1131.74	1140.21	1143.22	1146.79	0.018481	20.58	597.57	106.40	1.53
1	7054.132	Design Flow	12300.00	1130.31	1138.60	1140.34	1144.83	0.016098	20.02	614.41	103.67	1.45
1	7027.804	Design Flow	12300.00	1126.56	1134.39	1137.31	1143.93	0.031246	24.77	496.50	97.50	1.94
1	6969.027	Design Flow	12300.00	1124.96	1132.42	1135.33	1142.04	0.032626	24.89	494.22	101.87	1.99
1	6882.363	Design Flow	12300.00	1124.51	1132.72	1134.52	1139.09	0.016873	20.25	607.40	103.44	1.47
1	6754.417	Design Flow	12300.00	1124.44	1133.02	1133.25	1136.94	0.007899	15.87	774.84	107.36	1.04
1	6716.515	Design Flow	12300.00	1119.18	1127.58	1130.24	1135.99	0.025495	23.26	528.76	99.24	1.78
1	6653.246	Design Flow	12300.00	1118.33	1126.40	1128.79	1134.26	0.023924	22.49	546.94	103.26	1.72
1	6573.628	Design Flow	12300.00	1117.90	1126.42	1127.93	1132.17	0.014529	19.23	639.64	104.73	1.37
1	6465.29	Design Flow	12300.00	1117.54	1126.92	1126.95	1130.66	0.007298	15.51	793.19	107.42	1.01
1	6433.633	Design Flow	12300.00	1117.27	1126.25	1126.62	1130.37	0.008438	16.30	754.79	106.04	1.08
1	6407.497	Design Flow	12300.00	1113.75	1122.00	1124.32	1129.68	0.022728	22.24	553.03	101.51	1.68
1	6350.499	Design Flow	12300.00	1111.84	1120.87	1123.16	1128.32	0.022675	21.89	561.95	106.33	1.68
1	6294.441	Design Flow	12300.00	1111.26	1120.44	1122.33	1126.91	0.017608	20.41	602.77	104.99	1.50
1	6182.436	Design Flow	12300.00	1111.04	1120.30	1121.10	1124.87	0.010228	17.14	717.79	107.89	1.17
1	6065.472	Design Flow	12300.00	1110.46	1118.70	1119.70	1123.59	0.011020	17.73	693.55	105.39	1.22
1	6033.218	Design Flow	12300.00	1109.74	1118.57	1119.42	1123.24	0.010386	17.34	709.32	106.51	1.18
1	6015.436	Design Flow	12300.00	1105.93	1113.85	1116.50	1122.56	0.026657	23.66	519.77	95.90	1.79
1	5799.549	Design Flow	12300.00	1104.66	1112.78	1113.84	1117.80	0.011688	17.98	684.14	106.11	1.25
1	5739.189	Design Flow	12300.00	1103.93	1112.18	1113.14	1117.09	0.011179	17.78	691.78	105.53	1.22
1	5713.722	Design Flow	12300.00	1099.36	1107.31	1110.05	1116.26	0.027244	24.00	512.56	95.38	1.83
1	5642.817	Design Flow	12300.00	1098.36	1106.50	1108.80	1114.09	0.023000	22.09	556.81	105.28	1.69
1	5580.129	Design Flow	12300.00	1098.08	1106.42	1108.08	1112.44	0.015653	19.68	625.01	105.61	1.43
1	5552.958	Design Flow	12300.00	1098.00	1106.86	1107.84	1111.75	0.011290	17.73	693.70	106.85	1.23
1	5439.993	Design Flow	12300.00	1097.21	1105.63	1106.63	1110.55	0.011252	17.80	691.17	105.24	1.22
1	5401.168	Design Flow	12300.00	1093.35	1100.73	1103.39	1109.41	0.026768	23.62	520.70	100.49	1.83
1	5352.139	Design Flow	12300.00	1092.06	1100.04	1102.44	1107.93	0.024119	22.53	545.90	103.88	1.73
1	5295.071	Design Flow	12300.00	1091.52	1100.28	1101.90	1106.26	0.015851	19.62	627.01	106.27	1.42
1	5141.326	Design Flow	12300.00	1090.80	1100.13	1100.31	1103.96	0.007791	15.71	783.14	109.45	1.04
1	5117.463	Design Flow	12300.00	1090.43	1098.70	1099.69	1103.64	0.011087	17.81	690.44	104.35	1.22
1	5097.181	Design Flow	12300.00	1087.18	1096.00	1098.12	1103.12	0.019986	21.41	574.61	102.83	1.60
1	5006.528	Design Flow	12300.00	1085.73	1093.99	1096.17	1101.24	0.021335	21.60	569.34	105.24	1.64
1	4946.52	Design Flow	12300.00	1085.46	1093.79	1095.43	1099.76	0.015817	19.60	627.40	106.98	1.43

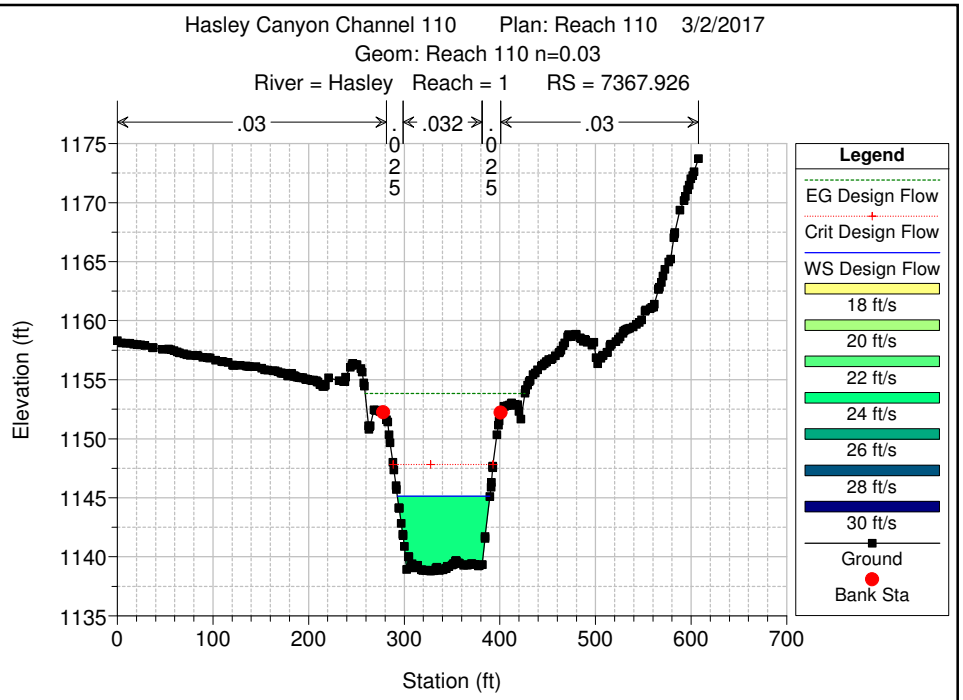
HEC-RAS Plan: Reach 110 River: Hasley Reach: 1 Profile: Design Flow (Continued)

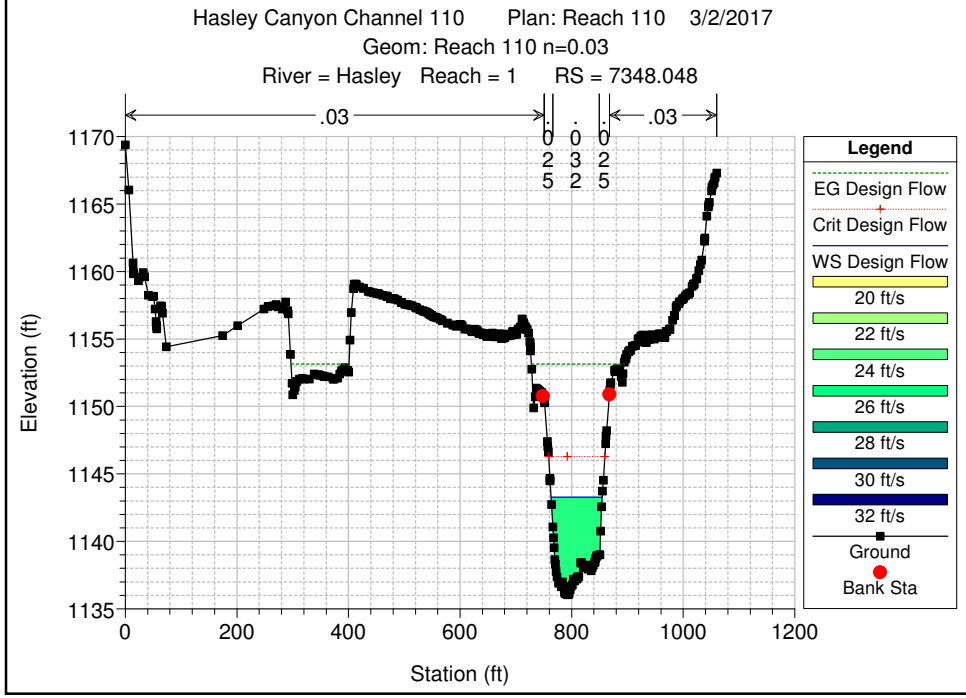
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	4926.44	Design Flow	12300.00	1084.99	1093.55	1095.12	1099.43	0.015260	19.44	632.56	106.40	1.41
1	4892.486	Design Flow	12300.00	1080.97	1090.46	1092.91	1098.55	0.025449	22.82	539.11	103.94	1.77
1	4763.02	Design Flow	12300.00	1078.95	1088.49	1090.48	1095.20	0.020345	20.78	592.03	108.50	1.57
1	4716.15	Design Flow	12300.00	1078.90	1088.23	1089.84	1094.09	0.016197	19.42	633.26	109.67	1.43
1	4678.845	Design Flow	12300.00	1078.82	1088.21	1089.39	1093.33	0.013205	18.13	678.26	110.82	1.29
1	4639.804	Design Flow	12300.00	1075.31	1084.32	1086.76	1092.33	0.026609	22.70	541.95	106.52	1.77
1	4500		Bridge									
1	4395.956	Design Flow	12300.00	1073.63	1084.02	1084.02	1087.53	0.007515	15.05	817.53	117.80	1.01
1	4318.117	Design Flow	12300.00	1072.96	1082.99	1083.26	1086.82	0.008396	15.70	783.37	115.37	1.06
1	4155.965	Design Flow	12300.00	1071.86	1079.62	1080.94	1084.94	0.013983	18.51	664.64	113.27	1.35
1	4107.706	Design Flow	12300.00	1071.48	1079.96	1080.48	1084.08	0.009450	16.28	755.63	115.42	1.12
1	4087.444	Design Flow	12300.00	1066.99	1076.02	1078.25	1083.45	0.023402	21.87	562.49	106.52	1.68
1	3911.677	Design Flow	12300.00	1065.31	1074.46	1075.74	1079.60	0.014263	18.20	675.82	119.53	1.35
1	3829.697	Design Flow	12300.00	1065.10	1074.45	1074.83	1078.30	0.008829	15.75	781.06	119.54	1.09
1	3743.888	Design Flow	12300.00	1064.67	1073.28	1073.92	1077.48	0.009829	16.43	748.80	117.08	1.15
1	3637.3	Design Flow	12300.00	1064.21	1072.72	1072.86	1076.41	0.007736	15.42	797.72	114.22	1.03
1	3614.738	Design Flow	12300.00	1060.85	1067.89	1070.25	1075.72	0.023036	22.44	548.03	101.75	1.70
1	3450.237	Design Flow	12300.00	1059.88	1070.00	1066.57	1071.01	0.010013	8.03	1531.81	182.74	0.49

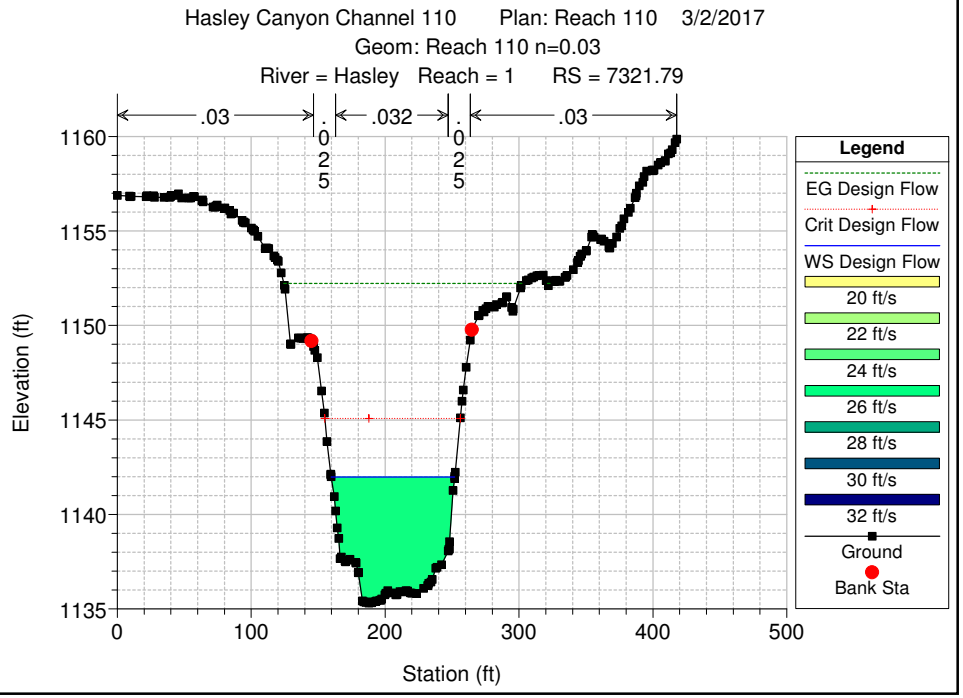
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03

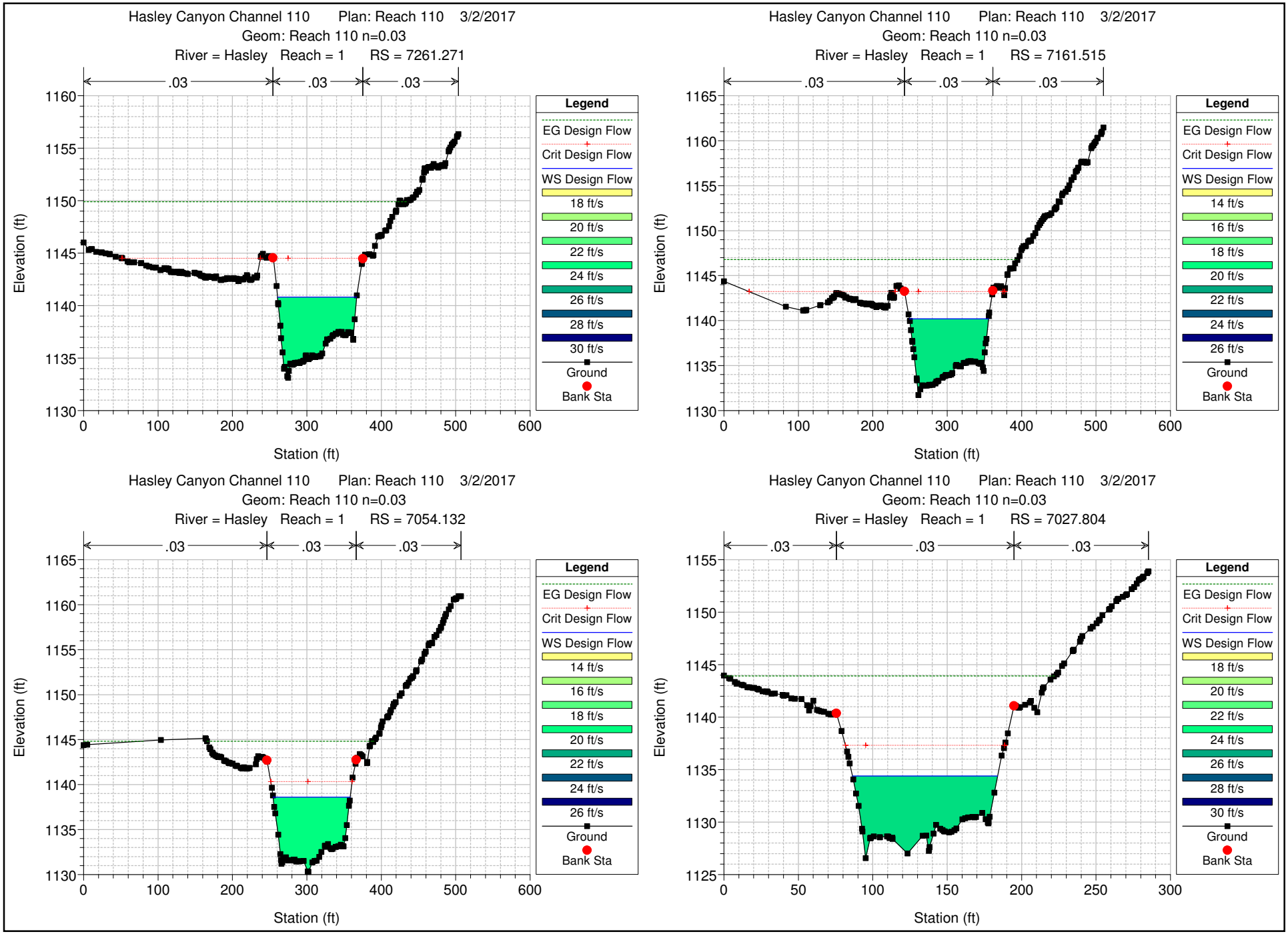


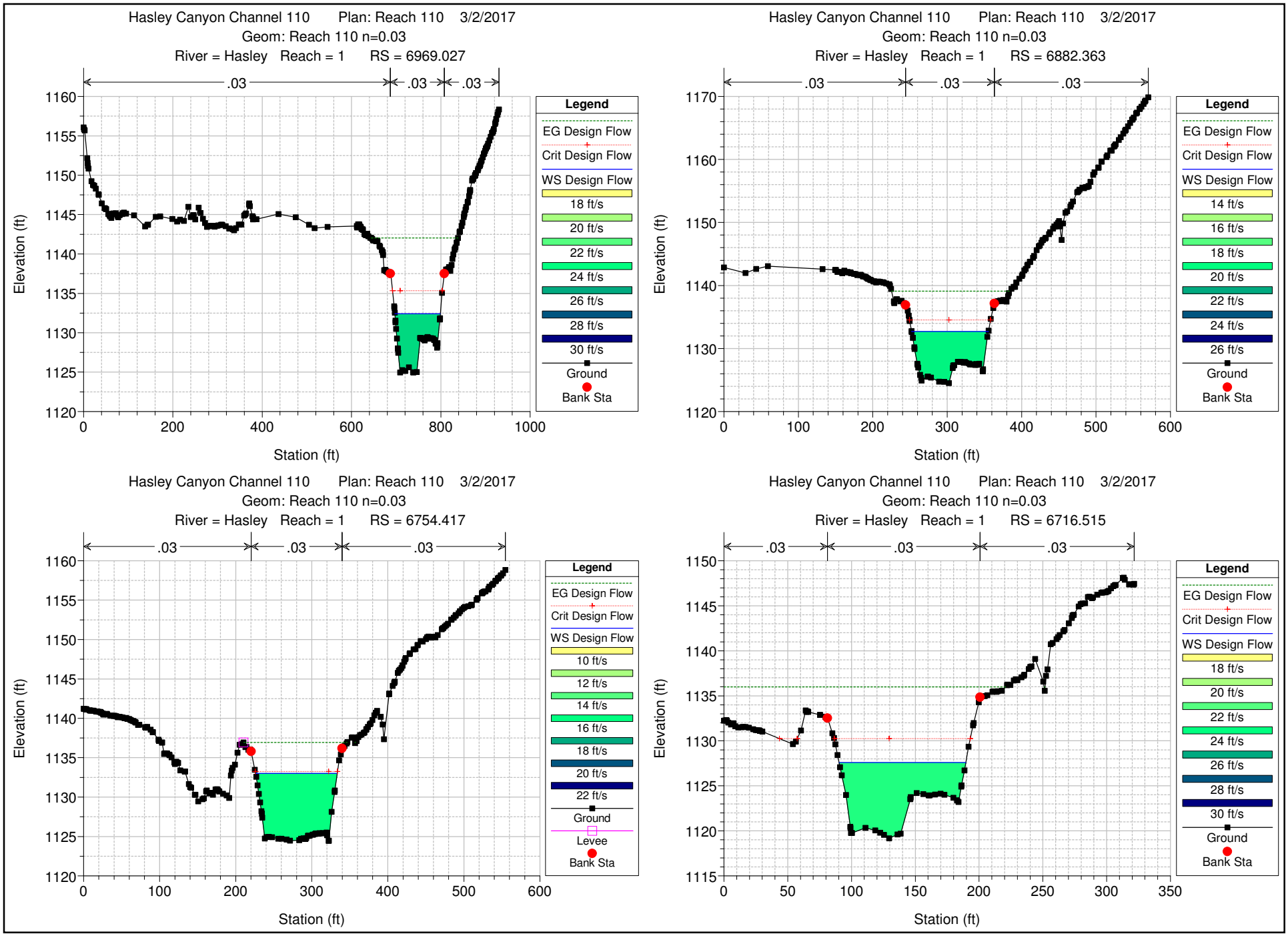

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 7672.401
.03
.025
.043
.025
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta

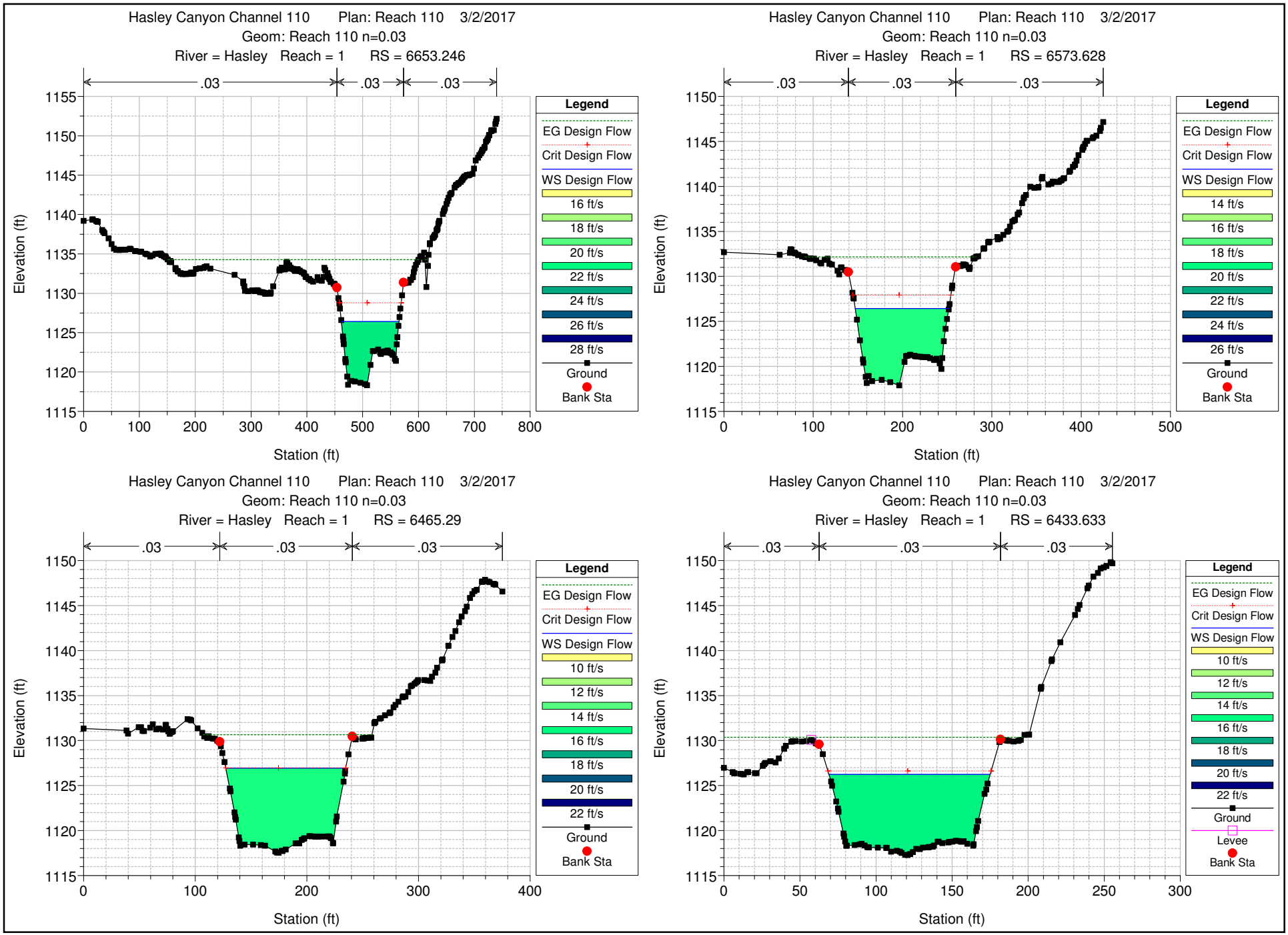

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 7367.926
.03
.025
.032
.025
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
Ground
Bank Sta

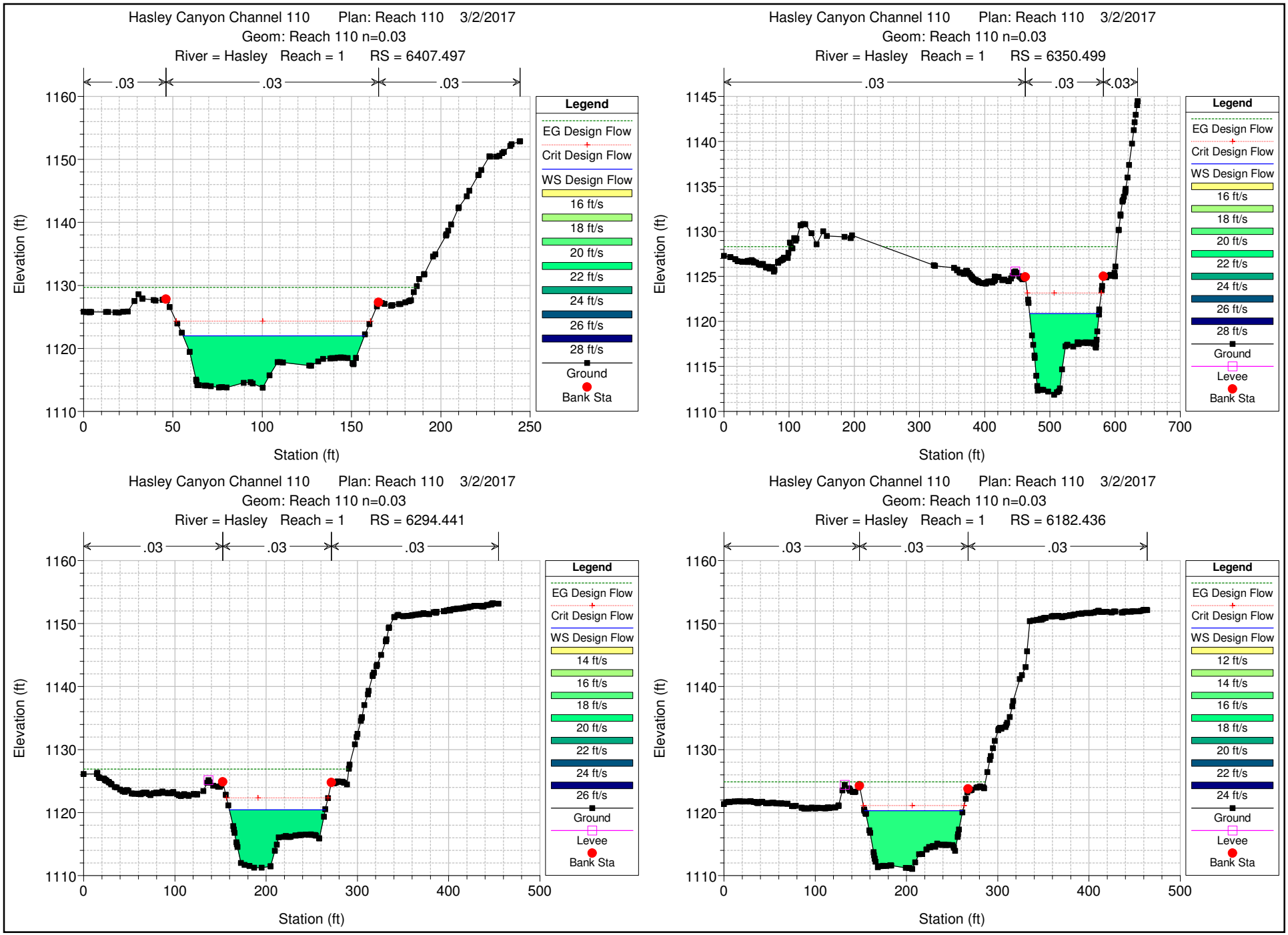

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 7348.048
.03
.025
.032
.025
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
32 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 7321.79
.03
.025
.032
.025
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
32 ft/s
Ground
Bank Sta

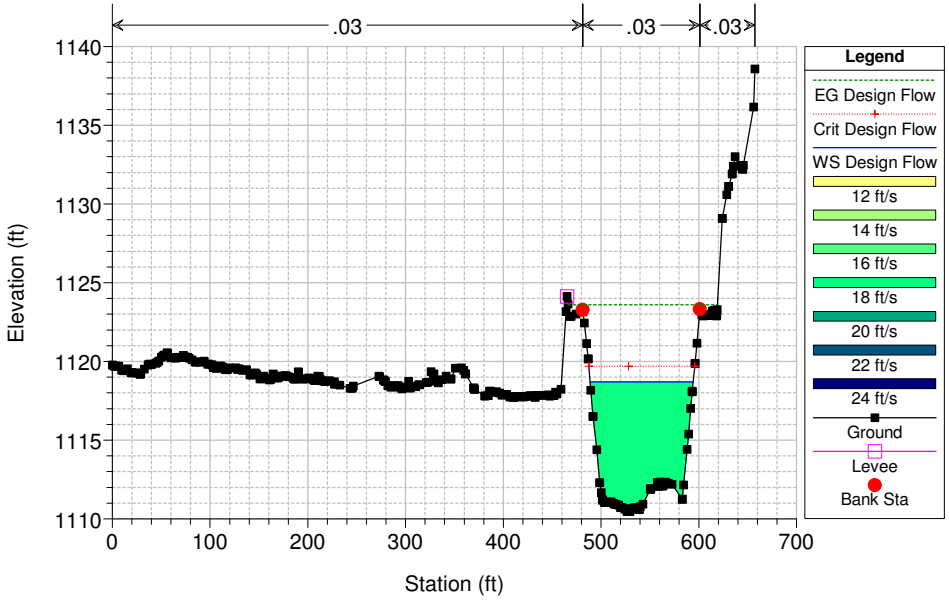

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 7261.271
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 7161.515
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 7054.132
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 7027.804
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6969.027
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6882.363
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6754.417
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Levee
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6716.515
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
Ground
Bank Sta

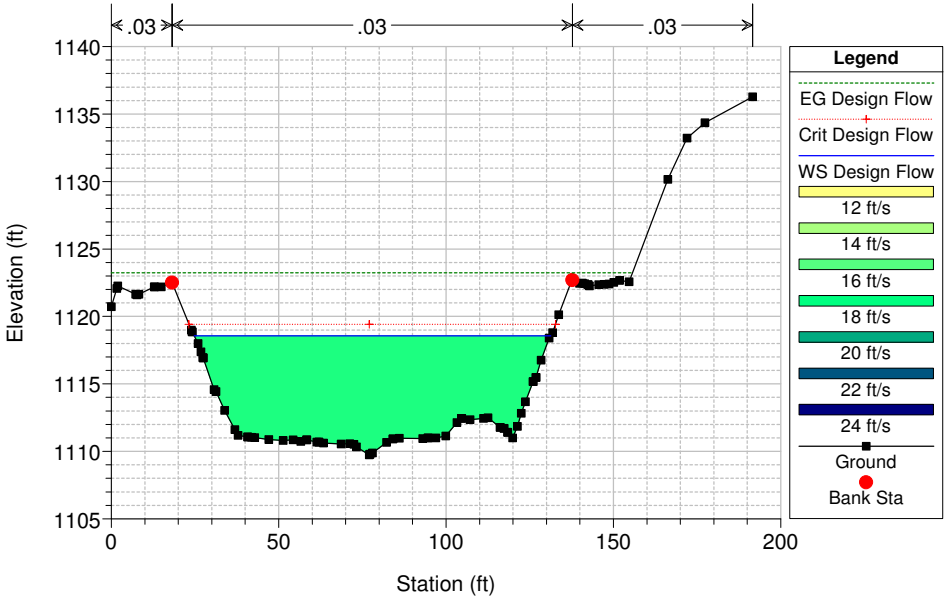

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6653.246
.03
.03
.03
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6573.628
.03
.03
.03
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6465.29
.03
.03
.03
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6433.633
.03
.03
.03
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6407.497
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6350.499
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Levee
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6294.441
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Levee
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6182.436
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Levee
Bank Sta

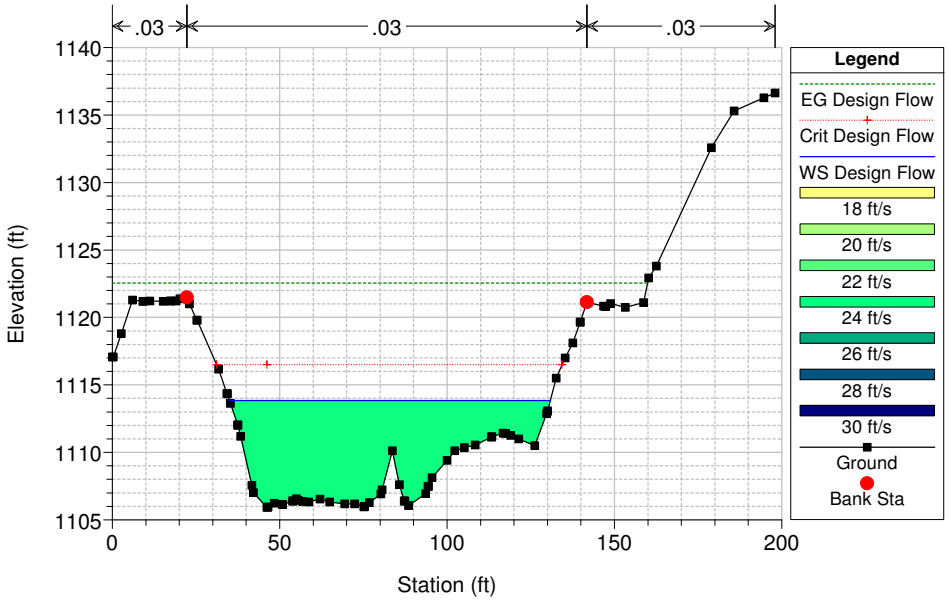
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6065.472



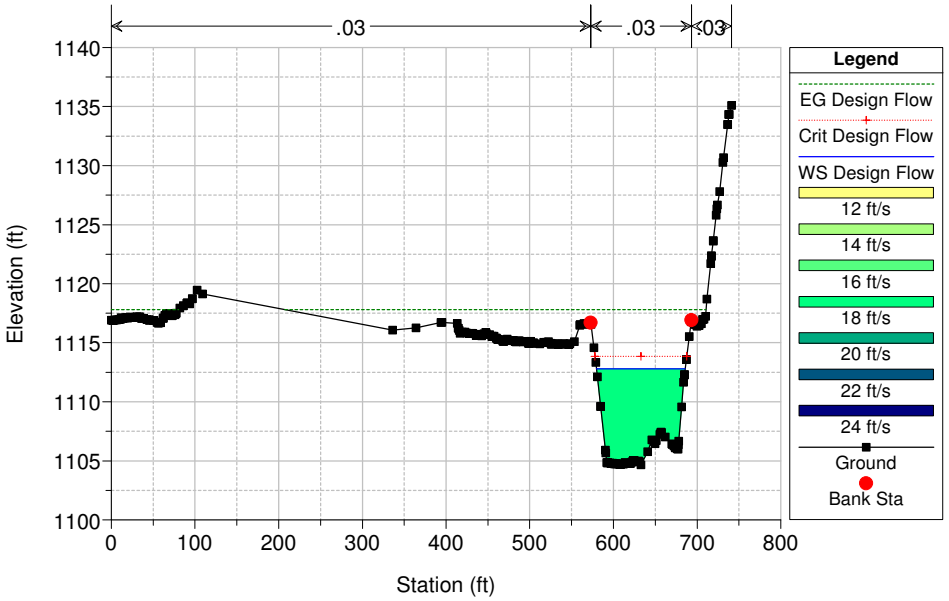
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6033.218

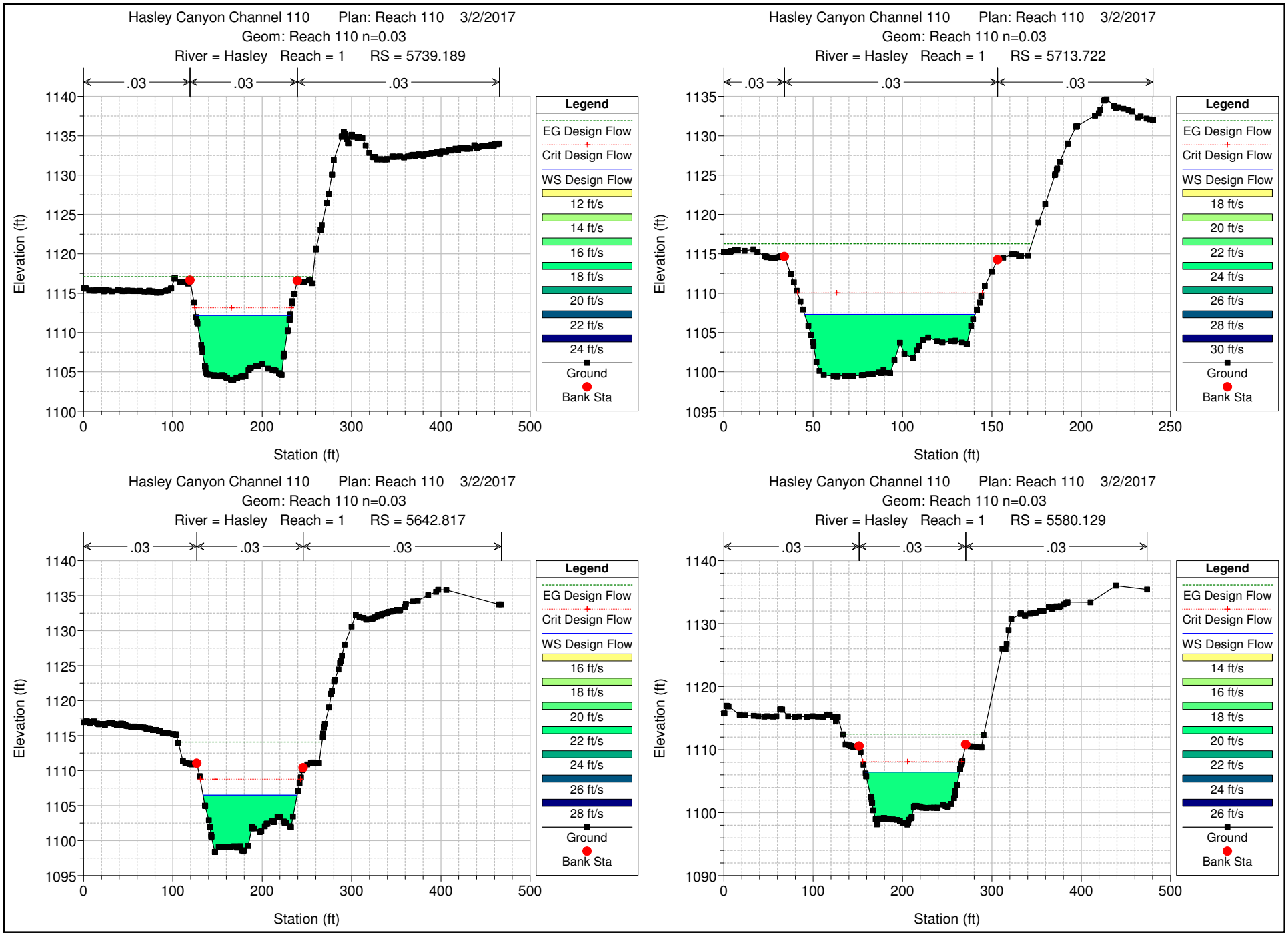


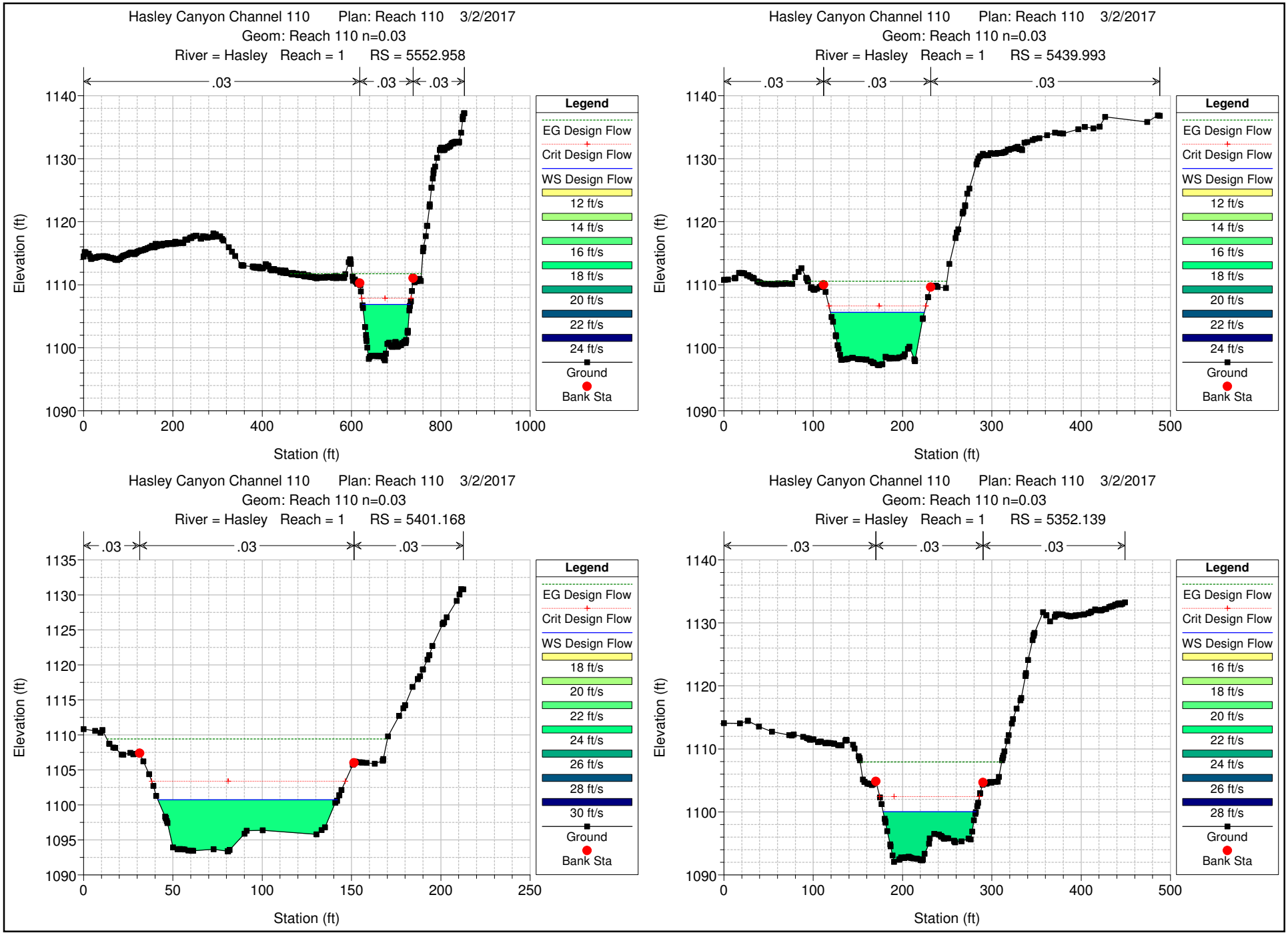
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 6015.436

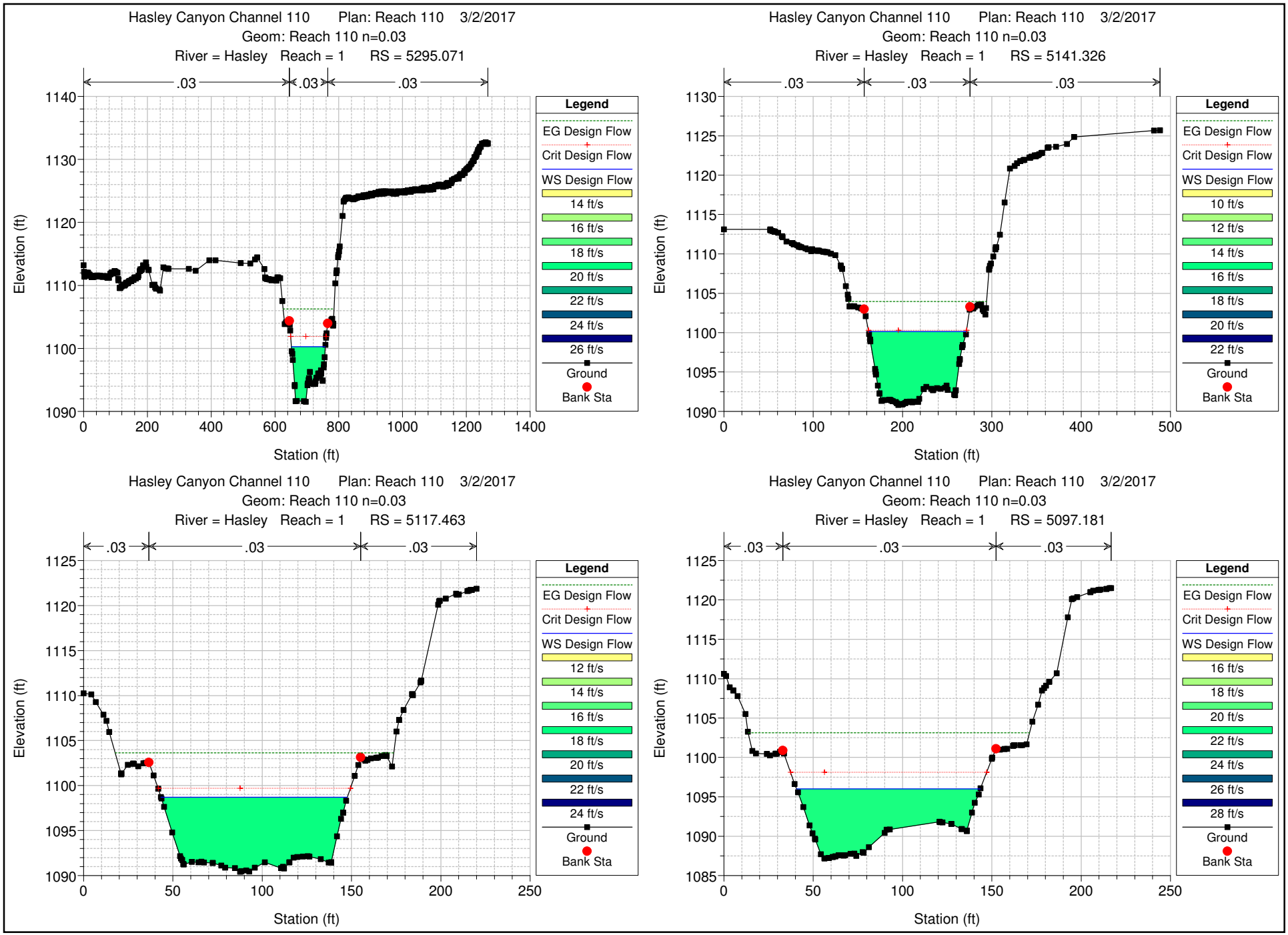


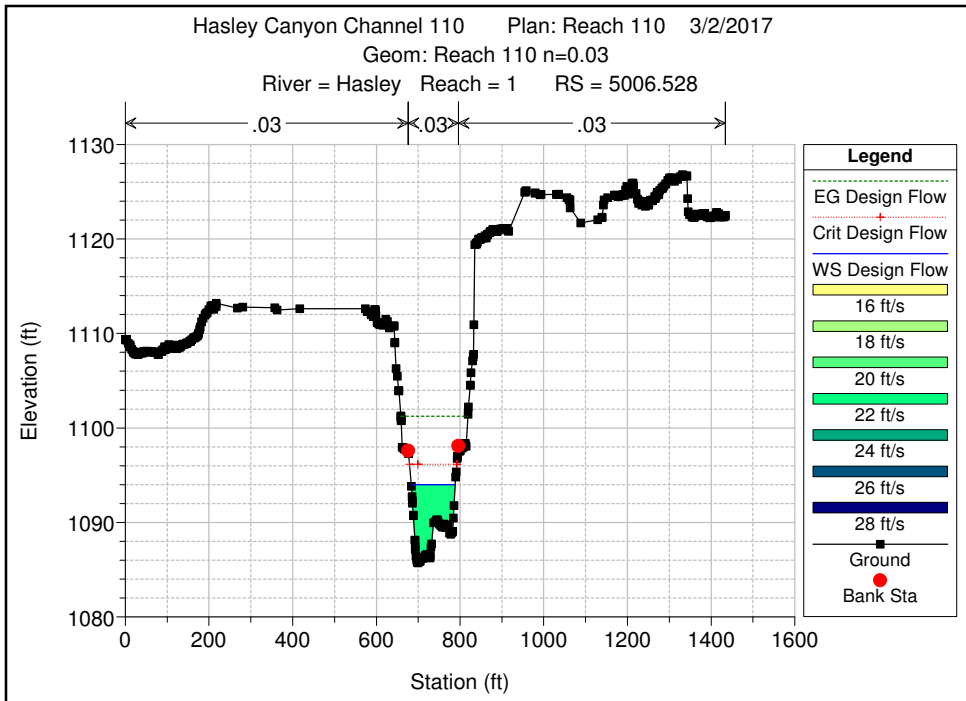
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5799.549

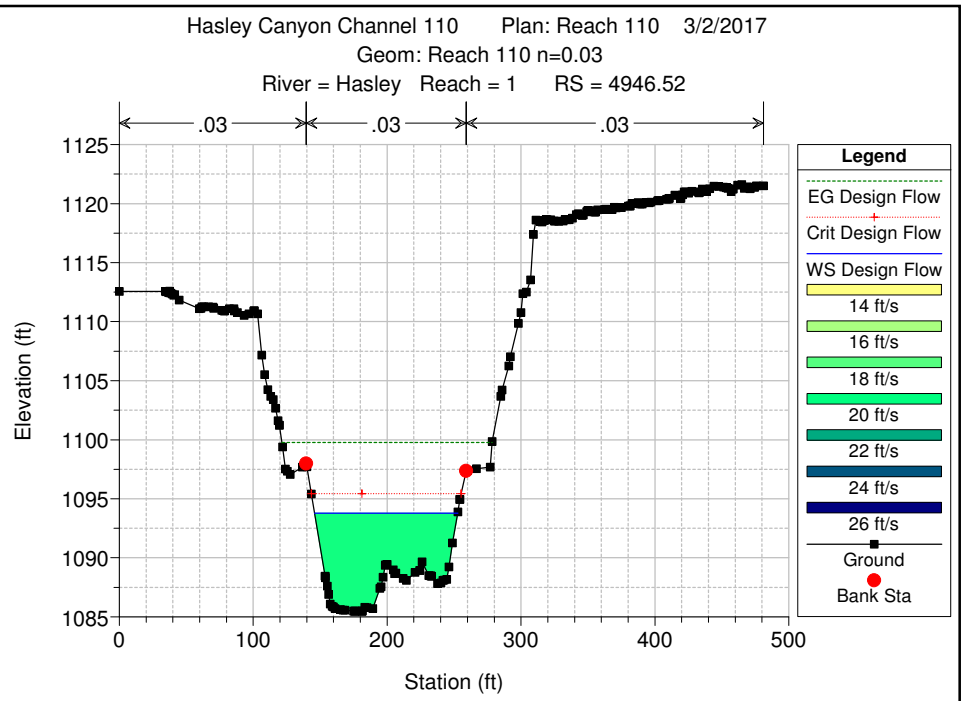


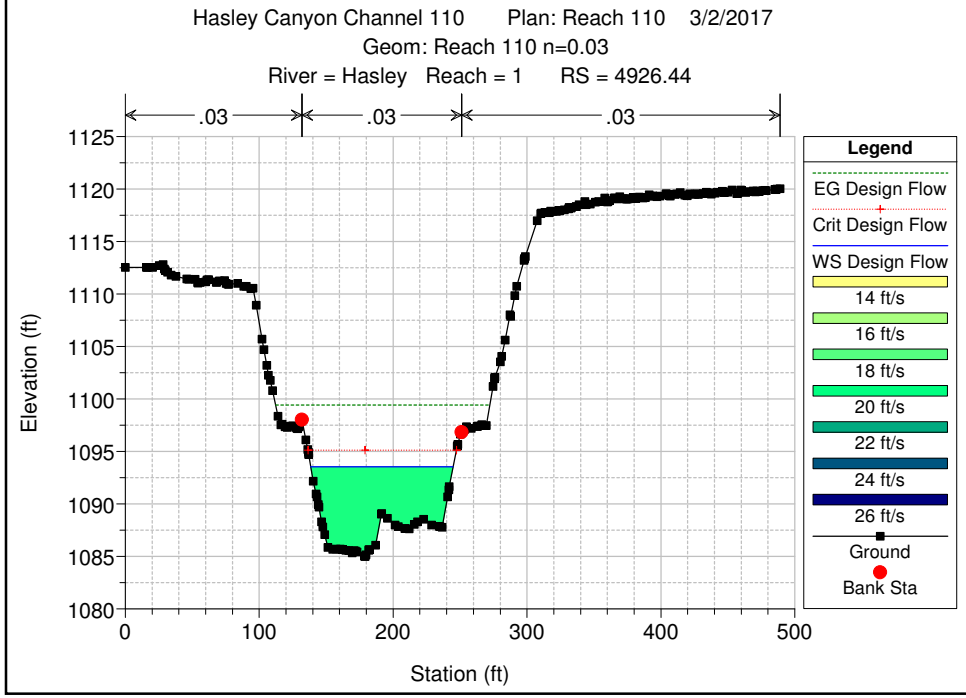

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5739.189
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5713.722
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5642.817
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5580.129
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta

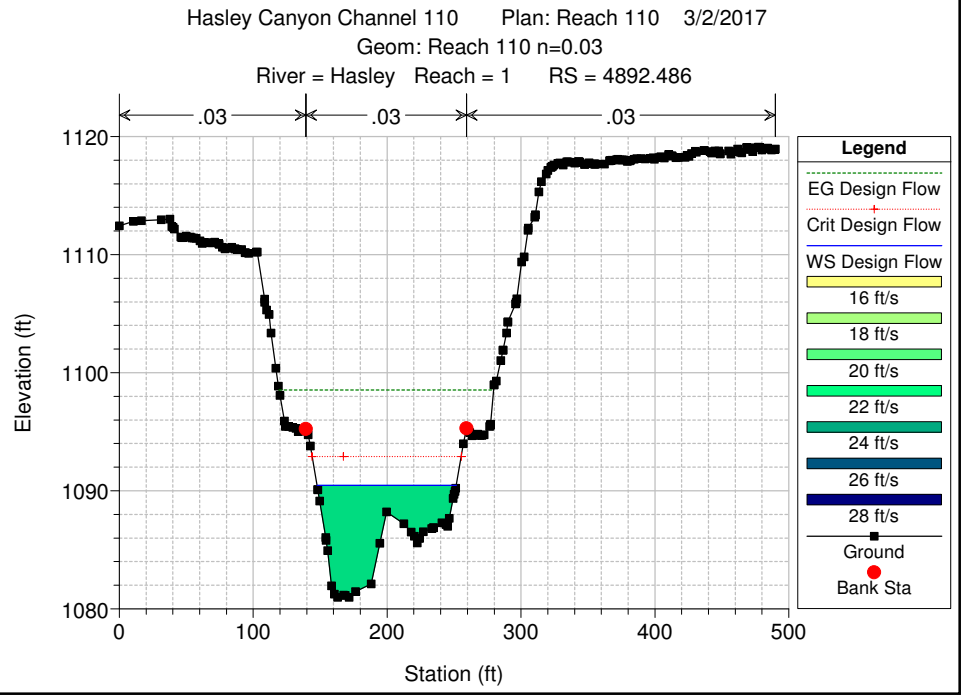

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5552.958
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5439.993
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5401.168
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
30 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5352.139
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta

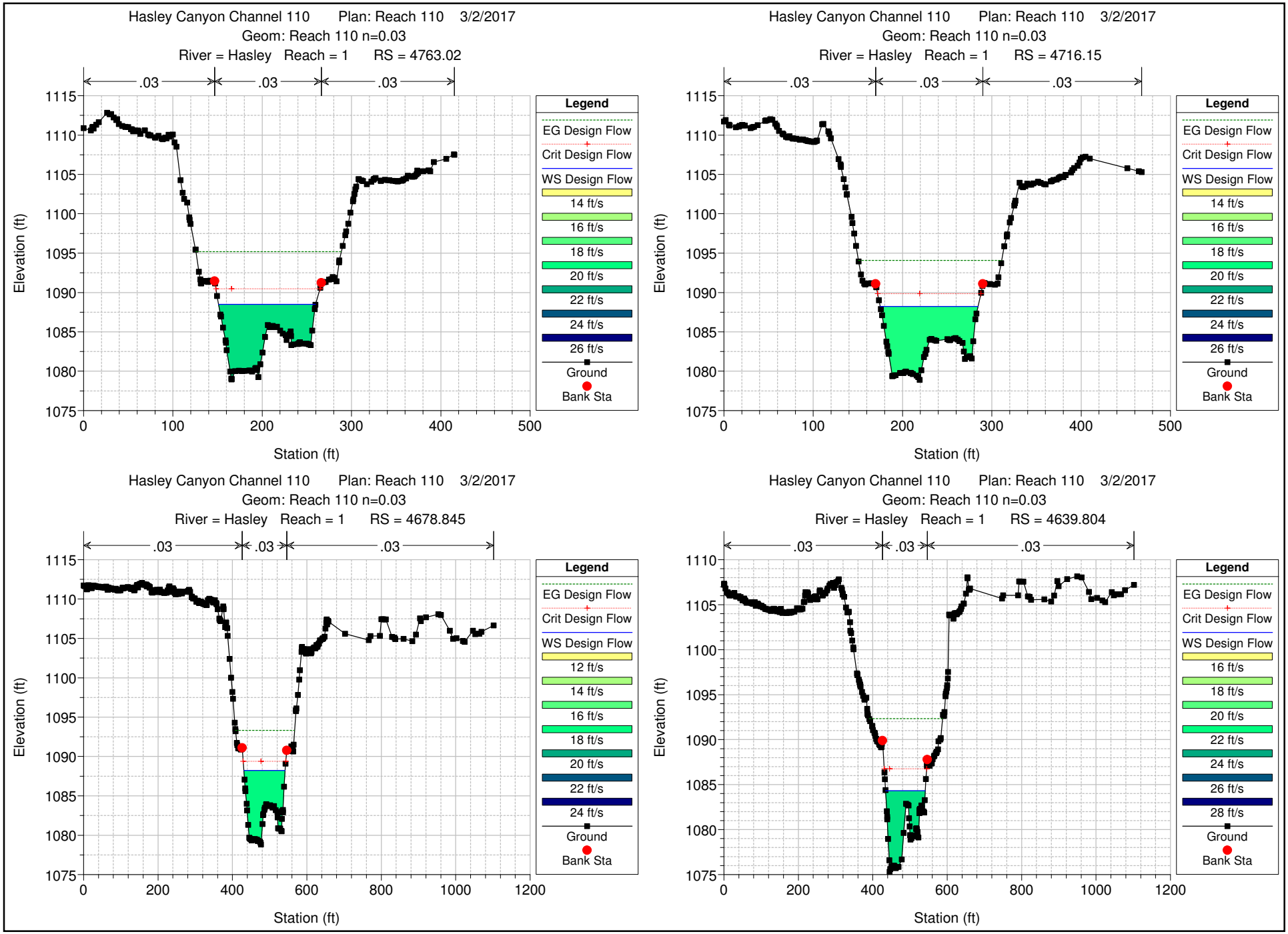

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5295.071
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5141.326
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5117.463
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5097.181
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 5006.528
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta

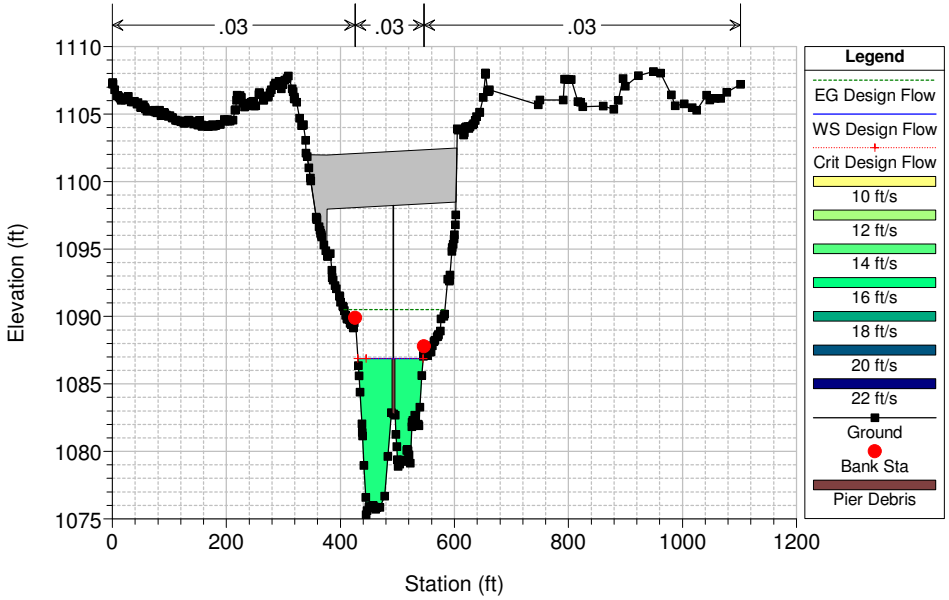

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4946.52
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4926.44
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta

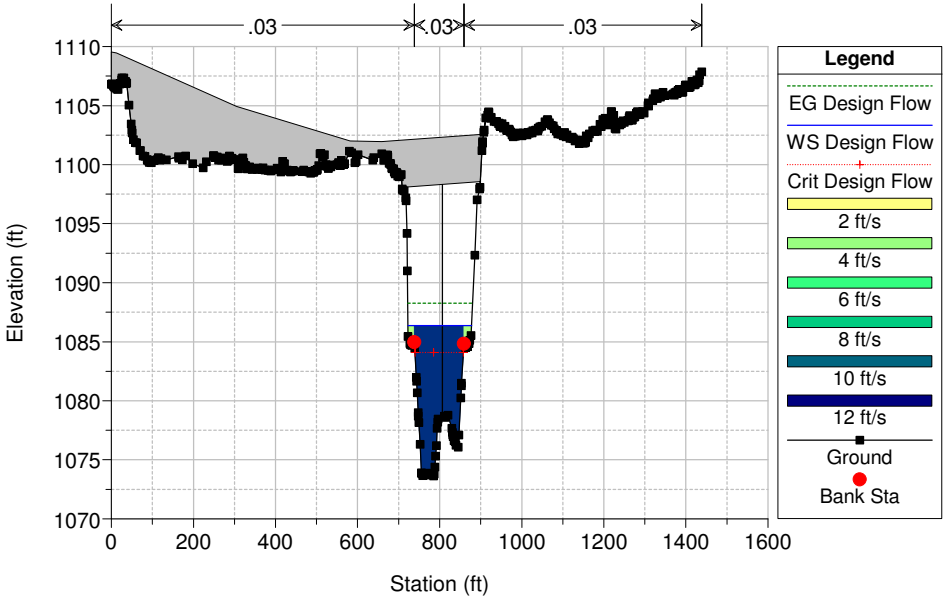

Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4892.486
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4763.02
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4716.15
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4678.845
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
Ground
Bank Sta
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4639.804
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta

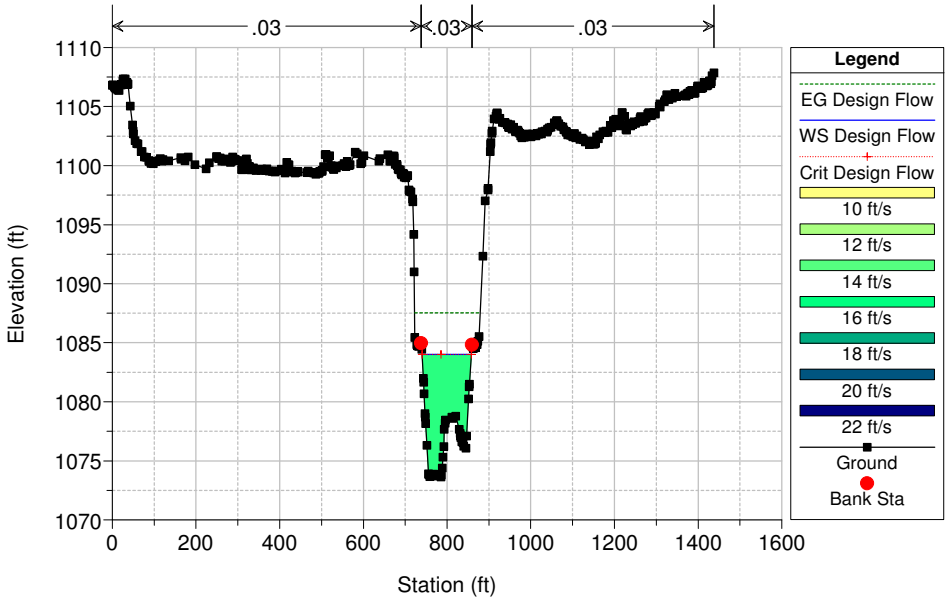
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4500 BR



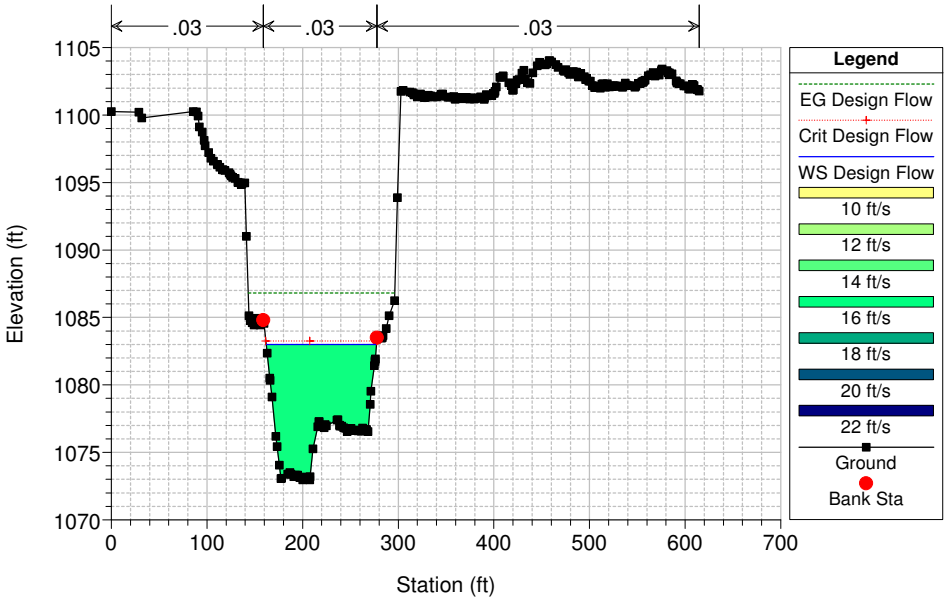
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4500 BR



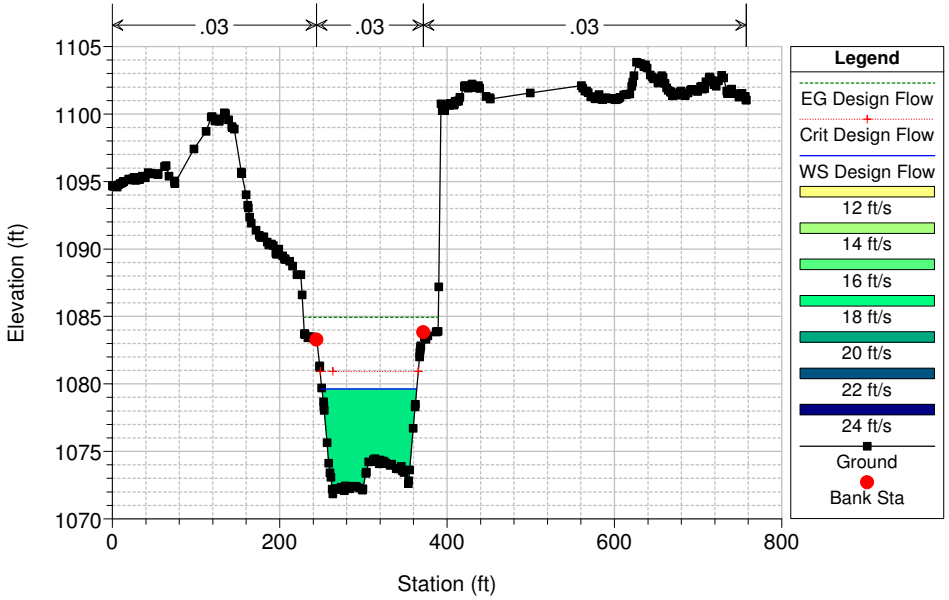
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4395.956



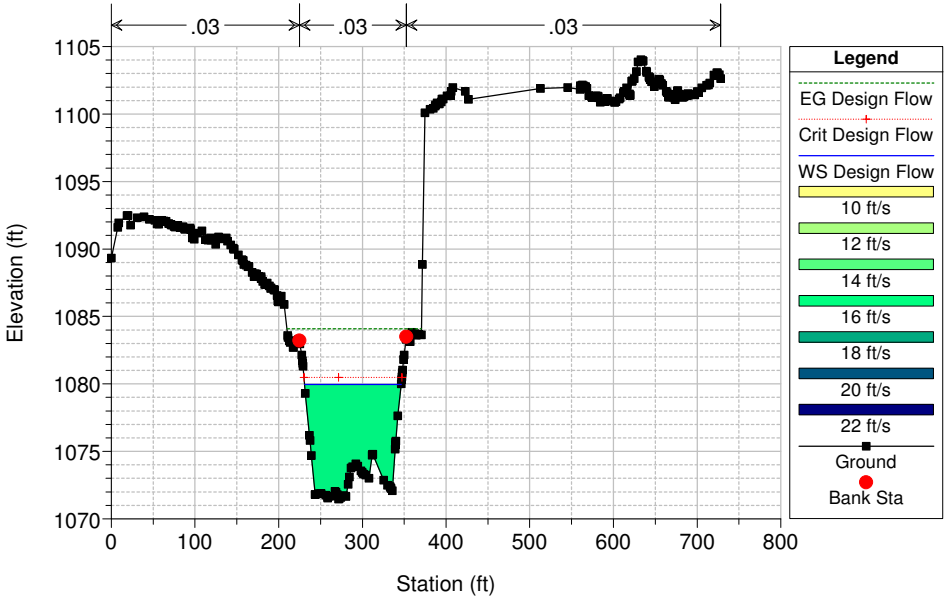
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4318.117



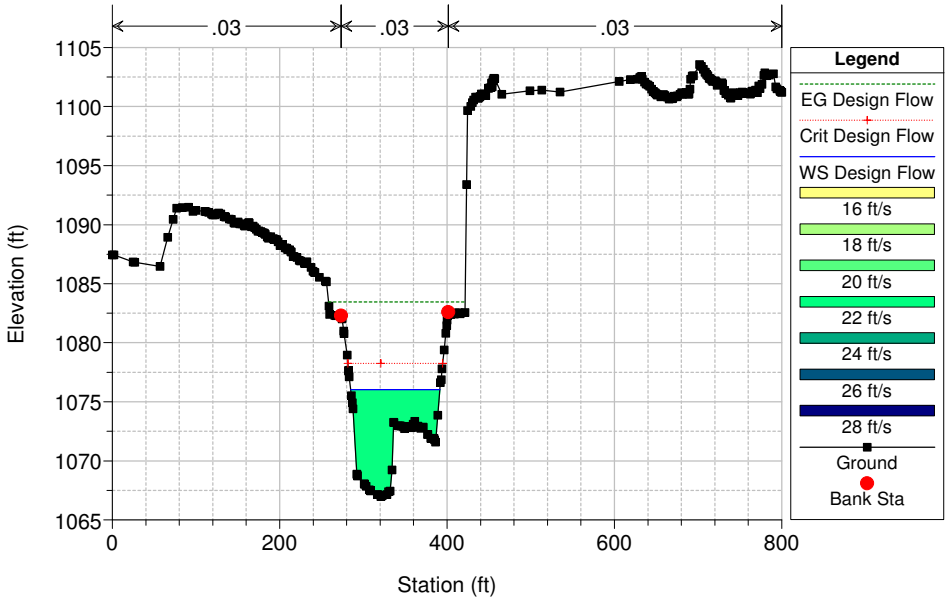
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4155.965



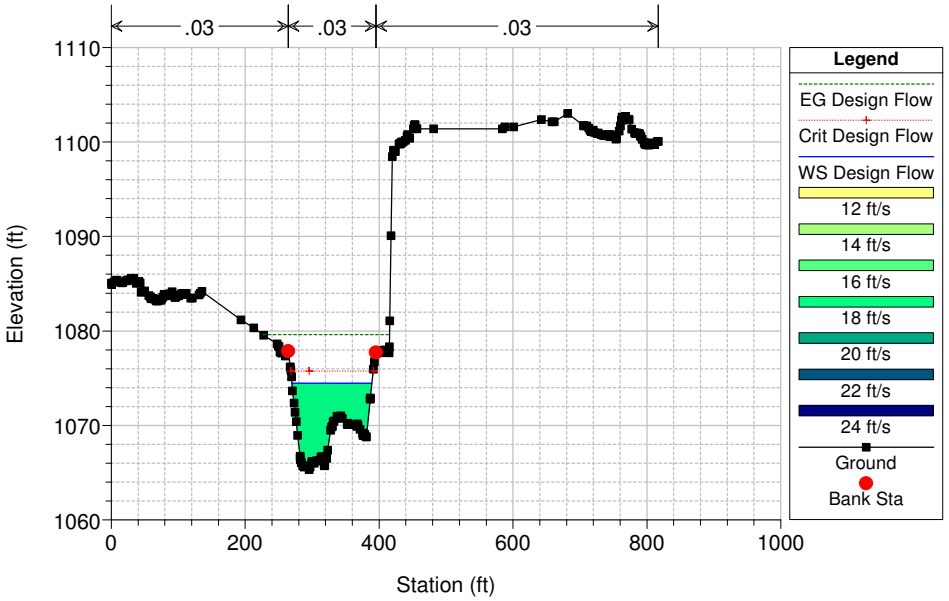
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4107.706

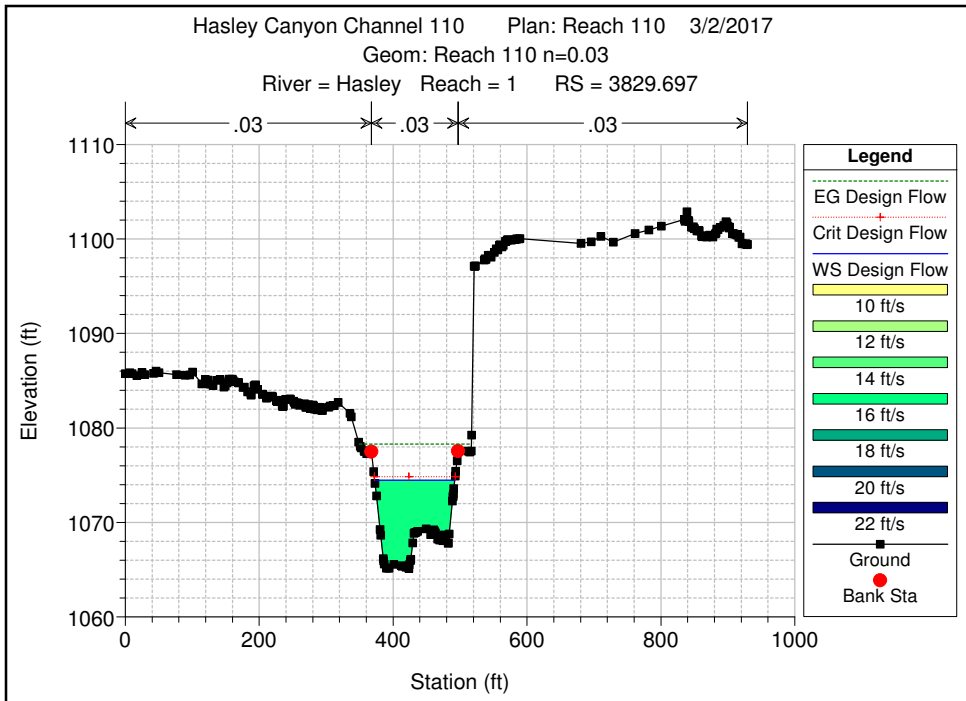


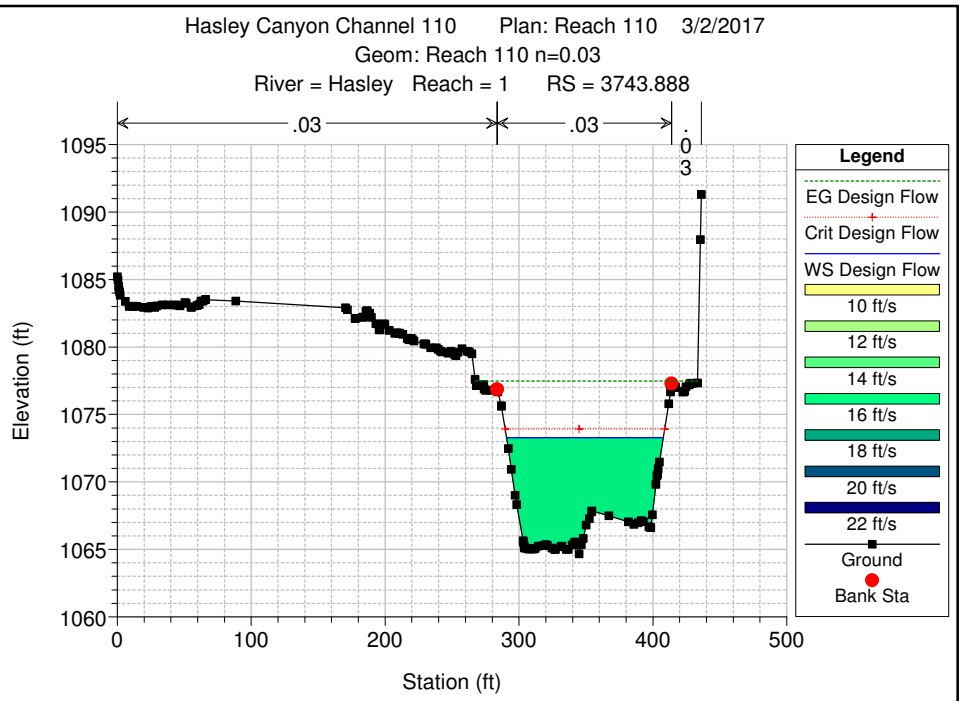
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 4087.444

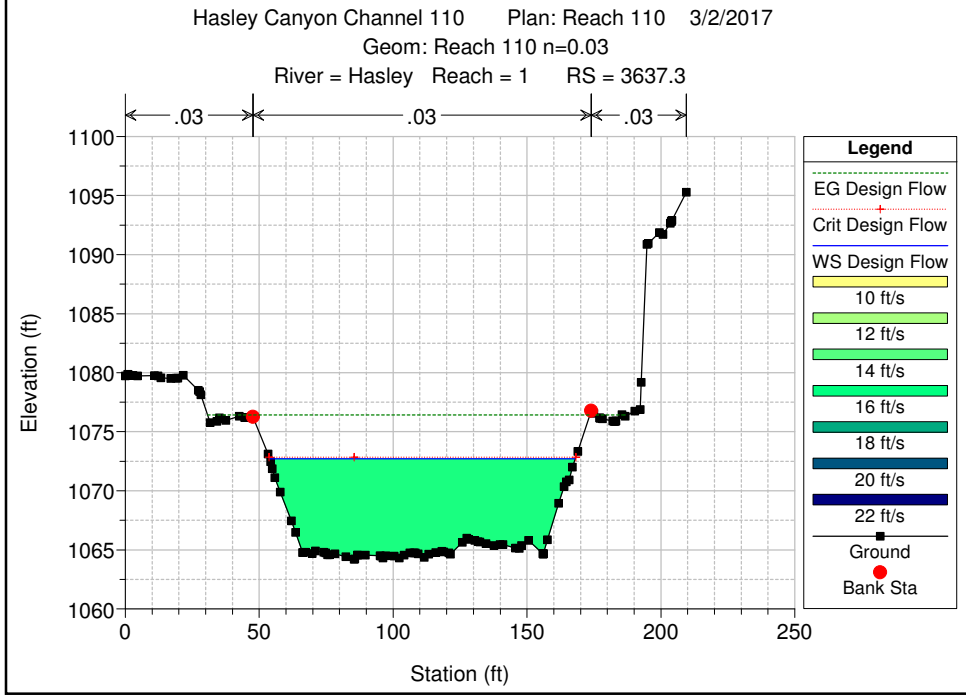


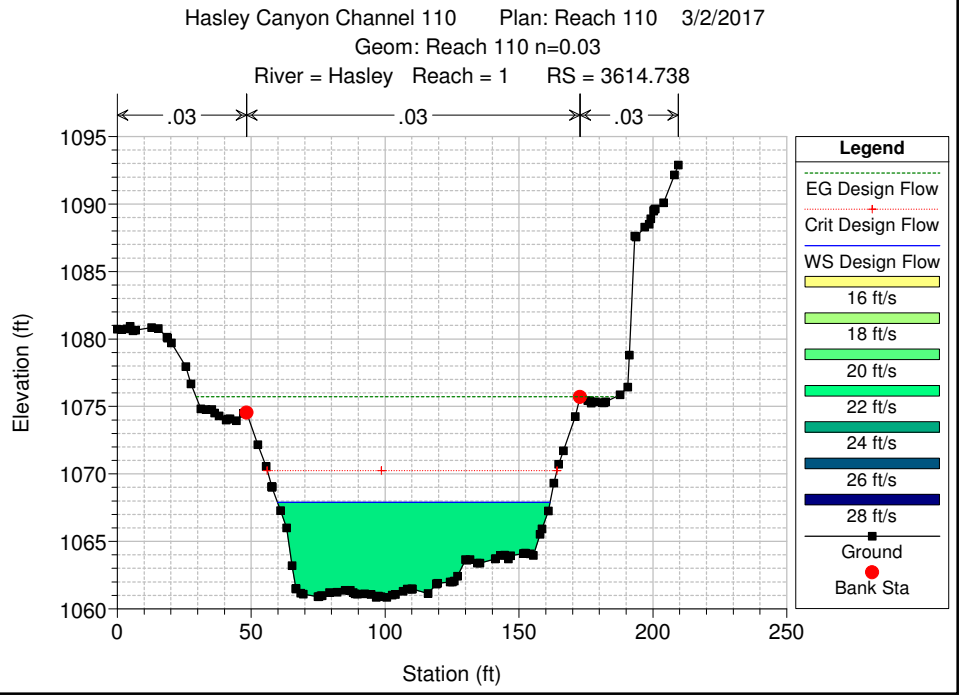
Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 3911.677

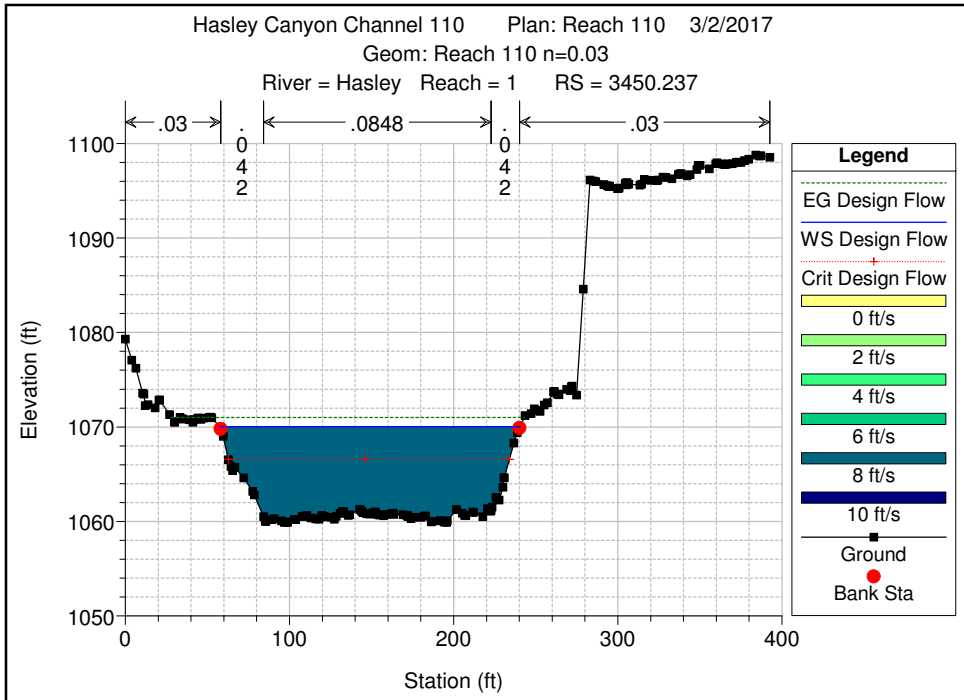



Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 3829.697
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 3743.888
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 3637.3
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
22 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 3614.738
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG Design Flow
Crit Design Flow
WS Design Flow
16 ft/s
18 ft/s
20 ft/s
22 ft/s
24 ft/s
26 ft/s
28 ft/s
Ground
Bank Sta


Hasley Canyon Channel 110 Plan: Reach 110 3/2/2017
Geom: Reach 110 n=0.03
River = Hasley Reach = 1 RS = 3450.237
.03
.042
.0848
.042
.03
1100
1090
1080
1070
1060
1050
Elevation (ft)
0
100
200
300
400
Station (ft)
Legend
EG Design Flow
WS Design Flow
Crit Design Flow
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

Appendix F – Fluvial Study Calculations and Supporting Documentation

Cowan Method

Prepared By: JPB
Reviewed By: JC

Cowan Method for Determining Manning's Roughness Coefficient

8/7/2019

OBJECTIVE: To estimate Manning's roughness coefficient using the Cowan Method

SOLUTION:

Variable	Description of Alternatives	Recommended Range	Selected Value
Base n	Sand	0.026 - 0.035	
	Firm Soil	0.025 - 0.032	0.025
	Gravel	0.024 - 0.035	
	Concrete	0.012 - 0.018	
	Cobble/Boulder	0.03 - 0.07	
Surface Irregularity	Smooth	0	
	Minor	0.001 - 0.005	
	Moderate	0.006 - 0.010	0.008
	Severe	0.011 - 0.020	
Variation in Channel Cross Section	Gradual	0	
	Alternating Occassionally	0.001 - 0.005	0.003
	Alternating Frequently	0.010 - 0.015	
Obstructions	Negligible	0.000 - 0.004	0.002
	Minor	0.005 - 0.015	
	Appreciable	0.020 - 0.030	
	Severe	0.040 - 0.050	
Vegetation	Small	0.002 - 0.010	
	Medium	0.010 - 0.025	
	Large	0.025 - 0.050	
	Very Large	0.050 - 0.100	
Meandering	Negligible	0	0
	Appreciable	$0.15n_{vegetation}$	
	Severe	$0.30n_{vegetation}$	

TOTAL Manning's n	**0.038**

PACE

Appendix F – Fluvial Study Calculations and Supporting Documentation

Summary of SAM Analysis

SAM Inputs		
Reach	**1**	**2**
Discharge (cfs)	1750	1750
Velocity (ft/s)	7.14	7.83
Depth (ft)	2.35	4.55
Top Width (ft)	138.63	83.28
Energy Slope (ft/ft)	0.016	0.013
Temperature (°F)	60	60

SAM Outputs		
Reach	**1**	**2**
Stable Slope (ft/ft)	0.01	0.008
Sediment Supply (tons/day)	347,986	347,986
Sediment Transport (tons/day)	324,241	314,751
% Difference in Sediment	3.4%	0.5%

REACH 1 SAM ANALYSIS

River Sta	Min Ch El (ft)	W.S. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Ch Length (ft)	Effective Depth (ft)	Ch Length × Vel Chnl ft^2/s	Top Width × Ch Length (ft^2)	Eff Depth × Ch Length (ft^2)	E.G. Slope × Ch Length (ft)
4055.5	1030.71	1037.83	0.005069	6.68	262.17	64.77	95.96	4.05	641.01	6,215.33	388.42	0.49
3940.5	1029.75	1036.32	0.009891	9.7	180.34	38.45	116.04	4.69	1,125.59	4,461.74	544.26	1.15
3844	1028.59	1035.19	0.017784	7.69	227.51	123.28	96.25	1.85	740.16	11,865.70	177.63	1.71
3747	1027.62	1033.87	0.005474	5.09	344.01	144.59	98.46	2.38	501.16	14,236.33	234.26	0.54
3650	1026.64	1032.48	0.018473	7.38	237.12	141.72	100.25	1.67	739.85	14,207.43	167.73	1.85
3554	1025.64	1029.57	0.035559	8.87	197.34	145.08	114.85	1.36	1,018.72	16,662.44	156.22	4.08
3440.5	1024.49	1028.99	0.005733	5	350.27	157.02	71.4	2.23	357.00	11,211.23	159.27	0.41
3372	1023.77	1028.05	0.01723	6.43	271.99	189.84	63.24	1.43	406.63	12,005.48	90.61	1.09
3304	1023.14	1026.92	0.020473	6	291.69	261.36	114.08	1.12	684.48	29,815.95	127.32	2.34

Q	1750	cfs
E.G. Slope	0.016	ft/ft
Velocity	7.14	fps
Width	138.63	ft
Depth	2.35	ft
Ch Slope	0.010	
Supply Reach	313,320	tons/day
Hasley	324,241	tons/day
% Difference	3.43%	

REACH 2 SAM ANALYSIS

River Sta	Min Ch El (ft)	W.S. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Ch Length (ft)	Effective Depth (ft)	Ch Length × Vel Chnl ft^2/s	Top Width × Ch Length (ft^2)	Eff Depth × Ch Length (ft^2)	E.G. Slope × Ch Length (ft)
3105	1009.98	1018.06	0.00135	4.78	366.24	48.45	88.74	7.56	424.18	4,299.45	670.80	0.12
3020	1009.27	1017.86	0.001595	5.17	338.29	39.85	84.59	8.49	437.33	3,370.91	718.09	0.13
2934	1008.6	1014.71	0.020564	13.85	126.33	21.09	113.73	5.99	1,575.16	2,398.57	681.25	2.34
2820.5	1007.69	1014.72	0.00351	6.99	250.51	40.29	71.57	6.22	500.27	2,883.56	445.00	0.25
2748	1007.11	1013.8	0.007094	9.07	192.92	28.82	85.95	6.69	779.57	2,477.08	575.35	0.61
2675.5	1006.43	1013.38	0.007085	8.08	216.52	34.94	92.95	6.20	751.04	3,247.67	576.00	0.66
2560.5	1005.68	1011.63	0.01144	10.92	160.22	28.27	92.99	5.67	1,015.45	2,628.83	527.02	1.06
2476	1004.94	1012.08	0.003882	5.02	348.74	111.46	85.52	3.13	429.31	9,532.06	267.58	0.33
2391	1004.26	1011.34	0.007099	6.55	267.19	89.28	72.07	2.99	472.06	6,434.41	215.69	0.51
2305.5	1003.68	1011.39	0.002489	3.43	510.08	215.2	10	2.37	34.30	2,152.00	23.70	0.02
2190.5	1002.89	1007.71	0.053871	10.96	159.71	116.82	84.91	1.37	930.61	9,919.19	116.08	4.57
2122	1002.22	1006.69	0.004131	6.11	286.6	73.55	77.14	3.90	471.33	5,673.65	300.59	0.32
2054	1001.6	1006.01	0.019615	6.51	268.92	205.04	90.41	1.31	588.57	18,537.67	118.58	1.77
1940.5	1000.87	1004.08	0.021851	6.77	258.33	203.25	85.32	1.27	577.62	17,341.29	108.44	1.86
1872	1000.19	1002.71	0.011529	6.53	268.09	137.88	67.8	1.94	442.73	9,348.26	131.83	0.78

Q	1750	cfs
E.G. Slope	0.013	ft/ft
Velocity	7.83	fps
Width	83.28	ft
Depth	4.55	ft
Ch Slope	0.008	
Supply Reach	313320.1	tons/day
Hasley	314750.8	tons/day
% Difference	0.46%	

Appendix F – Fluvial Study Calculations and Supporting Documentation

HEC-1 Model Inputs and Outputs

```
ID   Hasley Creek
ID   NOAA Atlas 14 Rainfall
ID   Mountain S Graph
IT    60 16OCT17       0      28
KK   HS1
KM   Runoff Watershed 1
BA  7.89
$P    15    7.89
$Q  0.37   0.894    1.38    2.58    3.79    6.95    0.59    0.26
$U  7.12    4.17  169.15    0.50       1       0       1
ZZ
```

```
1*************************************
 *                                   *
 *   L.A. DISTRICT HEC-1 PREPROCESSOR  *
 *              MARCH 1984           *
 *                                   *
 *       LAST REVISED 19 APR 1993    *
 *                                   *
 *  RUN DATE 11/13/2019  TIME 10:41:55 *
 *                                   *
 *************************************



               L           A     PPPPPP   RRRRRR   EEEEEEE   1
               L          A A    P     P  R     R  E        11
               L         A   A   P     P  R     R  E         1
               L        A     A  PPPPPP   RRRRRR   EEEEE     1
               L        AAAAAAA  P        R   R    E         1
               L        A     A  P        R    R   E         1
               LLLLLLL  A     A  P        R     R  EEEEEEE  111

 ID   Hasley Creek


 ID   NOAA Atlas 14 Rainfall


 ID   Mountain S Graph


 TIME INTERVAL IS  0 HR 30 MIN


================================================================================
=

 KK   HS1


 AREA =   7.89 SQ.MI.

  PRECIP   DRAIN   TRAIN     RAF       CN        A        B        C
     15.     7.9     .00   .0000     .00      .00      .00      .00

    OCEMA STORM PATTERN USER INPUT
   5MIN   30MIN  1HR    3HR    6HR    24HR   SLP    XRA

    .37    .89   1.38   2.58   3.79   6.95    .59    .26

    OCEMA AREA REDUCTION FACTORS:
      5-MINUTE FACTOR =  .804
```

30-MINUTE FACTOR = .804
1-HOUR FACTOR = .804
3-HOUR FACTOR = .968
6-HOUR FACTOR = .984
24-HOUR FACTOR = .991

RAINFALL HYETOGRAPH -- INCIDENTAL PRECIPITATION

Rainfall in inches/period

.0106 .0106 .0106 .0107 .0107 .0107 .0108 .0108 .0108 .0109
.0109 .0109 .0110 .0110 .0110 .0111 .0111 .0111 .0112 .0112
.0112 .0113 .0113 .0113 .0114 .0114 .0115 .0115 .0115 .0116
.0116 .0117 .0117 .0117 .0118 .0118 .0119 .0119 .0120 .0120
.0121 .0121 .0121 .0122 .0122 .0123 .0123 .0124 .0124 .0125
.0125 .0126 .0126 .0127 .0127 .0128 .0128 .0129 .0129 .0130
.0130 .0131 .0132 .0132 .0133 .0133 .0134 .0134 .0135 .0135
.0136 .0137 .0138 .0138 .0139 .0139 .0140 .0141 .0142 .0142
.0143 .0143 .0144 .0145 .0146 .0146 .0147 .0148 .0149 .0150
.0151 .0151 .0152 .0153 .0154 .0155 .0156 .0156 .0158 .0158
.0160 .0160 .0162 .0162 .0164 .0164 .0166 .0166 .0168 .0169
.0170 .0171 .0173 .0173 .0175 .0176 .0178 .0179 .0180 .0181
.0183 .0184 .0186 .0187 .0189 .0190 .0192 .0193 .0196 .0197
.0199 .0200 .0203 .0204 .0207 .0208 .0211 .0212 .0215 .0217
.0220 .0221 .0225 .0226 .0301 .0302 .0306 .0308 .0312 .0314
.0318 .0320 .0325 .0327 .0332 .0334 .0340 .0342 .0348 .0351
.0357 .0360 .0367 .0371 .0378 .0382 .0390 .0395 .0515 .0518
.0527 .0531 .0540 .0545 .0555 .0561 .0573 .0580 .0594 .0602
.0619 .0629 .0650 .0662 .0588 .0610 .0659 .0691 .0617 .0684
.0924 .1211 .2976 .0777 .0729 .0632 .0676 .0639 .0610

.0587
.0567 .0550 .0535 .0522 .0399 .0386 .0374 .0364 .0354
.0345
.0337 .0330 .0323 .0316 .0310 .0304 .0228 .0223 .0218
.0214
.0209 .0205 .0202 .0198 .0194 .0191 .0188 .0185 .0182
.0179
.0177 .0174 .0172 .0169 .0167 .0165 .0163 .0161 .0159
.0157
.0155 .0153 .0152 .0150 .0148 .0147 .0145 .0144 .0142
.0141
.0140 .0138 .0137 .0136 .0135 .0133 .0132 .0131 .0130
.0129
.0128 .0127 .0126 .0125 .0124 .0123 .0122 .0121 .0120
.0119
.0118 .0118 .0117 .0116 .0115 .0114 .0114 .0113 .0112
.0111
.0111 .0110 .0109 .0109 .0108 .0107 .0107 .0106

********** NOTICE **********
YOU HAVE SELECTED THE ORANGE COUNTY LOSS RATE FUNCTION
****

LOSS RATE REDUCED RAINFALL -- EFFECTIVE PRECIP.

Rainfall in inches/period

.0043 .0043 .0044 .0044 .0044 .0044 .0044 .0044 .0044
.0044
.0045 .0045 .0045 .0045 .0045 .0045 .0046 .0046 .0046
.0046
.0046 .0046 .0046 .0047 .0047 .0047 .0047 .0047 .0047
.0047
.0048 .0048 .0048 .0048 .0048 .0048 .0049 .0049 .0049
.0049
.0049 .0050 .0050 .0050 .0050 .0050 .0051 .0051 .0051
.0051
.0051 .0051 .0052 .0052 .0052 .0052 .0053 .0053 .0053
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.0053 .0054 .0054 .0054 .0054 .0055 .0055 .0055 .0055
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.0056 .0056 .0056 .0057 .0057 .0057 .0057 .0058 .0058
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.0059 .0059 .0059 .0059 .0060 .0060 .0060 .0061 .0061
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.0062 .0062 .0062 .0063 .0063 .0063 .0064 .0064 .0065
.0065
.0065 .0066 .0066 .0067 .0067 .0067 .0068 .0068 .0069
.0069

.0070 .0070 .0071 .0071 .0072 .0072 .0073 .0073 .0074
.0074
.0075 .0075 .0076 .0077 .0078 .0078 .0079 .0079 .0080
.0081
.0082 .0082 .0083 .0084 .0085 .0085 .0086 .0087 .0088
.0089
.0090 .0091 .0092 .0093 .0123 .0124 .0125 .0126 .0128
.0129
.0130 .0131 .0133 .0134 .0136 .0137 .0139 .0140 .0143
.0144
.0146 .0148 .0151 .0154 .0161 .0165 .0174 .0178 .0298
.0302
.0310 .0314 .0323 .0328 .0339 .0344 .0356 .0363 .0377
.0385
.0402 .0412 .0434 .0446 .0372 .0393 .0442 .0475 .0400
.0468
.0708 .0995 .2759 .0561 .0512 .0415 .0459 .0422 .0393
.0370
.0350 .0333 .0319 .0306 .0182 .0169 .0158 .0149 .0145
.0142
.0138 .0135 .0132 .0130 .0127 .0125 .0094 .0091 .0089
.0088
.0086 .0084 .0083 .0081 .0080 .0078 .0077 .0076 .0075
.0074
.0072 .0071 .0070 .0069 .0069 .0068 .0067 .0066 .0065
.0064
.0064 .0063 .0062 .0062 .0061 .0060 .0060 .0059 .0058
.0058
.0057 .0057 .0056 .0056 .0055 .0055 .0054 .0054 .0053
.0053
.0052 .0052 .0052 .0051 .0051 .0050 .0050 .0050 .0049
.0049
.0049 .0048 .0048 .0048 .0047 .0047 .0047 .0046 .0046
.0046
.0045 .0045 .0045 .0045 .0044 .0044 .0044 .0044

XL	XLCA	S	BN	NNT	ZFAC	RATIOL
7.12	4.17	169.15	.050	1	.0	1.00

MOUNTAIN S-GRAPH

UNIT HYDROGRAPH LH= 43 PERCENT LAG= 30.45 LAG= 1.64 UG VOL.=
10178.
888. 2155. 1694. 979. 616. 483. 401. 331. 274.
238.
212. 182. 155. 138. 122. 118. 109. 103. 95.
91.
80. 80. 66. 61. 61. 54. 45. 45. 45.
45.
20. 16. 16. 16. 16. 16. 16. 16. 16.

16.

16. 16. 11.

```
ID   Hasley Creek

ID   NOAA Atlas 14 Rainfall

ID   Mountain S Graph

IT    30 16OCT17       0      88

KK   HS1

KM   Runoff Watershed 1

BA  7.89

KM   OCEMA STORM PATTERN WITH CONTINUOUS                 DEPTH-AREA ADJUSTMENT

PB  3.52
PI  .314    .320    .326    .332    .339    .346    .354    .362    .370
.379
PI  .389    .399    .411    .423    .436    .451    .466    .484    .504
.526
PI  .551    .579    .612    .651    .907    .963   1.033   1.179   2.250
2.598
PI 2.950   4.185   6.154   2.486   1.134    .944    .639    .570    .518
.478
PI  .446    .419    .396    .376    .359    .344    .330    .318
KM UHG FROM MOUNTAIN S-GRAPH

UI  888.   2155.   1694.    979.    616.    483.    401.    331.    274.
238.
UI  212.    182.    155.    138.    122.    118.    109.    103.     95.
91.
UI  80.5    80.5    66.5    61.4    61.4    54.4    44.6    44.6    44.6
44.6
UI  20.5    16.2    16.2    16.2    16.2    16.2    16.2    16.2    16.2
16.2
UI  16.2    16.2    11.3
ZZ
```

```
1****************************************
             ****************************************
 *                                      *
             *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
             *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *
             *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *
             *          609 SECOND STREET           *
 *                                      *
             *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   13NOV19  TIME  10:43:31   *
             *           (916) 756-1104             *
 *                                      *
             *                                      *
 ****************************************
             ****************************************
```

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

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS

RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT


```
          LINE
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9....
..10

             1           ID     Hasley Creek

             2           ID     NOAA Atlas 14 Rainfall

             3           ID     Mountain S Graph

             4           IT      30 16OCT17       0      88


             5           KK     HS1

             6           KM     Runoff Watershed 1

             7           BA    7.89

             8           KM     OCEMA STORM PATTERN WITH CONTINUOUS
     DEPTH-AREA ADJUSTMENT
             9           PB    3.52

            10           PI    .314    .320    .326    .332    .339    .346
 .354    .362    .370    .379
            11           PI    .389    .399    .411    .423    .436    .451
 .466    .484    .504    .526
            12           PI    .551    .579    .612    .651    .907    .963
1.033   1.179   2.250   2.598
            13           PI   2.950   4.185   6.154   2.486   1.134    .944
 .639    .570    .518    .478
            14           PI    .446    .419    .396    .376    .359    .344
 .330    .318
            15           KM   UHG FROM MOUNTAIN S-GRAPH

            16           UI    888.   2155.   1694.    979.    616.    483.
 401.    331.    274.    238.
            17           UI    212.    182.    155.    138.    122.    118.
 109.    103.     95.     91.
            18           UI    80.5    80.5    66.5    61.4    61.4    54.4
 44.6    44.6    44.6    44.6
            19           UI    20.5    16.2    16.2    16.2    16.2    16.2
 16.2    16.2    16.2    16.2
            20           UI    16.2    16.2    11.3
```

```
            21           ZZ

1*************************************
             *************************************
 *                                   *
             *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
             *    U.S. ARMY CORPS OF ENGINEERS     *
 *              JUN   1998             *
             *    HYDROLOGIC ENGINEERING CENTER    *
 *            VERSION 4.1              *
             *          609 SECOND STREET          *
 *                                   *
             *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   13NOV19  TIME  10:43:31   *
             *           (916) 756-1104            *
 *                                   *
             *                                   *
 *************************************
             *************************************
```

Hasley Creek

NOAA Atlas 14 Rainfall

Mountain S Graph

```
     IT          HYDROGRAPH TIME DATA
                       NMIN          30  MINUTES IN COMPUTATION INTERVAL
                      IDATE     16OCT17  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ          88  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     17OCT17  ENDING DATE
                     NDTIME        1930  ENDING TIME
                     ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .50 HOURS
                       TOTAL TIME BASE   43.50 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
```

SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

```
          **************
          *            *
 5 KK     *       HS1  *
          *            *
          **************
```

Runoff Watershed 1

OCEMA STORM PATTERN WITH CONTINUOUS DEPTH-AREA ADJUSTMENT

UHG FROM MOUNTAIN S-GRAPH

SUBBASIN RUNOFF DATA

7 BA SUBBASIN CHARACTERISTICS
TAREA 7.89 SUBBASIN AREA

PRECIPITATION DATA

9 PB STORM 3.52 BASIN TOTAL PRECIPITATION

10 PI INCREMENTAL PRECIPITATION PATTERN

.31	.32	.33	.33	.34	.35	.35	.36	.37	.38
.39	.40	.41	.42	.44	.45	.47	.48	.50	.53
.55	.58	.61	.65	.91	.96	1.03	1.18	2.25	2.60
2.95	4.18	6.15	2.49	1.13	.94	.64	.57	.52	.48
.45	.42	.40	.38	.36	.34	.33	.32		

15 UI INPUT UNITGRAPH, 43 ORDINATES, VOLUME = 1.00

888.0	2155.0	1694.0	979.0	616.0	483.0	401.0	331.0	274.0	238.0
212.0	182.0	155.0	138.0	122.0	118.0	109.0	103.0	95.0	91.0
80.5	80.5	66.5	61.4	61.4	54.4	44.6	44.6	44.6	44.6
20.5	16.2	16.2	16.2	16.2	16.2				

16.2 16.2 16.2 16.2
16.2 16.2 11.3

***

****
****

HYDROGRAPH AT STATION HS1

****
****

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q		DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
16	OCT	0000	1	.00	.00	.00	0.	*	16	OCT	2200	45	.03	.00	.03	660.
16	OCT	0030	2	.03	.00	.03	23.	*	16	OCT	2230	46	.03	.00	.03	614.
16	OCT	0100	3	.03	.00	.03	80.	*	16	OCT	2300	47	.03	.00	.03	577.
16	OCT	0130	4	.03	.00	.03	126.	*	16	OCT	2330	48	.03	.00	.03	546.
16	OCT	0200	5	.03	.00	.03	154.	*	17	OCT	0000	49	.03	.00	.03	520.
16	OCT	0230	6	.03	.00	.03	173.	*	17	OCT	0030	50	.00	.00	.00	474.
16	OCT	0300	7	.03	.00	.03	189.	*	17	OCT	0100	51	.00	.00	.00	398.
16	OCT	0330	8	.03	.00	.03	203.	*	17	OCT	0130	52	.00	.00	.00	336.
16	OCT	0400	9	.03	.00	.03	216.	*	17	OCT	0200	53	.00	.00	.00	294.
16	OCT	0430	10	.03	.00	.03	228.	*	17	OCT	0230	54	.00	.00	.00	263.
16	OCT	0500	11	.03	.00	.03	239.	*	17	OCT	0300	55	.00	.00	.00	238.
16	OCT	0530	12	.03	.00	.03	250.	*	17	OCT	0330	56	.00	.00	.00	212.
16	OCT	0600	13	.03	.00	.03	261.	*	17	OCT	0400	57	.00	.00	.00	192.
16	OCT	0630	14	.03	.00	.03	271.	*	17	OCT	0430	58	.00	.00	.00	175.
16	OCT	0700	15	.04	.00	.04	282.	*	17	OCT	0500	59	.00	.00	.00	159.
16	OCT	0730	16	.04	.00	.04	293.	*	17	OCT	0530	60	.00	.00	.00	141.

```
        16 OCT 0800   17     .04     .00     .04       304.       *       17
OCT 0600   61     .00     .00     .00       128.
        16 OCT 0830   18     .04     .00     .04       316.       *       17
OCT 0630   62     .00     .00     .00       116.
        16 OCT 0900   19     .04     .00     .04       329.       *       17
OCT 0700   63     .00     .00     .00       102.
        16 OCT 0930   20     .04     .00     .04       342.       *       17
OCT 0730   64     .00     .00     .00        85.
        16 OCT 1000   21     .04     .00     .04       357.       *       17
OCT 0800   65     .00     .00     .00        74.
        16 OCT 1030   22     .05     .00     .05       373.       *       17
OCT 0830   66     .00     .00     .00        68.
        16 OCT 1100   23     .05     .00     .05       390.       *       17
OCT 0900   67     .00     .00     .00        63.
        16 OCT 1130   24     .05     .00     .05       409.       *       17
OCT 0930   68     .00     .00     .00        59.
        16 OCT 1200   25     .05     .00     .05       430.       *       17
OCT 1000   69     .00     .00     .00        55.
        16 OCT 1230   26     .08     .00     .08       469.       *       17
OCT 1030   70     .00     .00     .00        51.
        16 OCT 1300   27     .08     .00     .08       535.       *       17
OCT 1100   71     .00     .00     .00        48.
        16 OCT 1330   28     .09     .00     .09       597.       *       17
OCT 1130   72     .00     .00     .00        44.
        16 OCT 1400   29     .10     .00     .10       658.       *       17
OCT 1200   73     .00     .00     .00        39.
        16 OCT 1430   30     .19     .00     .19       798.       *       17
OCT 1230   74     .00     .00     .00        34.
        16 OCT 1500   31     .22     .00     .22      1062.       *       17
OCT 1300   75     .00     .00     .00        29.
        16 OCT 1530   32     .25     .00     .25      1333.       *       17
OCT 1330   76     .00     .00     .00        21.
        16 OCT 1600   33     .35     .00     .35      1647.       *       17
OCT 1400   77     .00     .00     .00        14.
        16 OCT 1630   34     .51     .00     .51      2167.       *       17
OCT 1430   78     .00     .00     .00        10.
        16 OCT 1700   35     .21     .00     .21      2529.       *       17
OCT 1500   79     .00     .00     .00         8.
        16 OCT 1730   36     .09     .00     .09      2232.       *       17
OCT 1530   80     .00     .00     .00         7.
        16 OCT 1800   37     .08     .00     .08      1750.       *       17
OCT 1600   81     .00     .00     .00         6.
        16 OCT 1830   38     .05     .00     .05      1412.       *       17
OCT 1630   82     .00     .00     .00         5.
        16 OCT 1900   39     .05     .00     .05      1196.       *       17
OCT 1700   83     .00     .00     .00         4.
        16 OCT 1930   40     .04     .00     .04      1047.       *       17
OCT 1730   84     .00     .00     .00         4.
        16 OCT 2000   41     .04     .00     .04       933.       *       17
OCT 1800   85     .00     .00     .00         3.
        16 OCT 2030   42     .04     .00     .04       844.       *       17
```

```
OCT 1830   86     .00     .00     .00         3.
        16 OCT 2100   43     .03     .00     .03       773.       *       17
OCT 1900   87     .00     .00     .00         2.
        16 OCT 2130   44     .03     .00     .03       713.       *       17
OCT 1930   88     .00     .00     .00         2.
                                                                  *

**********************************************************************
**************************************************

     TOTAL RAINFALL =    3.52, TOTAL LOSS =     .00, TOTAL EXCESS =    3.52

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR
43.50-HR
+   (CFS)       (HR)
                             (CFS)
+    2529.     17.00                  1511.        690.        412.
412.
                           (INCHES)     1.780       3.252       3.518
3.518
                            (AC-FT)      749.       1368.       1480.
1480.

                            CUMULATIVE AREA =    7.89 SQ MI

1
                                                              RUNOFF SUMMARY
                                                    FLOW IN CUBIC FEET PER
SECOND
                                                      TIME IN HOURS,  AREA IN SQUARE
MILES

                                          PEAK   TIME OF     AVERAGE FLOW FOR
MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION      FLOW     PEAK
                 AREA      STAGE     MAX STAGE
+                                                          6-HOUR     24-HOUR
   72-HOUR

          HYDROGRAPH AT
+                            HS1      2529.   17.00        1511.        690.
      412.       7.89


 *** NORMAL END OF HEC-1 ***
```

Appendix F – Fluvial Study Calculations and Supporting Documentation

General Adjustment Analysis Calculations

GENERAL SCOUR ANALYSIS STEPS

1) Run HEC-RAS analysis for supply reach and design reaches for flow rates ranging from 50 to 7,000 cfs.
- Every 40 cfs from 50 cfs to 250 cfs
- Every 250 cfs from 250 cfs to 7,000 cfs
- Mixed flow regime, critical depth downstream boundary condition

2) Calculate the average hydraulic parameters for each subreach.
- Take the weighted average (by length between cross-sections) of velocity, depth, top width, and energy grade slope
- Note that the depth is taken as effective depth = flow area/ top width

3) Input hydraulic parameters into SAM and calculate the sediment transport for each subreach at each flow rate using the Yang equation.
- The Yang equation was selected using the SAMAid function

4) Create a sediment transport rating curve for each reach by plotting sediment transport rate calculated from SAM vs. flow rate and determing the curve of best fit.
- Two sediment transport rating curves were made for each reach to best fit the data: one for flow rates greater than 250 cfs and one for flow rates less than 250 cfs

- A 6th order polynomial function was found to be the best representative function of the results.

$$TP = AQ^6 + BQ^5 + CQ^4 + DQ^3 + EQ^2 + FQ + Intercept$$

Where:
- TP = transport potential (tons/day)
- Q = discharge (cfs)
- A, B, C, D, E, F = coefficients

5) Create a top width rating curve for each reach by plotting top width vs. flow rate and determing the curve of best fit
- Two two top width rating curves were made for each reach to best fit the data: one for flow rates greater than 250 cfs and one for flow rates less than 250 cfs

- 5th and 6th order polynomial functions were found to be the best representative function of the results.

$$b = AQ^6 + BQ^5 + CQ^4 + DQ^3 + EQ^2 + FQ + Intercept$$

Where:
- b = top width (ft)
- Q = discharge (cfs)
- A, B, C, D, E, F = coefficients

6) Use the sediment transport rating curves to determine the rate of transport at each time step of the hydrograph.
- Two hydrographs were used:
(1) a 24-hour SCS hydrograph with a peak flow equal to the design flow of 7,000 cfs;
(2) a 24-hour, 100-year storm with flow rates calculated from HEC-1 using an Orange County rainfall distribution pattern and rainfall loss parameters.

7) Use the top width transport rating curve to determine the top width in each reach at each time step of the hydrograph.

8) Find the transport potential deficit or surplus in each reach at each time step:

$$\Delta TP = TP_{reach\ i} - TP_{reach\ i-1}$$

Where:

- $TP_{reach\ i}$ = transport potential (tons/day) in the given reach

- $TP_{reach\ i-1}$ = transport potential (tons/day) in the reach immediately upstream of the given reach

9) Calculate the change in bed elevation (ft) at each time step using the following equation:

$$\Delta_{bed\ elevation} = \frac{\Delta TP * \Delta t * 2{,}000 \frac{lbs}{ton}}{\rho * RL * b}$$

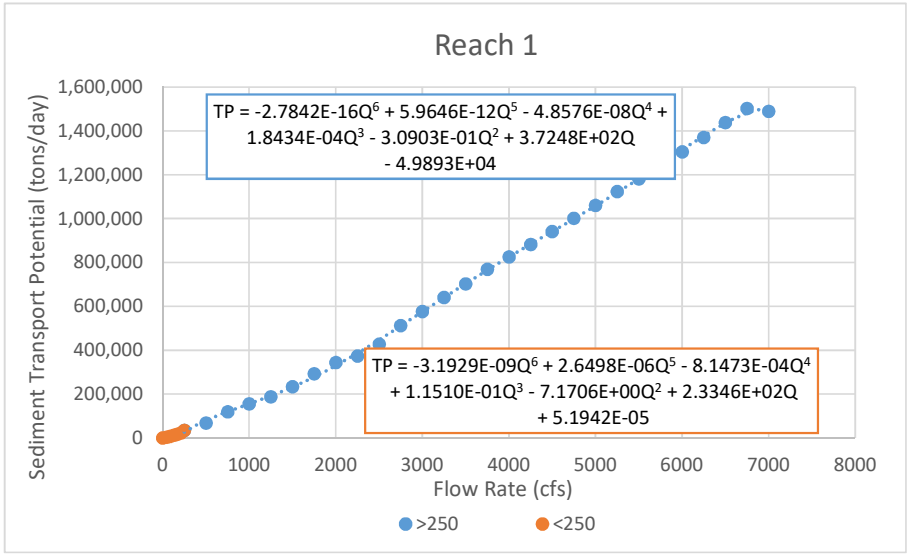
Where:

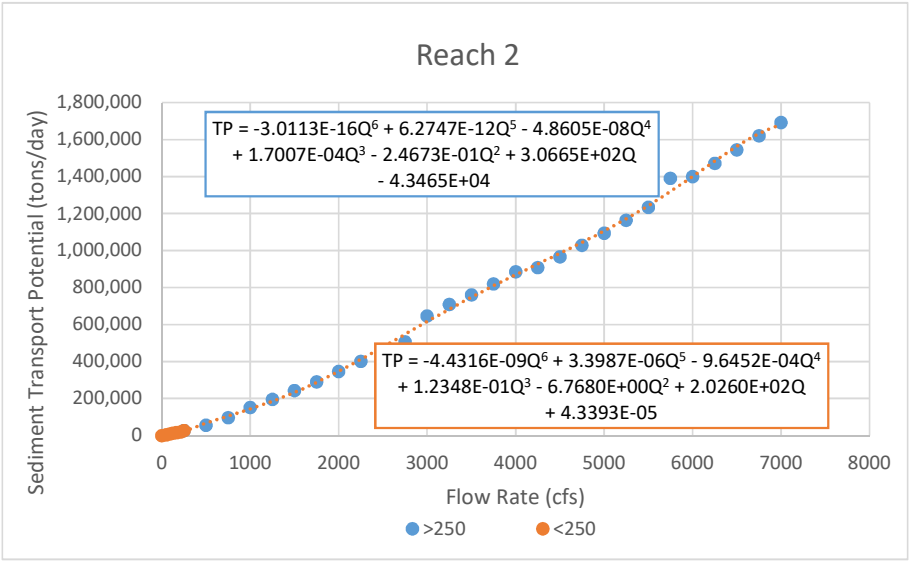
- ΔTP = transport potential deficit or surplus (tons/day)
- Δt = time step (days)
- ρ = density of rock (165.36 lbs/cu ft)
- RL = reach length (ft)
- b = top width (ft)

10) Calculate the change in bed elevation caused by the storm by taking the sum of the change in bed elevation at each time step of the hydrograph. Results are summarized below.

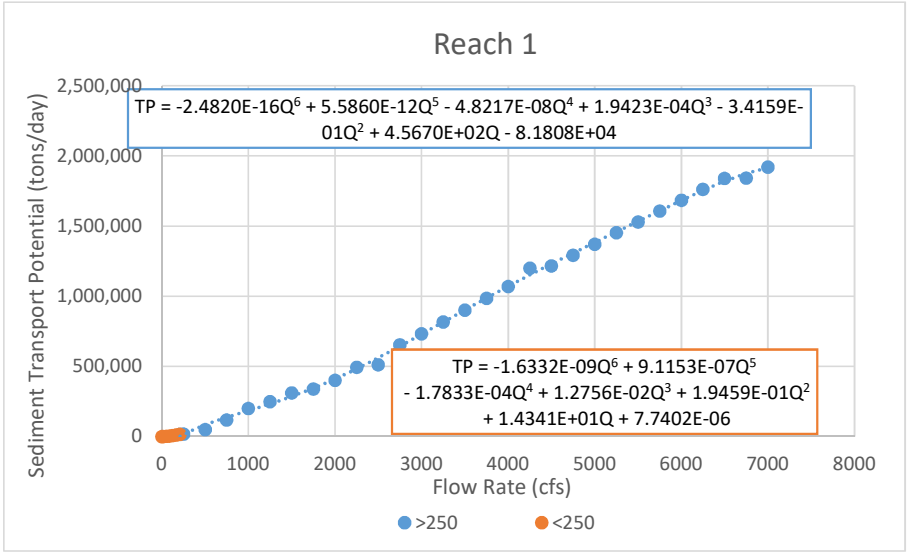
	Δ Bed Elevation (ft)	
Reach	**HEC-1 Storm**	**SCS Storm**
1	-2.03	1.47
2	0.67	-0.78

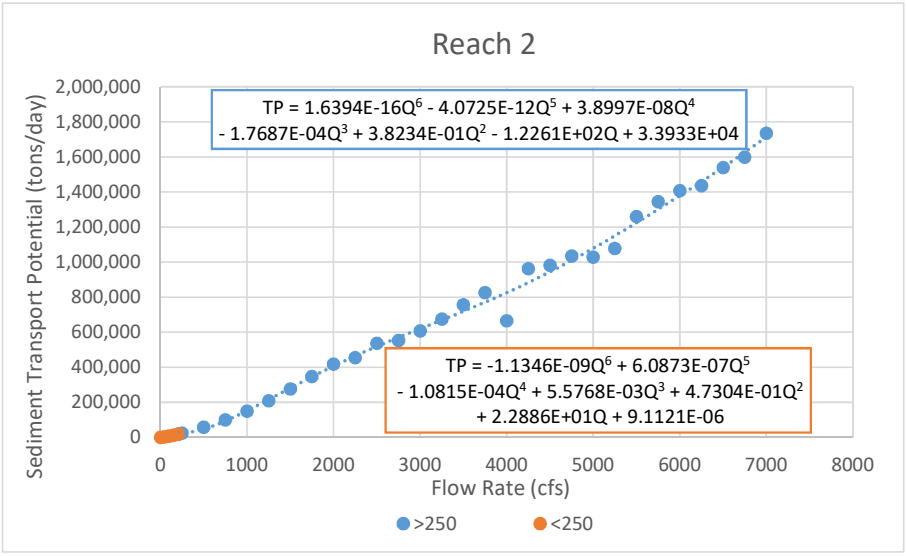
DESIGN SLOPE		
	Transport Potential (tons/day)	
Flow Rate (cfs)	Reach 1	Reach 2
0	0	0
50	3,820	3,610
90	7,330	7,861
130	12,310	12,565
170	16,614	15,516
210	22,562	19,775
250	34,188	26,424
500	67,601	56,145
750	119,027	96,661
1000	155,134	151,623
1250	187,646	195,762
1500	233,694	243,321
1750	293,138	290,183
2000	344,348	346,412
2250	373,279	401,910
2500	427,327	458,423
2750	512,914	506,612
3000	576,394	646,089
3250	640,491	709,081
3500	702,797	761,450
3750	769,108	819,990
4000	825,459	885,904
4250	881,897	907,698
4500	941,407	965,588
4750	1,001,521	1,029,264
5000	1,061,530	1,094,506
5250	1,123,476	1,164,345
5500	1,181,087	1,233,630
5750	1,240,697	1,390,642
6000	1,304,980	1,399,619
6250	1,371,084	1,471,182
6500	1,438,126	1,545,250
6750	1,502,656	1,621,585
7000	1,490,440	1,692,893



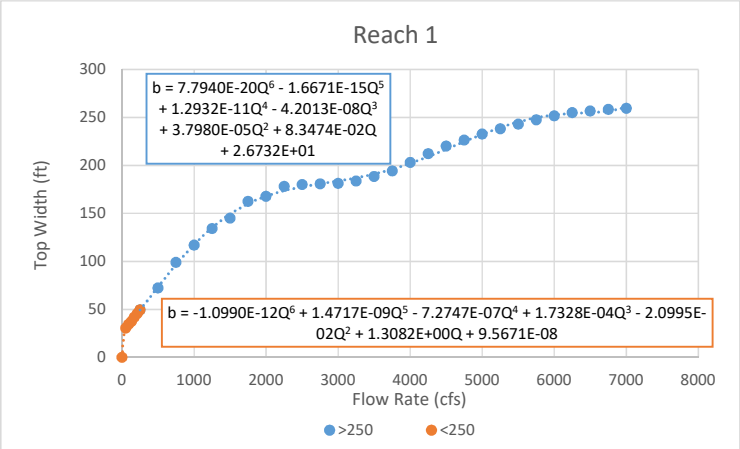


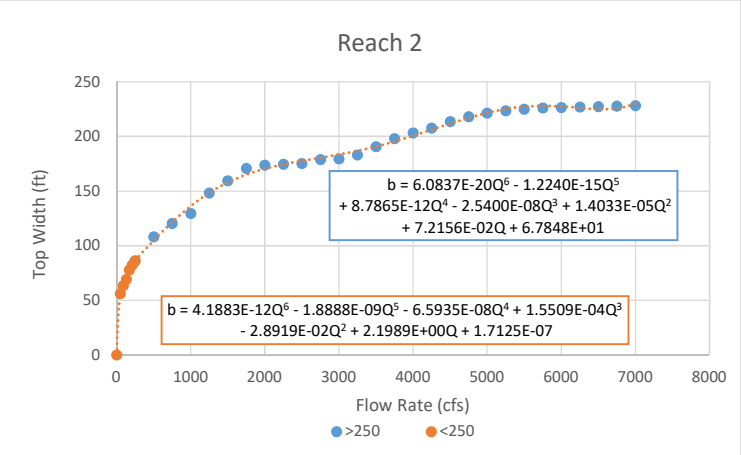
STABLE SLOPE		
	Transport Potential (tons/day)	
Flow Rate (cfs)	Reach 1	Reach 2
0	0	0
10	173.93	280.72
50	1942.82	2520.58
90	4980.34	5852.78
130	8205.99	9458.89
170	11789.62	13678.78
210	15,106.64	18,289.17
250	18,844.46	23,239.96
500	50,968.52	58,098.91
750	118,489.57	99,445.17
1000	201,482.30	149,103.53
1250	248,128.22	208,834.56
1500	310,636.31	276,007.88
1750	339606.19	347416.97
2000	400573.06	416567.22
2250	494386.03	454559.41
2500	512647.72	536688.44
2750	653660.38	552947.81
3000	732839.44	606321.56
3250	817,800.44	674,807.44
3500	901991.31	756254.38
3750	984506.75	824969.94
4000	1070221.25	664969.75
4250	1200533.5	961476.56
4500	1216105.88	980585.75
4750	1,292,530.13	1,034,616.06
5000	1,371,155.25	1,027,488.38
5250	1,452,729.50	1,076,649.63
5500	1,530,051.63	1,258,494.00
5750	1,608,135.13	1,344,528.50
6000	1,684,568.75	1,406,384.88
6250	1,762,193.38	1,436,126.00
6500	1,840,798.13	1,538,464.25
6750	1,842,038.75	1,597,313.00
7000	1920982.13	1733514.13



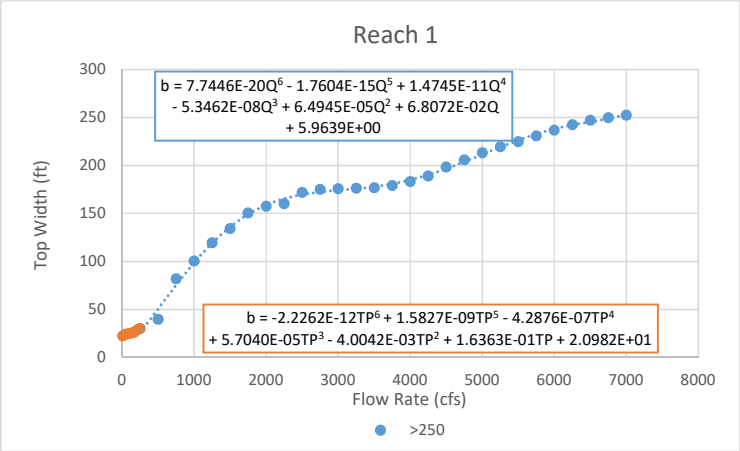


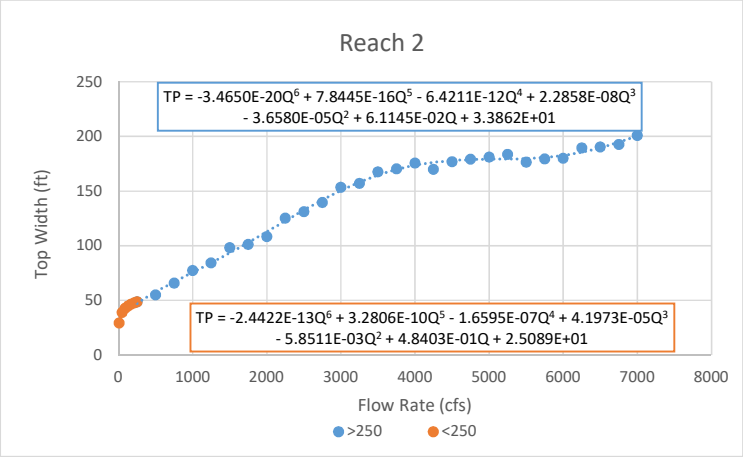
DESIGN SLOPE		
	Top Width (ft)	
Flow Rate (cfs)	Reach 1	Reach 2
0	0	0
50	30	56
90	34	63
130	38	69
170	42	78
210	46	82
250	50	86
500	72	108
750	99	120
1000	117	129
1250	134	148
1500	145	159
1750	163	171
2000	168	174
2250	178	175
2500	180	175
2750	181	179
3000	181	179
3250	184	183
3500	189	191
3750	194	198
4000	203	203
4250	212	208
4500	220	214
4750	226	218
5000	233	221
5250	238	224
5500	243	225
5750	248	226
6000	252	226
6250	255	227
6500	257	227
6750	258	228
7000	260	228





STABLE SLOPE		
	Top Width (ft)	
Flow Rate (cfs)	Reach 1	Reach 2
10	22	29
50	24	39
90	25	43
130	25	45
170	26	47
210	29	48
250	30	49
500	40	55
750	82	66
1000	100	77
1250	119	84
1500	134	98
1750	151	101
2000	157	108
2250	160	125
2500	172	131
2750	175	140
3000	176	153
3250	176	157
3500	177	168
3750	179	170
4000	183	176
4250	189	170
4500	198	177
4750	206	179
5000	213	181
5250	220	184
5500	225	177
5750	231	180
6000	237	180
6250	243	190
6500	247	190
6750	250	193
7000	252	201





RATING CURVE COEFFICIENTS

	Q>250 cfs					Q<250 cfs				
Coefficient	**Reach 2**	**Reach 1**	**Supply**	**Width- R2**	**Width- R1**	**Reach 2**	**Reach 1**	**Supply**	**Width- R2**	**Width- R1**
A	-3.01E-16	-2.78E-16	1.09E-16	6.08E-20	7.79E-20	-4.43E-09	-3.19E-09	1.24E-09	4.19E-12	-1.10E-12
B	6.27E-12	5.96E-12	-3.05E-12	-1.22E-15	-1.67E-15	3.40E-06	2.65E-06	-9.89E-07	-1.89E-09	1.47E-09
C	-4.86E-08	-4.86E-08	3.07E-08	8.79E-12	1.29E-11	-9.65E-04	-8.15E-04	2.94E-04	-6.59E-08	-7.27E-07
D	1.70E-04	1.84E-04	-1.40E-04	-2.54E-08	-4.20E-08	1.23E-01	1.15E-01	-3.99E-02	1.55E-04	1.73E-04
E	-2.47E-01	-3.09E-01	3.06E-01	1.40E-05	3.80E-05	-6.77E+00	-7.17E+00	2.46E+00	-2.89E-02	-2.10E-02
F	3.07E+02	3.72E+02	-8.59E+01	7.22E-02	8.35E-02	2.03E+02	2.33E+02	3.69E+01	2.20E+00	1.31E+00
Intercept	-4.35E+04	-4.99E+04	3.45E+04	6.78E+01	2.67E+01	4.34E-05	5.19E-05	4.38E-05	1.71E-07	9.57E-08

Reach Lengths (ft)	
R1	966.5
R2	1386.5

ESTIMATED SCS HYDROGRAPH

				Step 6: Sediment Transport Rate (tons/day)			**Step 7: Top Width (ft)**		**Step 9: Sediment Transported (tons)**			**Step 9: Δ Bed Elevation (ft)**	
T (hr)	**Q (cfs)**	**Q avg**	**ΔT**	**Reach 2**	**Reach 1**	**Supply**	**Reach 2**	**Reach 1**	**Reach 2**	**Reach 1**	**Supply**	**Reach 2**	**Reach 1**
0	0	75	0.02	6003.47	5696.46	6971.12	61.88	33.42	120.07	113.93	139.42	0.00	0.01
0.48	210	770	0.04	108561.38	122330.52	96266.43	122.90	98.46	4342.46	4893.22	3850.66	0.04	-0.13
1.44	1330	1750	0.02	287506.91	277800.52	315070.22	165.03	160.13	5750.14	5556.01	6301.40	-0.01	0.06
1.92	2170	3395	0.04	720580.10	676735.32	677945.52	189.02	189.33	28823.20	27069.41	27117.82	-0.08	0.00
2.88	4620	5180	0.02	1152396.20	1101817.10	1223928.22	224.25	237.79	23047.92	22036.34	24478.56	-0.04	0.13
3.36	5740	6125	0.02	1441056.23	1346325.57	1563837.26	226.85	253.84	28821.12	26926.51	31276.75	-0.07	0.21
3.84	6510	6720	0.02	1623262.25	1477198.73	1733325.95	225.45	256.98	32465.25	29543.97	34666.52	-0.11	0.25
4.32	6930	6965	0.02	1673138.46	1502570.16	1782120.58	229.38	261.03	33462.77	30051.40	35642.41	-0.13	0.27
4.8	7000	6965	0.02	1673138.46	1502570.16	1782120.58	229.38	261.03	33462.77	30051.40	35642.41	-0.13	0.27
5.28	6930	6720	0.02	1623262.25	1477198.73	1733325.95	225.45	256.98	32465.25	29543.97	34666.52	-0.11	0.25
5.76	6510	6265	0.02	1487231.22	1381874.95	1608856.03	226.06	254.57	29744.62	27637.50	32177.12	-0.08	0.22
6.24	6020	5390	0.04	1210472.52	1154079.35	1301256.94	226.50	243.15	48418.90	46163.17	52050.28	-0.09	0.30
7.2	4760	3990	0.04	866570.43	822820.08	831763.63	200.34	201.94	34662.82	32912.80	33270.55	-0.08	0.02
8.16	3220	2765	0.04	551806.28	514482.01	537048.03	180.65	181.06	22072.25	20579.28	21481.92	-0.07	0.06
9.12	2310	1890	0.06	320349.30	306065.49	346923.47	168.24	164.88	19220.96	18363.93	20815.41	-0.04	0.19
10.56	1470	1120	0.08	163403.87	172148.63	169598.82	142.37	126.40	13072.31	13771.89	13567.91	0.04	-0.02
12.48	770	525	0.12	70682.43	83698.96	55871.32	106.54	75.86	8481.89	10043.88	6704.56	0.13	-0.55
15.36	280.00	271.90	0.02	24834.30	31986.16	31165.60	88.04	51.46	517.38	666.38	649.28	0.01	0.00
15.86	263.80	255.69	0.02	21454.69	28024.25	30375.26	86.83	49.91	446.97	583.84	632.82	0.01	0.01
16.36	247.59	239.49	0.02	25009.27	30662.26	24072.23	83.55	48.29	521.03	638.80	501.50	0.01	-0.04
16.86	231.39	223.29	0.02	22073.73	25790.29	22481.88	82.52	46.73	459.87	537.30	468.37	0.01	-0.02
17.36	215.19	207.08	0.02	19354.48	22012.03	20805.29	82.22	45.35	403.22	458.58	433.44	0.01	-0.01
17.86	198.98	190.88	0.02	17301.46	19236.69	18978.82	81.10	43.91	360.45	400.76	395.39	0.00	0.00
18.36	182.78	174.68	0.02	15865.10	17159.85	17051.36	78.74	42.30	330.52	357.50	355.24	0.00	0.00
18.86	166.57	158.47	0.02	14749.96	15419.23	15118.87	75.41	40.55	307.29	321.23	314.98	0.00	0.00
19.36	150.37	142.27	0.02	13610.59	13708.93	13275.03	71.73	38.78	283.55	285.60	276.56	0.00	0.00
19.86	134.17	126.06	0.02	12189.70	11851.90	11578.02	68.35	37.13	253.95	246.91	241.21	0.00	0.00
20.36	117.96	109.86	0.02	10398.49	9830.96	10033.39	65.71	35.73	216.64	204.81	209.03	0.00	0.00
20.86	101.76	93.66	0.02	8339.29	7778.12	8593.10	63.83	34.61	173.74	162.04	179.02	0.00	0.01
21.36	85.56	77.45	0.02	6270.42	5922.31	7170.67	62.15	33.57	130.63	123.38	149.39	0.00	0.01
21.86	69.35	61.25	0.02	4513.28	4495.49	5672.41	59.49	32.15	94.03	93.66	118.18	0.00	0.01
22.36	53.15	45.05	0.02	3301.77	3597.18	4044.87	53.96	29.43	68.79	74.94	84.27	0.00	0.00
22.86	36.94	28.84	0.02	2573.82	3017.33	2338.28	43.00	23.95	53.62	62.86	48.71	0.00	-0.01
23.36	20.74	10.37	0.03	1500.14	1769.17	606.25	19.87	11.49	40.00	47.18	16.17	0.00	-0.03
24	0										**Total:**	**-0.78**	**1.47**

RATING CURVE COEFFICIENTS

	Q>250 cfs					Q<250 cfs				
Coefficient	**Reach 2**	**Reach 1**	**Supply**	**Width- R2**	**Width- R1**	**Reach 2**	**Reach 1**	**Supply**	**Width- R2**	**Width- R1**
A	-3.01E-16	-2.78E-16	1.09E-16	6.08E-20	7.79E-20	-4.43E-09	-3.19E-09	1.24E-09	4.19E-12	-1.10E-12
B	6.27E-12	5.96E-12	-3.05E-12	-1.22E-15	-1.67E-15	3.40E-06	2.65E-06	-9.89E-07	-1.89E-09	1.47E-09
C	-4.86E-08	-4.86E-08	3.07E-08	8.79E-12	1.29E-11	-9.65E-04	-8.15E-04	2.94E-04	-6.59E-08	-7.27E-07
D	1.70E-04	1.84E-04	-1.40E-04	-2.54E-08	-4.20E-08	1.23E-01	1.15E-01	-3.99E-02	1.55E-04	1.73E-04
E	-2.47E-01	-3.09E-01	3.06E-01	1.40E-05	3.80E-05	-6.77E+00	-7.17E+00	2.46E+00	-2.89E-02	-2.10E-02
F	3.07E+02	3.72E+02	-8.59E+01	7.22E-02	8.35E-02	2.03E+02	2.33E+02	3.69E+01	2.20E+00	1.31E+00
Intercept	-4.35E+04	-4.99E+04	3.45E+04	6.78E+01	2.67E+01	4.34E-05	5.19E-05	4.38E-05	1.71E-07	9.57E-08

Reach Lengths	
R3	966.5
R2	1386.5

24 HR, 100 YR HYDROGRAPH, HEC-1

				Step 6: Sediment Transport Rate (tons/day)			Step 7: Top Width (ft)		Step 9: Sediment Transported (tons)			Step 9: Δ Bed Elevation (ft)	
T (hr)	**Q (cfs)**	**Q avg**	**Δt**	**Reach 2**	**Reach 3**	**Supply**	**Reach 2**	**Reach 3**	**Reach 2**	**Reach 3**	**Supply**	**Reach 2**	**Reach 3**
0.00	0.00	75.23	0.02	6003.47	5696.46	6971.12	61.88	33.42	125.07	118.68	145.23	0.00	0.01
0.50	23.00	51.50	0.02	3713.44	3895.80	4708.55	56.66	30.75	77.36	81.16	98.09	0.00	0.01
1.00	80.00	103.00	0.02	9547.13	8953.74	9415.19	64.84	35.23	198.90	186.54	196.15	0.00	0.00
1.50	126.00	140.00	0.02	13432.67	13459.91	13027.89	71.22	38.54	279.85	280.41	271.41	0.00	0.00
2.00	154.00	163.50	0.02	15083.14	15943.83	15712.92	76.51	41.10	314.23	332.16	327.35	0.00	0.00
2.50	173.00	181.00	0.02	16368.27	17910.66	17809.91	79.80	42.95	341.01	373.14	371.04	0.00	0.00
3.00	189.00	196.00	0.02	17874.21	20021.36	19570.70	81.59	44.38	372.38	417.11	407.72	0.00	0.00
3.50	203.00	209.50	0.02	19721.71	22506.43	21064.93	82.29	45.56	410.87	468.88	438.85	0.01	-0.01
4.00	216.00	222.00	0.02	21839.68	25449.37	22353.69	82.50	46.62	454.99	530.20	465.70	0.01	-0.02
4.50	228.00	233.50	0.02	23957.05	28742.42	23483.23	82.93	47.67	499.11	598.80	489.23	0.01	-0.03
5.00	239.00	244.50	0.02	25792.25	32354.95	24579.70	84.46	48.87	537.34	674.06	512.08	0.01	-0.04
5.50	250.00	255.50	0.02	21413.71	27976.12	30366.44	86.81	49.89	446.12	582.84	632.63	0.01	0.01
6.00	261.00	266.00	0.02	23612.09	30555.09	30865.28	87.60	50.90	491.92	636.56	643.03	0.01	0.00
6.50	271.00	276.50	0.02	25781.69	33094.04	31409.85	88.38	51.90	537.12	689.46	654.37	0.02	-0.01
7.00	282.00	287.50	0.02	28024.67	35712.02	32028.57	89.21	52.96	583.85	744.00	667.26	0.02	-0.02
7.50	293.00	298.50	0.02	30237.95	38288.19	32695.80	90.03	54.01	629.96	797.67	681.16	0.02	-0.03
8.00	304.00	310.00	0.02	32521.12	40937.91	33444.30	90.89	55.12	677.52	852.87	696.76	0.02	-0.04
8.50	316.00	322.50	0.02	34968.43	43768.92	34315.84	91.82	56.33	728.51	911.85	714.91	0.02	-0.04
9.00	329.00	335.50	0.02	37477.03	46660.46	35285.02	92.78	57.58	780.77	972.09	735.10	0.02	-0.05
9.50	342.00	349.50	0.02	40138.54	49716.23	36398.81	93.82	58.94	836.22	1035.75	758.31	0.02	-0.06
10.00	357.00	365.00	0.02	43038.91	53031.41	37714.70	94.97	60.44	896.64	1104.82	785.72	0.02	-0.07
10.50	373.00	381.50	0.02	46075.57	56484.94	39208.66	96.18	62.03	959.91	1176.77	816.85	0.02	-0.07
11.00	390.00	399.50	0.02	49331.77	60167.29	40944.98	97.51	63.78	1027.75	1253.49	853.02	0.02	-0.08
11.50	409.00	419.50	0.02	52884.89	64159.47	43000.63	98.97	65.71	1101.77	1336.66	895.85	0.02	-0.08
12.00	430.00	449.50	0.02	58096.74	69963.30	46324.00	101.15	68.61	1210.35	1457.57	965.08	0.02	-0.09
12.50	469.00	502.00	0.02	66919.74	79636.11	52792.23	104.91	73.66	1394.16	1659.09	1099.84	0.02	-0.10
13.00	535.00	566.00	0.02	77261.16	90707.93	61705.11	109.41	79.76	1609.61	1889.75	1285.52	0.02	-0.09
13.50	597.00	627.50	0.02	86883.81	100734.69	71220.82	113.62	85.53	1810.08	2098.64	1483.77	0.02	-0.09
14.00	658.00	728.00	0.02	102217.00	116149.12	88497.39	120.24	94.72	2129.52	2419.77	1843.70	0.02	-0.08
14.50	798.00	930.00	0.02	132931.06	145140.52	128213.95	132.42	111.98	2769.40	3023.76	2671.12	0.02	-0.04
15.00	1062.00	1197.50	0.02	176597.50	183530.08	187154.93	145.99	131.73	3679.11	3823.54	3899.06	0.01	0.01
15.50	1333.00	1490.00	0.02	231480.78	230145.76	254903.42	157.48	148.80	4822.52	4794.70	5310.49	0.00	0.04
16.00	1647.00	1907.00	0.02	324453.22	309618.43	350758.31	168.59	165.40	6759.44	6450.38	7307.46	-0.02	0.06
16.50	2167.00	2348.00	0.02	437841.92	409794.56	447777.00	175.74	175.41	9121.71	8537.39	9328.69	-0.03	0.06

17.00	2529.00	2380.50	0.02	446595.39	417693.06	454771.61	176.16	175.94	9304.07	8701.94	9474.41	-0.03	0.05
17.50	2232.00	1991.00	0.02	345071.76	327543.22	369597.50	170.23	167.81	7188.99	6823.82	7699.95	-0.02	0.07
18.00	1750.00	1581.00	0.02	250318.46	246110.05	276066.57	160.38	153.16	5214.97	5127.29	5751.39	0.00	0.05
18.50	1412.00	1304.00	0.02	195606.81	199752.99	211652.51	150.57	138.50	4075.14	4161.52	4409.43	0.01	0.02
19.00	1196.00	1121.50	0.02	163654.49	172366.12	169935.76	142.44	126.51	3409.47	3590.96	3540.33	0.01	-0.01
19.50	1047.00	990.00	0.02	142311.08	153595.05	140961.89	135.72	116.74	2964.81	3199.90	2936.71	0.02	-0.03
20.00	933.00	888.50	0.02	126541.26	139288.25	119615.27	130.05	108.59	2636.28	2901.84	2491.98	0.02	-0.05
20.50	844.00	808.50	0.02	114377.21	127902.20	103635.78	125.28	101.82	2382.86	2664.63	2159.08	0.02	-0.06
21.00	773.00	743.00	0.02	104484.30	118370.94	91238.01	121.20	96.06	2176.76	2466.06	1900.79	0.02	-0.07
21.50	713.00	686.50	0.02	95924.11	109905.91	81124.87	117.55	90.97	1998.42	2289.71	1690.10	0.02	-0.08
22.00	660.00	637.00	0.02	88349.72	102238.23	72766.74	114.26	86.42	1840.62	2129.96	1515.97	0.02	-0.09
22.50	614.00	595.50	0.02	81908.50	95584.35	66160.20	111.45	82.54	1706.43	1991.34	1378.34	0.02	-0.09
23.00	577.00	561.50	0.02	76546.35	89952.33	61044.02	109.10	79.33	1594.72	1874.01	1271.75	0.02	-0.09
23.50	546.00	533.00	0.02	71978.34	85089.27	56975.59	107.11	76.63	1499.55	1772.69	1186.99	0.02	-0.10
24.00	520.00	497.00	0.02	66094.08	78739.47	52142.07	104.56	73.18	1376.96	1640.41	1086.29	0.02	-0.09
24.50	474.00	436.00	0.02	55768.11	67378.05	44793.61	100.17	67.31	1161.84	1403.71	933.20	0.02	-0.09
25.00	398.00	367.00	0.02	43409.73	53454.11	37890.72	95.12	60.63	904.37	1113.63	789.39	0.02	-0.07
25.50	336.00	315.00	0.02	33504.27	42076.37	33785.73	91.26	55.60	698.01	876.59	703.87	0.02	-0.04
26.00	294.00	278.50	0.02	26191.76	33573.20	31518.70	88.53	52.09	545.66	699.44	656.64	0.02	-0.01
26.50	263.00	250.50	0.02	20356.50	26733.70	30145.20	86.44	49.41	424.09	556.95	628.02	0.01	0.02
27.00	238.00	225.00	0.02	22387.92	26255.06	22651.50	82.56	46.88	466.42	546.98	471.91	0.01	-0.02
27.50	212.00	202.00	0.02	18633.68	21045.12	20247.70	82.00	44.91	388.20	438.44	421.83	0.01	0.00
28.00	192.00	183.50	0.02	16585.41	18226.17	18108.20	80.18	43.20	345.53	379.71	377.25	0.00	0.00
28.50	175.00	167.00	0.02	15318.67	16314.47	16130.28	77.25	41.48	319.14	339.88	336.05	0.00	0.00
29.00	159.00	150.00	0.02	14176.84	14536.00	14138.95	73.48	39.62	295.35	302.83	294.56	0.00	0.00
29.50	141.00	134.50	0.02	12974.46	12841.80	12441.45	70.04	37.96	270.30	267.54	259.20	0.00	0.00
30.00	128.00	122.00	0.02	11774.36	11357.46	11177.24	67.61	36.75	245.30	236.61	232.86	0.00	0.00
30.50	116.00	109.00	0.02	10294.08	9720.94	9954.86	65.59	35.67	214.46	202.52	207.39	0.00	0.00
31.00	102.00	93.50	0.02	8318.73	7758.74	8579.36	63.81	34.60	173.31	161.64	178.74	0.00	0.01
31.50	85.00	79.50	0.02	6521.03	6137.17	7352.71	62.39	33.71	135.85	127.86	153.18	0.00	0.01
32.00	74.00	71.00	0.02	5516.23	5292.40	6587.51	61.30	33.09	114.92	110.26	137.24	0.00	0.01
32.50	68.00	65.50	0.02	4927.53	4818.74	6076.98	60.38	32.60	102.66	100.39	126.60	0.00	0.01
33.00	63.00	61.00	0.02	4490.11	4477.66	5648.33	59.44	32.12	93.54	93.28	117.67	0.00	0.01
33.50	59.00	57.00	0.02	4138.11	4210.22	5258.41	58.41	31.61	86.21	87.71	109.55	0.00	0.01
34.00	55.00	53.00	0.02	3822.39	3975.66	4860.05	57.18	31.01	79.63	82.83	101.25	0.00	0.01
34.50	51.00	49.50	0.02	3576.11	3795.78	4504.84	55.90	30.38	74.50	79.08	93.85	0.00	0.01
35.00	48.00	46.00	0.02	3356.99	3637.14	4144.04	54.41	29.65	69.94	75.77	86.33	0.00	0.00
35.50	44.00	41.50	0.02	3112.06	3458.87	3673.46	52.13	28.53	64.83	72.06	76.53	0.00	0.00
36.00	39.00	36.50	0.02	2880.49	3283.30	3145.13	49.04	27.01	60.01	68.40	65.52	0.00	0.00
36.50	34.00	31.50	0.02	2677.28	3113.42	2616.64	45.30	25.12	55.78	64.86	54.51	0.00	-0.01
37.00	29.00	25.00	0.02	2419.72	2860.16	1942.48	39.28	22.02	50.41	59.59	40.47	0.00	-0.01
37.50	21.00	17.50	0.02	2049.57	2434.26	1211.62	30.45	17.33	42.70	50.71	25.24	0.00	-0.02
38.00	14.00	12.00	0.02	1650.81	1951.60	734.21	22.49	12.96	34.39	40.66	15.30	0.00	-0.02
38.50	10.00	9.00	0.02	1359.08	1599.04	504.35	17.56	10.19	28.31	33.31	10.51	0.00	-0.03
39.00	8.00	7.50	0.02	1187.92	1393.65	399.38	14.93	8.70	24.75	29.03	8.32	0.00	-0.03
39.50	7.00	6.50	0.02	1063.18	1244.72	333.50	13.11	7.66	22.15	25.93	6.95	0.00	-0.03
40.00	6.00	5.50	0.02	929.25	1085.54	271.12	11.24	6.59	19.36	22.62	5.65	0.00	-0.03

40.50	5.00	4.50	0.02	785.51	915.52	212.46	9.32	5.48	16.36	19.07	4.43	0.00	-0.03
41.00	4.00	4.00	0.02	709.77	826.27	184.58	8.34	4.91	14.79	17.21	3.85	0.00	-0.03
41.50	4.00	3.50	0.02	631.34	734.08	157.70	7.35	4.33	13.15	15.29	3.29	0.00	-0.03
42.00	3.00	3.00	0.02	550.14	638.89	131.86	6.34	3.74	11.46	13.31	2.75	0.00	-0.04
42.50	3.00	2.50	0.02	466.09	540.60	107.07	5.32	3.14	9.71	11.26	2.23	0.00	-0.04
43.00	2.00	2.00	0.02	379.10	439.15	83.38	4.28	2.53	7.90	9.15	1.74	0.00	-0.04
43.50	2.00												
											Total:	**0.67**	**-2.03**

Updated Stable Slope SCS Results
Grade Control Option

RATING CURVE COEFFICIENTS		
	Q > 250 cfs	Q ≤ 250 cfs
Coefficient	Supply	Supply
A	6.94E-17	-8.37E-10
B	-2.09E-12	5.88E-07
C	2.25E-08	-1.57E-04
D	-1.09E-04	2.03E-02
E	2.62E-01	-1.23E+00
F	-7.21E+01	1.18E+02
Intercept	4.25E+04	-1.09E-10

Reach Lengths (ft)

R1	984
R2	1,395

				Sediment Transport Rate (tons/day)			Top Width (ft)		Sediment Transported (tons)			Δ Bed Elevation (ft)	
T (hr)	Q (cfs)	Q avg	ΔT, day	Reach 2	Reach 1	Supply	Reach 2	Reach 1	Reach 2	Reach 1	Supply	Reach 2	Reach 1
0	0	105	0.02	3,851	8,398	9,659	14.51	13.74	77	168	193	0.05	0.02
0.48	210	770	0.04	28,243	61,587	99,452	106.42	100.78	1,130	2,463	3,978	0.11	0.18
1.44	1,330	1,750	0.02	77,413	166,708	309,893	143.86	166.26	1,548	3,334	6,198	0.11	0.21
1.92	2,170	3,395	0.04	167,511	361,793	683,564	173.41	211.37	6,700	14,472	27,343	0.39	0.75
2.88	4,620	5,180	0.02	305,662	579,682	1,213,157	189.29	239.81	6,113	11,594	24,263	0.25	0.65
3.36	5,740	6,125	0.02	384,658	700,959	1,554,649	195.68	252.03	7,693	14,019	31,093	0.28	0.83
3.84	6,510	6,720	0.02	441,026	779,365	1,747,182	199.26	258.11	8,821	15,587	34,944	0.29	0.92
4.32	6,930	6,965	0.02	464,236	811,650	1,812,045	200.74	260.61	9,285	16,233	36,241	0.30	0.94
4.8	7,000	6,965	0.02	464,236	811,650	1,812,045	200.74	260.61	9,285	16,233	36,241	0.30	0.94
5.28	6,930	6,720	0.02	441,026	779,365	1,747,182	199.26	258.11	8,821	15,587	34,944	0.29	0.92
5.76	6,510	6,265	0.02	397,921	719,407	1,603,170	196.53	253.46	7,958	14,388	32,063	0.28	0.86
6.24	6,020	5,390	0.04	323,109	606,380	1,288,430	190.75	242.61	12,924	24,255	51,537	0.51	1.38
7.2	4,760	3,990	0.04	210,877	433,423	836,003	179.70	222.06	8,435	17,337	33,440	0.43	0.89
8.16	3,220	2,765	0.04	128,421	286,280	538,659	162.84	194.88	5,137	11,451	21,546	0.34	0.64
9.12	2,310	1,890	0.06	84,184	183,155	341,988	146.52	170.25	5,051	10,989	20,519	0.35	0.69
10.56	1,470	1,120	0.08	44,783	97,068	168,022	127.35	129.01	3,583	7,765	13,442	0.28	0.54
12.48	770	525	0.12	19,257	41,991	62,503	72.56	68.72	2,311	5,039	7,500	0.33	0.44
15.36	280	272	0.02	9,973	21,747	40,121	37.58	35.59	208	453	836	0.06	0.13
15.86	264	256	0.02	9,379	20,451	39,398	35.34	33.47	195	426	821	0.06	0.14
16.36	248	239	0.02	8,784	19,155	24,495	33.10	31.35	183	399	510	0.06	0.04
16.86	231	223	0.02	8,190	17,859	22,754	30.86	29.23	171	372	474	0.06	0.04
17.36	215	207	0.02	7,596	16,563	20,746	28.62	27.10	158	345	432	0.06	0.04
17.86	199	191	0.02	7,001	15,267	18,729	26.38	24.98	146	318	390	0.06	0.04
18.36	183	175	0.02	6,407	13,971	16,817	24.14	22.86	133	291	350	0.06	0.03
18.86	167	158	0.02	5,813	12,675	15,031	21.90	20.74	121	264	313	0.06	0.03
19.36	150	142	0.02	5,218	11,379	13,346	19.66	18.62	109	237	278	0.06	0.03
19.86	134	126	0.02	4,624	10,083	11,723	17.42	16.50	96	210	244	0.06	0.03
20.36	118	110	0.02	4,030	8,787	10,132	15.18	14.38	84	183	211	0.06	0.02
20.86	102	94	0.02	3,435	7,491	8,564	12.94	12.26	72	156	178	0.06	0.02
21.36	86	77	0.02	2,841	6,195	7,030	10.70	10.14	59	129	146	0.06	0.02
21.86	69	61	0.02	2,247	4,899	5,554	8.47	8.02	47	102	116	0.06	0.02
22.36	53	45	0.02	1,652	3,603	4,147	6.23	5.90	34	75	86	0.06	0.02
22.86	37	29	0.02	1,058	2,307	2,779	3.99	3.78	22	48	58	0.06	0.03
23.36	21	10	0.03	380	829	1,115	1.43	1.36	10	22	30	0.07	0.07
24	0												
											Total:	**5.88**	**12.58**

Updated Stable Slope HEC-1 Results
Grade Control Option

RATING CURVE COEFFICIENTS		
	Q > 250 cfs	Q ≤ 250 cfs
Coefficient	Supply	Supply
A	6.94E-17	-8.37E-10
B	-2.09E-12	5.88E-07
C	2.25E-08	-1.57E-04
D	-1.09E-04	2.03E-02
E	2.62E-01	-1.23E+00
F	-7.21E+01	1.18E+02
Intercept	4.25E+04	-1.09E-10

Reach Lengths (ft)

R1	984
R2	1,395

				Sediment Transport Rate (tons/day)			Top Width (ft)		Sediment Transported (tons)			Δ Bed Elevation (ft)	
T (hr)	Q (cfs)	Q avg	ΔT, day	Reach 2	Reach 1	Supply	Reach 2	Reach 1	Reach 2	Reach 1	Supply	Reach 2	Reach 1
0	0	12	0.02	422	920	1,226	1.59	1.51	9	19	26	0.06	0.05
0.5	23	52	0.02	1,889	4,119	4,699	7.12	6.74	39	86	98	0.06	0.02
1	80	103	0.02	3,778	8,238	9,465	14.24	13.48	79	172	197	0.06	0.02
1.5	126	140	0.02	5,135	11,198	13,116	19.35	18.32	107	233	273	0.06	0.03
2	154	164	0.02	5,997	13,077	15,573	22.60	21.40	125	272	324	0.06	0.03
2.5	173	181	0.02	6,639	14,477	17,548	25.02	23.69	138	302	366	0.06	0.03
3	189	196	0.02	7,189	15,677	19,358	27.09	25.65	150	327	403	0.06	0.04
3.5	203	210	0.02	7,684	16,757	21,050	28.95	27.42	160	349	439	0.06	0.04
4	216	222	0.02	8,143	17,756	22,600	30.68	29.06	170	370	471	0.06	0.04
4.5	228	234	0.02	8,565	18,676	23,907	32.27	30.56	178	389	498	0.06	0.04
5	239	245	0.02	8,968	19,556	24,913	33.79	32.00	187	407	519	0.06	0.04
5.5	250	256	0.02	9,372	20,436	39,390	35.31	33.44	195	426	821	0.06	0.15
6	261	266	0.02	9,757	21,276	39,847	36.76	34.82	203	443	830	0.06	0.14
6.5	271	277	0.02	10,142	22,115	40,344	38.21	36.19	211	461	841	0.06	0.13
7	282	288	0.02	10,545	22,995	40,908	39.73	37.63	220	479	852	0.06	0.12
7.5	293	299	0.02	10,949	23,875	41,515	41.25	39.07	228	497	865	0.06	0.12
8	304	310	0.02	11,371	24,795	42,194	42.84	40.57	237	517	879	0.06	0.11
8.5	316	323	0.02	11,829	25,795	42,985	44.57	42.21	246	537	896	0.06	0.10
9	329	336	0.02	12,306	26,834	43,863	46.37	43.91	256	559	914	0.06	0.10
9.5	342	350	0.02	12,819	27,954	44,871	48.30	45.74	267	582	935	0.06	0.09
10	357	365	0.02	13,388	29,194	46,062	50.45	47.77	279	608	960	0.06	0.09
10.5	373	382	0.02	13,993	30,514	47,414	52.73	49.93	292	636	988	0.06	0.09
11	390	400	0.02	14,653	31,953	48,984	55.21	52.29	305	666	1,020	0.06	0.08
11.5	409	420	0.02	15,387	33,553	50,843	57.98	54.91	321	699	1,059	0.06	0.08
12	430	450	0.02	16,487	35,953	53,850	62.12	58.83	343	749	1,122	0.06	0.08
12.5	469	502	0.02	18,413	40,152	59,710	69.38	65.70	384	836	1,244	0.06	0.08
13	535	566	0.02	20,760	45,271	67,804	78.22	74.08	433	943	1,413	0.06	0.08
13.5	597	628	0.02	23,016	50,190	76,476	86.72	82.13	480	1,046	1,593	0.06	0.08
14	658	728	0.02	26,702	58,228	92,301	100.61	95.29	556	1,213	1,923	0.06	0.09
14.5	798	930	0.02	34,943	76,065	129,086	122.37	117.78	728	1,585	2,689	0.06	0.12
15	1,062	1,198	0.02	48,797	105,635	184,728	129.38	133.59	1,017	2,201	3,849	0.08	0.15
15.5	1,333	1,490	0.02	63,947	137,968	250,264	137.05	150.89	1,332	2,874	5,214	0.10	0.19
16	1,647	1,907	0.02	85,006	185,152	345,875	146.85	170.74	1,771	3,857	7,206	0.12	0.24
16.5	2,167	2,348	0.02	106,336	236,959	445,616	155.22	183.32	2,215	4,937	9,284	0.15	0.29
17	2529	2,381	0.02	107,908	240,776	452,887	155.84	184.24	2,248	5,016	9,435	0.15	0.29
17.5	2232	1,991	0.02	89,069	195,020	365,041	148.44	173.14	1,856	4,063	7,605	0.13	0.25
18	1750	1,581	0.02	68,660	148,027	271,086	139.43	156.27	1,430	3,084	5,648	0.10	0.20
18.5	1412	1,304	0.02	54,313	117,407	208,229	132.17	139.89	1,132	2,446	4,338	0.09	0.17
19	1196	1,122	0.02	44,861	97,234	168,342	127.39	129.10	935	2,026	3,507	0.07	0.14
19.5	1047	990	0.02	38,050	82,698	141,013	123.94	121.33	793	1,723	2,938	0.07	0.12
20	933	889	0.02	32,793	71,478	121,074	121.28	115.32	683	1,489	2,522	0.06	0.11
20.5	844	809	0.02	29,655	64,667	106,255	111.74	105.82	618	1,347	2,214	0.06	0.10
21	773	743	0.02	27,253	59,428	94,821	102.69	97.25	568	1,238	1,975	0.06	0.09
21.5	713	687	0.02	25,180	54,909	85,535	94.88	89.85	525	1,144	1,782	0.06	0.09
22	660	637	0.02	23,365	50,949	77,888	88.04	83.37	487	1,061	1,623	0.06	0.08
22.5	614	596	0.02	21,842	47,630	71,860	82.30	77.94	455	992	1,497	0.06	0.08
23	577	562	0.02	20,595	44,911	67,203	77.60	73.49	429	936	1,400	0.06	0.08
23.5	546	533	0.02	19,550	42,631	63,506	73.66	69.76	407	888	1,323	0.06	0.08
24	520	497	0.02	18,230	39,752	59,120	68.69	65.05	380	828	1,232	0.06	0.08
24.5	474	436	0.02	15,992	34,873	52,465	60.26	57.07	333	727	1,093	0.06	0.08
25	398	367	0.02	13,461	29,354	46,221	50.72	48.04	280	612	963	0.06	0.09
25.5	336	315	0.02	11,554	25,195	42,504	43.53	41.23	241	525	886	0.06	0.11
26	294	279	0.02	10,215	22,275	40,443	38.49	36.45	213	464	843	0.06	0.13
26.5	263	251	0.02	9,188	20,036	39,187	34.62	32.79	191	417	816	0.06	0.15
27	238	225	0.02	8,253	17,996	22,957	31.10	29.45	172	375	478	0.06	0.04
27.5	212	202	0.02	7,409	16,157	20,106	27.92	26.44	154	337	419	0.06	0.04
28	192	184	0.02	6,731	14,677	17,842	25.36	24.02	140	306	372	0.06	0.03
28.5	175	167	0.02	6,125	13,357	15,956	23.08	21.86	128	278	332	0.06	0.03
29	159	150	0.02	5,502	11,998	14,140	20.73	19.63	115	250	295	0.06	0.03
29.5	141	135	0.02	4,933	10,758	12,562	18.59	17.60	103	224	262	0.06	0.03
30	128	122	0.02	4,475	9,758	11,322	16.86	15.97	93	203	236	0.06	0.03
30.5	116	109	0.02	3,998	8,718	10,048	15.06	14.27	83	182	209	0.06	0.02
31	102	94	0.02	3,430	7,478	8,549	12.92	12.24	71	156	178	0.06	0.02
31.5	85	80	0.02	2,916	6,359	7,221	10.99	10.41	61	132	150	0.06	0.02
32	74	71	0.02	2,604	5,679	6,434	9.81	9.29	54	118	134	0.06	0.02
32.5	68	66	0.02	2,402	5,239	5,934	9.05	8.57	50	109	124	0.06	0.02
33	63	61	0.02	2,237	4,879	5,531	8.43	7.98	47	102	115	0.06	0.02
33.5	59	57	0.02	2,091	4,559	5,178	7.88	7.46	44	95	108	0.06	0.02
34	55	53	0.02	1,944	4,239	4,829	7.32	6.94	40	88	101	0.06	0.02
34.5	51	50	0.02	1,816	3,959	4,527	6.84	6.48	38	82	94	0.06	0.02
35	48	46	0.02	1,687	3,679	4,228	6.36	6.02	35	77	88	0.06	0.02
35.5	44	42	0.02	1,522	3,319	3,846	5.74	5.43	32	69	80	0.06	0.02
36	39	37	0.02	1,339	2,919	3,425	5.04	4.78	28	61	71	0.06	0.03
36.5	34	32	0.02	1,155	2,519	3,004	4.35	4.12	24	52	63	0.06	0.03
37	29	25	0.02	917	2,000	2,450	3.46	3.27	19	42	51	0.06	0.04
37.5	21	18	0.02	642	1,400	1,789	2.42	2.29	13	29	37	0.06	0.04
38	14	12	0.02	440	960	1,274	1.66	1.57	9	20	27	0.06	0.05
38.5	10	9	0.02	330	720	979	1.24	1.18	7	15	20	0.06	0.06
39	8	8	0.02	275	600	826	1.04	0.98	6	12	17	0.06	0.06
39.5	7	7	0.02	238	520	722	0.90	0.85	5	11	15	0.06	0.06
40	6	6	0.02	202	440	617	0.76	0.72	4	9	13	0.06	0.06
40.5	5	5	0.02	165	360	509	0.62	0.59	3	7	11	0.06	0.06
41	4	4	0.02	147	320	455	0.55	0.52	3	7	9	0.06	0.07
41.5	4	4	0.02	128	280	400	0.48	0.46	3	6	8	0.06	0.07
42	3	3	0.02	110	240	344	0.41	0.39	2	5	7	0.06	0.07
42.5	3	3	0.02	92	200	288	0.35	0.33	2	4	6	0.06	0.07
43	2	2	0.02	73	160	232	0.28	0.26	2	3	5	0.06	0.07
43.5	2												
											Total:	5.43	7.00

PACE
Advanced Water Engineering

Appendix G: Rock Chute and Stilling Basin Design

Rock Chute Design Data

(Version WI-Nov. 2017, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: A535 Hasley Canyon Creek **County:** LA County
Designer: Angel Ramirez **Checked by:**
Date: July 1, 2019 **Date:**

Input Geometry:

→ Upstream Channel	→ Chute		→ Downstream Channel
Bw = 85.0 ft.	Bw = 85.0 ft.		Bw = 185.0 ft.
Side slopes = 1.5 (m:1)	Factor of safety = 1.20 (F_s)	1.2 Min	Side slopes = 2.0 (m:1)
Velocity n-value = 0.025	Side slopes = 2.0 (m:1) →	2.0:1 max.	Velocity n-value = 0.025
Bed slope = 0.0050 ft./ft.	Bed slope (3:1) = 0.333 ft./ft →	3.0:1 max.	Bed slope = 0.0217 ft./ft.
Note: n value = a) velocity n from waterway program	Freeboard = 0.5 ft. →		
or b) computed mannings n for channel	Outlet apron depth, d = 6.0 ft.		Base flow = 7000.0 cfs

Design Storm Data (Table 2, FOTG, WI-NRCS Grade Stabilization Structure No. 410):

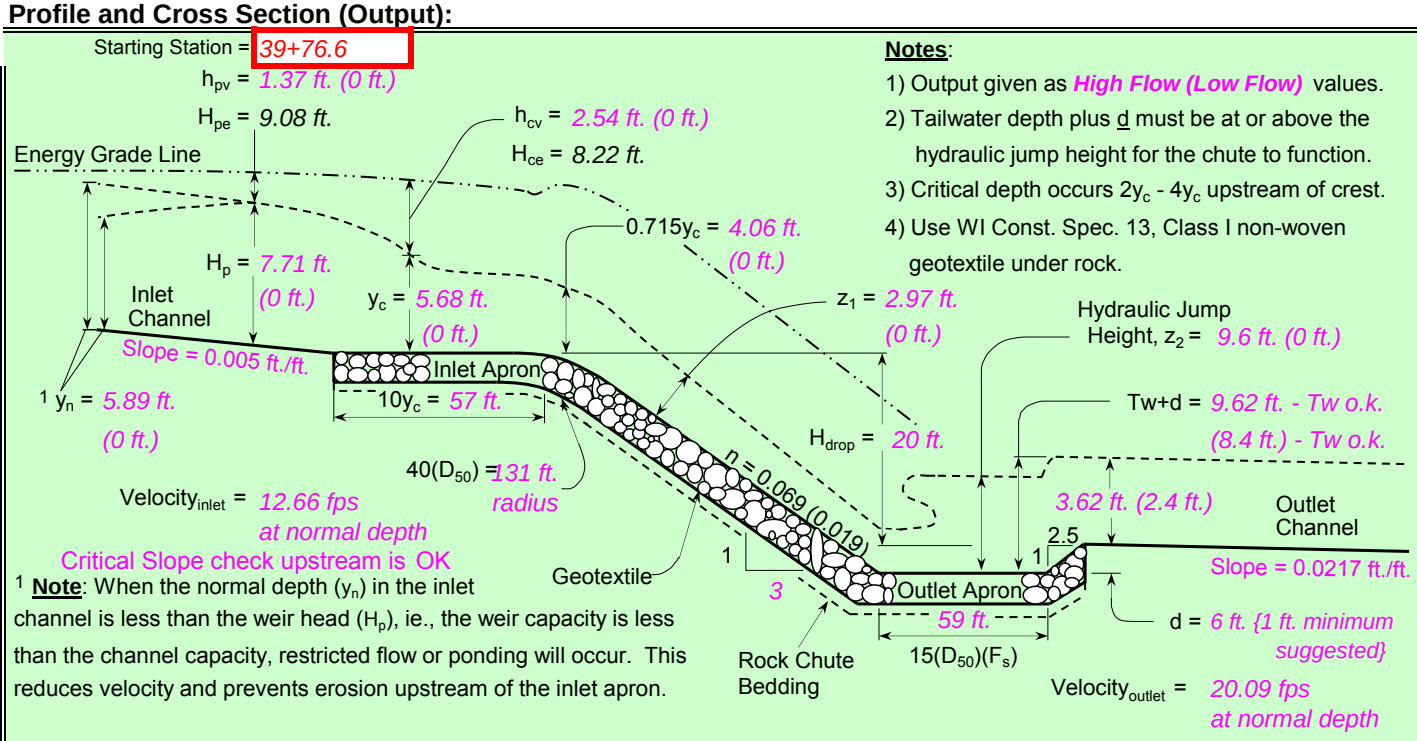
Apron elev. --- Inlet = 1059.5 ft. ------ Outlet 1033.5 ft. --- (H_{drop} = 20 ft.)

Q_{high} = Runoff from design storm capacity from Table 2, FOTG Standard 410
Q_5 = Runofff from a 5-year,24-hour storm.

Q_{high} = 7000.0 cfs High flow storm through chute → Tw (ft.) = Program
Q_5 = 0.0 cfs Low flow storm through chute → Tw (ft.) = Program

***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*
***Input tailwater (Tw)**:* 0.33 1.20

Profile and Cross Section (Output):



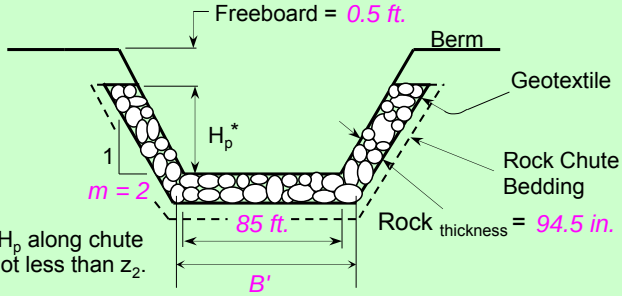
Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs 2y_c - 4y_c upstream of crest.
4) Use WI Const. Spec. 13, Class I non-woven geotextile under rock.

[1] **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Critical Slope check upstream is OK

Profile Along Centerline of Chute

Typical Cross Section



* Use H_p along chute but not less than z_2.

	76.81 cfs/ft.	Equivalent unit discharge
F_S =	1.20	Factor of safety (multiplier)
z_1 =	2.97 ft.	Normal depth in chute
n-value =	0.069	Manning's roughness coefficient
$D_{50}(F_s)$ =	47.2 in.	Minimum Design D50*
$2(D_{50})(F_s)$ =	94.5 in.	Rock chute thickness
Tw + d =	9.62 ft.	Tailwater above outlet apron
z_2 =	9.6 ft.	Hydraulic jump height
*** The outlet	will	*function adequately*

High Flow Storm Information

Rock Chute Design Calculations

(Version WI-Nov. 2017, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: A535 Hasley Canyon Creek **County:** LA County
Designer: Angel Ramirez **Checked by:**
Date: 7/1/2019 **Date:**

I. Calculate the normal depth in the inlet channel

	High Flow		*Low Flow*		
y_n =	**5.89**	**ft.**	**0.00**	**ft.**	(Normal depth)
Area =	553.0	ft^2	0.0	ft^2	(Flow area in channel)
Q_{high} =	7000.0	cfs	Q_{low} = 0.0	cfs	(Capacity in channel)
Scupstreamchannel =	0.005	ft/ft			

II. Calculate the critical depth in the chute

	High Flow		*Low Flow*		
y_c =	**5.68**	**ft.**	**0.00**	**ft.**	(Critical depth in chute)
Area =	547.3	ft^2	0.0	ft^2	(Flow area in channel)
Q_{high} =	7000.0	cfs	Q_{low} = 0.0	cfs	(Capacity in channel)
H_{ce} =	8.22	ft.	0.00	ft.	(Total minimum specific energy head)
h_{cv} =	2.54	ft.	0.00	ft.	(Velocity head corresponding to y_c)
$10y_c$ =	**56.80**	**ft.**	---	---	(Required inlet apron length)
$0.715y_c$ =	**4.06**	**ft.**	**$0.715y_c$ =** **0.00**	**ft.**	(Depth of flow over the weir crest or brink)

III. Calculate the tailwater depth in the outlet channel

	High Flow		*Low Flow*		
Tw =	**3.62**	**ft.**	**2.40**	**ft.**	(Tailwater depth)
Area =	696.7	ft^2	454.6	ft^2	(Flow area in channel)
Q_{high} =	14000.0	cfs	Q_{low} = 7000.0	cfs	(Capacity in channel)
H_2 =	0.00	ft.	H_2 = 0.00	ft.	(Downstream head above weir crest, $H_2 = 0$, if $H_2 < 0.715*y_c$)

IV. Calculate the head for a trapezoidal shaped broadcrested weir

Cd = 1.00 (Coefficient of discharge for broadcrested weirs)

	High Flow				
H_p =	8.64	ft.	**7.71**	**ft.**	(Weir head)
Area =	846.1	ft^2	744.9	ft^2	(Flow area in channel)
V_o =	0.00	fps	**9.40**	**fps**	(Approach velocity)
h_{pv} =	0.00	ft.	1.37	ft.	(Velocity head corresponding to H_p)
Q_{high} =	7000.0	cfs	7000.0	cfs	(Capacity in channel)

Trial and error procedure solving simultaneously for velocity and head

	Low Flow				
H_p =	0.00	ft.	**0.00**	**ft.**	(Weir head)
Area =	0.0	ft^2	0.0	ft^2	(Flow area in channel)
V_o =	0.00	fps	**0.05**	**fps**	(Approach velocity)
h_{pv} =	0.00	ft.	0.00	ft.	(Velocity head corresponding to H_p)
Q_{low} =	0.0	cfs	0.0	cfs	(Capacity in channel)

Trial and error procedure solving simultaneously for velocity and head

Rock Chute Design Calculations

(Version WI-Nov. 2017, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: A535 Hasley Canyon Creek **County:** LA County
Designer: Angel Ramirez **Checked by:**
Date: 7/1/2019 **Date:**

V. Calculate the rock chute parameters (w/o a factor of safety applied)

	High Flow		*Low Flow*		
q_t =	7.14 cms/m	q_t =	0.00 cms/m	(Equivalent unit discharge)
D_{50} (mm) =	999.79 → ***(39.36 in.)***	D_{50} =	0.17 mm	(Median ***angular*** rock size)
n =	0.069	n =	0.019	(Manning's roughness coefficient)
z_1 =	2.97 ft.	z_1 =	0.00 ft.	(Normal depth in the chute)
A_1 =	270.2 ft^2	A_1 =	0.0 ft^2	(Area associated with normal depth)
Velocity =	25.91 fps	Velocity =	0.00 fps	(Velocity in chute slope)
z_{mean} =	2.79 ft.	z_{mean} =	0.00 ft.	(Mean depth)
F_1 =	2.73	F_1 =	0.00	(Froude number)
$L_{rock\ apron}$ =	49.20 ft.	----	----	(Length of rock outlet apron = 15*D_{50})

VI. Calculate the height of hydraulic jump height (conjugate depth)

	High Flow		*Low Flow*		
z_2 =	**9.60 ft.**	**z_2 =**	**0.00 ft.**	(Hydraulic jump height)
Q_{high} =	7000.0 cfs	Q_{high} =	0.0 cfs	(Capacity in channel)
A_2 =	999.8 ft^2	A_2 =	0.0 ft^2	(Flow area in channel)

VII. Calculate the energy lost through the jump (absorbed by the rock)

	High Flow		*Low Flow*	
E_1 =	13.39 ft.	E_1 =	0.00 ft.	(Total energy before the jump)
E_2 =	10.36 ft.	E_2 =	0.00 ft.	(Total energy after the jump)
R_E =	22.67 %	R_E =	-245.54%	(Relative loss of energy)

Calculate Quantities for Rock Chute

-------Rock Riprap Volume-------

Area Calculations		**Length @ Rock CL**	
h =	9.60	Inlet =	59.27
x_1 =	20.12	Outlet =	126.60
L =	21.47	Slope =	82.06
A_s =	193.20	2.5:1 Lip =	15.22
x_2 =	18.00	**Total =**	**283.15 ft.**
A_b =	965.24	**Rock Volume**	
A_b+2*A_s =	**1351.64 ft^2**	**14174.68**	**yd^3**

-------Bedding Volume-------

Area Calculations			
h =	18.60	**Bedding Thickness**	
x_1 =	0.00	t_1, t_2 =	***0.00*** in.
L =	41.59		
A_s =	0.00	**Length @ Bed CL**	
x_2 =	0.00	**Total =**	**283.08 ft.**
A_b =	0.00	**Bedding Volume**	
A_b+2*A_s =	**0.00 ft^2**	**0.00**	**yd^3**

-------Geotextile Quantity-------

Width		**Length @ Bot. Rock**	
2*Slope =	83.18	**Total =**	**283.08 ft.**
Bottom =	89.25	**Geotextile Area**	
Total =	**172.43 ft.**	**5423.60**	**yd^2**

Note: 1) The radius is not considered when calculating quantities of riprap, bedding, or geotextile.
2) The geotextile quantity does not include over-overlapping (18-in. min.) or anchoring material (18-in. min. along sides, 24-in. min. on ends).

Appendix H: Alternative Design Approach

Appendix H – Alternative Design Approach

Adjustment, Freeboard and Toe-Down Discussion

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Appendix H – Alternative Design Approach Discussion

As part of the analysis presented in this DCR, an alternative bank protection design was considered that did not include the two grade control structures. The freeboard and toe down calculations for this alternative design are presented below. The alternative bank protection design has lower toe of bank elevations because it does not include the grade control structures. As a result, the design toe of the bank could be much lower than the groundwater elevation at the time of construction. In order to avoid a significant amount of dewatering, launch stone may be constructed. The assumed groundwater level (12 feet below the minimum channel elevation) used for the launch stone design calculations is based on the most current available data. However, groundwater levels fluctuate which means that it will be determined whether the use of launch stone is necessary at the time of construction. **Figure H.1** shows the proposed conditions floodplain for the alternative design.

Fluvial Study

PACE adapted the hydraulic modeling and the sediment transport analysis from the Fluvial Study discussed in **Section 5** of the report to determine the top of bank and toe of bank elevations of the alternative design. If the soil cement bank protection will be constructed based on this alternative design, a fluvial study that more closely reflects a proposed condition without grade control structures may be warranted. However, the long-term scour values and general scour values presented in this appendix are conservative.

Similar to the Fluvial Study discussed in **Section 5**, two geometries were considered for the alternative design approach: (1) design slope geometry, and (2) stable slope geometry. The design slope geometry represents the alternative design conditions with the existing channel invert elevations, whereas the stable slope geometry represents the alternative design conditions with the stable equilibrium slope. The design slope geometry and stable slope geometry were considered when performing toe-down calculations. Because the stable slope geometric configuration represents a condition where Hasley Creek has scoured to its equilibrium slope, the Creek would have more capacity in the stable slope condition than in the design slope condition. Therefore, the stable slope geometric configuration was not considered when performing freeboard calculations.

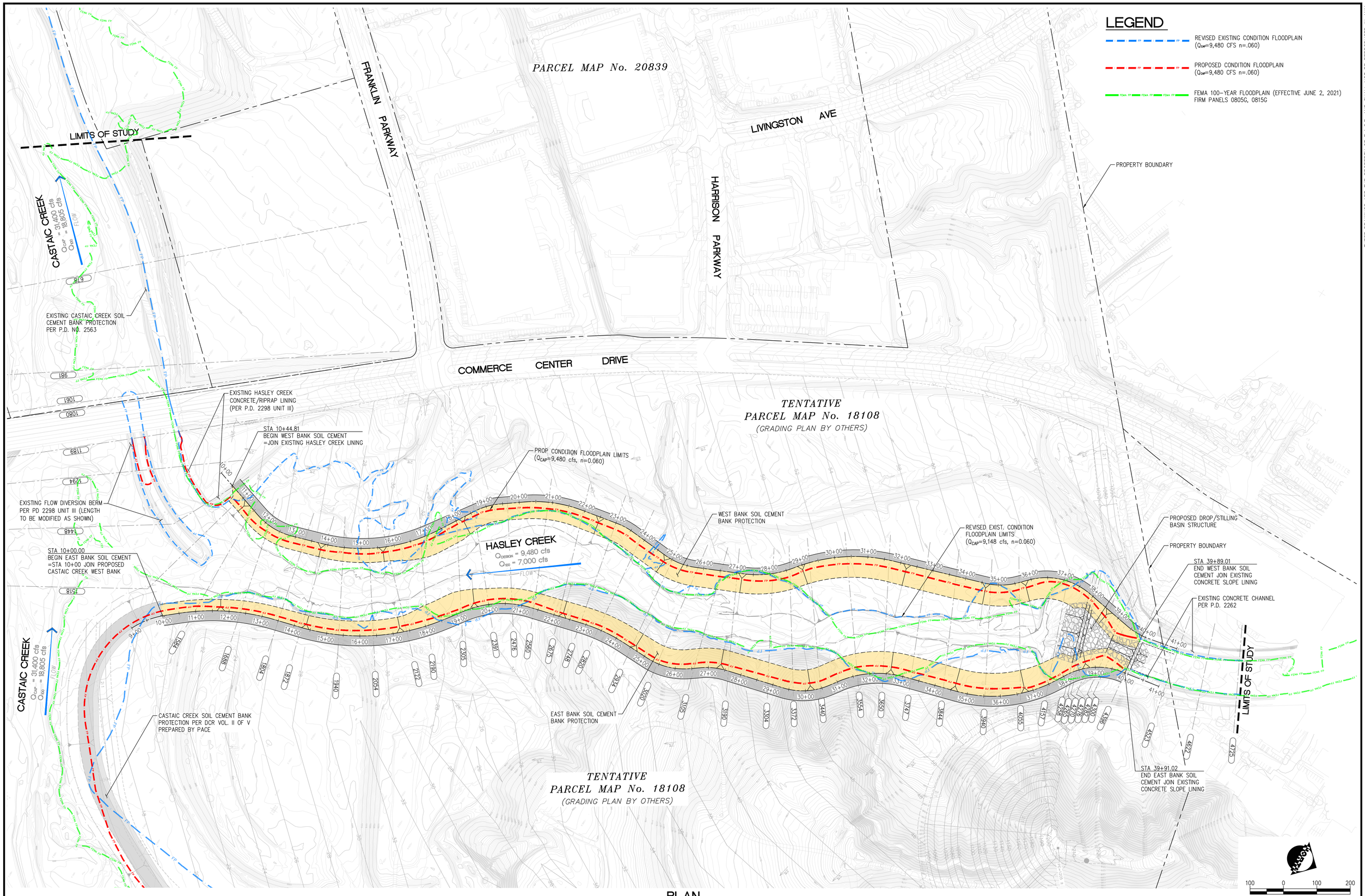
Long-Term Adjustment

As discussed in **Section 5**, the SAM analysis yielded an equilibrium slope of 1% for Reach 1 and equilibrium slope of 0.8% for Reach 2. These slopes were used to perform a SAM analysis for the alternative design. The results of this analysis indicate that the transport capacity for the supply reach was larger than the transport capacity of the design reaches, indicating the equilibrium slope for the alternative design would be steeper than the configuration used for the SAM analysis in the grade control design condition.

As a conservative measure, PACE assumed an equilibrium slope of 0.8% for determining long-term scour. Although the equilibrium slope for the alternative design condition will most likely be steeper, a flatter equilibrium slope will result in greater estimates of long-term scour. The long-term scour values calculated for each HEC-RAS Section are listed in **Table H.3.**

General Adjustment

The general adjustment values used to determine the design top and toe elevations for the alternative design were calculated using the procedure described in **Section 5.4**. The grade control structures described in the report text are buried; therefore, the general scour analysis for the design slope is the same with and without grade control structures. However, the long-term adjustment and the general adjustment values at the stable slope condition calculated for the alternative design will be different than the values presented for the design option with grade control structures. The general adjustment values calculated for the alternative design are shown in **Table H.1.** General adjustment calculations are included at the end of this appendix.



PLAN

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NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK
SOIL CEMENT BANK PROTECTION
TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

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PREPARED	JOSE CRUZ
PROJECT ENGINEER R.C.E. NO.	72249
EXP.	06/30/2022
DRAWN	BDP
SCALE	AS SHOWN
DESIGNED	JC
CHECKED	MEK
DATE	7/19/2021

REGISTERED PROFESSIONAL ENGINEER JOSE CRUZ No. 72249 Exp. 06-30-22 CIVIL STATE OF CALIFORNIA

TITLE

PROPOSED CONDITION FLOODPLAIN MAPPING

EIMP. 20190000489

FIGURE H.1

JOB NO. A535

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Table H.1 – General Adjustment (GA) results

Reach	HEC-RAS River Section	Design Slope GA[1,4] (ft)		Stable Slope GA[6] (ft)	
		HEC-1 Hydrograph	SCS Hydrograph	HEC-1 Hydrograph	SCS Hydrograph
1	3190.5 to 4157	**-2.03**	1.47	19.15	29.61
2	1804 to 3190.5	0.67	**-0.78**	0.77	**-5.03**

Notes:

1. *GA= General Adjustment.*
2. *Values in bold indicate scour values used in subsequent toe down calculations.*
3. *Underlined values indicate aggradation values used in subsequent freeboard calculations.*
4. *General adjustment results from Reach 3 were not realistic and are omitted from this table.*
5. *The design slope refers to the proposed slope on the plans.*
6. *Stable slope refers to the long-term equilibrium slope of the channel, assumed to be 0.8% for this analysis. Note that freeboard was not calculated for the stable slope condition because Hasley Canyon Creek will have more capacity in the stable slope condition.*

Toe Down

The total scour at each HEC-RAS cross section is the sum of general adjustment, long-term adjustment, and other scour components described in **Section 5.6.** The larger degradation value of the analyzed hydrographs was used as the general scour value for each reach. For the design slope configuration, the long-term scour was taken as the difference between the design slope and the long-term stable slope. The stable slope configuration features the long-term stable slope; thus, long-term scour was set to zero. **Table H.2** summarizes the long-term and general scour components for the total scour analysis.

Table H.2 – Summary of general and long-term scour used in toe down calculations.

Reach	HEC-RAS River Sections	General Scour[1,2] (ft)		Long-Term Scour	
		Design Slope Configuration	Stable Slope Configuration	Design Slope Configuration	Stable Slope Configuration
1	4157 to 3190.5	-2.03	0	Difference between invert elevation and 0.8% slope.	0
2	3190.5 to 1804	-0.78	-7.86	Difference between invert elevation and 0.8% slope.	0

Notes:

1. *General aggradation for each reach is the larger aggradation computed from the two hydrographs.*

Table H.3 summarizes the results of the total scour analysis, which includes the scour depth and elevation for both geometry configurations (i.e., design slope and stable slope).

Table H.3 – Summary of total scour results.

HEC-RAS Section	Design Invert Elevation[1] (ft)	Stable Slope Invert Elevation[2] (ft)	East Bank				West Bank			
			Design Slope Toe-Down[3] (ft)	Design Slope Scour Elevation[4] (ft)	Stable Slope Toe-Down[5] (ft)	Stable Slope Scour Elevation[6] (ft)	Design Slope Toe-Down[7] (ft)	Design Slope Scour Elevation[4] (ft)	Stable Slope Toe-Down[8] (ft)	Stable Slope Scour Elevation[6] (ft)
4157	1035.56	1013.36	29.11	**1006.45**	5.87	1007.49	33.17	1002.39	12.01	**1001.35**
4055.5	1033.00	1012.45	34.13	998.87	15.76	**996.69**	28.53	**1004.47**	7.48	1004.97
3940.5	1031.00	1011.69	34.00	997.00	16.59	**995.10**	27.37	**1003.63**	8.05	1003.64
3844	1030.00	1010.76	29.09	**1000.91**	7.67	1003.09	29.09	**1000.91**	7.67	1003.09
3747	1029.17	1009.99	28.75	**1000.43**	7.55	1002.44	28.75	**1000.43**	7.55	1002.44
3650	1028.00	1009.20	26.92	1001.08	8.57	**1000.63**	29.04	**998.96**	6.46	1002.74
3554	1027.00	1008.40	27.51	**999.49**	6.91	1001.49	28.16	**998.84**	8.28	1000.12
3440.5	1025.32	1007.48	27.12	**998.20**	6.70	1000.78	27.12	**998.20**	6.70	1000.78
3372	1025.00	1006.91	26.59	**998.41**	6.45	1000.46	26.59	**998.41**	6.45	1000.46
3304	1023.50	1006.40	25.94	**997.57**	5.94	1000.46	25.94	**997.57**	5.94	1000.46
3190.5	1022.00	1005.49	26.65	**995.35**	9.89	995.60	23.81	**998.19**	5.82	999.67
3105	1021.00	1004.89	25.97	995.03	10.63	**994.26**	22.87	**998.13**	6.29	998.60
3020	1019.68	1004.18	25.38	994.30	10.96	**993.22**	23.51	**996.17**	6.21	997.97
2934	1018.19	1003.50	21.47	996.72	8.43	**995.07**	21.47	996.72	8.43	**995.07**
2820.5	1016.37	1002.59	21.21	**995.17**	6.93	995.66	21.21	995.17	6.93	995.66
2748	1015.00	1002.02	20.31	**994.69**	6.91	995.11	20.31	**994.69**	6.91	995.11
2675.5	1014.00	1001.33	20.35	**993.66**	6.80	994.53	22.21	991.79	9.86	**991.47**
2560.5	1012.00	1000.59	19.06	**992.94**	7.48	993.11	21.74	990.26	11.04	**989.55**
2476	1010.49	999.84	18.09	**992.41**	6.38	993.46	20.18	990.31	9.71	**990.13**
2391	1009.71	999.16	17.70	992.01	7.22	**991.94**	19.77	**989.94**	6.45	992.71
2305.5	1007.87	998.58	25.65	982.22	17.76	**980.82**	25.65	982.22	17.76	**980.82**
2190.5	1006.00	997.80	28.36	**977.64**	18.73	979.07	28.36	977.64	18.73	**979.07**
2122	1004.00	997.12	17.38	**986.62**	9.45	987.67	14.87	**989.14**	6.58	990.54
2054	1003.00	996.50	16.53	986.47	10.34	**986.16**	14.24	**988.76**	7.66	988.84
1940.5	1001.76	995.78	15.23	**986.53**	8.15	987.63	13.35	**988.42**	6.23	989.55
1872	1001.00	995.09	12.90	**988.10**	5.74	989.35	12.90	**988.10**	5.74	989.35
1804	999.65	994.55	12.24	**987.41**	5.44	989.11	12.24	**987.41**	4.73	989.82
1688.6	997.49	993.63	10.91	**986.59**	5.47	988.16	10.91	**986.59**	5.47	988.16
1584	995.00	992.83	8.06	**986.94**	4.93	987.90	8.06	**986.94**	4.93	987.90

Notes:

1. *Design Slope invert elevations were obtained from HEC-RAS output for the design slope configuration (see **Appendix B**)*
2. *Stable Slope invert elevations were obtained from HEC-RAS output for the stable slope configuration (see **Appendix C**)*
3. *Design Slope Toe-Down for the East Bank was obtained from **Table H.6**.*
4. *Design Slope Scour Elevations were calculated by subtracting the Design Slope Toe-Down from the Design Invert Elevation.*
5. *Stable Slope Toe-Down for the East Bank was obtained from **Table H.8**.*
6. *Stable Slope Scour Elevations were calculated by subtracting the Stable Slope Toe-Down from the Stable Slope Invert Elevation.*
7. *Design Slope Toe-Down for the West Bank was obtained from **Table H.7**.*
8. *Stable Slope Toe-Down for the West Bank was obtained from **Table H.9**.*
9. ***Bold values** indicate the Final Design Scour Elevation.*

Plunge Scour

PACE also calculated plunge scour at the end of the stilling basin at the upstream end of the design reach. The Veronese method described in **Section 5.8** was used to calculate a plunge scour of approximately 4.2 feet. As described in **Section 5.8**, the plunge scour will not be added to the total scour depth, however, launch stone placed downstream of the stilling basin will provide scour protection should the channel degrade to expose a drop. Calculations of plunge scour at the end of the stilling basin for the alternative design are presented at the end of this appendix.

Freeboard

PACE also performed freeboard calculations to determine top of bank elevations. The SAM analysis predicted degradation at every reach of Hasley Canyon Creek over the long-term, thus a long-term aggradation value (Y_{AGG}) of zero was applied to each HEC-RAS section. General aggradation (Y_{GA}) values were obtained from the design slope analysis described in **Section 5.4**. Of the two analyzed hydrographs, the greater general aggradation value was used for the freeboard calculations. The freeboard calculations for the stable slope configuration were not presented because the stable slope channel invert is much lower than the channel invert for the design slope; therefore, the stable slope condition will have more capacity than the design slope condition. **Table H.4** is a summary of the general aggradation and long-term aggradation values used to calculate freeboard.

Table H.4 – Summary of general and long-term aggradation used for freeboard calculations.

Reach	HEC-RAS River Sections	General Aggradation[1] (ft)	Long-Term Aggradation (ft)
1	4157 to 3190.5	1.47	0
2	3190.5 to 1804	0.67	0
3[2]	1584 to 1804	0.67	0

Notes:

1. General scour for each reach is the larger aggradation computed from the two hydrographs.

2. Because the sediment transport results for Reach 2 were not realistic, the general aggradation for Reach 2 was applied to Reach 3.

Table H.5 summarizes the results of the freeboard analysis, including the minimum top of bank elevations for the design slope configuration. Calculation spreadsheets for the design slope configuration, which are the same for the alternative design and the design with the grade control structures, are presented in **Table H.10 and Table H.11**.

Table H.5 – Summary of freeboard results

HEC-RAS Section	Design Slope WSE[1] (ft)	East Bank		West Bank	
		Design Slope Freeboard[2] (ft)	Design Slope Top of Bank Elevation[3] (ft)	Design Slope Freeboard[4] (ft)	Design Slope Top of Bank Elevation[3] (ft)
4396	1066.39	9.44	1075.83	9.44	1075.83
4300	1045.43	14.02	1059.45	14.02	1059.45
4282	1039.42	14.91	1054.33	14.92	1054.34
4276	1045.49	2.50	1047.97	2.50	1047.99
4270	1045.68	2.50	1048.18	2.50	1048.18
4265	1045.20	2.50	1047.70	2.50	1047.70
4258	1045.17	2.50	1047.67	2.50	1047.67
4157	1045.18	2.50	1047.68	2.50	1047.68

HEC-RAS Section	Design Slope WSE[1] (ft)	East Bank		West Bank	
		Design Slope Freeboard[2] (ft)	Design Slope Top of Bank Elevation[3] (ft)	Design Slope Freeboard[4] (ft)	Design Slope Top of Bank Elevation[3] (ft)
4055.5	1044.33	2.50	1046.83	2.50	1046.83
3940.5	1042.61	2.50	1045.11	2.50	1045.11
3844	1040.58	2.50	1043.08	2.50	1043.08
3747	1039.36	2.50	1041.86	2.50	1041.86
3650	1038.00	2.50	1040.50	2.50	1040.50
3554	1035.83	2.50	1038.33	2.50	1038.33
3440.5	1034.23	2.50	1036.73	2.50	1036.73
3372	1032.80	2.50	1035.30	2.50	1035.30
3304	1032.08	2.50	1034.58	2.50	1034.58
3190.5	1031.12	2.50	1033.62	2.50	1033.62
3105	1030.10	2.50	1032.60	2.50	1032.60
3020	1028.99	2.50	1031.49	2.50	1031.49
2934	1027.15	2.50	1029.65	2.50	1029.65
2820.5	1024.59	2.50	1027.09	2.50	1027.09
2748	1023.47	2.50	1025.97	2.50	1025.97
2675.5	1021.88	2.50	1024.38	2.50	1024.38
2560.5	1019.92	2.50	1022.42	2.50	1022.42
2476	1018.91	2.50	1021.41	2.50	1021.41
2391	1018.06	2.50	1020.56	2.50	1020.56
2305.5	1017.59	2.50	1020.09	2.50	1020.09
2190.5	1013.72	2.50	1016.22	2.50	1016.22
2122	1012.19	2.50	1014.69	2.50	1014.69
2054	1010.80	2.50	1013.30	2.50	1013.30
1940.5	1009.54	2.50	1012.04	2.50	1012.04
1872	1007.69	2.50	1010.19	2.50	1010.19
1804	1006.19	2.50	1008.69	2.50	1008.69
1688.62	1005.28	2.50	1007.78	2.50	1007.78
1584	1005.11	2.50	1007.61	2.50	1007.61
1518	1003.88	N/A	N/A	2.50	1006.38
1448	1001.36	N/A	N/A	2.50	1003.86

Notes:

1. *The Design Slope Water Surface Elevation (WSE) was obtained from HEC-RAS Output in **Appendix B**.*
2. *The Design Slope Freeboard for the East Bank was obtained from **Table H.10**.*
3. *The Design Slope Top of Bank Elevation was calculated by adding the Design Slope WSE and the Design Slope Freeboard.*
4. *The Design Slope Freeboard for the West Bank was obtained from **Table H.11**.*

TABLE H.6 - HASLEY CANYON EAST BANK PROTECTION PROJECT FOR DESIGN SLOPE WITH Q_{100} AND n = 0.025
CALCULATIONS FOR TOE-DOWN BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Ch. Invert Elevation (ft)	Scour Elevation (ft)	Z_{MAX}	Z_{TOT}	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	BANK PROT	Z_{LS}+ BANK	Z_{LS}+ BRIDGE	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_I+	H/2	Z_{DM}
4396	1059.45	1053.49	21.00	5.96	20.2	3.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.6	0.153	96.7	900	0.1	2.0	1.9	21.0
4300	1039.45	1033.30	14.00	6.15	27.5	4.3	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.9	0.236	65.6	900	0.0	2.0	2.2	14.0
4282	1033.45	1027.45	14.00	6.01	31.2	4.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.6	0.140	62.0	900	0.0	2.0	2.0	14.0
4276	1033.45	1027.90	14.00	5.55	24.2	3.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.119	97.7	0	0.0	2.0	1.6	14.0
4270	1033.45	1029.21	6.00	4.24	4.2	9.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	8.8	0.001	188.4	0	0.0	2.0	0.2	6.0
4265	1037.00	1032.07	8.00	4.93	8.3	5.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.8	0.007	174.8	0	0.0	2.0	0.9	8.0
4258	1036.78	1032.11	8.00	4.67	7.1	5.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	5.2	0.002	190.1	0	0.0	2.0	0.7	8.0
4157	1035.56	1006.45	29.11	29.11	3.8	7.0	22.9	2.0	0	0.0	1	0.0	0	2.0	0.0	0	6.7	0.000	274.1	0	0.0	2.0	0.2	6.0
4055.5	1033.00	998.87	34.13	34.13	9.5	8.2	21.3	2.0	0	0.0	1	0.0	0	2.0	0.0	1	2.8	0.007	266.7	300	5.6	2.0	1.2	12.0
3940.5	1031.00	997.00	34.00	34.00	9.8	9.4	20.0	2.0	0	0.0	1	0.0	0	2.0	0.0	1	2.5	0.008	280.9	300	6.6	2.0	1.3	12.0
3844	1030.00	1000.91	29.09	29.09	14.8	6.9	20.0	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.019	193.0	0	0.0	2.1	2.9	10.0
3747	1029.17	1000.43	28.75	28.75	15.6	5.6	19.9	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.016	150.7	0	0.0	2.0	2.8	12.5
3650	1028.00	1001.08	26.92	26.92	10.1	7.2	19.5	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.009	283.7	0	0.0	2.0	1.4	10.0
3554	1027.00	999.49	27.51	27.51	15.9	4.3	19.3	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.7	0.020	165.8	0	0.0	2.0	2.2	12.5
3440.5	1025.32	998.20	27.12	27.12	13.7	4.8	18.6	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.013	174.6	0	0.0	2.1	2.4	10.0
3372	1025.00	998.41	26.59	26.59	11.4	5.1	18.8	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.008	201.1	0	0.0	2.0	1.7	10.0
3304	1023.50	997.57	25.94	25.94	14.8	4.2	17.8	2.0	0	0.0	1	0.0	0	2.0	0.0	0	1.8	0.029	265.9	0	0.0	2.0	2.1	10.0
3190.5	1022.00	995.35	26.65	26.65	6.5	6.4	17.2	2.0	0	0.0	1	0.0	0	2.0	0.0	1	4.3	0.002	248.8	500	2.8	2.0	0.6	12.0
3105	1021.00	995.03	25.97	25.97	9.6	6.4	16.8	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.8	0.007	258.6	500	3.1	2.0	1.2	12.0
3020	1019.68	994.30	25.38	25.38	14.2	5.0	16.2	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.9	0.014	168.5	500	1.9	2.0	2.5	15.0
2934	1018.19	996.72	21.47	21.47	9.7	7.0	15.4	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.007	251.8	0	0.0	2.0	1.3	8.0
2820.5	1016.37	995.17	21.21	21.21	17.6	3.9	14.5	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.025	152.7	0	0.0	2.0	1.9	12.5
2748	1015.00	994.69	20.31	20.31	17.1	3.6	13.7	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.025	166.7	0	0.0	2.0	1.8	12.5
2675.5	1014.00	993.66	20.35	20.35	13.2	4.4	13.4	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.7	0.014	200.1	0	0.0	2.0	2.2	10.0
2560.5	1012.00	992.94	19.06	19.06	12.6	5.1	12.1	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.1	0.017	262.5	0	0.0	2.0	2.1	10.0
2476	1010.49	992.41	18.09	18.09	14.4	3.9	11.4	0.8	0	0.0	1	0.0	0	2.0	0.0	0	1.8	0.026	265.2	0	0.0	2.0	1.9	10.0
2391	1009.71	992.01	17.70	17.70	11.0	4.3	11.3	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.7	0.009	239.4	0	0.0	2.0	1.6	10.0
2305.5	1007.87	982.22	25.65	25.65	6.8	6.3	10.0	0.8	0.9	6.0	1	0.0	1	0.0	12.2	0	4.4	0.002	232.1	0	0.0	2.0	0.6	8.0
2190.5	1006.00	977.64	28.36	28.36	11.6	4.5	9.0	0.8	0.9	6.0	1	0.0	1	0.0	14.7	0	2.9	0.009	208.7	0	0.0	2.0	1.8	10.0
2122	1004.00	986.62	17.38	17.38	13.5	4.7	7.7	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.5	0.016	211.6	400	2.5	2.0	2.4	15.0
2054	1003.00	986.47	16.53	16.53	13.9	4.2	7.3	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.4	0.018	212.4	400	2.3	2.0	2.1	15.0
1940.5	1001.76	986.53	15.23	15.23	14.6	3.5	6.8	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.3	0.020	210.2	400	1.9	2.0	1.7	15.0
1872	1001.00	988.10	12.90	12.90	10.1	4.6	6.8	0.8	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.006	221.4	0	0.0	2.0	1.4	10.0
1804	999.65	987.41	12.50	12.24	15.1	3.0	5.9	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.2	0.023	211.4	0	0.0	2.0	1.5	12.5
1688.62	997.49	986.59	10.91	10.91	14.4	2.8	4.7	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.1	0.022	232.8	0	0.0	2.0	1.4	10.0
1584	995.00	986.94	8.06	8.06	4.3	6.5	3.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.001	329.7	0	0.0	2.0	0.2	6.0
MAXIMUM=			34.1	34.1			22.9	2.0							14.7						6.6		2.9	21.0
MINIMUM=			6.0	4.2			0.0	0.0							0.0						0.0		0.2	6.0

DEFINITIONS

Z_{TOT} = TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG} = LONG TERM DEGRADATION IN FEET
Z_{GS} = GENERAL SCOUR IN FEET
Z_{LS} = LOCAL SCOUR IN FEET [Z_{LS} **BANK +** Z_{LS} **BRIDGE**]
Z_{LS} **BRIDGE** = BRIDGE LOCAL SCOUR IN FEET [PIER (APP C-4) + ABUTMENT (APP C-6)]
Z_{LS} **BANK** = LEVEE/BANK LOCAL SCOUR = **2.0'** IF BANK PROTECTION PRESENT
BANK PROT = BANK PROTECTION ON CHANNEL BANK
0 = YES; **1** = NO
PIER TYPE = PIER SHAPE FACTOR; IF NO PIERS = **0**
1.0 = SQUARE NOSE; **0.9** = ROUND NOSE; **0.9** = CYLINDER;
0.8 = SHARP NOSE; **0.9** = GROUP OF CYLINDERS
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
B = WIDTH OF PIERS IN FEET; NO PIER = **0**
ABUT TYPE = VERT WALL FACTOR; IF VERT = **2**; NON VERT = **1**
A = ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
Z_{BS} = BEND SCOUR IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND = **0**, BEND = **1**
HYD DEPTH = HYDRAULIC DEPTH IN FEET
E SLOPE = ENERGY SLOPE, UNITLESS
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I = LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H = BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-59 AND ASSOCIATED APPENDICES (APPENDIX C). VALUES FOR TOE-DOWN BASED ON THE CUT-OFF DEPTHS TABLE (PAGE F-31) IN THE LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF TOE-DOWN BETWEEN THE TWO METHODOLOGIES (Z_{MAX}). THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT-OFF DEPTH BASED ON FIGURE F-06 (PAGE F-37). LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR VALUES ARE INTERPOLATED FROM THE GENERAL DEGRADATION GRAPH IN APPENDIX C (PAGE C-3) OF THE LACDPW SEDIMENTATION MANUAL. BEND SCOUR AND LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON APPENDIX C (PAGES C-6 TO C-8) OF THE LACDPW SEDIMENTATION MANUAL. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON APPENDIX C-9 OF THE SEDIMENTATION MANUAL. THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY REVISION INCLUDES THE Z_{MAX} CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

LACDPW = LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES
OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

PACE
Advanced Water Engineering

TABLE H.7 - HASLEY CANYON WEST BANK PROTECTION PROJECT FOR DESIGN SLOPE WITH Q_{100} AND n = 0.025
CALCULATIONS FOR TOE-DOWN BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Ch. Invert Elevation (ft)	Scour Elevation (ft)	Z_{MAX}	Z_{TOT}	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	BANK PROT	Z_{LS}+ BANK	Z_{LS}+ BRIDGE	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_{I}+	H/2	Z_{DM}
4396	1059.45	1053.54	14.00	5.91	20.2	3.8	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.6	0.153	96.7	0	0.0	2.0	1.9	14.0
4300	1039.45	1033.30	14.00	6.15	27.5	4.3	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.9	0.236	65.6	0	0.0	2.0	2.2	14.0
4282	1033.45	1027.45	14.00	6.01	31.2	4.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	3.6	0.140	62.0	0	0.0	2.0	2.0	14.0
4276	1033.45	1027.00	21.00	6.45	24.2	3.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	3.0	0.119	97.7	300	0.9	2.0	1.6	21.0
4270	1033.45	1025.93	9.00	7.52	4.2	9.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	8.8	0.001	188.4	300	3.3	2.0	0.2	9.0
4265	1037.00	1030.20	12.00	6.80	8.3	5.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.8	0.007	174.8	300	1.9	2.0	0.9	12.0
4258	1036.78	1029.23	12.00	7.55	7.1	5.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	5.2	0.002	190.1	300	2.9	2.0	0.7	12.0
4157	1035.56	1002.39	33.17	33.17	3.8	7.0	22.9	2.0	0	0.0	1	0.0	0	2.0	0.0	1	6.7	0.000	274.1	300	4.1	2.0	0.2	9.0
4055.5	1033.00	1004.47	28.53	28.53	9.5	8.2	21.3	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.8	0.007	266.7	0	0.0	2.0	1.2	8.0
3940.5	1031.00	1003.63	27.37	27.37	9.8	9.4	20.0	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.008	280.9	0	0.0	2.0	1.3	8.0
3844	1030.00	1000.91	29.09	29.09	14.8	6.9	20.0	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.019	193.0	0	0.0	2.1	2.9	10.0
3747	1029.17	1000.43	28.75	28.75	15.6	5.6	19.9	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.0	0.016	150.7	0	0.0	2.0	2.8	12.5
3650	1028.00	998.96	29.04	29.04	10.1	7.2	19.5	2.0	0	0.0	1	0.0	0	2.0	0.0	1	2.5	0.009	283.7	1,000	2.1	2.0	1.4	15.0
3554	1027.00	998.84	28.16	28.16	15.9	4.3	19.3	2.0	0	0.0	1	0.0	0	2.0	0.0	1	2.7	0.020	165.8	1,000	0.6	2.0	2.2	18.0
3440.5	1025.32	998.20	27.12	27.12	13.7	4.8	18.6	2.0	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.013	174.6	0	0.0	2.1	2.4	10.0
3372	1025.00	998.41	26.59	26.59	11.4	5.1	18.8	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.008	201.1	0	0.0	2.0	1.7	10.0
3304	1023.50	997.57	25.94	25.94	14.8	4.2	17.8	2.0	0	0.0	1	0.0	0	2.0	0.0	0	1.8	0.029	265.9	0	0.0	2.0	2.1	10.0
3190.5	1022.00	998.19	23.81	23.81	6.5	6.4	17.2	2.0	0	0.0	1	0.0	0	2.0	0.0	0	4.3	0.002	248.8	0	0.0	2.0	0.6	8.0
3105	1021.00	998.13	22.87	22.87	9.6	6.4	16.8	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.8	0.007	258.6	0	0.0	2.0	1.2	8.0
3020	1019.68	996.17	23.51	23.51	14.2	5.0	16.2	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.014	168.5	0	0.0	2.0	2.5	10.0
2934	1018.19	996.72	21.47	21.47	9.7	7.0	15.4	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.9	0.007	251.8	0	0.0	2.0	1.3	8.0
2820.5	1016.37	995.17	21.21	21.21	17.6	3.9	14.5	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.6	0.025	152.7	0	0.0	2.0	1.9	12.5
2748	1015.00	994.69	20.31	20.31	17.1	3.6	13.7	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.025	166.7	0	0.0	2.0	1.8	12.5
2675.5	1014.00	991.79	22.21	22.21	13.2	4.4	13.4	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.7	0.014	200.1	500	1.9	2.0	2.2	15.0
2560.5	1012.00	990.26	21.74	21.74	12.6	5.1	12.1	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.1	0.017	262.5	500	2.7	2.0	2.1	15.0
2476	1010.49	990.31	20.18	20.18	14.4	3.9	11.4	0.8	0	0.0	1	0.0	0	2.0	0.0	1	1.8	0.026	265.2	500	2.1	2.0	1.9	15.0
2391	1009.71	989.94	19.77	19.77	11.0	4.3	11.3	0.8	0	0.0	1	0.0	0	2.0	0.0	1	2.7	0.009	239.4	500	2.1	2.0	1.6	15.0
2305.5	1007.87	982.22	25.65	25.65	6.8	6.3	10.0	0.8	0.9	6.0	1	0.0	1	0.0	12.2	0	4.4	0.002	232.1	0	0.0	2.0	0.6	8.0
2190.5	1006.00	977.64	28.36	28.36	11.6	4.5	9.0	0.8	0.9	6.0	1	0.0	1	0.0	14.7	0	2.9	0.009	208.7	0	0.0	2.0	1.8	10.0
2122	1004.00	989.14	14.87	14.87	13.5	4.7	7.7	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.5	0.016	211.6	0	0.0	2.0	2.4	10.0
2054	1003.00	988.76	14.24	14.24	13.9	4.2	7.3	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.4	0.018	212.4	0	0.0	2.0	2.1	10.0
1940.5	1001.76	988.42	13.35	13.35	14.6	3.5	6.8	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.3	0.020	210.2	0	0.0	2.0	1.7	10.0
1872	1001.00	988.10	12.90	12.90	10.1	4.6	6.8	0.8	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.006	221.4	0	0.0	2.0	1.4	10.0
1804	999.65	987.41	12.50	12.24	15.1	3.0	5.9	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.2	0.023	211.4	0	0.0	2.0	1.5	12.5
1688.62	997.49	986.59	10.91	10.91	14.4	2.8	4.7	0.8	0	0.0	1	0.0	0	2.0	0.0	0	2.1	0.022	232.8	0	0.0	2.0	1.4	10.0
1584	995.00	986.94	8.06	8.06	4.3	6.5	3.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.001	329.7	0	0.0	2.0	0.2	6.0
1518	995.00	984.28	21.00	10.72	10.4	4.9	4.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	3.2	0.005	222.0	0	0.0	2.0	1.9	21.0
1448	993.63	986.91	6.72	6.72	11.9	4.8	0.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	3.1	0.007	155.2	0	0.0	2.0	1.9	6.0
MAXIMUM=			33.17	33.2			22.9	2.0							14.7						4.1		2.9	
MINIMUM=			6.72	5.9			0.0	0.0							0.0						0.0		0.2	

DEFINITIONS

Z_{TOT} = TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG} = LONG TERM DEGRADATION IN FEET
Z_{GS} = GENERAL SCOUR IN FEET
Z_{LS} = LOCAL SCOUR IN FEET [Z_{LS} **BANK** + Z_{LS} **BRIDGE**]
Z_{LS} **BRIDGE** = BRIDGE LOCAL SCOUR IN FEET [PIER (APP C-4) + ABUTMENT (APP C-6)]
Z_{LS} **BANK** = LEVEE/BANK LOCAL SCOUR = **2.0'** IF BANK PROTECTION PRESENT
BANK PROT = BANK PROTECTION ON CHANNEL BANK
0 = YES; **1** = NO
PIER TYPE = PIER SHAPE FACTOR; IF NO PIERS = **0**
1.0 = SQUARE NOSE; **0.9** = ROUND NOSE; **0.9** = CYLINDER;
0.8 = SHARP NOSE; **0.9** = GROUP OF CYLINDERS
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
B = WIDTH OF PIERS IN FEET; NO PIER = **0**
ABUT TYPE = VERT WALL FACTOR; IF VERT = **2**; NON VERT = **1**
A = ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
Z_{BS} = BEND SCOUR IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND = **0**, BEND = **1**
HYD DEPTH = HYDRAULIC DEPTH IN FEET
E SLOPE = ENERGY SLOPE, UNITLESS
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I = LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H = BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-59 AND ASSOCIATED APPENDICES (APPENDIX C). VALUES FOR TOE-DOWN BASED ON THE CUT-OFF DEPTHS TABLE (PAGE F-31) IN THE LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF TOE-DOWN BETWEEN THE TWO METHODOLOGIES (Z_{MAX}). THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT-OFF DEPTH BASED ON FIGURE F-06 (PAGE F-37). LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR VALUES ARE INTERPOLATED FROM THE GENERAL DEGRADATION GRAPH IN APPENDIX C (PAGE C-3) OF THE LACDPW SEDIMENTATION MANUAL. BEND SCOUR AND LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON APPENDIX C (PAGES C-6 TO C-8) OF THE LACDPW SEDIMENTATION MANUAL. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON APPENDIX C-9 OF THE SEDIMENTATION MANUAL. THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY REVISION INCLUDES THE Z_{MAX} CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

LACDPW = LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES
OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

PACE
Advanced Water Engineering

TABLE H.8 - HASLEY CANYON EAST BANK PROTECTION PROJECT FOR STABLE SLOPE (NO RGC), Q_{100} AND n = 0.025
CALCULATIONS FOR TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Z_{TOT}	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	BANK PROT	Z_{LS}+ BANK	Z_{LS}+ BRIDGE	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_I+	H/2
4396	6.40	13.0	5.7	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	5.3	0.064	102.5	900	0.1	2.0	2.3
4300	6.48	23.5	5.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.4	0.266	67.6	900	0.0	2.0	2.5
4282	9.05	24.6	5.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.4	0.294	64.9	900	0.0	4.6	2.5
4276	7.28	7.2	9.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	8.3	0.011	116.7	0	0.0	4.6	0.7
4270	6.81	4.2	9.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	8.9	0.003	188.7	0	0.0	4.6	0.2
4265	4.90	8.2	5.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.027	175.1	0	0.0	2.0	0.9
4258	4.83	7.9	4.9	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.7	0.026	188.7	0	0.0	2.0	0.8
4176.36	5.63	1.5	29.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	21.5	0.000	222.1	0	0.0	3.6	0.0
4157	5.87	1.0	29.2	0.0	0.1	0	0.0	1	0.0	0	2.0	0.0	0	24.5	0.000	274.0	0	0.0	3.8	0.0
4055.5	15.76	4.6	29.8	0.0	0.7	0	0.0	1	0.0	0	2.0	0.0	1	5.4	0.009	282.4	300	8.3	4.5	0.3
3940.5	16.59	6.3	28.9	0.0	1.1	0	0.0	1	0.0	0	2.0	0.0	1	3.9	0.026	281.9	300	8.5	4.4	0.5
3844	7.67	5.5	27.6	0.0	0.9	0	0.0	1	0.0	0	2.0	0.0	0	4.6	0.016	281.2	0	0.0	4.4	0.4
3747	7.55	5.1	27.1	0.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.012	279.1	0	0.0	4.4	0.4
3650	8.57	8.9	24.9	0.0	1.8	0	0.0	1	0.0	0	2.0	0.0	0	4.7	0.044	168.3	0	0.0	3.7	1.1
3554	6.91	6.2	23.9	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	6.7	0.013	169.0	0	0.0	3.4	0.5
3440.5	6.70	6.5	23.0	0.0	1.1	0	0.0	1	0.0	0	2.0	0.0	0	5.7	0.018	188.3	0	0.0	3.0	0.6
3372	6.45	6.4	22.4	0.0	1.1	0	0.0	1	0.0	0	2.0	0.0	0	5.6	0.017	196.1	0	0.0	2.8	0.6
3304	5.94	5.2	22.1	0.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	5.0	0.012	270.9	0	0.0	2.8	0.4
3190.5	9.89	4.4	22.1	0.0	0.7	0	0.0	1	0.0	0	2.0	0.0	1	6.5	0.006	243.9	500	4.1	2.9	0.3
3105	10.63	5.2	22.0	0.0	0.8	0	0.0	1	0.0	0	2.0	0.0	1	5.3	0.011	254.7	500	4.3	3.1	0.4
3020	10.96	5.2	21.7	0.0	0.8	0	0.0	1	0.0	0	2.0	0.0	1	5.2	0.011	258.9	500	4.3	3.5	0.4
2934	8.43	9.3	19.7	0.0	1.9	0	0.0	1	0.0	0	2.0	0.0	0	5.1	0.039	147.3	0	0.0	3.4	1.2
2820.5	6.93	6.1	19.1	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	7.2	0.010	158.9	0	0.0	3.4	0.5
2748	6.91	5.9	18.9	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	5.8	0.013	206.5	0	0.0	3.5	0.5
2675.5	6.80	5.7	18.5	0.0	0.9	0	0.0	1	0.0	0	2.0	0.0	0	5.9	0.013	206.9	0	0.0	3.4	0.4
2560.5	7.48	8.4	16.4	0.0	1.6	0	0.0	1	0.0	0	2.0	0.0	0	3.3	0.052	250.5	0	0.0	2.9	0.9
2476	6.38	4.5	16.3	0.0	0.7	0	0.0	1	0.0	0	2.0	0.0	0	5.6	0.007	275.6	0	0.0	3.4	0.3
2391	7.22	6.2	15.7	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	4.6	0.018	244.2	0	0.0	3.7	0.5
2305.5	17.76	6.1	15.1	0.0	1.0	0.9	6.0	1	0.0	1	0.0	13.1	0	5.0	0.015	229.1	0	0.0	3.2	0.5
2190.5	18.73	7.2	13.6	0.0	1.3	0.9	6.0	1	0.0	1	0.0	13.9	0	4.5	0.025	213.9	0	0.0	2.8	0.7
2122	9.45	5.4	13.3	0.0	0.9	0	0.0	1	0.0	0	2.0	0.0	1	5.9	0.009	221.7	400	2.9	3.3	0.4
2054	10.34	9.6	11.3	0.0	2.0	0	0.0	1	0.0	0	2.0	0.0	1	3.4	0.064	215.8	400	2.7	2.5	1.2
1940.5	8.15	7.7	8.7	0.0	1.4	0	0.0	1	0.0	0	2.0	0.0	1	4.4	0.028	205.6	400	1.9	2.0	0.8
1872	5.74	6.6	8.1	0.0	1.1	0	0.0	1	0.0	0	2.0	0.0	0	7.5	0.011	140.5	0	0.0	2.0	0.6
1804	5.44	5.9	8.0	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	5.6	0.012	210.7	0	0.0	2.0	0.5
1688.62	5.47	6.0	7.4	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	5.0	0.014	236.9	0	0.0	2.0	0.5
1584	4.93	4.4	7.3	0.0	0.7	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.008	320.5	0	0.0	2.0	0.3
MAXIMUM=	18.7			0.0	2.0							13.9						8.5		2.5
MINIMUM=	4.8			0.0	0.0							0.0						0.0		0.0

DEFINITIONS

V(FPS) = VELOCITY IN FEET PER SECOND
Z_{TOT} = TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG} = LONG TERM DEGRADATION IN FEET
Z_{GS} = GENERAL SCOUR IN FEET
Z_{LS} = LOCAL SCOUR IN FEET [Z_{LS} **BANK** + Z_{LS} **BRIDGE**]
Z_{LS} **BRIDGE** = BRIDGE LOCAL SCOUR IN FEET [PIER (APP C-4) + ABUTMENT (APP C-6)]
Z_{LS} **BANK** = LEVEE/BANK LOCAL SCOUR = **2.0'** IF BANK PROTECTION PRESENT
BANK PROT = BANK PROTECTION ON CHANNEL BANK
0 = YES; **1** = NO
PIER TYPE = PIER SHAPE FACTOR; IF NO PIERS = **0**
1.0 = SQUARE NOSE; **0.9** = ROUND NOSE; **0.9** = CYLINDER;
0.8 = SHARP NOSE; **0.9** = GROUP OF CYLINDERS
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
B = WIDTH OF PIERS IN FEET; NO PIER = **0**
ABUT TYPE = VERT WALL FACTOR; IF VERT = **2**; NON VERT = **1**
A = ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
Z_{BS} = BEND SCOUR IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND = **0**, BEND = **1**
HYD DEPTH = HYDRAULIC DEPTH IN FEET
E SLOPE = ENERGY SLOPE, UNITLESS
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I = LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H = BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE SCOUR PROTECTION (TOE DOWN) BASED ON LACDPW COUNTY SEDIMENTATION MANUAL (2006) PAGES 51-59 AND ASSOCIATED APPENDICES (APPENDIX C). VALUES FOR TOE-DOWN BASED ON THE CUT-OFF DEPTHS TABLE (PAGE F-31) IN THE LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF TOE-DOWN BETWEEN THE TWO METHODOLOGIES (Z_{MAX}). THE CALCULATION DOES NOT CONSIDER ADJUSTMENTS TO CUT-OFF DEPTH BASED ON FIGURE F-06 (PAGE F-37). LONG TERM DEGRADATION IS USER SUPPLIED. GENERAL SCOUR VALUES ARE INTERPOLATED FROM THE GENERAL DEGRADATION GRAPH IN APPENDIX C (PAGE C-3) OF THE LACDPW SEDIMENTATION MANUAL. BEND SCOUR AND LOCAL SCOUR AT BENDS AND ABUTMENTS ARE BASED ON APPENDIX C (PAGES C-6 TO C-8) OF THE LACDPW SEDIMENTATION MANUAL. A LONGITUDINAL EXTENT BASED ON SECONDARY CURRENTS IS NOT INCLUDED. BEDFORM HEIGHT IS BASED ON APPENDIX C-9 OF THE SEDIMENTATION MANUAL. THE OCTOBER, 2005 REVISION INCLUDES ADDITIONAL TOEDOWN AT BRIDGES/ABUTMENTS WITH SOFT BOTTOMS. THE OCTOBER, 2006 REVISION INCLUDES BLOCKAGES AT BRIDGE PIERS. THE MAY REVISION INCLUDES THE Z_{MAX} CALCULATION AND UPDATES FOR THE 2006 SEDIMENTATION MANUAL.

LACDPW = LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

PACE
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TABLE H.9 - HASLEY CANYON WEST BANK PROTECTION PROJECT FOR STABLE SLOPE (NO RGC), Q_{100} AND n = 0.025
CALCULATIONS FOR TOTAL TOE-DOWN BY INDIVIDUAL ADJUSTMENT COMPONENT BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Z_{TOT}	V (FPS)	FLOW DEPTH (FT)	Z_{DEG}+	Z_{GS}+	PIER TYPE	B	ABUT TYPE	A	BANK PROT	Z_{LS}+ BANK	Z_{LS}+ BRIDGE	BEND COEFF	HYD DEPTH	E SLOPE	TOP WIDTH	RADIUS	Z_{BS}+	Z_I+	H/2
4396	6.29	13.0	5.7	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	5.3	0.064	102.5	0	0.0	2.0	2.3
4300	6.48	23.5	5.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.4	0.266	67.6	0	0.0	2.0	2.5
4282	9.05	24.6	5.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	0	4.4	0.294	64.9	0	0.0	4.6	2.5
4276	8.93	7.2	9.4	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	8.3	0.011	116.7	300	1.7	4.6	0.7
4270	8.97	4.2	9.6	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	8.9	0.003	188.7	300	2.2	4.6	0.2
4265	6.16	8.2	5.1	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.9	0.027	175.1	300	1.3	2.0	0.9
4258	4.26	3.8	0.5	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	4.7	0.026	188.7	300	0.1	2.0	0.2
4176.36	11.41	1.5	29.0	0.0	0.0	0	0.0	1	0.0	0	2.0	0.0	1	21.5	0.000	222.1	300	5.8	3.6	0.0
4157	12.01	1.0	29.2	0.0	0.1	0	0.0	1	0.0	0	2.0	0.0	1	24.5	0.000	274.0	300	6.1	3.8	0.0
4055.5	7.48	4.6	29.8	0.0	0.7	0	0.0	1	0.0	0	2.0	0.0	0	5.4	0.009	282.4	0	0.0	4.5	0.3
3940.5	8.05	6.3	28.9	0.0	1.1	0	0.0	1	0.0	0	2.0	0.0	0	3.9	0.026	281.9	0	0.0	4.4	0.5
3844	7.67	5.5	27.6	0.0	0.9	0	0.0	1	0.0	0	2.0	0.0	0	4.6	0.016	281.2	0	0.0	4.4	0.4
3747	7.55	5.1	27.1	0.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.012	279.1	0	0.0	4.4	0.4
3650	6.46	3.8	0.5	0.0	0.5	0	0.0	1	0.0	0	2.0	0.0	1	4.7	0.044	168.3	1000	0.0	3.7	0.2
3554	8.28	6.2	23.9	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	1	6.7	0.013	169.0	1000	1.4	3.4	0.5
3440.5	6.70	6.5	23.0	0.0	1.1	0	0.0	1	0.0	0	2.0	0.0	0	5.7	0.018	188.3	0	0.0	3.0	0.6
3372	6.45	6.4	22.4	0.0	1.1	0	0.0	1	0.0	0	2.0	0.0	0	5.6	0.017	196.1	0	0.0	2.8	0.6
3304	5.94	5.2	22.1	0.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	5.0	0.012	270.9	0	0.0	2.8	0.4
3190.5	5.82	4.4	22.1	0.0	0.7	0	0.0	1	0.0	0	2.0	0.0	0	6.5	0.006	243.9	0	0.0	2.9	0.3
3105	6.29	5.2	22.0	0.0	0.8	0	0.0	1	0.0	0	2.0	0.0	0	5.3	0.011	254.7	0	0.0	3.1	0.4
3020	6.21	3.8	0.5	0.0	0.5	0	0.0	1	0.0	0	2.0	0.0	0	5.2	0.011	258.9	0	0.0	3.5	0.2
2934	8.43	9.3	19.7	0.0	1.9	0	0.0	1	0.0	0	2.0	0.0	0	5.1	0.039	147.3	0	0.0	3.4	1.2
2820.5	6.93	6.1	19.1	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	7.2	0.010	158.9	0	0.0	3.4	0.5
2748	6.91	5.9	18.9	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	5.8	0.013	206.5	0	0.0	3.5	0.5
2675.5	9.86	5.7	18.5	0.0	0.9	0	0.0	1	0.0	0	2.0	0.0	1	5.9	0.013	206.9	500	3.1	3.4	0.4
2560.5	11.04	8.4	16.4	0.0	1.6	0	0.0	1	0.0	0	2.0	0.0	1	3.3	0.052	250.5	500	3.6	2.9	0.9
2476	9.71	4.5	16.3	0.0	0.7	0	0.0	1	0.0	0	2.0	0.0	1	5.6	0.007	275.6	500	3.3	3.4	0.3
2391	6.45	3.8	0.5	0.0	0.5	0	0.0	1	0.0	0	2.0	0.0	1	4.6	0.018	244.2	500	0.1	3.7	0.2
2305.5	17.76	6.1	15.1	0.0	1.0	0.9	6.0	1	0.0	1	0.0	13.1	0	5.0	0.015	229.1	0	0.0	3.2	0.5
2190.5	18.73	7.2	13.6	0.0	1.3	0.9	6.0	1	0.0	1	0.0	13.9	0	4.5	0.025	213.9	0	0.0	2.8	0.7
2122	6.58	5.4	13.3	0.0	0.9	0	0.0	1	0.0	0	2.0	0.0	0	5.9	0.009	221.7	0	0.0	3.3	0.4
2054	7.66	9.6	11.3	0.0	2.0	0	0.0	1	0.0	0	2.0	0.0	0	3.4	0.064	215.8	0	0.0	2.5	1.2
1940.5	6.23	7.7	8.7	0.0	1.4	0	0.0	1	0.0	0	2.0	0.0	0	4.4	0.028	205.6	0	0.0	2.0	0.8
1872	5.74	6.6	8.1	0.0	1.1	0	0.0	1	0.0	0	2.0	0.0	0	7.5	0.011	140.5	0	0.0	2.0	0.6
1804	4.73	3.8	0.5	0.0	0.5	0	0.0	1	0.0	0	2.0	0.0	0	5.6	0.012	210.7	0	0.0	2.0	0.2
1688.62	5.47	6.0	7.4	0.0	1.0	0	0.0	1	0.0	0	2.0	0.0	0	5.0	0.014	236.9	0	0.0	2.0	0.5
1584	4.93	4.4	7.3	0.0	0.7	0	0.0	1	0.0	0	2.0	0.0	0	4.9	0.008	320.5	0	0.0	2.0	0.3
MAXIMUM=	18.7			0.0	2.0							13.9						6.1		2.5
MINIMUM=	4.3			0.0	0.0							0.0						0.0		0.0

DEFINITIONS

V(FPS) = VELOCITY IN FEET PER SECOND
Z_{TOT} = TOTAL POTENTIAL VERTICAL ADJUSTMENT IN FEET
Z_{DEG} = LONG TERM DEGRADATION IN FEET
Z_{GS} = GENERAL SCOUR IN FEET
Z_{LS} = LOCAL SCOUR IN FEET [Z_{LS} **BANK** + Z_{LS} **BRIDGE**]
Z_{LS} **BRIDGE** = BRIDGE LOCAL SCOUR IN FEET [PIER (APP C-4) + ABUTMENT (APP C-6)]
Z_{LS} **BANK** = LEVEE/BANK LOCAL SCOUR = **2.0'** IF BANK PROTECTION PRESENT
BANK PROT = BANK PROTECTION ON CHANNEL BANK
0 = YES; **1** = NO
PIER TYPE = PIER SHAPE FACTOR; IF NO PIERS = **0**
1.0 = SQUARE NOSE; **0.9** = ROUND NOSE; **0.9** = CYLINDER;
0.8 = SHARP NOSE; **0.9** = GROUP OF CYLINDERS
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
B = WIDTH OF PIERS IN FEET; NO PIER = **0**
ABUT TYPE = VERT WALL FACTOR; IF VERT = **2**; NON VERT = **1**
A = ABUTMENT PROTRUSION INTO FLOW PATH IN FEET
Z_{BS} = BEND SCOUR IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND = **0**, BEND = **1**
HYD DEPTH = HYDRAULIC DEPTH IN FEET
E SLOPE = ENERGY SLOPE, UNITLESS
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
Z_I = LOW-FLOW INCISEMENT IN FEET, MEASURED OR 2'; VALUE **NOT LESS THAN 2'**
H = BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963)

GENERAL

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OUTPUT
DATA FROM HEC-RAS
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INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
OCTOBER, 2004
OCTOBER, 2005, REVISED
OCTOBER, 2006, REVISED
MAY, 2008, REVISED
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

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TABLE H.10 - HASLEY CANYON EAST BANK PROTECTION PROJECT FOR DESIGN SLOPE WITH Qcap AND n = 0.085
CALCULATIONS FOR FREEBOARD BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Y_{MAX}	Y_{TOT}	V (FPS)	FLOW DEPTH (FT)	Y_{AGG}+	Y_{GA}+	FROUDE NUMBER	CHANNEL TYPE	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	Y_{SE}+	BEND COEFF	SIDE SLOPE	RADIUS	H/2	Y_{DM}
4396	9.44	3.7	14.3	6.9	0.0	0.0	1.0	3.0	87.4	106.1	1.0	1	1.5	900	2.7	9.4
4300	14.02	3.0	25.7	6.0	0.0	0.0	2.0	3.0	55.0	70.7	0.0	0	1.5	0	3.0	14.0
4282	14.91	3.0	26.9	6.0	0.0	0.0	2.1	3.0	63.5	67.9	0.0	0	1.5	0	3.0	14.9
4276	2.50	0.7	7.4	12.0	0.0	0.0	0.4	2.0	101.8	124.5	0.0	0	1.5	0	0.7	2.5
4270	2.50	0.3	4.3	12.2	0.0	0.0	0.2	2.0	173.4	196.7	0.0	0	1.5	0	0.3	2.5
4265	2.50	0.6	6.7	8.2	0.0	0.0	0.4	2.0	162.2	184.3	0.0	0	1.5	0	0.6	2.5
4258	2.50	0.5	6.2	8.2	0.0	0.0	0.4	2.0	175.1	198.5	0.0	0	1.5	0	0.5	2.5
4157	2.50	1.7	3.7	9.6	0.0	1.5	0.2	2.0	256.3	281.9	0.0	0	1.5	0	0.2	2.5
4055.5	2.50	1.9	5.8	11.3	0.0	1.5	0.4	2.0	43.8	295.2	0.0	0	3.0	300	0.5	2.5
3940.5	2.50	2.1	7.0	11.6	0.0	1.5	0.6	2.0	34.3	294.3	0.0	0	3.0	300	0.7	2.5
3844	2.50	2.0	6.4	10.6	0.0	1.5	0.5	2.0	40.8	294.5	0.0	0	3.0	0	0.5	2.5
3747	2.50	1.9	5.9	10.2	0.0	1.5	0.4	2.0	129.0	292.9	0.0	0	3.0	0	0.5	2.5
3650	2.50	2.0	6.2	10.0	0.0	1.5	0.5	2.0	44.3	303.5	0.0	0	3.0	0	0.5	2.5
3554	2.50	2.2	7.5	8.8	0.0	1.5	0.6	2.0	112.8	263.2	0.0	0	3.0	0	0.8	2.5
3440.5	2.50	1.9	5.6	8.9	0.0	1.5	0.4	2.0	153.6	340.9	0.0	0	3.0	0	0.4	2.5
3372	2.50	2.1	6.9	7.8	0.0	1.5	0.6	2.0	133.0	323.2	0.0	0	3.0	0	0.6	2.5
3304	2.50	1.9	5.6	8.6	0.0	1.5	0.4	2.0	60.8	292.3	0.0	0	3.0	0	0.4	2.5
3190.5	2.50	2.1	5.4	9.1	0.0	1.5	0.4	2.0	131.5	264.9	0.2	1	3.0	500	0.4	2.5
3105	2.50	1.4	6.5	9.1	0.0	0.7	0.5	2.0	73.4	275.1	0.2	1	3.0	500	0.6	2.5
3020	2.50	1.3	5.9	9.3	0.0	0.7	0.4	2.0	94.3	286.1	0.2	1	3.0	500	0.5	2.5
2934	2.50	1.5	7.7	9.0	0.0	0.7	0.6	2.0	64.4	263.6	0.0	0	3.0	0	0.8	2.5
2820.5	2.50	1.4	7.2	8.2	0.0	0.7	0.6	2.0	144.9	274.8	0.0	0	3.0	0	0.7	2.5
2748	2.50	1.2	6.3	8.5	0.0	0.7	0.5	2.0	146.8	293.0	0.0	0	3.0	0	0.5	2.5
2675.5	2.50	1.3	6.8	7.9	0.0	0.7	0.6	2.0	119.5	300.7	0.0	0	3.0	0	0.6	2.5
2560.5	2.50	1.3	7.0	7.9	0.0	0.7	0.6	2.0	101.7	295.4	0.0	0	3.0	0	0.7	2.5
2476	2.50	1.1	5.4	8.4	0.0	0.7	0.4	2.0	113.3	292.5	0.0	0	3.0	0	0.4	2.5
2391	2.50	1.1	5.8	8.4	0.0	0.7	0.4	2.0	88.3	263.5	0.0	0	3.0	0	0.4	2.5
2305.5	2.50	1.0	5.1	9.7	0.0	0.7	0.3	2.0	192.8	252.4	0.0	0	3.0	0	0.4	2.5
2190.5	2.50	1.4	7.3	7.7	0.0	0.7	0.5	2.0	89.5	227.9	0.0	0	3.0	0	0.7	2.5
2122	2.50	1.7	7.4	8.2	0.0	0.7	0.6	2.0	72.2	232.4	0.3	1	3.0	400	0.7	2.5
2054	2.50	1.8	7.3	7.8	0.0	0.7	0.6	2.0	119.8	233.8	0.4	1	3.0	400	0.7	2.5
1940.5	2.50	1.6	6.6	7.8	0.0	0.7	0.5	2.0	154.6	236.0	0.4	1	3.0	400	0.6	2.5
1872	2.50	1.5	8.0	6.7	0.0	0.7	0.6	2.0	134.9	234.2	0.0	0	3.0	0	0.9	2.5
1804	2.50	1.4	7.3	6.7	0.0	0.7	0.6	2.0	164.6	233.8	0.0	0	3.0	0	0.7	2.5
1688.62	2.50	1.1	5.5	7.8	0.0	0.7	0.4	2.0	144.9	262.7	0.0	0	3.0	0	0.4	2.5
1584	2.50	0.8	3.3	10.1	0.0	0.7	0.2	2.0	283.6	401.3	0.0	0	3.0	0	0.1	2.5
MAX=	14.9	3.7									1.0				3.0	14.9
MIN=	2.5	0.3									0.0				0.1	2.5

DEFINITIONS

Y_{MAX} = MAXIMUM EMBANKMENT PROTECTION (FREEBOARD) VALUE IN FEET BETWEEN LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL
Y_{TOT} = TOTAL EMBANKMENT PROTECTION (FREEBOARD) IN FEET BASED ON THE LACDPW SEDIMENTATION MANUAL
V(FPS) = VELOCITY IN FEET PER SECOND
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
Y_{AGG} = LONG TERM AGGRADATION IN FEET
Y_{GA} = GENERAL AGGRADATION IN FEET
CHANNEL TYPE = CHANNEL SHAPE/FLOW FACTOR:
IF Fr < 1, RECTANGULAR = **0**; IF Fr > 1, RECTANGULAR = **1**;
IF Fr < 1, TRAPEZOIDAL = **2**; IF Fr > 1, TRAPEZOIDAL = **3**.
BOTTOM WIDTH = CHANNEL BOTTOM WIDTH IN FEET, LOW FLOW WATER SURFACE WIDTH
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
Y_{SE} = SUPER ELEVATION IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND=**0**, BEND=**1**
SIDE SLOPE = CHANNEL SIDE SLOPE (H:V), UNITLESS
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
H/2 = HALF BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH, AFTER KENNEDY (1963)
Y_{DM} = EMBANKMENT PROTECTION (FREEBOARD) IN FEET REQUIRED BY THE LACFCD HYDRAULIC DESIGN MANUAL

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE EMBANKMENT PROTECTION (FREEBOARD) BASED ON THE LACDPW SEDIMENTATION MANUAL (2006), PAGES 59-60 AND ASSOCIATED APPENDICES. FREEBOARD VALUES BASED ON LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF FREEBOARD BETWEEN THE TWO METHODOLOGIES (Y_{MAX}). ALL VELOCITIES ARE IN FEET PER SECOND (FPS), WITH NO MAXIMUM VALUE. THE USER SHOULD CONSIDER A PRACTICAL MAXIMUM VELOCITY OF APPROXIMATELY 20 TO 30 FPS. LONG TERM AGGRADATION IS USER SUPPLIED. GENERAL AGGRADATION IS ALSO USER SUPPLIED. SUPER ELEVATION AT BENDS IS BASED ON EQUATIONS IN SECTION C-3.1 (PAGE C-10) OF THE LACFCD HYDRAULIC DESIGN MANUAL. BEDFORM HEIGHT, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963), IS BASED ON EQUATIONS IN APPENDIX C OF THE LACDPW SEDIMENTATION MANUAL. IF FLOW IS SUPERCRITICAL, SPREADSHEET REPORTS LACFCD HYDRAULIC DESIGN MANUAL TOTAL WALL HEIGHT INSTEAD OF FREEBOARD. BOTTOM WIDTH IS BASED ON THE 2-YEAR WATER SURFACE WIDTH AFTER U.S. ARMY CORPS OF ENGINEERS PROCEDURES.

LACDPW = LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
LACFCD = LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COLOR CODES

OUTPUT
DATA FROM HEC-RAS
USER SUPPLIED DATA
INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
AUGUST, 2005
FEBRUARY, 2009, REVISED
FEBRUARY, 2014, REVISED

TABLE H.11 - HASLEY CANYON WEST BANK PROTECTION PROJECT FOR DESIGN SLOPE WITH Qcap AND n = 0.085
CALCULATIONS FOR FREEBOARD BASED ON LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL

SECTION	Y_{MAX}	Y_{TOT}	V (FPS)	FLOW DEPTH (FT)	Y_{AGG}+	Y_{GA}+	FROUDE NUMBER	CHANNEL TYPE	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	Y_{SE}+	BEND COEFF	SIDE SLOPE	RADIUS	H/2	Y_{DM}
4396	9.44	2.7	14.3	6.9	0.0	0.0	1.0	3.0	87.4	106.1	0.0	0	1.5	0	2.7	9.4
4300	14.02	9.5	25.7	6.0	0.0	0.0	2.0	3.0	55.0	70.7	6.5	1	1.5	300	3.0	14.0
4282	14.92	10.9	26.9	6.0	0.0	0.0	2.1	3.0	63.5	67.9	7.9	1	1.5	300	3.0	14.9
4276	2.50	1.2	7.4	12.0	0.0	0.0	0.4	2.0	101.8	124.5	0.4	1	1.5	300	0.7	2.5
4270	2.50	0.5	4.3	12.2	0.0	0.0	0.2	2.0	173.4	196.7	0.2	1	1.5	300	0.3	2.5
4265	2.50	1.1	6.7	8.2	0.0	0.0	0.4	2.0	162.2	184.3	0.5	1	1.5	300	0.6	2.5
4258	2.50	1.0	6.2	8.2	0.0	0.0	0.4	2.0	175.1	198.5	0.5	1	1.5	300	0.5	2.5
4157	2.50	1.9	3.7	9.6	0.0	1.5	0.2	2.0	256.3	281.9	0.2	1	1.5	300	0.2	2.5
4055.5	2.50	1.9	5.8	11.3	0.0	1.5	0.4	2.0	43.8	295.2	0.0	0	3.0	0	0.5	2.5
3940.5	2.50	2.1	7.0	11.6	0.0	1.5	0.6	2.0	34.3	294.3	0.0	0	3.0	0	0.7	2.5
3844	2.50	2.0	6.4	10.6	0.0	1.5	0.5	2.0	40.8	294.5	0.0	0	3.0	0	0.5	2.5
3747	2.50	1.9	5.9	10.2	0.0	1.5	0.4	2.0	129.0	292.9	0.0	0	3.0	0	0.5	2.5
3650	2.50	2.1	6.2	10.0	0.0	1.5	0.5	2.0	44.3	303.5	0.1	1	3.0	1000	0.5	2.5
3554	2.50	2.4	7.5	8.8	0.0	1.5	0.6	2.0	112.8	263.2	0.2	1	3.0	1000	0.8	2.5
3440.5	2.50	1.9	5.6	8.9	0.0	1.5	0.4	2.0	153.6	340.9	0.0	0	3.0	0	0.4	2.5
3372	2.50	2.1	6.9	7.8	0.0	1.5	0.6	2.0	133.0	323.2	0.0	0	3.0	0	0.6	2.5
3304	2.50	1.9	5.6	8.6	0.0	1.5	0.4	2.0	60.8	292.3	0.0	0	3.0	0	0.4	2.5
3190.5	2.50	1.9	5.4	9.1	0.0	1.5	0.4	2.0	131.5	264.9	0.0	0	3.0	0	0.4	2.5
3105	2.50	1.2	6.5	9.1	0.0	0.7	0.5	2.0	73.4	275.1	0.0	0	3.0	0	0.6	2.5
3020	2.50	1.1	5.9	9.3	0.0	0.7	0.4	2.0	94.3	286.1	0.0	0	3.0	0	0.5	2.5
2934	2.50	1.5	7.7	9.0	0.0	0.7	0.6	2.0	64.4	263.6	0.0	0	3.0	0	0.8	2.5
2820.5	2.50	1.4	7.2	8.2	0.0	0.7	0.6	2.0	144.9	274.8	0.0	0	3.0	0	0.7	2.5
2748	2.50	1.2	6.3	8.5	0.0	0.7	0.5	2.0	146.8	293.0	0.0	0	3.0	0	0.5	2.5
2675.5	2.50	1.6	6.8	7.9	0.0	0.7	0.6	2.0	119.5	300.7	0.3	1	3.0	500	0.6	2.5
2560.5	2.50	1.6	7.0	7.9	0.0	0.7	0.6	2.0	101.7	295.4	0.3	1	3.0	500	0.7	2.5
2476	2.50	1.2	5.4	8.4	0.0	0.7	0.4	2.0	113.3	292.5	0.2	1	3.0	500	0.4	2.5
2391	2.50	1.3	5.8	8.4	0.0	0.7	0.4	2.0	88.3	263.5	0.2	1	3.0	500	0.4	2.5
2305.5	2.50	1.0	5.1	9.7	0.0	0.7	0.3	2.0	192.8	252.4	0.0	0	3.0	0	0.4	2.5
2190.5	2.50	1.4	7.3	7.7	0.0	0.7	0.5	2.0	89.5	227.9	0.0	0	3.0	0	0.7	2.5
2122	2.50	1.4	7.4	8.2	0.0	0.7	0.6	2.0	72.2	232.4	0.0	0	3.0	0	0.7	2.5
2054	2.50	1.4	7.3	7.8	0.0	0.7	0.6	2.0	119.8	233.8	0.0	0	3.0	0	0.7	2.5
1940.5	2.50	1.3	6.6	7.8	0.0	0.7	0.5	2.0	154.6	236.0	0.0	0	3.0	0	0.6	2.5
1872	2.50	1.5	8.0	6.7	0.0	0.7	0.6	2.0	134.9	234.2	0.0	0	3.0	0	0.9	2.5
1804	2.50	1.4	7.3	6.7	0.0	0.7	0.6	2.0	164.6	233.8	0.0	0	3.0	0	0.7	2.5
1688.62	2.50	1.1	5.5	7.8	0.0	0.7	0.4	2.0	144.9	262.7	0.0	0	3.0	0	0.4	2.5
1584	2.50	0.8	3.3	10.1	0.0	0.7	0.2	2.0	283.6	401.3	0.0	0	3.0	0	0.1	2.5
1518	2.50	0.7	6.1	8.9	0.0	0.7	0.4	2.0	134.6	234.0	0.0	0	3.0	0	0.0	2.5
1448	2.50	0.7	8.5	7.7	0.0	0.7	0.6	2.0	151.3	160.6	0.0	0	3.0	0	0.0	2.5
MAX=	14.9	10.9									7.9				3.0	14.9
MIN=	2.5	0.5									0.0				0.1	2.5

DEFINITIONS

Y_{MAX} = MAXIMUM EMBANKMENT PROTECTION (FREEBOARD) VALUE IN FEET BETWEEN LACDPW SEDIMENTATION MANUAL AND LACFCD HYDRAULIC DESIGN MANUAL
Y_{TOT} = TOTAL EMBANKMENT PROTECTION (FREEBOARD) IN FEET BASED ON THE LACDPW SEDIMENTATION MANUAL
V(FPS) = VELOCITY IN FEET PER SECOND
FLOW DEPTH = WATER DEPTH IN CHANNEL IN FEET
Y_{AGG} = LONG TERM AGGRADATION IN FEET
Y_{GA} = GENERAL AGGRADATION IN FEET
CHANNEL TYPE = CHANNEL SHAPE/FLOW FACTOR:
IF Fr < 1, RECTANGULAR = **0**; IF Fr > 1, RECTANGULAR = **1**;
IF Fr < 1, TRAPEZOIDAL = **2**; IF Fr > 1, TRAPEZOIDAL = **3**.
BOTTOM WIDTH = CHANNEL BOTTOM WIDTH IN FEET, LOW FLOW WATER SURFACE WIDTH
TOP WIDTH = CHANNEL TOP WIDTH IN FEET
Y_{SE} = SUPER ELEVATION IN FEET
BEND COEFF = BEND COEFFICIENT; IF NO BEND=**0**, BEND=**1**
SIDE SLOPE = CHANNEL SIDE SLOPE (H:V), UNITLESS
RADIUS = RADIUS OF CURVATURE TO CENTERLINE IN FEET
H/2 = HALF BEDFORM HEIGHT IN FEET, LIMITED TO FLOW DEPTH, AFTER KENNEDY (1963)
Y_{DM} = EMBANKMENT PROTECTION (FREEBOARD) IN FEET REQUIRED BY THE LACFCD HYDRAULIC DESIGN MANUAL

GENERAL

THIS SPREADSHEET IS DESIGNED TO CALCULATE EMBANKMENT PROTECTION (FREEBOARD) BASED ON THE LACDPW SEDIMENTATION MANUAL (2006), PAGES 59-60 AND ASSOCIATED APPENDICES. FREEBOARD VALUES BASED ON LACFCD HYDRAULIC DESIGN MANUAL ARE PRESENTED AS PART OF THE CALCULATIONS FOR COMPARISON. THE SPREADSHEET DETERMINES THE GREATER VALUE OF FREEBOARD BETWEEN THE TWO METHODOLOGIES (Y_{MAX}). ALL VELOCITIES ARE IN FEET PER SECOND (FPS), WITH NO MAXIMUM VALUE. THE USER SHOULD CONSIDER A PRACTICAL MAXIMUM VELOCITY OF APPROXIMATELY 20 TO 30 FPS. LONG TERM AGGRADATION IS USER SUPPLIED. GENERAL AGGRADATION IS ALSO USER SUPPLIED. SUPER ELEVATION AT BENDS IS BASED ON EQUATIONS IN SECTION C-3.1 (PAGE C-10) OF THE LACFCD HYDRAULIC DESIGN MANUAL. BEDFORM HEIGHT, LIMITED TO FLOW DEPTH AFTER KENNEDY (1963), IS BASED ON EQUATIONS IN APPENDIX C OF THE LACDPW SEDIMENTATION MANUAL. IF FLOW IS SUPERCRITICAL, SPREADSHEET REPORTS LACFCD HYDRAULIC DESIGN MANUAL TOTAL WALL HEIGHT INSTEAD OF FREEBOARD. BOTTOM WIDTH IS BASED ON THE 2-YEAR WATER SURFACE WIDTH AFTER U.S. ARMY CORPS OF ENGINEERS PROCEDURES.

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OUTPUT
DATA FROM HEC-RAS
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INTERMEDIATE CALCULATIONS (INDIVIDUAL SHEETS ONLY)

DESIGNED BY DAVID A JAFFE, PHD, PE
PACIFIC ADVANCED CIVIL ENGINEERING, INC
AUGUST, 2005
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FEBRUARY, 2014, REVISED

PACE
Advanced Water Engineering

Full Depth Soil Cement Top of Bank and Toe of Bank Elevations

The profiles for the bank top and bank toe are shown on **Figures H.2 and H.3**. The top of bank and toe of bank elevations were initially set using the final design elevations presented in **Table H.3** and **Table H.5**. The bank top and toe elevations were then modified to eliminate numerous changes in grade along the top of the proposed bank protection. Grade break locations were sent so the top of bank elevations satisfied the freeboard requirements. **Tables H.12 and H.13** list the top and toe soil cement bank protection elevations.

Table H.12 - Hasley Canyon Creek "East" Full Depth Soil Cement Bank Protection Top and Toe Elevations

HEC-RAS River Station	Bank Station (ft)	Final Design Top Elevation (ft)	Actual Top Elevation[1] (ft)	Final Design Toe Elevation (ft)	Actual Toe Elevation[2] (ft)	Bank Height[3] (ft)
End Toe SC	40+30.45	-	**-**	-	**1044.65**	-
End Top SC	40+29.97	-	-	-	1044.65	-
-	40+15.89	-	-	-	1044.62	-
-	40+05.82	-	-	-	1044.60	-
-	40+02.98	-	-	-	1044.60	-
4396	39+91.02	1075.83	**1071.06***	-	**1044.45**	26.5
4300	39+29.98	1059.45	1064.95	-	1028.71	20.5
-	39+13.09	1054.73	1063.27	-	**1024.45**	38.8
4282	39+11.65	1054.33	1063.12	-	1024.45	38.7
4276	38+74.34	1047.99	1059.39	-	1024.45	34.9
4270	38+43.10	1048.18	1056.26	-	1024.45	31.8
4265	38+32.25	1047.68	1055.18	-	1024.45	30.7
4258	38+20.42	1047.67	1054.00	-	1024.45	29.6
-	38+17.27	1047.67	1053.68	-	**1024.45**	29.2
-	38+01.37	1047.67	**1052.09**	-	1016.50	35.6
-	37+93.84	1047.67	1052.01	-	**1012.73**	39.3
-	37+73.40	1047.68	1051.78	-	**1002.59**	49.2
-	37+51.07	1047.68	1051.53	-	1001.41	50.1
4157	37+48.37	1047.68	1051.50	1007.49	1001.26	50.2
4055.5	36+60.38	1046.83	1050.53	996.69	**996.60**	53.9
-	35+53.94	1045.11	1049.34	995.10	995.00	54.3
3940.5	35+53.64	1045.11	**1049.34**	995.10	**995.00**	54.3
3844	34+26.58	1043.08	1047.17	1003.09	**1000.27**	46.9
3747	33+25.47	1041.86	1045.45	1002.44	1000.27	45.2
3650	32+40.49	1040.50	1044.00	1000.63	**1000.27**	43.7
3554	31+63.21	1038.33	1042.68	1001.49	999.42	43.3
3440.5	30+45.90	1036.73	1040.68	1000.46	**998.12**	42.6
3372	29+63.35	1035.30	1039.27	1000.46	**998.12**	41.2
3304	28+84.58	1034.58	1037.93	997.78	996.96	41.0
3190.5	27+60.89	1033.62	1035.82	995.60	**995.14**	40.7
3105	26+56.85	1032.60	1034.05	994.26	994.20	39.8
3020	25+44.48	1031.49	**1032.13**	993.22	**993.18**	39.0
-	25+22.44	1031.05	1031.56	993.67	993.62	37.9
2934	24+53.29	1029.65	1029.89	995.07	**994.99**	34.9
2820.5	23+39.34	1027.09	**1027.09**	995.66	**994.99**	32.1
-	23+17.17	1026.65	1026.73		994.70	32.0

HEC-RAS River Station	Bank Station (ft)	Final Design Top Elevation (ft)	Actual Top Elevation[1] (ft)	Final Design Toe Elevation (ft)	Actual Toe Elevation[2] (ft)	Bank Height[3] (ft)
2748	22+82.85	1025.97	1026.16	994.69	994.26	31.9
2675.5	22+15.00	1024.38	1025.04	993.66	**993.38**	31.7
2560.5	21+36.58	1022.42	1023.75	992.94	992.84	30.9
2476	20+70.49	1021.41	1022.67	992.41	992.39	30.3
2391	20+00.15	1020.56	1021.51	991.94	**991.91**	29.6
2305.5	19+14.24	1020.09	1020.09	980.82	**977.60**	42.5
2190.5	18+09.13	1016.22	1018.36	977.64	**977.60**	40.8
2122	17+41.40	1014.69	1017.25	986.62	**986.10**	31.2
2054	16+40.43	1013.30	1015.59	986.16	986.10	29.5
1940.5	15+36.82	1012.04	**1013.88**	986.53	986.10	27.8
1872	14+22.46	1010.19	1011.95	988.10	986.10	25.9
1804	13+50.46	1008.89	1010.73	987.41	986.10	24.6
1688.62	12+34.30	1007.78	**1008.77**	986.59	**986.10**	22.7
-	11+62.29	1007.69	1008.16	986.77	984.10	24.1
1584	10+97.28	1007.61	1007.61	986.94	982.30	25.3
Begin Top/Toe SC	10+00.00	-	**1006.79**	-	**979.60**	27.2

Notes:

*1. Actual Top Elevation values shown in **bold** font indicate Grade Break locations as shown on **Figure H.2.***
*2. Actual Toe Elevation values shown in **bold** font indicate Grade Break locations as shown on **Figure H.2**.*
3. Bank Height is the difference of the Actual Top Elevation and the Actual Toe Elevation.
** The Actual Top Elevation is lower than the Design Top Elevation because the soil cement is tying into the existing concrete lining (P.D. 2262).*

Table H.13 - Hasley Canyon Creek "West" Full Depth Soil Cement Bank Protection Top and Toe Elevations

HEC-RAS River Station	Bank Station (ft)	Final Design Top Elevation (ft)	Actual Top Elevation[1] (ft)	Final Design Toe Elevation (ft)	Actual Toe Elevation[2] (ft)	Bank Height (ft)
End Toe SC	40+27.04	-	**-**	-	**1044.66**	-
4396/**End Top SC**	39+89.01	1075.83	**1071.09**	-	**1044.45**	26.6
4300	39+27.91	1059.45	1064.98	-	1029.04	35.9
-	39+09.69	1054.71	1063.16	-	**1024.45**	38.7
4282	39+08.28	1054.34	1063.02	-	1024.45	38.6
4276	38+65.51	1047.97	1058.74	-	1024.45	34.3
	38+08.15	1048.18	**1053.00**		1024.45	28.6
4270	38+07.80	1048.18	1053.00	-	1024.45	28.6
4265	37+97.72	1047.68	1052.89	-	1024.45	28.4
4258	37+85.91	1047.68	1052.76	-	1024.45	28.3
-	37+82.74	1047.68	1052.72	-	**1024.45**	28.3
-	37+56.67	1047.68	1052.43	-	1011.50	40.9
-	37+53.07	1047.68	1052.39	-	1009.71	42.7
	37+36.09	1047.68	1052.21	-	**1001.27**	50.9
-	37+16.27	1047.68	1051.99	-	1001.27	50.7
4157	37+09.64	1047.68	1051.92	1001.35	1001.27	50.7
4055.5	35+63.04	1046.83	1050.30	1004.47	**1001.27**	49.0
3940.5	34+77.22	1045.11	**1049.36**	1003.63	1001.06	48.3

HEC-RAS River Station	Bank Station (ft)	Final Design Top Elevation (ft)	Actual Top Elevation[1] (ft)	Final Design Toe Elevation (ft)	Actual Toe Elevation[2] (ft)	Bank Height (ft)
-	34+70.32	1044.98	1049.24	1003.45	1001.04	48.2
3844	33+70.62	1043.08	1047.50	1000.91	**1000.80**	46.7
3747	32+79.01	1041.86	1045.90	1000.43	999.93	46.0
3650	31+64.34	1040.50	1043.89	998.96	**998.85**	45.0
3554	30+37.39	1038.33	1041.68	998.84	998.35	43.3
3440.5	29+23.41	1036.73	1039.68	998.20	997.90	41.8
3372	28+60.84	1035.30	1038.59	998.41	997.66	40.9
3304	28+08.81	1034.58	1037.68	997.57	**997.45**	40.2
-	27+71.46	1034.16	1037.03	997.79	997.45	39.6
-	27+23.42	1033.82	1036.19	998.06	997.45	38.7
3190.5	27+01.61	1033.62	1035.81	998.19	**997.45**	38.4
3105	26+53.53	1032.60	1034.97	998.13	996.86	38.1
3020	25+83.13	1031.49	1033.74	996.17	995.99	37.8
2934	25+02.70	1029.65	1032.33	995.07	**994.99**	37.3
2820.5	23+87.44	1027.09	1030.32	995.17	**994.85**	35.5
2748	23+00.00	1025.97	1028.79	994.69	993.28	35.5
2675.5	21+95.89	1024.38	1026.97	991.47	991.40	35.6
2560.5	20+87.57	1022.42	1025.08	989.55	**989.45**	35.6
2476	19+64.82	1021.41	1022.94	990.13	989.45	33.5
2391	18+61.46	1020.56	1021.13	989.94	**989.45**	31.7
2305.5	18+01.98	1020.09	**1020.09**	980.82	**977.60**	42.5
2190.5	16+83.64	1016.22	1017.98	977.64	**977.60**	40.4
2122	15+77.90	1014.69	1016.10	989.14	**989.02**	27.1
2054	15+24.32	1013.30	1015.14	988.76	988.56	26.6
1940.5	14+47.40	1012.04	**1013.77**	988.42	987.90	25.9
-	14+46.23	1011.91	1013.75	988.41	987.89	25.9
1872	13+93.42	1010.19	1013.00	988.10	987.43	25.6
-	13+73.52	1009.78	1012.71	987.88	**987.26**	25.5
1804	13+30.05	1008.89	1012.09	987.41	**986.89**	25.2
1688.62	12+13.58	1007.78	1010.42	986.59	**986.49**	23.9
1584	11+45.70	1007.61	1009.45	986.94	982.30	27.2
Begin Toe of SC	11+02.71	1006.56	1008.83	984.66	979.65	29.2
1518	10+95.52	1006.38	1008.73	984.28	-	-
1448	10+55.11	1003.86	1008.15	986.91	-	-
Begin Top of SC	10+44.81	-	**1008.00**	-	**-**	-

Notes:

*1. Actual Top Elevation values shown in **bold** font indicate Grade Break locations shown on **Figure H.3**.*
*2. Actual Toe Elevation values shown in **bold** font indicate Grade Break locations as shown on **Figure H.3**.*
3. Bank Height is the difference of the Actual Top Elevation and the Actual Toe Elevation.
** The Top of Bank ties in with the existing Hasley Creek Concrete Riprap Lining (P.D. 2298 Unit III). The Top of Bank Elevations are lower than the final design elevations in these locations due to their proximity to the tie-in with the existing Hasley Creek Concrete Riprap Lining (P.D. 2298 Unit III).*

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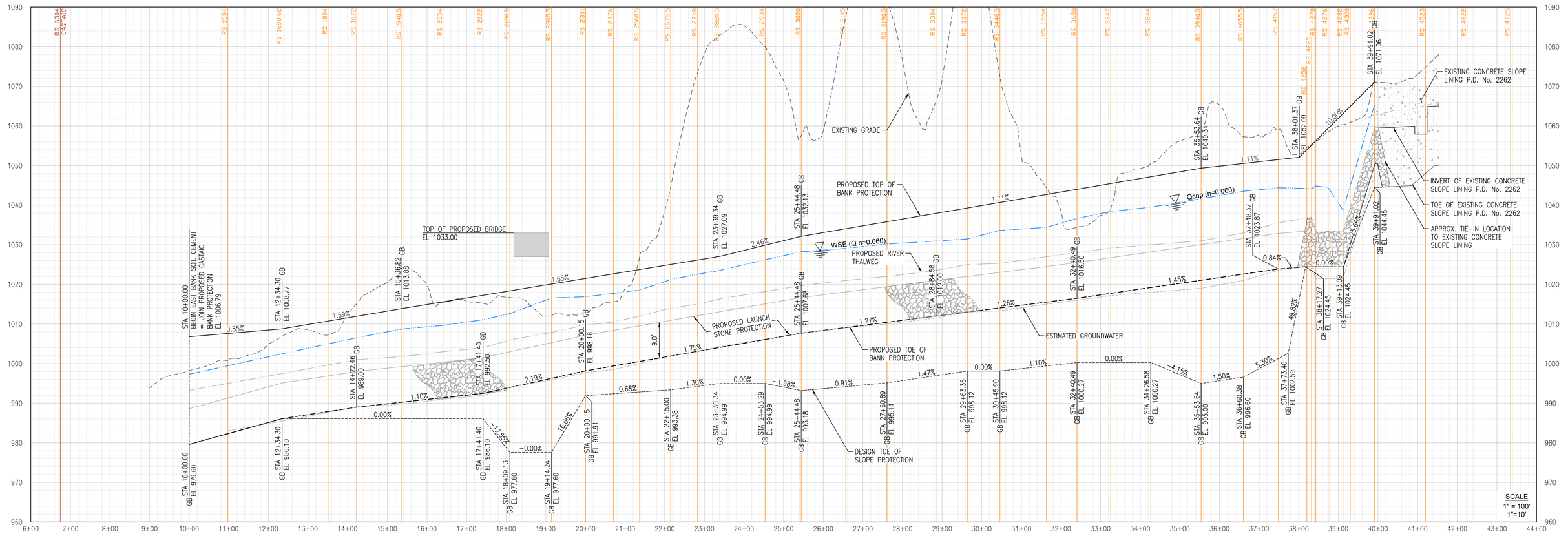
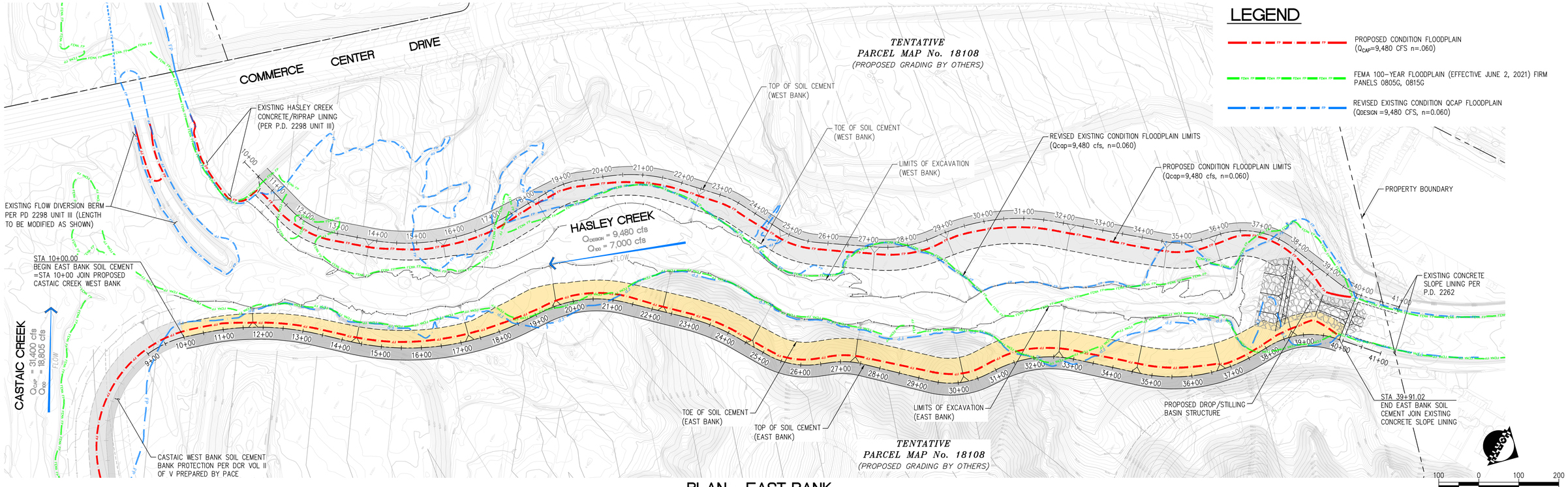


PROFILE - EAST BANK



PLAN - EAST BANK

NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK

SOIL CEMENT BANK PROTECTION

TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

PACE
Advanced Water Engineering
17520 Newhope Street, Suite 200 | Fountain Valley, CA 92708
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PREPARED JOSE CRUZ
PROJECT ENGINEER
R.C.E. No. 72249
EXP. 06/30/2022
DRAWN BDP | SCALE AS SHOWN
DESIGNED JC
CHECKED MEK | DATE 7/19/2021

REGISTERED PROFESSIONAL ENGINEER JOSE CRUZ No. 72249 Exp. 06-30-22 CIVIL STATE OF CALIFORNIA

TITLE

EAST BANK PROTECTION PLAN AND PROFILE

EIMP. 20190000489

FIGURE H.2

JOB NO. A535

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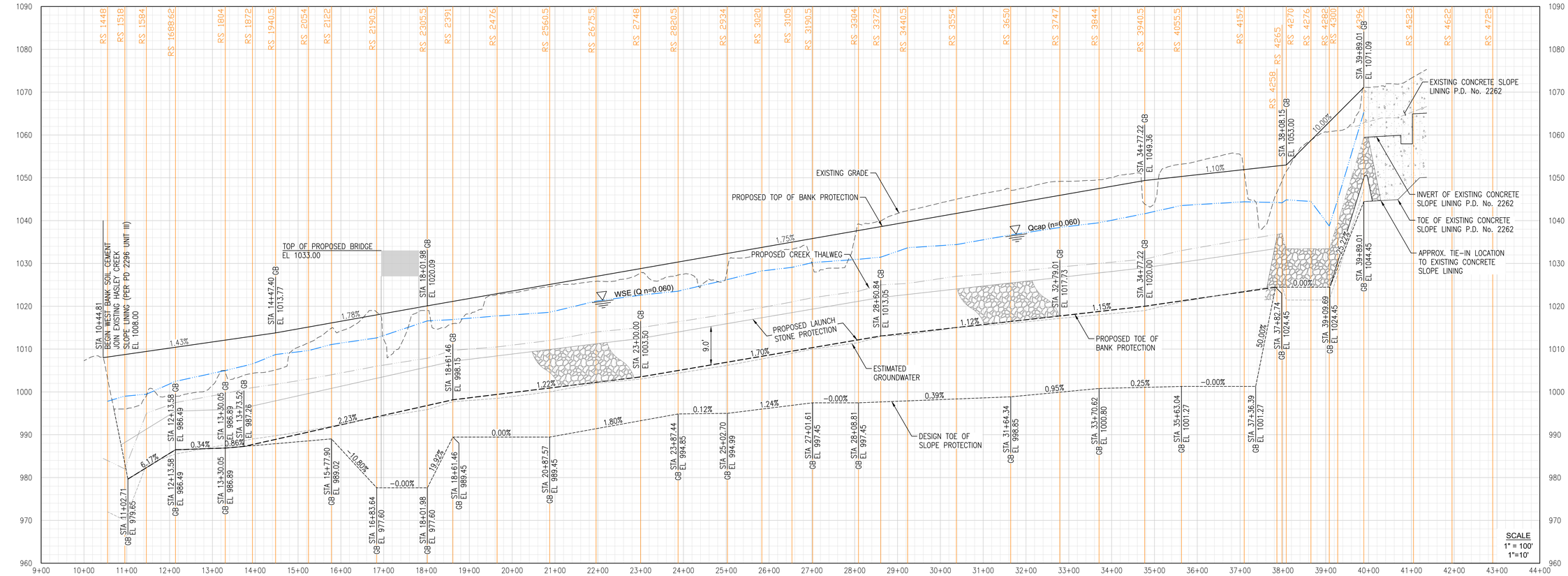
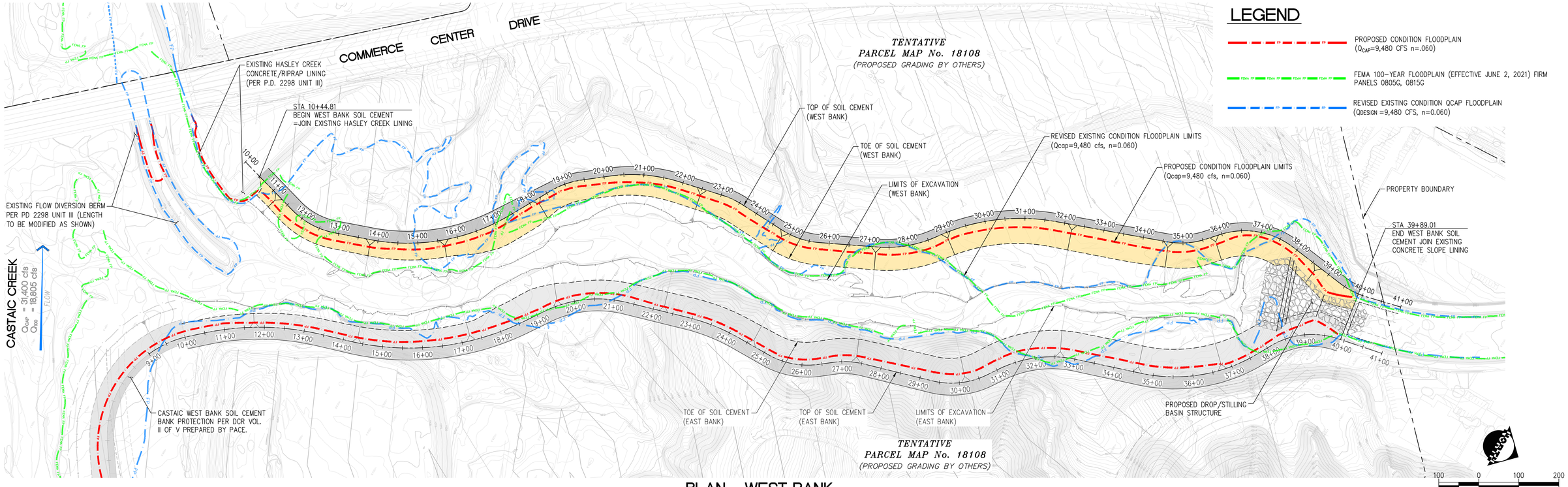


PROFILE - WEST BANK



PLAN - WEST BANK

NO	BY	DATE		DATE	APP.

JOB

HASLEY CREEK
SOIL CEMENT BANK PROTECTION
TPM. #18108 DCR VOL. III OF V

LOS ANGELES COUNTY CA.

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PREPARED	JOSE CRUZ
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EXP.	06/30/2022
DRAWN	BDP
SCALE	AS SHOWN
DESIGNED	JC
CHECKED	MEK
DATE	7/19/2021

REGISTERED PROFESSIONAL ENGINEER JOSE CRUZ No. 72249 Exp. 06-30-22 CIVIL STATE OF CALIFORNIA

TITLE

WEST BANK PROTECTION PLAN AND PROFILE

EIMP. 20190000489

FIGURE H.3

JOB NO. A535

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Design of Launch Stone Protection

The alternative design results in lower toe of bank elevations, which may be lower than the groundwater elevation. To avoid significant costs associated with dewatering, launch stone could be used to raise the toe of bank. The assumed groundwater level (12 feet below the minimum channel elevation) used for the launch stone design calculations is based on the most current available data. However, groundwater levels fluctuate, so the need for launch stone will be determined at the time of construction

As discussed at the beginning of this appendix, it will be determined whether the use of launch stone is warranted at the time of construction. Preliminary launch stone design calculations are presented in this section. However, groundwater levels are uncertain, and launch stone may not be necessary if the water table is much deeper than the proposed toe of bank elevation discussed in **Section 5**. If the groundwater level is above the toe of the proposed bank protection during construction, launch stone (rip-rap apron) may be utilized in conjunction with soil cement bank protection to provide the necessary level of flood and erosion protection for the VCC Industrial Park project site. The use of launch stone is an alternative to traditional river bank protection construction in cases where the presence of high groundwater may prevent soil cement from being installed to the required cut-off depth without dewatering. An apron of launch stone will be placed adjacent to the face of soil cement bank and is designed to replace the volume of soil cement not placed due to high groundwater encountered during construction.

Required Volume of Launch Stone

The procedure for designing the launch stone apron begins with determining the minimum required volume of rip-rap material. The required volume of rip-rap is calculated based on the volume of soil cement not placed due to high groundwater (assumed to be approximately 12-ft below the creek thalweg elevation) encountered during construction. This unit volume is determined at each cross-section using the groundwater elevation and the design toe of bank elevation. The required volume of launch stone is equivalent to 2.2 times the unit volume of soil cement not placed below the groundwater level. In accordance with LACDPW requirements, the design toe of bank protection is based on the required cut-off depth, which is calculated using velocity results from the HEC-RAS model using Capital Flood (Q_{CAP}) discharge, a minimum roughness value of 0.025 and a mixed flow regime.

Dimensions of the launch stone apron are determined based on physical constraints in the vicinity of the proposed bank protection. The bottom width of the launch stone apron involves taking the required unit volume (cross-sectional area) and rearranging the area equation of a trapezoid (square piece plus a triangle piece) to solve for bottom width. The equation to calculate the minimum bottom width of the launch stone apron is:

$$b = \frac{A - \frac{1}{2}zh^2}{h}$$

where,

b = bottom width (ft)
A = minimum required area (ft^2)
z = side slope ratio of soil cement (H:V)
h = height of launch stone apron (ft)

Figure H.4 shows a typical section of bank protection comprised of soil cement and launch stone.

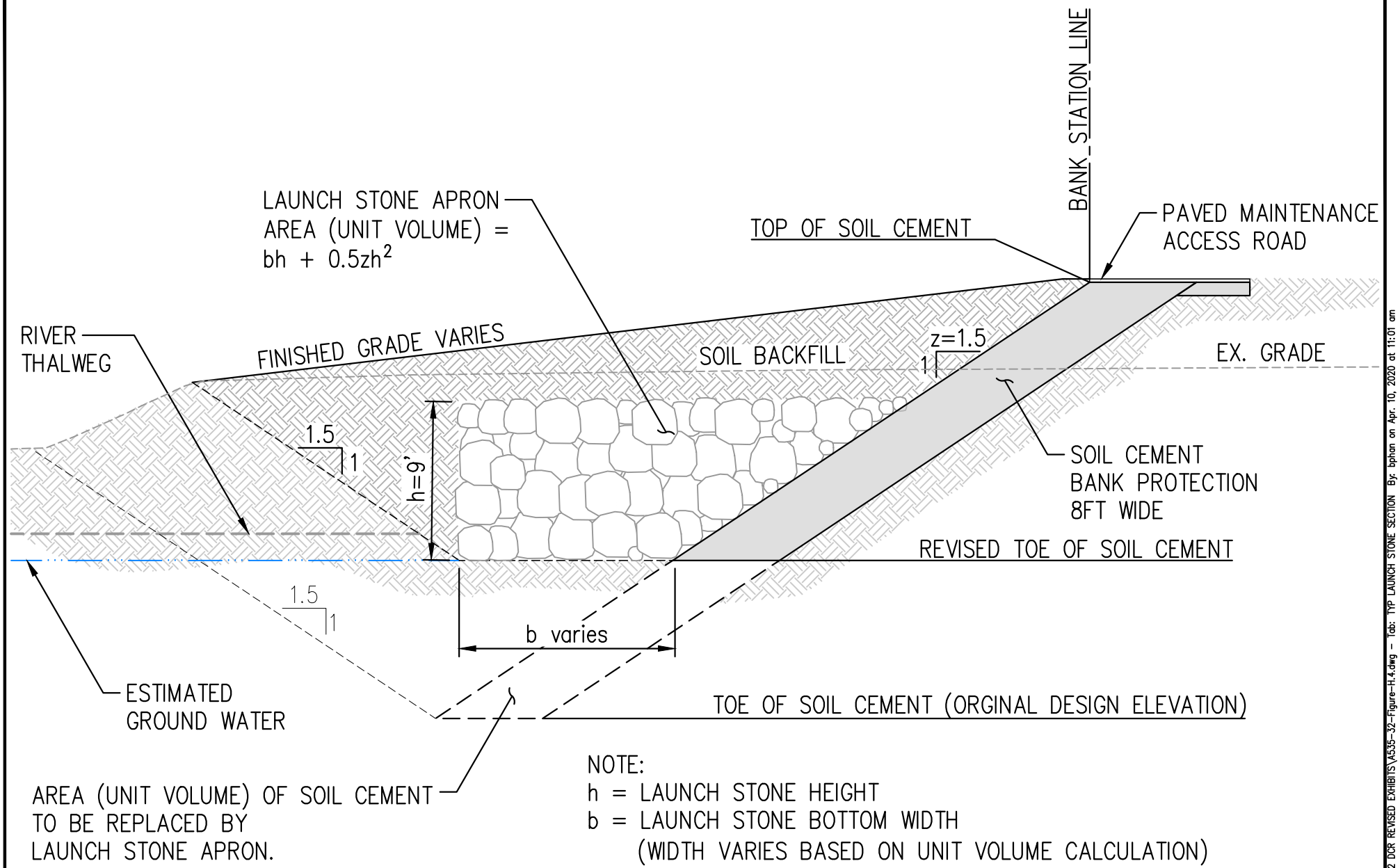

FIGURE H.4

SOIL CEMENT / LAUNCH STONE BANK PROTECTION TYPICAL SECTION

P:\A535\Engineering\GlobalExhibits\A535-32 DCR REVISED EXHIBITS\A535-32-Figure-H.4.dwg — Tab: TYP LAUNCH STONE SECTION By: bphan on Apr. 10, 2020 at 11:01 am

The configuration of the launch stone apron is constrained both vertically and horizontally. Vertically, it is preferred to have the launch stone installed in a buried condition, and horizontally, the launch stone apron must minimize, if not avoid, encroachment of jurisdictional boundaries set by the United States Army Corps of Engineers (ACOE) and the California Department of Fish and Wildlife (CDFW). A constant height (thickness) of nine feet was selected for the launch stone rip-rap apron. This height allows the apron to be buried while minimizing, and in some cases completely avoiding, encroachment of jurisdictional boundaries within the Creek. **Tables H.12 and H.13** summarize the calculations to determine the volume and bottom width of the launch stone apron. The minimum required bottom width of the launch stone apron ranges from 6.0 to 34.5 feet. The actual bottom width provided either meets or exceeds the minimum required quantity of launch stone.

Table H.14 - Hasley Canyon Creek "East" Launch Stone Volume Calculation

Bank Station	Design Min. Toe Elevation[1] (ft)	Revised Toe of Bank Elevation[2] (ft)	Unit Volume of Soil Cement Below Groundwater (ft^3/ft)	Min. Required Launch Stone Unit Volume (ft^3/ft)	Min. Required Bottom Width of Launch Stone (ft)	Actual Bottom Width of Launch Stone (ft)
37+00	1001.08	1022.15	168.6	370.9	34.5	35.0
35+00	997.55	1018.58	168.2	370.0	34.4	24.0
33+00	1000.49	1016.82	130.7	287.4	25.2	26.0
31+00	998.79	1014.09	122.4	269.3	23.2	24.0
29+00	997.73	1011.79	112.5	247.5	20.8	21.0
27+00	994.71	1009.41	117.6	258.8	22.0	23.0
25+00	994.12	1006.95	102.7	225.8	18.3	19.0
23+00	994.83	1003.42	68.7	151.0	10.0	11.0
21+00	992.64	999.16	52.2	114.8	6.0	7.0
19+00	980.39	995.62	121.8	268.0	23.0	24.0
17+00	986.43	991.59	41.3	90.9	N/A[3]	7.0
15+00	987.04	989.52	19.8	43.7	N/A[3]	7.0
13+00	987.05	986.71	-2.7	-6.0	N/A[3]	7.0
11+00	986.93	983.05	-31.1	-68.4	N/A[3]	7.0

Notes:

1. *Design Min. Toe Elevation values for full depth soil cement bank protection construction are obtained from* **Table H.11.**
2. *Revised Toe of Bank Elevation is the Estimated Groundwater Elevation (assumed as 12 feet below Creek Thalweg Elevation).*
3. *The groundwater level is near the Design Min. Toe Elevation such that the Min. Required Launch Stone Unit Volume is minimal. Thus, the equation used to calculate the Min. Required Bottom Width of Launch Stone is not applicable. The Actual Bottom Width of Launch Stone provided will be 7' for these locations, based on the launch stone cross section at RS 6304 of the Castaic Creek design.*

Table H.15 - Hasley Canyon Creek "West" Launch Stone Volume Calculation

Bank Station	Design Min. Toe Elevation[1] (ft)	Revised Toe of Bank Elevation[2] (ft)	Unit Volume of Soil Cement Below Groundwater (ft^3/ft)	Min. Required Launch Stone Unit Volume (ft^3/ft)	Min. Required Bottom Width of Launch Stone (ft)	Actual Bottom Width of Launch Stone (ft)
37+00	1001.55	1023.24	173.5	381.7	35.7	36.0
35+00	1003.85	1020.33	131.8	290.0	25.5	26.0
33+00	1000.54	1017.97	139.5	306.8	27.3	28.0
31+00	998.90	1015.73	134.6	296.2	26.2	27.0
29+00	998.28	1013.49	121.7	267.7	23.0	23.0
27+00	998.18	1010.31	97.0	213.4	17.0	17.0
25+00	995.07	1006.90	94.7	208.2	16.4	15.0
23+00	994.69	1003.50	70.5	155.1	10.5	11.0
21+00	989.77	1001.06	90.3	198.7	15.3	16.0
19+00	990.01	998.62	68.9	151.5	10.1	14.0
17+00	978.08	995.00	135.3	297.8	N/A[3]	7.0
15+00	988.65	991.11	19.7	43.3	N/A[3]	7.0
13+00	987.20	987.22	0.2	0.4	N/A[3]	7.0
11+00	981.70	983.33	13.0	28.7	N/A[3]	7.0

Notes:

1. *Design Min. Toe Elevation values for full depth soil cement bank protection construction were obtained from* **Table H.11**.
2. *Revised Toe of Bank Elevation is the Estimated Groundwater Elevation (assumed as 12 feet below Creek Thalweg Elevation).*
3. *The groundwater level is near the Design Min. Toe Elevation such that the Min. Required Launch Stone Unit Volume is minimal. Thus, the equation used to calculate the Min. Required Bottom Width of Launch Stone is not applicable. The Actual Bottom Width of Launch Stone provided will be 7' for these locations, based on the launch stone cross section at RS 6304 of the Castaic Creek design.*

Tables H.16 and H.17 show the actual toe of soil cement/bottom of launch stone elevations based on the launch stone apron configuration.

Table H.16 - Hasley Canyon Creek "East" Launch Stone/Soil Cement Toe Elevations

HEC-RAS River Station	Bank Station (ft)	Minimum Channel Invert Elevation (ft)	Toe of Launch Stone Elevation[1] (ft)
End Toe of SC	38+17.27	1036.72	**1024.45**
-	38+00.00	1036.39	1024.30
4157	37+48.37	1035.56	**1023.87**
4055.5	36+60.38	1033.00	1022.59
-	36+00.00	1031.87	1021.71
3940.5	35+53.64	1031.00	**1021.04**
3844	34+26.58	1030.00	1019.20
-	34+00.00	1029.78	1018.81
3747	33+25.47	1029.17	1017.33
3650	32+40.49	1028.00	**1016.50**
-	32+00.00	1027.48	1015.99
3554	31+63.21	1027.00	1015.52
3440.5	30+45.90	1025.32	1014.04
-	30+00.00	1025.14	1013.46
3372	29+63.35	1025.00	1013.00
3304	28+84.58	1023.50	**1012.00**
-	28+00.00	1022.47	1010.93
3190.5	27+60.89	1022.00	1010.43
3105	26+56.85	1021.00	1009.11
-	26+00.00	1020.33	1008.39
3020	25+44.48	1019.68	**1007.68**
2934	24+53.29	1018.19	1006.09
-	24+00.00	1017.34	1005.15
2820.5	23+39.34	1016.37	1004.09
2748	22+82.85	1015.00	1003.10
2675.5	22+15.00	1014.00	1001.92
-	22+00.00	1013.62	1001.66
2560.5	21+36.58	1012.00	1000.55
2476	20+70.49	1010.49	999.39
2391	20+00.15	1009.71	**998.16**
-	20+00.00	1009.71	998.16
2305.5	19+14.24	1007.87	996.28
2190.5	18+09.13	1006.00	993.98
-	18+00.00	1005.73	993.78
2122	17+41.40	1004.00	**992.50**
2054	16+40.43	1003.00	991.39
-	16+00.00	1002.52	990.95
1940.5	15+36.82	1001.76	990.26
1872	14+22.46	1001.00	**989.00**
-	14+00.00	1000.58	988.65
1804	13+50.46	999.65	987.89
1688.62	12+34.30	997.49	**986.10**
-	12+00.00	996.87	985.15
1584	10+97.28	995.00	982.30
-	10+00.00	992.93	**979.60**
Begin Toe of SC	6+74.53	983.00	-

Notes:

1. *Toe of Launch Stone Elevation is equal to the Minimum Channel Invert (Thalweg) Elevation minus approximately 12 feet. Values shown in **bold** font indicate Grade Break locations shown on **Figure H.2**.*

Table H.17 - Hasley Canyon "West" Launch Stone/Soil Cement Toe Elevations

HEC-RAS River Station	Bank Station (ft)	Minimum Channel Invert Elevation (ft)	Toe of Launch Stone Elevation[1] (ft)
End Toe of SC	37+82.74	1036.73	**1024.45**
4157	37+09.64	1035.56	1023.39
-	36+00.00	1033.65	1021.79
4055.5	35+63.04	1033.00	1021.25
3940.5	34+77.22	1031.00	**1020.00**
-	34+00.00	1030.28	1019.12
3844	33+70.62	1030.00	1018.78
3747	32+79.01	1029.17	**1017.73**
-	32+00.00	1028.36	1016.84
3650	31+64.34	1028.00	1016.45
3554	30+37.39	1027.00	1015.03
-	30+00.00	1026.45	1014.61
3440.5	29+23.41	1025.32	1013.75
3372	28+60.84	1025.00	**1013.05**
3304	28+08.81	1023.50	1012.16
-	28+00.00	1023.38	1012.01
3190.5	27+01.61	1022.00	1010.34
3105	26+53.53	1021.00	1009.52
-	26+00.00	1020.00	1008.61
3020	25+83.13	1019.68	1008.32
2934	25+02.70	1018.19	1006.95
-	24+00.00	1016.57	1005.20
2820.5	23+87.44	1016.37	1004.99
2748	23+00.00	1015.00	**1003.50**
-	22+00.00	1014.04	1002.28
2675.5	21+95.89	1014.00	1002.23
2560.5	20+87.57	1012.00	1000.91
-	20+00.00	1010.92	999.84
2476	19+64.82	1010.49	999.41
2391	18+61.46	1009.71	**998.15**
2305.5	18+01.98	1007.87	996.82
-	18+00.00	1007.84	996.78
2190.5	16+83.64	1006.00	994.18
-	16+00.00	1004.42	992.32
2122	15+77.90	1004.00	991.82
2054	15+24.32	1003.00	990.63
1940.5	14+47.40	1001.76	988.91
-	14+00.00	1001.09	987.85
1872	13+93.42	1001.00	987.70
-	13+73.52	1000.58	**987.26**
1804	13+30.05	999.65	**986.89**
1688.62	12+13.58	997.49	**986.49**
-	12+00.00	996.99	985.67
1584	11+45.70	995.00	982.41
Begin Toe of SC	11+02.71	993.12	**979.82**

Notes:

1. *Toe of Launch Stone Elevation is equal to the Minimum Channel Invert (Thalweg) Elevation minus approximately 12 feet. Values shown in **bold** font indicate Grade Break locations shown on **Figure H.3**.*

Launch Stone Sizing

The next step in the process is to determine the rip-rap sizing to be used for the launch stone apron. In previous cases, the velocity from the proposed project condition HEC-RAS model (using Manning's roughness of 0.025 and mixed flow regime) at each cross-section location was used and compared to the range of velocities presented in the rip-rap sizing chart in the LACFCD Hydraulic Design Manual to determine the corresponding rip-rap size. In a technical memorandum on launch stone apron design for San Jose Flats, a similar bank protection project located along the Santa Clara River, a sensitivity analysis was performed to determine the appropriate Manning's roughness value for launch stone sizing. In this memorandum, PACE recommended the use of Cowan's method for selecting the appropriate Manning's roughness value used in the rip-rap sizing calculations for launch stone design. The Cowan Method indicated that a Manning's roughness value of 0.035 was appropriate for the San Jose Flats project. Therefore, a Manning's roughness value of 0.035 was applied to the hydraulic model used to perform launch stone design calculations.

Using the methodology described in the memorandum, the size of launch stone was determined using flow velocities from the proposed project condition HEC-RAS model applying the 100-year flow rate (Q_{100}), a Manning's roughness value of 0.035 and a mixed flow regime. The velocity at each cross-section location was used and compared to the range of velocities presented in the rip-rap sizing chart in the LACFCD Hydraulic Design Manual to determine the corresponding rip-rap size. The rip-rap sizes determined for the study reach were then adjusted for consistency to provide smooth transitions between varying rip-rap sizes. **Tables H.18 and H.19** summarize the rip-rap sizing for the Hasley Canyon "East" and "West" bank protection based on the HEC-RAS model cross sections.

Table H.18 - Hasley Canyon "East" Launch Stone Sizing (Q_{100}, n = 0.035)

HEC-RAS River Station	Bank Station (ft)	Velocity (fps)	Launch Stone Size (D_{50})[1]	Actual Launch Stone Size (D_{50})[3]
4258	38+20.42	7.1	100 lb. (12")	1/2-Ton (27")
4157	37+48.37	3.7	50 lb. (10")	1/2-Ton (27")
4055.5	36+60.38	7.5	100 lb. (12")	1/2-Ton (27")
3940.5	35+53.64	9.3	150 lb. (15")	1/2-Ton (27")
3844	34+26.58	12.1	1/2-Ton (27")	1/2-Ton (27")
3747	33+25.47	8.0	100 lb. (12")	1/2-Ton (27")
3650	32+40.49	9.4	150 lb. (15")	1/2-Ton (27")
3554	31+63.21	14.0	1-Ton (34")	1-Ton (34")
3440.5	30+45.90	7.4	100 lb. (12")	1/2-Ton (27")
3372	29+63.35	10.4	300 lb. (18")	1/2-Ton (27")
3304	28+84.58	13.4	1-Ton (34")	1-Ton (34")
3190.5	27+60.89	6.2	50 lb. (10")	1/2-Ton (27")
3105	26+56.85	9.6	150 lb. (15")	1/2-Ton (27")
3020	25+44.48	7.6	100 lb. (12")	1/2-Ton (27")
2934	24+53.29	9.7	150 lb. (15")	1-Ton (34")
2820.5	23+39.34	15.3	2-Ton (43")	2-Ton (43")
2748	22+82.85	13.5	1-Ton (34")	1-Ton (34")
2675.5	22+15.00	10.4	300 lb. (18")	1/2-Ton (27")
2560.5	21+36.58	10.7	300 lb. (18")	1/2-Ton (27")
2476	20+70.49	12.0	1/4-Ton (21")	1/2-Ton (27")
2391	20+00.15	9.8	150 lb. (15")	1/2-Ton (27")
2305.5	19+14.24	6.4	50 lb. (10")	1/2-Ton (27")
Proposed Franklin Parkway Bridge				
2190.5	18+09.13	10.2	300 lb. (18")	1/2-Ton (27")
2122	17+41.40	11.6	1/4-Ton (21")	1/2-Ton (27")
2054	16+40.43	11.3	1/4-Ton (21")	1/2-Ton (27")
1940.5	15+36.82	8.5	100 lb. (12")	1/2-Ton (27")
1872	14+22.46	10.1	300 lb. (18")	1/2-Ton (27")
1804	13+50.46	13.5	1-Ton (34")	1-Ton (34")
1688.62	12+34.30	8.7	100 lb. (12")	1/2-Ton (27")
1584	10+97.28	3.9	50 lb. (10")	1/2-Ton (27")

Notes:

1. *Velocity values are obtained from Proposed Condition (n = 0.035) HEC-RAS Model Output included in **Appendix H**.*
2. *Launch Stone Size is determined from the rip-rap sizing chart on page F-32 in the LACFCD Hydraulic Design Manual.*
3. *Actual Launch Stone Size will be a minimum of 1/2-Ton. Additionally, larger rock sizes are provided for smoother transitions between gradations.*

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Table H.19 - Hasley Canyon "West" Launch Stone Sizing (Q_{100}, n = 0.035)

HEC-RAS River Station	Bank Station (ft)	Velocity (fps)	Launch Stone Size $(D_{50})^1$	Actual Launch Stone Size $(D_{50})^3$
4258	37+85.91	7.1	100 lb. (12")	1/2-Ton (27")
4157	37+09.64	3.7	50 lb. (10")	1/2-Ton (27")
4055.5	3563.04	7.5	100 lb. (12")	1/2-Ton (27")
3940.5	34+77.22	9.3	150 lb. (15")	1/2-Ton (27")
3844	33+70.62	12.1	1/2-Ton (27")	1/2-Ton (27")
3747	32+79.01	8.0	100 lb. (12")	1/2-Ton (27")
3650	31+64.34	9.4	150 lb. (15")	1/2-Ton (27")
3554	30+37.39	14.0	1-Ton (34")	1-Ton (34")
3440.5	29+23.41	7.4	100 lb. (12")	1/2-Ton (27")
3372	28+60.84	10.4	300 lb. (18")	1/2-Ton (27")
3304	28+08.81	13.4	1-Ton (34")	1-Ton (34")
3190.5	27+01.61	6.2	50 lb. (10")	1/2-Ton (27")
3105	26+53.53	9.6	150 lb. (15")	1/2-Ton (27")
3020	25+83.13	7.6	100 lb. (12")	1/2-Ton (27")
2934	25+02.70	9.7	150 lb. (15")	1-Ton (34")
2820.5	23+87.44	15.3	2-Ton (43")	2-Ton (43")
2748	23+00.00	13.5	1-Ton (34")	1-Ton (34")
2675.5	21+95.89	10.4	300 lb. (18")	1/2-Ton (27")
2560.5	20+87.57	10.7	300 lb. (18")	1/2-Ton (27")
2476	19+64.82	12.0	1/4-Ton (21")	1/2-Ton (27")
2391	18+61.46	9.8	150 lb. (15")	1/2-Ton (27")
2305.5	18+01.98	6.4	50 lb. (10")	1/2-Ton (27")
Proposed Franklin Parkway Bridge				
2190.5	16+83.64	10.2	300 lb. (18")	1/2-Ton (27")
2122	15+77.90	11.6	1/4-Ton (21")	1/2-Ton (27")
2054	15+24.32	11.3	1/4-Ton (21")	1/2-Ton (27")
1940.5	14+47.40	8.5	100 lb. (12")	1/2-Ton (27")
1872	13+93.42	10.1	300 lb. (18")	1/2-Ton (27")
1804	13+30.05	13.5	1-Ton (34")	1-Ton (34")
1688.62	12+13.58	8.7	100 lb. (12")	1/2-Ton (27")
1584	11+45.70	3.9	50 lb. (10")	1/2-Ton (27")
1518	10+95.52	10.2	300 lb. (18")	1/2-Ton (27")
1448	10+55.11	11.6	1/4-Ton (21")	1/2-Ton (27")

Notes:

1. *Velocity values are obtained from Proposed Condition (n = 0.035) HEC-RAS Model Output.*
2. *Launch Stone Size is determined from the rip-rap sizing chart on page F-32 in the LACFCD Hydraulic Design Manual.*
3. *Actual Launch Stone Size will be a minimum of 1/2-Ton. Additionally, larger rock sizes are provided for smoother transitions between gradations.*

PACE

Although the rip-rap sizing chart from the LACFCD Hydraulic Design Manual indicates smaller minimum required launch stone sizes, the minimum launch stone size will be 1/2-Ton. Additionally, larger rock sizes are provided to provide for smoother transitions between gradations. The corresponding range of launch stone rip-rap sizing along the bank protection are provided in **Tables H.20 and H.21**.

Table H.20 - Summary of Launch Stone Sizing for Hasley Canyon "East" Bank Protection

Bank Station (ft)	Launch Stone Size (D_{50})
32+00.00 to 38+20.42	1/2-Ton (27")
31+00.00 to 32+00.00	1-Ton (34")
29+00.00 to 31+00.00	1/2-Ton (27")
27+00.00 to 29+00.00	1-Ton (34")
25+00.00 to 27+00.00	1/2-Ton (27")
24+50.00 to 25+00.00	1-Ton (34")
23+00.00 to 24+50.00	2-Ton (43")
22+50.00 to 23+00.00	1-Ton (34")
14+00.00 to 22+50.00	1/2-Ton (27")
13+50.00 to 14+00.00	1-Ton (34")
10+00.00 to 13+50.00	1/2-Ton (27")

Table H.21 - Summary of Launch Stone Sizing Hasley Canyon "West" Bank Protection

Bank Station (ft)	Launch Stone Size (D_{50})
31+00.00 to 37+85.91	1/2-Ton (27")
30+00.00 to 31+00.00	1-Ton (34")
28+50.00 to 30+00.00	1/2-Ton (27")
26+50.00 to 28+50.00	1-Ton (34")
24+50.00 to 26+50.00	1/2-Ton (27")
24+00.00 to 24+50.00	1-Ton (34")
23+50.00 to 24+00.00	2-Ton (43")
22+50.00 to 23+50.00	1-Ton (34")
13+50.00 to 22+50.00	1/2-Ton (27")
12+50.00 to 13+50.00	1-Ton (34")
10+55.11 to 12+50.00	1/2-Ton (27")

Plunge Scour Calculations

Hydraulics

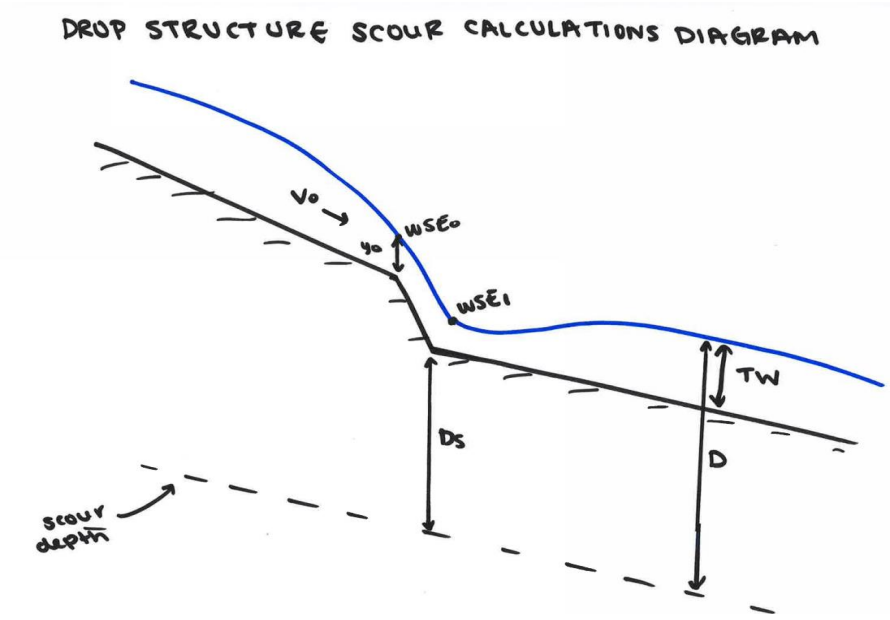
The hydraulics at the toe of the drop structure were calculated as described in **Section 5.8. Table H.22** summarizes the calculations, including hydraulics at the toe of the drop (y_1, A_1) and the hydraulic jump length (L_j). Values in the blue cells represent values obtained from the HEC-RAS model, green cells represent user inputs. The Excel Goal Seek function was used to set the Orange cells to the desired values by adjusting the values in bold type. The variables in the table are defined as follows:

- y_0 = Water depth at the crest of the drop structure (ft)
- z_0 = Elevation at the crest of the drop structure (ft)
- V_0 = Velocity at the crest of the drop structure (ft/s)
- W_{b1} = Channel width at the toe of the drop structure (ft)
- z_1 = Elevation at the toe of the drop structure (ft)
- Drop height= Elevation difference between the top and toe of the drop structure (ft)
- m = Channel side slope (H:V)
- Q = Discharge (cfs)
- y_1 = Water depth at the toe of the drop structure (ft)
- A_1 = Area of at the toe of the drop structure (sq ft)
- $(P+M)_1$ =Pressure and momentum term at the toe of the drop structure
- $(P+M)_2$ =Pressure and momentum term of the sequent depth
- y_2 = Sequent depth (ft)
- L_j = Hydraulic jump length (ft)

Table H.22- Hydraulic calculations at the toe of the drop

y_0	3.22
Z_0	1037
V_0	12.16
W_{b1}	181.80
z_1	1013.52
Drop height	23.48
m	1.50
Q	7,000
y_1	**0.91**
A_1	165.81
$(P+M)_1$	9252.59
$(P+M)_2$	9252.59
y_2	**9.39**
L_j	56.33

Plunge Scour



$$D = K\frac{q^x H^y}{d^z}$$

$$D_s = D - TW$$

D = Scour depth measured from the tailwater elevation
D_S = Depth of scour below river bed
H = Elevation Difference between U/S and D/S WSE (m)
$H = WSE_0 - WSE_1$
q = discharge per unit width (m^2/s)
$q = V_0 \times Y_0$
Y_0 = water depth at crest
V_0 =velocity at the crest
WSE_0 = Water surface elevation at the crest
WSE_1 = Water Surface Elevation at the toe
TW = tailwater depth
d = mean grain size of sediment
K =0.202
x = 0.54
y = 0.225
z = 0.42

WSE_0 (ft)	1041.79
Y_0 (ft)	3.22
Y_0 (m)	0.98
V_0 (ft/s)	12.16
V_0 (m/s)	3.71
WSE_1	1014.43
H (m)	8.34
TW (ft)	9.93
d (mm)	11
d (m)	0.011
TW (m)	3.03
q (m^2/s)	3.64
D_S (m)	1.29
D_S (ft)	**4.24**

Appendix H – Alternative Design Approach

Launch Stone Sizing Methodology and HEC-RAS Results (n = 0.035)

HEC-RAS Plan: Hasley Creek River: Hasley Reach: 1 Profile: 100-Year

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)	
1	4725	100-Year	7000.00	1069.00	1073.25	1074.16	1076.88	0.018503	15.29	457.81	116.92	1.36
1	4622	100-Year	7000.00	1067.00	1072.13	1072.59	1075.12	0.012589	13.88	504.21	113.32	1.16
1	4523	100-Year	7000.00	1064.20	1069.78	1070.73	1073.57	0.017950	15.61	448.31	108.24	1.35
1	4396	100-Year	7000.00	1059.45	1063.66	1065.17	1068.79	0.112120	18.17	385.34	97.89	1.61
1	4300	100-Year	7000.00	1039.45	1043.80	1047.03	1055.27	0.237684	27.17	257.63	65.78	2.42
1	4282	100-Year	7000.00	1033.45	1037.50	1041.24	1052.23	0.147232	30.78	227.39	62.18	2.84
1	4276	100-Year	7000.00	1033.45	1042.79	1039.05	1043.62	0.002794	7.32	956.86	116.44	0.45
1	4270	100-Year	7000.00	1033.45	1043.13	1037.30	1043.40	0.000820	4.15	1688.61	188.98	0.24
1	4265	100-Year	7000.00	1037.00	1042.38	1040.85	1043.31	0.006111	7.76	901.82	175.78	0.60
1	4258	100-Year	7000.00	1037.00	1042.45	1040.64	1043.22	0.003130	7.06	991.68	190.27	0.55
1	4157	100-Year	7000.00	1035.56	1042.77	1038.41	1042.98	0.000581	3.68	1902.07	274.66	0.25
1	4055.5	100-Year	7000.00	1033.00	1041.89	1041.16	1042.76	0.006354	7.48	935.21	280.50	0.72
1	3940.5	100-Year	7000.00	1031.00	1040.51	1040.51	1041.85	0.013410	9.31	751.61	281.71	1.01
1	3844	100-Year	7000.00	1030.00	1037.37	1038.02	1039.66	0.026065	12.14	576.70	241.96	1.39
1	3747	100-Year	7000.00	1029.17	1036.76	1036.26	1037.75	0.007608	7.95	879.97	277.32	0.79
1	3650	100-Year	7000.00	1028.00	1035.35	1035.35	1036.72	0.013937	9.39	745.64	287.56	1.03
1	3554	100-Year	7000.00	1027.00	1031.66	1032.47	1034.71	0.026018	14.00	499.86	166.93	1.43
1	3440.5	100-Year	7000.00	1025.32	1031.95	1031.21	1032.80	0.007489	7.42	943.99	327.17	0.77
1	3372	100-Year	7000.00	1025.00	1030.35	1030.35	1032.04	0.012448	10.44	670.50	202.74	1.01
1	3304	100-Year	7000.00	1023.50	1027.86	1028.68	1030.64	0.040803	13.38	523.12	266.99	1.69
1	3190.5	100-Year	7000.00	1022.00	1028.68	1026.96	1029.27	0.002839	6.17	1135.22	250.25	0.51
1	3105	100-Year	7000.00	1021.00	1027.35	1027.35	1028.79	0.013081	9.61	728.45	258.62	1.01
1	3020	100-Year	7000.00	1019.68	1026.57	1025.85	1027.46	0.006367	7.59	922.35	271.53	0.73
1	2934	100-Year	7000.00	1018.19	1025.18	1025.18	1026.65	0.013138	9.73	719.39	251.82	1.01
1	2820.5	100-Year	7000.00	1016.37	1020.60	1021.66	1024.25	0.031090	15.33	456.68	154.28	1.57
1	2748	100-Year	7000.00	1015.00	1019.29	1019.98	1022.11	0.022916	13.47	519.59	169.36	1.36
1	2675.5	100-Year	7000.00	1014.00	1019.07	1019.07	1020.74	0.012269	10.37	674.89	203.49	1.00
1	2560.5	100-Year	7000.00	1012.00	1017.46	1017.82	1019.26	0.021101	10.74	651.99	280.70	1.24
1	2476	100-Year	7000.00	1010.49	1014.74	1015.33	1016.96	0.028092	11.96	585.24	267.44	1.43
1	2391	100-Year	7000.00	1009.71	1014.37	1014.37	1015.86	0.012583	9.79	715.05	241.35	1.00
1	2305.5	100-Year	7000.00	1007.87	1014.52	1012.75	1015.14	0.002863	6.35	1102.34	233.96	0.52
1	2250		Bridge									
1	2190.5	100-Year	7000.00	1006.00	1010.91	1010.91	1012.54	0.012173	10.23	684.55	211.05	1.00
1	2122	100-Year	7000.00	1004.00	1009.12	1009.50	1011.21	0.018955	11.60	603.32	213.98	1.22
1	2054	100-Year	7000.00	1003.00	1007.77	1008.12	1009.77	0.017723	11.35	616.92	215.62	1.18
1	1940.5	100-Year	7000.00	1001.76	1006.85	1006.23	1007.97	0.006885	8.48	825.37	219.84	0.77
1	1872	100-Year	7000.00	1001.00	1005.55	1005.55	1007.14	0.012517	10.12	691.99	221.35	1.01
1	1804	100-Year	7000.00	999.65	1002.91	1003.71	1005.75	0.031150	13.52	517.74	212.90	1.53
1	1688.62	100-Year	7000.00	997.49	1001.64	1001.26	1002.82	0.008493	8.71	803.51	240.78	0.84
1	1584	100-Year	7000.00	995.00	1002.10	998.91	1002.33	0.000868	3.86	1815.03	333.07	0.29
1	1518	100-Year	7000.00	995.00	1001.22	999.88	1001.98	0.003491	7.28	1016.16	226.00	0.58
1	1500		Lat Struct									
1	1448	100-Year	6172.68	993.63	999.07	999.07	1000.91	0.010247	11.63	580.06	156.32	1.00
1	1294	100-Year	4420.80	991.00	996.92	996.97	999.01	0.010492	11.60	381.20	94.72	1.02
1	1189	100-Year	4420.80	990.00	993.99	994.99	997.42	0.026118	14.86	297.54	97.41	1.50
1	1132		Bridge									
1	1080	100-Year	4420.80	980.01	991.78	983.79	991.80	0.000052	1.18	3744.04	500.85	0.08
1	1061	100-Year	28820.80	980.00	991.80	988.46	992.63	0.001872	7.32	3936.09	506.51	0.46
1	981	100-Year	28820.80	979.00	990.01	989.61	992.17	0.008386	11.78	2447.38	461.23	0.90
1	678	100-Year	28820.80	977.00	988.01	987.27	989.98	0.007007	11.25	2561.15	450.94	0.83

A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

Hasley 1

Legend

WS 100-Year

Lat Struct

Ground

Elevation (ft)

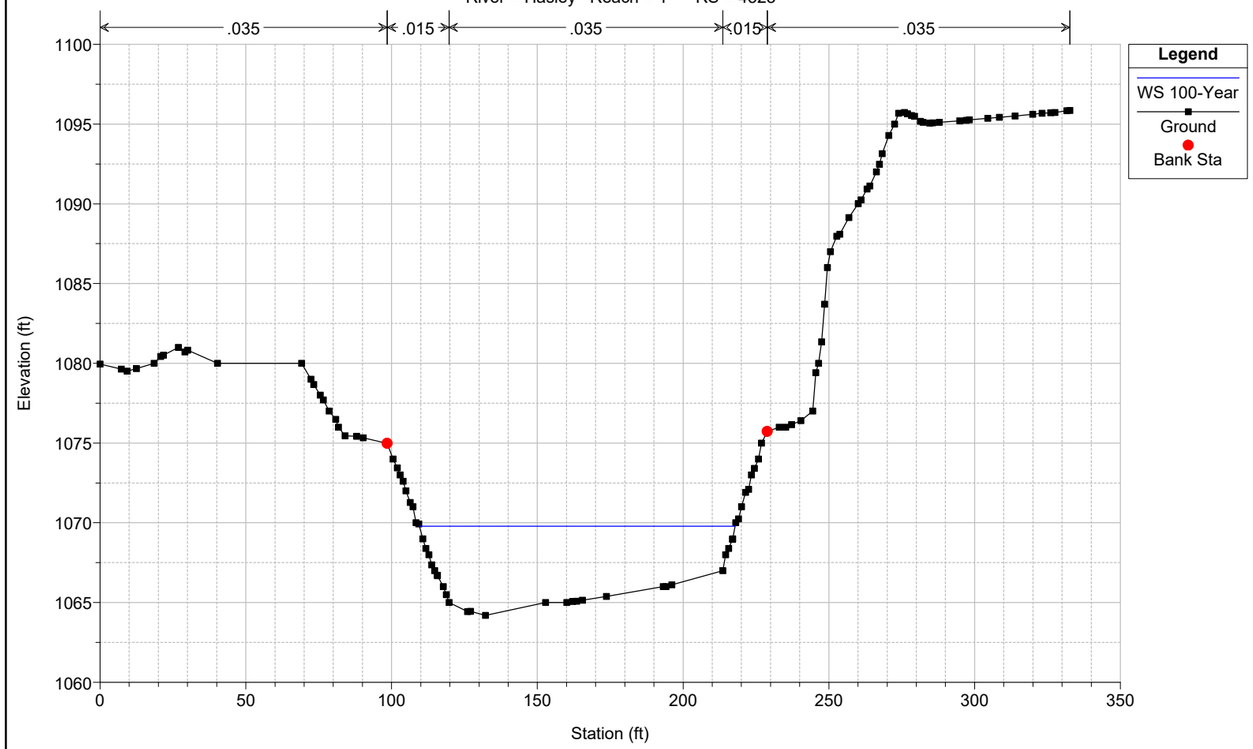
1080
1060
1040
1020
1000
980
960

0
1000
2000
3000
4000
5000

Main Channel Distance (ft)

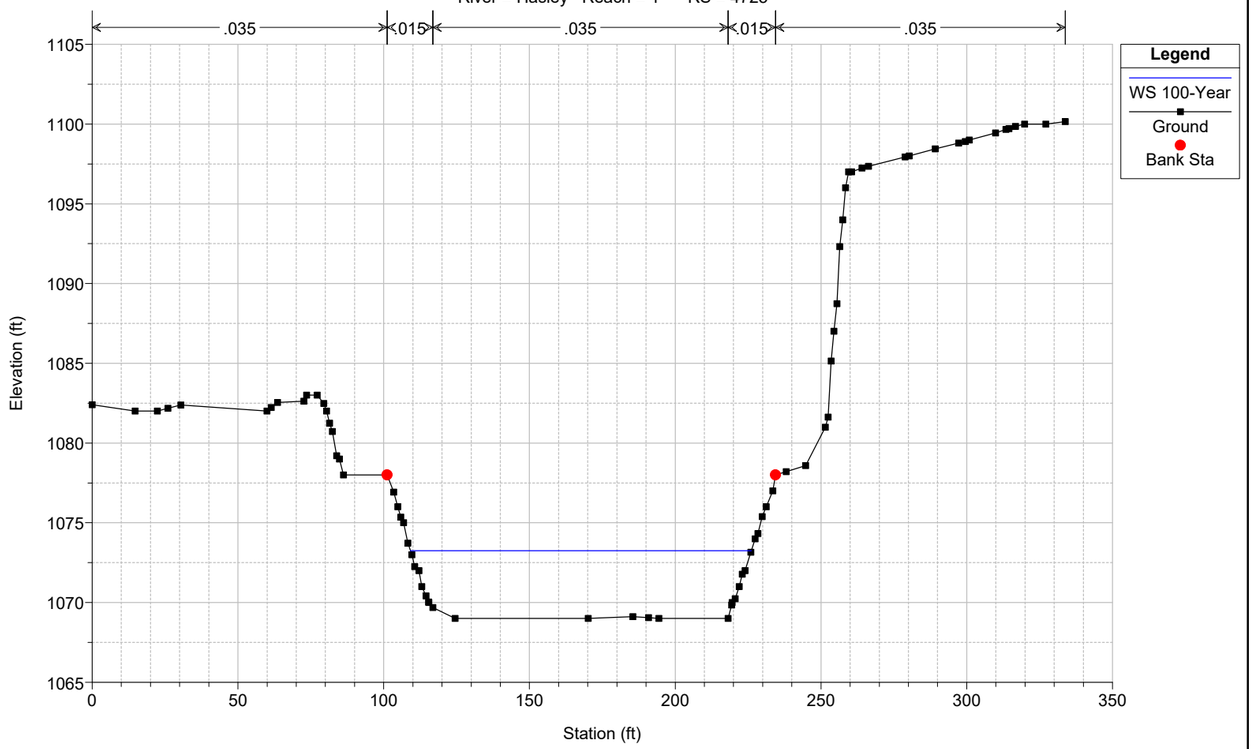
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4523



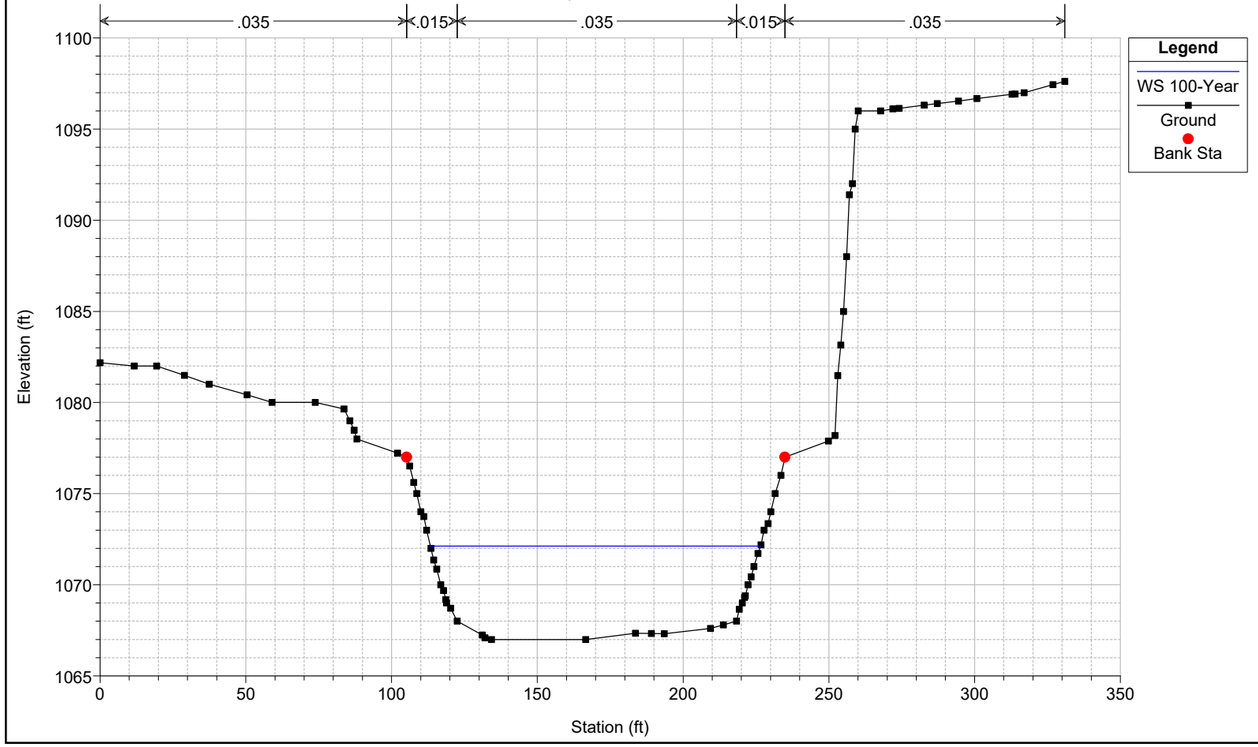
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4725



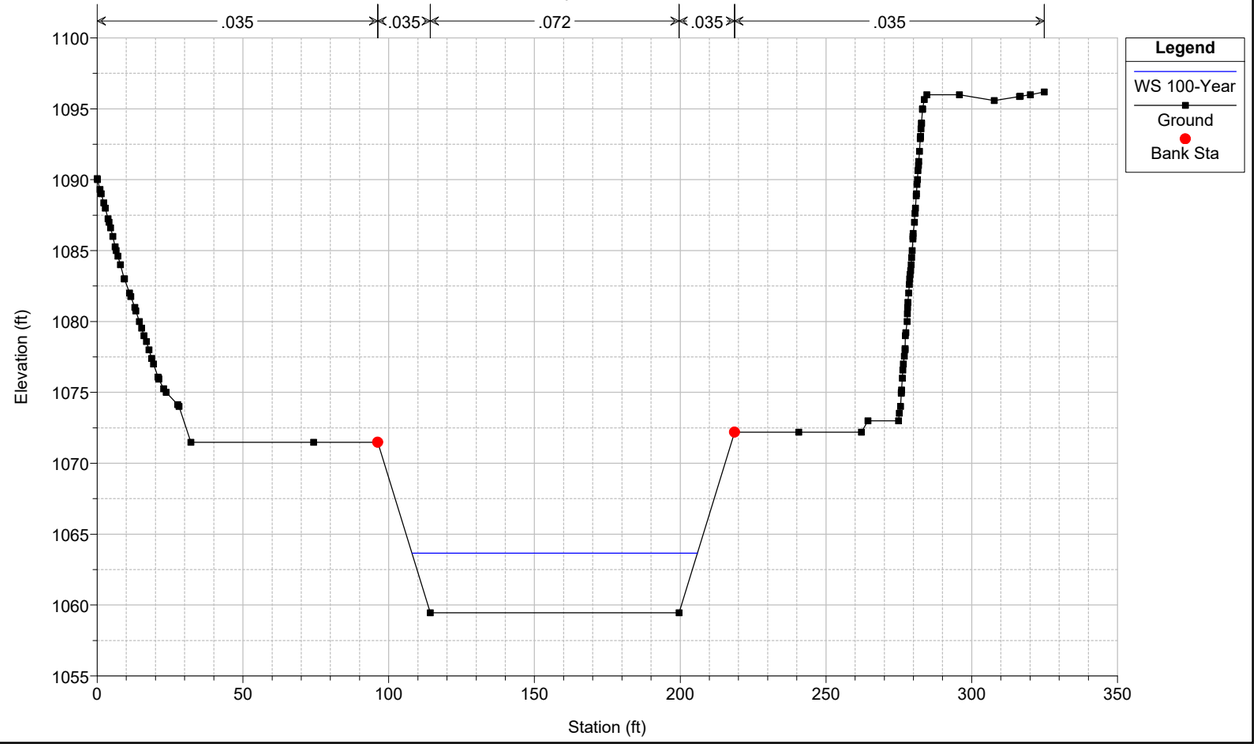
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4622



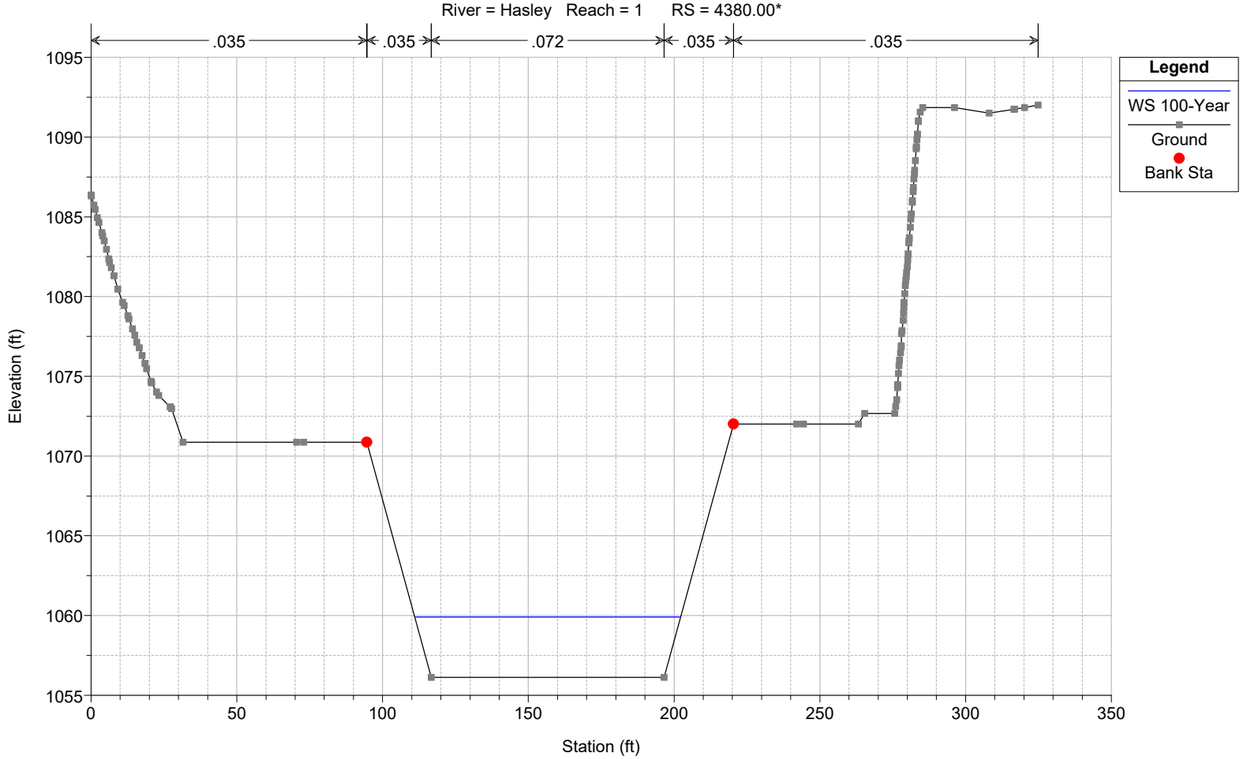
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4396



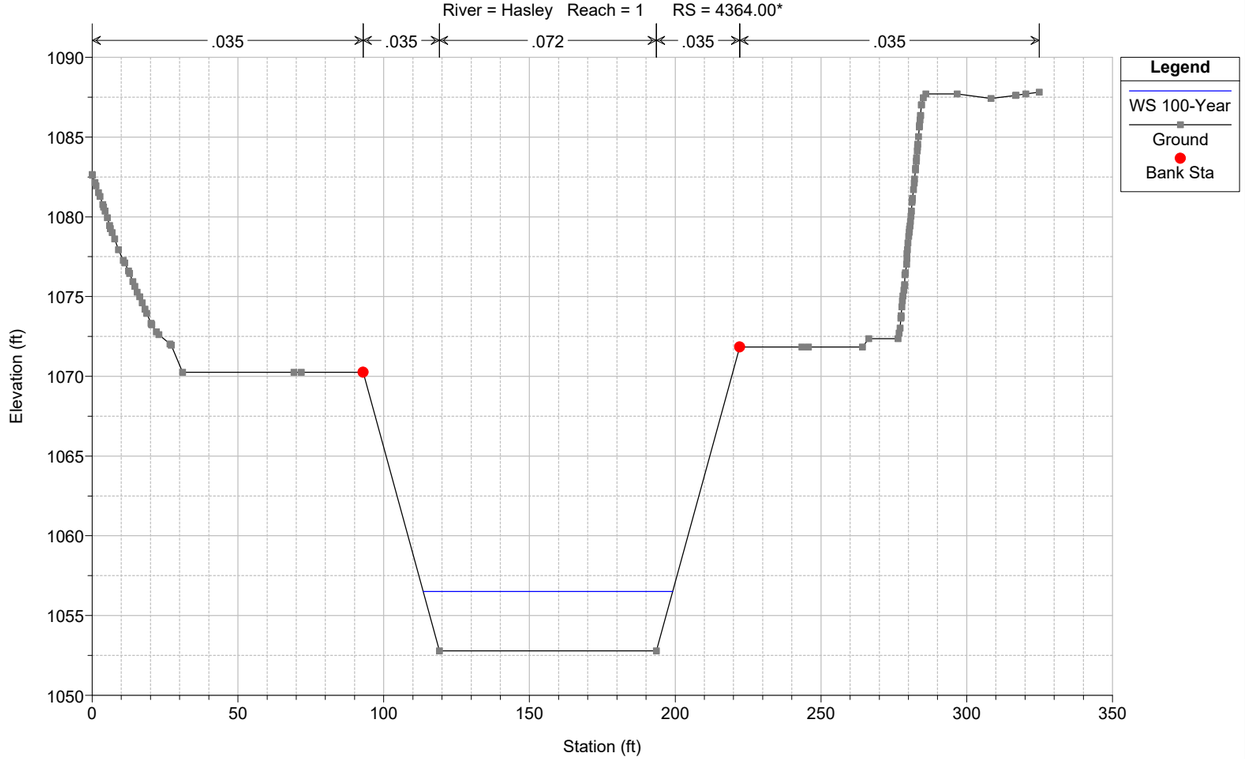
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4380.00*



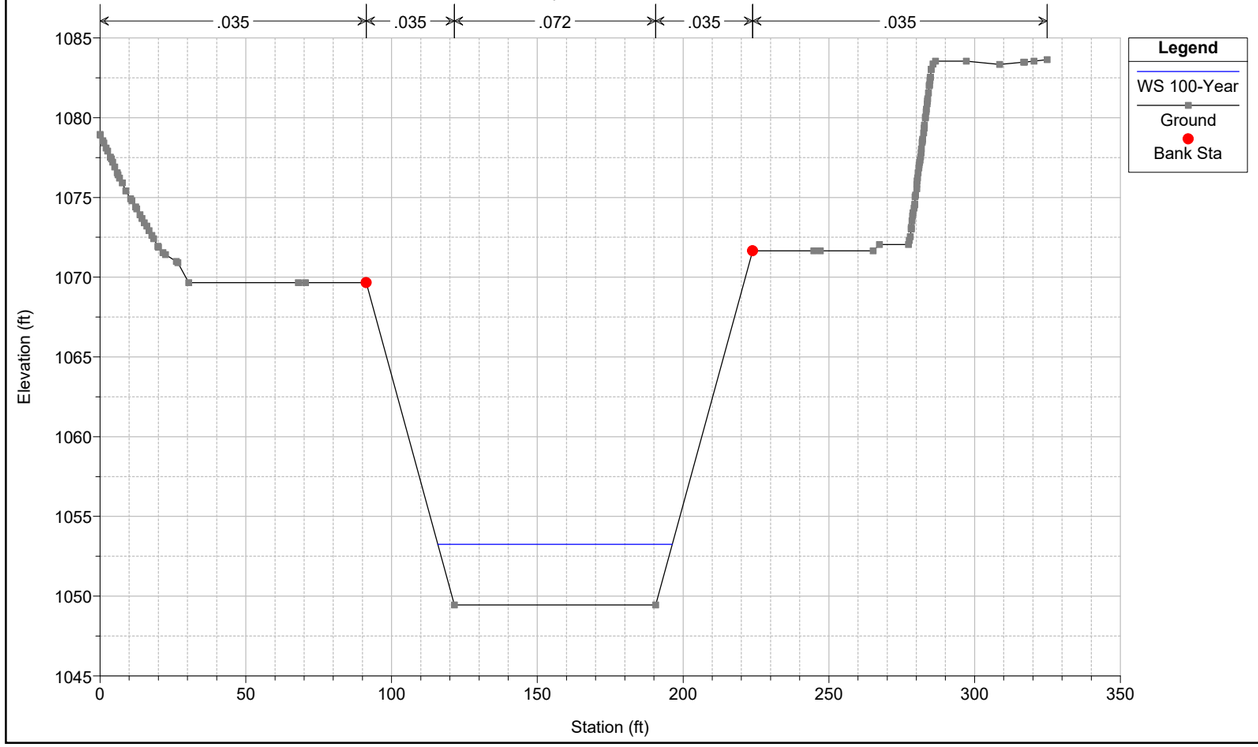
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4364.00*



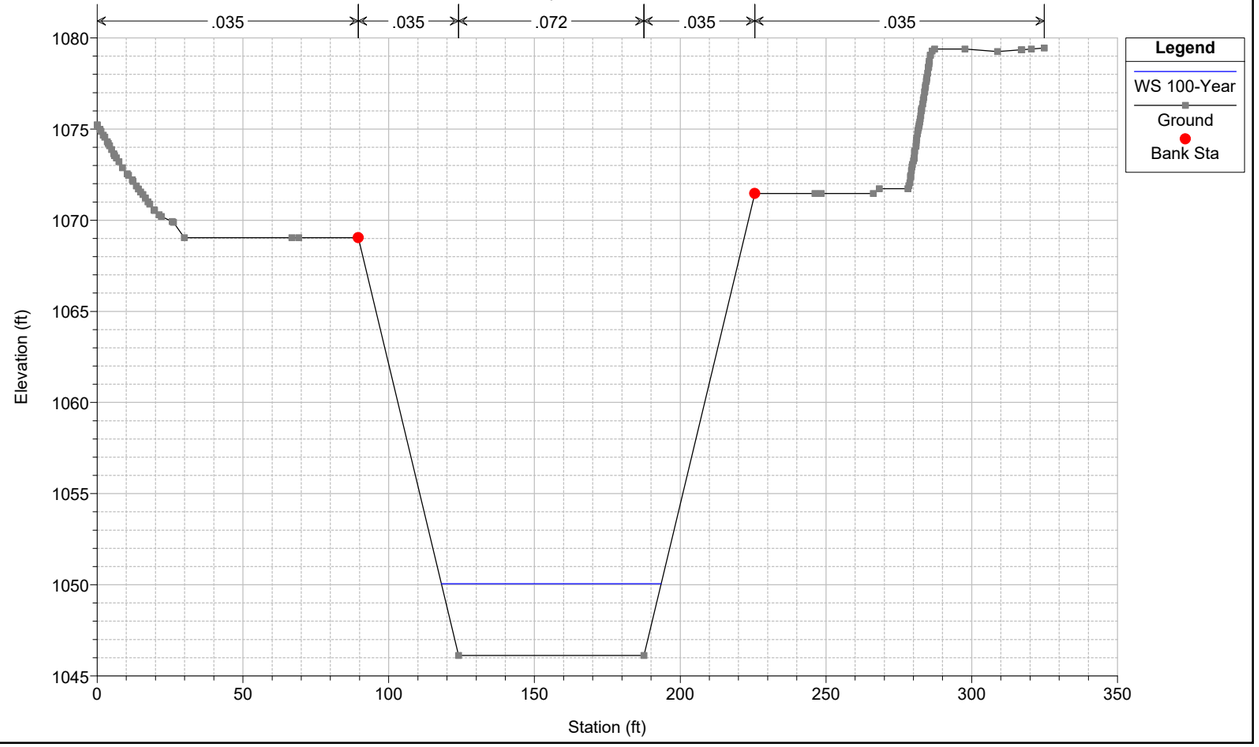
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4348.00*



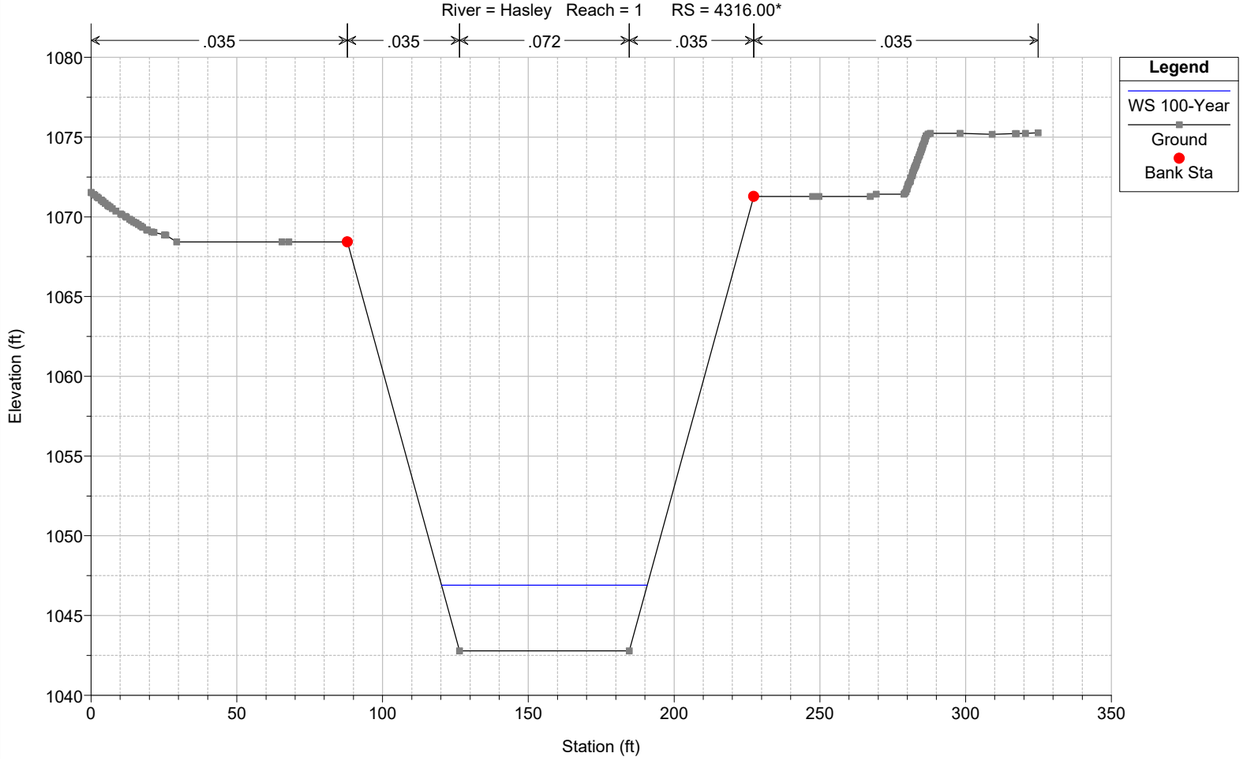
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4332.00*



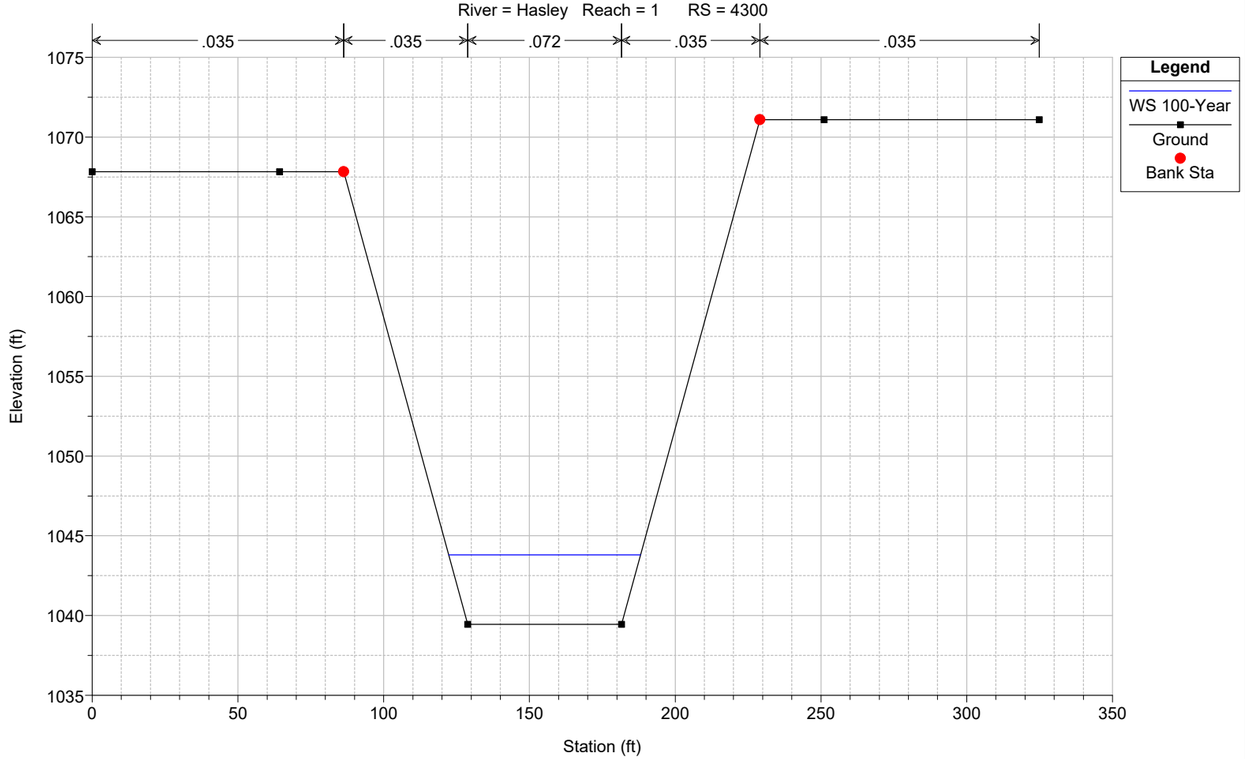
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4316.00*



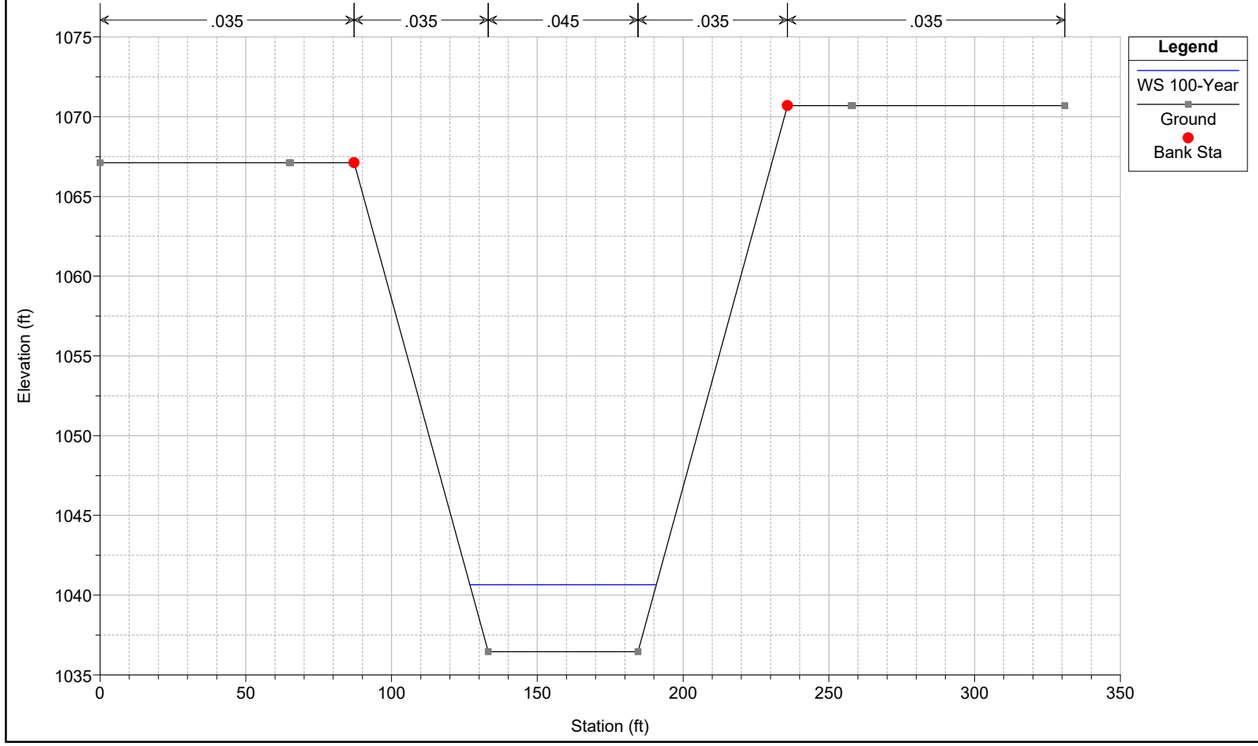
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4300



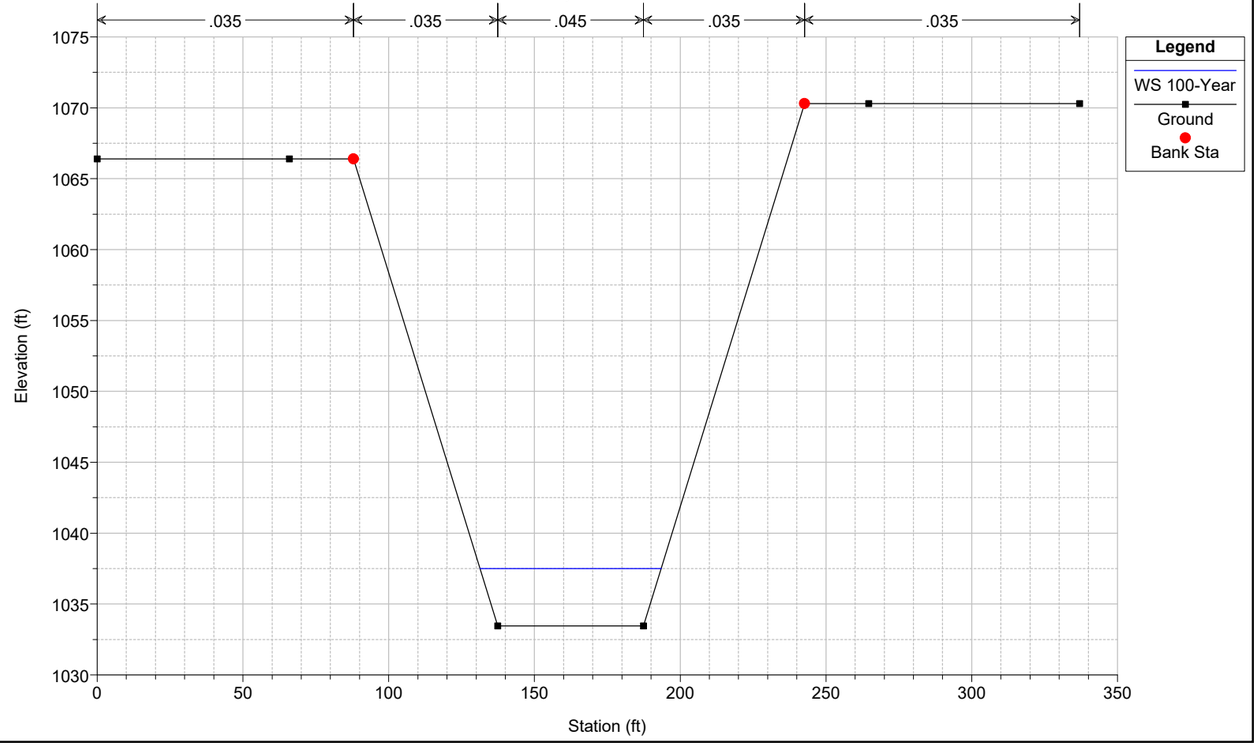
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4291.00*



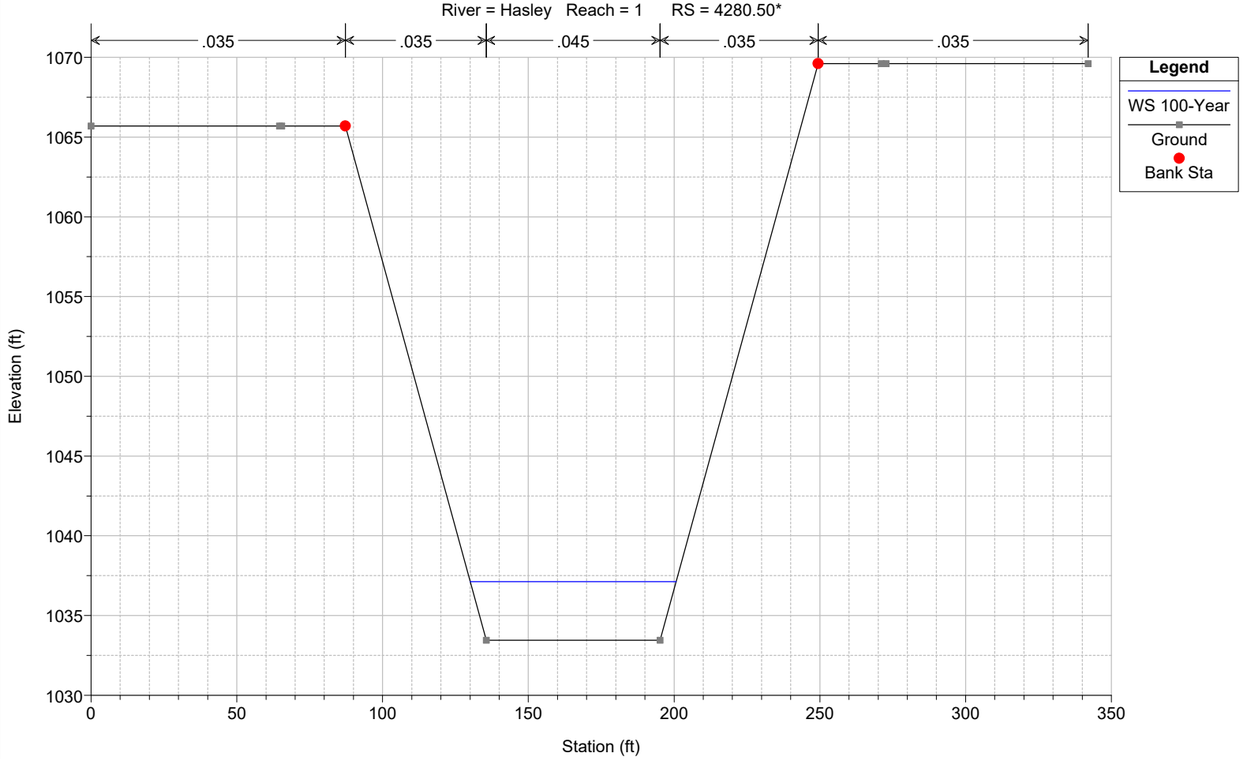
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4282



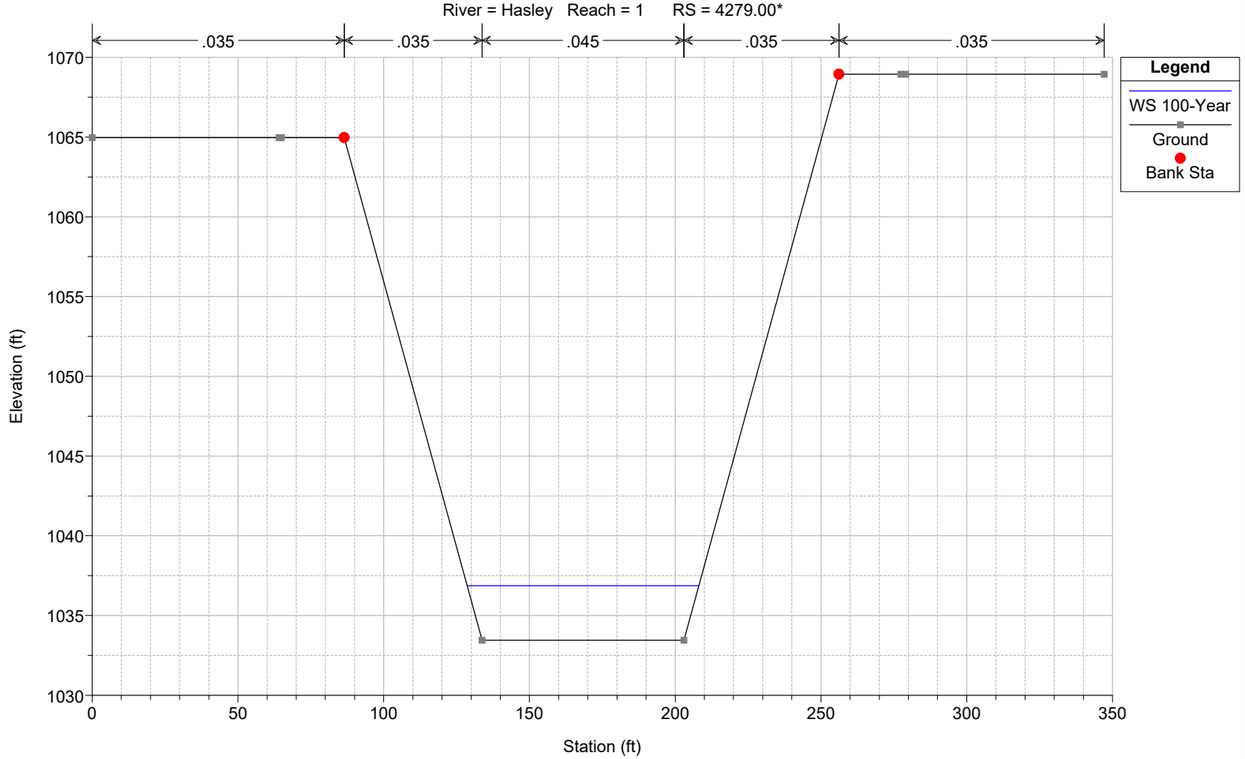
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4280.50*



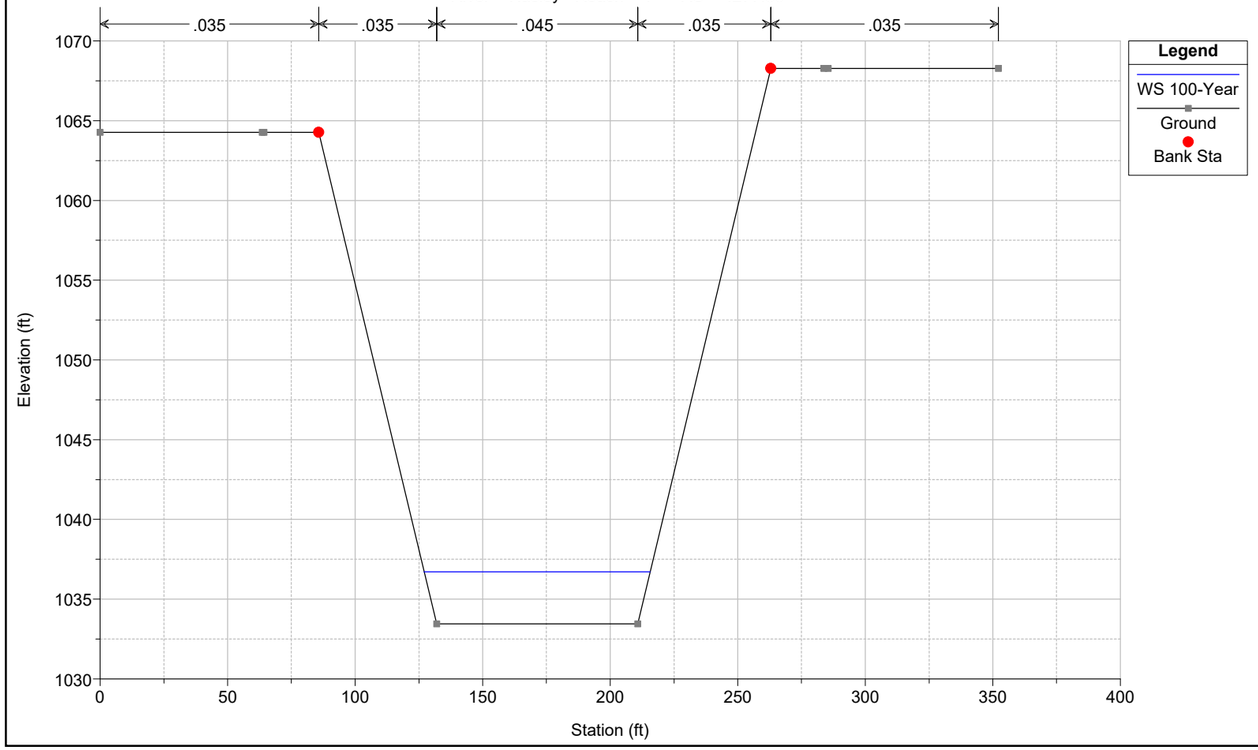
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4279.00*



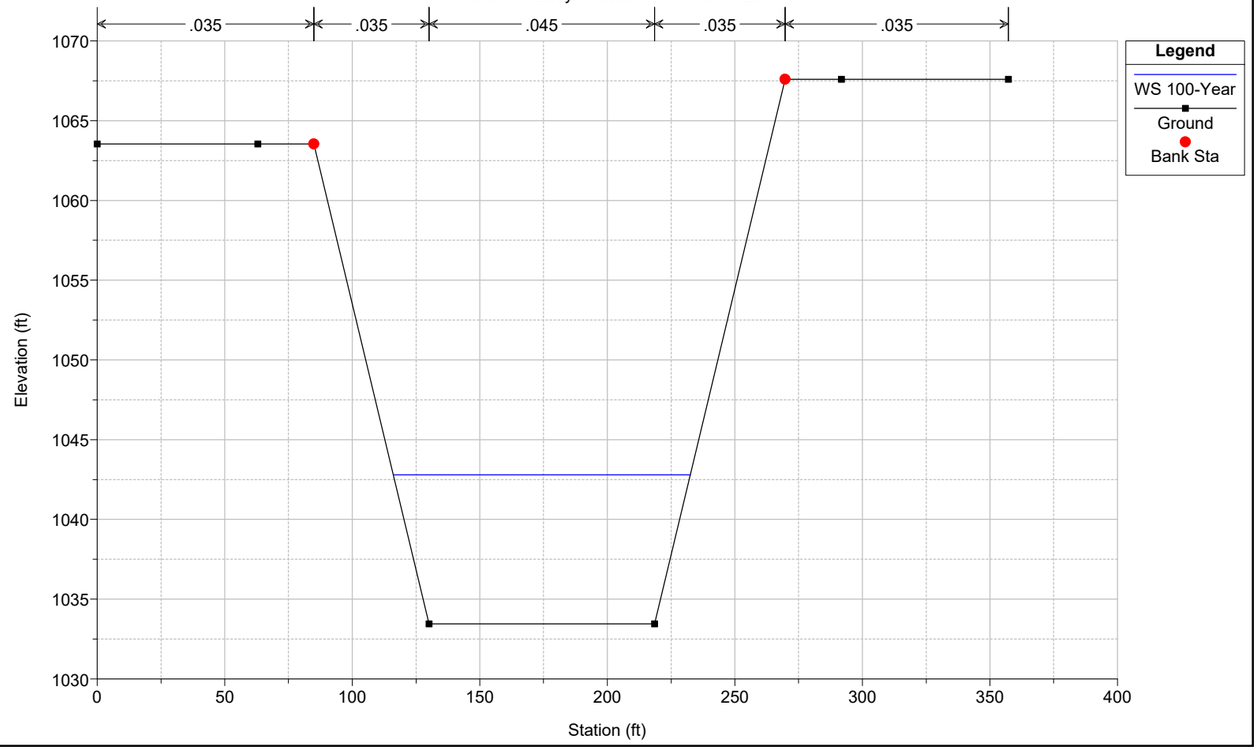
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4277.50*



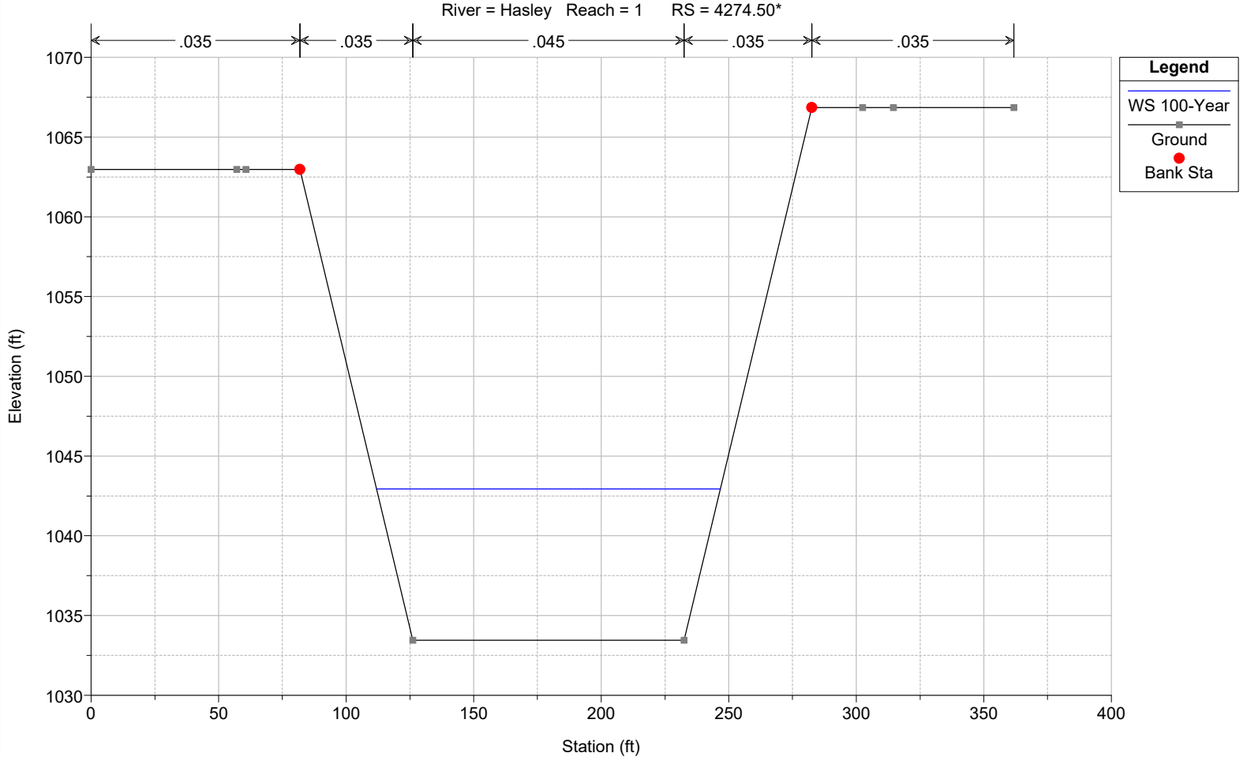
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4276



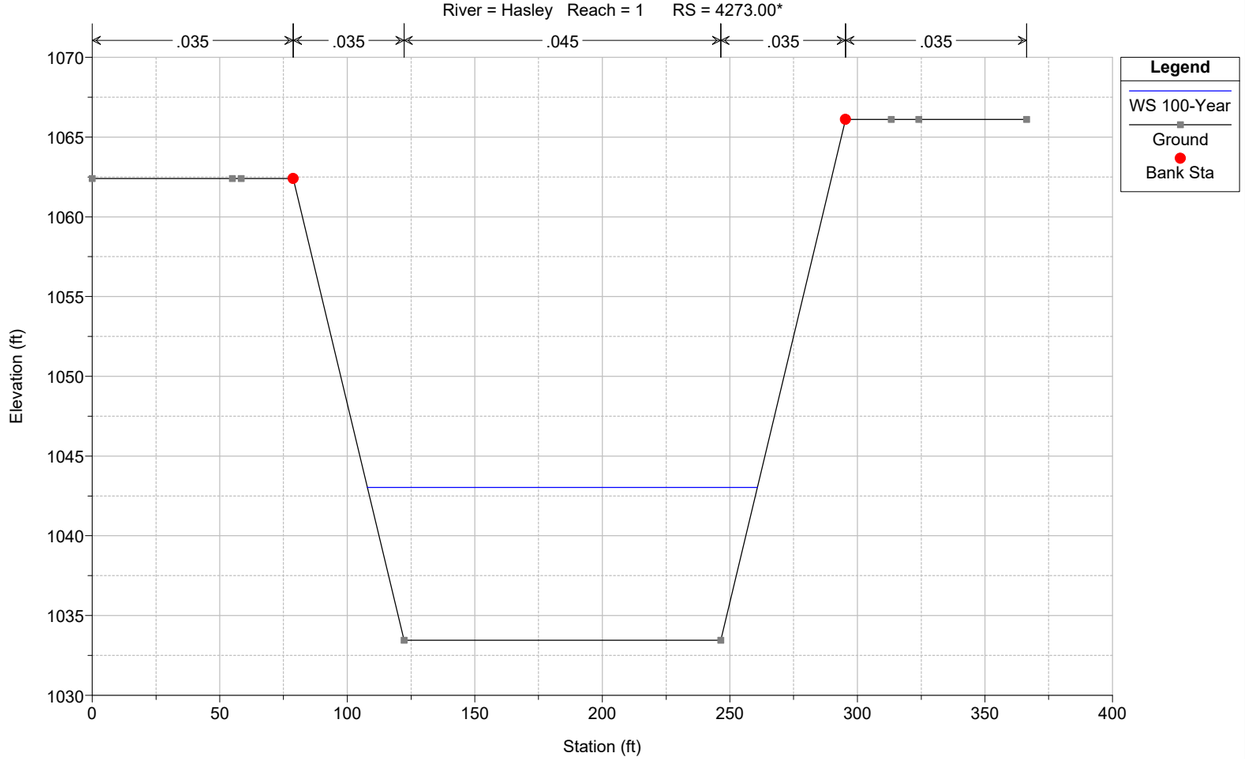
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4274.50*



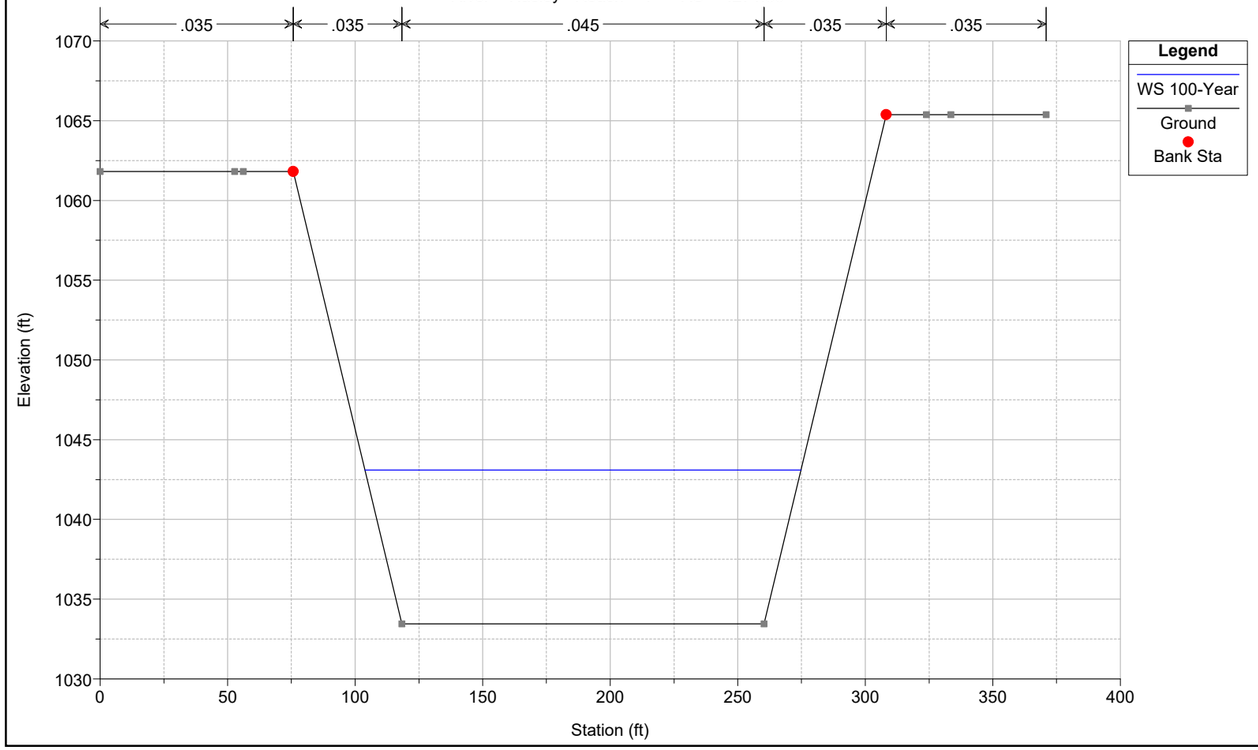
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4273.00*



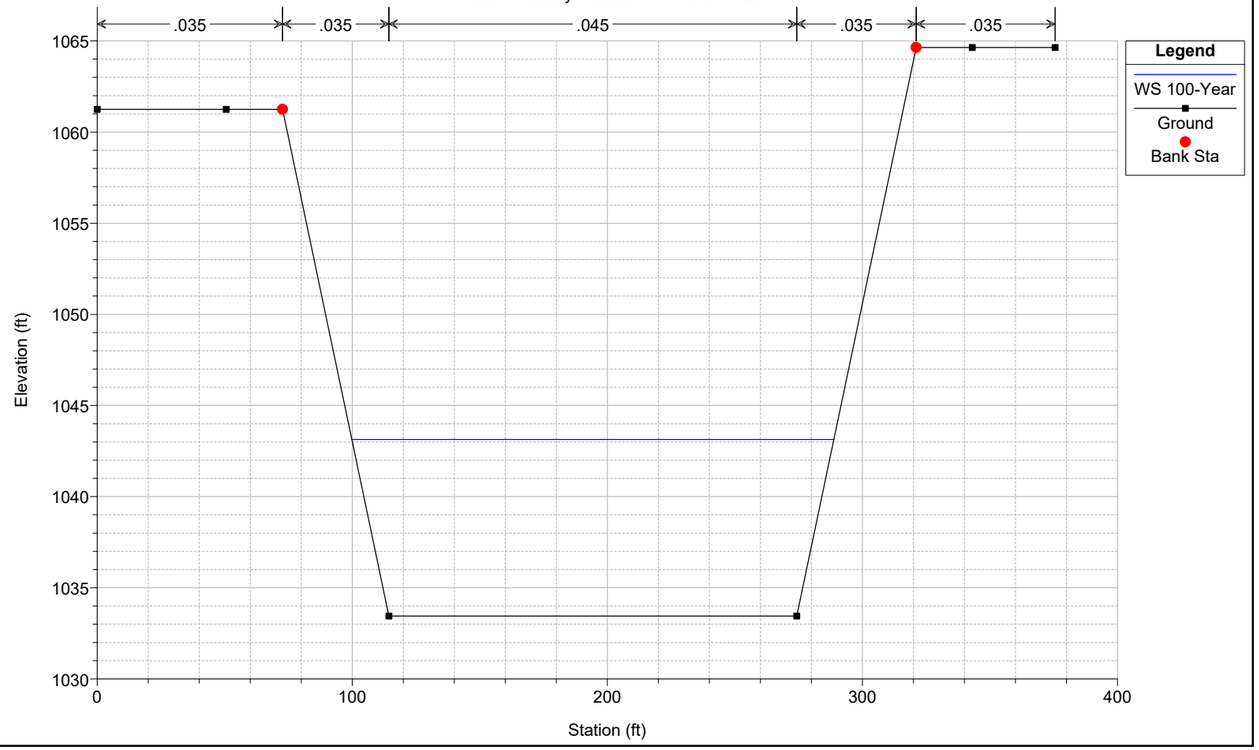
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4271.50*



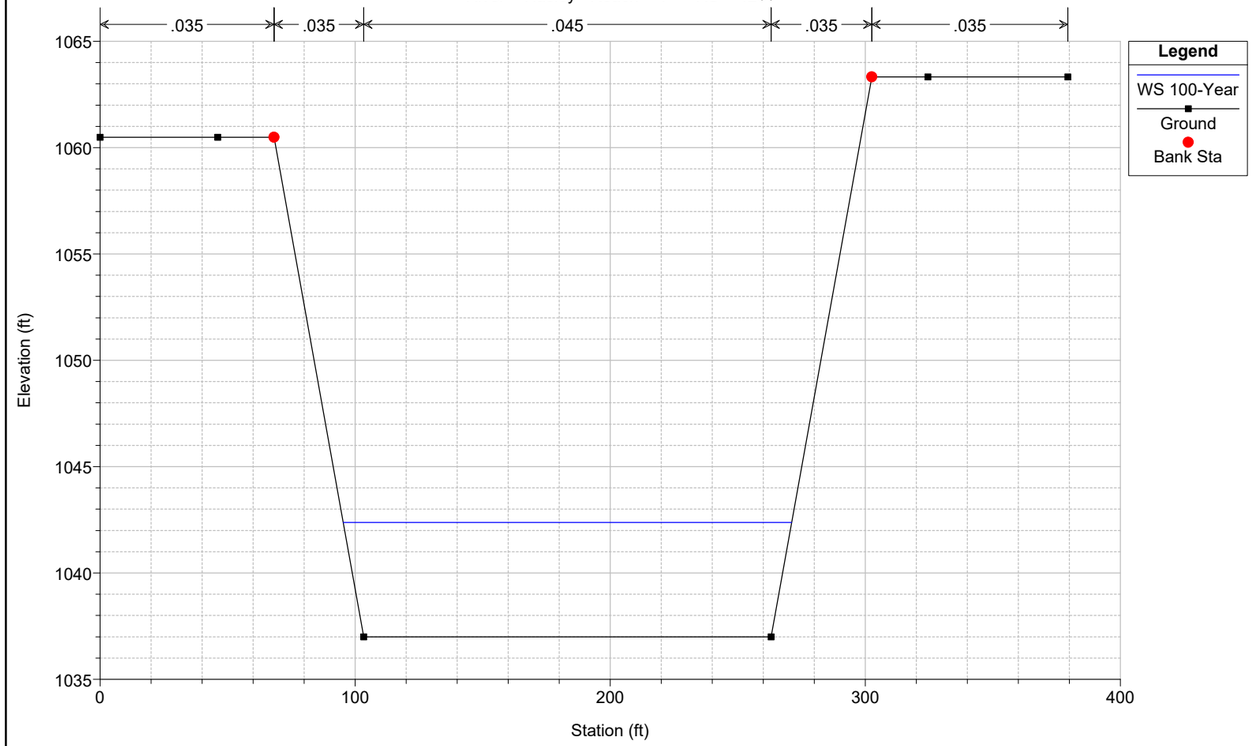
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4270



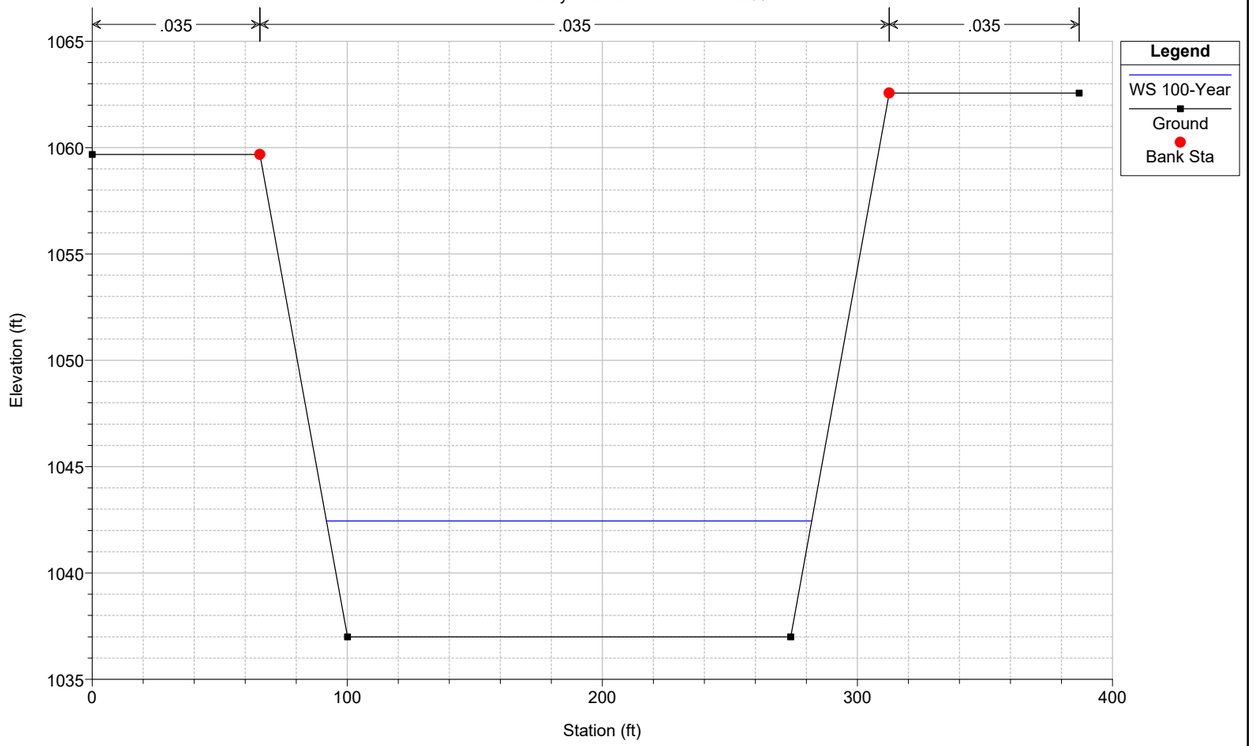
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4265



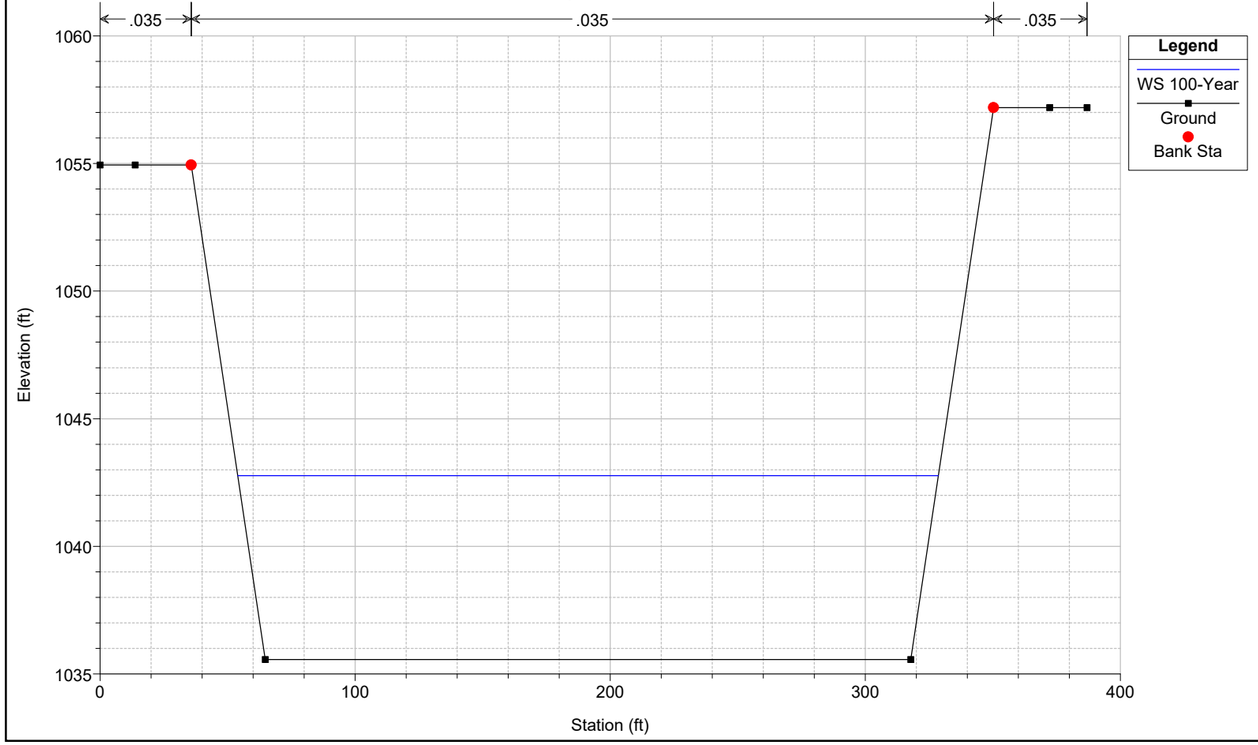
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4258



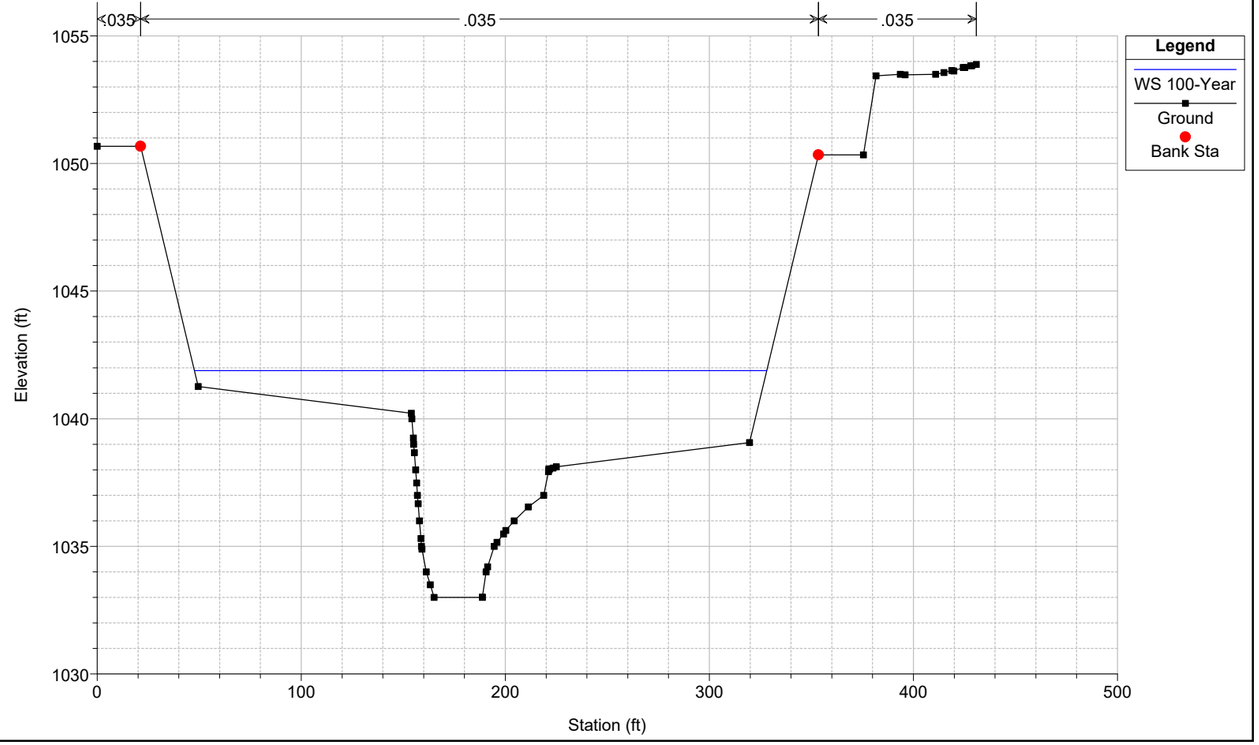
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4157



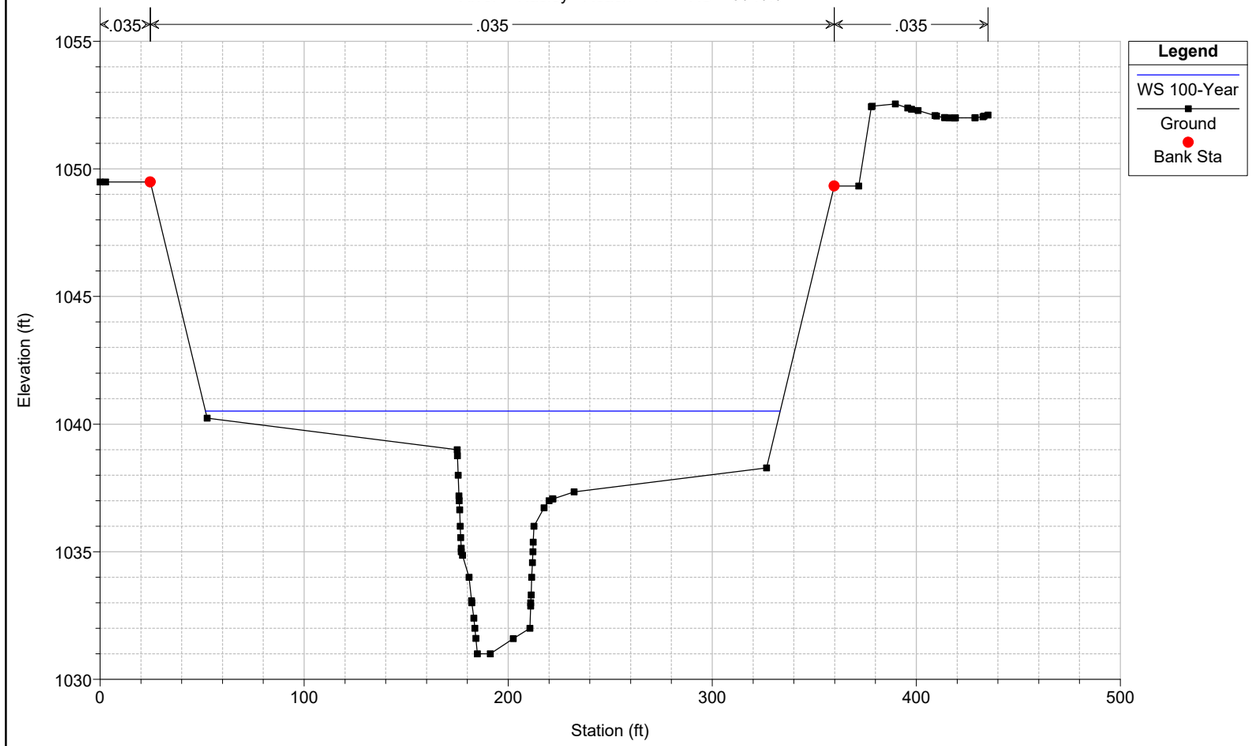
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 4055.5



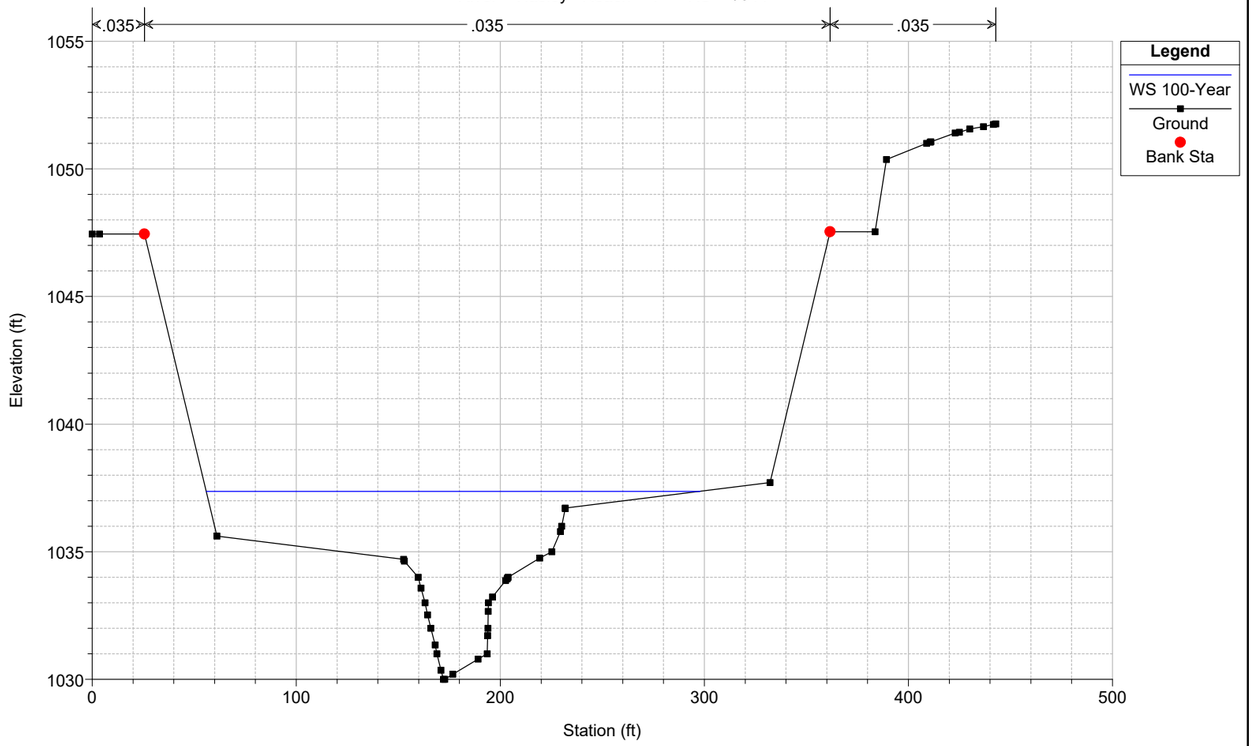
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3940.5



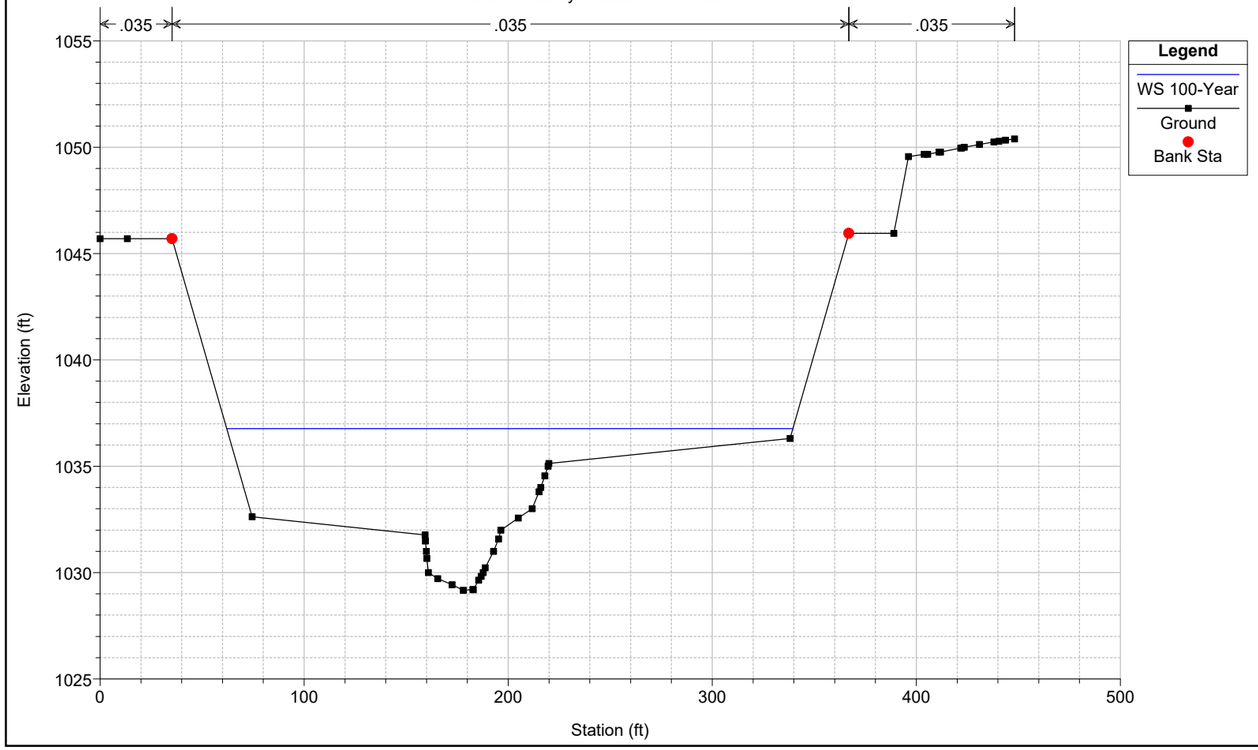
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3844



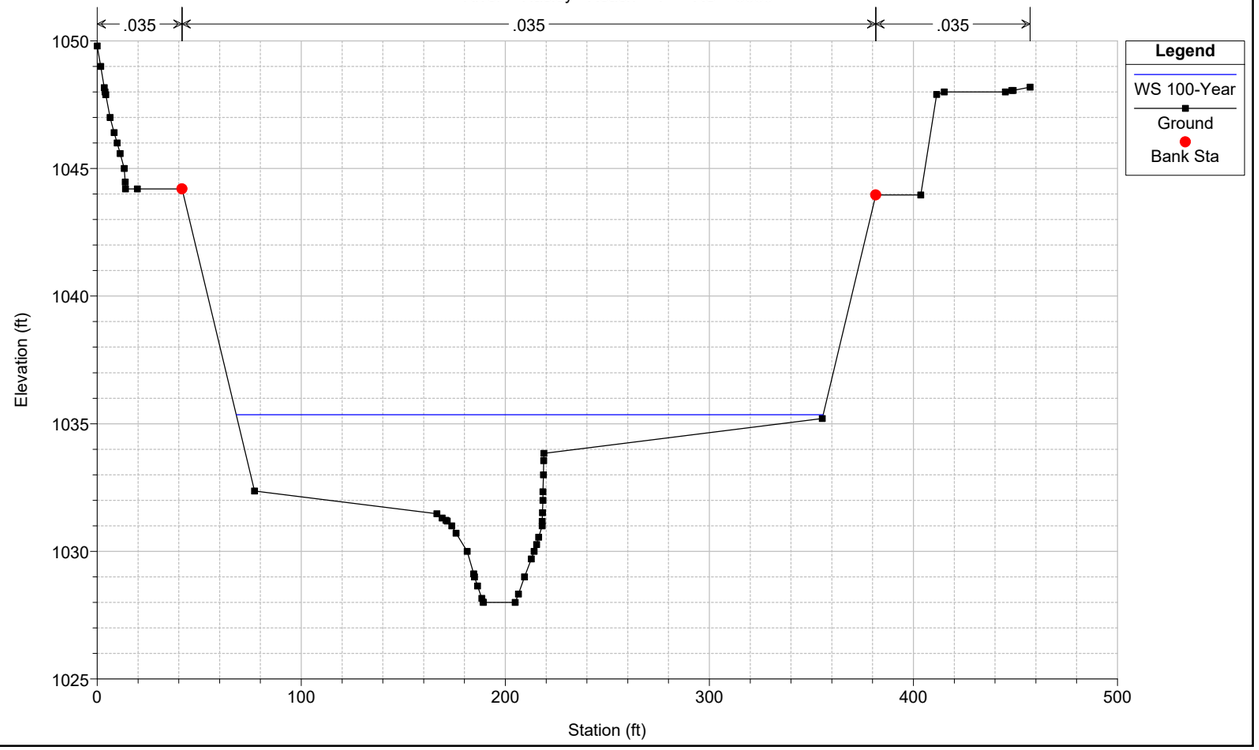
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3747



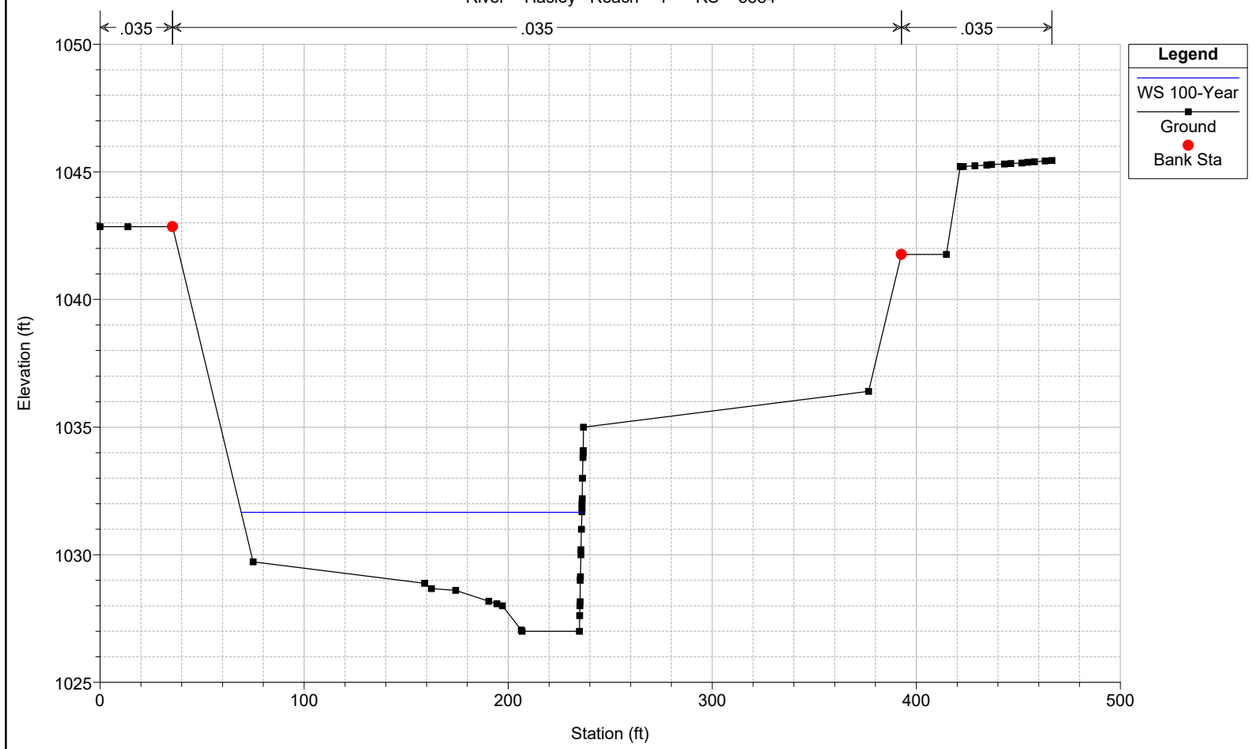
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3650



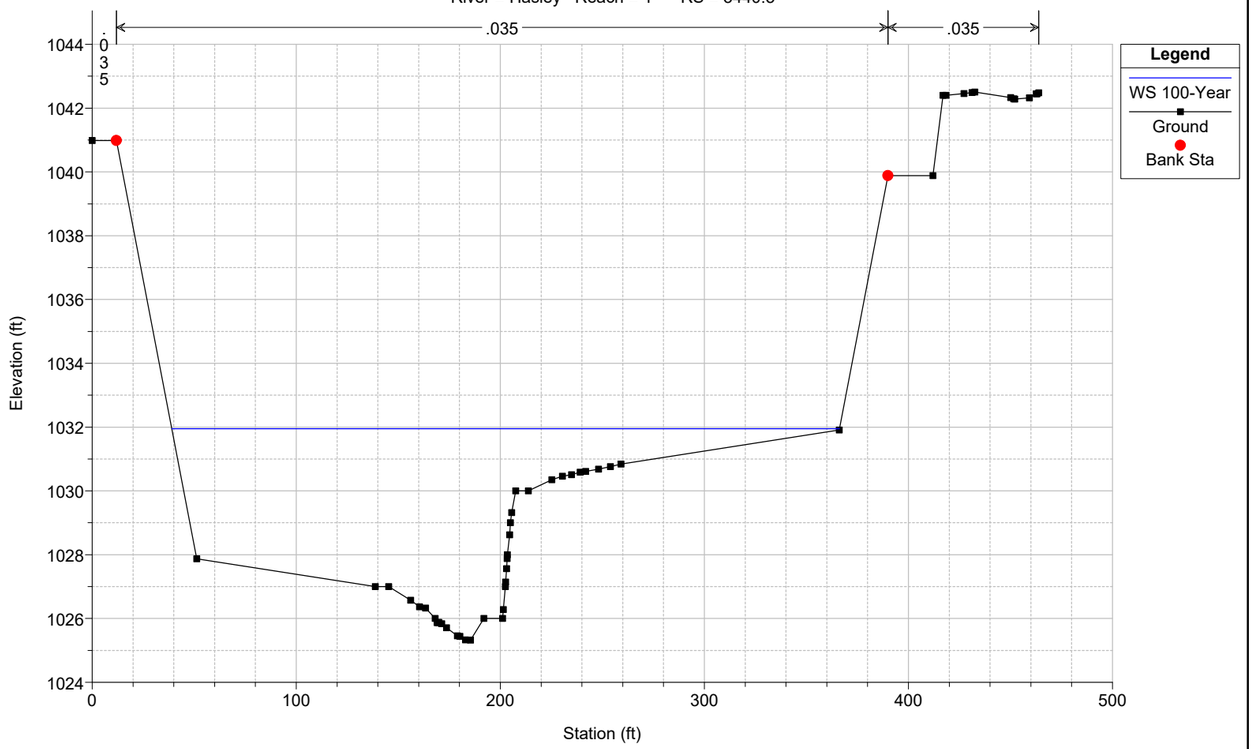
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3554



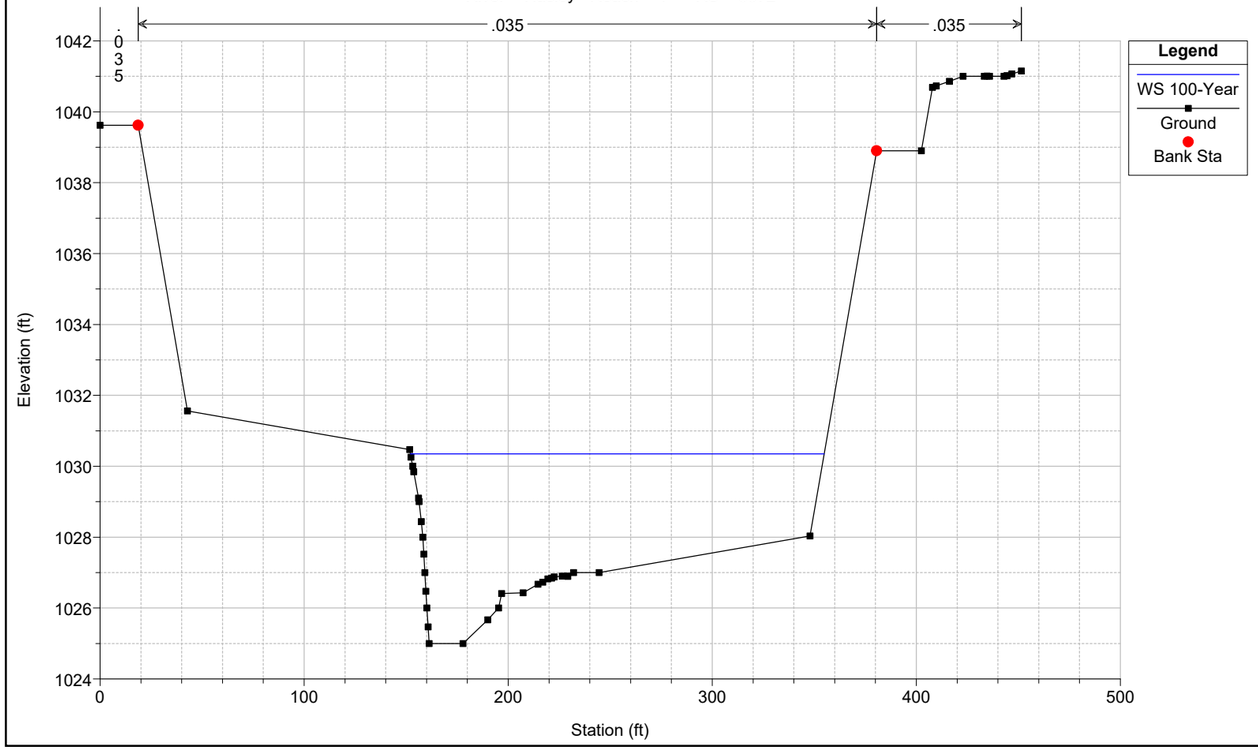
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3440.5



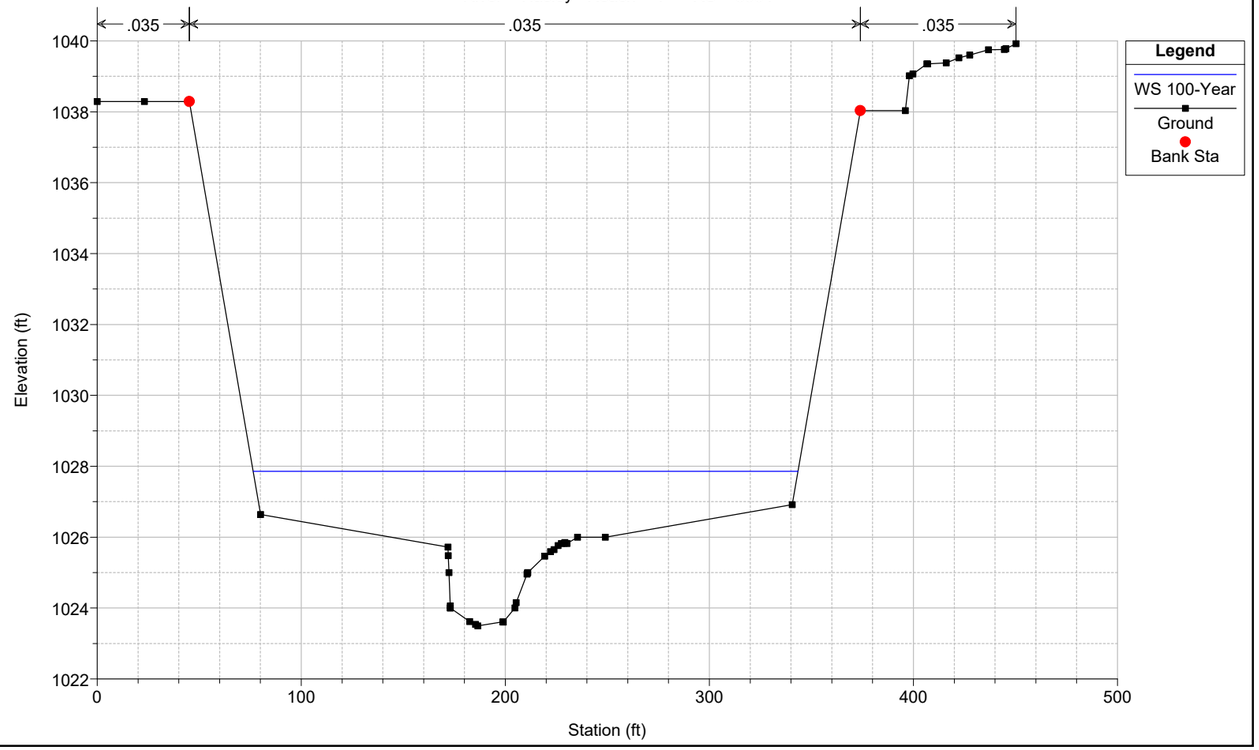
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3372



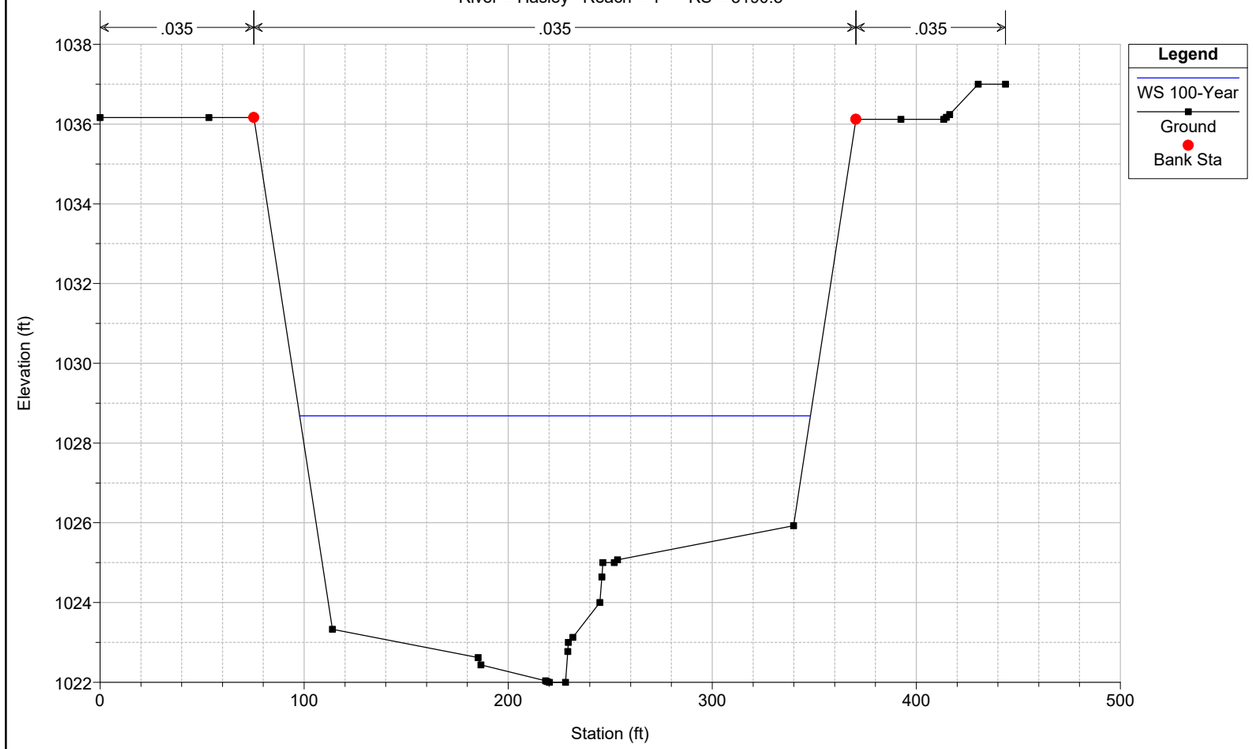
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3304



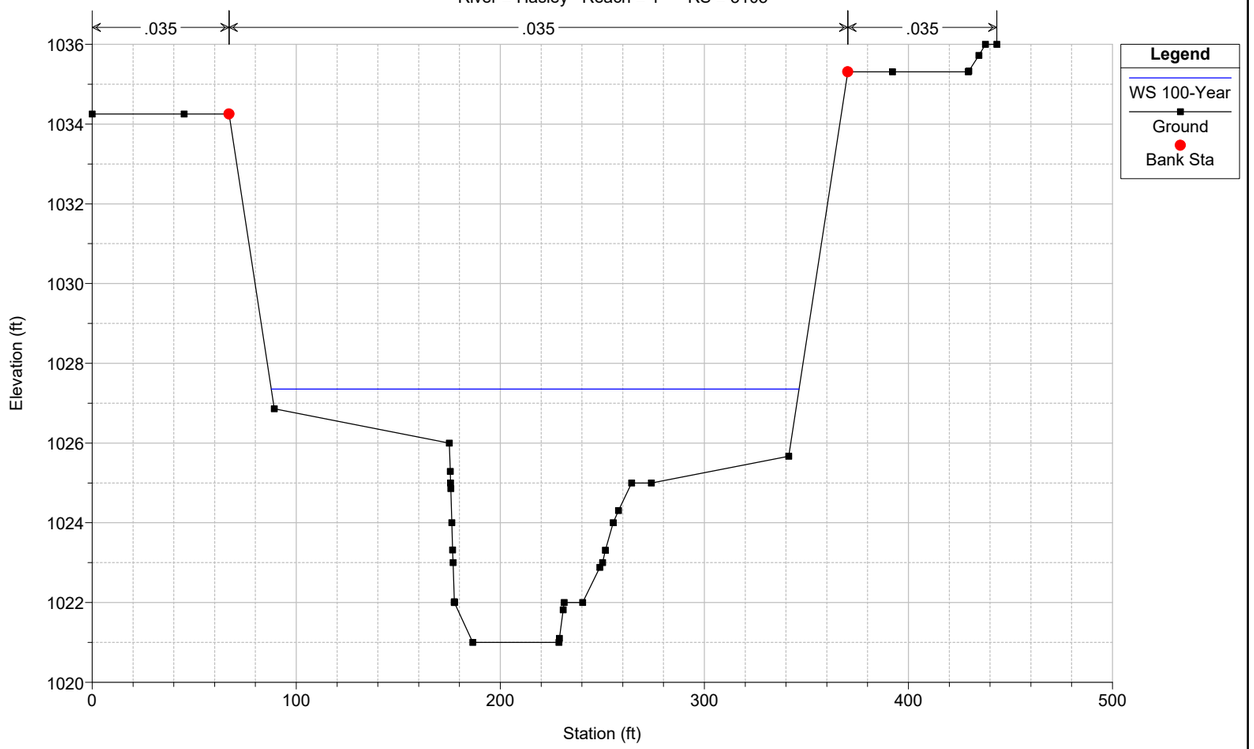
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3190.5



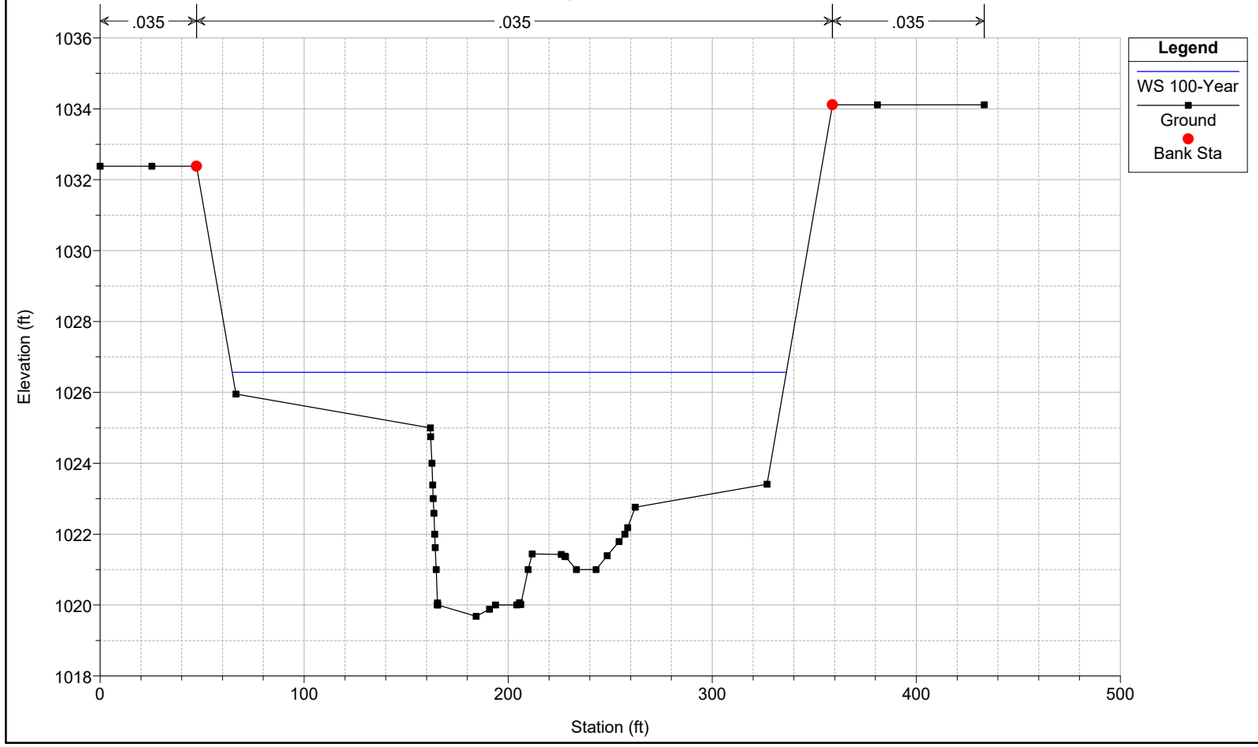
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3105



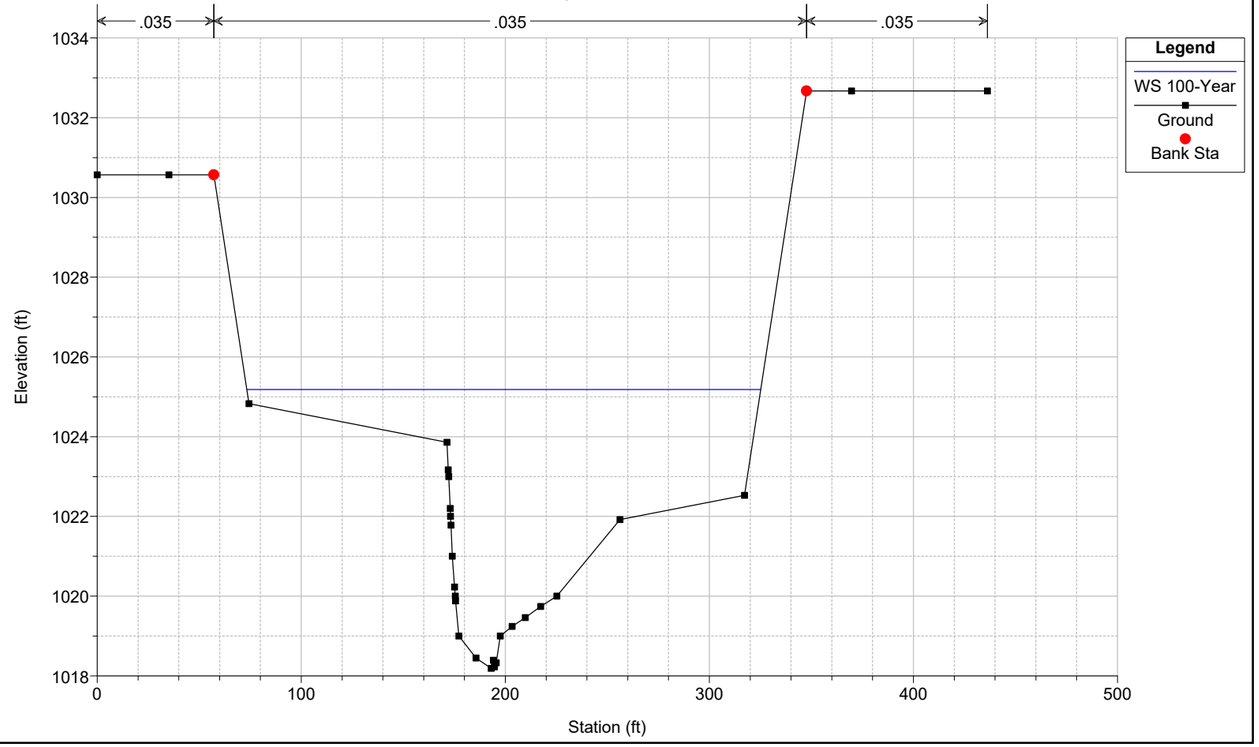
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 3020



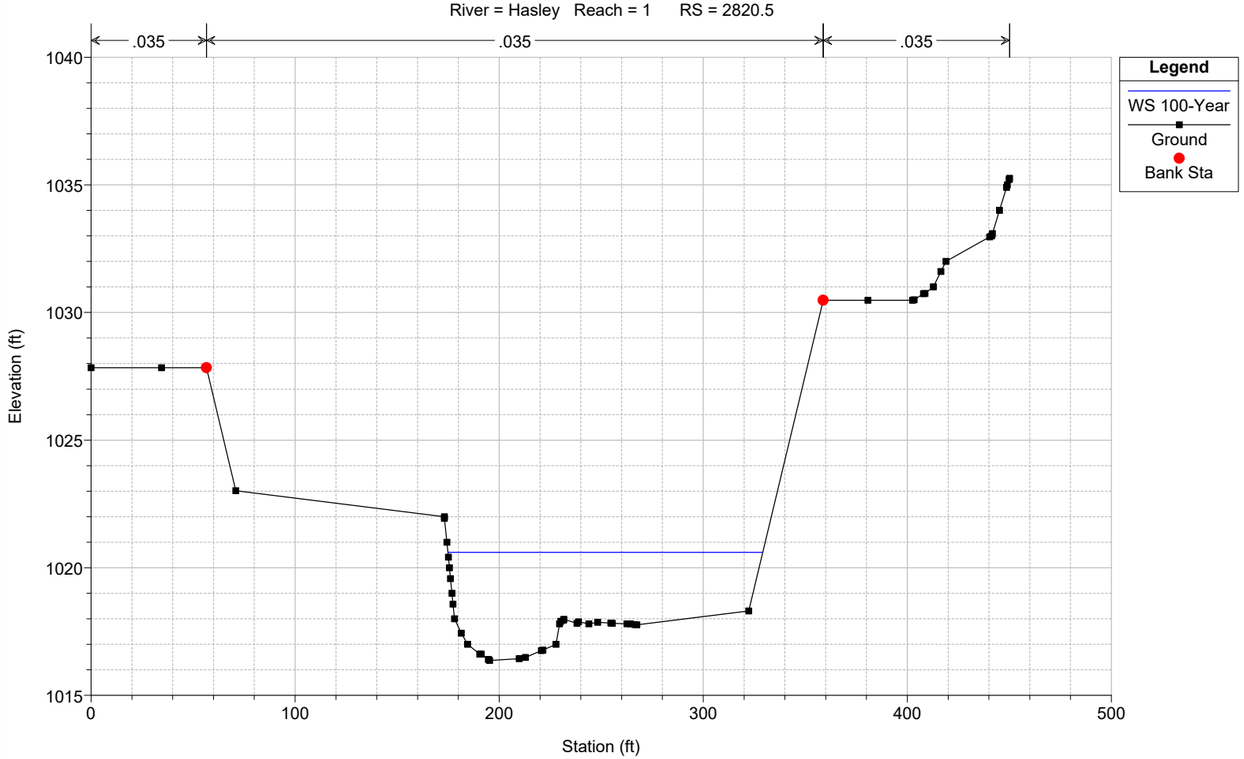
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2934



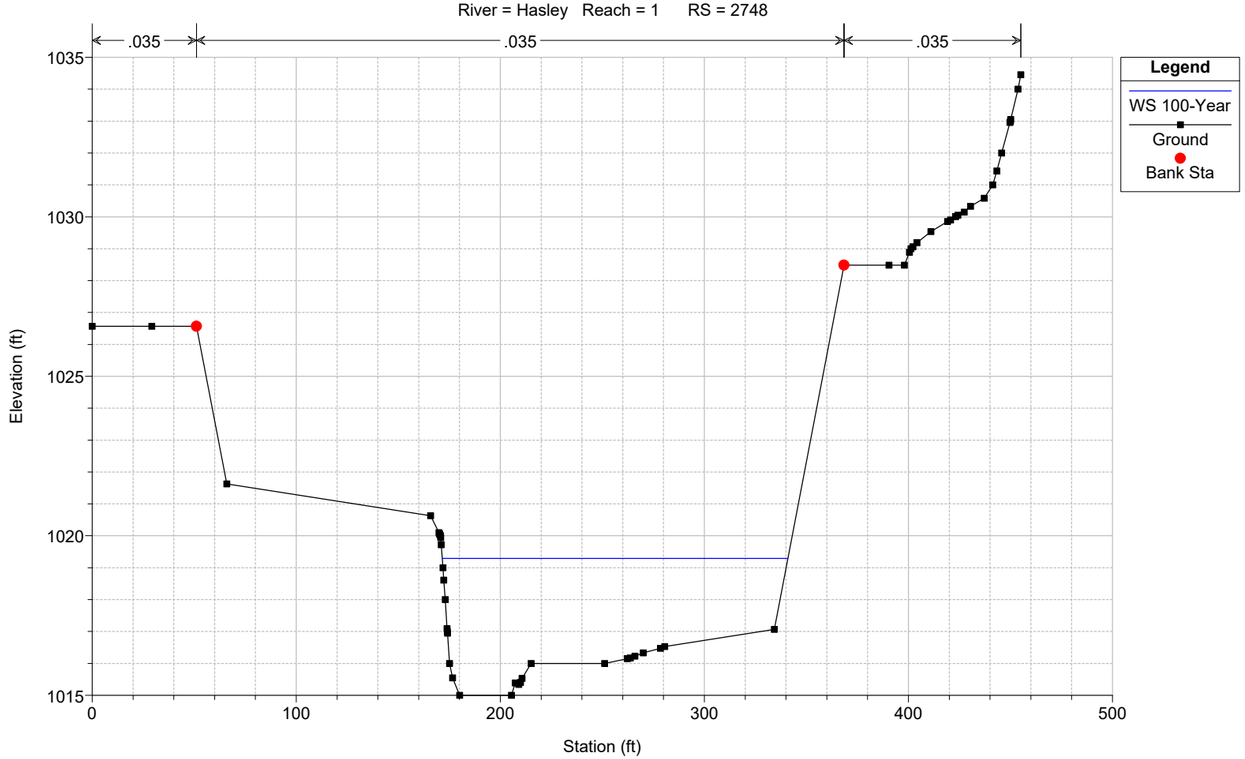
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2820.5



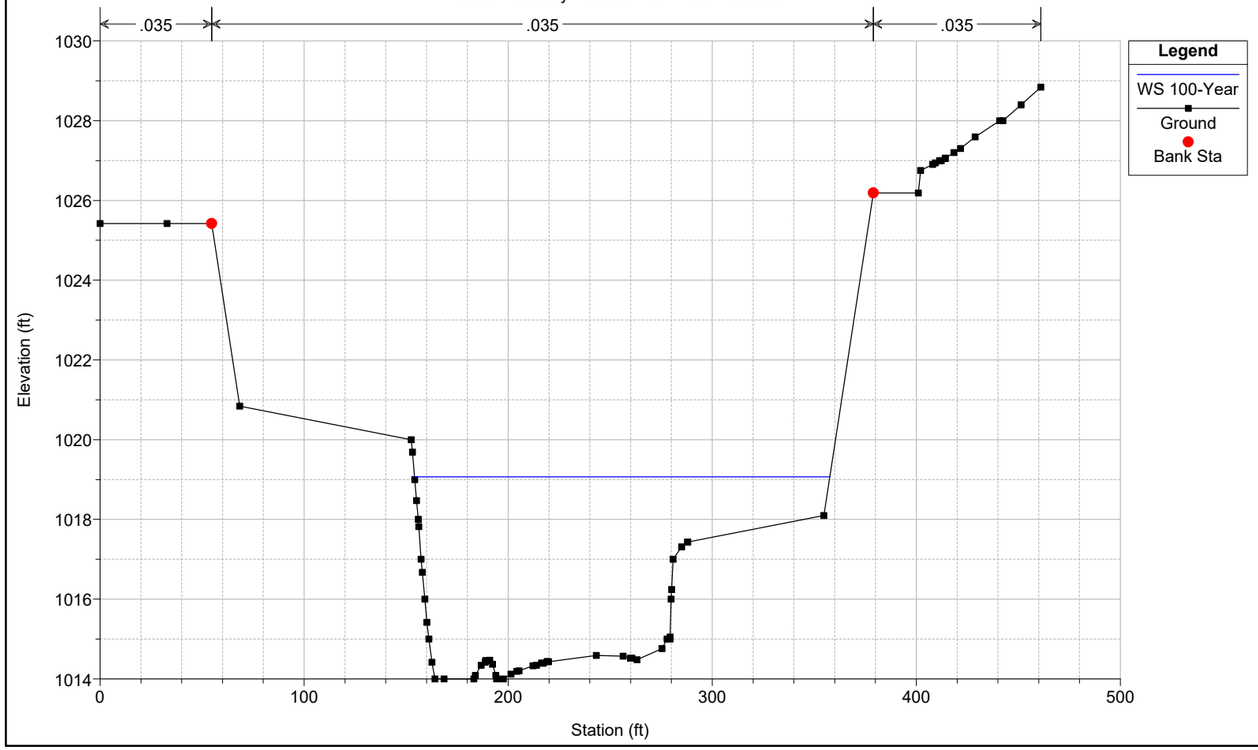
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2748



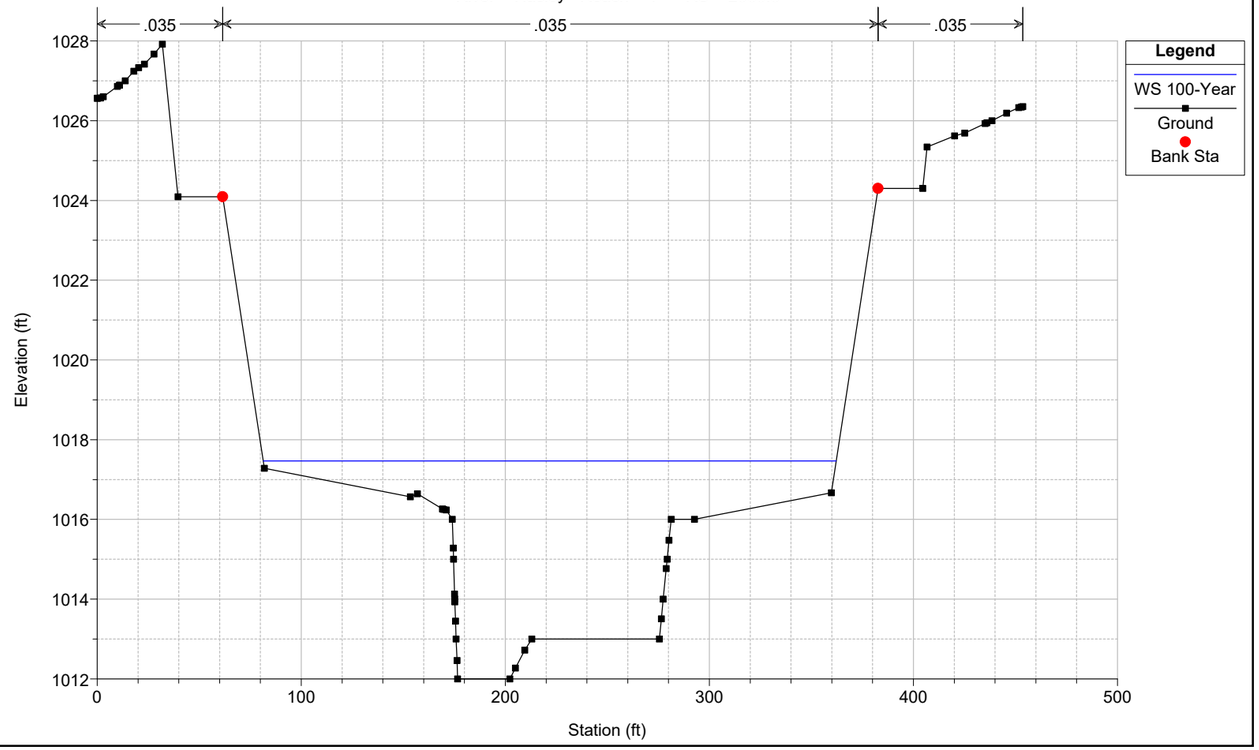
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2675.5



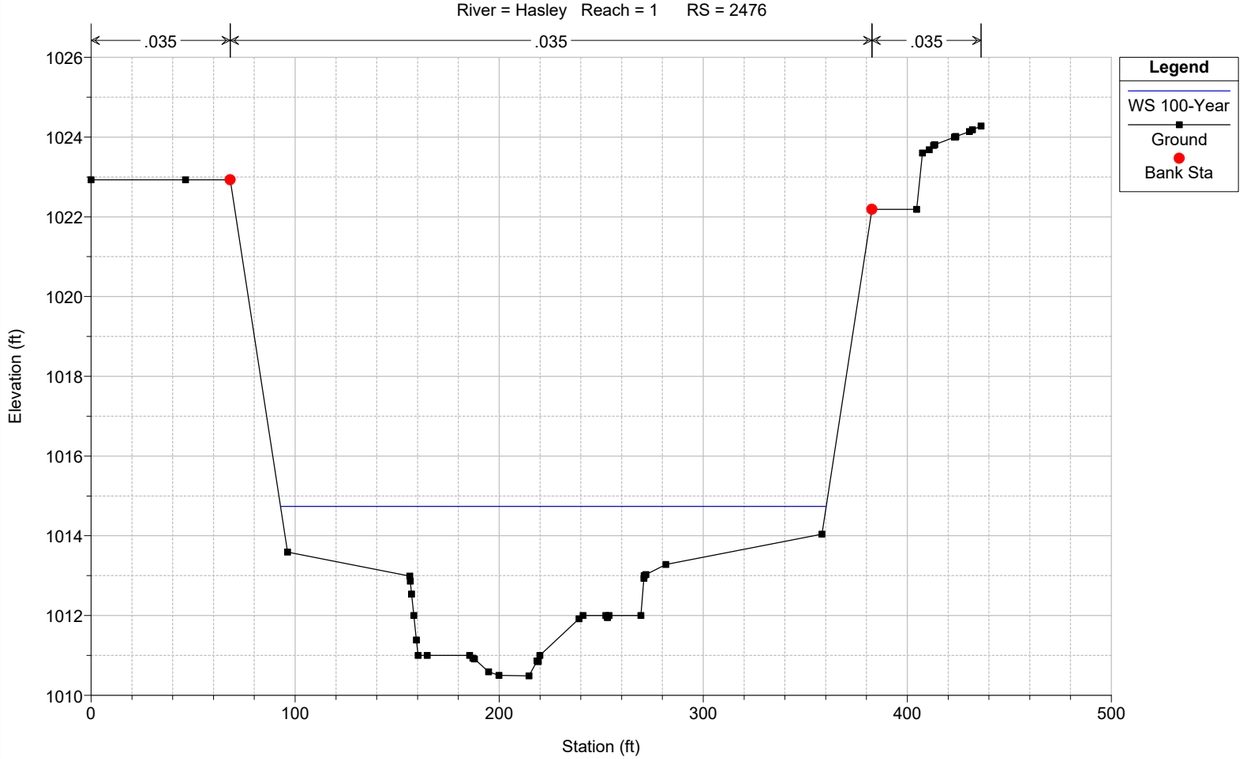
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2560.5



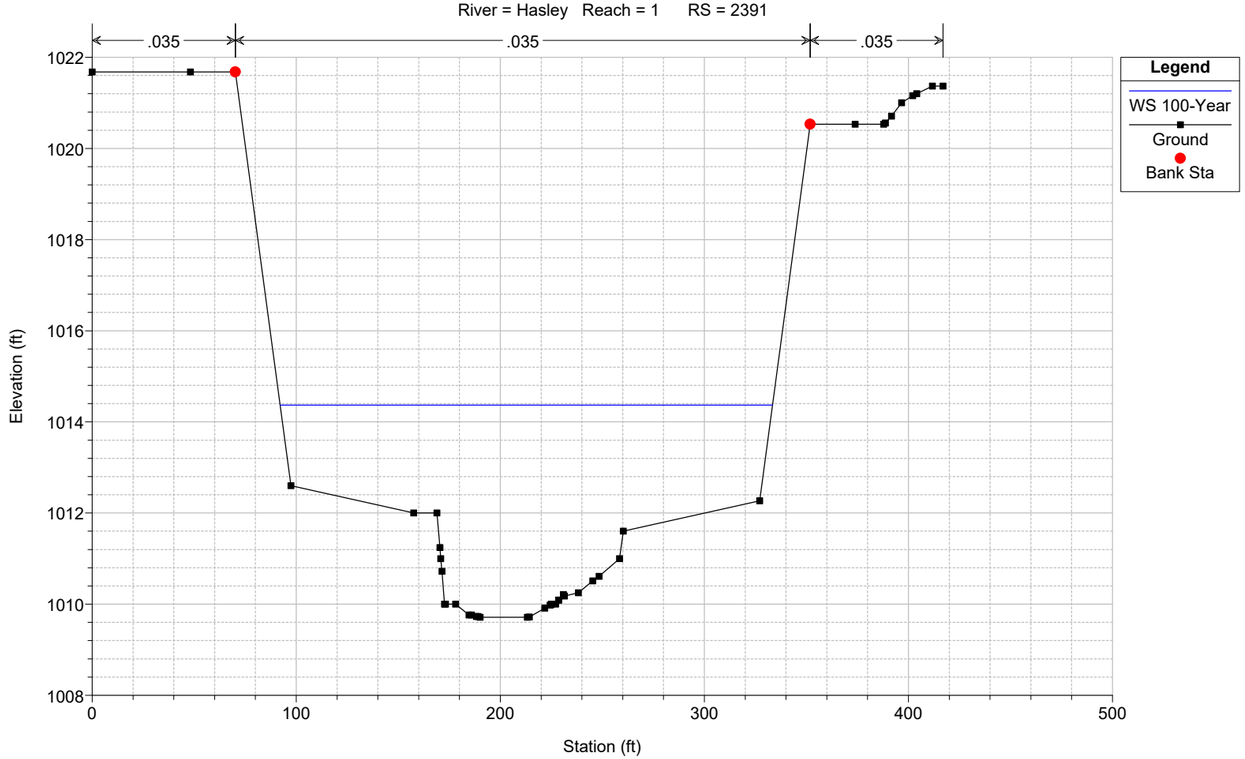
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2476



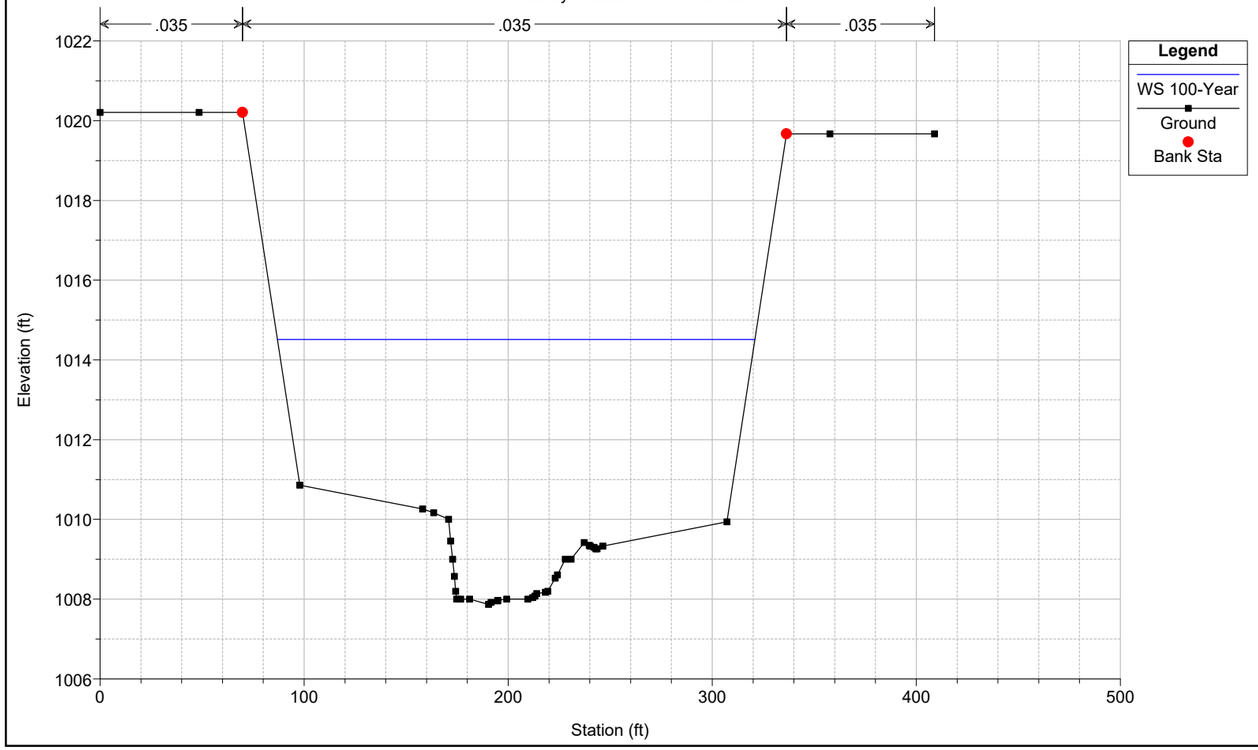
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2391



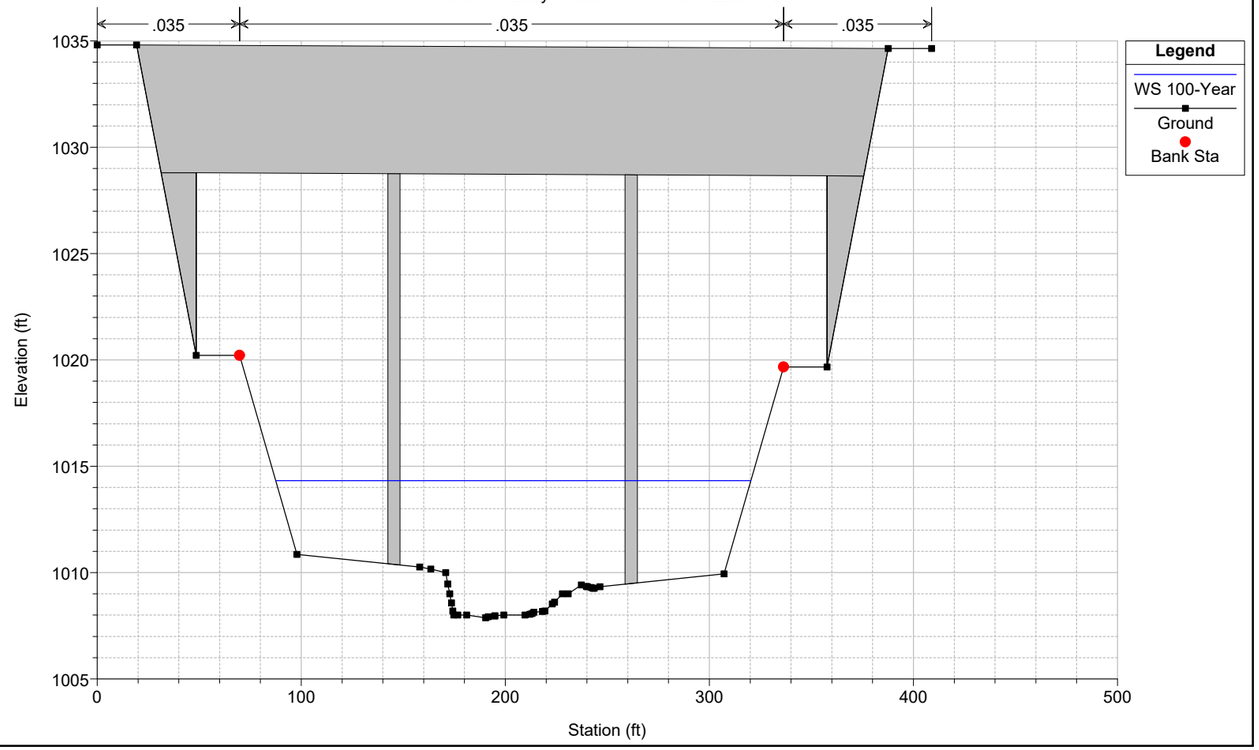
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2305.5



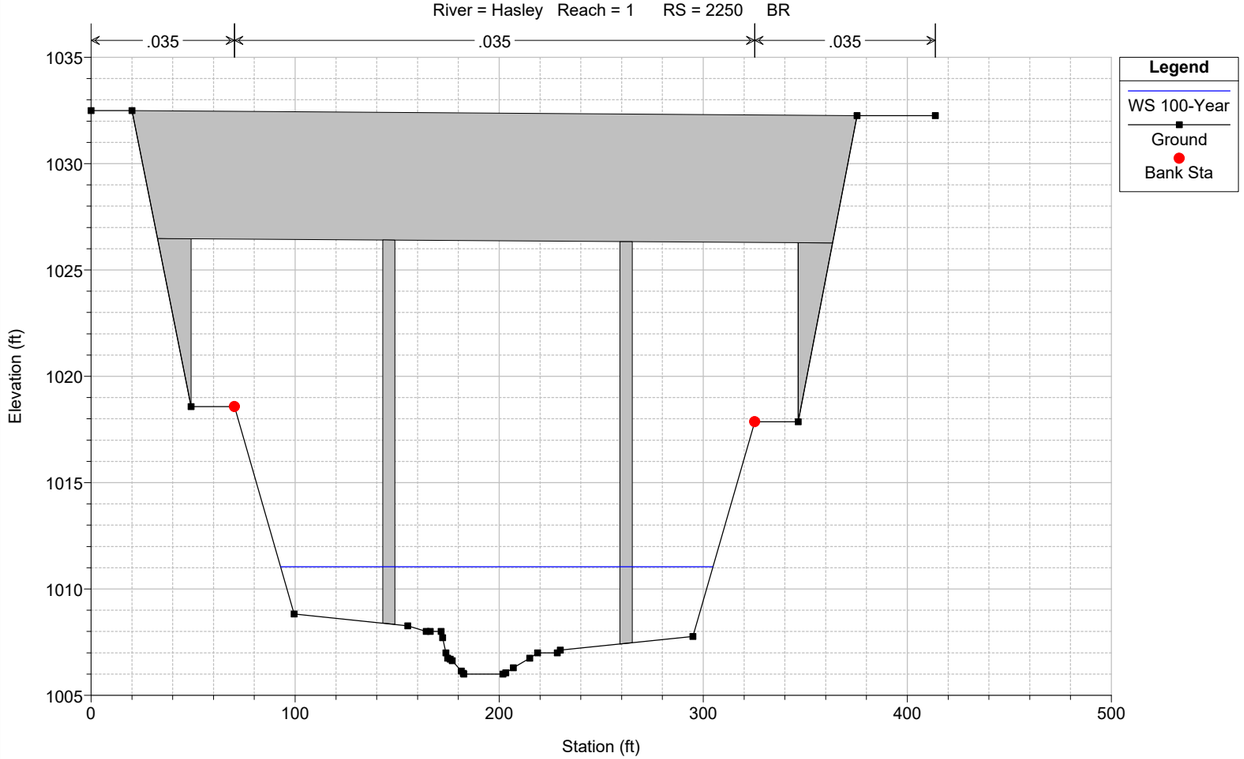
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2250 BR



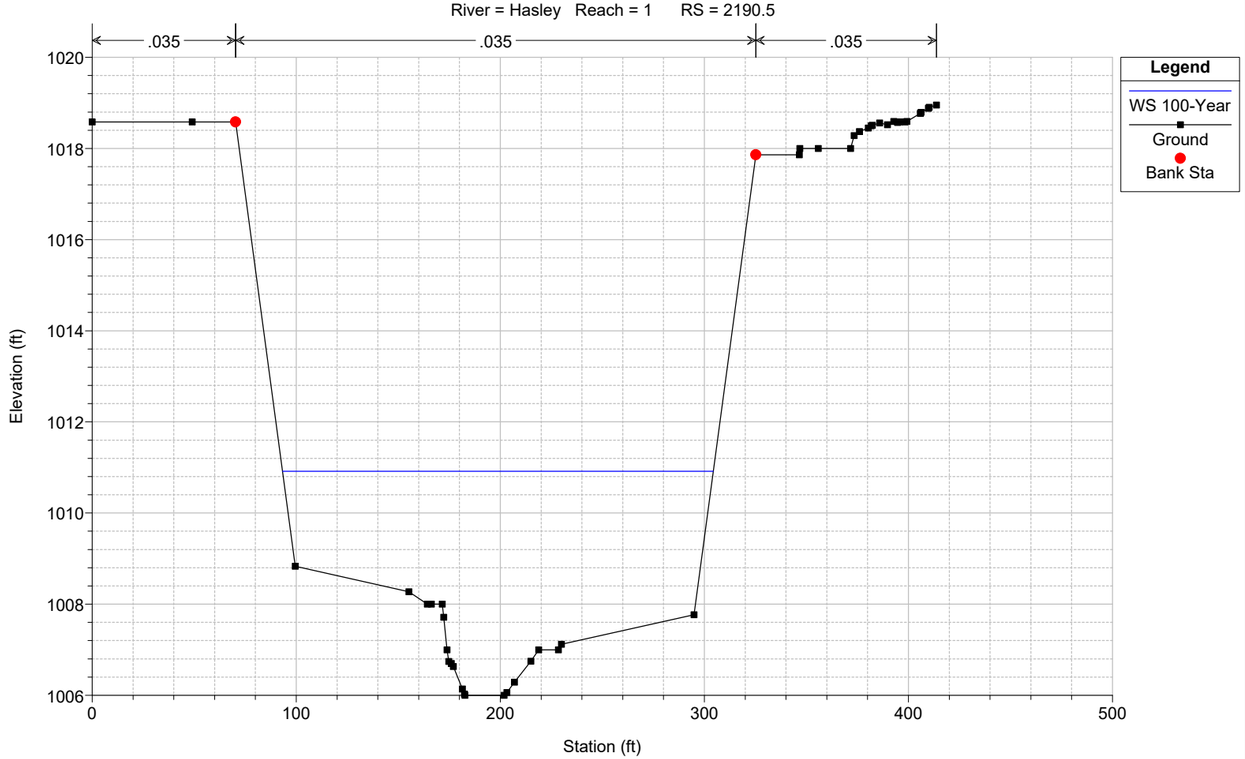
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2250 BR



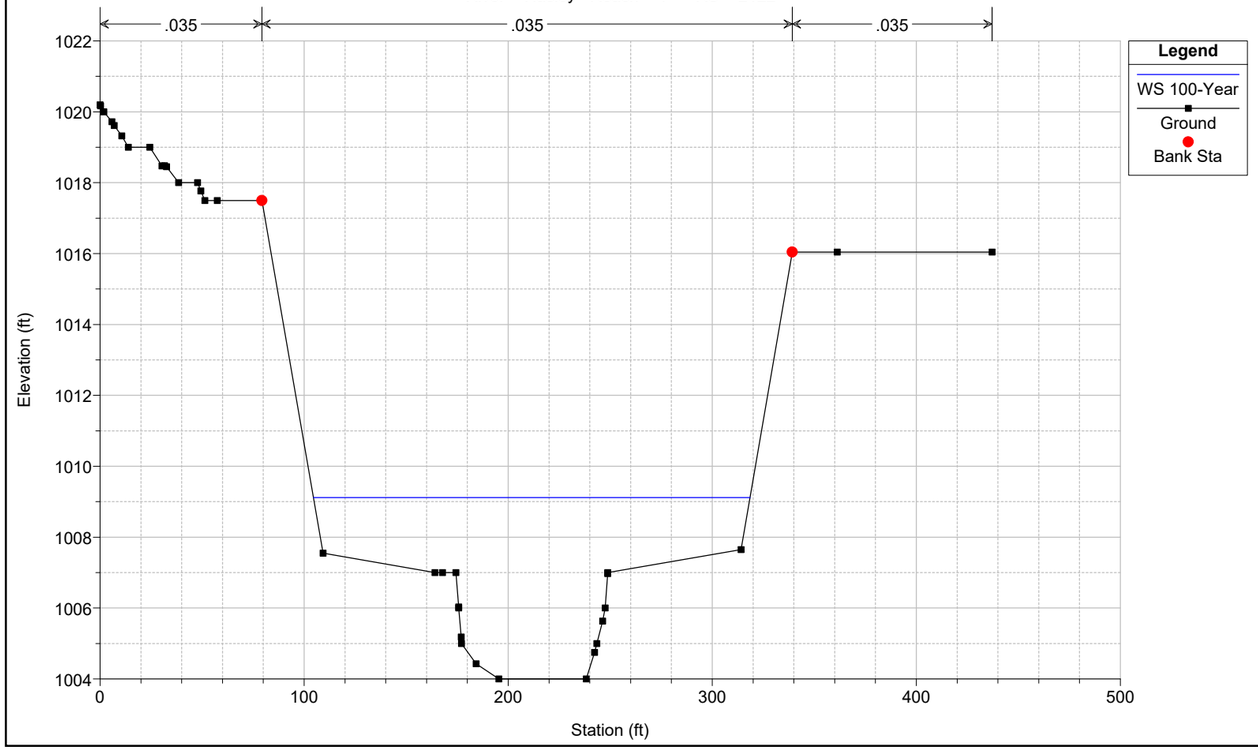
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2190.5



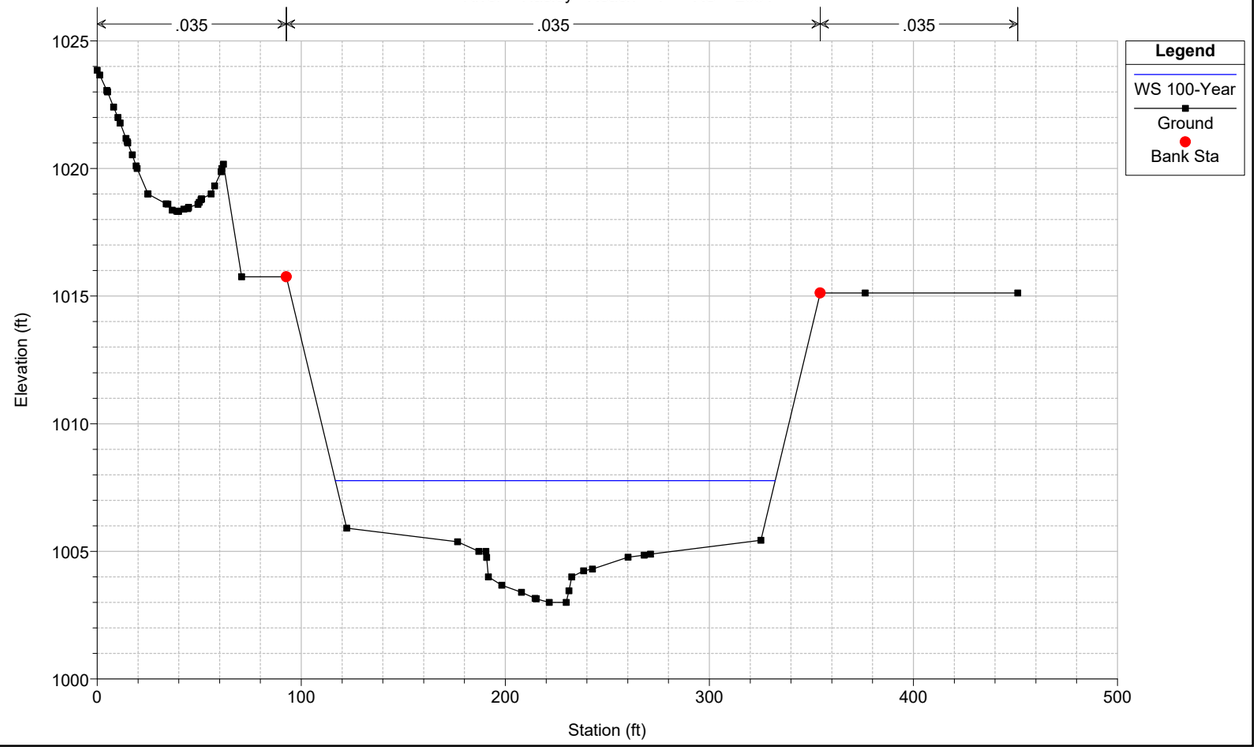
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2122



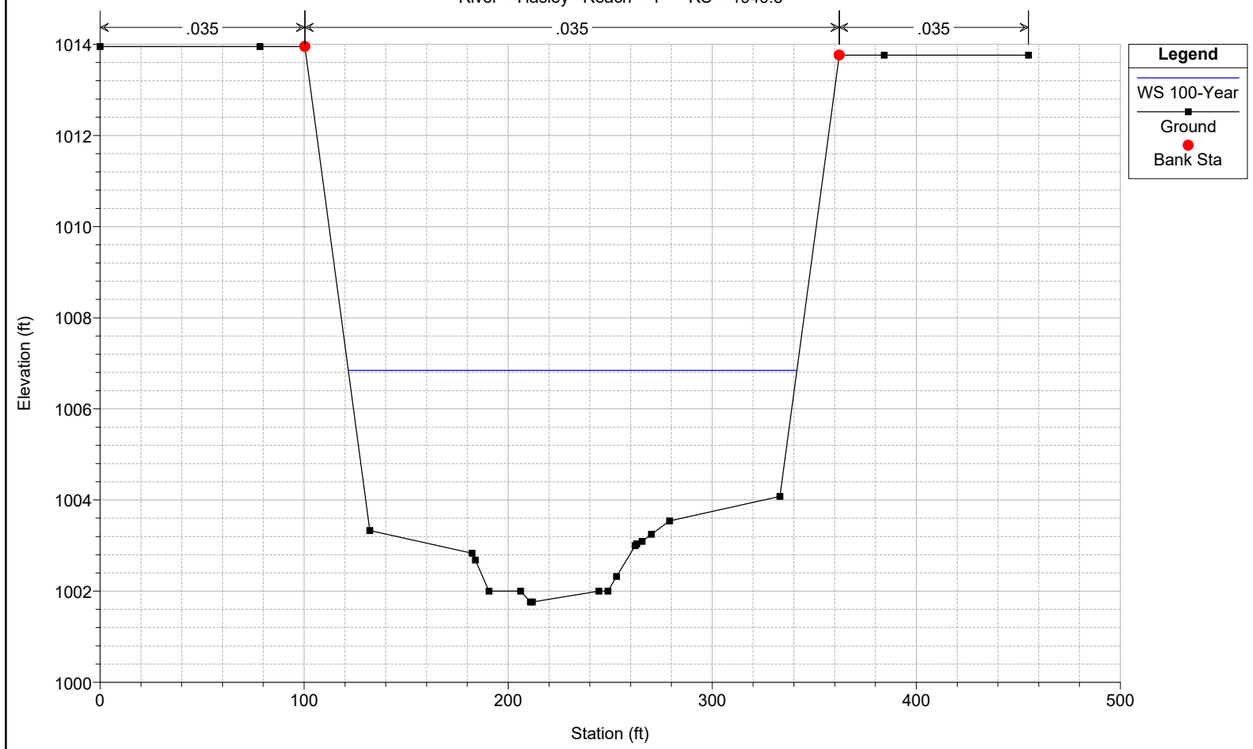
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 2054



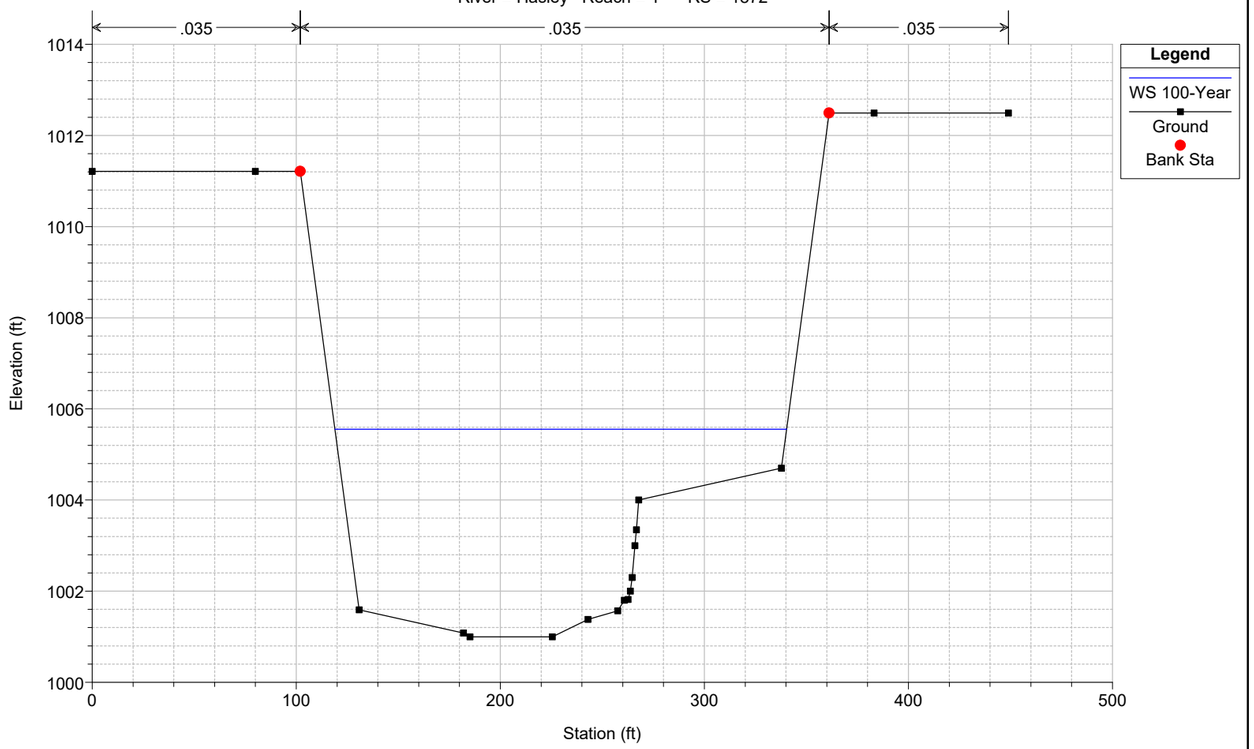
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1940.5



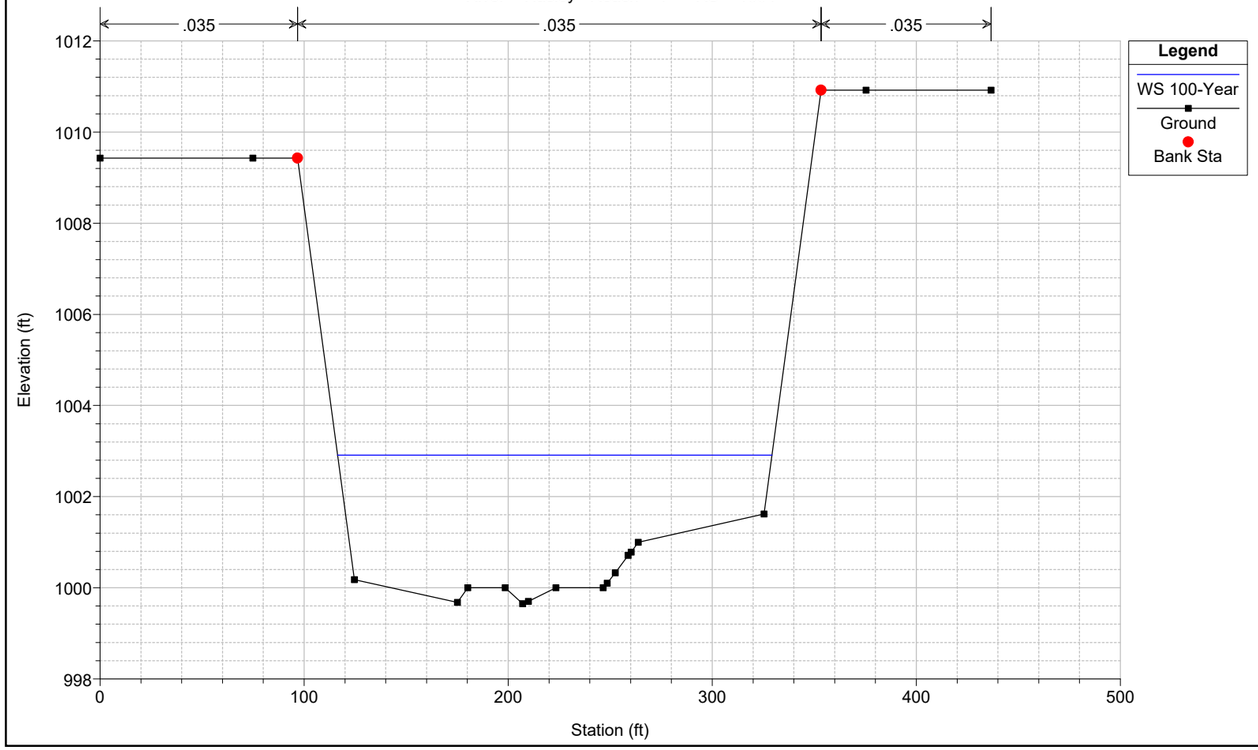
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1872



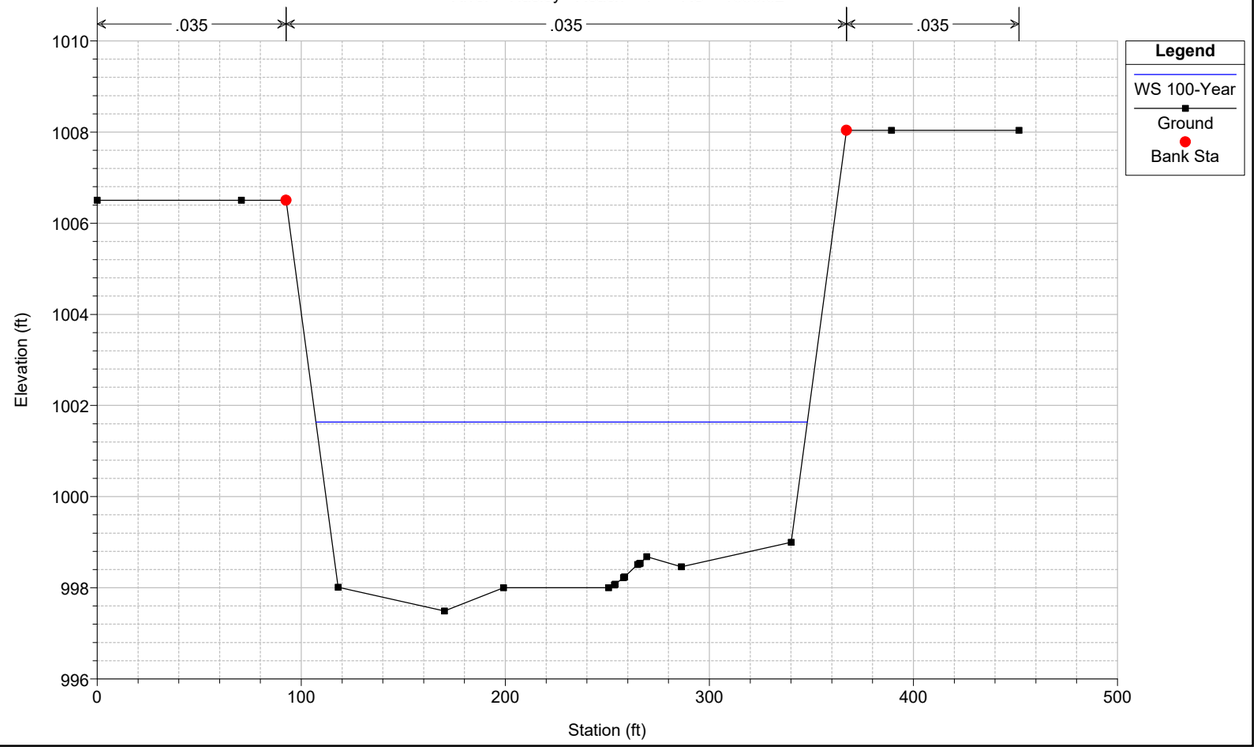
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1804



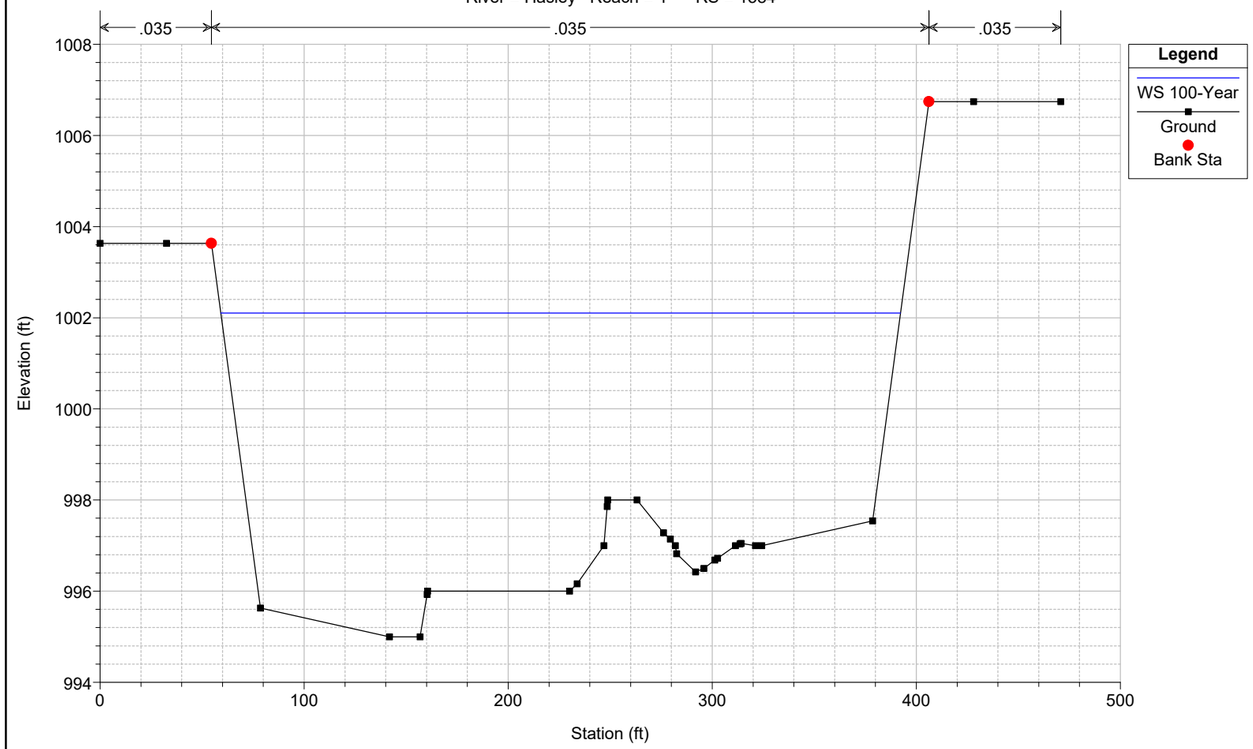
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1688.62



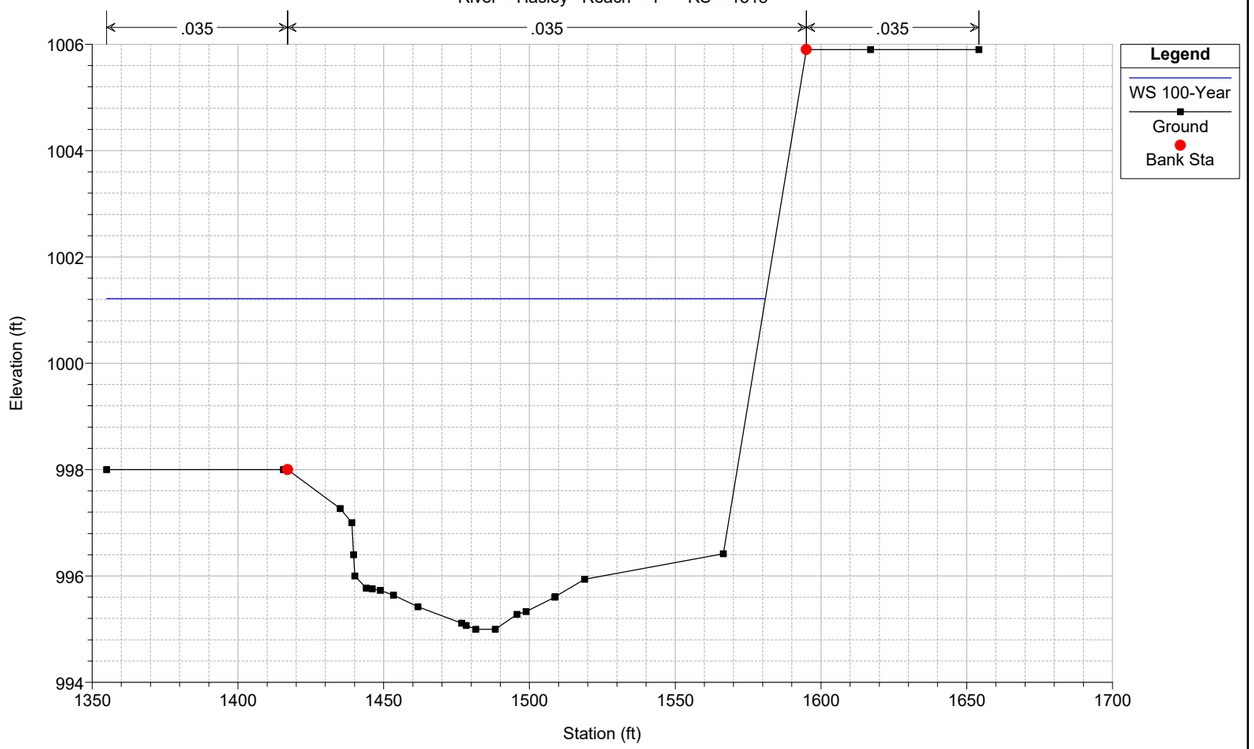
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1584



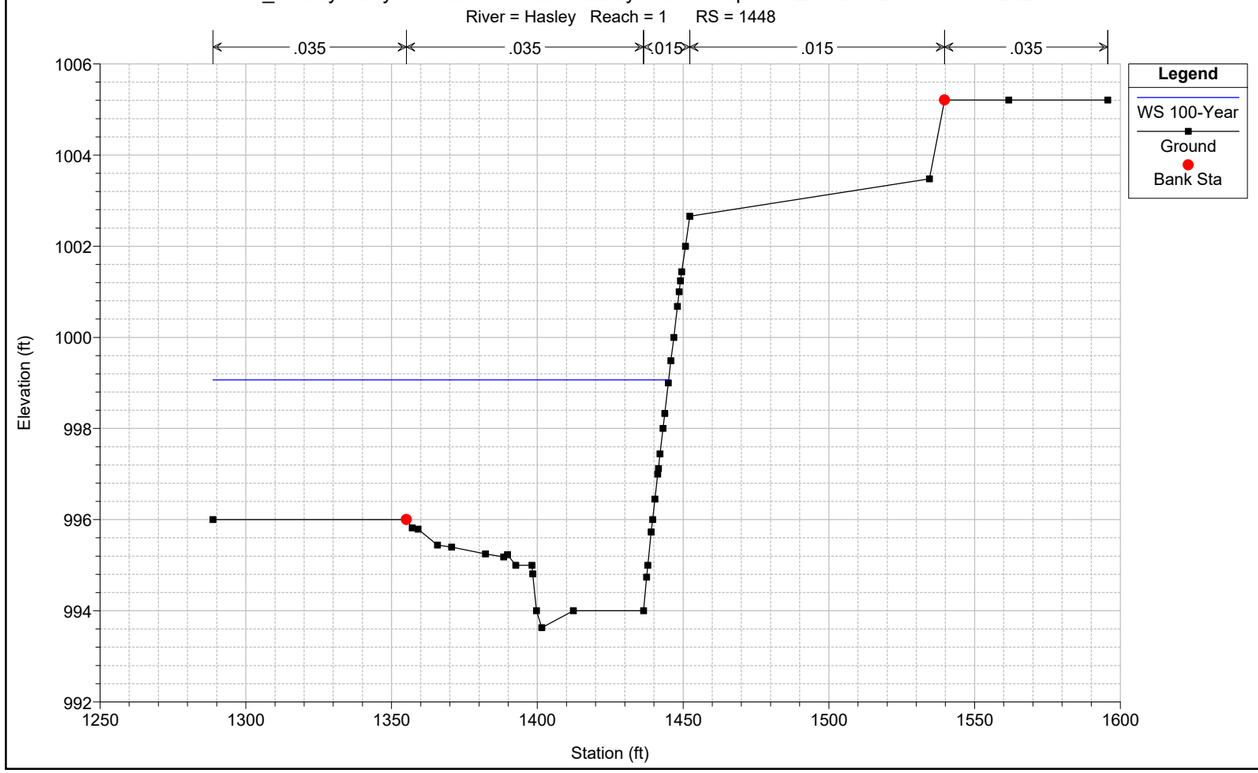
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1518



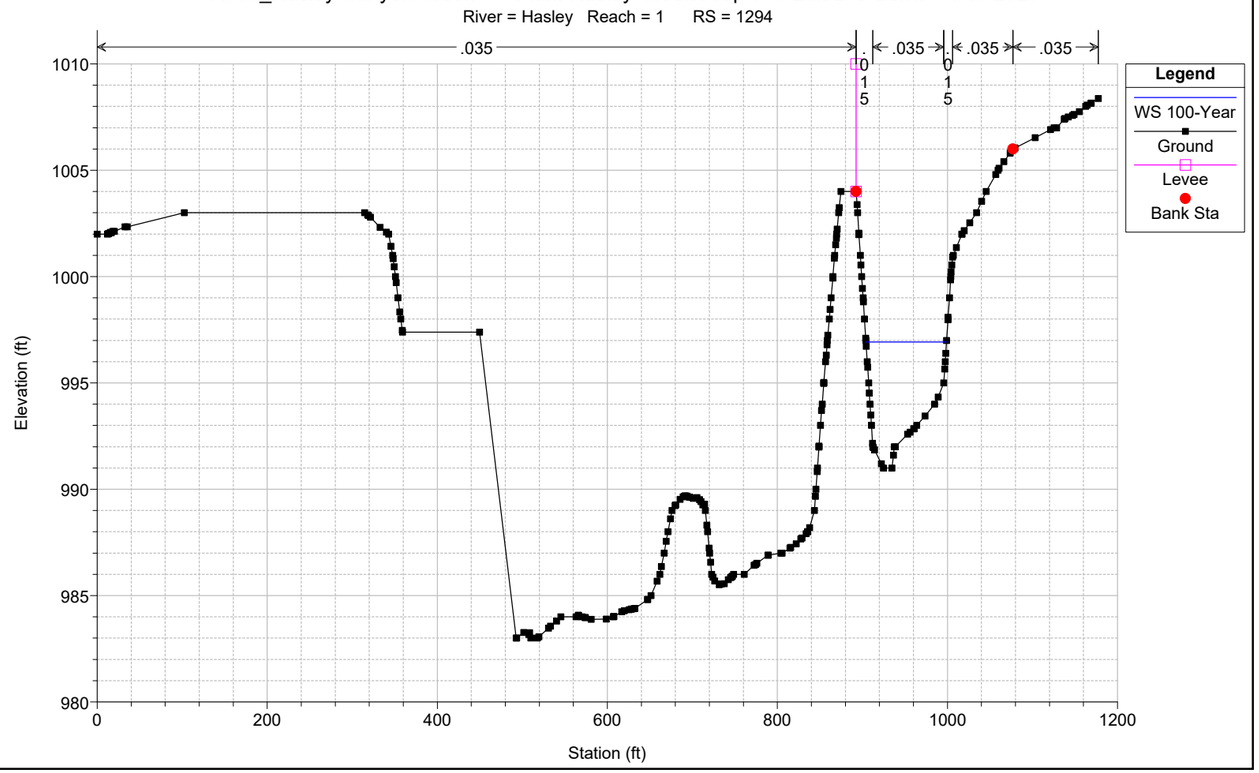
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1448



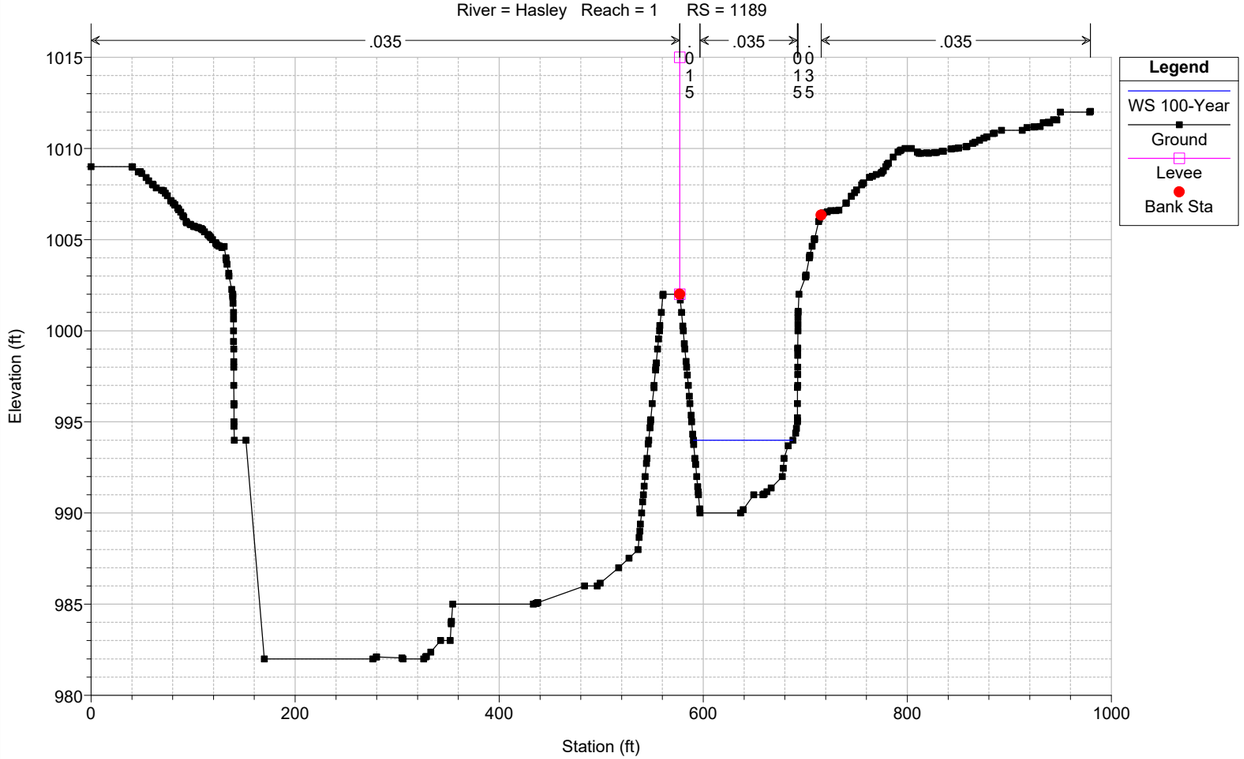
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1294



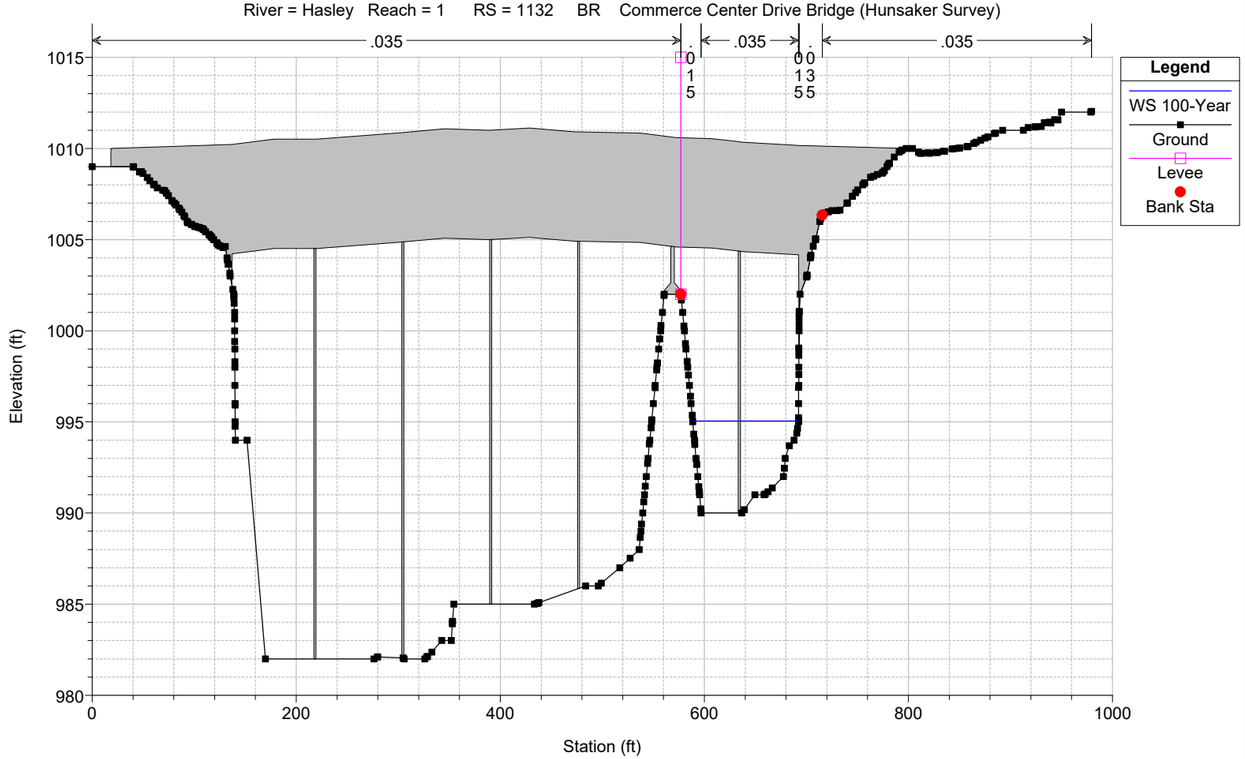
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1189



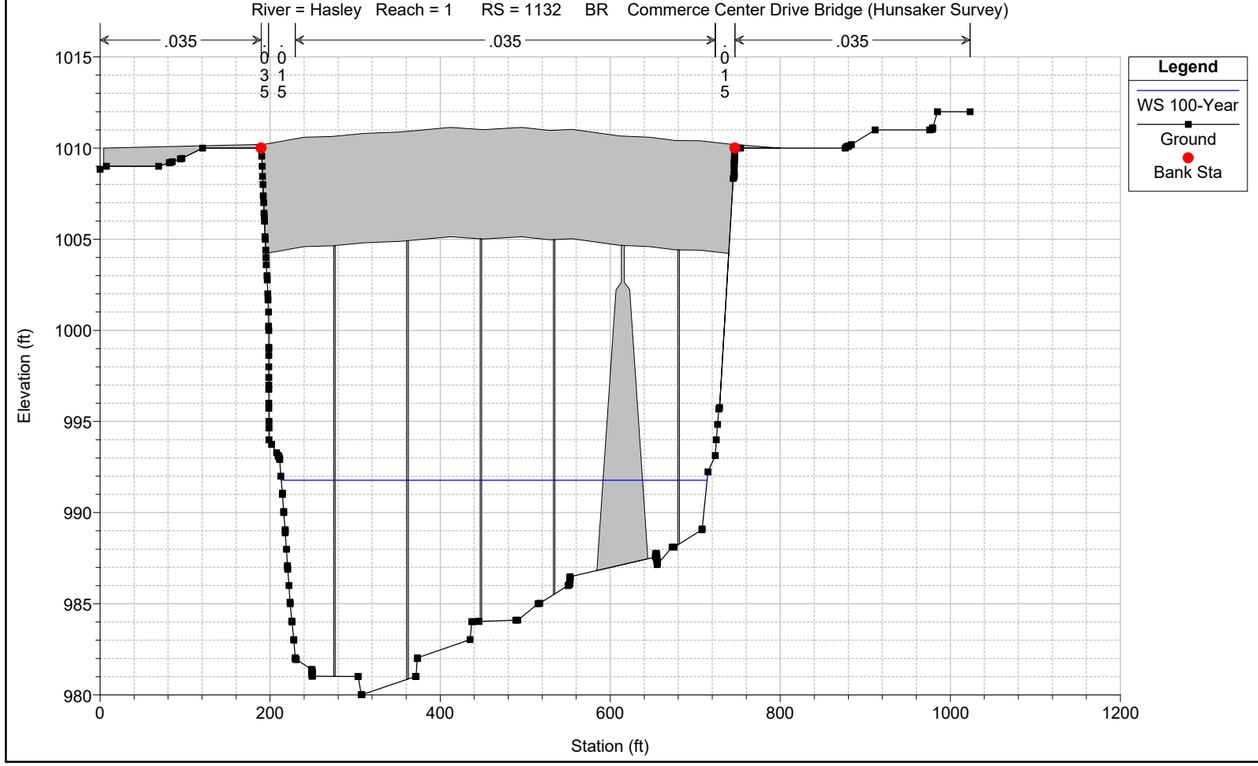
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)



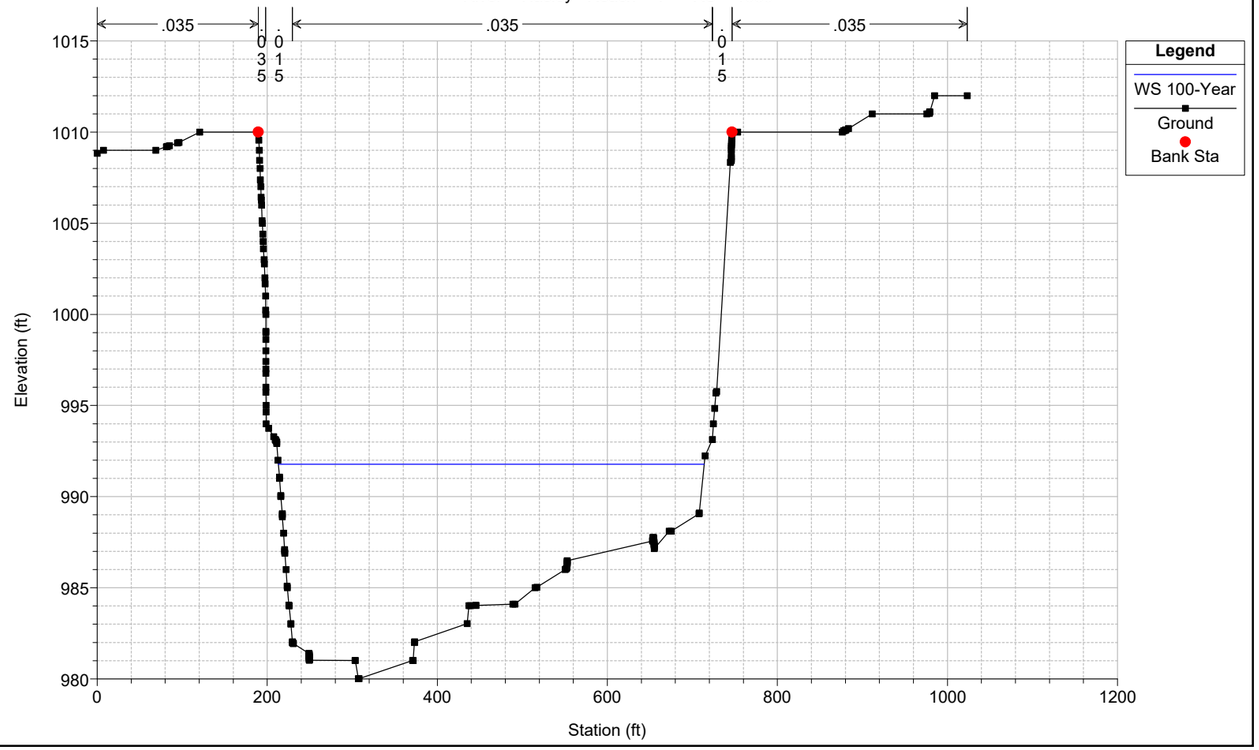
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1132 BR Commerce Center Drive Bridge (Hunsaker Survey)



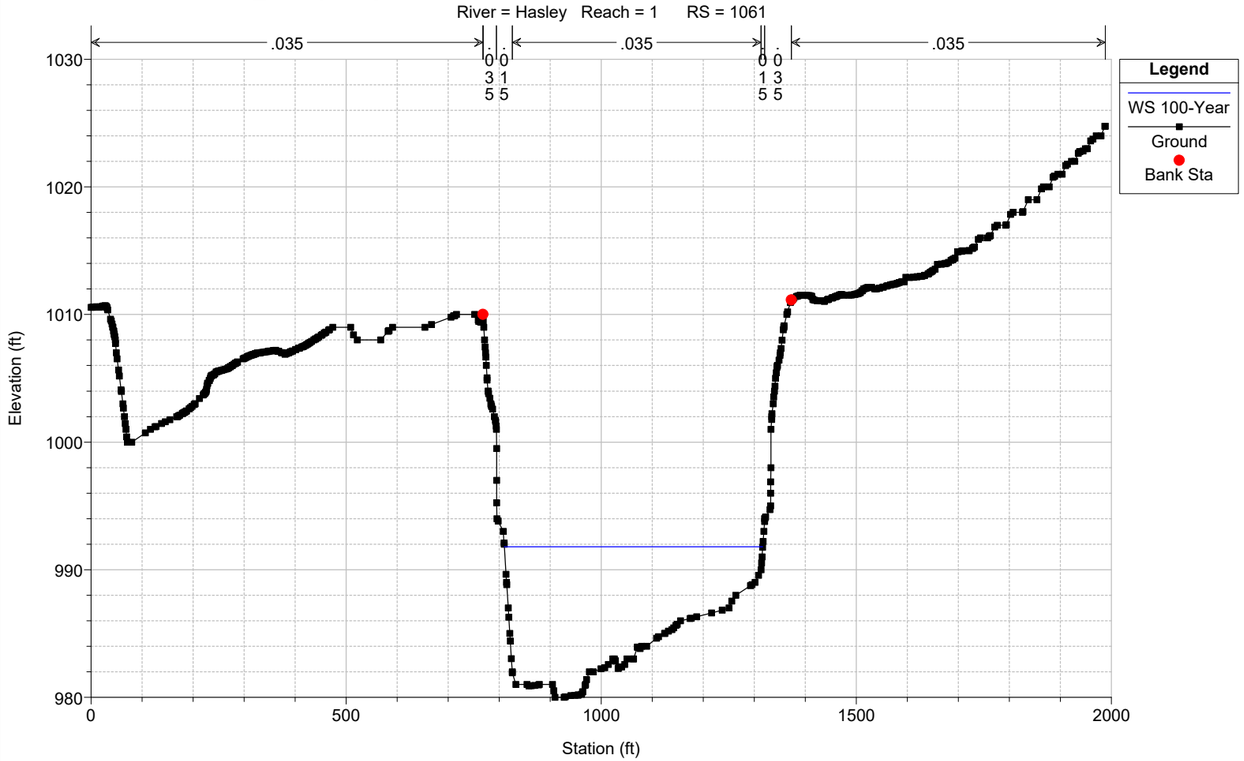
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1080



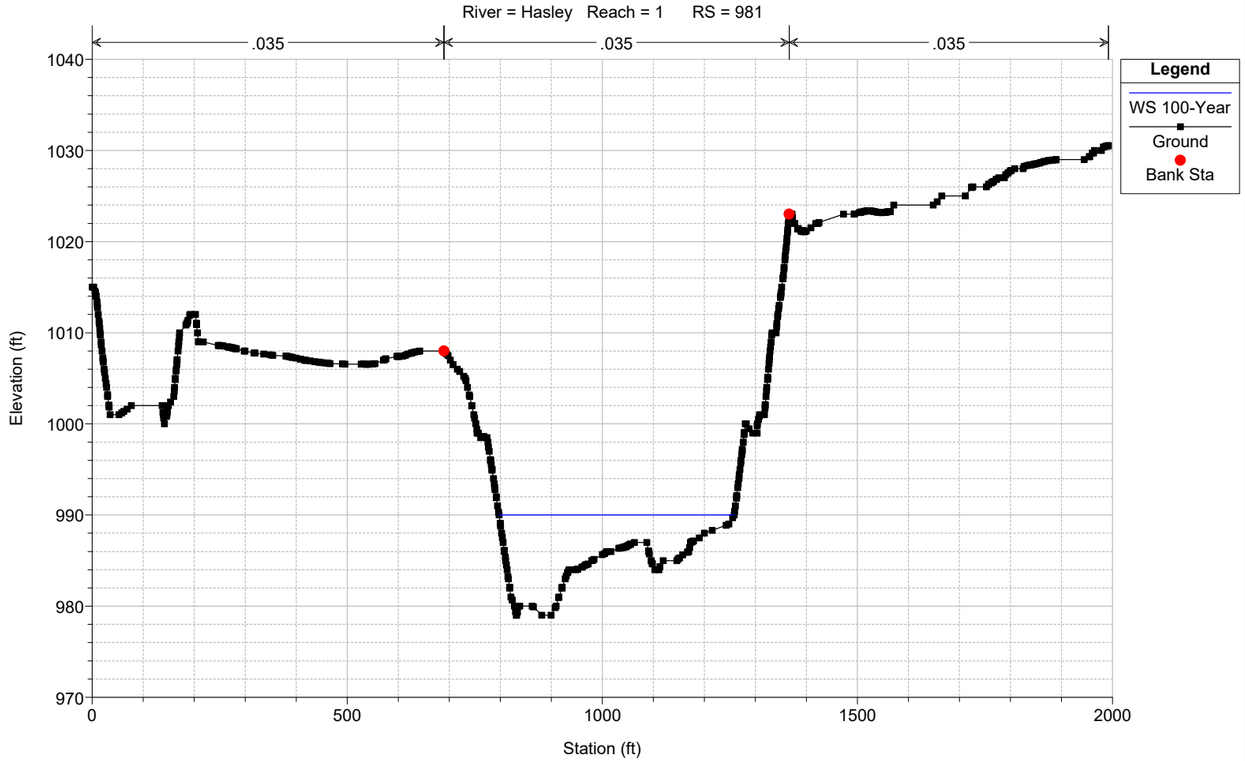
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 1061



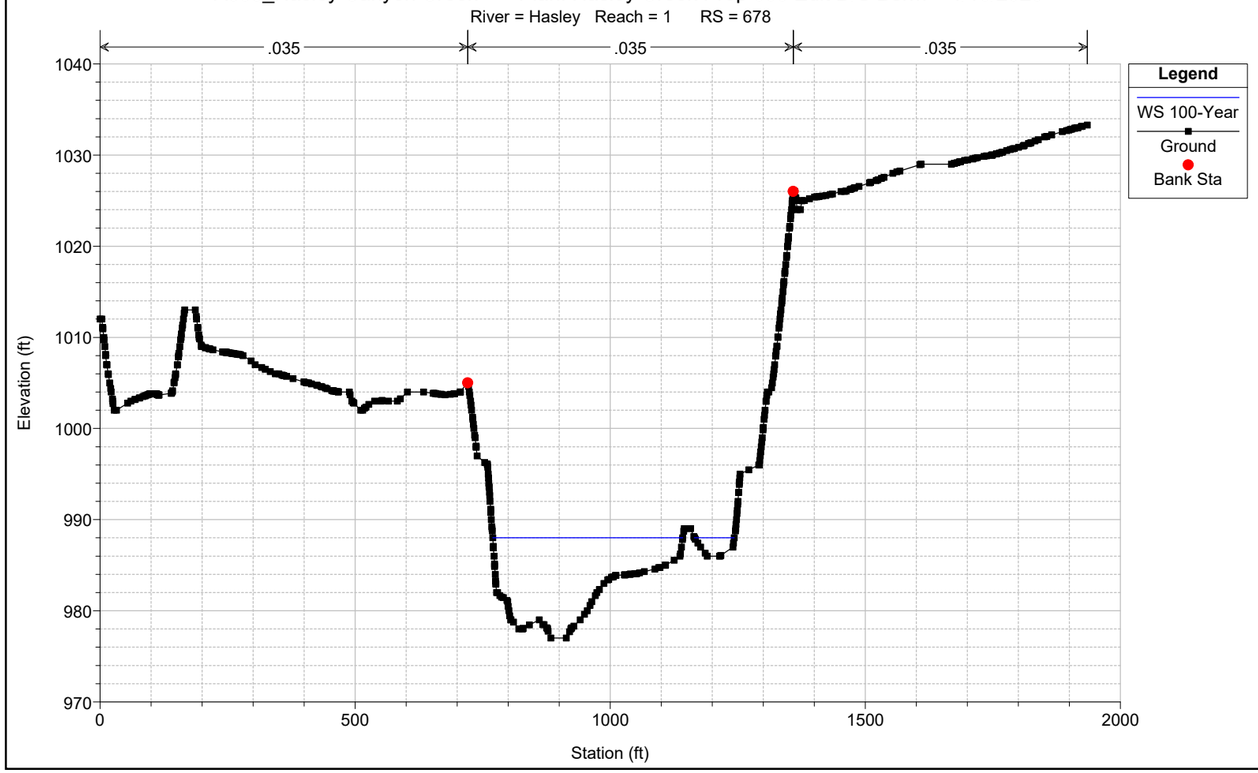
A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 981



A535_Hasley Canyon Creek Plan: Hasley Creek Prop 035 Edit D/S Berm 4/16/2020

River = Hasley Reach = 1 RS = 678



PACE
Advanced Water Engineering

Technical Memorandum

Date: March 20, 2018

To: Andrew Ross, PE – LADPW Land Development
Michele Chimienti, PE – LADPW Land Development

From: Mark E. Krebs, PE – PACE
Jose Cruz, PE – PACE

Re: Launch Stone Design Methodology # 9862E

Introduction

Due to environmental constraints, potential high groundwater during construction, along with the difficulty and expense of dewatering, Newhall Land will be using launch stone rip-rap in conjunction with soil cement for bank protection in lieu of traditional full depth soil cement bank protection for the Mission Village - San Jose Flats project. The combination of launch stone and soil cement bank protection has been approved by LACDPW, and implemented in previous cases; however, the design procedure for launch stone is not standardized or provided in LACDPW Manual. The purpose of this memorandum is to review the current approach used to determine the volume and sizing requirements of the launch stone rip-rap, and propose an alternative approach for use with the bank stabilization design associated with San Jose Flats bank, as shown in Figure 1.

Design Procedure for Bank Protection with Launch Stone

The design of bank protection (flood and erosion protection) involves the calculation of freeboard and scour (cut-off) depth, which is used to establish the top and toe for the proposed bank protection. LACDPW has established minimum requirements for freeboard and cut-off depth, which are described in the Sedimentation Manual and Hydraulic Design Manual. In some cases, the presence of high groundwater may prevent traditional bank protection from being installed to the required cut-off depth without dewatering. In these cases, LACDPW has approved the use of launch stone, rip-rap placed above the groundwater level to provide a rip-rap apron that can provide protection against scour in areas where traditional full-depth bank protection could not be installed.

The procedure for designing the launch stone (rip-rap apron) begins with determining the minimum required volume of rip-rap material. The required volume of rip-rap is calculated based on the volume of soil cement not placed due to high groundwater encountered during construction. This volume is determined on a cross-sectional basis, where the unit volume of rip-rap is calculated at each cross-section using the groundwater elevation and the toe of bank elevation. In accordance with LACDPW requirements, the toe of bank protection is based on the required cut-off depth, which is calculated using velocity results from the HEC-RAS model using a minimum roughness value of n = 0.025 and a mixed flow regime.

Based on previous project applications and discussions with LACDPW, the volumetric ratio of 2.2 to 1 (rip-rap to soil cement) has been used to determine the minimum required launch stone rip-rap volume. Therefore, the launch stone apron will have more than twice the volume of the soil cement bank protection it replaces. A typical cross-section for bank protection using soil cement and launch stone is

shown on Figure 2, which illustrates the portion of soil cement not placed, and the corresponding volume of the launch stone apron.

Current Approach to Launch Stone Sizing

The next step in the process is to determine the rip-rap sizing to be used for the launch stone apron. In previous cases, the velocity from the proposed project condition HEC-RAS model (using manning's roughness of n = 0.025 and mixed flow regime) at each cross-section location was used and compared to the range of velocities presented in the rip-rap sizing chart in the LACFCD Hydraulic Design Manual to determine the corresponding rip-rap size. The rip-rap sizes determined for the study reach are then adjusted for consistency and to provide smooth transitions between varying rip-rap sizes. Applying this previously used methodology, without adjusting for consistency and smooth transitions, the rip-rap sizing for San Jose Flats is as shown in Table 1.

Table 1 – Hydraulic Model Results for Qcap and n=0.025

HEC-RAS River Station	Minimum Channel Invert	Water Surface Elevation	Flow Depth	Velocity	Froude Number	Launch Stone Size (D_{50})
	(ft)	(ft)	(ft)	(ft/s)	(ft/ft)	
34310	963.0	971.5	8.5	19.0	1.2	4-Ton (54")
34090	962.0	970.3	8.3	17.6	1.4	2-Ton (43")
33880	960.0	970.3	10.3	14.2	1.0	1-Ton (34")
33710	959.0	968.6	9.6	16.0	1.2	2-Ton (43")
33500	958.0	968.1	10.1	14.5	1.0	1-Ton (34")

Results of this analysis indicate abrupt changes in the HEC-RAS model flow depth and velocity between cross-section locations, and also show the flow regime fluctuating between critical and supercritical flow. Given the amount of flow in the River, these abrupt changes in depth and velocity are unexpected and appear to be a result of hydraulic model instability resulting from the combination of using a mixed flow regime with a very low manning's roughness value. The low manning's value of 0.025 is used to determine maximum cut-off depth with a factor of safety. We contend that this low manning's value is not appropriate (overly conservative) for selection of the launch stone rip-rap size.

Alternative for Manning's Roughness Value Assessment

In order to provide accurate hydraulic modeling results to be used for rip-rap sizing in launch stone design, PACE proposes to use a more suitable, yet still conservative, manning's value that represents the minimum roughness and characteristics of the study reach being analyzed. The roughness value will be determined using the Cowan method, as outlined in USGS Water Supply Paper 2339 (*Arcement, USGS, 1989*). The Cowan method estimates the effects of the type and size of the materials that compose the bed and banks of the natural channel, as well as the channel's shape, in order to determine its roughness value. In this procedure, the roughness value is defined by several characteristics of the natural channel such as surface irregularity, variation in channel geometry, obstructions in flow path, density of vegetation, and stream meandering.

The value of 'n' may be computed using the following equation:

$$n = (n_b + n_1 + n_2 + n_3 + n_4)\, m$$

Where:

n_b = base value of 'n' for a straight, uniform, smooth channel in natural materials
n_1 = correction factor for the effect of surface irregularities
n_2 = value for variations in shape and size of the channel cross section
n_3 = value for obstructions
n_4 = value for vegetation and flow conditions
m = correction factor for meandering of the channel

For sand channels, the base 'n' value may be determined by using Table 3, below, which shows the relationship between median grain size of bed material and values of 'n'. Median grain sizes for the study reach were obtained from the *Newhall Ranch-Santa Clara Phase 1 River Fluvial Study* (*PACE, 2006*) approved by LACDPW in March 2006. Sediment samples were taken at various locations along the River as part of the Fluvial Study. Based on the sediment data for sub-reaches C and D, which corresponds to the study reach for the current analysis, the median grain size for the study reach was found to be 1-mm (See Appendix C for excerpts from Fluvial Study).

Sediment data is also presented in the *Assessment of Geomorphic Processes for the Upper Santa Clara River Watershed* report (*Stillwater Sciences, 2011*). According to this study, the median grain size of the bed (D_{50}) ranges between 0.7-mm and 2-mm for Reach M12, which corresponds to the study reach discussed herein. Since the Fluvial Study was developed specifically for this specific reach of the River, and the fact that the median grain size values coincide with the range of values from the Stillwater Report, the median grain size of 1-mm was assumed for the study reach. Based on Table 2 below, the corresponding roughness value is 0.026 for a median grain size of 1-mm. However, in order to match the LACDPW recommendation of a bare channel condition, the base 'n' value used for this assessment is 0.025.

Table 2 – Base Values of Manning's n

Bed Material	Median Grain Size of Bed Material (mm)	Base 'n' value	
		Straight Uniform Channel	Smooth Channel
Sand Channels			
Sand	0.2	0.012	-
	0.3	0.017	-
	0.4	0.020	-
	0.5	0.022	-
	0.6	0.023	-
	0.8	0.025	-
	1.0	0.026	-
Stable Channels and Flood Plains			
Concrete	-	0.012-0.018	0.011
Rock Cut	-	-	0.025
Firm Soil	-	0.025-0.032	0.020
Coarse Sand	1-2	0.026-0.035	-
Fine Gravel	-	-	0.024
Gravel	2-64	0.028-0.035	-
Coarse Gravel	-	-	0.026
Cobble	64-256	0.030-0.050	-
Boulder	>256	0.040-0.070	-

**Obtained from USGS WSP 2339, Page 4, Table 1*

Channel irregularities (n_1) account for additional roughness caused by eroded and scalloped banks, projecting points, and exposed tree roots along the banks. The degree of irregularity for the sub-reaches within the area of study was assumed to be minor, corresponding to characteristics of carefully dredged channels in good condition but having slightly eroded or scoured side slopes. The range of 'n' adjustment values is between 0.001 and 0.005 for the condition of minor channel irregularity, and 0.005 was chosen based on judgement of the reach.

Roughness due to variation in channel cross section (n_2) is primarily dependent on the number of alternations of large and small sections, with the magnitude of those changes being a contributing factor. Upon careful study of the aerial photography of the study region, cross sections within the channel appear to alternate occasionally and shift from side to side due to the changes in cross sectional shape. The 'n' value adjustment for this condition ranges from 0.001 to 0.005; however, for purposes of this analysis, the adjustment for channel variation has been disregarded.

Obstructions (n_3) – such as logs, stumps, boulders, debris, pilings, and bridge piers – disturb the flow pattern in the channel and increase roughness. Due to the presence of vegetation within the River, some level of obstruction is expected to be present within the sub-reaches studied. Effects of obstruction are assumed to be minor, occupying less than 15 percent of the cross-sectional area, with spacing between obstructions such that the sphere of influence around one obstruction does not extend to the sphere of influence around another obstruction. The range of 'n' value adjustment is between 0.005 and 0.015 for minor effects of obstruction, and thus an 'n' value adjustment of 0.010 was chosen for the sub-reaches within the study area.

Vegetation (n_4) within a channel will impede and obstruct flow, thereby contributing to an increase in roughness. Assuming a condition in which most to all vegetation within the channel is removed; the 'n' value adjustment for vegetation is considered negligible. Although Table 2 of the USGS publication shows that the minimum channel condition category for vegetation is 'small' – corresponding to an 'n' value adjustment between 0.002 and 0.010 – PACE believes it is more appropriate to conservatively assume that the vegetation contribution is zero, to be in line with the County's recommendation of n = 0.025 for a bare channel condition. Substantial vegetation scouring has occurred during larger storm events, but complete removal of all vegetation has not been observed and is a conservative assumption.

The degree of meandering (m) is dependent on the ratio of the total length of the meandering channel in the reach being considered to the straight length of the channel reach. Meandering of the sub-reaches studied appears to have a ratio of 1.0 to 1.2 – corresponding to a minor condition. The contributing 'n' value adjustment for meandering is assumed to be 1.0 for the minor condition, meaning there is no impact to the total 'n' value.

Based on the Cowan method procedure, an assessment of minimum roughness values was prepared for the River in the vicinity of the subject project. Results of the Cowan method assessment are presented in Figure 3, along with a summary of the variables used in the calculation. According to the Cowan method results, a roughness value of n = 0.040 was calculated for the study reach.

Results of Revised Hydraulic Analysis

Using the roughness value of n = 0.040 from the Cowan method assessment, the proposed project condition HEC-RAS model was run to determine the hydraulic characteristics of the River in the vicinity of the project. In an effort to provide a sensitivity analysis and range of results for the designer and reviewer, the proposed project condition HEC-RAS model was also run for roughness values of 0.035 and 0.030. Values for flow depth, velocity and Froude number are presented for these conditions in the following sections.

Hydraulic Analysis for n=0.040

Results of the hydraulic model using a roughness of 0.040 indicate subcritical flow under these conditions, which produces less fluctuation in flow depth and velocity between cross-sections. The range of flow depth and velocity appears to be stable in comparison to results from the model using a roughness of 0.025. Table 3 summarizes the model results for n=0.040 in the vicinity of the project.

Table 3 – Hydraulic Model Results for Qcap and n=0.040

HEC-RAS River Station	Minimum Channel Invert	Water Surface Elevation	Flow Depth	Velocity	Froude Number	Launch Stone Size (D_{50})
	(ft)	(ft)	(ft)	(ft/s)	(ft/ft)	
34310	963.0	973.9	10.9	13.2	0.8	1-Ton (34")
34090	962.0	972.9	10.9	11.6	0.7	1/4-Ton (21")
33880	960.0	971.7	11.7	11.6	0.8	1/4-Ton (21")
33710	959.0	970.8	11.8	11.3	0.7	1/4-Ton (21")
33500	958.0	969.6	11.6	11.6	0.7	1/4-Ton (21")

Hydraulic Analysis for n=0.035

Results of the hydraulic model using a roughness of 0.035 also indicate subcritical flow under these conditions. The range of flow depth appears to be stable; however, the range of velocity has amplified due to the reduction in roughness value. Table 4 summarizes the model results for n=0.035 in the vicinity of the project.

Table 4 – Hydraulic Model Results for Qcap and n=0.035

HEC-RAS River Station	Minimum Channel Invert	Water Surface Elevation	Flow Depth	Velocity	Froude Number	Launch Stone Size (D_{50})
	(ft)	(ft)	(ft)	(ft/s)	(ft/ft)	
34310	963.0	973.2	10.2	14.7	0.9	1-Ton (34")
34090	962.0	972.3	10.3	12.6	0.8	1/2-Ton (27")
33880	960.0	971.1	11.1	12.7	0.9	1/2-Ton (27")
33710	959.0	970.2	11.2	12.3	0.8	1/2-Ton (27")
33500	958.0	968.9	10.9	12.9	0.8	1/2-Ton (27")

Hydraulic Analysis for n=0.030

Results of the hydraulic model using a roughness of 0.030 indicate a flow regime that fluctuates between subcritical and supercritical flow under these conditions, which produces more variation in flow depth and velocity between cross-sections. The range of flow depth and velocity appears to be unstable in comparison to results from the model using a roughness of 0.040 and 0.035. Table 5 summarizes the model results for n=0.035 in the vicinity of the project

Table 5 – Hydraulic Model Results for Q_{cap} and n=0.030

HEC-RAS River Station	Minimum Channel Invert	Water Surface Elevation	Flow Depth	Velocity	Froude Number	Launch Stone Size (D_{50})
	(ft)	(ft)	(ft)	(ft/s)	(ft/ft)	
34310	963.0	972.8	9.8	15.4	0.9	1-Ton (34")
34090	962.0	970.8	8.8	15.9	1.2	1-Ton (34")
33880	960.0	970.3	10.3	14.2	1.0	1-Ton (34")
33710	959.0	969.8	10.8	13.1	0.9	1-Ton (34")
33500	958.0	968.2	10.2	14.4	1.0	1-Ton (34")

Summary and Recommendations

The use of launch stone protection has previously been used on projects where high groundwater was encountered during construction of soil cement bank protection. Since the presence of groundwater was not anticipated for these projects, an alternative design solution was not considered during the design phase. Due to the immediate need for a solution in these cases, and the minimal length of bank protection affected by groundwater, the design of the launch stone apron was based on assumptions and guidance from the LACDPW standard design procedure for traditional bank protection. At the time, the cost of delaying construction greatly outweighed the additional costs associated with the launch stone, so the need to refine the design process was not of the utmost importance. However, in the case of the San Jose Flats bank stabilization and other upcoming projects, the need for launch stone protection is anticipated due to the expectation of groundwater above the bank protection to elevation in the vicinity of the proposed project bank protections.

Upon review of the rip-rap sizing methods and calculations presented in this memorandum, PACE recommends the use of Cowan's method for selecting the appropriate manning's roughness value used in the rip-rap sizing calculations for launch stone design. The method previously used for design of launch stone results in a near-critical flow regime, which generates zones of high velocities, thus requiring a larger rip-rap gradation. PACE believes using Cowan's method to determine a more suitable roughness value that represents the characteristics of the study reach being analyzed results in consistent flow depths and velocities, which produces rip-rap sizing that is economically feasible, more practical, and better suited for use in launch stone application. It must be noted that this method is to be used strictly for rip-rap sizing, and not intended to replace the current procedures used to calculate top and toe elevations for bank protection design.

V. References

1. Pacific Advanced Civil Engineering, Inc., *Newhall Ranch – Santa Clara River Phase I Fluvial Study*. March, 2006.

2. Stillwater Sciences, *Assessment of Geomorphic Processes for the Upper Santa Clara River Watershed*. May, 2011.

3. Los Angeles County Flood Control District (1989). "Hydraulic Design Manual," Los Angeles, California, p. F-32.

4. Arcement, George J., and Schneider, V. R., 1989, Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains: U.S. Geological Survey Water-Supply Paper 2339, p. 1-8.

5. HEC-RAS, Version 4.1.0 River Analysis System, U.S. Army Corps of Engineers, Davis, California 2004.

VICINITY MAP
SCALE 1"=4000'

SANTA CLARA RIVER

32265
32605
32795
33115
33310
33500
33710
33880
34090
34310
34495
34720
34860

"SAN JOSE FLATS BANK"
PROPOSED SOIL
CEMENT BANK PROTECTION

NORTH

200 100 0 200 400

TITLE
CROSS SECTION
LOCATION AERIAL MAP

JOB
MISSION VILLAGE
SAN JOSE FLATS
BANK PROTECTION
LOS ANGELES COUNTY CA

SCALE	1"= 200'
DESIGNED	JC
DRAWN	JEP
CHECKED	JC
DATE	MARCH 2018
JOB NO.	9862

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FIGURE
01

Dimscale = 1000; LTscale = 0.5; PSltscale = 1; Acad Ver. = 21.0s (LMS Tech); Visretain = 1

P:\9862\FP_MissionVillageFinalDesign\Engineering\9862-03 San Jose Flats 01's\exhibits\9862-FIG-01-02-03-CROSS SECTION LOCATION AERIA

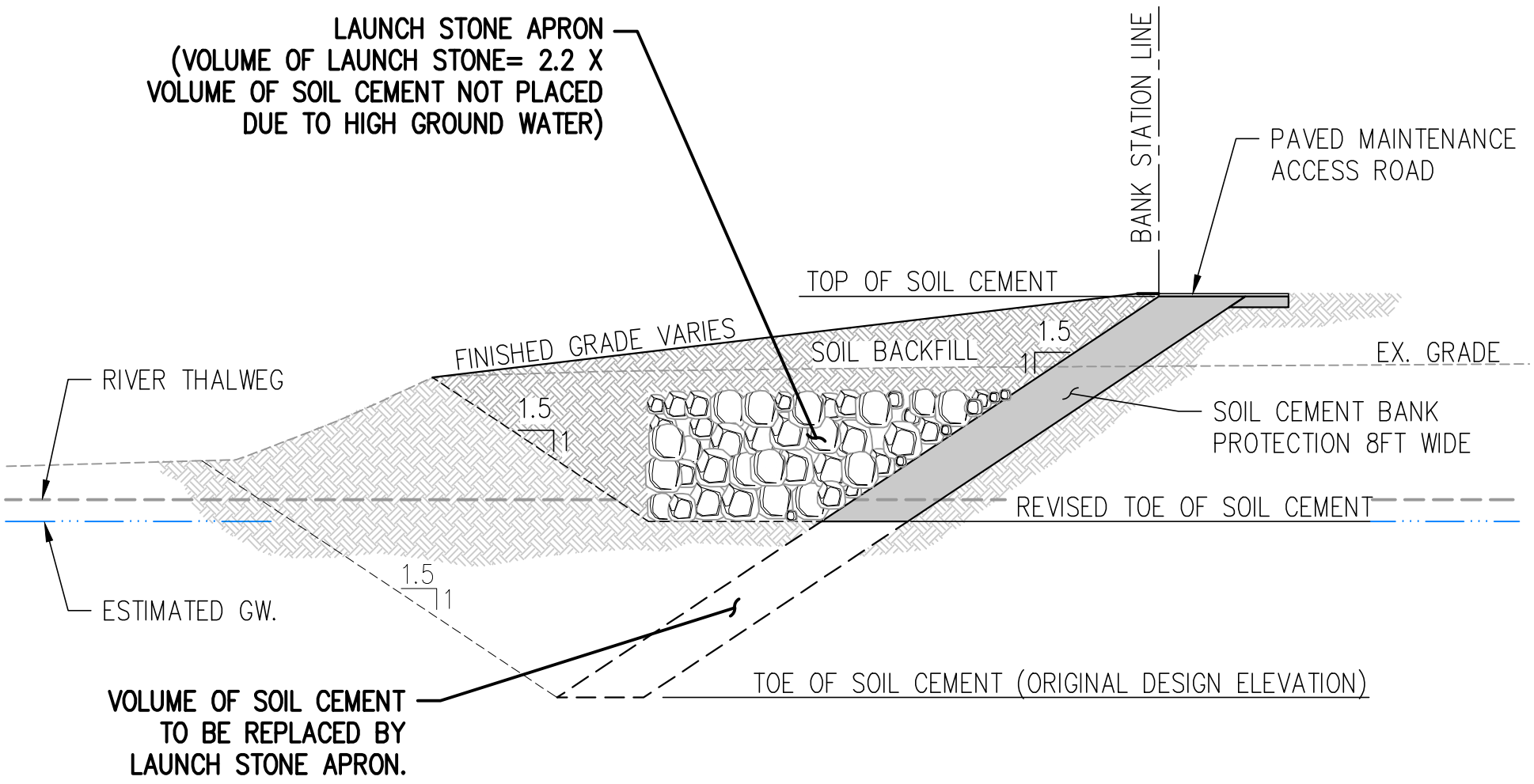

FIGURE 02 - SOIL CEMENT / LAUNCH STONE BANK PROTECTION TYPICAL SECTION

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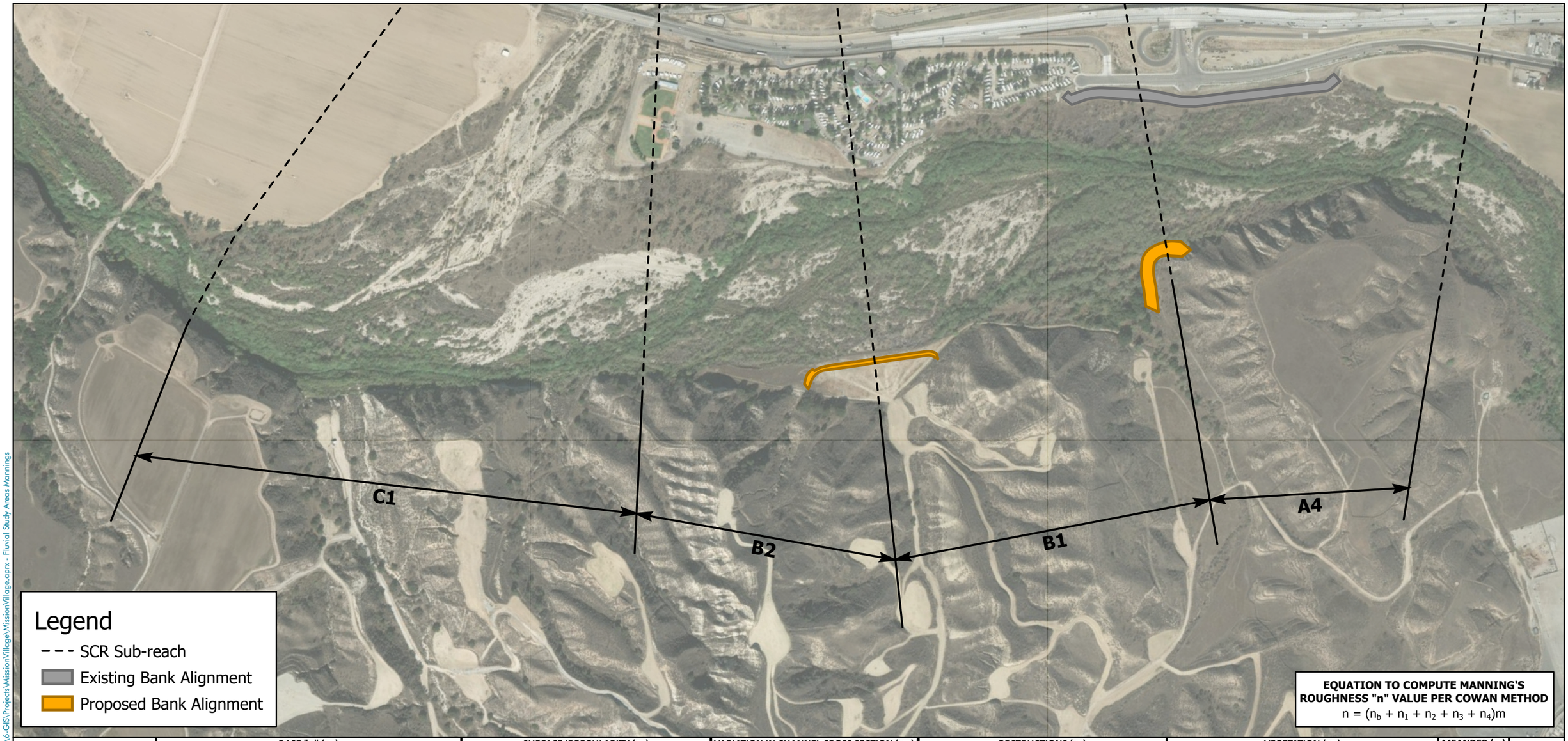
Dimscale = 1; LTscale = 0.5; PSltscale = 1; Acad Ver. = 21.0s (LMS Tech); Visretain = 1
P:\9862EP_MissionVillageFinalDesign\Engineering\9862-03 San Jose Flats CD's\exhibits\9862-FIG-01-02-03-CROSS SECT LOCATION MAP EXH\9862-Fig-02-SA



River Study Reach[1]	BASE "n" (n_b)					SURFACE IRREGULARITY (n_1)				VARIATION IN CHANNEL CROSS SECTION (n_2)			OBSTRUCTIONS (n_3)				VEGETATION (n_4)				MEANDER (m)	TOTAL "n"
	0.026 - 0.035	0.025 - 0.032	0.024 - 0.035	0.012 - 0.018	0.03 - 0.07	0	0.001 - 0.005	0.006 - 0.010	0.011 - 0.020	0	0.001 - 0.005	0.010 - 0.015	0.000 - 0.004	0.005 - 0.015	0.020 - 0.030	0.040 - 0.050	0.002 - 0.010	0.010 - 0.025	0.025 - 0.050	0.050 - 0.100	1	
	Sand[2]	Firm Soil	Gravel	Concrete	Cobble / boulder	Smooth	Minor	Moderate	Severe	Gradual	Alternating Occasionally	Alternating Frequently	Negligible	Minor	Appreciable	Severe	Small	Medium	Large	Very Large	Negligible	
A4	0.025						0.005			0				0.01			0				1	0.04
B1	0.025						0.005			0				0.01			0				1	0.04
B2	0.025						0.005			0				0.01			0				1	0.04
C1	0.025						0.005			0				0.01			0				1	0.04

(1) From Newhall Ranch Santa Clara River Fluvial Study
(2) Manning's value of 0.025 used for SCR to be consistent with LADPW guidelines for bare channel condition

P:\9862EP_MissionVillageFinalDesign\6-GIS\Projects\MissionVillage\MissionVillage.aprx - Fluvial Study Areas Mannings

MISSION VILLAGE FINAL DESIGN

ASSESSMENT OF MANNING'S ROUGHNESS COEFFICIENT

PACE Advanced Water Engineering

0 350 700 1,400 Feet

Date: 3/20/2018

Job Number: 9862E

Figure 3

HEC-RAS Plan: Pr.025 River: SCR Reach: Project Profile: Rev BB

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)	
Project	35245	Rev BB	116236.00	968.00	980.43	980.59	983.82	0.003569	15.23	8281.71	1384.87	0.93
Project	35040	Rev BB	116236.00	967.00	978.13	979.26	982.83	0.004904	19.11	7369.78	1224.09	1.08
Project	34860	Rev BB	116236.00	966.00	976.44	977.77	981.72	0.007556	18.45	6301.14	1146.45	1.39
Project	34720	Rev BB	116236.00	965.50	974.95	976.42	980.55	0.008618	18.99	6121.96	1125.22	1.43
Project	34495	Rev BB	116236.00	964.00	972.68	974.29	978.47	0.009850	19.32	6017.04	1168.24	1.50
Project	34310	Rev BB	116236.00	963.00	971.51	972.96	976.79	0.006864	18.98	6653.48	1244.36	1.23
Project	34090	Rev BB	116236.00	962.00	970.29	971.47	975.08	0.007393	17.56	6617.98	1291.36	1.37
Project	33880	Rev BB	116236.00	960.00	970.33	970.34	973.47	0.004095	14.22	8171.80	1338.20	1.01
Project	33710	Rev BB	116236.00	959.00	968.58	969.30	972.53	0.006009	15.96	7280.69	1344.75	1.21
Project	33500	Rev BB	116236.00	958.00	968.14	968.18	971.24	0.004393	14.49	8451.55	1377.94	0.96
Project	33310	Rev BB	116236.00	957.00	966.20	966.98	970.20	0.005901	16.07	7234.62	1389.73	1.24
Project	33115	Rev BB	116236.00	956.00	964.41	965.40	968.75	0.008945	16.71	6958.09	1356.27	1.30
Project	32795	Rev BB	116236.00	954.00	965.37	964.35	967.65	0.002550	12.12	9590.41	1361.00	0.80
Project	32605	Rev BB	116236.00	952.00	965.41	963.52	967.06	0.001732	10.30	11280.74	1501.14	0.66
Project	32265	Rev BB	140776.00	950.00	962.83	962.83	966.06	0.003663	14.42	9761.50	1508.87	1.00

HEC-RAS Plan: Prop.040 River: SCR Reach: Project Profile: Rev BB

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)	
Project	35245	Rev BB	116236.00	968.00	981.26	980.59	983.89	0.006430	13.51	9430.79	1390.26	0.78
Project	35040	Rev BB	116236.00	967.00	979.68	979.26	982.54	0.006476	15.12	9288.49	1254.24	0.79
Project	34860	Rev BB	116236.00	966.00	978.23	977.77	981.22	0.008565	13.89	8370.00	1164.18	0.91
Project	34720	Rev BB	116236.00	965.50	976.62	976.42	979.89	0.009891	14.50	8017.70	1136.14	0.96
Project	34495	Rev BB	116236.00	964.00	975.01	974.28	977.74	0.008078	13.25	8774.65	1195.48	0.86
Project	34310	Rev BB	116236.00	963.00	973.91	972.96	976.37	0.005955	13.23	9723.93	1292.84	0.75
Project	34090	Rev BB	116236.00	962.00	972.90	971.47	974.99	0.005681	11.61	10012.75	1310.99	0.74
Project	33880	Rev BB	116236.00	960.00	971.70	970.35	973.79	0.005762	11.60	10019.35	1348.06	0.75
Project	33710	Rev BB	116236.00	959.00	970.80	969.28	972.78	0.005500	11.29	10297.37	1365.05	0.72
Project	33500	Rev BB	116236.00	958.00	969.63	968.19	971.61	0.005634	11.63	10513.98	1386.48	0.70
Project	33310	Rev BB	116236.00	957.00	968.83	966.99	970.59	0.004584	10.64	10920.93	1403.89	0.67
Project	33115	Rev BB	116236.00	956.00	968.32	965.41	969.68	0.003545	9.36	12415.44	1422.21	0.56
Project	32795	Rev BB	116236.00	954.00	967.13	964.35	968.57	0.003417	9.61	12092.23	1456.03	0.59
Project	32605	Rev BB	116236.00	952.00	966.71	963.52	967.91	0.002741	8.79	13230.27	1508.31	0.52
Project	32265	Rev BB	140776.00	950.00	962.83	962.83	966.06	0.009377	14.42	9761.50	1508.87	1.00

HEC-RAS Plan: Prop.035 River: SCR Reach: Project Profile: Rev BB

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)	
Project	35245	Rev BB	116236.00	968.00	980.59	980.59	983.81	0.006522	14.87	8503.76	1385.92	0.90
Project	35040	Rev BB	116236.00	967.00	979.16	979.26	982.50	0.006116	16.28	8640.27	1244.13	0.87
Project	34860	Rev BB	116236.00	966.00	977.55	977.77	981.20	0.008771	15.34	7577.37	1156.88	1.06
Project	34720	Rev BB	116236.00	965.50	976.14	976.42	979.90	0.009374	15.56	7471.86	1133.06	1.07
Project	34495	Rev BB	116236.00	964.00	973.85	974.29	977.69	0.010470	15.74	7386.49	1181.94	1.11
Project	34310	Rev BB	116236.00	963.00	973.16	972.96	976.21	0.006196	14.66	8764.93	1286.73	0.86
Project	34090	Rev BB	116236.00	962.00	972.28	971.47	974.75	0.005597	12.62	9207.21	1306.36	0.84
Project	33880	Rev BB	116236.00	960.00	971.06	970.35	973.56	0.005779	12.71	9148.77	1343.43	0.86
Project	33710	Rev BB	116236.00	959.00	970.21	969.28	972.54	0.005399	12.25	9487.98	1359.63	0.82
Project	33500	Rev BB	116236.00	958.00	968.89	968.19	971.34	0.005974	12.90	9490.33	1382.25	0.81
Project	33310	Rev BB	116236.00	957.00	968.12	966.99	970.25	0.004683	11.72	9919.42	1400.05	0.78
Project	33115	Rev BB	116236.00	956.00	967.73	965.41	969.29	0.003413	10.04	11577.97	1418.38	0.62
Project	32795	Rev BB	116236.00	954.00	966.62	964.35	968.25	0.003153	10.25	11341.43	1450.34	0.65
Project	32605	Rev BB	116236.00	952.00	966.31	963.52	967.62	0.002423	9.21	12620.64	1506.09	0.56
Project	32265	Rev BB	140776.00	950.00	962.83	962.83	966.06	0.007179	14.42	9761.50	1508.87	1.00

HEC-RAS Plan: Prop.030 River: SCR Reach: Project Profile: Rev BB

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)	
Project	35245	Rev BB	116236.00	968.00	980.59	980.59	983.81	0.004792	14.87	8503.76	1385.92	0.90
Project	35040	Rev BB	116236.00	967.00	978.53	979.26	982.63	0.005902	17.93	7854.68	1231.78	0.99
Project	34860	Rev BB	116236.00	966.00	976.95	977.77	981.37	0.008457	16.86	6893.46	1151.30	1.21
Project	34720	Rev BB	116236.00	965.50	975.52	976.42	980.10	0.009238	17.17	6771.58	1129.02	1.24
Project	34495	Rev BB	116236.00	964.00	973.28	974.28	977.93	0.010230	17.30	6718.92	1175.28	1.28
Project	34310	Rev BB	116236.00	963.00	972.83	972.96	976.21	0.005276	15.40	8331.10	1283.96	0.92
Project	34090	Rev BB	116236.00	962.00	970.82	971.47	974.75	0.008082	15.91	7304.04	1295.35	1.18
Project	33880	Rev BB	116236.00	960.00	970.34	970.34	973.47	0.005865	14.20	8187.57	1338.29	1.01
Project	33710	Rev BB	116236.00	959.00	969.77	969.30	972.42	0.004817	13.07	8893.44	1355.64	0.90
Project	33500	Rev BB	116236.00	958.00	968.19	968.19	971.24	0.006170	14.38	8519.10	1378.22	0.95
Project	33310	Rev BB	116236.00	957.00	966.73	966.98	970.03	0.006478	14.57	7976.47	1392.59	1.07
Project	33115	Rev BB	116236.00	956.00	967.07	965.40	968.92	0.003299	10.91	10649.63	1414.28	0.70
Project	32795	Rev BB	116236.00	954.00	966.04	964.35	967.94	0.002884	11.06	10507.70	1443.98	0.72
Project	32605	Rev BB	116236.00	952.00	965.88	963.52	967.34	0.002085	9.71	11975.56	1503.72	0.61
Project	32265	Rev BB	140776.00	950.00	962.83	962.83	966.06	0.005274	14.42	9761.50	1508.87	1.00

Appendix H – Alternative Design Approach

Calculations and Spreadsheets: Long-term Adjustment

River Sta	Profile	Q (cfs)	Min Ch El (ft)	Cum Ch Len (ft)	Stable Ch. Elev (ft)	Long-Term	Stable Slope	0.008
4725	100-Year	7,000	1069	4122.88	1019.44	49.6		
4622	100-Year	7,000	1067	4019.81	1018.62	48.4		
4523	100-Year	7,000	1064.2	3920.69	1017.82	46.4		
4396	100-Year	7,000	1059.45	3793.77	1016.81	42.6		
4380.00*	100-Year	7,000	1056.12	3783.76	1016.73	39.4		
4364.00*	100-Year	7,000	1052.78	3773.75	1016.65	36.1		
4348.00*	100-Year	7,000	1049.45	3763.74	1016.57	32.9		
4332.00*	100-Year	7,000	1046.12	3753.73	1016.49	29.6		
4316.00*	100-Year	7,000	1042.78	3743.72	1016.41	26.4		
4300	100-Year	7,000	1039.45	3733.72	1016.33	23.1		
4291.00*	100-Year	7,000	1036.45	3724.72	1016.25	20.2		
4282	100-Year	7,000	1033.45	3715.72	1016.18	17.3		
4280.50*	100-Year	7,000	1033.45	3706.51	1016.11	17.3		
4279.00*	100-Year	7,000	1033.45	3697.3	1016.04	17.4		
4277.50*	100-Year	7,000	1033.45	3688.09	1015.96	17.5		
4276	100-Year	7,000	1033.45	3678.88	1015.89	17.6		
4274.50*	100-Year	7,000	1033.45	3669.11	1015.81	17.6		
4273.00*	100-Year	7,000	1033.45	3659.34	1015.73	17.7		
4271.50*	100-Year	7,000	1033.45	3649.57	1015.65	17.8		
4270	100-Year	7,000	1033.45	3639.8	1015.58	17.9		
4265	100-Year	7,000	1037	3630.75	1015.50	21.5		
4258	100-Year	7,000	1037	3620.75	1015.42	21.6		
4157	100-Year	7,000	1035.56	3556.24	1014.91	20.7		
4055.5	100-Year	7,000	1033	3442.92	1014.00	19.0		
3940.5	100-Year	7,000	1031	3346.96	1013.23	17.8		
3844	100-Year	7,000	1030	3230.92	1012.30	17.7		
3747	100-Year	7,000	1029.17	3134.67	1011.53	17.6		
3650	100-Year	7,000	1028	3036.21	1010.75	17.3		
3554	100-Year	7,000	1027	2935.96	1009.94	17.1		
3440.5	100-Year	7,000	1025.32	2821.11	1009.03	16.3		
3372	100-Year	7,000	1025	2749.71	1008.45	16.5		
3304	100-Year	7,000	1023.5	2686.47	1007.95	15.6		
3190.5	100-Year	7,000	1022	2572.39	1007.04	15.0		
3105	100-Year	7,000	1021	2497.01	1006.43	14.6		
3020	100-Year	7,000	1019.68	2408.27	1005.72	14.0		
2934	100-Year	7,000	1018.19	2323.68	1005.05	13.1		
2820.5	100-Year	7,000	1016.37	2209.95	1004.14	12.2		
2748	100-Year	7,000	1015	2138.38	1003.56	11.4		
2675.5	100-Year	7,000	1014	2052.43	1002.88	11.1		
2560.5	100-Year	7,000	1012	1959.48	1002.13	9.9		
2476	100-Year	7,000	1010.49	1866.49	1001.39	9.1		
2391	100-Year	7,000	1009.71	1780.97	1000.70	9.0		
2305.5	100-Year	7,000	1007.87	1708.9	1000.13	7.7		
2190.5	100-Year	7,000	1006	1596.28	999.23	6.8		
2122	100-Year	7,000	1004	1511.37	998.55	5.5		
2054	100-Year	7,000	1003	1434.23	997.93	5.1		
1940.5	100-Year	7,000	1001.76	1343.82	997.21	4.6		
1872	100-Year	7,000	1001	1258.5	996.52	4.5		
1804	100-Year	7,000	999.65	1190.7	995.98	3.7		
1688.62	100-Year	7,000	997.49	1074.92	995.06	2.4		
1584	100-Year	7,000	995	974.81	994.26	0.7		
1518	100-Year	7,000	995	851.63	993.27	1.7		

River Sta	Profile	Q (cfs)	Min Ch El (ft)	Cum Ch Len (ft)	Stable Ch. Elev (ft)	Long-Term	Stable Slope	0.008
1448	100-Year	5,227	993.63	676.97	991.87	1.8		
1353				565.419	990.98			
1294	100-Year	3,744	991	496.14				
1189	100-Year	3,744	990	403.57				
1132		Bridge						
1080	100-Year	3,744	980.01	393.57				
1061	100-Year	28,144	980	374.14				
981	100-Year	28,144	979	278.11				
678	100-Year	28,144	977	0				

Appendix H – Alternative Design Approach

Calculations and Spreadsheets: Summary of SAM Analysis

SUMMARY OF SAM ANALYSIS FOR LONG-TERM STABLE SLOPE

River Sta	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	Ch Length	Effective Depth	Ch Length × Vel Chnl	Top Width × Ch Length	Eff Depth × Ch Length	E.G. Slope × Ch Length
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)	ft^2/s	(ft^2)	(ft^2)	(ft)
4157	1750	1015.77	1025.69	1017.13	1025.7	0.000025	0.85	2068.59	223.42	0.05	113.32	9.26	96.32	25,317.95	1,049.20	0.00
4055.5	1750	1014.64	1024.83	1020.16	1025.61	0.003335	7.11	246.2	24.66	0.4	95.96	9.98	682.28	2,366.37	958.04	0.32
3940.5	1750	1013.68	1023.49	1020.43	1025.06	0.008375	10.03	174.54	18	0.57	116.04	9.70	1,163.88	2,088.72	1,125.20	0.97
3844	1750	1012.52	1022.84	1019.28	1024.14	0.00629	9.13	191.67	20.15	0.52	96.25	9.51	878.76	1,939.44	915.55	0.61
3747	1750	1011.56	1020.09	1019.43	1023.01	0.018396	13.71	127.64	16.93	0.88	98.46	7.54	1,349.89	1,666.93	742.32	1.81
3650	1750	1010.57	1017.59	1017.59	1020.95	0.022875	14.71	118.98	17.69	1	100.25	6.73	1,474.68	1,773.42	674.26	2.29
3554	1750	1009.57	1017.01	1014.52	1018.1	0.005505	8.35	209.6	28.27	0.54	114.85	7.41	959.00	3,246.81	851.52	0.63
3440.5	1750	1008.42	1014.14	1014.14	1016.87	0.018684	13.25	132.08	24.05	1	71.4	5.49	946.05	1,717.17	392.12	1.33
3372	1750	1007.71	1014.91	1012.05	1015.68	0.003708	7.06	247.74	34.79	0.47	63.24	7.12	446.47	2,200.12	450.33	0.23
3304	1750	1007.08	1012.58	1012.58	1015.08	0.02	12.68	137.99	27.48	1.00	114.08	5.02	1,446.53	3,134.92	572.85	1.91
3190.5	1750	1005.94	1012.88	1009.74	1013.44	0.00	6.00	291.69	42.53	0.40	75.38	6.86	452.28	3,205.91	516.99	0.19
3105	1750	1005.33	1012.8	1009.07	1013.23	0.00	5.29	330.68	46.36	0.35	88.74	7.13	469.43	4,113.99	632.97	0.16
3020	1750	1004.62	1012.57	1008.6	1013.06	0.00	5.62	311.51	39.51	0.35	84.59	7.88	475.40	3,342.15	666.94	0.17
2934	1750	1003.95	1009.84	1009.84	1012.46	0.02	13.00	134.63	25.49	1.00	113.73	5.28	1,478.49	2,898.98	600.69	1.98
2820.5	1750	1003.04	1010.25	1007.57	1011.04	0.00	7.11	246.27	37.34	0.49	71.57	6.60	508.86	2,672.42	472.03	0.26
2748	1750	1002.46	1009.59	1007.31	1010.69	0.01	8.40	208.31	29.60	0.56	85.95	7.04	721.98	2,544.12	604.87	0.49
2675.5	1750	1001.78	1009.13	1006.71	1010.12	0.01	7.96	219.85	32.41	0.54	92.95	6.78	739.88	3,012.51	630.52	0.64
2560.5	1750	1001.03	1008.03	1006.25	1009.41	0.01	9.44	185.45	27.43	0.64	92.99	6.76	877.83	2,550.72	628.69	0.70
2476	1750	1000.29	1008.42	1004.49	1008.83	0.00	5.15	339.67	49.99	0.35	85.52	6.79	440.43	4,275.14	581.09	0.15
2391	1750	999.6	1007.51	1004.99	1008.54	0.00	8.14	214.87	31.20	0.55	72.07	6.89	586.65	2,248.58	496.34	0.35
2305.5	1750	999.03	1006.83	1005.03	1008.11	0.01	9.10	192.27	31.06	0.64	98.00	6.19	891.80	3,043.88	606.65	0.63
2190.5	1750	998.24	1004.99	1004.35	1007.19	0.01	11.89	147.24	24.42	0.85	84.91	6.03	1,009.58	2,073.50	511.96	1.11
2122	1750	997.56	1006.28	1000.71	1006.45	0.00	3.26	536.97	72.47	0.21	77.14	7.41	251.48	5,590.34	571.57	0.04
2054	1750	996.95	1005.49	1005.49	1006.26	0.019882	7.05	248.31	160.82	1	90.41	1.54	637.39	14,539.74	139.60	1.80
1940.5	1750	996.22	997.94	999.21	1002.46	0.098792	17.06	102.6	61.16	2.32	85.32	1.68	1,455.56	5,218.17	143.13	8.43
1872	1750	995.54	998.98	998.09	999.68	0.006279	6.69	261.68	76.62	0.64	67.80	3.42	453.58	5,194.84	231.56	0.43
1804	1750	995	997.66	997.66	998.97	0.016371	9.18	190.68	72.35	1	115.78	2.64	1,062.86	8,376.68	305.14	1.90
1688.62	1750	993.96	996.38	995.88	996.99	0.008224	6.23	280.94	115.96	0.71	100.11	2.42	623.69	11,608.76	242.54	0.82
1584	1750	993.06	996.33	994.67	996.52	0.001873	3.53	495.52	158.48	0.35	82.64	3.13	291.72	13,096.79	258.39	0.15
1501	1750	992.31	995.36	995.36	996.11	0.018396	6.93	252.63	167.84	1	73.16	1.51	507.00	12,279.17	110.12	1.35
1428	1750	991.65	994.1	993.61	994.68	0.010888	6.09	287.15	155.98	0.79	74.84	1.84	455.78	11,673.54	137.78	0.81
1353	1750	990.98	993.07	993.07	993.5	0.022402	5.26	332.79	388.98	1	99.25	0.86	522.06	38,606.27	84.91	2.22

Appendix H – Alternative Design Approach

Calculations and Spreadsheets: General Adjustment

GENERAL SCOUR ANALYSIS STEPS

1) Run HEC-RAS analysis for supply reach and design reaches for flow rates ranging from 50 to 7,000 cfs.
- Every 40 cfs from 50 cfs to 250 cfs
- Every 250 cfs from 250 cfs to 7,000 cfs
- Mixed flow regime, critical depth downstream boundary condition

2) Calculate the average hydraulic parameters for each subreach.
- Take the weighted average (by length between cross-sections) of velocity, depth, top width, and energy grade slope
- Note that the depth is taken as effective depth = flow area/ top width

3) Input hydraulic parameters into SAM and calculate the sediment transport for each subreach at each flow rate using the Yang equation.
- The Yang equation was selected using the SAMAid function

4) Create a sediment transport rating curve for each reach by plotting sediment transport rate calculated from SAM vs. flow rate and determing the curve of best fit.
Piecewise functions were used to best-represent the data, where different polynomial functions were fit to ranges of flow rates.

5) Create a top width rating curve for each reach by plotting top width vs. flow rate and determing the curve of best fit
Piecewise functions were used to best-represent the data, where different polynomial functions were fit to ranges of flow rates.

6) Use the sediment transport rating curves to determine the rate of transport at each time step of the hydrograph.
- Two hydrographs were used:
(1) a 24-hour SCS hydrograph with a peak flow equal to the design flow of 7,000 cfs;
(2) a 24-hour, 100-year storm with flow rates calculated from HEC-1 using an Orange County rainfall distribution pattern and rainfall loss parameters.

7) Use the top width transport rating curve to determine the top width in each reach at each time step of the hydrograph.

8) Find the transport potential deficit or surplus in each reach at each time step:

$$\Delta TP = TP_{reach\ i} - TP_{reach\ i-1}$$

Where:
- $TP_{reach\ i}$ = transport potential (tons/day) in the given reach
- $TP_{reach\ i-1}$ = transport potential (tons/day) in the reach immediately upstream of the given reach

9) Calculate the change in bed elevation (ft) at each time step using the following equation:

$$\Delta_{bed\ elevation} = \frac{\Delta TP * \Delta t * 2{,}000 \frac{lbs}{ton}}{\rho * RL * b}$$

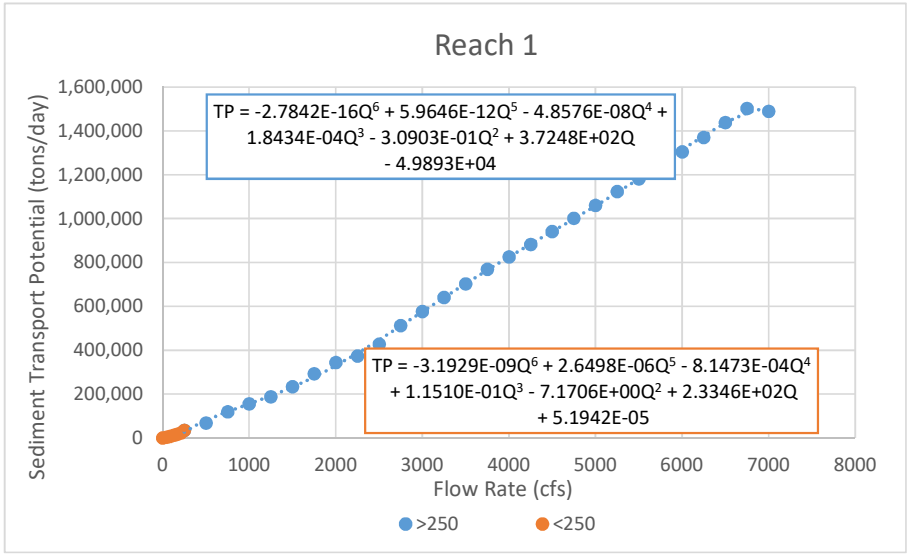
Where:

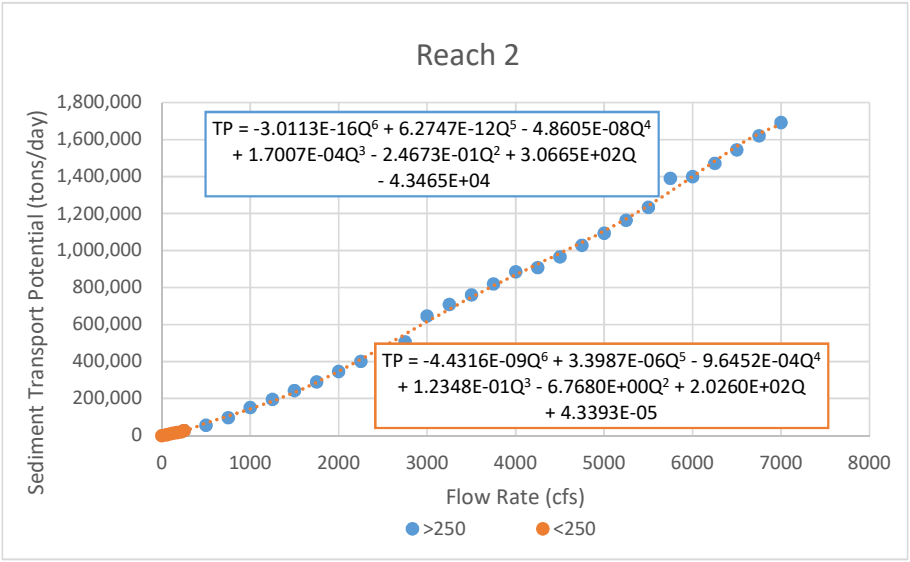
- ΔTP = transport potential deficit or surplus (tons/day)
- Δt = time step (days)
- ρ = density of rock (165.36 lbs/cu ft)
- RL = reach length (ft)
- b = top width (ft)

10) Calculate the change in bed elevation caused by the storm by taking the sum of the change in bed elevation at each time step of the hydrograph. Results are summarized below.

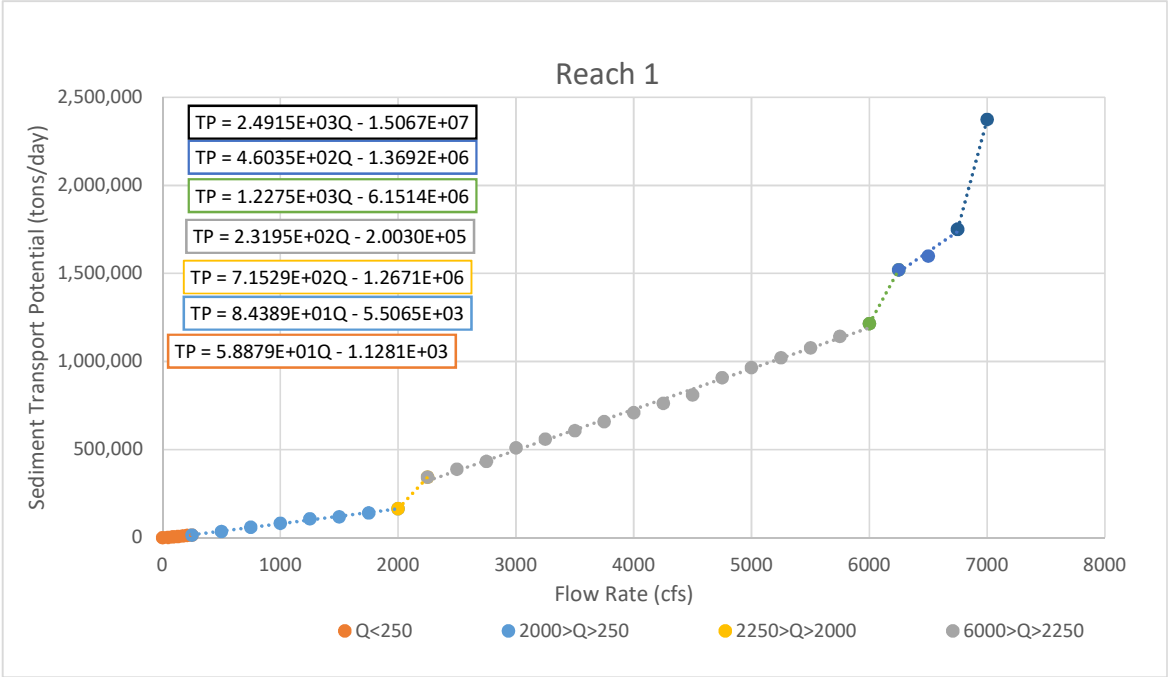
	Δ Bed Elevation (ft)			
	Design Slope		**Stable Slope**	
Reach	**HEC-1 Storm**	**SCS Storm**	**HEC-1 Storm**	**SCS Storm**
1	-2.03	1.47	20.02	23.01
2	0.67	-0.78	-7.86	-0.85

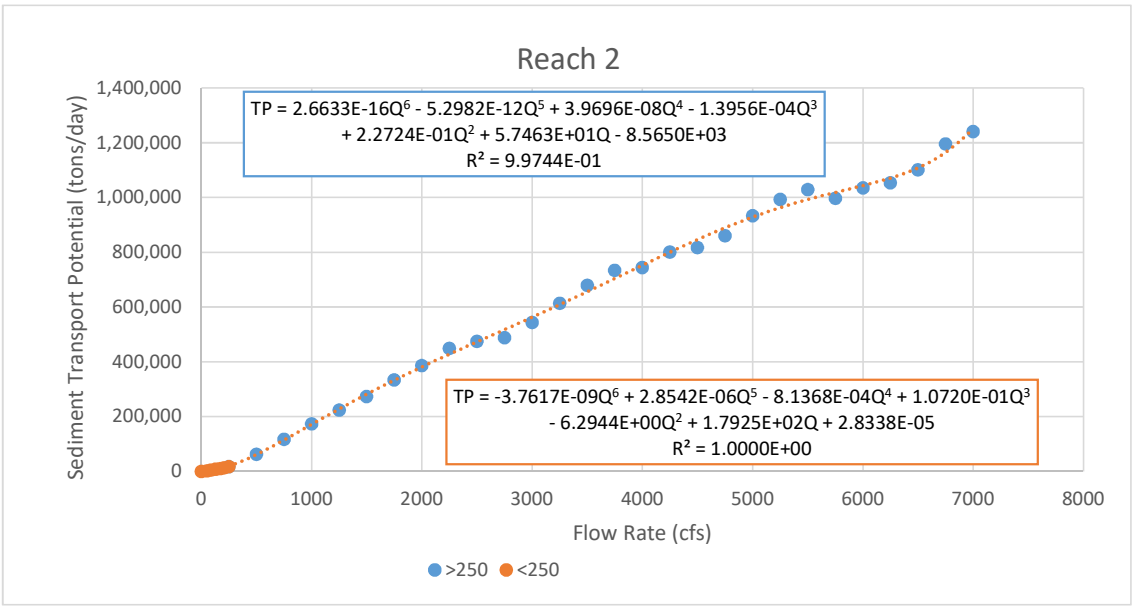
DESIGN SLOPE		
	Transport Potential (tons/day)	
Flow Rate (cfs)	Reach 1	Reach 2
0	0	0
50	3,820	3,610
90	7,330	7,861
130	12,310	12,565
170	16,614	15,516
210	22,562	19,775
250	34,188	26,424
500	67,601	56,145
750	119,027	96,661
1000	155,134	151,623
1250	187,646	195,762
1500	233,694	243,321
1750	293,138	290,183
2000	344,348	346,412
2250	373,279	401,910
2500	427,327	458,423
2750	512,914	506,612
3000	576,394	646,089
3250	640,491	709,081
3500	702,797	761,450
3750	769,108	819,990
4000	825,459	885,904
4250	881,897	907,698
4500	941,407	965,588
4750	1,001,521	1,029,264
5000	1,061,530	1,094,506
5250	1,123,476	1,164,345
5500	1,181,087	1,233,630
5750	1,240,697	1,390,642
6000	1,304,980	1,399,619
6250	1,371,084	1,471,182
6500	1,438,126	1,545,250
6750	1,502,656	1,621,585
7000	1,490,440	1,692,893



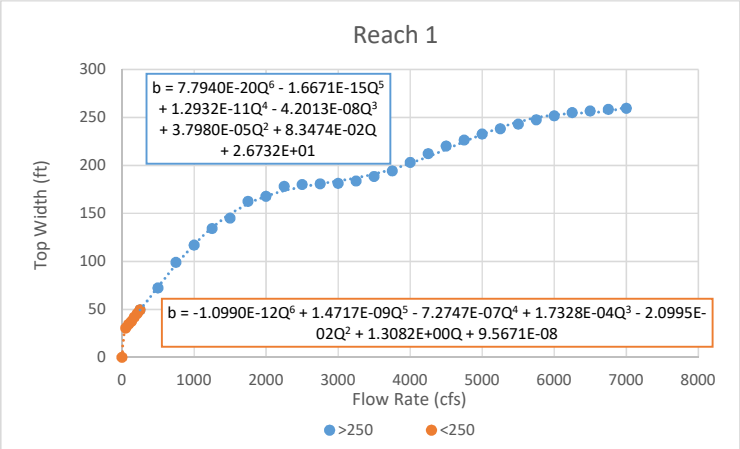


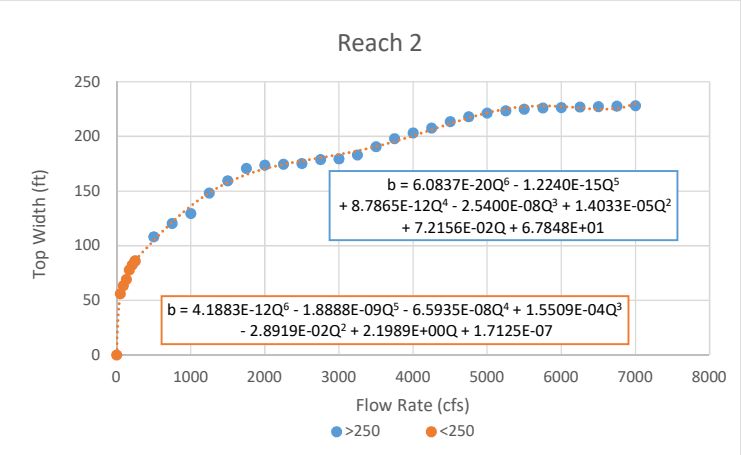
	Transport Potential (tons/day)	
Flow Rate (cfs)	Reach 1	Reach 2
0	0	0
50	1,475	2,374
90	3,457	4,767
130	5,863	7,871
170	8,557	10,110
210	11,380	13,461
250	14,361	16,929
500	35,013	62,644
750	57,822	117,113
1000	81,588	173,225
1250	105,758	223,736
1500	117,251	273,312
1750	140,160	333,784
2000	163,502	386,044
2250	342,324	449,535
2500	387,133	474,679
2750	433,326	488,227
3000	509,477	543,760
3250	558,529	613,401
3500	607,241	679,209
3750	658,597	733,695
4000	709,901	744,675
4250	761,514	800,660
4500	809,217	817,602
4750	907,068	860,236
5000	964,684	933,111
5250	1,020,848	993,229
5500	1,077,598	1,028,935
5750	1,143,068	997,138
6000	1,213,659	1,035,498
6250	1,520,535	1,053,792
6500	1,597,967	1,101,007
6750	1,750,708	1,195,516
7000	2,373,578	1,241,255



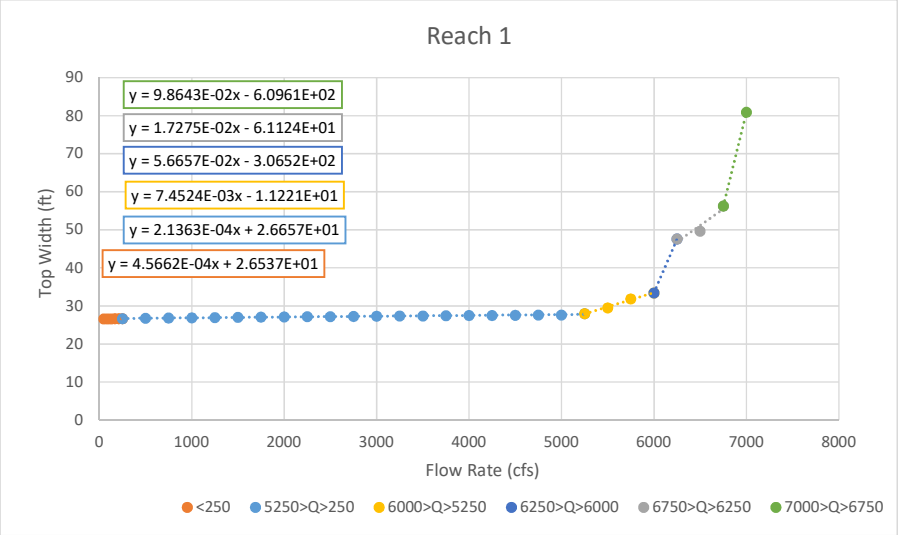


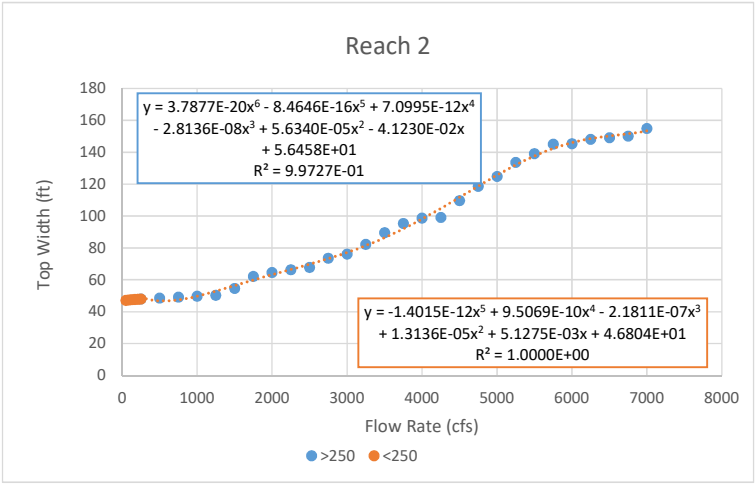
DESIGN SLOPE		
	Top Width (ft)	
Flow Rate (cfs)	Reach 1	Reach 2
0	0	0
50	30	56
90	34	63
130	38	69
170	42	78
210	46	82
250	50	86
500	72	108
750	99	120
1000	117	129
1250	134	148
1500	145	159
1750	163	171
2000	168	174
2250	178	175
2500	180	175
2750	181	179
3000	181	179
3250	184	183
3500	189	191
3750	194	198
4000	203	203
4250	212	208
4500	220	214
4750	226	218
5000	233	221
5250	238	224
5500	243	225
5750	248	226
6000	252	226
6250	255	227
6500	257	227
6750	258	228
7000	260	228





Top Width (ft)	
Reach 1	Reach 2
0	0
27	47
27	47
27	47
27	48
27	48
27	48
27	49
27	49
27	50
27	50
27	55
27	62
27	64
27	66
27	68
27	73
27	76
27	82
27	90
27	95
27	99
28	99
28	110
28	119
28	125
28	134
30	139
32	145
33	145
48	148
50	149
56	150
81	155





RATING CURVE COEFFICIENTS

	Q>250 cfs					Q<250 cfs				
Coefficient	**Reach 2**	**Reach 1**	**Supply**	**Width- R2**	**Width- R1**	**Reach 2**	**Reach 1**	**Supply**	**Width- R2**	**Width- R1**
A	-3.01E-16	-2.78E-16	1.09E-16	6.08E-20	7.79E-20	-4.43E-09	-3.19E-09	1.24E-09	4.19E-12	-1.10E-12
B	6.27E-12	5.96E-12	-3.05E-12	-1.22E-15	-1.67E-15	3.40E-06	2.65E-06	-9.89E-07	-1.89E-09	1.47E-09
C	-4.86E-08	-4.86E-08	3.07E-08	8.79E-12	1.29E-11	-9.65E-04	-8.15E-04	2.94E-04	-6.59E-08	-7.27E-07
D	1.70E-04	1.84E-04	-1.40E-04	-2.54E-08	-4.20E-08	1.23E-01	1.15E-01	-3.99E-02	1.55E-04	1.73E-04
E	-2.47E-01	-3.09E-01	3.06E-01	1.40E-05	3.80E-05	-6.77E+00	-7.17E+00	2.46E+00	-2.89E-02	-2.10E-02
F	3.07E+02	3.72E+02	-8.59E+01	7.22E-02	8.35E-02	2.03E+02	2.33E+02	3.69E+01	2.20E+00	1.31E+00
Intercept	-4.35E+04	-4.99E+04	3.45E+04	6.78E+01	2.67E+01	4.34E-05	5.19E-05	4.38E-05	1.71E-07	9.57E-08

Reach Lengths (ft)	
R1	966.5
R2	1386.5

ESTIMATED SCS HYDROGRAPH

				Step 6: Sediment Transport Rate (tons/day)			**Step 7: Top Width (ft)**		**Step 9: Sediment Transported (tons)**			**Step 9: Δ Bed Elevation (ft)**	
T (hr)	**Q (cfs)**	**Q avg**	**ΔT**	**Reach 2**	**Reach 1**	**Supply**	**Reach 2**	**Reach 1**	**Reach 2**	**Reach 1**	**Supply**	**Reach 2**	**Reach 1**
0	0	75	0.02	6003.47	5696.46	6971.12	61.88	33.42	120.07	113.93	139.42	0.00	0.01
0.48	210	770	0.04	108561.38	122330.52	96266.43	122.90	98.46	4342.46	4893.22	3850.66	0.04	-0.13
1.44	1330	1750	0.02	287506.91	277800.52	315070.22	165.03	160.13	5750.14	5556.01	6301.40	-0.01	0.06
1.92	2170	3395	0.04	720580.10	676735.32	677945.52	189.02	189.33	28823.20	27069.41	27117.82	-0.08	0.00
2.88	4620	5180	0.02	1152396.20	1101817.10	1223928.22	224.25	237.79	23047.92	22036.34	24478.56	-0.04	0.13
3.36	5740	6125	0.02	1441056.23	1346325.57	1563837.26	226.85	253.84	28821.12	26926.51	31276.75	-0.07	0.21
3.84	6510	6720	0.02	1623262.25	1477198.73	1733325.95	225.45	256.98	32465.25	29543.97	34666.52	-0.11	0.25
4.32	6930	6965	0.02	1673138.46	1502570.16	1782120.58	229.38	261.03	33462.77	30051.40	35642.41	-0.13	0.27
4.8	7000	6965	0.02	1673138.46	1502570.16	1782120.58	229.38	261.03	33462.77	30051.40	35642.41	-0.13	0.27
5.28	6930	6720	0.02	1623262.25	1477198.73	1733325.95	225.45	256.98	32465.25	29543.97	34666.52	-0.11	0.25
5.76	6510	6265	0.02	1487231.22	1381874.95	1608856.03	226.06	254.57	29744.62	27637.50	32177.12	-0.08	0.22
6.24	6020	5390	0.04	1210472.52	1154079.35	1301256.94	226.50	243.15	48418.90	46163.17	52050.28	-0.09	0.30
7.2	4760	3990	0.04	866570.43	822820.08	831763.63	200.34	201.94	34662.82	32912.80	33270.55	-0.08	0.02
8.16	3220	2765	0.04	551806.28	514482.01	537048.03	180.65	181.06	22072.25	20579.28	21481.92	-0.07	0.06
9.12	2310	1890	0.06	320349.30	306065.49	346923.47	168.24	164.88	19220.96	18363.93	20815.41	-0.04	0.19
10.56	1470	1120	0.08	163403.87	172148.63	169598.82	142.37	126.40	13072.31	13771.89	13567.91	0.04	-0.02
12.48	770	525	0.12	70682.43	83698.96	55871.32	106.54	75.86	8481.89	10043.88	6704.56	0.13	-0.55
15.36	280.00	271.90	0.02	24834.30	31986.16	31165.60	88.04	51.46	517.38	666.38	649.28	0.01	0.00
15.86	263.80	255.69	0.02	21454.69	28024.25	30375.26	86.83	49.91	446.97	583.84	632.82	0.01	0.01
16.36	247.59	239.49	0.02	25009.27	30662.26	24072.23	83.55	48.29	521.03	638.80	501.50	0.01	-0.04
16.86	231.39	223.29	0.02	22073.73	25790.29	22481.88	82.52	46.73	459.87	537.30	468.37	0.01	-0.02
17.36	215.19	207.08	0.02	19354.48	22012.03	20805.29	82.22	45.35	403.22	458.58	433.44	0.01	-0.01
17.86	198.98	190.88	0.02	17301.46	19236.69	18978.82	81.10	43.91	360.45	400.76	395.39	0.00	0.00
18.36	182.78	174.68	0.02	15865.10	17159.85	17051.36	78.74	42.30	330.52	357.50	355.24	0.00	0.00
18.86	166.57	158.47	0.02	14749.96	15419.23	15118.87	75.41	40.55	307.29	321.23	314.98	0.00	0.00
19.36	150.37	142.27	0.02	13610.59	13708.93	13275.03	71.73	38.78	283.55	285.60	276.56	0.00	0.00
19.86	134.17	126.06	0.02	12189.70	11851.90	11578.02	68.35	37.13	253.95	246.91	241.21	0.00	0.00
20.36	117.96	109.86	0.02	10398.49	9830.96	10033.39	65.71	35.73	216.64	204.81	209.03	0.00	0.00
20.86	101.76	93.66	0.02	8339.29	7778.12	8593.10	63.83	34.61	173.74	162.04	179.02	0.00	0.01
21.36	85.56	77.45	0.02	6270.42	5922.31	7170.67	62.15	33.57	130.63	123.38	149.39	0.00	0.01
21.86	69.35	61.25	0.02	4513.28	4495.49	5672.41	59.49	32.15	94.03	93.66	118.18	0.00	0.01
22.36	53.15	45.05	0.02	3301.77	3597.18	4044.87	53.96	29.43	68.79	74.94	84.27	0.00	0.00
22.86	36.94	28.84	0.02	2573.82	3017.33	2338.28	43.00	23.95	53.62	62.86	48.71	0.00	-0.01
23.36	20.74	10.37	0.03	1500.14	1769.17	606.25	19.87	11.49	40.00	47.18	16.17	0.00	-0.03
24	0										**Total:**	**-0.78**	**1.47**

RATING CURVE COEFFICIENTS

	Q>250 cfs					Q<250 cfs				
Coefficient	**Reach 2**	**Reach 1**	**Supply**	**Width- R2**	**Width- R1**	**Reach 2**	**Reach 1**	**Supply**	**Width- R2**	**Width- R1**
A	-3.01E-16	-2.78E-16	1.09E-16	6.08E-20	7.79E-20	-4.43E-09	-3.19E-09	1.24E-09	4.19E-12	-1.10E-12
B	6.27E-12	5.96E-12	-3.05E-12	-1.22E-15	-1.67E-15	3.40E-06	2.65E-06	-9.89E-07	-1.89E-09	1.47E-09
C	-4.86E-08	-4.86E-08	3.07E-08	8.79E-12	1.29E-11	-9.65E-04	-8.15E-04	2.94E-04	-6.59E-08	-7.27E-07
D	1.70E-04	1.84E-04	-1.40E-04	-2.54E-08	-4.20E-08	1.23E-01	1.15E-01	-3.99E-02	1.55E-04	1.73E-04
E	-2.47E-01	-3.09E-01	3.06E-01	1.40E-05	3.80E-05	-6.77E+00	-7.17E+00	2.46E+00	-2.89E-02	-2.10E-02
F	3.07E+02	3.72E+02	-8.59E+01	7.22E-02	8.35E-02	2.03E+02	2.33E+02	3.69E+01	2.20E+00	1.31E+00
Intercept	-4.35E+04	-4.99E+04	3.45E+04	6.78E+01	2.67E+01	4.34E-05	5.19E-05	4.38E-05	1.71E-07	9.57E-08

Reach Lengths	
R3	966.5
R2	1386.5

24 HR, 100 YR HYDROGRAPH, HEC-1

				Step 6: Sediment Transport Rate (tons/day)			Step 7: Top Width (ft)		Step 9: Sediment Transported (tons)			Step 9: Δ Bed Elevation (ft)	
T (hr)	**Q (cfs)**	**Q avg**	**Δt**	**Reach 2**	**Reach 3**	**Supply**	**Reach 2**	**Reach 3**	**Reach 2**	**Reach 3**	**Supply**	**Reach 2**	**Reach 3**
0.00	0.00	75.23	0.02	6003.47	5696.46	6971.12	61.88	33.42	125.07	118.68	145.23	0.00	0.01
0.50	23.00	51.50	0.02	3713.44	3895.80	4708.55	56.66	30.75	77.36	81.16	98.09	0.00	0.01
1.00	80.00	103.00	0.02	9547.13	8953.74	9415.19	64.84	35.23	198.90	186.54	196.15	0.00	0.00
1.50	126.00	140.00	0.02	13432.67	13459.91	13027.89	71.22	38.54	279.85	280.41	271.41	0.00	0.00
2.00	154.00	163.50	0.02	15083.14	15943.83	15712.92	76.51	41.10	314.23	332.16	327.35	0.00	0.00
2.50	173.00	181.00	0.02	16368.27	17910.66	17809.91	79.80	42.95	341.01	373.14	371.04	0.00	0.00
3.00	189.00	196.00	0.02	17874.21	20021.36	19570.70	81.59	44.38	372.38	417.11	407.72	0.00	0.00
3.50	203.00	209.50	0.02	19721.71	22506.43	21064.93	82.29	45.56	410.87	468.88	438.85	0.01	-0.01
4.00	216.00	222.00	0.02	21839.68	25449.37	22353.69	82.50	46.62	454.99	530.20	465.70	0.01	-0.02
4.50	228.00	233.50	0.02	23957.05	28742.42	23483.23	82.93	47.67	499.11	598.80	489.23	0.01	-0.03
5.00	239.00	244.50	0.02	25792.25	32354.95	24579.70	84.46	48.87	537.34	674.06	512.08	0.01	-0.04
5.50	250.00	255.50	0.02	21413.71	27976.12	30366.44	86.81	49.89	446.12	582.84	632.63	0.01	0.01
6.00	261.00	266.00	0.02	23612.09	30555.09	30865.28	87.60	50.90	491.92	636.56	643.03	0.01	0.00
6.50	271.00	276.50	0.02	25781.69	33094.04	31409.85	88.38	51.90	537.12	689.46	654.37	0.02	-0.01
7.00	282.00	287.50	0.02	28024.67	35712.02	32028.57	89.21	52.96	583.85	744.00	667.26	0.02	-0.02
7.50	293.00	298.50	0.02	30237.95	38288.19	32695.80	90.03	54.01	629.96	797.67	681.16	0.02	-0.03
8.00	304.00	310.00	0.02	32521.12	40937.91	33444.30	90.89	55.12	677.52	852.87	696.76	0.02	-0.04
8.50	316.00	322.50	0.02	34968.43	43768.92	34315.84	91.82	56.33	728.51	911.85	714.91	0.02	-0.04
9.00	329.00	335.50	0.02	37477.03	46660.46	35285.02	92.78	57.58	780.77	972.09	735.10	0.02	-0.05
9.50	342.00	349.50	0.02	40138.54	49716.23	36398.81	93.82	58.94	836.22	1035.75	758.31	0.02	-0.06
10.00	357.00	365.00	0.02	43038.91	53031.41	37714.70	94.97	60.44	896.64	1104.82	785.72	0.02	-0.07
10.50	373.00	381.50	0.02	46075.57	56484.94	39208.66	96.18	62.03	959.91	1176.77	816.85	0.02	-0.07
11.00	390.00	399.50	0.02	49331.77	60167.29	40944.98	97.51	63.78	1027.75	1253.49	853.02	0.02	-0.08
11.50	409.00	419.50	0.02	52884.89	64159.47	43000.63	98.97	65.71	1101.77	1336.66	895.85	0.02	-0.08
12.00	430.00	449.50	0.02	58096.74	69963.30	46324.00	101.15	68.61	1210.35	1457.57	965.08	0.02	-0.09
12.50	469.00	502.00	0.02	66919.74	79636.11	52792.23	104.91	73.66	1394.16	1659.09	1099.84	0.02	-0.10
13.00	535.00	566.00	0.02	77261.16	90707.93	61705.11	109.41	79.76	1609.61	1889.75	1285.52	0.02	-0.09
13.50	597.00	627.50	0.02	86883.81	100734.69	71220.82	113.62	85.53	1810.08	2098.64	1483.77	0.02	-0.09
14.00	658.00	728.00	0.02	102217.00	116149.12	88497.39	120.24	94.72	2129.52	2419.77	1843.70	0.02	-0.08
14.50	798.00	930.00	0.02	132931.06	145140.52	128213.95	132.42	111.98	2769.40	3023.76	2671.12	0.02	-0.04
15.00	1062.00	1197.50	0.02	176597.50	183530.08	187154.93	145.99	131.73	3679.11	3823.54	3899.06	0.01	0.01
15.50	1333.00	1490.00	0.02	231480.78	230145.76	254903.42	157.48	148.80	4822.52	4794.70	5310.49	0.00	0.04
16.00	1647.00	1907.00	0.02	324453.22	309618.43	350758.31	168.59	165.40	6759.44	6450.38	7307.46	-0.02	0.06
16.50	2167.00	2348.00	0.02	437841.92	409794.56	447777.00	175.74	175.41	9121.71	8537.39	9328.69	-0.03	0.06

17.00	2529.00	2380.50	0.02	446595.39	417693.06	454771.61	176.16	175.94	9304.07	8701.94	9474.41	-0.03	0.05
17.50	2232.00	1991.00	0.02	345071.76	327543.22	369597.50	170.23	167.81	7188.99	6823.82	7699.95	-0.02	0.07
18.00	1750.00	1581.00	0.02	250318.46	246110.05	276066.57	160.38	153.16	5214.97	5127.29	5751.39	0.00	0.05
18.50	1412.00	1304.00	0.02	195606.81	199752.99	211652.51	150.57	138.50	4075.14	4161.52	4409.43	0.01	0.02
19.00	1196.00	1121.50	0.02	163654.49	172366.12	169935.76	142.44	126.51	3409.47	3590.96	3540.33	0.01	-0.01
19.50	1047.00	990.00	0.02	142311.08	153595.05	140961.89	135.72	116.74	2964.81	3199.90	2936.71	0.02	-0.03
20.00	933.00	888.50	0.02	126541.26	139288.25	119615.27	130.05	108.59	2636.28	2901.84	2491.98	0.02	-0.05
20.50	844.00	808.50	0.02	114377.21	127902.20	103635.78	125.28	101.82	2382.86	2664.63	2159.08	0.02	-0.06
21.00	773.00	743.00	0.02	104484.30	118370.94	91238.01	121.20	96.06	2176.76	2466.06	1900.79	0.02	-0.07
21.50	713.00	686.50	0.02	95924.11	109905.91	81124.87	117.55	90.97	1998.42	2289.71	1690.10	0.02	-0.08
22.00	660.00	637.00	0.02	88349.72	102238.23	72766.74	114.26	86.42	1840.62	2129.96	1515.97	0.02	-0.09
22.50	614.00	595.50	0.02	81908.50	95584.35	66160.20	111.45	82.54	1706.43	1991.34	1378.34	0.02	-0.09
23.00	577.00	561.50	0.02	76546.35	89952.33	61044.02	109.10	79.33	1594.72	1874.01	1271.75	0.02	-0.09
23.50	546.00	533.00	0.02	71978.34	85089.27	56975.59	107.11	76.63	1499.55	1772.69	1186.99	0.02	-0.10
24.00	520.00	497.00	0.02	66094.08	78739.47	52142.07	104.56	73.18	1376.96	1640.41	1086.29	0.02	-0.09
24.50	474.00	436.00	0.02	55768.11	67378.05	44793.61	100.17	67.31	1161.84	1403.71	933.20	0.02	-0.09
25.00	398.00	367.00	0.02	43409.73	53454.11	37890.72	95.12	60.63	904.37	1113.63	789.39	0.02	-0.07
25.50	336.00	315.00	0.02	33504.27	42076.37	33785.73	91.26	55.60	698.01	876.59	703.87	0.02	-0.04
26.00	294.00	278.50	0.02	26191.76	33573.20	31518.70	88.53	52.09	545.66	699.44	656.64	0.02	-0.01
26.50	263.00	250.50	0.02	20356.50	26733.70	30145.20	86.44	49.41	424.09	556.95	628.02	0.01	0.02
27.00	238.00	225.00	0.02	22387.92	26255.06	22651.50	82.56	46.88	466.42	546.98	471.91	0.01	-0.02
27.50	212.00	202.00	0.02	18633.68	21045.12	20247.70	82.00	44.91	388.20	438.44	421.83	0.01	0.00
28.00	192.00	183.50	0.02	16585.41	18226.17	18108.20	80.18	43.20	345.53	379.71	377.25	0.00	0.00
28.50	175.00	167.00	0.02	15318.67	16314.47	16130.28	77.25	41.48	319.14	339.88	336.05	0.00	0.00
29.00	159.00	150.00	0.02	14176.84	14536.00	14138.95	73.48	39.62	295.35	302.83	294.56	0.00	0.00
29.50	141.00	134.50	0.02	12974.46	12841.80	12441.45	70.04	37.96	270.30	267.54	259.20	0.00	0.00
30.00	128.00	122.00	0.02	11774.36	11357.46	11177.24	67.61	36.75	245.30	236.61	232.86	0.00	0.00
30.50	116.00	109.00	0.02	10294.08	9720.94	9954.86	65.59	35.67	214.46	202.52	207.39	0.00	0.00
31.00	102.00	93.50	0.02	8318.73	7758.74	8579.36	63.81	34.60	173.31	161.64	178.74	0.00	0.01
31.50	85.00	79.50	0.02	6521.03	6137.17	7352.71	62.39	33.71	135.85	127.86	153.18	0.00	0.01
32.00	74.00	71.00	0.02	5516.23	5292.40	6587.51	61.30	33.09	114.92	110.26	137.24	0.00	0.01
32.50	68.00	65.50	0.02	4927.53	4818.74	6076.98	60.38	32.60	102.66	100.39	126.60	0.00	0.01
33.00	63.00	61.00	0.02	4490.11	4477.66	5648.33	59.44	32.12	93.54	93.28	117.67	0.00	0.01
33.50	59.00	57.00	0.02	4138.11	4210.22	5258.41	58.41	31.61	86.21	87.71	109.55	0.00	0.01
34.00	55.00	53.00	0.02	3822.39	3975.66	4860.05	57.18	31.01	79.63	82.83	101.25	0.00	0.01
34.50	51.00	49.50	0.02	3576.11	3795.78	4504.84	55.90	30.38	74.50	79.08	93.85	0.00	0.01
35.00	48.00	46.00	0.02	3356.99	3637.14	4144.04	54.41	29.65	69.94	75.77	86.33	0.00	0.00
35.50	44.00	41.50	0.02	3112.06	3458.87	3673.46	52.13	28.53	64.83	72.06	76.53	0.00	0.00
36.00	39.00	36.50	0.02	2880.49	3283.30	3145.13	49.04	27.01	60.01	68.40	65.52	0.00	0.00
36.50	34.00	31.50	0.02	2677.28	3113.42	2616.64	45.30	25.12	55.78	64.86	54.51	0.00	-0.01
37.00	29.00	25.00	0.02	2419.72	2860.16	1942.48	39.28	22.02	50.41	59.59	40.47	0.00	-0.01
37.50	21.00	17.50	0.02	2049.57	2434.26	1211.62	30.45	17.33	42.70	50.71	25.24	0.00	-0.02
38.00	14.00	12.00	0.02	1650.81	1951.60	734.21	22.49	12.96	34.39	40.66	15.30	0.00	-0.02
38.50	10.00	9.00	0.02	1359.08	1599.04	504.35	17.56	10.19	28.31	33.31	10.51	0.00	-0.03
39.00	8.00	7.50	0.02	1187.92	1393.65	399.38	14.93	8.70	24.75	29.03	8.32	0.00	-0.03
39.50	7.00	6.50	0.02	1063.18	1244.72	333.50	13.11	7.66	22.15	25.93	6.95	0.00	-0.03
40.00	6.00	5.50	0.02	929.25	1085.54	271.12	11.24	6.59	19.36	22.62	5.65	0.00	-0.03

40.50	5.00	4.50	0.02	785.51	915.52	212.46	9.32	5.48	16.36	19.07	4.43	0.00	-0.03
41.00	4.00	4.00	0.02	709.77	826.27	184.58	8.34	4.91	14.79	17.21	3.85	0.00	-0.03
41.50	4.00	3.50	0.02	631.34	734.08	157.70	7.35	4.33	13.15	15.29	3.29	0.00	-0.03
42.00	3.00	3.00	0.02	550.14	638.89	131.86	6.34	3.74	11.46	13.31	2.75	0.00	-0.04
42.50	3.00	2.50	0.02	466.09	540.60	107.07	5.32	3.14	9.71	11.26	2.23	0.00	-0.04
43.00	2.00	2.00	0.02	379.10	439.15	83.38	4.28	2.53	7.90	9.15	1.74	0.00	-0.04
43.50	2.00												
											Total:	**0.67**	**-2.03**

RATING CURVE COEFFICIENTS

	Q>250 cfs			Q<250 cfs			Reach 1 Sediment Rating Curve			Reach 1 Width Rating Curve			Reach Lengths (ft)	
Coefficient	Reach 2	Supply	Width- R2	Reach 2	Supply	Width- R2	Flow Range	Slope	y-intercept	Flow Range	Slope	y-intercept	R1	966.5
A	2.66E-16	1.09E-16	3.79E-20	-3.76E-09	1.24E-09	-8.96E-12	Q<250	5.89E+01	-1.13E+03	Q<250	4.57E-04	2.65E+01	R2	1386.5
B	-5.30E-12	-3.05E-12	-8.46E-16	2.85E-06	-9.89E-07	8.07E-09	2000>Q>250	8.44E+01	-5.51E+03	5250>Q>250	2.14E-04	2.67E+01		
C	3.97E-08	3.07E-08	7.10E-12	-8.14E-04	2.94E-04	-2.90E-06	2250>Q>2000	7.15E+02	-1.27E+06	6000>Q>5250	7.45E-03	-1.12E+01		
D	-1.40E-04	-1.40E-04	-2.81E-08	1.07E-01	-3.99E-02	5.30E-04	6000>Q>2250	2.32E+02	-2.00E+05	6250>Q>6000	5.67E-02	-3.07E+02		
E	2.27E-01	3.06E-01	5.63E-05	-6.29E+00	2.46E+00	-5.15E-02	6250>Q>6000	1.23E+03	-6.15E+06	6750>Q>6250	1.73E-02	-6.11E+01		
F	5.75E+01	-8.59E+01	-4.12E-02	1.79E+02	3.69E+01	2.51E+00	6750>Q>6250	4.60E+02	-1.37E+06	7000>Q>6750	9.86E-02	-6.10E+02		
Intercept	-8.57E+03	3.45E+04	5.65E+01	2.82E-05	4.38E-05	9.99E-08	7000>Q>6750	2.49E+03	-1.51E+07					

ESTIMATED SCS HYDROGRAPH

				Step 6: Sediment Transport Rate (tons/day)			Step 7: Top Width (ft)		Step 9: Sediment Transported (tons)			Step 9: Δ Bed Elevation (ft)	
T (hr)	Q (cfs)	Q avg	ΔT	Reach 2	Reach 1	Supply	Reach 2	Reach 1	Reach 2	Reach 1	Supply	Reach 2	Reach 1
0	0	75	0.02	3636.73	3301.18	6971.12	47.61	26.57	72.73	66.02	139.42	0.00	0.03
0.48	210	770	0.04	119274.11	59473.03	96266.43	47.54	26.82	4770.96	2378.92	3850.66	-0.44	0.69
1.44	1330	1750	0.02	332958.40	142174.25	315070.22	59.84	27.03	6659.17	2843.49	6301.40	-0.56	1.60
1.92	2170	3395	0.04	636377.27	587170.25	677945.52	84.26	27.38	25455.09	23486.81	27117.82	-0.20	1.66
2.88	4620	5180	0.02	954624.98	1001201.00	1223928.22	130.31	27.76	19092.50	20024.02	24478.56	0.06	2.01
3.36	5740	6125	0.02	1058316.74	1367037.50	1563837.26	147.41	40.58	21166.33	27340.75	31276.75	0.37	1.21
3.84	6510	6720	0.02	1159325.27	1724352.00	1733325.95	151.47	54.96	23186.51	34487.04	34666.52	0.65	0.04
4.32	6930	6965	0.02	1241170.10	2286297.50	1782120.58	153.17	77.44	24823.40	45725.95	35642.41	1.19	-1.63
4.8	7000	6965	0.02	1241170.10	2286297.50	1782120.58	153.17	77.44	24823.40	45725.95	35642.41	1.19	-1.63
5.28	6930	6720	0.02	1159325.27	1724352.00	1733325.95	151.47	54.96	23186.51	34487.04	34666.52	0.65	0.04
5.76	6510	6265	0.02	1075009.76	1514892.75	1608856.03	148.68	47.10	21500.20	30297.86	32177.12	0.52	0.50
6.24	6020	5390	0.04	981076.55	1049910.50	1301256.94	135.31	28.95	39243.06	41996.42	52050.28	0.18	4.35
7.2	4760	3990	0.04	751060.27	725180.50	831763.63	97.86	27.51	30042.41	29007.22	33270.55	-0.09	1.94
8.16	3220	2765	0.04	520420.94	441041.75	537048.03	73.51	27.25	20816.84	17641.67	21481.92	-0.38	1.76
9.12	2310	1890	0.06	360440.63	153988.71	346923.47	61.73	27.06	21626.44	9239.32	20815.41	-1.75	5.35
10.56	1470	1120	0.08	198422.54	89009.18	169598.82	51.18	26.90	15873.80	7120.73	13567.91	-1.49	3.00
12.48	770	525	0.12	66851.27	38797.73	55871.32	46.78	26.77	8022.15	4655.73	6704.56	-0.63	0.96
15.36	280.00	271.90	0.02	21262.51	17438.71	31165.60	48.88	26.72	442.97	363.31	649.28	-0.01	0.13
15.86	263.80	255.69	0.02	18815.75	16071.30	30375.26	49.16	26.71	391.99	334.82	632.82	-0.01	0.14
16.36	247.59	239.49	0.02	16586.72	12972.88	24072.23	48.58	26.65	345.56	270.27	501.50	-0.01	0.11
16.86	231.39	223.29	0.02	14990.69	12018.82	22481.88	48.25	26.64	312.31	250.39	468.37	-0.01	0.10
17.36	215.19	207.08	0.02	13119.55	11064.76	20805.29	47.74	26.63	273.32	230.52	433.44	-0.01	0.10
17.86	198.98	190.88	0.02	11547.44	10110.70	18978.82	47.54	26.62	240.57	210.64	395.39	-0.01	0.09
18.36	182.78	174.68	0.02	10380.19	9156.64	17051.36	47.59	26.62	216.25	190.76	355.24	0.00	0.08
18.86	166.57	158.47	0.02	9474.72	8202.59	15118.87	47.67	26.61	197.39	170.89	314.98	0.00	0.07
19.36	150.37	142.27	0.02	8609.43	7248.53	13275.03	47.61	26.60	179.36	151.01	276.56	-0.01	0.06
19.86	134.17	126.06	0.02	7605.57	6294.47	11578.02	47.39	26.59	158.45	131.13	241.21	-0.01	0.05
20.36	117.96	109.86	0.02	6399.59	5340.41	10033.39	47.18	26.59	133.32	111.26	209.03	0.00	0.05
20.86	101.76	93.66	0.02	5066.45	4386.35	8593.10	47.22	26.58	105.55	91.38	179.02	0.00	0.04
21.36	85.56	77.45	0.02	3793.94	3432.30	7170.67	47.55	26.57	79.04	71.51	149.39	0.00	0.04
21.86	69.35	61.25	0.02	2807.91	2478.24	5672.41	47.74	26.56	58.50	51.63	118.18	0.00	0.03
22.36	53.15	45.05	0.02	2248.55	1524.18	4044.87	46.33	26.56	46.84	31.75	84.27	0.00	0.02
22.86	36.94	28.84	0.02	1997.61	570.12	2338.28	40.32	26.55	41.62	11.88	48.71	-0.01	0.02
23.36	20.74	10.37	0.03	1292.44	-517.50	606.25	21.02	26.54	34.47	0.00	16.17	-0.01	0.01
24	0												
											Total:	**-0.85**	**23.01**

RATING CURVE COEFFICIENTS

	Q>250 cfs			Q<250 cfs			Reach 1 Sediment Rating Curve			Reach 1 Width Rating Curve			Reach Lengths (ft)	
Coefficient	Reach 2	Supply	Width- R2	Reach 2	Supply	Width- R2	Flow Range	Slope	y-intercept	Flow Range	Slope	y-intercept	R3	966.5
A	2.66E-16	1.09E-16	3.79E-20	-3.76E-09	1.24E-09	-8.96E-12	Q<250	5.89E+01	-1.13E+03	Q<250	4.57E-04	2.65E+01	R2	1386.5
B	-5.30E-12	-3.05E-12	-8.46E-16	2.85E-06	-9.89E-07	8.07E-09	2000>Q>250	8.44E+01	-5.51E+03	5250>Q>250	2.14E-04	2.67E+01		
C	3.97E-08	3.07E-08	7.10E-12	-8.14E-04	2.94E-04	-2.90E-06	2250>Q>2000	7.15E+02	-1.27E+06	6000>Q>5250	7.45E-03	-1.12E+01		
D	-1.40E-04	-1.40E-04	-2.81E-08	1.07E-01	-3.99E-02	5.30E-04	6000>Q>2250	2.32E+02	-2.00E+05	6250>Q>6000	5.67E-02	-3.07E+02		
E	2.27E-01	3.06E-01	5.63E-05	-6.29E+00	2.46E+00	-5.15E-02	6250>Q>6000	1.23E+03	-6.15E+06	6750>Q>6250	1.73E-02	-6.11E+01		
F	5.75E+01	-8.59E+01	-4.12E-02	1.79E+02	3.69E+01	2.51E+00	6750>Q>6250	4.60E+02	-1.37E+06	7000>Q>6750	9.86E-02	-6.10E+02		
Intercept	-8.57E+03	3.45E+04	5.65E+01	2.82E-05	4.38E-05	9.99E-08	7000>Q>6750	2.49E+03	-1.51E+07					

24 HR, 100 YR HYDROGRAPH, HEC-1

				Step 6: Sediment Transport Rate (tons/day)			Step 7: Top Width (ft)		Step 9: Sediment Transported (tons)			Step 9: Δ Bed Elevation (ft)	
T (hr)	Q (cfs)	Q avg	Δt	Reach 2	Reach 1	Supply	Reach 2	Reach 1	Reach 2	Reach 1	Supply	Reach 2	Reach 1
0.00	0.00	75.23	0.02	3636.73	3301.18	6971.12	47.61	26.57	75.77	68.77	145.23	0.00	0.04
0.50	23.00	51.50	0.02	2419.64	1904.17	4708.55	47.23	26.56	50.41	39.67	98.09	0.00	0.03
1.00	80.00	103.00	0.02	5841.73	4936.44	9415.19	47.15	26.58	121.70	102.84	196.15	0.00	0.04
1.50	126.00	140.00	0.02	8480.12	7114.96	13027.89	47.58	26.60	176.67	148.23	271.41	-0.01	0.06
2.00	154.00	163.50	0.02	9740.96	8498.62	15712.92	47.66	26.61	202.94	177.05	327.35	0.00	0.07
2.50	173.00	181.00	0.02	10793.40	9529.00	17809.91	47.55	26.62	224.86	198.52	371.04	0.00	0.08
3.00	189.00	196.00	0.02	11998.70	10412.18	19570.70	47.57	26.63	249.97	216.92	407.72	-0.01	0.09
3.50	203.00	209.50	0.02	13387.14	11207.05	21064.93	47.80	26.63	278.90	233.48	438.85	-0.01	0.10
4.00	216.00	222.00	0.02	14840.68	11943.04	22353.69	48.21	26.64	309.18	248.81	465.70	-0.01	0.10
4.50	228.00	233.50	0.02	16092.32	12620.15	23483.23	48.55	26.64	335.26	262.92	489.23	-0.01	0.11
5.00	239.00	244.50	0.02	16845.50	13267.82	24579.70	48.45	26.65	350.95	276.41	512.08	-0.01	0.11
5.50	250.00	255.50	0.02	18786.82	16054.89	30366.44	49.16	26.71	391.39	334.48	632.63	-0.01	0.14
6.00	261.00	266.00	0.02	20363.85	16940.97	30865.28	48.98	26.71	424.25	352.94	643.03	-0.01	0.14
6.50	271.00	276.50	0.02	21969.94	17827.06	31409.85	48.81	26.72	457.71	371.40	654.37	-0.02	0.13
7.00	282.00	287.50	0.02	23682.91	18755.34	32028.57	48.64	26.72	493.39	390.74	667.26	-0.02	0.13
7.50	293.00	298.50	0.02	25426.21	19683.62	32695.80	48.48	26.72	529.71	410.08	681.16	-0.02	0.13
8.00	304.00	310.00	0.02	27280.33	20654.09	33444.30	48.32	26.72	568.34	430.29	696.76	-0.02	0.12
8.50	316.00	322.50	0.02	29331.29	21708.95	34315.84	48.15	26.73	611.07	452.27	714.91	-0.03	0.12
9.00	329.00	335.50	0.02	31502.49	22806.01	35285.02	47.99	26.73	656.30	475.13	735.10	-0.03	0.12
9.50	342.00	349.50	0.02	33882.86	23987.46	36398.81	47.83	26.73	705.89	499.74	758.31	-0.04	0.12
10.00	357.00	365.00	0.02	36567.51	25295.49	37714.70	47.67	26.73	761.82	526.99	785.72	-0.04	0.12
10.50	373.00	381.50	0.02	39480.04	26687.90	39208.66	47.51	26.74	822.50	556.00	816.85	-0.05	0.12
11.00	390.00	399.50	0.02	42718.96	28206.91	40944.98	47.36	26.74	889.98	587.64	853.02	-0.06	0.12
11.50	409.00	419.50	0.02	46389.61	29894.69	43000.63	47.21	26.75	966.45	622.81	895.85	-0.06	0.13
12.00	430.00	449.50	0.02	52028.99	32426.36	46324.00	47.03	26.75	1083.94	675.55	965.08	-0.08	0.14
12.50	469.00	502.00	0.02	62247.93	36856.78	52792.23	46.82	26.76	1296.83	767.85	1099.84	-0.10	0.16
13.00	535.00	566.00	0.02	75226.44	42257.67	61705.11	46.75	26.78	1567.22	880.37	1285.52	-0.13	0.19
13.50	597.00	627.50	0.02	88142.86	47447.60	71220.82	46.84	26.79	1836.31	988.49	1483.77	-0.16	0.23
14.00	658.00	728.00	0.02	109961.61	55928.69	88497.39	47.27	26.81	2290.87	1165.18	1843.70	-0.21	0.32
14.50	798.00	930.00	0.02	155340.49	72975.27	128213.95	48.96	26.86	3236.26	1520.32	2671.12	-0.31	0.54
15.00	1062.00	1197.50	0.02	215823.28	95549.33	187154.93	52.19	26.91	4496.32	1990.61	3899.06	-0.42	0.89

15.50	1333.00	1490.00	0.02	279552.88	120233.11	254903.42	56.22	26.98	5824.02	2504.86	5310.49	-0.51	1.30
16.00	1647.00	1907.00	0.02	363722.20	155423.32	350758.31	61.96	27.06	7577.55	3237.99	7307.46	-0.61	1.88
16.50	2167.00	2348.00	0.02	445634.35	344318.60	447777.00	67.77	27.16	9284.05	7173.30	9328.69	-0.27	0.99
17.00	2529.00	2380.50	0.02	451498.04	351856.98	454771.61	68.20	27.17	9406.21	7330.35	9474.41	-0.27	0.99
17.50	2232.00	1991.00	0.02	379775.02	162512.00	369597.50	63.08	27.08	7911.98	3385.67	7699.95	-0.63	1.99
18.00	1750.00	1581.00	0.02	298607.84	127912.51	276066.57	57.50	26.99	6221.00	2664.84	5751.39	-0.54	1.43
18.50	1412.00	1304.00	0.02	239427.64	104536.76	211652.51	53.63	26.94	4988.08	2177.85	4409.43	-0.46	1.04
19.00	1196.00	1121.50	0.02	198760.76	89135.76	169935.76	51.20	26.90	4140.85	1857.00	3540.33	-0.39	0.78
19.50	1047.00	990.00	0.02	168970.39	78038.61	140961.89	49.61	26.87	3520.22	1625.80	2936.71	-0.33	0.61
20.00	933.00	888.50	0.02	145928.61	69473.13	119615.27	48.54	26.85	3040.18	1447.36	2491.98	-0.29	0.49
20.50	844.00	808.50	0.02	127883.36	62722.01	103635.78	47.83	26.83	2664.24	1306.71	2159.08	-0.25	0.40
21.00	773.00	743.00	0.02	113276.75	57194.53	91238.01	47.36	26.82	2359.93	1191.55	1900.79	-0.22	0.33
21.50	713.00	686.50	0.02	100861.73	52426.55	81124.87	47.05	26.80	2101.29	1092.22	1690.10	-0.19	0.28
22.00	660.00	637.00	0.02	90171.13	48249.29	72766.74	46.87	26.79	1878.57	1005.19	1515.97	-0.16	0.24
22.50	614.00	595.50	0.02	81373.45	44747.15	66160.20	46.77	26.78	1695.28	932.23	1378.34	-0.14	0.21
23.00	577.00	561.50	0.02	74297.30	41877.92	61044.02	46.75	26.78	1547.86	872.46	1271.75	-0.13	0.19
23.50	546.00	533.00	0.02	68468.99	39472.84	56975.59	46.77	26.77	1426.44	822.35	1186.99	-0.11	0.17
24.00	520.00	497.00	0.02	61256.91	36434.83	52142.07	46.84	26.76	1276.19	759.06	1086.29	-0.10	0.15
24.50	474.00	436.00	0.02	49472.12	31287.10	44793.61	47.10	26.75	1030.67	651.81	933.20	-0.07	0.13
25.00	398.00	367.00	0.02	36917.58	25464.26	37890.72	47.65	26.74	769.12	530.51	789.39	-0.04	0.12
25.50	336.00	315.00	0.02	28096.32	21076.04	33785.73	48.25	26.72	585.34	439.08	703.87	-0.03	0.12
26.00	294.00	278.50	0.02	22279.10	17995.84	31518.70	48.78	26.72	464.15	374.91	656.64	-0.02	0.13
26.50	263.00	250.50	0.02	18046.26	15632.94	30145.20	49.25	26.71	375.96	325.69	628.02	-0.01	0.14
27.00	238.00	225.00	0.02	15188.15	12119.68	22651.50	48.31	26.64	316.42	252.49	471.91	-0.01	0.10
27.50	212.00	202.00	0.02	12582.09	10765.46	20247.70	47.64	26.63	262.13	224.28	421.83	-0.01	0.09
28.00	192.00	183.50	0.02	10970.65	9676.20	18108.20	47.54	26.62	228.56	201.59	377.25	0.00	0.08
28.50	175.00	167.00	0.02	9932.00	8704.69	16130.28	47.64	26.61	206.92	181.35	336.05	0.00	0.07
29.00	159.00	150.00	0.02	9030.70	7703.75	14138.95	47.66	26.61	188.14	160.49	294.56	-0.01	0.06
29.50	141.00	134.50	0.02	8152.56	6791.13	12441.45	47.51	26.60	169.84	141.48	259.20	-0.01	0.06
30.00	128.00	122.00	0.02	7321.44	6055.14	11177.24	47.32	26.59	152.53	126.15	232.86	0.00	0.05
30.50	116.00	109.00	0.02	6330.68	5289.71	9954.86	47.17	26.59	131.89	110.20	207.39	0.00	0.05
31.00	102.00	93.50	0.02	5053.43	4377.09	8579.36	47.22	26.58	105.28	91.19	178.74	0.00	0.04
31.50	85.00	79.50	0.02	3943.29	3552.78	7352.71	47.50	26.57	82.15	74.02	153.18	0.00	0.04
32.00	74.00	71.00	0.02	3355.52	3052.31	6587.51	47.70	26.57	69.91	63.59	137.24	0.00	0.03
32.50	68.00	65.50	0.02	3027.95	2728.47	6076.98	47.76	26.57	63.08	56.84	126.60	0.00	0.03
33.00	63.00	61.00	0.02	2795.91	2463.52	5648.33	47.73	26.56	58.25	51.32	117.67	0.00	0.03
33.50	59.00	57.00	0.02	2618.56	2228.00	5258.41	47.61	26.56	54.55	46.42	109.55	0.00	0.03
34.00	55.00	53.00	0.02	2468.81	1992.49	4860.05	47.37	26.56	51.43	41.51	101.25	0.00	0.03
34.50	51.00	49.50	0.02	2359.80	1786.41	4504.84	47.01	26.56	49.16	37.22	93.85	0.00	0.03
35.00	48.00	46.00	0.02	2269.97	1580.33	4144.04	46.50	26.56	47.29	32.92	86.33	0.00	0.03
35.50	44.00	41.50	0.02	2178.92	1315.38	3673.46	45.55	26.56	45.39	27.40	76.53	0.00	0.02
36.00	39.00	36.50	0.02	2101.56	1020.98	3145.13	44.01	26.55	43.78	21.27	65.52	0.00	0.02
36.50	34.00	31.50	0.02	2035.11	726.59	2616.64	41.81	26.55	42.40	15.14	54.51	-0.01	0.02
37.00	29.00	25.00	0.02	1931.36	343.88	1942.48	37.71	26.55	40.24	7.16	40.47	-0.01	0.02
37.50	21.00	17.50	0.02	1712.00	-97.72	1211.62	30.68	26.54	35.67	0.00	25.24	-0.01	0.01
38.00	14.00	12.00	0.02	1413.67	-421.55	734.21	23.52	26.54	29.45	0.00	15.30	-0.01	0.01
38.50	10.00	9.00	0.02	1176.38	-598.19	504.35	18.76	26.54	24.51	0.00	10.51	-0.01	0.00

39.00	8.00	7.50	0.02	1033.03	-686.51	399.38	16.12	26.54	21.52	0.00	8.32	-0.01	0.00
39.50	7.00	6.50	0.02	927.21	-745.39	333.50	14.26	26.54	19.32	0.00	6.95	-0.01	0.00
40.00	6.00	5.50	0.02	812.57	-804.27	271.12	12.31	26.54	16.93	0.00	5.65	-0.01	0.00
40.50	5.00	4.50	0.02	688.60	-863.14	212.46	10.28	26.54	14.35	0.00	4.43	-0.01	0.00
41.00	4.00	4.00	0.02	622.95	-892.58	184.58	9.24	26.54	12.98	0.00	3.85	-0.01	0.00
41.50	4.00	3.50	0.02	554.74	-922.02	157.70	8.16	26.54	11.56	0.00	3.29	-0.01	0.00
42.00	3.00	3.00	0.02	483.93	-951.46	131.86	7.07	26.54	10.08	0.00	2.75	-0.01	0.00
42.50	3.00	2.50	0.02	410.43	-980.90	107.07	5.95	26.54	8.55	0.00	2.23	-0.01	0.00
43.00	2.00	2.00	0.02	334.17	-1010.34	83.38	4.81	26.54	6.96	0.00	1.74	-0.01	0.00
43.50	2.00												
											Total:	**-7.86**	**20.02**

Appendix I: Castaic Creek and Hasley Canyon General Maintenance Plan (Aquatic Consulting Services, Inc.) – Dated March 2002

GENERAL MAINTENANCE PLAN

CASTAIC CREEK AND HASLEY CANYON DRAIN

Prepared for

Newhall Land
Valencia, California

Prepared by

Aquatic Consulting Services, Inc.
Ventura, California
Field Report 132.98R
September 1998
(Revised March 2002)

DOCUMENT CONCURRENCE

This document has been reviewed by the U.S. Army Corps of Engineers, California Department of Fish and Game, Los Angeles County Public Works, and Newhall Land Company. The signatures below indicate that each authorized agency/company representative concurs with the contents of this document and will abide by the general maintenance procedures for Castaic Creek and Hasley Canyon Drain described herein:

U.S. Army Corps of Engineers:

_____ _____

Signature Date

_____

Printed Name

California Department of Fish and Game:

_____ _____

Signature Date

_____

Printed Name

Los Angeles County Department of Public Works:

Signature 4/11/02

Date

PHIL SCUDAR for report dated March 2002

Printed Name

Newhall Land Company:

Signature 3/12/02

Date

ROSS PISTONE

Printed Name

I. PROJECT BACKGROUND

During July 1988, Newhall Land Company held field meetings with personnel from the U.S. Army Corps of Engineers (ACOE) and the U.S. Fish & Wildlife Service (USFWS) to discuss industrial and commercial development within Castaic and Hasley Canyon drainages. As a result of this meeting, Newhall submitted necessary project plans and supporting documents to obtain an individual permit for this planned development. The ACOE issued a Section 404 individual permit (No. 89-419-EV) for development within this drainage. The permit contained 21 special conditions. Six of these special conditions relate to revegetation of the work areas (special conditions 1, 7, 8, and 14) and/or routine maintenance work (special conditions 5, 7, and 11) within the drainage following project construction. A copy of the ACOE permit and pertinent correspondence is included within Appendix A. This 404 permit currently expires December 11, 2005 unless an extension is issued. As part of the original permitting process, the ACOE completed an Environmental Assessment for the project (Department of the Army 1990). Portions of this document have been included within this report. Figure 1 is a general location map showing the two drainages.

In October 1997, Newhall applied for a Section 401 Water Quality Certification for a channel lining project and bridge project to be constructed within Castaic Creek. Both these projects had been previously permitted under the ACOE's Individual Permit (No. 89-419-EV). In December 1997, during a telephone conversation, the Los Angeles Regional Water Quality Control Board (LARWQCB) decided that since both projects were previously permitted under an existing ACOE Section 404 permit, a Section 401 Water Quality Certification was not required and that the Board would take no further actions on these projects. The LARWQCB also requested that Newhall withdraw their application and request a refund of all application fees. A letter dated December 12, 1997 was sent to the Board formally withdrawing the two permit applications and requesting the application fees be refunded. A copy of this letter is included in Appendix B. Subsequently, on December 17, 1997, the LARWQCB formally waived Section 401 Water Quality Certification since the ACOE had issued an individual permit for construction of the bridge and flood-control structures within this drainage. A copy of the LARWQCB's letter is included within Appendix B.

Site development required construction of infrastructure consisting of flood-control structures, roadways, and bridges. These structures were necessary to provide flood protection to lands contiguous to the creek. Development of flood protection has been divided into three phases:

A. PHASE I

Phase I includes construction of a flood-control channel and bridge within central Hasley Canyon with concrete sides and an 80-foot-wide soft bottom along an existing man-made ditch. This phase of the project temporarily impacted a total of 5.4 acres of "waters" devoid of wetlands. The 1603 Agreement (#5-160-90) issued for this phase of work required that 2.0 acres of sandy wash habitat within the new flood-control channel be naturally revegetated as mitigation (0.37:1) for these projects. A copy of this agreement is included in Appendix C. Both projects were completed in 1992. Revegetation work was completed in 1993 and the area has since developed into valuable habitat. Approximately 5,530 linear feet of bank stabilization remain to be constructed within upper Hasley Canyon drainage and 2,850 linear

General Location Map f Hasley Canyon Drainage and
Castaic Creek in Relatu ighway 126 and Interstate 5

RE

feet of bank stabilization remain to be constructed within lower Hasley Canyon drainage. Together these projects will impact 9.33 acres of habitat. The completed soft-bottom drain will connect with outlet structures already constructed as part of the Castaic Creek Bridge project. Figure 2 shows the general location of bridges and bank stabilization projects within both Castaic Creek and Hasley Canyon drainage that have already been approved by the ACOE.

B. PHASE II

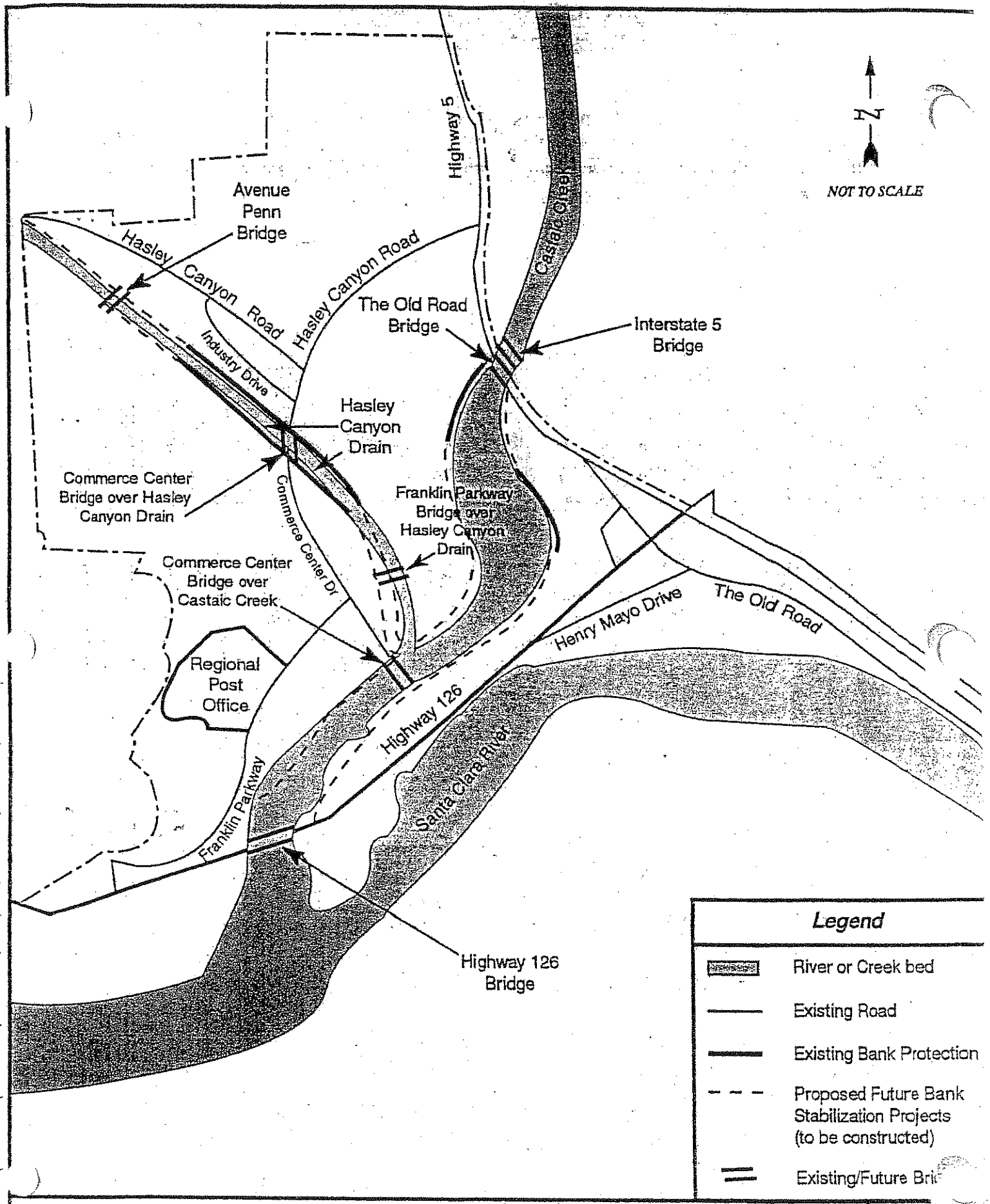
This phase involves discharge of fill into 4.0 acres of an ephemeral streambed to construct an underground stormdrain for the U.S. Postal Service general mail facility. No wetlands were affected. The 1603 Agreement #5-081-90 issued for this work required that Newhall Company establish, through aided or natural revegetation, four acres of sandy wash habitat within the completed flood-control channel in Hasley Canyon. . This mitigation work was completed in 1993. A copy of this agreement is included in Appendix C.

C. PHASE III

Phase III involves stabilization of a 1.7-mile-long reach of Castaic Creek banks with 19,400 feet of bank stabilization (2:1 graded slope). Construction also includes installation of Commerce Center Bridge crossing over Castaic Creek immediately north of Highway 126. Portions of phase III work that began in the spring of 1998 included construction of Commerce Center Bridge over Castaic Creek and 2,070 linear feet of bank stabilization along the Castaic Creek east bank upstream of the bridge. The CDFG issued two Streambed Alteration Agreements (#5-346-97 and 5-370-97) for the bank stabilization and bridge projects constructed in 1998. These two agreements also imposed conditions relating to revegetation and routine channel maintenance (conditions #4, 9, 10, 11, and 12 in Agreement No. 5-346-97 and conditions #4, 9, 10, 11, and 12 in Agreement No.5-370-97). Copies of both agreements are included within Appendix C.

The large site maps at the end of the document indicate the general location of future revegetation areas within Castaic Creek. The first phase of revegetation work that was completed within this area was associated with the Castaic Creek Bridge (Commerce Center Bridge) and the initial channel-lining project located along the east bank. These projects were authorized under USACOE #89-419-EV, CDFG 1603 Agreements # 5-370-97 and 5-346-97 respectively. Following discussions with the agencies, the two-revegetation projects were combined to create one large area, immediately west of the channel-lining site (Figure 3). This 8.98-acre site contained four contiguous areas that provided suitable topographic features. This site also expanded an existing riparian corridor to provide a valuable wildlife corridor. Selection of this composite site was based upon discussions with both agencies during June 1999. This area will not be subject to any future development. This site was subsequently revegetated during September 1999, and has been monitored and weeded as required by the agencies. Revegetation monitoring reports were submitted in 2000, 2001, and 2002.

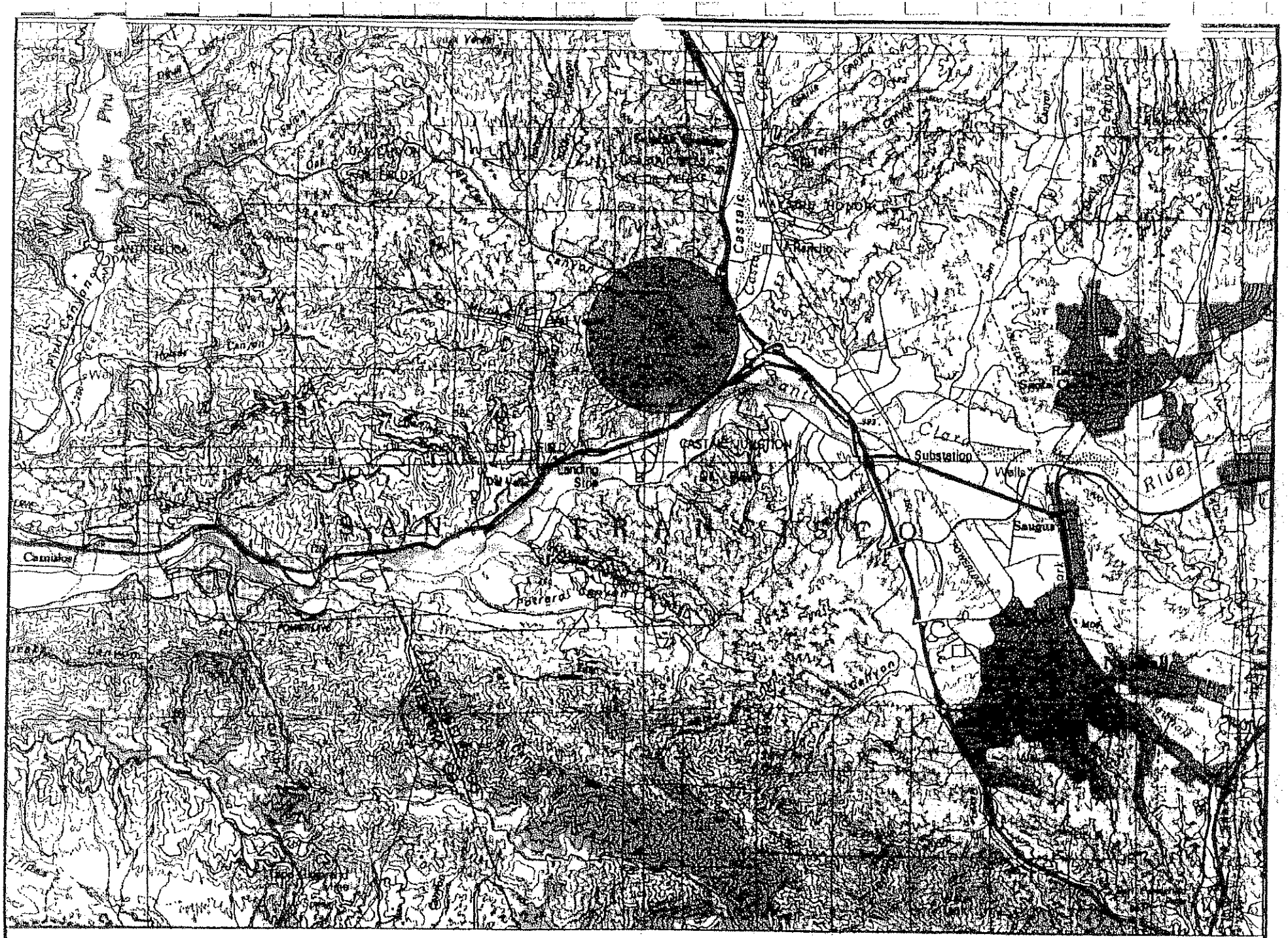
Approximately 17,400 linear feet of bank stabilization still need to be constructed. Figure 2 shows the general locations of future bank stabilization along Castaic Creek that have already



ACS

Castaic Creek and Hasley Canyon Drainage, Showing Approximate Locations of Existing and Proposed Future Bank Stabilization Projects and Bridges

FIGURE 2



General Location Map f Hasley Canyon Drainage and
Castaic Creek in Relation ighway 126 and Interstate 5

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U.S. Army Corps of Engineers:

_____ _____

Signature Date

_____

Printed Name

California Department of Fish and Game:

_____ _____

Signature Date

_____

Printed Name

Los Angeles County Department of Public Works:

[signature] 4/11/02

Signature Date

PHIL SCUDAR for report dated March 2002

Printed Name

Newhall Land Company:

Ron Pistone 3/12/02

Signature Date

ROSS PISTONE

Printed Name

GENERAL MAINTENANCE PLAN

CASTAIC CREEK AND HASLEY CANYON DRAIN

Prepared for

Newhall Land
Valencia, California

Prepared by

Aquatic Consulting Services, Inc.
Ventura, California
Field Report 132.98R
September 1998
(Revised March 2002)

APPENDIX B

"General Maintenance Plan Castaic Creek and Hasley Canyon Drain," prepared by Aquatic Consulting Services, Inc. dated March 2002 and accepted by LACDPW on April 11, 2002.

approved by ACOE. Two large GMP maps for Castaic Creek (southern half area map) and Hasley Canyon drain (northern half area map), included in the envelope at the back of this report, shows the approximate locations of future bank stabilization projects, proposed future revegetation areas, and County of Los Angeles Department of Public Works (County) access corridors, as discussed within this plan. As part of the normal permitting process, the County will review and approve all project grading and Site Development Plans.

Since completed flood-control projects will ultimately be transferred County jurisdiction, it is critical to have their concurrence with any proposed routine flood-control maintenance activities within these two drainages. On May 12, 1998, a joint meeting was held with the ACOE, California Department of Fish and Game (CDFG), Los Angeles County Department of Public Works (LACPW), and the Newhall Land Company. The purpose of this meeting was to discuss future flood-control maintenance activities within the Castaic and Hasley Canyon drainages relative to specific revegetation projects as required under existing 1998 project permits. One goal was to identify those routine flood-maintenance activities that would be required for the entire drainage once all identified flood-control projects were constructed. Subsequent to this meeting, County personnel provided additional information concerning specific maintenance activities within Hasley Canyon drainage. The present plan was revised and also incorporated general management concepts presented in the EIS/EIR jointly prepared by the ACOE and CDFG for Newhall's Natural River Management Plan (ACOE and CDFG 1997 and 1998). The revised draft General Maintenance Plan (GMP), dated October 1998, was again submitted to the ACOE and CDFG for review and comment during the spring of 1999. Their written comments were used to update the current plan. Copies of agency responses are included in Appendix D.

The purpose of the current GMP is to describe general operational guidelines for routine maintenance procedures to be used within the Castaic Creek and Hasley Canyon drainage. This document represents consensus of the regulatory agencies (ACOE and CDFG), Newhall Land Company, and the Los Angeles Department of Public Works.

II. GENERAL MAINTENANCE GUIDELINES

Routine maintenance activities within the two drainages could potentially impact natural vegetation areas or revegetation areas created as mitigation for present and future projects. Following discussions with the County, ACOE, and CDFG, it became obvious that two specific factors could impact vegetated areas. The first factor was the physical design of the bridge or channel-lining project. If the flood-control structure or bridge was designed with the appropriate Manning's "n" value (n = roughness coefficient), then it did not matter where vegetation naturally grows or where revegetation areas were created within the channel. Properly designed structures incorporating the correct Manning's coefficient would theoretically permit vegetation to grow along the entire channel bottom without reducing flood flow capacity. However, routine channel-maintenance and repair activities following completion of project construction requires periodic access into the channel along the lateral edges. Provision would need to be made for periodic access into the channel bottom within

controlled access corridors. Based upon discussions with County staff, it was determined that a 45-foot-wide access corridor between the new bank stabilization and revegetation area would need to be kept clear of all vegetation for projects located within Castaic Creek. This width would conform to the work area defined as 30 feet from the levee at the invert as presented in the NRMP. All vegetation will be routinely cleared from this area.

The second factor involved areas where the appropriate Manning coefficient could not be incorporated because the channel would be too narrow. Vegetation growing along the bottom of these channels would also need to be periodically cleared to maintain adequate flood-flow capacity. The criteria to be used for initiating channel clearance would need to be clearly defined. This factor specifically relates to the Hasley Canyon drainage.

A successful General Maintenance Program must specifically address these two factors to provide adequate protection for any natural vegetation growing within the channel bottom or any revegetation project to be installed within the two drainages.

Typical County flood-maintenance programs include the following components:

- Periodic clearing of vegetation immediately upstream and downstream of certain existing bridges which were not designed in accordance with the proper Manning's coefficient.
- Periodic removal of woody vegetation from rip-rap to protect its structural integrity.
- Periodic clearing of stormdrain outlets to ensure proper drainage.
- Periodic removal of ponded water that cause odor problems.
- As-needed repairs of bridges.
- As-needed repairs of bank protection.
- Clearing vegetation from Hasley Canyon drainage channel bottom.
- Water diversions around work areas.

III. SPECIFIC WORK ACTIVITIES

The following detailed description of each proposed County flood-maintenance activity was taken from the Natural River Management Plan (Tettemer, 1997). These activities have been previously accepted by LACDPW (Vandermost, personal communication, 1997). The language has been modified as necessary to specifically apply to Castaic and Hasley Canyon drainages. The environmental protection measures and notification procedures (and form) to inform CDFG and the ACOE for all required maintenance activities are also included (see Appendix E). There are specific differences in the maintenance programs for Castaic Creek and Hasley Canyon drain because of their different design criteria.

A. CHANNEL CLEARING NEAR BRIDGES

Vegetation and/or debris will be removed from around the following bridges, on an as-needed basis, as determined by LACDPW:

- Highway 126 Bridge over Castaic Creek - 50 feet upstream and 50 feet downstream;
- Commerce Center Drive Bridge over Castaic Creek – 50 feet upstream and 50 feet downstream;
- Commerce Center Drive Bridge over Hasley Canyon drain – 50 feet upstream and 50 feet downstream;
- Franklin Parkway Bridge over Hasley Canyon drain - 50 feet upstream and 50 feet downstream;
- Avenue Penn Bridge over Upper Hasley Canyon drain – 50 feet upstream and 50 feet downstream;
- The Old Road Bridge over Castaic Creek – 50 feet upstream and 50 feet downstream;
- Interstate 5 Bridge over Castaic Creek – 50 feet upstream and 50 feet downstream of the structure.

Vegetation and debris may be removed by heavy equipment (D-8 dozer or equivalent). Equipment within the streambed shall be operated within the above-described removal areas, which will be demarcated with fencing or staking. This work shall be conducted between September 1 and March 15, to avoid impacting nesting birds.

B. REMOVAL OF VEGETATION FROM ROCK RIP-RAP (CASTAIC CREEK)

Control of vegetation on the rock face of the levee to the invert access roads by LACDPW shall proceed under current policies, procedure, and practices. Careful attention to chemical handling and wind drift shall be observed. Chemicals shall be suitable for use around aquatic areas. For existing and new levees constructed within Castaic Creek, LACDPW may remove trees that grow in levees, and remove large trees, defined as trees with trunks four inches or more in diameter at breast height (dbh), within 15 feet of the levee toe in order to maintain the structural integrity of the levees. Whenever possible, this work shall be performed from the levee access road. If access to the bottom of the creek is required, the work area shall be limited to a 30-foot-wide zone extending outward from the levee at the invert and 15 feet upstream and downstream on either side of the tree to be removed. Hand-held equipment shall be used. Whenever possible, this work shall occur between September 1 and March 15, which is outside of the nesting season of the least Bell's vireo.

C. REMOVAL OF VEGETATION FROM RIP-RAP (HASLEY CANYON DRAIN)

Control of vegetation on the rock face of the levee to the invert access roads by LACDPW shall proceed under current policies, procedure, and practices. Careful attention to chemical handling and wind drift shall be observed. Chemicals shall be suitable for use around aquatic

areas. For existing and new levees constructed within Hasley Canyon drain, LACDPW may remove trees that grow in levees, and remove large trees, defined as trees with trunks four inches or more in diameter at breast height (dbh), within 15 feet of the levee toe in order to maintain the structural integrity of the levees. Whenever possible, this work shall be performed from the levee access road. If access to the bottom of the creek is required, the work area shall be limited to a 30-foot-wide zone extending outward from the levee at the invert and 15 feet upstream and downstream on either side of the tree to be removed. Hand-held equipment shall be used. Whenever possible, this work shall occur between September 1 and March 15, which is outside of the nesting season of the least Bell's vireo. Only one side of the levee can be cleared of large trees in any one year.

D. CLEANING STORM-DRAIN OUTLETS

Sediment buildup at existing drains shall be removed on an as-needed basis as determined by the LACDPW. The County shall use light equipment to create a swale up to 75 feet in length and up to 10 feet wide, to allow water to drain. Light equipment such as a Caterpillar D-6 or equivalent may enter areas of the creek as long as they avoid areas of ponded or flowing water (not including water discharging from the side drains) to remove sediment. Large riparian trees defined as trees with trunks in excess of four inches in diameter at breast height (dbh) shall be avoided. The maintenance area will be demarcated with flagging. New side drains will be designed with a rock apron to maintain a clear area large enough to provide sufficient hydraulic capacity to maintain flow from the side drain. Equipment shall be introduced into the creek by means of an earth ramp constructed on the side slope in the immediate vicinity, or from an adjacent invert access ramp if within 1,000 feet of the area to be maintained. If the equipment must access the creek, care will be taken to minimize impacts to vegetation and to avoid destruction of large trees, defined as trees with trunks in excess of four inches in diameter at breast height (dbh).

E. CONTROL OF ODOR FROM STAGNANT PONDS

In order to drain stagnant water that is causing an odor problem, LACDPW shall dig a swale using a Caterpillar D-6 or its equivalent or may hand shovel a swale, up to 75 feet in length and up to 10 feet wide to allow ponded water to percolate. LACDPW will notify the ACOE and CDFG prior to performing this work. Prior to initiating in-channel maintenance activities, all work sites and access roads shall be inspected by a qualified biologist for the presence of sensitive aquatic species. The ACOE and CDFG shall be notified of the inspection and have the option of attending. If ACOE and CDFG feel that there is a concern about endangered species being present in an area, every effort will be made to schedule a field meeting within ten working days. At the field meeting, the ACOE and/or CDFG will determine if the work can be completed without take of an endangered species. The ACOE is expected to coordinate with the USFWS regarding the presence of endangered species in the area. If a take will occur, the County will apply for the appropriate endangered species permits.

F. BRIDGE REPAIR

Whenever practical, repairs to bridges shall be made from the bridge deck. If this is not practical, minimum encroachment upstream and/or downstream of the bridge will be acceptable. The maintenance work area for structural repairs shall be limited to 30 feet on either side of the bridge and under the bridge itself. Equipment shall be introduced into the creekbed by means of an earth ramp constructed on the side slope in the immediate vicinity, or from an adjacent invert access ramp if within 1,000 feet of the bridge. If the equipment must access the creekbed, care shall be taken to minimize impacts to vegetation and to avoid destruction of large trees, defined as trees with trunks in excess of four inches diameter at breast height (dbh). Prior to conducting the work in non-emergency situations, LACDPW shall contact the ACOE and CDFG two weeks in advance, or in emergency situations, shall notify the ACOE and CDFG within two weeks of work being initiated. Non-emergency maintenance should be scheduled between September 1 and March 15 to avoid the least Bell's vireo nesting season.

G. REPAIRS TO BANK PROTECTION

Structural repairs to levees, bridges, side drains, water quality facilities, utility crossings, etc., shall be performed on an as-needed basis to maintain the integrity of the structure. The work area shall be limited to the section of the structure, plus a 30-foot work area extending out from the levee at the invert and upstream and downstream within the 30-foot width of the structure to be repaired. The ACOE and CDFG will be notified two weeks in advance of any work that encroaches into the creekbed unless it is emergency work, in which case the ACOE and CDFG shall be notified within two weeks of initiation of work.

H. CLEARING VEGETATION FROM THE BOTTOM OF HASLEY CANYON DRAIN

Since the new Hasley Canyon drainage channel design will not conform to the required Manning's "n" of 0.085, periodic clearing of the channel bottom will be required to provide flood-flow capacity. Existing native vegetation growing along the channel bottom will be cleared whenever there is more than 50-percent vegetative cover over three feet tall within the channel. When this criteria is met or exceeded, only one side of the channel bottom (extending out 40 feet from the toe of the lining with the existing channel bottom) will be cleared in any one year. Heavy equipment will be used to clear the vegetation. Any vegetative clearing that is necessary within 100 feet of the Castaic Creek confluence shall only be done using hand.

I. WATER DIVERSIONS AROUND WORK AREAS NEAR ENDANGERED SPECIES AQUATIC SITES

If water diversions are required to perform work, LACDPW shall provide for the protection of any aquatic species that may exist within the surface water. This would include securing appropriate endangered species permits. The following provisions apply:

1. Prior to initiating construction, the site shall be inspected by a qualified biologist for the presence of any sensitive aquatic species. ACOE and CDFG will be notified of the inspection and will have the option of attending. If either agency is not represented, the

biologist will file a written report of the inspection with the agency not in attendance within ten days of completion of the survey. If any sensitive species is present, the following conditions will apply:

- The site will be surveyed and cleared of the sensitive species immediately before the work is to be carried out, immediately before any equipment is moved into or through the stream, and immediately before diverting any stream water. Any species collected will be moved out of the work area and returned to the stream in a manner and at a location to ensure their survival.

- Blocking nets, or fences with 1/4-inch square mesh, 18-inches high, and buried 6 inches, will be placed upstream and downstream of the work area to assure that no sensitive species moves into the work area.

- A qualified biologist will be present at the moment any stream diversion takes place and will patrol the area, both within and downstream of the work area, to rescue any species stranded by diversion of surface water. If there is a possibility that additional downstream sections of the stream will be dewatered, additional biologists will be available for downstream patrol. These rescue patrols will continue until all dewatered portions of the stream are determined to be cleared.

- Once it is determined that the construction site or a portion of the site and work area boundary does not contain sensitive species, the site shall be fenced with construction fencing along the stream side, and maintenance personnel and equipment will not enter the creek beyond the fence.

- A water-control system will be installed to intercept stream flow upstream of the work area and carry it around the work site. The system will be completed before turning water into it. The process of turning water into this bypass system shall be done so as to minimize sediment movement.

- LACDPW will use best efforts to ensure that no debris, bark, slash, sawdust, rubbish, cement, concrete, or washings thereof, oil or petroleum products, or other organic material from construction or associated activity will be allowed to enter into or be placed where it may be washed by rainfall or runoff into the creek. Sediment control best management practices (BMPs) shall be utilized during construction.

- Impacts to endangered species may require obtaining appropriate endangered species permits.

2. If no sensitive aquatic species is found in the area, standard diversion practices shall be utilized as follows:

   - Pilot Channel - pilot channels constructed to divert flows around work areas shall be sized to maintain existing water velocities, with wide, shallow channels being utilized.

The channel should be kept as small as possible, extending no more than 25 feet upstream and downstream of the work area. Construction of pilot channels should start at the downstream end. Once water is diverted into the new channel, the original channel should be visually inspected, and any stranded fish shall be removed and returned to the water downstream of the diversion. Once the diversion is no longer needed, the area shall be restored as closely as practical to its original configuration.

- Pump - the use of a pump to divert flows around a work site is also acceptable. The pump must have at least a 1/4-inch mesh screen. Water should be discharged downstream, within 25 feet of the work area. Any dams installed across flowing water for the diversion shall be removed upon completion of construction, and the area shall be restored as closely as practical to its original configuration.

LACDPW will contact the ACOE and CDFG to identify areas of potential endangered species habitat. If either agency believes the work may adversely impact endangered species or its habitat resources, or if the LACDPW wishes to consult with the either agency, a field meeting will be scheduled. At the field meeting, the agencies will provide information regarding endangered or threatened species that could be impacted by the project. If take of an endangered species will occur, the appropriate endangered species permits will be required. To the extent that a CDFG Section 2081 Memorandum of Agreement has been completed for the species present, the mitigation measures shall be implemented and maintenance activities may proceed as described above.

IV. NOTIFICATION GUIDELINES

This GMP will require that the County first obtain a long-term maintenance permit from the ACOE (Section 404 permit). Under the ACOE's current permit program, long-term maintenance activities within existing flood control facilities would qualify under Nationwide Permit #31. These activities will not result in discharge of fill into "waters of the U.S." The County will also need to establish a renewable general maintenance 1601 Agreement with the CDFG. This agreement would permit the routine flood control maintenance activities previously described and could be extended for five-year terms.

Routine maintenance operations within Castaic and Hasley Canyon drainages will require notification be sent to both ACOE and CDFG. The type of notification (non-emergency or emergency project) will depend on whether or not the activity is considered to be a routine operation or occurring as part of an emergency situation. The notification form is included as Appendix E.

The Operator shall use the General Maintenance Notification (Emergency/Non-emergency) form (Appendix E) to describe the type of work to be performed. In non-emergency situations, the form should be filled out and faxed to ACOE and CDFG at least two weeks in advance of the work. LACDPW may contact ACOE and CDFG to identify areas of potential endangered species habitat. If the ACOE and CDFG believe the work may adversely impact an endangered species or its habitat resources, or if the LACDPW wishes to consult with ACOE and CDFG, a field

meeting will be scheduled. At the field meeting, ACOE and CDFG will provide information regarding endangered or threatened species that could be impacted by the project. If take of an endangered species will occur, the appropriate endangered species permits will be required. To the extent that a USFWS Section 7 and CDFG Section 2081 Memorandum of Agreement have already been completed for the species present, the identified mitigation measures will be implemented, and maintenance activities may proceed as outlined in these documents.

The notification is provided to demonstrate consistency with the policies of the GMP. In non-emergency situations, CDFG must respond to the notification within twenty working days. If CDFG believes that the work is inconsistent with the GMP, a field meeting will be scheduled to review the site and determine how the work may proceed. If CDFG does not respond within twenty working days, the work shall proceed as described in the notification. However, appropriate endangered species permits may be required for any impacts to endangered species.

If the project qualifies under the law as an emergency, LACDPW shall complete a GMP Notification form describing how the emergency work was performed in conformance with the guidelines in the GMP. This form will be mailed to ACOE and CDFG within ten days of initiating work activities.

V. LITERATURE CITED

Department of the Army, Los Angeles District Corps of Engineers 1990. Environmental Assessment 404(b)(1) Evaluation Public Interest Review. Permit Application Number 90-419-EV. Applicant: Valencia Company.

Tettemer, J.M., Vance, H.A. and Vandermost, J. 1993. U.S. Army Corps of Engineers General Section 404 Permit Santa Clara River from Castaic Creek to one-half mile above the Los Angeles Aqueduct and portions of San Francisquito Creek and the Santa Clara River, South Fork Los Angeles County, California for levee linings, bridges, storm drain outlets, and related drainage and water quality projects proposed by the Valencia Company. July.

Tettemer, John and Associates, Ltd. 1997. Natural River Management Plan for Santa Clara River from Castaic Creek to One-half Mile above the Los Angeles Aqueduct and Portions of San Francisquito Creek and the Santa Clara River, South Fork, Los Angeles County, California. Prepared for the Valencia Company.

U.S. Army Corps of Engineers and California Department of Fish and Game. 1997. Draft Environmental Impact Statement/Environmental Impact Report. 404 Permit and 1603 Streambed Alteration Agreement for Portions of the Santa Clara River and its Tributaries, Los Angeles. December.

U.S. Army Corps of Engineers and California Department of Fish and Game. 1998. Final Environmental Impact Statement/Environmental Impact Report. 404 Permit and 1603 Streambed Alteration Agreement for Portions of the Santa Clara River and its Tributaries, Los Angeles. August.

DATE: March 4, 2002

TO: Project Files

FROM: Louis Courtois LC

SUBJECT: Update to CESPL-CO-R May 26, 1999 ACOE Memorandum For The Record: Castaic Creek Maintenance/Revegetation Plan 90-00419-EV

ACOE Comment #1 - Please refer to page 11 of latest (March 2002) General Maintenance Plan.

ACOE Comment #2 - The ACOE permit referred to was #90-00419-EV. Following a June 14, 1999 telephone discussion with the CDFG, a revised revegetation plan specific to the Castaic Creek Bridge and Castaic Creek Channel Lining projects was submitted to the agencies (June 18, 1999). This plan included an expanded planting plan that showed the location of revegetation site in relation to the channel lining project site and planting acreage of each area. Combined the two projects required that 549 trees (312 cottonwoods and 237 willows) be planted. However, a total of 868 trees were planted during the first week of August 1999. The extra 319 trees were to be used for mitigating future projects. These extra trees were planted because the revegetation site was larger than required by the two projects. Monitoring reports have been submitted to the agencies for 2000, 2001, and 2002.

1891 Goodyear Avenue, Suite 619 • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-8270 • aquaserv@west.net

DATE: March 4, 2002

TO: Project Files

FROM: Louis Courtois LC

SUBJECT: Update to CDFG May 27, 1999 letter regarding Castaic Creek General Maintenance and Revegetation Plan (1603 No. 5-346-97 and 5-370-97)

I discussed these two comments with Ms. Leslie MacNair (CDFG) on June 14, 1999. At that time she said Newhall could amend the existing 1603 Agreements to add in maintenance activities. She requested Newhall submit a revegetation plan for each site or alternatively, combine the revegetation requirements for both sites together and plant a larger area. Newhall decided to combine the two project's revegetation requirements together and plant one large site. The revegetation site is located immediately opposite (west) the channel lining site. Combined the two projects required that 549 trees (312 cottonwoods and 237 willows) be planted. However, a total of 868 trees were planted during the first week of August 1999. The extra 319 trees were to be used for mitigating future projects. These extra trees were planted because the revegetation site was larger than required by the two projects. Monitoring reports have been submitted to the agencies for 2000, 2001, and 2002.

CDFG Comment #1 - A detailed revegetation plan (dated 6-18-99) was submitted to the agencies. This plan included an expanded planting plan that showed existing creek topography and the location and acreage for each area.

CDFG Comment #2 - The detailed revegetation plan (dated 6-18-99) provided detailed procedures for weed eradication.

APPENDIX A

404 PERMIT NO. 89-00419-AOA

ACOE CORRESPONDENCE

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

November 16, 2000

REPLY TO
ATTENTION OF:
Office of the Chief
Regulatory Branch

Mr. Ross Pistone
Valencia Company
23823 Valencia Boulevard
Valencia, California 91355-2194

Dear Mr. Pistone:

Reference is made to your request of November 3, 2000 to amend Permit No. 89-00419-AOA which authorized you to construct flood control and site drainage facilities for the construction of the Valencia Commerce Center in Castaic Creek in the City of Santa Clarita, Los Angeles County, California.

Under the provisions of 33 Code of Federal Regulations 325.6(d), the start date is to remain the same and the completion date is extended from December 11, 2000 to December 11, 2005.

Please be aware that the above project is located in proposed critical habitat for the arroyo southwestern toad. The Corps has determined that this project would not adversely modify the proposed critical habitat and, as a result, a Conference is not required for this permit extension. However, if the project area is designated as critical habitat for the arroyo southwestern toad, the Corps may have to suspend this permit to complete an informal/formal Section 7 Consultation with the U.S. Fish and Wildlife Service.

The terms and conditions of Permit No. 8900419-AOA, except as changed herein, remain in full force and effect.

Please note that a copy of this letter is being forwarded to those agencies on the enclosed list.

Sincerely,

Mark Durham

George L. Beams, P.E.
Chief, Construction -
Operations Division

for

Enclosure

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
300 NORTH LOS ANGELES STREET
LOS ANGELES, CALIFORNIA 90012

REPLY TO
ATTENTION OF:

Office of the Chief
Regulatory Branch

November 15, 1995

Mark Subbotin
Senior Vice President, Planning
Valencia Company
23823 Valencia Boulevard
Valencia, California 91355-2194

Dear Mr. Subbotin:

Reference is made to your request of August 21, 1995 to amend Permit No. 89-00419-EV which authorized you to construct flood control and site drainage facilities associated with the Valencia Commerce Center in Castaic Creek near the City of Santa Clarita, Los Angeles County, California.

Under the provisions of 33 Code of Federal Regulation 325.6(d), the start date is to remain the same and the completion date is extended from December 11, 1995 to December 11, 2000.

The terms and conditions of Permit No. 89-00419-EV, except as changed herein, remain in full force and effect.

In response to your request for a ten year extension, the Corps of Engineers rarely, if ever, grants permit extensions for that amount of time. Your reference to 33 CFR Part 325.6(b) does not apply to time extensions for pending projects but for completed projects (e.g. a dam, once completed, would not require a new 404 authorization every five years).

Please note that a copy of this letter is being forwarded to those agencies on the enclosed list. If you have any questions, please contact Aaron Allen at (213) 894-0349.

Sincerely,

Richard J. Schubel

Richard J. Schubel
Acting Chief, Regulatory Branch

Enclosure

Copies forwarded:

U.S. Fish and Wildlife Service
Attn: Field Supervisor
2140 Eastman Avenue, Suite 100
Ventura, California 93003

U.S. Environmental Protection Agency
Attn: Mr. Jeff Rosenblum
Wetlands and Dredged Material Section (W-7-2)
75 Hawthorne Street
San Francisco, California 94105

California Department of Fish and Game
Attn: Mr. Curt Taucher
330 Golden Shore, Suite 50
Long Beach, California 90802

Valencia Company

23823 Valencia Boulevard, Valencia, California 91355-2194 • (805) 255-4000

805-255-4069

WRITER'S DIRECT DIAL NUMBER

August 21, 1995

Mr. David Castanon
Chief, North Coast Section
Department of the Army
Los Angeles District Corps of Engineers
Ventura Field Office
2151 Allesandro Drive, Suite 255
Ventura, CA 93001

CERTIFIED MAIL

Dear Mr. Castanon:

In review of your letter dated December 9, 1993, which granted Valencia Company a two year extension to the Valencia Commerce Center, Individual Permit No. 89-419-EV, we are asking for an additional extension of ten years. Current market conditions in the Santa Clarita Valley and Southern California as a whole are such that implementation and completion of this permit by December 11, 1995, would cause an undue financial burden. Significant reliance has been made by Valencia on the continued use of the permit.

The scope of work under this permit is for an activity of a permanent nature and the provisions of 33 Code of Federal Regulation 325.6 (b) would allow a permit with an indefinite duration, or certainly longer than two years for a project of this extent.

Thank you for your attention to this matter. Please call me if you have any questions or I can provide further clarification.

Sincerely yours,

Mark Subbotin
Senior Vice President
Planning

bcc: Phil Stidham
Ross Pistone
Steve Kessler
Ron Horn

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2711
LOS ANGELES, CALIFORNIA 90053-2325

DEC 14

December 9 ,1993

REPLY TO
ATTENTION OF
Office of the Chief
Regulatory Branch

Valencia Company
(Att: Mark Subbotin)
23823 W. Valencia Boulevard
Valencia, California 91355

Gentlemen:

Reference is made to your request dated June 9, 1993 to amend Permit No. 89-419-EV which authorized you to:

1. Line of approximately 19,400 feet of bank as protection along both sides of a 1.7 mile stretch of Castaic Creek;

2. Construct a flood control channel in Halsey Canyon along an existing man-made ditch that will impact a total of 5.4 acres of watercourse;

3. Discharge fill into 4.0 acres of an ephemeral streambed to construct an underground storm drain.

These activities are located in Castaic Creek at a site adjacent to Interstate 5 and State Route 126, Halsey Canyon watershed draining into Castaic Creek and an unnamed drainage in the vicinity, also feeding Castiac Creek, Los Angeles County, California.

Under the provisions of 33 Code of Federal Regulation 325.6(d), the start date is to remain the same and the completion date is extended from December 11, 1993 to December 11, 1995.

The terms and conditions of Permit No. 89-419-EV, except as changed herein, remain in full force and effect. In addition, as per Condition A in After-the-Fact Permit No. 86-255, the applicant shall include the above project (No. 89-419-EV) in the NEPA document scope of analysis for the Valencia Long-Range Plan. Any further time extensions for permit No. 89-419-EV will be based on the results from the above referenced study.

Please note that a copy of this letter is being forwarded to those agencies on the enclosed list.

Sincerely,

Diane K. Noda

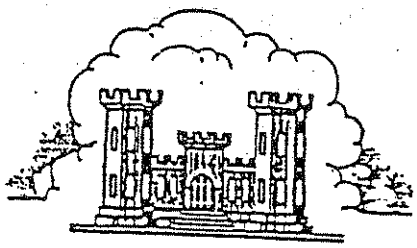
for John A. Gill
Chief, Regulatory Branch

Enclosure
Copies Forwarded:

Fish and Wildlife Enhancement
U.S. Fish and Wildlife Service
Attn: Mr. Jack Fancher
2730 Loker Avenue West
Carlsbad, California 92008

U.S. Environmental Protection Agency
Attn: Mr. Clyde Morris
Wetlands and Dredged Material Section (W-7-2)
75 Hawthorne Street
San Francisco, California 94105

California Department of Fish and Game
Attn: Mr. Bruce Eliason
330 Golden Shore, Suite 50
Long Beach, California 90802



LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

CERTIFICATION OF COMPLIANCE WITH DEPARTMENT OF THE ARMY PERMIT

Permit Number: 89-419-EV

Name of Permittee: Valencia Company
23823 Valencia Boulevard
Valencia, CA 91355

Date of Issuance: December 11, 1990

Upon completion of the activity authorized by this permit, sign this certification and return it to the following address:

U.S. Army Engineer District
ATTN: SPLCO-R-89-419-EV
P.O. Box 2711
Los Angeles, California 90053-2325

Please note that your permitted activity is subject to a compliance inspection by an Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit.

_____
Signature of Permittee

Valencia Company

23823 Valencia Boulevard, Valencia, California 91355 • (805) 255-4000

December 11, 1990

WRITER'S DIRECT DIAL NUMBER

(805) 255-4069

Liz Varnhagen
Department of the Army, Los Angeles District
Corps of Engineers, Regulatory Branch
P.O. Box 2711
Los Angeles, CA 90053

SUBJECT: VALENCIA COMPANY INDIVIDUAL PERMIT 89-419-EV

Dear Liz:

Attached is an original copy of the 404 Permit for Castaic Creek signed by Stephen Schmidt. You will also find a check in the amount of $100.00 and the notification of commencement of work for the unnamed drainage and that portion of Hasley Creek for which we have executed 1603 Agreements.

The 1603 Agreements are attached for your file, pursuant to Condition #17 of the 404 Permit.

Again, I want to thank you for all your efforts in this process and look forward to working with you in the future as we make headway with Flood Control District.

Sincerely,

Mark Subbotin
Assistant Vice President

MAS:jw

cc: John Gray

LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY PERMIT

Permittee:

Valencia Company
23823 Valencia Boulevard
Valencia, CA 91355

Permit Number:

89-419-EV

Issuing Office:

Los Angeles District

Note: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description:

1) Install bank protection along the 1.7-mile stretch of Castaic Creek from the bridge of The Old Road, downstream to the Route 126 Bridge just above its confluence with the Santa Clara River. The bank protection shall be in the form of either shotcrete, closed, or open-celled articulating precast concrete tiles as specified on the attached drawing. Portions of the natural bank of the Creek shall be excavated and other areas filled, and graded to a 2H:1V slope to achieve a smooth bank alignment as illustrated in Figure 2 attached

to this permit.

Construct Backer Road Bridge across Castaic Creek at the location shown in the attached drawing, and install an energy dissipator in the creekbed below the bridge.

2) Fill the unnamed tributary to Castaic Creek that is approximately 1,500 feet long and empties into the Creek about 800 feet upstream of the Route 126 bridge as shown in Figure 1 attached to this permit.

3) Widen and install shotcrete lining on Hasley Creek as shown in Figure 1. Energy dissipators will be installed approximately every 300 to 500 feet.

Project Location: In Castaic Creek, H sley Creek, and an unnamed tributary to Castaic Creek at a 1.7 mile stretch between The Old Road bridge and Highway 126 bridge, Los Angeles County.

Permit Conditions

General Conditions:

1. The time limit for completing the authorized activity ends on ecember 11, 1993. If you find that you need more time to complete the thorized activity, submit your request for a time extension to this ffice for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification from this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this uthorization.

. If a conditioned water quality certification has been issued for your

project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished with the terms and conditions of your permit.

Special Conditions: See attached sheet.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

Section 404 of the Clean Water Act (33 U.S.C. 1344).

2. Limits of this authorization.

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measure ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give you favorable consideration to a request for an extension of this time limit.

You signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Stephen C. Eckhardt
(PERMITTEE)

12-11-90
(DATE)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

for David L. Castaños
CHARLES M. HOLT, P.E.
Chief, Regulatory Branch
(for the District Engineer)

12-11-90
(DATE)

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE)

(DATE)

SPECIAL CONDITIONS FOR THE VALENCIA COMMERCE CENTER PERMIT, APPLICATION NUMBER 89-419-EV

1. Low-growing dry wash vegetation shall be allowed to establish naturally within the bottom of Hasley Creek to compensate for the loss of dry wash habitat along the unnamed drainage. There shall be no clearing of any native riparian vegetation that establishes itself within the creek channel unless it grows excessively dense so as to impede water flow. Any vegetative clearing that is necessary within 100 feet of the confluence with Castaic Creek shall be done by hand only.

2. The permittee shall record in deed the Castaic Creek corridor as a conservation easement for the purpose of retaining and enhancing fish and wildlife values in perpetuity. Copies of these deed restrictions shall be furnished to the Corps of Engineers, the U.S. Fish and Wildlife Service and the California Department of Fish and Game for our files prior to approval of final construction drawings as set forth in condition 6 below, and within twelve months of the issuance of this permit.

3. The permittee shall require through project conditions, covenants and restrictions any industrial user which handles toxic or hazardous substances within the Valencia Commerce Center, to build an on-site self-containment system in accordance with applicable local, state, and federal laws that will prevent these substances from accidentally entering Hasley Creek or Castaic Creek. This measure shall minimize the potential of contaminating the unarmored three-spine stickleback and least Bell's vireo habitats downstream in the event of an accident. This shall be verified by the Corps personnel making inspections of the channel each year for the duration of the construction period.

4. Parking lots in the Valencia Commerce Center shall have a drainage system to divert non-storm flows to an oil and grease trap that will separate such contaminants before the runoff is diverted to Hasley or Castaic Creek. These parking lot runoff control systems shall be verified by Corps personnel while making annual inspections of the channels for the duration of the construction period.

5. Prior to the initiation of any construction in Castaic Creek, or any maintenance clearing within the bottom 100 feet of Hasley Creek, the permittee shall furnish the Corps with a letter that is signed by Los Angeles County Department of

Public Works which declares that they agree to comply with the special conditions of this permit. Maintenance vegetative clearing is permitted only in the upper portion of Hasley Creek, and for emergency repair work to structures within the channel and the bank lining. Under such conditions, clearing of vegetation should be kept to a minimum, and the permittee shall perform remedial replacement of damaged vegetation (especially from the construction of access roads if they are necessary) immediately upon completion.

6. Installation of the channel lining and storm drain system shall occur during the period of April 1 to November 1 to avoid winter runoff. Erosion and sediment control measures shall be established prior to all construction activities in any water course on the project site. In the event that the contractors are not able to finish the construction in this time window, the permittee shall inform the Corps in advance of November 1 in writing, and request permission for a one or two month time extension.

7. Bank protection that allows for growth of native herbaceous vegetation shall be utilized along the sides of Castaic Creek as indicated on the attached map, except on portions of the creek where there is a high propensity for scouring under high flow conditions, or adjacent to certain structures. The preferred form of bank protection is articulating concrete tiles of the open-cell variety. These and closed cell tiles which are permitted only in areas where open cell tiles cannot provide adequate protection, shall be installed in areas as indicated on the attached concept map. Gunite lining shall also be used only where explicitly indicated on the concept map. This plan has been reviewed by the U.S. Fish and Wildlife Service and their objection to the issuance of this permit has been lifted largely based on the assumption that this concept map shall be implemented. Final construction drawings of all haul-routes, channel lining, bridges, point stabilizers, outlets, and appurtenant facilities in and along the entire stretch of Castaic Creek within project boundaries, shall be submitted to the Corps in coordination with the USFWS prior to the initiation of any phased construction on Castaic Creek for final review and approval.

8. The new lining along Castaic Creek shall be seeded with native herbaceous vegetation and initially irrigated after installation to encourage the development of low-growing riparian growth.

9. The areal extent and duration of construction activities along Castaic Creek shall be minimized as much as possible. Construction zones for the installation of bank protection and haul routes shall be flagged and staked in the field to minimize intrusion and disturbance of existing vegetation shown on the bypass concept (attached as Exhibit B). All marshalling and equipment storage areas shall be located outside of the channel. The staked boundaries of the impact zone shall be verified by the Corps and the U.S. Fish and Wildlife Service prior to the commencement of construction.

10. The permittee shall replace all living and dead willow and cottonwood trees that have a diameter at breast height of 6 inches or more, at a ratio of 1.5 new trees for each tree lost. These trees shall not be any smaller than those out of five gallon containers, and preferably a mixture of large sizes. Replacement plants shall be placed in augered holes in portions of the Castaic Creek channel that appear to have suitable environmental conditions for such trees to establish naturally. Potentially suitable areas are shown on the attached bypass concept (Attached).

Prior to construction in Castaic Creek, a formal mitigation plan shall be submitted to the Corps for review and approval in coordination with the U.S. Fish and Wildlife Service (USFWS). This plan shall include the numbers of the different species of trees to be planted, the sizes, and locations of planting. The plan shall also describe maintenance of the planted area with regard to irrigation (as needed) and weed iradication. These replacement trees shall be monitored for five years following the completion of the construction phase of channel, to ensure their successful establishment.

Survey and re-vegetation plan monitoring documents shall be submitted to the Corps and USFWS in the form of annual reports in December of each year. These shall be reviewed and amended as necessary to ensure success. All failed plantings shall be replaced. If the agencies determine that restoration has not been successful, the program shall be re-assessed, irrigation introduced if necessary, and restoration efforts shall continue on a year-to-year basis until success has been demonstrated.

In the event of significant flood flows which wipe out much of the existing and newly planted vegetation within the five year monitoring and maintenance period, the applicant shall restore

the mitigation site(s) in accordance with the approved mitigation plan.

11. Emergency repair of the channel lining or bridges across Castaic Creek or Hasley Creek shall occur as needed. Any sensitive riparian habitat in the vicinity shall be staked in advance to minimize the area of adverse impacts to vegetation. Routine maintenance in the form of vegetative clearing within and along Castaic Creek shall not occur in vegetated or mitigation areas. All riparian vegetation disturbed by maintenance and repair shall be replaced at a ratio of 1:1.

12. The permittee shall remove the existing road that crosses Castaic Creek near its confluence with Hasley Creek, immediately following the construction of the new bridge. The area shall be restored to match the surrounding creek contours and revegetated with native willow and mulefat cuttings and trees at sizes and densities similar to those in the immediate vicinity.

13. Excavation of mounds of tailings from past sand and gravel mining operations within the creek may occur, but any trees and shrubs removed in the process that are greater than 6 inches at breast height shall be replaced on site at a 1.5:1 ratio.

14. A weed eradication and control program shall be established as part of the restoration efforts and implemented on a regular basis during the five-year restoration period. During monitoring efforts, a crew shall examine all disturbed portions of Castaic Creek and remove by hand (and by topical application of approved herbicides) stands of Arundo donax, Tamarisk, castor bean and tree tobacco.

15. As this permit will expire before all elements of the project along waters of the United States have been installed at least six months prior to its expiration, the permittee shall request an extension in writing.

16. Surveys for the presence of the least Bell's vireo, (Vireo belli pusillus), shall be conducted at weekly intervals during the months of April and May, for the duration of the construction of the bank protection in Castaic Creek. Following the culmination of these surveys, documentation and results of the surveys shall be submitted to the Corps for review. In the event that a vireo is spotted, the surveys shall be extended through June or until a nest is located. If

nesting vireos occur in the area, then any construction within 300 feet of the nest shall be discontinued until the nest is abandoned. The vireo shall not be harassed in any way, and if one is hurt or killed, the U.S. Fish and Wildlife Service shall be notified immediately pursuant to the Endangered Species Act.

17. This permit is not valid without valid Streambed Alteration Agreements from the California Department of Fish and Game for the individual portion(s) of the project about to be constructed. Final copies of these executed agreements and their renewals shall be submitted to the Corps for the file.

18. Landscaping along the top of the bank protection shall utilize native drought tolerant plants.

19. The following measures shall be implemented for cultural and paleontological resources:

(a) Prior to the installation of lining along Hasley Creek, detailed field surveys will be conducted at the Pyle Ranch and Tsavangu Rancheria sites, particularly in croplands.

(b) The Pyle Ranch site shall be fully documented and limited subsurface testing shall be conducted prior to grading.

(c) A qualified archaeologist shall be hired to perform the monitoring and shall send a letter to the Corps stating that he or she has been retained in order for the permittee to comply with the conditions of the permit.

(d) All grading and subsurface excavation work in the course of constructing bank stabilization for the Valencia Commerce Center will be monitored by the archaeologist. If he or she decides it is unnecessary to monitor any portion of the project area, he will include in his report with justification for the avoidance. All monitoring will be conducted to satisfy the terms of Section 106 of the National Historic Preservation Act.

(e) The archeologist shall provide the Corps with periodic progress reports of the monitoring. The reports will be submitted bi-weekly or monthly, depending on the length of time estimated for the subsurface activities to take place. The archeologist will indicate which is appropriate.

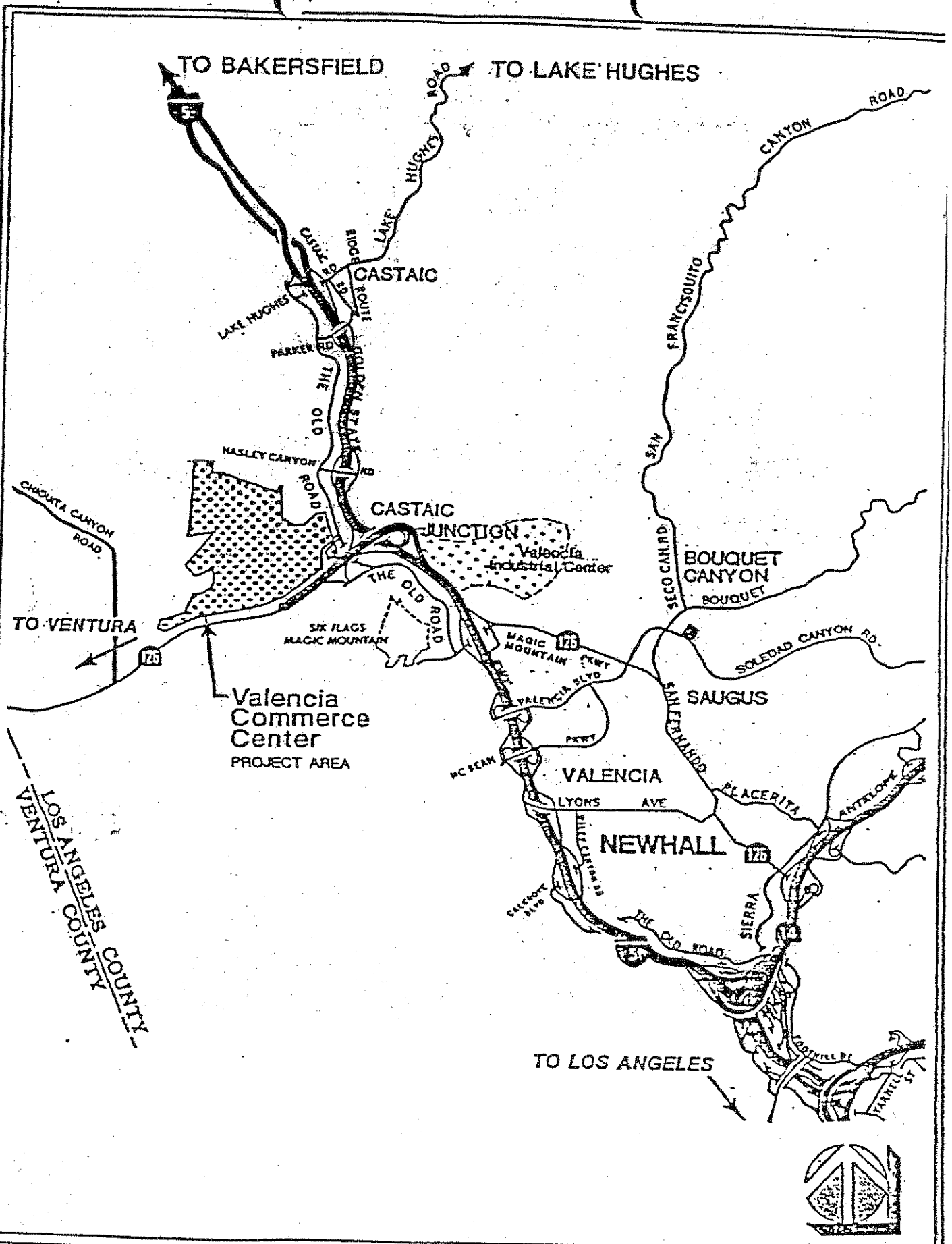
(f) After completion of the monitoring project, the archeologist will immediately submit a report to the Corps for evaluation.

If a negative report is accepted by the Corps, no further archeological work will be required.

If an archeological deposit is found, the Corps should be notified immediately. Additional subsurface testing may be required.

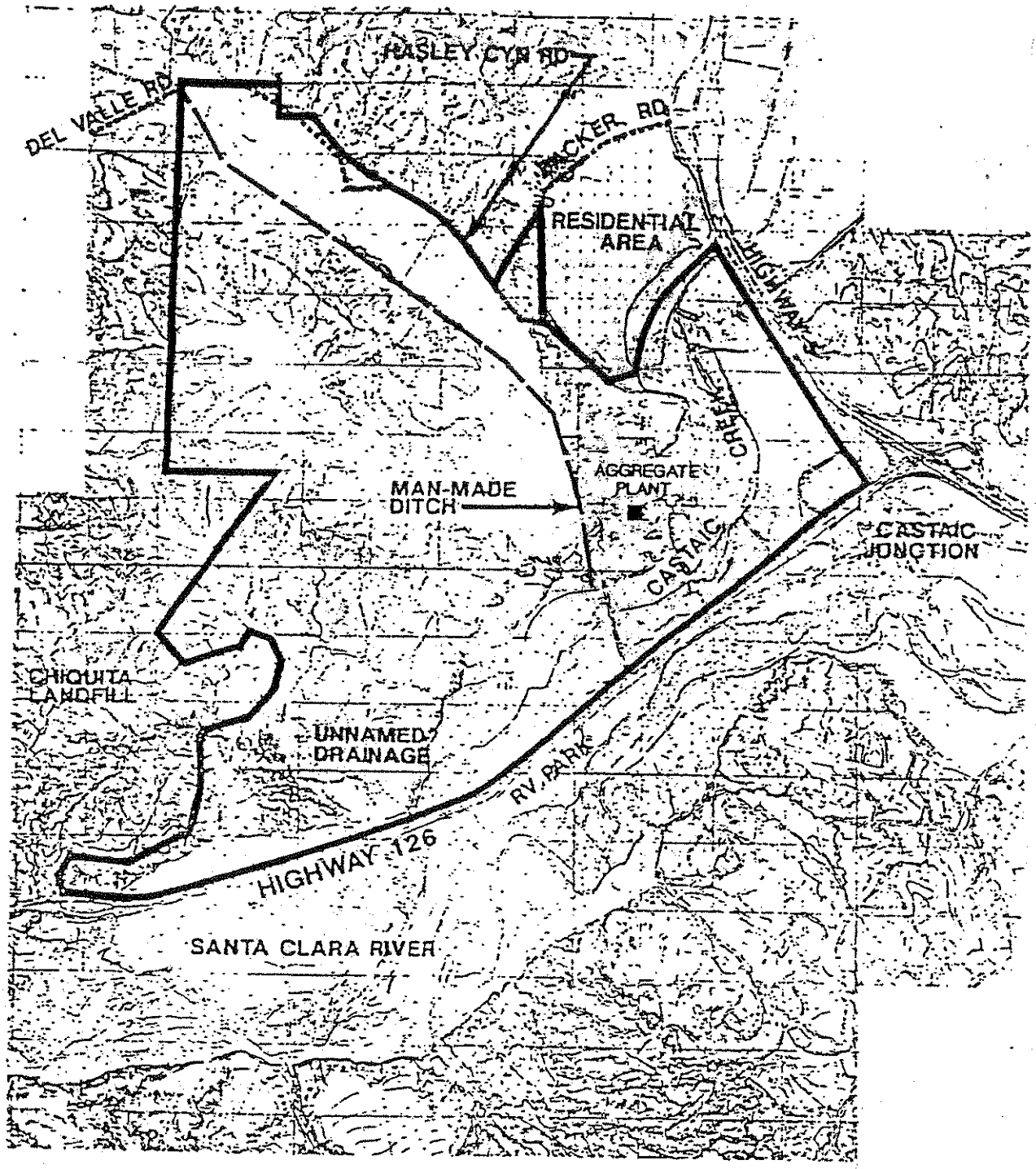
20. Prior to excavation activities associated with installation of the channel lining and storm drain, the permittee shall contact a qualified paleontologist to conduct a full survey of the area to be affected and identify locations that could potentially contain significant fossils. The paleontologist shall provide recommendations on the need and scope of construction monitoring at these locations in order to salvage significant fossils. The report with these recommendations will be submitted to the Corps for our files, and to the Los Angeles County Museum for review. If construction monitoring and salvage are deemed necessary, the recommendations by the Museum concerning artifact handling, curation and documentation will be followed.

21. The permittee shall coordinate with Caltrans for work in the State right-of-way near the Route 126 Bridge and the Old Road bridge. A complete set of project engineering plans including details on the lining tie-in to the bridges, and data on flood velocities and elevations at the structures will be submitted to Caltrans.



Regional Location of Project Area
Valencia Commerce Center

FIGURE
1



Project Area
Valencia Commerce Center

FIGURE
2

Preliminary Bank Stabilization Plan for Castaic Creek
Valencia Commerce Center

FIGURE
4

APPENDIX B

LOS ANGELES
REGIONAL WATER QUALITY CONTROL BOARD

401 WATER QUALITY WAIVER

EPA

Los Angeles
Regional Water
Quality Control
Board

01 Centre Plaza Drive
Monterey Park, CA
1754-2156
213) 266-7500
AX (213) 266-7600

Pete Wilson
Governor

December 17, 1997

Mr. Ross Pistone
Valencia Company
23823 Valencia Blvd.
Valencia, CA 91355

WITHDRAWAL OF APPLICATION FOR SECTION 401 WATER QUALITY CERTIFICATION - PROPOSED CASTAIC CREEK CHANNEL LINING PROJECT, CITY OF SANTA CLARITA, LOS ANGELES COUNTY (File No. 97-148)

We received your request to withdraw your application for a Section 401 Water Quality Certification (WQC) for the subject project. According to the submitted application packet, the proposed project is covered under an existing Section 404 permit (No. 90-419-EV) issued by the U. S. Army Corps of Engineers. If no other federal permit or license is required for this project, then no additional Section 401 WQC is required. However, the work implemented shall be in compliance with all the water quality objectives, prohibitions, and policies set forth in the *Water Quality Control Plan, Los Angeles Region (1994)*. Appendix I summarizes a subset of these objectives that may apply to the proposed project. In addition, this project may be subject to other State requirements (see Appendix II). No unpermitted discharges to surface waters of non-stormwater runoff are allowed. These activities would require coordination and approval from this Regional Board.

We have processed a refund request of $3,800.00 with the State Water Resources Control Board. We are retaining $200.00 to cover costs already incurred on your project. Please contact Darlene McCoy at (916) 657-1225, Division of Administrative Services, State Board, for further information.

Should you have any questions regarding this letter, please contact Rueen-Fang Wang at (213) 266-7533.

J. MICHAEL LYONS
Chief, Surveillance Unit

enclosures

cc: Becky Jones, Streambed Alteration Team,
California Department of Fish and Game (Long Beach)
Mary Meyer, California Department of Fish and Game (Ojai)
Aaron Allen, U.S. Army Corps of Engineers (Los Angeles) (No. 89-00419-EV)
Field Supervisor, U.S. Fish and Wildlife Service (Ventura)
Becky Tuden, U.S. Environmental Protection Agency (San Francisco, WTR-8)
Louis A. Courtois, Aquatic Consulting Services, 6416 Curlew Place, Ventura, CA 93003

Appendix I

In accordance with the *Porter-Cologne Water Quality Control Act* (§13243), the following represent specific water quality objectives contained in the *Water Quality Control Plan (Basin Plan), Los Angeles Region (1994)* that may apply to the proposed project:

- Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.
- Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.
- Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect beneficial uses.
- Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.
- Waters shall not contain floating materials, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.
- All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in, human, plant, animal, or aquatic life.
- Waters shall be free of substances that result in increases in the biochemical oxygen demand (BOD_5) which adversely affects beneficial uses.
- Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.
- Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use.
- Exotic vegetation shall not be introduced around stream courses to the extent that such growth causes nuisance or adversely affects beneficial uses.

The following are specific water quality objectives for protection of wetlands contained in the Regional Board's *Basin Plan (1994)* that may apply to the proposed project:

- Natural hydrologic conditions necessary to support the physical, chemical, and biological characteristics present in wetlands shall be protected to prevent significant adverse effects on:
  - natural temperature, pH, dissolved oxygen, and other natural physical/chemical conditions,
  - movement of aquatic fauna,
  - survival and reproduction of aquatic flora and fauna, and
  - water levels.

- Existing habitats and associated populations of wetlands fauna and flora shall be maintained by:
  - maintaining substrate characteristics necessary to support flora and fauna which would be present naturally,
  - protecting food supplies for fish and wildlife,
  - protecting reproductive and nursery areas, and
  - protecting wildlife corridors.

Appendix II

This project may be subject to the following State requirements:

(√) For inland disposal of nonhazardous contaminated soils and materials, contact Rodney Nelson, Groundwater Regulatory Unit, at (213) 266-7548 regarding Waste Discharge Requirements. All waste material removed must be relocated to a legal point of disposal or recycled for use as a soil amendment, if applicable. A legal point of disposal is defined as one for which Waste Discharge Requirements have been established by a California Regional Water Quality Control Board, and is in full compliance therewith.

(√) If the overall project area is larger than five acres, the proposed project may be subject to the State Board's General Construction Activity Storm Water Permit. For further information, please contact:

(√) Mark Pumford, Watershed I - Ventura Coastal Unit, at (213) 266-7596;
( ) Winnie Jesena, Watershed II - L.A. Coastal Unit, at (213) 266-7593;
( ) Joshua Workman, Watershed III - L.A. Inland Unit, at (213) 266-7615.

( ) The proposed project may be subject to the State Board's General Industrial Activities Storm Water Permit. For further information, please contact Dan Radulescu, Watershed III - L.A. Inland Unit, at (213) 266-7630.

(√) Any construction and/or groundwater dewatering, if required, would be subject to NPDES/Waste Discharge Requirements if water is discharged to surface waters or storm drains, including dry streambeds. For further information, please contact:

(√) Mark Pumford, Watershed I - Ventura Coastal Unit, at (213) 266-7596;
( ) Winnie Jesena, Watershed II - L.A. Coastal Unit, at (213) 266-7593;
( ) Joshua Workman, Watershed III - L.A. Inland Unit, at (213) 266-7615.

(√) Any construction and/or groundwater dewatering, if required, would be subject to Waste Discharge Requirements if water is discharged to groundwater or land. For further information, please contact Rodney Nelson, Groundwater Regulatory Unit, at (213) 266-7548 .

(√) The project shall also comply with the local regulations associated with the Regional Board's stormwater permit that is issued to:

(√) Los Angeles County and co-permittees under NPDES No. CAS614001 and Waste Discharge Requirements Order No. 96-054;
( ) Ventura County and co-permittees under NPDES No. CAS063339 and Waste Discharge Requirements Order No. 94-082.

AQUATIC CONSULTING SERVICES

December 12, 1997

Ms. Rueen-Fang Wang
Surveillance Unit
California Regional Water Quality Control Board
Los Angeles Region
101 Centre Plaza Drive
Monterey Park, CA 91754-2156

RE: Application for Section 401 Water Quality Certification for Castaic Creek Channel-Lining and Bridge Projects (Valencia Company)

Dear Ms. Wang:

This letter is a follow-up to your telephone call today concerning Valencia Company's application for a Water Quality Certification for the projects to be constructed within Castaic Creek. Based upon your telephone call, the Board has decided that since these projects were previously permitted under an existing U.S. Army Corps Individual 404 Section Permit (No. 90-419-EV), a Section 401 certification would not be required. It is also my understanding that the Board will take no further action on these projects. You also asked that Valencia Company withdraw their application and request a refund of all application fees. This letter formally withdraws the two permit applications and requests that a refund of application fees be sent directly to the Valencia Company at 23823 Valencia Blvd., Valencia, CA 91355-2194.

Please do not hesitate to call me at (805) 644-1208 if you have any further questions about this project.

Respectfully,

Louis A. Courtois

Louis A. Courtois, Ph.D.
Consultant

cc: Ross Pistone, Valencia Company

6416 Curlew Place • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-8220

APPENDIX C

1603 AGREEMENTS:

#5-160-90
#5-081-90
#5-346-97
#5-370-97

Hasley Creek #5-160-90

CALIFORNIA DEPARTMENT OF FISH AND GAME
330 Golden Shore, Suite 50
Long Beach, California 90802

Notification No. 5-160-90
Page 1 of 3

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and the Valencia Company, State of California, hereinafter called the Operator, is as follows:

WHEREAS, pursuant to Section 1603 of California Fish and Game Code, the Operator, notified the Department that they intend to substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed of, the following water: Hasley Canyon, Los Angeles County, California, Section 11, Township 4N, Range 16W.

WHEREAS, the Department (represented by DAVID P. DRAKE has made an inspection of subject area and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including: sandy wash habitat and herptofauna.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife resources during the Operator's work. The Operator hereby agrees to accept the following measures/conditions as part of the proposed work: (see attached list of proposed measures).

If the Operator's work changes from that stated in the notification specified above, this Agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this Agreement and with other pertinent code sections, including but not limited to Fish and Game Code Sections 2081, 3503, 3503.5, 5650, 5652, 5937 and 5948 may result in prosecution.

Nothing in this Agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. A consummated Agreement does not constitute Department of Fish and Game endorsement of the proposed operation, or assure the Department's concurrence with permits required from other agencies.

This Agreement becomes effective on date of Operator's signature and terminates 1 year from initiation of construction activities for project construction only. This Agreement shall remain in effect for that time necessary to satisfy the terms/conditions of this Agreement. If project construction does not begin within 90 days of the Operator's signing of the Agreement this Agreement shall be voided.

CONCURRENCE

Operator signature

Stephen C. Schmidt
(signature) (date)

California Department of Fish and Game

David P. Drake June 8, 1990
(signature) (date)

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-160-90

1. The following provisions constitute the limit of activities agreed to and resolved by this agreement. The signing of this agreement does not imply that the Operator is precluded from doing other activities, at the site. However, activities not specifically agreed to and resolved by this agreement are subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq..

2. The Operator proposes to alter the streambed for extension of Backer Road, realignment of Hasley Canyon Road and construction of a flood control channel..

* 3. The Operator shall submit to the Department for review and approval prior to initiation of project activities a detailed maintenance plan for the new channel that will allow for the establishment of at least 2 acres of sandy wash habitat to remain undisturbed by human activitiy. This area shall not be subject to flood control activities.

4. The Operator shall comply with all litter and pollution laws. All contractors, subcontractors and employees shall also obey these laws and it shall be the responsiblity of the Operator to insure their compliance.

5. No equipment maintenance shall be done within or near any stream channel or lake margin where petroleum products or other pollutants from the equipment may enter these areas under any flow.

6. The Department reserves the right to enter the project site at any time to ensure that there is compliance with terms/conditions of this Agreement.

7. The Department reserves the right to suspend and/or revoke this Agreement if the Department determines that the circumstances warrant. The circumstances that could require a reevaluation include, but are not limited to, the following:

a. Failure to comply with the terms/conditions of this Agreement.

b. The information provided by the Operator in support of the Agreement/Notification is determined by the Department to be incomplete, or inaccurate.

c. When new information becomes available to the Department representative(s) that was not known when preparing the original terms/conditions of this Agreement.

d. The project as described in the Notification/Agreement has changed, or conditions affecting fish and wildlife resources change.

8. The Operator shall provide a copy of this Agreement to all contractors, subcontractors, and the Operator's project supervisors. Copies of the agreement shall be readily available at work sites at all times during periods of active work and must be presented to any Department personnel, or enforcement personnel from another agency upon demand.

9. The Operator shall notify the Department, in writing, at least five(5) days prior to initiation of construction(project) activities and at least five(5) days prior to completion of construction(project) activities. Notification shall be sent to the Department at 330 Golden Shore, Suite 50, Long Beach,Ca., 90802, Attn: Environmental Services.

CONCURRENCE

(Operator's name)

Stephen C. Schmidt
(signature) (date)

Stephen C. Schmidt
Executive Vice President
Community Development

California Department of
Fish and Game

David P. Duke June 8, 1990
(signature) (date)

* Our execution of this agreement is based on the following understanding of Condition #3. If you do not concur with this interpretation, please notify us within 7 days so we can discuss the matter further.

Condition #3 requires Valencia Company to establish, through aided or natural revegetation, 2 acres of sandy wash habitat within the proposed flood control channel in Hasley Canyon subsequent to the completion of the project. This vegetation shall remain in the channel and shall not be removed or disturbed by flood control activities. If the sandy wash vegetation progresses into woody riparian vegetation over time, Valencia Company may reduce it to a low shrubby growth characteristic of sandy wash by the use of hand equipment. Prior to occupancy of the buildings abutting the flood control channel, Valencia Company shall submit to the Department for review and approval a revegetation and maintenance plan for the two-acre restored habitat. The Department shall take action on the plan within 10 days of receipt of the plan.

Post Office - Drainage #5-081-90

CALIFORNIA DEPARTMENT OF FISH AND GAME
330 Golden Shore, Suite 50
Long Beach, California 90802

Notification No. 5-081-90
Page 1 of 3

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and ~~U.S.~~ Valencia Com ~~Postal Service~~, hereinafter called the Operator, is as follows:

WHEREAS, pursuant to Section ~~1601~~ 1603 of California Fish and Game Code, the Operator, notified the Department that they intend to substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed of, the following water: unnamed tributary to Castaic Creek, Los Angeles County, California, Township 4N, Range 16W.

WHEREAS, the Department (represented by DAVID P. DRAKE has made an inspection of subject area and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including: sandy wash habitat and associated herptofauna.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife resources during the Operator's work. The Operator hereby agrees to accept the following measures/conditions as part of the proposed work: (see attached list of proposed measures).

If the Operator's work changes from that stated in the notification specified above, this Agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this Agreement and with other pertinent code sections, including but not limited to Fish and Game Code Sections 2081, 3503, 3503.5, 5650, 5652, 5937 and 5948 may result in prosecution.

Nothing in this Agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. A consummated Agreement does not constitute Department of Fish and Game endorsement of the proposed operation, or assure the Department's concurrence with permits required from other agencies.

This Agreement becomes effective on date of Operator's signature and terminates 1 year from initiation of construction activities for project construction only. This Agreement shall remain in effect for that time necessary to satisfy the terms/conditions of this Agreement. If project construction does not begin within 90 days of the Operator's signing of the Agreement this Agreement shall be voided.

CONCURRENCE

Operator signature

Stephen C. Schmitt 6/18/90
(signature) (date)
Title Executive Vice President
Community Development
Valencia Company

California Department of Fish and Game

David P. Drake June 8, 1990
(signature) (date)
Title Associate Wildlife Biologist

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-081-90

1. The following provisions constitute the limit of activities agreed to and resolved by this agreement. The signing of this agreement does not imply that the Operator is precluded from doing other activities, at the site. However, activities not specifically agreed to and resolved by this agreement are subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq..

2. The Operator proposes to fill the streambed for construction of a Postal Facility, construction of at least two retention basins and a storm drain outlet to Castaic Creek.

*3. The Operator shall submit to the Department for review and approval prior to initiation of construction activities detailed engineering plans for the retention basins and storm drain outlet. Included within those plans shall be a limit of construction boundry that shall be readily identifiable during all construction activities. The Operator shall include a revegetation plan for that area disturbed by construction of the retention basins. All revegetation shall be subject to a survival rate of 80% after the first year's growth and 100% for years two and three.

The Operator shall submit to the Department for review and approval, prior to initiation of project activities, a detailed planting palette indicating species, quantity, and location of plantings. Included with the planting palette shall be a proposed maintenance plan for the revegetation area.

*4. The Operator shall submit to the Department for review and approval prior to initiation of construction activities, a proposed mitigation area of at least four acres in size, to mitigate for the loss of habitat from project construction. This mitigation area shall be maintained in perpetuity for fish and wildlife resources through the placement of a conservation easement on said property.

5. The Operator shall comply with all litter and pollution laws. All contractors, subcontractors and employees shall also obey these laws and it shall be the responsiblity of the Operator to insure their compliance.

6. No equipment maintenance shall be done within or near any stream channel or lake margin where petroleum products or other pollutants from the equipment may enter these areas under any flow.

7. The Department reserves the right to enter the project site at any time to ensure that there is compliance with terms/conditions of this Agreement.

8. The Department reserves the right to suspend and/or revoke this Agreement if the Department determines that the circumstances warrant. The circumstances that could require a reevaluation include, but are not limited to, the following:

a. Failure to comply with the terms/conditions of this Agreement.

b. The information provided by the Operator in support of the Agreement/Notification is determined by the Department to be incomplete, or inaccurate.

c. When new information becomes available to the Department representative(s) that was not known when preparing the original terms/conditions of this Agreement.

9. The Operator shall provide a copy of this Agreement to all contractors, subcontractors, and the Operator's project supervisors. Copies of the agreement shall be readily available at work sites at all times during periods of active work and must be presented to any Department personnel, or enforcement personnel from another agency upon demand.

10. The Operator shall notify the Department, in writing, at least five(5) days prior to initiation of construction(project) activities and at least five(5) days prior to completion of construction(project) activities. Notification shall be sent to the Department at 330 Golden Shore, Suite 50, Long Beach,Ca., 90802, Attn: Environmental Services.

CONCURRENCE

(Operator's name)

Stephen C. Schmidt 6/18/90
(signature) (date)

Stephen C. Schmidt
Executive Vice President
Community Development
Valencia Company

California Department of
Fish and Game

David P. Dick June 8, 1990
(signature) (date)

Our execution of this agreement is based on the following understanding of Conditions #3 and #4. If you do not concur with this interpretation, please notify us within 7 days so we can discuss the matter further.

3. The Operator shall submit to the Department for review prior to occupancy of the Post Office the County-approved engineering plans for the retention basins and storm drain outlet. These plans shall include the limits of construction disturbance which shall also be conspicuously flagged on the field. A revegetation plan shall also be included for the retention basins. It will specify planting methods and seed mixtures to establish scrub habitat in portions of the basins that will not be subject to sediment removal. The performance goals for the revegetation plans is to achieve shrub densities (i.e., plants per square meter) that are 80% of similar nearby scrub vegetation within 3 years of planting. The plan shall specify methods to establish plants and provide long-term maintenance to ensure successful restoration of scrub habitat.

4. The Operator shall submit to the Department for review and approval prior to occupancy of the Post Office a revegetation and maintenance plan for 4 acres of sandy wash habitat to compensate for the loss of habitat from project construction. Valencia Company will establish, through aided or natural revegetation, 4 acres of sandy wash habitat within the completed flood control channel in Hasley Canyon subsequent to the completion of the project. This vegetation shall remain in the channel and shall not be removed or disturbed by flood control activities. If the sandy wash vegetation progresses into woody riparian vegetation over time, Valencia Company may reduce it to a low shrubby growth characteristic of sandy wash by the use of hand equipment. The maintenance plan shall provide long-term assurances that the mitigation habitat will remain intact and protected from any future development, thereby precluding a need for a formal conservation easement. The Department shall take action on the plan within 10 days of receipt of the plan.

Channel Lining

CALIFORNIA DEPARTMENT OF FISH AND GAME
330 Golden Shore, Suite 50
Long Beach, California 90802

Notification No. 5-346-97 (Revision 2)

December 11, 1997

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and Ross Pistone of Valencia Company, 23823 Valencia Blvd., Valencia, 91355, (805) 255-4048, State of California, hereinafter called the Operator, is as follows:

WHEREAS, pursuant to Section 1603 of California Fish and Game Code, the Operator, on the 8th day of October, 1997, notified the Department that they intend to divert or obstruct the natural flow of, or change the bed, channel, or bank of, or use material from the streambed(s) of, the following water(s): Castaic Creek, tributary to Santa Clara River, Los Angeles County, California, Section -, Township 4 N Range 17 W.

WHEREAS, the Department (represented by Leslie S. MacNair through a site visit on November 4, 1997) has determined that such construction may substantially adversely affect those existing fish and wildlife resources within the Santa Clara River, specifically identified as follows: Fishes: unarmored threespined stickleback; Amphibians: Pacific tree frog, southwestern arroyo toad, red-legged frog, California newt, and salamanders; Reptiles: western pond turtle, western fence lizard, side-blotched lizard, coastal whiptail, coast horned-lizard, Pacific gopher snake, common kingsnake, and garter snake; Birds: southwestern willow flycatcher, least Bell's vireo, Cooper's hawk, red-tailed hawk, red-shouldered hawk, sparrows, warblers, hummingbirds, and chats; Mammals: bobcat, raccoon, coyote, deer, California ground squirrel, and rabbits; Riparian vegetation which provides habitat for those species: willows, mulefat, and cottonwoods; and all other fish and wildlife resources, including that riparian vegetation which provides habitat for such species, in the area.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife resources during the Operator's work. The Operator hereby agrees to accept the following measures/conditions as part of the proposed work.

If the Operator's work changes from that stated in the notification specified above, this Agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this Agreement and with other pertinent code sections, including but not limited to Fish and Game Code Sections 5650, 5652, 5937, and 5948, may result in prosecution.

Nothing in this Agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. A consummated Agreement does not constitute Department of Fish and Game endorsement of the proposed operation, or assure the Department's concurrence with permits required from other agencies.

This Agreement becomes effective the date of Department's signature and terminates November 30, 1998 for project construction only. This Agreement shall remain in effect for that time necessary to satisfy the terms/conditions of this Agreement.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-346-97

1. The following provisions constitute the limit of activities agreed to and resolved by this Agreement. The signing of this Agreement does not imply that the Operator is precluded from doing other activities at the site. However, activities not specifically agreed to and resolved by this Agreement shall be subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq.

2. The Operator proposes to alter the streambed to construct 2,070 linear feet of ungrouted, rock rip-rap channel lining along the east bank of Castaic Creek to stabilize the banks. The total stream area, with cottonwood/willow riparian vegetation, impacted by the project will be 3.2 acres (2.5 acres of temporary impact and 0.7 acres of permanent impact). A total of 0.8 acres of streambed with riparian habitat will be created as a result of the project by the excavation of existing uplands. The project is located along the east bank of Castaic Creek. The north end of the channel lining is located approximately 914 feet west of the Old Road and 933 feet south of the Old Road bridge over Castaic Creek. The channel lining runs 2,070 linear feet downstream. The south end of the lining is located approximately 963 feet north of Highway 126 and 1,172 feet west of the Old Road.

3. The agreed work includes activities associated with No. 2 above. The proposed project is located in Castaic Creek, tributary to Santa Clara River, Los Angeles County. Specific work areas and mitigation measures are described on/in the plans and documents submitted by the Operator, including the "Tree Survey Along Castaic Creek Channel, Santa Clarita, California, For A Channel-Lining Project" dated September 1997 and "Field Survey of Castaic Creek Channel, Northwest of The Highway 126 and Interstate 5 Intersection, Santa Clarita, California, For A Channel-Lining Project" dated October 1997, prepared by Louis A. Courtois, Ph.D., Aquatic consulting Services for Valencia Company, and shall be implemented as proposed unless directed differently by this agreement.

4. The Operator shall not impact more than 3.2 acres of streambed with cottonwood/willow riparian habitat. A total of 31 trees (three cottonwoods and 28 willows) with a dbh of 6 inches or greater within the streambed will be removed as a result of the project. The Operator shall mitigate for the loss of riparian habitat, by revegetating the river bottom of the 2.5 acre area of temporary impact as well as the additional 0.8 acre of streambed created, with willow and cottonwood cuttings following completion of the channel lining project. A minimum of 93 trees (mixture of willows and cottonwoods) shall be planted, within the areas created and temporarily impacted in the streambed, as mitigation for the trees greater than 6 dbh and those under 6 dbh impacted by the project. The trees shall be planted so that they create a riparian corridor contiguous with the existing corridor upstream and downstream.

In addition, the Operator shall remove all non-native vegetation (including salt cedar, giant reed, tree tobacco, and castor bean) from the work area. Weed eradication shall be conducted annually, as needed, during the five-year restoration period. Weeds shall be removed by hand (and by topical application of Rodeo®).

All mitigation shall be installed no later than 180 days following project completion.

5. The Operator shall have a qualified biologist on site daily during any impacts to vegetation from March 1 through September 1. The Operator shall have a qualified biologist conduct surveys for the presence of least Bell's vireo (*Vireo belli pusillus*) and southwestern willow flycatcher *(Empidonax traillii extimus)* during the months of April and May. Surveys shall be conducted at weekly intervals during the construction period following U.S. Fish and Wildlife Service protocol. Following the culmination of these surveys, documentation and results of the surveys shall be submitted to CDFG for review. In the event that a vireo or flycatcher is spotted within the area, the surveys shall continue through June or until a nest is located. If nesting vireos and/or flycatchers occur in the area, then any construction within 300 feet of the nest shall be discontinued until the nest is abandoned. The vireos and flycatchers shall not be harassed in any way, and if one is hurt or killed, the Department shall be notified immediately, pursuant to California Endangered Species Act.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-346-97

6. If threatened or endangered species occur within the proposed work area, or could be impacted by the work proposed, the Operator shall obtain the required state and federal threatened and endangered species permits.

7. The perimeter of the work site shall be adequately fenced to prevent damage to adjacent riparian habitat.

8. The Operator shall avoid doing construction activities during the wet season, November 1 to April 1. If work needs to be conducted during the rainy season, then a surface water diversion plan shall be established to avoid siltation/turbidity to downstream stickleback habitat. The diversion plan shall be submitted to the Department for review prior to initiating diversion procedures.

9. The Operator shall implement all of the Special Conditions required by the U.S. Army Corps of Engineers (ACOE) as documented in the Operator's notification package.

10. Prior to the initiation of construction within Castaic Creek, the Operator shall obtain a letter from the Los Angeles County Department of Public Works which declares that they agree to comply with the ACOE Special Conditions as well as the conditions of this Agreement for routine maintenance activities. The language in this letter shall reflect similar language contained in the Santa Clara River Natural River Management Plan.

11. All planting shall have a minimum of 80% survival the first year and 100% survival thereafter and/or shall attain 75% cover after 3 years and 90% cover after 5 years for the life of the project. If the survival and cover requirements have not been met, the Operator is responsible for replacement planting to achieve these requirements. Replacement plants shall be monitored with the same survival and growth requirements for 5 years after planting. Should a storm event or other acts of God destroy all or part of the revegetation site, the Operator shall be responsible to replant the damaged areas one time only, not to exceed the cost of the original revegetation effort.

12. An annual report shall be submitted to the Department by Jan. 1 of each year for 5 years after planting. This report shall include the survival, % cover, and height of both tree and shrub species. The number by species of plants replaced, an overview of the revegetation effort, and the method used to assess these parameters shall also be included. Photos from designated photo stations shall be included.

13. No equipment shall be operated within the flowing stream. Vehicles shall not be driven or equipment operated in water covered portions of a stream.

14. Preparation shall be made so that runoff from steep, erodible surfaces will be diverted into stable areas with little erosion potential. Frequent water checks shall be placed on dirt roads, cat tracks, or other work trails to control erosion.

15. Water containing mud, silt or other pollutants from aggregate washing or other activities shall not be allowed to enter a lake or flowing stream or placed in locations that may be subjected to high storm flows.

16. If a stream channel has been altered during the operations, its low flow channel shall be returned as nearly as possible to pre-project conditions without creating a possible future bank erosion problem, or a flat wide channel or sluice-like area. If a lake margin has been altered, it shall be returned as nearly as possible to pre-project conditions without creating a future bank erosion problem.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-346-97

The gradient of the streambed or lake margin shall be returned to pre-project grade unless such operation is part of a restoration project, in which case, the change in grade must be approved by the Department prior to project commencement.

17. Structures and associated materials not designed to withstand high seasonal flows shall be removed to areas above the high water mark before such flows occur.

18. Staging/storage areas for equipment and materials shall be located outside of the stream.

19. The Operator shall comply with all litter and pollution laws. The Operator is responsible to inform all contractors, subcontractors, and employees about these laws. All contractors, subcontractors and employees shall also obey these laws.

20. Access to the worksite shall be via existing roads and access ramps.

21. Spoil sites shall not be located within a stream, where spoil shall be washed back into a stream, or where it will cover aquatic or riparian vegetation.

22. No equipment maintenance shall be done within or near any stream channel where petroleum products or other pollutants from the equipment may enter these areas under any flow.

23. Raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil and/or entering the waters of the state. These materials, placed within or where they may enter a stream/lake, by Operator or any party working under contract, or with the permission of the Operator, shall be removed immediately.

24. No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete or washings thereof, oil or petroleum products or other organic or earthen material from any construction, or associated activity of whatever nature shall be allowed to enter into or placed where it may be washed by rainfall or runoff into, waters of the State. When operations are completed, any excess materials or debris shall be removed from the work area. No rubbish shall be deposited within 150 feet of the high water mark of any stream or lake.

25. The Operator shall request an extension of this agreement prior to its termination. Extensions may be granted for up to 12 months from the date of termination of the agreement and are subject to Departmental approval. The extension request and fees shall be submitted to the Department's Region 5 Office at the above address. If the Operator fails to request the extension prior to the agreement's termination then the Operator shall submit a new notification with fees and required information to the Department. Any activities conducted under an expired agreement is a violation of Fish and Game Code Section 1600 et. seq. The Operator may request up to a maximum of 3 extensions of this agreement.

26. The Operator shall provide a copy of this Agreement to all contractors, subcontractors, and the Operator's project supervisors. Copies of the Agreement shall be readily available at work sites at all times during periods of active work and must be presented to any Department personnel, or personnel from another agency upon demand.

27. The Department reserves the right to enter the project site at any time to ensure compliance with terms/conditions of this Agreement.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-346-97

27. The Operator shall notify the Department, in writing, at least five (5) days prior to initiation of construction (project) activities and at least five (5) days prior to completion of construction (project) activities. Notification shall be sent to the Department at 330 Golden Shore, Suite 50, Long Beach, CA 90802, Attn: ES. SAA No. 5-346-97.

28. The Department reserves the right to suspend or cancel this Agreement for other reasons, including but not limited to the following:

a. The Department determines that the information provided by the Operator in support of the Notification/Agreement is incomplete or inaccurate;

b. The Department obtains new information that was not known to it in preparing the terms and conditions of the Agreement;

c. The project or project activities as described in the Notification/Agreement have changed;

d. The conditions affecting fish and wildlife resources change or the Department determines that project activities will result in a substantial adverse effect on the environment.

CONCURRENCE

(Operator's name)

Lou J Pistone 12-19-97
(signature) (date)

SR. VICE PRESIDENT
(title)

California Dept. of Fish and Game

Leslie A. MacNair 1/5/98
(signature) (date)

Environmental Specialist III
(title)

Castaic Bridge

CALIFORNIA DEPARTMENT OF FISH AND GAME
330 Golden Shore, Suite 50
Long Beach, California 90802

Notification No. 5-370-97 (Revision 1)

December 11, 1997

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the **Department**, and Ross Pistone of Valencia Company, 23823 Valencia Blvd., Valencia, 91355, (805) 255-4048, State of California, hereinafter called the **Operator**, is as follows:

WHEREAS, pursuant to Section 1603 of California Fish and Game Code, the Operator, on the 20th day of October, 1997, notified the Department that they intend to divert or obstruct the natural flow of, or change the bed, channel, or bank of, or use material from the streambed(s) of, the following water(s): Castaic Creek, tributary to Santa Clara River, Los Angeles County, California, Section - Township 4 N Range 17 W.

WHEREAS, the Department (represented by Leslie S. MacNair through a site visit on November 4, 1997) has determined that such construction may substantially adversely affect those existing fish and wildlife resources within the Santa Clara River, specifically identified as follows: Fishes: unarmored threespined stickleback; Amphibians: Pacific tree frog, southwestern arroyo toad, red-legged frog, California newt, and salamanders; Reptiles: western pond turtle, western fence lizard, side-blotched lizard, coastal whiptail, coast horned-lizard, Pacific gopher snake, common kingsnake, and garter snake; Birds: southwestern willow flycatcher, least Bell's vireo, Cooper's hawk, red-tailed hawk, red-shouldered hawk, sparrows, warblers, hummingbirds, and chats; Mammals: bobcat, raccoon, coyote, deer, California ground squirrel, and rabbits; Riparian vegetation which provides habitat for those species: willows, mulefat, and cottonwoods; and all other fish and wildlife resources, including that riparian vegetation which provides habitat for such species, in the area.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife resources during the Operator's work. The Operator hereby agrees to accept the following measures/conditions as part of the proposed work.

If the Operator's work changes from that stated in the notification specified above, this Agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this Agreement and with other pertinent code sections, including but not limited to Fish and Game Code Sections 5650, 5652, 5937, and 5948, may result in prosecution.

Nothing in this Agreement authorizes the Operator to trespass on any land or property, nor does it relieve the Operator of responsibility for compliance with applicable federal, state, or local laws or ordinances. A consummated Agreement does not constitute Department of Fish and Game endorsement of the proposed operation, or assure the Department's concurrence with permits required from other agencies.

This Agreement becomes effective the date of Department's signature and terminates March 30, 1999 for project construction only. This Agreement shall remain in effect for that time necessary to satisfy the terms/conditions of this Agreement.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-370-97

1. The following provisions constitute the limit of activities agreed to and resolved by this Agreement. The signing of this Agreement does not imply that the Operator is precluded from doing other activities at the site. However, activities not specifically agreed to and resolved by this Agreement shall be subject to separate notification pursuant to Fish and Game Code Sections 1600 et seq.

2. The Operator proposes to alter the streambed to construct a bridge over Castaic Creek. The Commerce Center Bridge will be constructed approximately 8,100 feet upstream from the Castaic Creek and Santa Clara River confluence. The bridge will extend approximately 565 feet across the creek using precast concrete girders resting on two abutments and six rectangular cast-in-place piers. The footprint of each of the piers will be 600 square feet, for a permanent loss 3,600 sq. feet (0.08 acres). The width of the bridge will be 98 feet wide. Therefore, approximately 1.27 acres of streambed will be shaded by the bridge. Bridge construction will temporarily disturb 3.39 acres of stream bed with cottonwood/willow riparian vegetation. Following construction, the stream bed will be returned to its preconstruction grade. The project is located in Castaic Creek north of Highway 126 and west of Interstate 5 at Commerce Center Drive.

3. The agreed work includes activities associated with No. 2 above. The proposed project is located in Castaic Creek, tributary to Santa Clara River, Los Angeles County. Specific work areas and mitigation measures are described on/in the plans and documents submitted by the Operator, including the "Tree Survey Along Castaic Creek Channel, Santa Clarita, California, For A Bridge Project" dated September 1997 and "Field Survey of Castaic Creek Channel: Northwest of The Highway 126 and Interstate 5 Intersection, Santa Clarita, California, For A Bridge Project" dated October 1997, prepared by Louis A. Courtois, Ph.D., Aquatic consulting Services for Valencia Company, and shall be implemented as proposed unless directed differently by this agreement.

4. The Operator shall not impact more than 3.39 acres of streambed with cottonwood/willow riparian habitat. A total of 152 trees (101 cottonwoods and 51 willows) with a dbh of 6 inches or greater within the streambed will be removed as a result of the project.

The Operator shall mitigate for the loss of riparian habitat, by revegetating the river bottom of the 3.39 acre area of temporary impact, with native herbaceous. A minimum of 456 cuttings (mixture of willows and cottonwoods) shall be planted, within the streambed, as mitigation for the trees greater than 6 dbh and those under 6 dbh impacted by the project. The trees shall be planted so that they create a riparian corridor contiguous with the existing corridor upstream and downstream. Any additional trees can be placed in the new area of streambed created as a result of the channel lining project upstream.

In addition, the Operator shall remove all non-native vegetation (including salt cedar, giant reed, tree tobacco, and castor bean) from the work area. Weed eradication shall be conducted annually, as needed, during the five-year restoration period. Weeds shall be removed by hand (and by topical application of Rodeo®).

All mitigation shall be installed no later than 180 days following project completion.

5. The Operator shall have a qualified biologist on site daily during any impacts to vegetation from March 1 through September 1. The Operator shall have a qualified biologist conduct surveys for the presence of least Bell's vireo (*Vireo belli pusillus*) and southwestern willow flycatcher (*Empidonax traillii extimus*) during the months of April and May. Surveys shall be conducted at weekly intervals during the construction period following U.S. Fish and Wildlife Service protocol. Following the culmination of these surveys, documentation and results of the surveys shall be submitted to CDFG for review. In the event that a vireo or flycatcher is spotted within the area, the surveys shall continue through June or until a nest is located. If nesting vireos and/or flycatchers occur in the area, then any construction

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-370-97

within 300 feet of the nest shall be discontinued until the nest is abandoned. The vireos and flycatchers shall not be harassed in any way, and if one is hurt or killed, the Department shall be notified immediately, pursuant to California Endangered Species Act.

6. If threatened or endangered species occur within the proposed work area, or could be impacted by the work proposed, the Operator shall obtain the required state and federal threatened and endangered species permits.

7. The perimeter of the work site shall be adequately fenced to prevent damage to adjacent riparian habitat.

8. The Operator shall avoid doing construction activities during the wet season, November 1 to April 1. If work needs to be conducted during the rainy season, then a surface water diversion plan shall be established to avoid siltation/turbidity to downstream stickleback habitat. The diversion plan shall be submitted to the Department for review prior to initiating diversion procedures.

9. The Operator shall implement all of the Special Conditions required by the U.S. Army Corps of Engineers (ACOE) as documented in the Operator's notification package.

10. Prior to the initiation of construction within Castaic Creek, the Operator shall obtain a letter from the Los Angeles County Department of Public Works which declares that they agree to comply with the ACOE Special Conditions as well as the conditions of this Agreement for routine maintenance activities. The language in this letter shall reflect similar language contained in the Santa Clara River Natural River Management Plan.

11. All planting shall have a minimum of 80% survival the first year and 100% survival thereafter and/or shall attain 75% cover after 3 years and 90% cover after 5 years for the life of the project. If the survival and cover requirements have not been met, the Operator is responsible for replacement planting to achieve these requirements. Replacement plants shall be monitored with the same survival and growth requirements for 5 years after planting. Should a storm event or other acts of God destroy all or part of the revegetation site, the Operator shall be responsible to replant the damaged areas one time only, not to exceed the cost of the original revegetation effort.

12. An annual report shall be submitted to the Department by Jan. 1 of each year for 5 years after planting. This report shall include the survival, % cover, and height of both tree and shrub species. The number by species of plants replaced, an overview of the revegetation effort, and the method used to assess these parameters shall also be included. Photos from designated photo stations shall be included.

13. No equipment shall be operated within the flowing stream. Vehicles shall not be driven or equipment operated in water covered portions of a stream.

14. Preparation shall be made so that runoff from steep, erodible surfaces will be diverted into stable areas with little erosion potential. Frequent water checks shall be placed on dirt roads, cat tracks, or other work trails to control erosion.

15. Water containing mud, silt or other pollutants from aggregate washing or other activities shall not be allowed to enter a lake or flowing stream or placed in locations that may be subjected to high storm flows.

16. Structures and associated materials not designed to withstand high seasonal flows shall be removed to areas above the high water mark before such flows occur.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-370-97

17. If a stream channel has been altered during the operations, its low flow channel shall be returned as nearly as possible to pre-project conditions without creating a possible future bank erosion problem, or a flat wide channel or sluice-like area. If a lake margin has been altered, it shall be returned as nearly as possible to pre-project conditions without creating a future bank erosion problem. The gradient of the streambed or lake margin shall be returned to pre-project grade unless such operation is part of a restoration project, in which case, the change in grade must be approved by the Department prior to project commencement.

18. Staging/storage areas for equipment and materials shall be located outside of the stream.

19. The Operator shall comply with all litter and pollution laws. The Operator is responsible to inform all contractors, subcontractors, and employees about these laws. All contractors, subcontractors and employees shall also obey these laws.

20. Access to the worksite shall be via existing roads and access ramps.

21. Spoil sites shall not be located within a stream, where spoil shall be washed back into a stream, or where it will cover aquatic or riparian vegetation.

22. No equipment maintenance shall be done within or near any stream channel where petroleum products or other pollutants from the equipment may enter these areas under any flow.

23. Raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil and/or entering the waters of the state. These materials, placed within or where they may enter a stream/lake, by Operator or any party working under contract, or with the permission of the Operator, shall be removed immediately.

24. No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete or washings thereof, oil or petroleum products or other organic or earthen material from any construction, or associated activity of whatever nature shall be allowed to enter into or placed where it may be washed by rainfall or runoff into, waters of the State. When operations are completed, any excess materials or debris shall be removed from the work area. No rubbish shall be deposited within 150 feet of the high water mark of any stream or lake.

25. The Operator shall request an extension of this agreement prior to its termination. Extensions may be granted for up to 12 months from the date of termination of the agreement and are subject to Departmental approval. The extension request and fees shall be submitted to the Department's Region 5 Office at the above address. If the Operator fails to request the extension prior to the agreement's termination then the Operator shall submit a new notification with fees and required information to the Department. Any activities conducted under an expired agreement is a violation of Fish and Game Code Section 1600 et. seq. The Operator may request up to a maximum of 3 extensions of this agreement.

26. The Operator shall provide a copy of this Agreement to all contractors, subcontractors, and the Operator's project supervisors. Copies of the Agreement shall be readily available at work sites at all times during periods of active work and must be presented to any Department personnel, or personnel from another agency upon demand.

STREAMBED ALTERATION CONDITIONS FOR NOTIFICATION NUMBER: 5-370-97

27. The Department reserves the right to enter the project site at any time to ensure compliance with terms/conditions of this Agreement.

28. The Operator shall notify the Department, in writing, at least five (5) days prior to initiation of construction (project) activities and at least five (5) days prior to completion of construction (project) activities. Notification shall be sent to the Department at 330 Golden Shore, Suite 50, Long Beach, CA 90802, Attn: ES. SAA No. 5-370-97.

29. The Department reserves the right to suspend or cancel this Agreement for other reasons, including but not limited to the following:

a. The Department determines that the information provided by the Operator in support of the Notification/Agreement is incomplete or inaccurate;

b. The Department obtains new information that was not known to it in preparing the terms and conditions of the Agreement;

c. The project or project activities as described in the Notification/Agreement have changed;

d. The conditions affecting fish and wildlife resources change or the Department determines that project activities will result in a substantial adverse effect on the environment.

CONCURRENCE

(Operator's name)

Louis J. Pistone 12-19-97
(signature) (date)

SR VICE PRESIDENT
(title)

California Dept. of Fish and Game

Leslie A. McHale 1/5/98
(signature) (date)

Environmental Specialist III
(title)

APPENDIX D

AGENCY RESPONSE TO GMP

CESPL-CO-R

May 26, 1999

MEMORANDUM FOR THE RECORD
SUBJECT: CASTAIC CREEK MAINTENANCE/REVEGETATION PLAN 90-00419-EV

A. Reference is made to your letter dated May 4, 1999 in which you requested the Corps of Engineers to review the Castaic Creek Drainage General Maintenance and Revegetation Plan associated with Permit No. 90-00419-EV. Based on our review of the above document, we have the following comments:

1. The document should contain a paragraph in Section IV which discusses long-term Section 404 authorization for the proposed maintenance activities. Specifically, the document should clarify the type of permit required and identify maintenance activities which would not result in a discharge of fill material in waters of the United States.

2. Please clarify which Army Corps General Permit is referenced on page 5 Section B "Planting Locations" and what general planting guidelines are stipulated in the above general permit.

This memorandum constitutes a preliminary approval of the general concept of the above document. If you have any questions, please contact Aaron Allen at (213) 452-3413.

Aaron O. Allen
Senior Project Manager
U.S. Army Corps of Engineers

STATE OF CALIFORNIA-THE RESOURCES AGENCY GRAY DAVIS, *Governor*

DEPARTMENT OF FISH AND GAME

Leslie S. MacNair
Habitat Conservation Planning Division
P.O. Box 6907
Laguna Niguel, CA 92607

May 27, 1999

Mr. Louis Courtois
Aquatic Consulting Services
1891 Goodyear Avenue, Suite 619
Ventura, CA 93003

Dear Mr. Courtois:

This letter is in regards to the Castaic Creek Drainage General Maintenance and Revegetation Plan prepared for the Valencia Company dated October 1998. The report was prepared as a requirement under Streambed Alteration Agreements 5-346-97 and 5-370-97 for impacts to Castaic Creek, in Los Angeles County, for channel lining and bridge construction. The plan also included maintenance guidelines to be followed for future maintenance activities within Castaic Creek and Hasley Creek by the Los Angeles County Department of Public Works. The maintenance plan was required for the construction of a bridge and flood control channel within Hasley Canyon under Streambed Alteration Agreement 5-160-90.

The Department has determined that the revegetation guidelines in the plan are acceptable, however, the following additional information is required for the revegetation plan to be deemed complete as required by the above mentioned Agreements:

1. Detailed plans indicating the locations for planting as required for each Streambed Alteration Agreement (include the size of the planting area, proposed arrangement of plants, etc.). Include on a topographic map of the Creek, the mitigation areas and reference each planting area with the associated Streambed Agreement number. The revegetation sites shall not include areas that will require future maintenance activities.

2. Weed eradication procedures as required under the Streambed Agreements.

Please submit a revised revegetation plan that includes the information described above, and that meets the revegetation requirements of the above mentioned Agreements.

Be advised that this letter does not approve the maintenance guidelines within this plan. A separate Streambed Alteration Agreement Notification Package will need to be submitted to the Department for a Maintenance Agreement before any future maintenance activities can occur within Castaic Creek and/or Hasley Creek. Once the Department reviews the notification package, a Maintenance Agreement may be prepared by the Department with measures to minimize impacts to riparian and aquatic resources.

The notification package for a maintenance agreement shall include the proposed activities required by the Operator (the County) for maintenance activities (i.e. your maintenance guidelines). Be

advised that the Natural River Management Plan (NRMP) for the Santa Clara River has been revised since 1997, and proposed maintenance activities shall follow those described in the revised NRMP. Maintenance areas shall not include mitigation/revegetation areas. All maintenance areas shall be identified on a map and each area shall reference the Agreement that the construction was permitted under. Be advised that Maintenance Agreements can only be issued for projects whose impacts were previously mitigated for under a prior Streambed Alteration Agreement.

Thank you for your cooperation in this matter. If you have any questions, you can reach me at (949) 831-7335.

Sincerely,

Leslie S. MacNair
Environmental Specialist III

AQUATIC CONSULTING SERVICES

January 26, 1998

Ms. Leslie MacNair, Environmental Specialist
California Department of Fish and Game
330 Golden Shore, Suite 50
Long Beach, CA 90802

RE: 1601 Notification for Castaic Creek Maintenance Activities

Dear Ms. MacNair:

I am writing this letter at the request of Los Angeles County Department of Public Works. They are submitting the enclosed 1601 Notification for long-term maintenance of flood control projects within the segment of Castaic Creek upstream of Highway 126 and downstream of Interstate 5. The Valencia Company will be constructing a section of channel lining (1603 Agreement #5-346-97) and a bridge (1603 Agreement #5-370-97) this year within this channel. Once completed these two projects will be transferred to the County. Once accepted, any future repairs or maintenance activities will be County responsibility.

The County will need to conduct routine maintenance activities along this channel including flood control activities. During our telephone discussion on January 23, 1998, you agreed that the County could apply for a long-term maintenance agreement for this channel. This agreement would authorize maintenance activities for a five year period. The maintenance agreement could simply be renewed by letter, each renewal lasting five years. During our recent telephone discussion you also said the general guidelines developed for the Natural River Management Plan could be incorporated for similar activities within Castaic Creek. Per you request I have attached a copy of the general guidelines for routine maintenance activities within Castaic Creek which I have also sent to the County. The County has tentatively agreed to these general guidelines but needs to have the assurance that they will be able to obtain the necessary long-term, renewable maintenance agreement for conducting this work.

I realize 1601 permit processing requires several days to complete but request that you review the enclosed general guidelines and respond to this letter at your earliest convenience. It is my understanding, based upon our recent discussion, that the Department of Fish and Game agrees with the attached general guidelines for routine maintenance procedures within this reach of Castaic Creek. Your signature on the line below indicates your agreement with the contents of this letter. Once signed and dated please mail this letter back to me in the enclosed self-addressed envelope. I would also appreciate your sending me a copy of this signed letter by facsimile as soon as it is available. My facsimile number is (805) 644-8270.

4416 Cordova Place • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-8270

Also attached to this 1601 Notification for the maintenance project is a check for $132.00 to cover the application fee. I have taken the liberty of signing for Terry Grant since time is of the essence. Should you have any questions, or need additional information, please contact me at (805) 644-1208.

Sincerely,

Louis Courtois

Louis A. Courtois, Ph.D.
Consultant

Enclosure: Self-Addressed Envelope
General Maintenance Guidelines - Castaic Creek
Check for $132.00
1601 Notification

cc: Ross Pistone, Valencia Company
Terry Grant, Los Angeles County Department of Public Works
Aaron Allen, Army Corps of Engineers

The attached guidelines cover some of the conditions required. There may be a few additional conditions or slight modifications to these conditions.

I concur with the contents of this letter

Signature: Leslie A. MacNair Date: 1/28/98
Leslie MacNair, CDFG

AQUATIC CONSULTING SERVICES, INC.

DATE: March 7, 2002

TO: Project Files

FROM: Louis Courtois

SUBJECT: Update to CESPL-CO-R May 26, 1999 ACOE Memorandum For The Record: Castaic Creek Maintenance/Revegetation Plan 90-00419-EV

ACOE Comment #1 - Please refer to page 11 of latest (March 2002) General Maintenance Plan.

ACOE Comment #2 - The ACOE permit referred to was #90-00419-EV. Following a June 14, 1999 telephone discussion with the agencies, a revised revegetation plan (dated July 1999) specific to the Castaic Creek Bridge and Castaic Creek Channel Lining projects along with the attached letter, was submitted to the Corps in July 1999. This plan included an expanded planting plan that showed the location of revegetation site in relation to the channel lining project site and planting acreage of each area. Combined the two projects required that 549 trees (312 cottonwoods and 237 willows) be planted. However, a total of 868 trees were planted during the first week of August 1999. The extra 319 trees were to be used for mitigating future projects. These extra trees were planted because the revegetation site was larger than required by the two projects. Monitoring reports have been submitted to the agencies for 2000, 2001, and 2002.

AQUATIC CONSULTING SERVICES, INC.

July 15, 1999

Mr. Aaron Allen
U.S. Army Corps of Engineers
Regulatory Branch
911 Wilshire Boulevard
Los Angeles, CA 90017

RE: Castaic Creek Maintenance/Revegetation Plan - ACOE Section 404 Permit No. 90-00419-EV (Valencia Company)

Dear Aaron:

This is a follow-up to your letter dated May 26, 1999 concerning the referenced plan. I have incorporated your previous comments into the enclosed revised plan. I would appreciate your review and comments on this latest version. If the plan is suitable to the Corps, please advise.

Valencia Company is also arranging a meeting with Los Angeles County Department of Public Works to discuss this plan and obtain their final agreement to the approach detailed in the document. Once the County concurs with the detailed approach, I will schedule a time to meet and obtain the Corps signature on the document.

I appreciate all the assistance you have provided on this effort. Should you have any questions or need additional information regarding this submittal, please contact me at (805) 644-1208.

Sincerely,

Lou Courtois

Louis A. Courtois, Ph.D.
Consultant

Enclosure: Revised Field Report 132.98R

cc: Ross Pistone, Valencia Company (w/o enclosure)
Leslie MacNair, CDFG (w/o enclosure)

1891 Goodyear Avenue, Suite 619 • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-9270

DATE: March 4, 2002

TO: Project Files

FROM: Louis Courtois

SUBJECT: Update to CDFG May 27, 1999 letter regarding Castaic Creek General Maintenance and Revegetation Plan (1603 No. 5-346-97 and 5-370-97)

I discussed these two comments with Ms. Leslie MacNair (CDFG) on June 14, 1999. At that time she said Newhall could amend the existing 1603 Agreements to add in maintenance activities. She requested Newhall submit a revegetation plan for each site or alternatively, combine the revegetation requirements for both sites together and plant a larger area. Newhall decided to combine the two project's revegetation requirements together and plant one large site. The revegetation site is located immediately opposite (west) the channel lining site. Combined the two projects required that 549 trees (312 cottonwoods and 237 willows) be planted. However, a total of 868 trees were planted during the first week of August 1999. The extra 319 trees were to be used for mitigating future projects. These extra trees were planted because the revegetation site was larger than required by the two projects. Monitoring reports have been submitted to the agencies for 2000, 2001, and 2002.

CDFG Comment #1 - A detailed revised revegetation plan dated July 1999 along with the attached cover letter was submitted to the CDFG. This plan included an expanded planting plan that showed the existing creek area in relation to the channel lining project site. The location and acreage for each revegetation area was also included.

CDFG Comment #2 - The detailed revegetation plan (July 1999) provided detailed procedures for weed eradication.

AQUATIC CONSULTING SERVICES, INC.

July 15, 1999

Ms. Leslie MacNair
California Department of Fish and Game
P.O. Box 6907
Laguna Niguel, CA 92607

RE: Castaic Creek Maintenance/Revegetation Plan - CDFG 1603 Agreements #5-346-97 and #5-370-97 (Valencia Company)

Dear Leslie:

This is a follow-up to your letter dated May 27, 1999 concerning the referenced plan. I have incorporated your previous comments into the enclosed revised plan. I would appreciate your review and comments on this latest version. If the plan is suitable to the Department, please advise.

Valencia Company is also arranging a meeting with Los Angeles County Department of Public Works to discuss this plan and obtain their final agreement to the approach detailed in the document. Once the County concurs with the detailed approach, I will schedule a time to meet and obtain the Department's signature on the document.

I appreciate all the assistance you have provided on this effort. Should you have any questions or need additional information regarding this submittal, please contact me at (805) 644-1208.

Sincerely,

Louis A. Courtois, Ph.D.
Consultant

Enclosure: Revised Field Report 132.98R

cc: Ross Pistone, Valencia Company (w/o enclosures)
Aaron Allen, ACOE (w/o enclosures)

1891 Goodyear Avenue, Suite 619 • Ventura, CA 93003 • (805) 644-1208 • Fax (805) 644-3270 • [illegible]

APPENDIX E

NOTIFICATION FORM

___ Emergency Project
___ Non-Emergency Work

EXHIBIT 1

SAMPLE
GENERAL MAINTENANCE NOTIFICATION
(EMERGENCY / NON-EMERGENCY

Date: _____

District Engineer
U.S. Army Corps of Engineers
Los Angeles District-SPLCO-R
P. O. Box 2711
Los Angeles, CA 90053-2325

Field Supervisor
U.S. Fish & Wildlife Service
2140 Eastman Avenue, Suite 100
Ventura, CA 93003

Regional Manager
Region 5
California Department of Fish and Game
4949 Viewridge Avenue
San Diego, CA 92123

SUBJECT: ACOE Permit #89-419-EV
Streambed Alteration Agreement No. _____
Castaic and Hasley Creeks
NOTIFICATON OF REPAIR AND RESTORATION

In accordance with the provisions of the subject U.S. Army Corps of Engineers Section 404 Permit and California Department of Fish and Game Section 1600 Streambed Alteration Agreement (Agreement), this is to inform you that repair and restoration work has been scheduled within the subject permit area. The work site is located:

_____

Work is scheduled to commence on _____
Date

The following applies (check all applicable items):
_____ Project is located in potential endangered species habitat—field meeting required.
_____ Access to the creek is required to repair a levee(s).
Levee location: _____
Nature of repair: _____

_____ Access to the creek is required to remove trees from a levee(s).
Levee location: _____

_____ Access to the creek is required for bridge maintenance.
Name of bridge(s): _____
Maintenance required: _____

_____ A water diversion will be necessary. The diversion will conform with the requirements of the Permit and the Agreement.

_____ An alternate water diversion is necessary. Description of proposed diversion:
_____

_____ The work will impact mature wetland habitat defined as trees with trunks in excess of 4" in diameter. A field meeting is required.

_____ The work will not impact mature wetland habitat.

_____ The work must be performed during the breeding season (March 15-September 1). A field meeting is requested.

_____ The work will be performed outside of the breeding season.

_____ A "get-away channel" to clear stagnant water is required.

_____ Other

Please contact me with any questions at (phone number). Please fax back your concurrence to (fax number).

Sincerely,

LACDPW

ACOE concurs that the project may proceed:

_____
Name

_____
Signature

_____
Date

CDFG concurs that the project may proceed:

_____
Name

_____
Signature

_____
Date

Appendix J: Water Resources Division Hydrology Section Information Request Summaries

Appendix J- Water Resources Division Hydrology Information Request Summaries

January 2003

PACE

Q-639

WATER RESOURCES DIVISION
Hydrology Section
INFORMATION REQUEST SUMMARY

Project Name: **HASLEY CANYON**

Project Location: Hasley Canyon Road and Del Valle Road *(TG 4459 E5)*

Project Engineer: Peter Imaa. PS

Technical Review by:

Information Requested: Burned and bulked Q's at Hasley Cyn Rd & Del Valle Rd.

Information Requested By: Luis J. Alvarez of PACE, Inc. (714 - 481-7240)

Information To Be Used For: Drainage Concept.

Will Information Be Used In Any Litigation? ☐ *Yes* ☒ *No*

Information Provided: Drainage map and the following:

Location	Tributary Area	Total Area	Q50-burned	Q50-burned&bulked
416 BC	-	4282 acres	7210 cfs	9480 cfs

OK. FOR DESIGN PER PETER IMAA

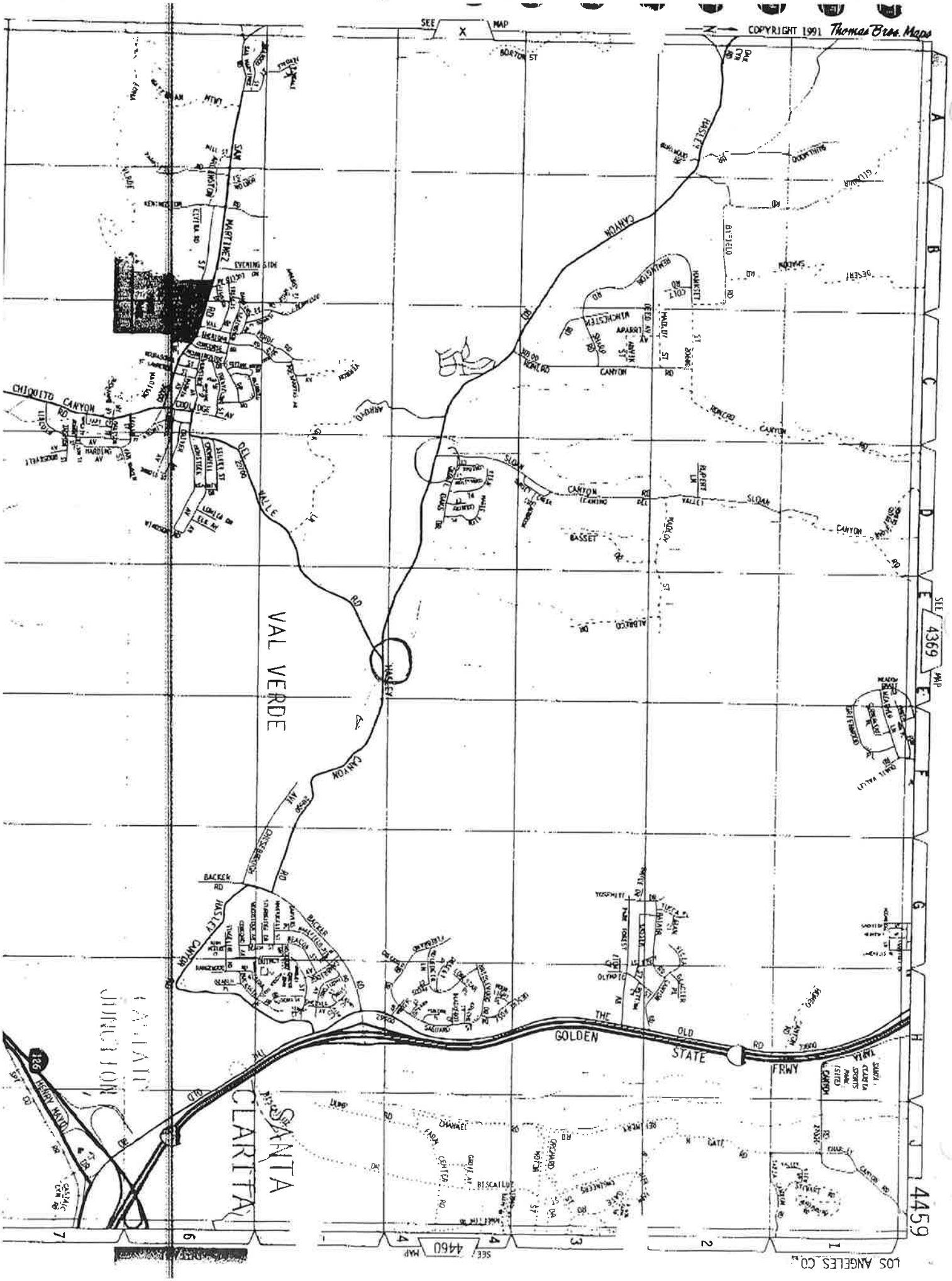
Date Provided: January 7, 2003

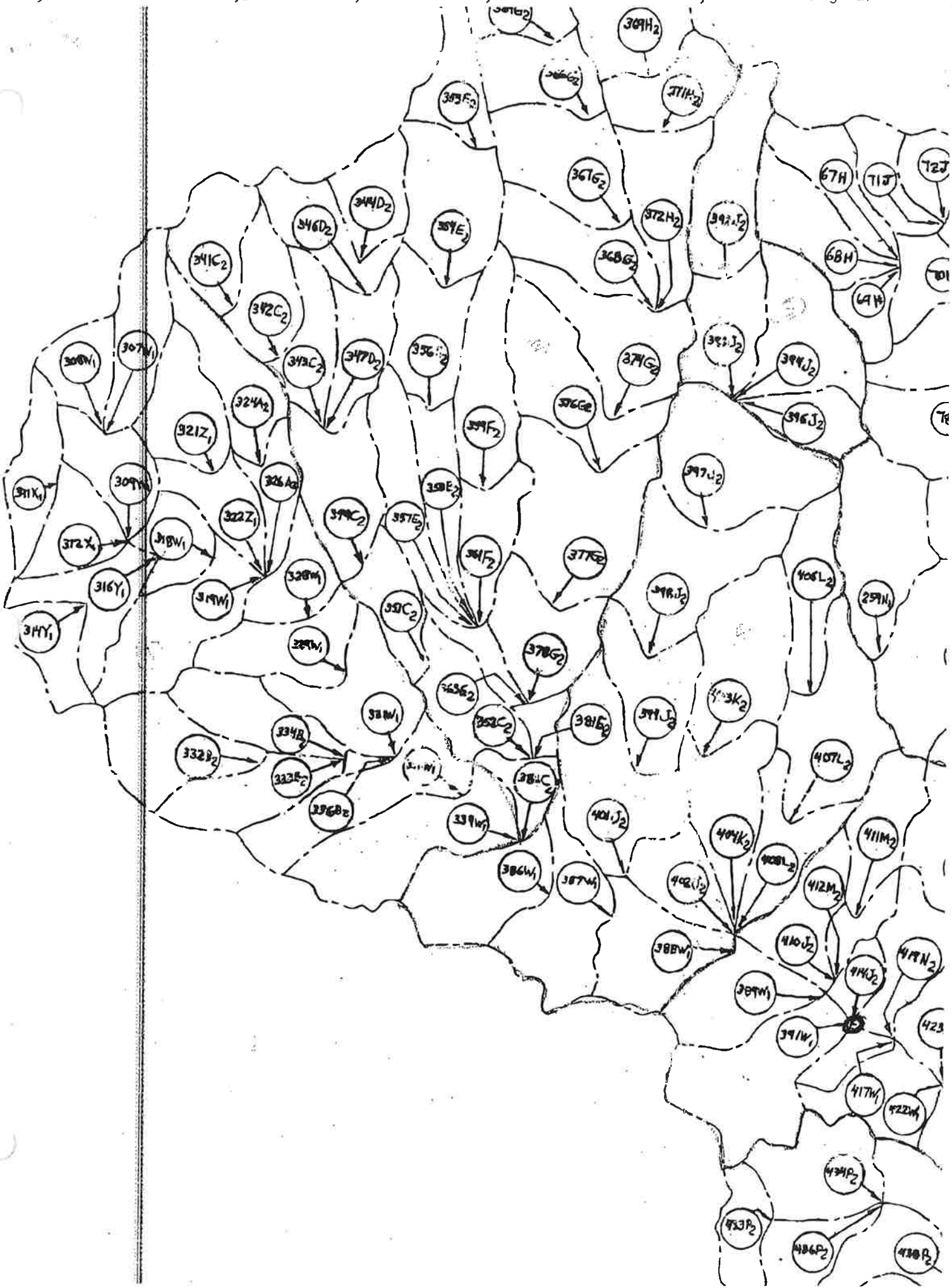
References: May 1992 Hasley Canyon information request, Castaic Creek File.

Calculations, Comments, Etc...: *The information provided above are for planning purposes.*

LAP\QREQUEST.TMP

Post-it® Fax Note 7671	Date 01-07-03	# of pages ▶ 3
To Luis J. Alvarez	From Peter Imaa	
Co./Dept. PACE, Inc.	Co. L.A. County D.P.W	
Phone # 714-481-7240	Phone # 626-458-6174	
Fax # 714-481-7299	Fax # 626-979-5436	


COPYRIGHT 1991 Thomas Bros. Maps
SEE X MAP
VAL VERDE
SANTA CLARITA
CHIQUITO CANYON RD
MARTINEZ
EVENING SIDE
HASLEY CANYON
BACKER RD
GOLDEN STATE FRWY
THE OLD
SEE 4369 MAP
SEE 4460 MAP
LOS ANGELES CO.


309H2
371H2
372H2
67H
71J
72J
68H
69H
346D2
344D2
341C2
342C2
343C2
347D2
324A2
321Z1
309W1
322Z1
318W1
316Y1
314Y1
328W1
329W1
332B2
334B2
333E2
338W1
339W1
386W1
387W1
388W1
389W1
391W1
417W1
422W1
434P2
453P2
436P2
438P2

Appendix J- Water Resources Division Hydrology Information Request Summaries

May 2014

PACE

WATER RESOURCES DIVISION
HYDROLOGY SECTION

Q-2305

INFORMATION REQUEST SUMMARY

Date: 05/05/2014

Project Name: Hasley Canyon

Project Location: Hasley Canyon from Hasley Canyon Rd to Commerce Center Dr | T.G. Page: 4459 | Grid: E-5 to H-7

Project Engineer: Long Thang

Technical Review by: Martin Araiza

Information Requested: Q50 clear, Q50 burn, Q50 burn & bulk, and any other available flow rates

Information Requested By: Jose Cruz, PACE, Advanced Water Engineering

Information To Be Used: hydraulics study

Will Information Be Used In Any Litigation? ☐ *Yes* ☒ *No*

Information Provided:
The available flow rates within the specified reach of Hasley Canyon are listed below. Also attached is a map of the referenced reaches.

Reach	Q50 Clear (cfs)	Q50 Burned (cfs)	Q50 Burned & Bulked (cfs)	Q100 (cfs)	Q500 (cfs)
O	3,900	4,200	5,500	7,000	12,800
P	4,000	4,300	5,600		
Q	4,100	4,500	5,700		
R	4,300	4,700	5,900		

Date Provided: 05/01/2014 via e-mail (jcruz@pacewater.com)

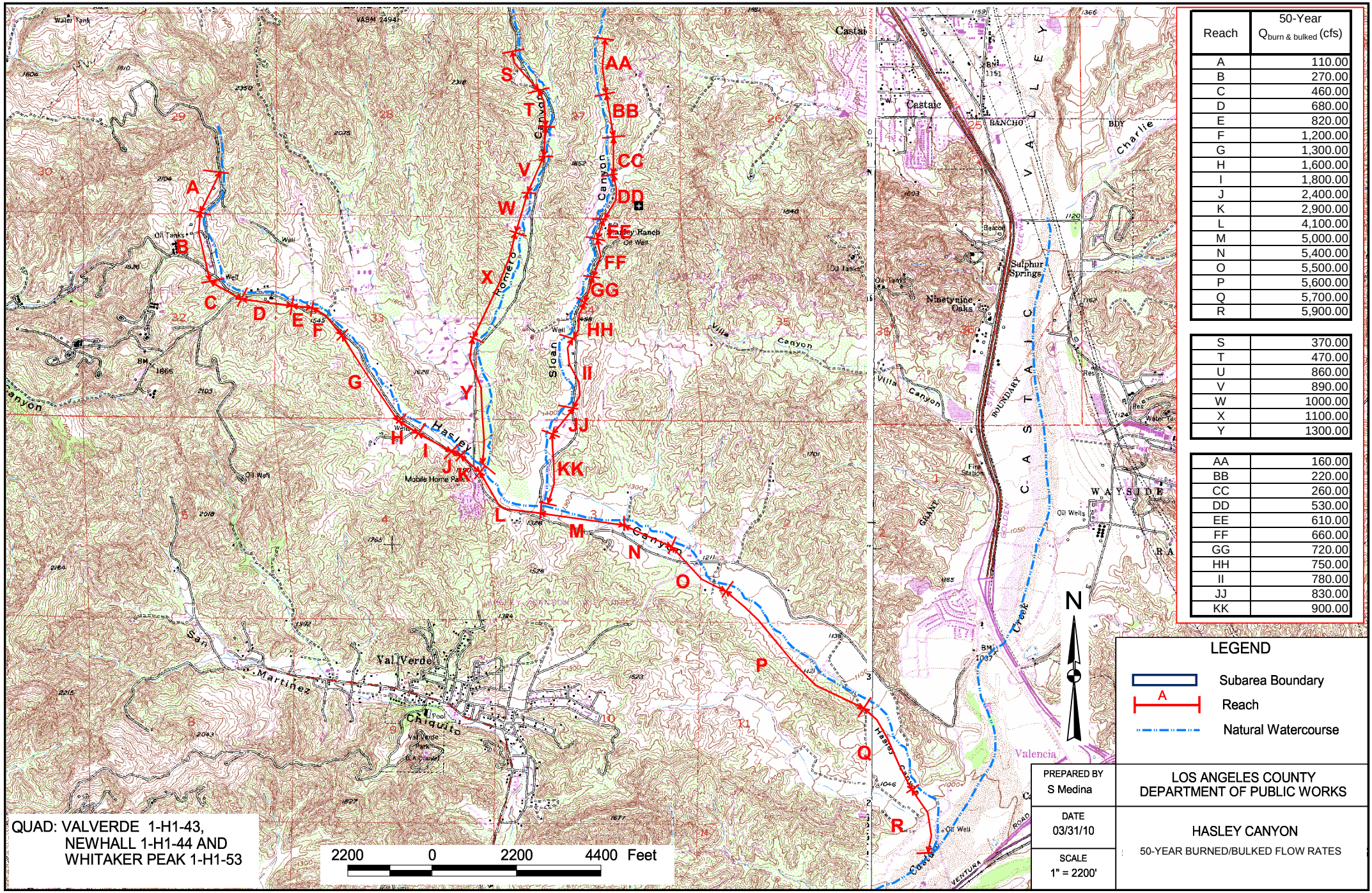
References:

- 2004 SCR Hydrology Study
- Santa Clarita Valley Flood Insurance Study, Vol. II dated 1979

Calculations, Comments, Etc.

The FEMA flow rates were calculated using a modified version of a regression equation developed by the US Army Corps of Engineers as stated in the 1979 study.

The Q50 Clear, Q50 Burn, and Q50 Burn & Bulk flow rates provided were calculated using the revised hydrologic method based on “rainfall isohyets” (Depth Method) (refer to the 2006 Hydrology Manual). The hydrologic study calculated flows resulting from a 50-year design storm. Landuse and drainage conditions may differ than those used/assumed in the 2004 study. The information provided should be used for planning purposes.



QUAD: VALVERDE 1-H1-43,
NEWHALL 1-H1-44 AND
WHITAKER PEAK 1-H1-53

Reach	50-Year $Q_{burn\ \&\ bulked}$ (cfs)
A	110.00
B	270.00
C	460.00
D	680.00
E	820.00
F	1,200.00
G	1,300.00
H	1,600.00
I	1,800.00
J	2,400.00
K	2,900.00
L	4,100.00
M	5,000.00
N	5,400.00
O	5,500.00
P	5,600.00
Q	5,700.00
R	5,900.00

S	370.00
T	470.00
U	860.00
V	890.00
W	1000.00
X	1100.00
Y	1300.00

AA	160.00
BB	220.00
CC	260.00
DD	530.00
EE	610.00
FF	660.00
GG	720.00
HH	750.00
II	780.00
JJ	830.00
KK	900.00

LEGEND

Subarea Boundary

A Reach

Natural Watercourse

PREPARED BY S Medina	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
DATE 03/31/10	HASLEY CANYON 50-YEAR BURNED/BULKED FLOW RATES
SCALE 1" = 2200'	

Appendix J- Water Resources Division Hydrology Information Request Summaries

December 2014

PACE

WATER RESOURCES DIVISION
HYDROLOGY SECTION

Q-2343

INFORMATION REQUEST SUMMARY

Date: 12/23/2014

Project Name: Castaic Creek		
Project Location: Castaic Creek between Interstate 5 and State Route 126	T.G. Page: 4459	Grid: H5-7, G-7
Project Engineer: Long Thang		
Technical Review by: Martin Araiza		
Information Requested: Q50 clear, Q50 burn, Q50 burn & bulk, and any other available flow rates		
Information Requested By: Jose Cruz, PACE		
Information To Be Used: hydraulic analysis of Castaic Creek		
Will Information Be Used In Any Litigation? ☐ *Yes* ☒ *No*		

Information Provided:

The flow rates you requested are summarized in the attached table. Also attached is a map showing the referenced reaches within your area of interest.

Please note that projects must not impact the existing floodways depicted on Los Angeles County's floodway maps and must be designed for the flow rates shown on those maps. These maps can be found at the Flood Zone Determination Website below by searching the project's location.

http://dpw.lacounty.gov/wmd/floodzone/index.cfm

If a project does impact a floodway or you would like to use the flow rate of a more recent study, a floodway map revision will be required. For more information on floodway map revisions, please contact George De La O of our Watershed Management Division at (626) 458-7155.

Date Provided: 12/23/2014 via e-mail (jcruz@pacewater.com)

References:

- 2005 Castaic Creek Special Study
- Santa Clarita Valley Flood Insurance Study, Vol. II dated 1979

Calculations, Comments, Etc.

The FEMA flow rates were calculated using a modified version of a regression equation developed by the US Army Corps of Engineers as stated in the 1979 study.

The Los Angeles County flow rates provided were calculated using the revised hydrologic method based on "rainfall isohyets" (Depth Method, refer to the 2006 Hydrology Manual). The hydrologic study calculated flows resulting from a 50-year design storm. Current landuse and drainage conditions may differ to those used/assumed in the study. The information provided should only be used for planning purposes.

2005 Los Angeles County Castaic Creek Special Study

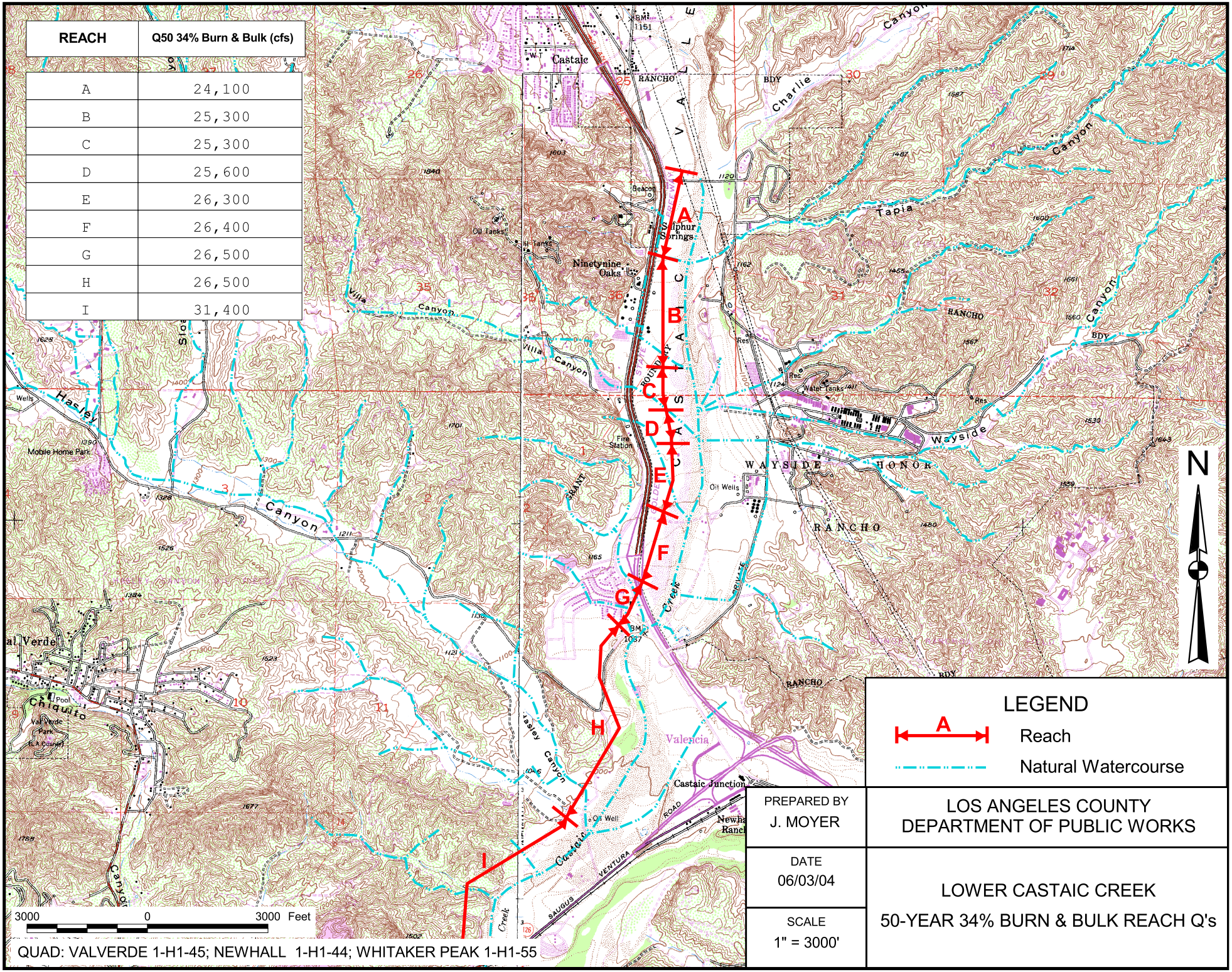
Reach	Q2 Clr (cfs)	Q2 Burn (cfs)	Q5 Clr (cfs)	Q5 Burn (cfs)	Q10 Clr (cfs)	Q10 Burn (cfs)	Q25 Clr (cfs)	Q25 Burn (cfs)	Q50 Clr (cfs)	Q50 Burn (cfs)	Q50 B&B (cfs)	Q100 Clr (cfs)	Q100 Burn (cfs)
F	3,500	3,600	7,400	7,900	10,700	11,500	15,300	16,600	19,500	21,700	26,400	22,900	25,000
G	3,600	3,700	7,500	8,000	10,700	11,600	15,400	16,700	19,700	21,800	26,500	23,000	25,200
H	3,600	3,700	7,500	8,000	10,800	11,600	15,400	16,700	19,800	21,900	26,500	23,200	25,300
I	4,200	4,400	9,000	9,600	12,900	13,900	18,500	20,000	23,900	26,200	31,400	28,000	30,300

1979 FEMA Flood Insurance Study

Reach	Q100 Burn (cfs)	Q500 (cfs)
F	n/a	n/a
G	16,400	31,100
H	16,900	32,200
I	17,600	33,400

Abreviations:

* Clr = clear
* B&B = Burn & Bulk


REACH
Q50 34% Burn & Bulk (cfs)
A 24,100
B 25,300
C 25,300
D 25,600
E 26,300
F 26,400
G 26,500
H 26,500
I 31,400
A
B
C
D
E
F
G
H
I
Castaic
Ninetynine Oaks
Sulphur Springs
Valencia
Castaic Junction
Hasley Canyon
Tapia
Charlie Canyon
Wayside Honor Rancho
Chiquito
Val Verde
Oil Wells
Oil Tanks
Mobile Home Park
Fire Station
Water Tanks
Res
Beacon
Pool
Park
Creek
Ventura
Saugus
N
3000 0 3000 Feet
LEGEND
Reach
Natural Watercourse
PREPARED BY
J. MOYER
DATE
06/03/04
SCALE
1" = 3000'
LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
LOWER CASTAIC CREEK
50-YEAR 34% BURN & BULK REACH Q's
QUAD: VALVERDE 1-H1-45; NEWHALL 1-H1-44; WHITAKER PEAK 1-H1-55

PACE
Advanced Water Engineering

Appendix K: As-Built Drawings

Appendix K- As-Built Drawings

Commerce Center Drive Bridge over Castaic Creek

PACE

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

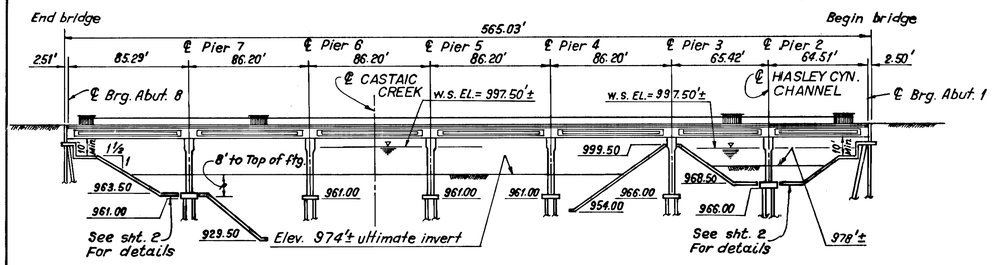
PLANS FOR BRIDGE

ON

COMMERCE CENTER DRIVE

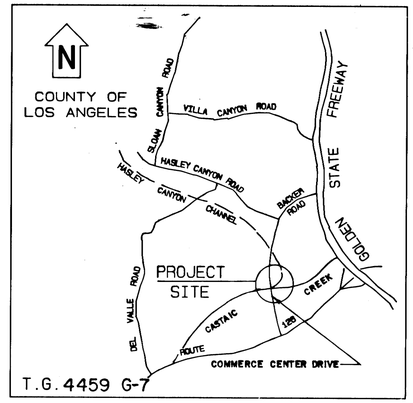
OVER

CASTAIC CREEK



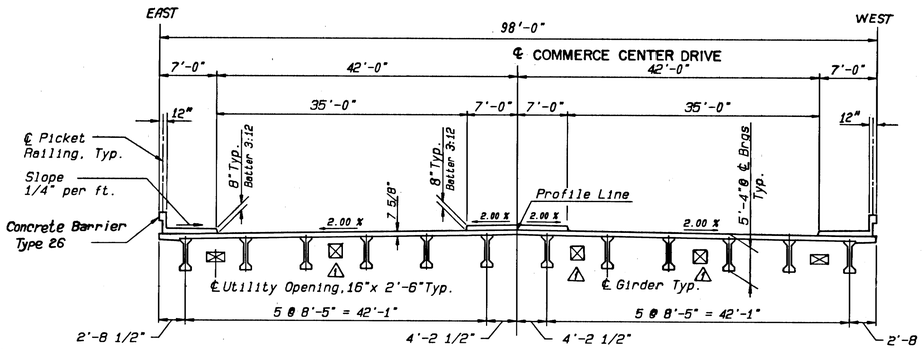
ELEVATION

Scale : 1"= 50'



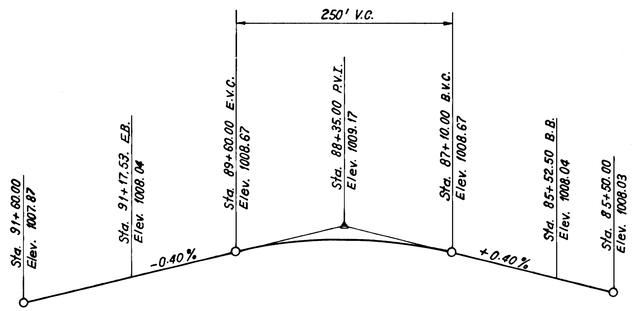
PROJECT LOCATION

No Scale



TYPICAL SECTION

Scale : 1" = 10'



PROFILE

No Scale

AS BUILT

Date: 1-26-01 Corrections by: G. Pereda

Resident Engineer: Zaven Abrahamian

No Changes

INDEX TO STANDARD PLANS

The Following State of California Department of Transportation Standard Plans, Dated July 1992, Are a Part of These Contract Drawings.

A 62-C --------Limits of Payment for Excavation and Backfill-Bridge
AT7-D --------Guard Rail Flares
AT7-F --------Miscellaneous Guard Rail Details
B2-5 --------Pile Details-Class 45 and Class 70
B6-21 --------Joint Seals
B7-5 --------Deck Drains
B11-54 --------Concrete Barrier Type 26
B0-5 -------- Deck Construction Joint

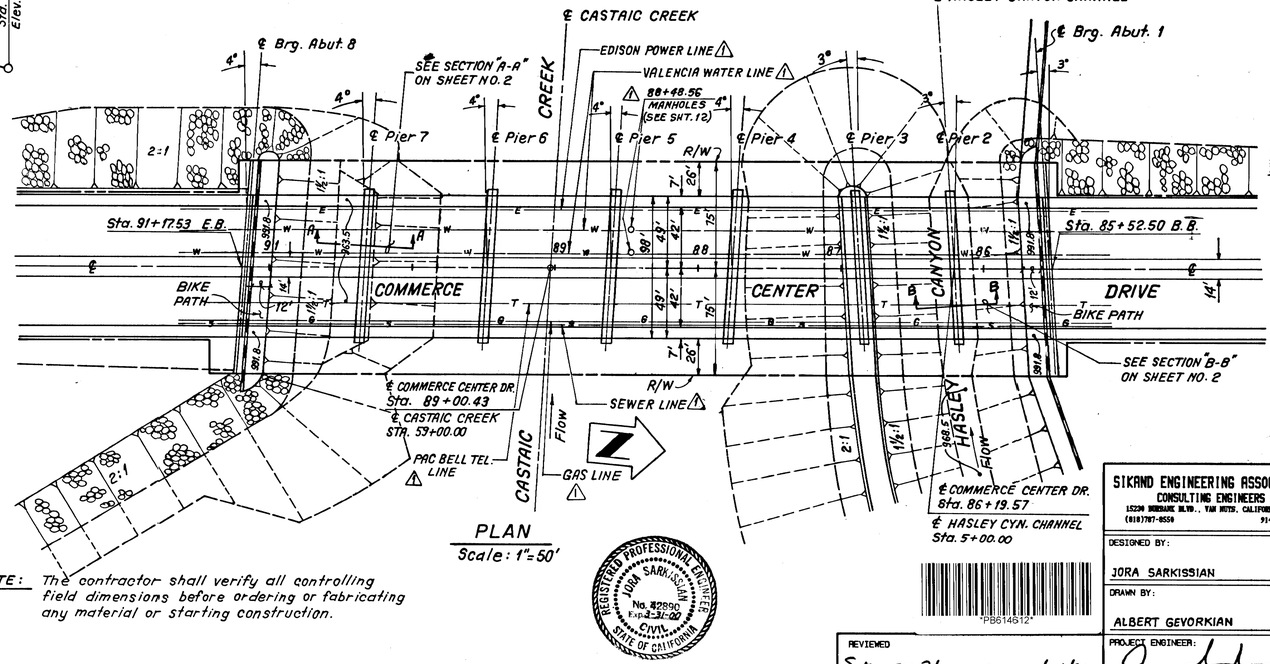
The Following Los Angeles County Department of Public Works Standard Plans, Latest Editon, are Part of These Contract Drawings.

6102--------Picket Railing

AMERICAN PUBLIC WORKS ASSOCIATION (APWA)

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION, 1994 EDITION

460-0---------Pull Boxes
465-0---------Conduit Expansion Details



PLAN

Scale: 1"=50'

NOTE: The contractor shall verify all controlling field dimensions before ordering or fabricating any material or starting construction.

INDEX	
SHEET	TITLE
1	TITLE SHEET
2	TOPOGRAPHY
3	PILE LAYOUT & WINGWALL DETAILS
4	ABUTMENTS
5	PIERS
6-8	PRESTRESSED GIRDER DETAILS
9	GIRDER DIAPHRAGMS
10-11	DECK DETAIL SHEETS
12	MISCELLANEOUS DETAILS
13-15	LOG OF TEST BORINGS

SPECIFICATIONS

DESIGN: Load Factor Design
Bridge Design Specifications (1989 A.A.S.H.T.O. with Interims and Caltrans Supplements)
Design Loading:
Dead Load: Includes 35 psf for future wearing surface
Live Load: HS20-44 and P13 overload
Seismic Load: Peak Rock Acceleration 0.60g., Depth to Alluvium 80'-150 ft.
Design Stresses: Reinforced Concrete: fy = 60,000 psi
f'c = 3,250 psi
n = 9
Transverse deck slab
fs = 20,000 psi
fc = 1,200 psi
n = 10
Prestressed Concrete: See "Prestressing Notes"
Structural Steel (A36): fy = 36,000 psi
Design Soil Pressure (net): 3,000 psf
Pile Design Load: Abuts 45 ton, Piers 70 ton

CONSTRUCTION:
Standard Specifications for Public Works Construction (1994) W/Current Supplements

DATUM:
NEWHALL 1983, RDBM TAG IN CB 4 FT N BCR 70 FT N & 32 FT E CL INT OLD ROAD & HASLEY CANYON ROAD OFF RAMP EL.1065.685 CL 3976

REVIEWED
Steve M. Hemmasee 11/24/97
STRUCTURAL SECTION DATE

REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 42890 Exp. 3-31-00 CIVIL STATE OF CALIFORNIA

"PB614612"

SIKAND ENGINEERING ASSOCIATES CONSULTING ENGINEERS 15230 BURBANK BLVD., VAN NUYS, CALIFORNIA (818)787-8550 91411	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK
DRAWN BY: ALBERT GEVORKIAN	TITLE SHEET
PROJECT ENGINEER: JORA SARKISSIAN	SUBMITTED: 11/24/97 CONSTRUCTION SECTION DIVISION DATE
	APPROVED: MARK W. PESTRELLA DIRECTOR OF PUBLIC WORKS BY: 11-25-97 COUNTY DIRECTOR DATE
	BRIDGE NO.: 3794 PROJECT NO.: SHT.: 1 OF: 15 DWG. NO.: 614612

1020-252-20

DRAWN	CHECKED	REVISIONS	⚠ ADDED MANHOLES, UTILITY OPENINGS AND UTILITY LINES.

SCALE: 1"= 60'

COMMERCE CENTER DRIVE

CASTAIC CREEK

HASLEY CREEK

ROUTE 126

STREET IMPROVEMENTS PER P.M. NO. 22261

STORM DRAIN PER P.D. 2298 (UNIT II)

STA. 86+19.57 ℄ COMMERCE CTR. DR.
STA. 5+00.00 ℄ HASLEY CREEK

STA. 89+00.43 ℄ COMMERCE CTR. DR.
STA. 59+00.00 ℄ CASTAIC CREEK

RIP-RAP SLOPE PROTECTION (TYP.) SEE DETAIL "B" HEREON

SEE SECTION "A-A" HEREON

SEE SECTION "B-B" HEREON

FUTURE LINING

℄ PIER 7 ℄ PIER 6 ℄ PIER 5 ℄ PIER 4 ℄ PIER 3 ℄ PIER 2

1000.0 TOP OF LINING

TOP ELEV. 1000.0

TOP OF SLOPE

BIKE PATH

CURB LINE

℄ OF STREET

R/W

S.D.

963.5

961.00

966.00

997.00

2.146%

0.41%

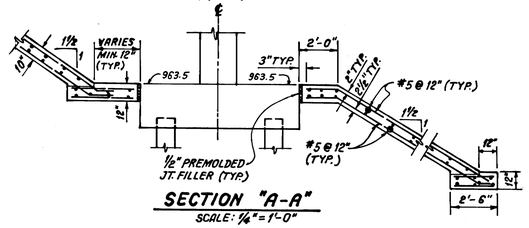
0.30%

0.50%

0.40%

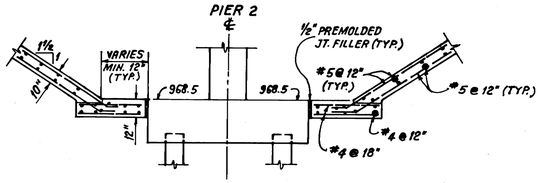
5.0%

PIER 7

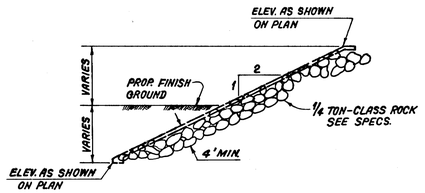


SECTION "A-A"
SCALE: ¼"= 1'-0"

PIER 2



SECTION "B-B"
SCALE: ¼"= 1'-0"



DETAIL "B"
NOT TO SCALE

AS BUILT
Date: 1-26-01 Corrections by: G. Pereda
Resident Engineer: Zaven Abrahamian
No Changes

NOTE: UNLESS OTHERWISE INDICATED:

1. EXISTING TOPOGRAPHY SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR.
2. FOR RELOCATION OR REMOVAL OF EXISTING UTILITIES; SEE SPECS.
3. ☐ INDICATES BOTTOM OF FOOTING ELEVATION.
4. SLOPE PAVING MAY BE PORTLAND CEMENT CONCRETE OR AIR-BLOWN MORTAR. SEE SPECS.
5. FOR GUARD RAIL DETAILS, SEE CALTRANS STD. PLAN A77-D, TYPE I FLARE AND A77-F, A77-E. FOR ANCHORAGE TO BRIDGE SIDEWALK, SEE STD. B11-54. TYP.
6. FOR SITE AND EMBANKMENT PREPARATION, SEE SPECS.
7. FOR TYPICAL SLOPE PAVING DETAILS SEE "MISCELLANEOUS DETAILS" ON SHEET NO. 12
8. LINING AND BIKE PATH TO BE CONSTRUCTED PER P.D. NO. 2298 (UNIT III)

NOTE:
CONTRACTOR'S ATTENTION IS DIRECTED TO THE PRESENCE OF GROUND WATER AT ELEVATION OF 2 TO 4 FEET BELOW THE RIVER BED GRADE. CONTRACTOR WILL BE REQUIRED TO PROVIDE ALL NECESSARY DEWATERING FACILITIES TO ADEQUATELY DEWATER BELOW THE SOFFIT OF PIER FOOTING OR BOTTOM OF THE FOOTING OF THE SLOPE PAVING PRIOR TO THE PLACEMENT OF ANY REINFORCEMENT AND STRUCTURAL OR AIR BLOWN CONCRETE. DEWATERING SHALL CONTINUE UNTIL THE STRENGTH OF STRUCTURAL OR AIR BLOWN CONCRETE BELOW THE WATER TABLE HAS REACHED THE STRENGTH OF 2000 P.S.I.

REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 32890 Exp. 3-31-00 CIVIL STATE OF CALIFORNIA

"PB614611"

REVISIONS | CHECKED | DRAWN

SIKAND ENGINEERING ASSOCIATES
CONSULTING ENGINEERS
(818)787-8558

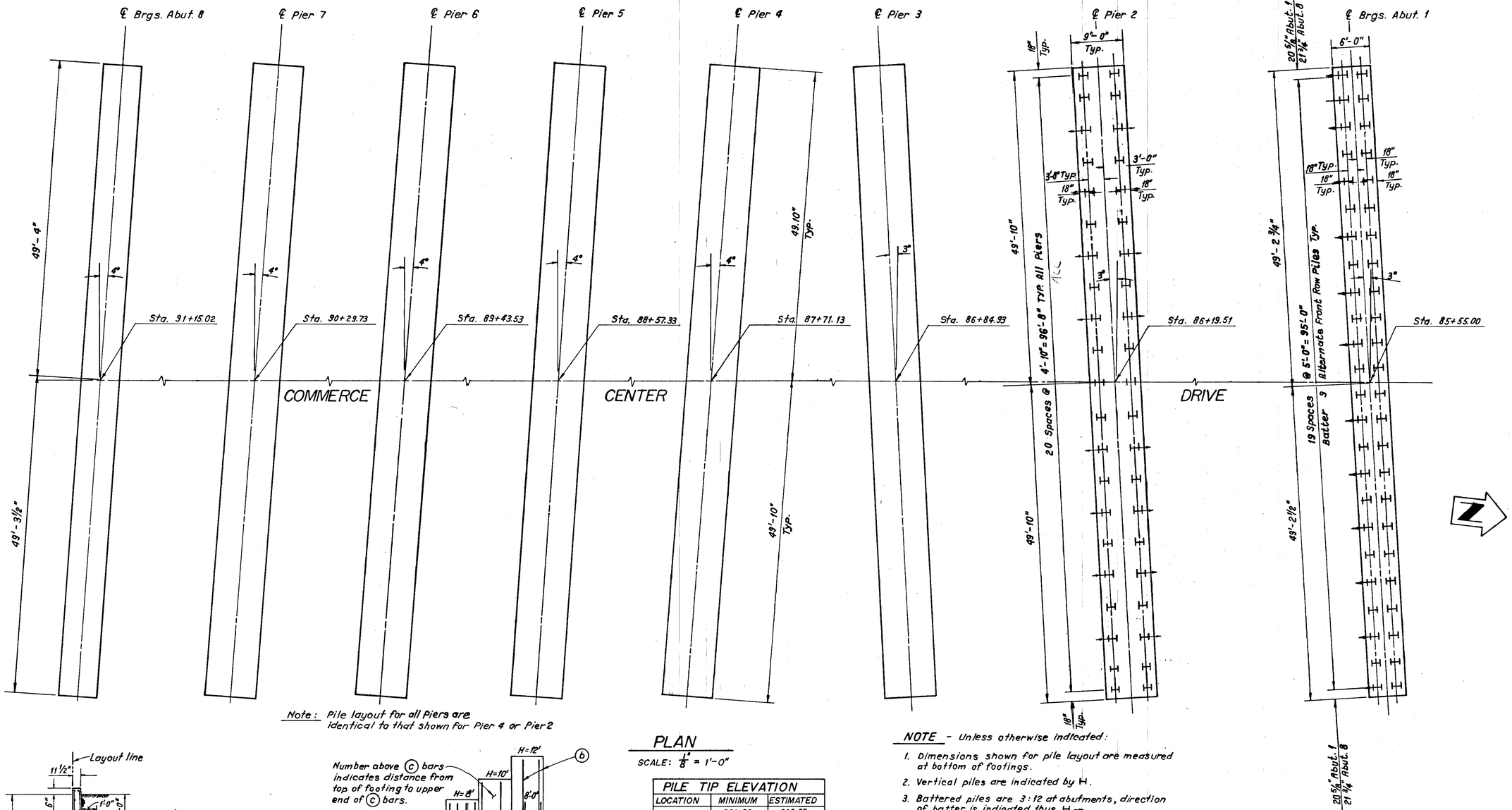
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION
STRUCTURES SECTION

DESIGNED BY: JORA SARKISSIAN
DRAWN BY: ALBERT GEVORKIAN
PROJECT ENGINEER: JORA SARKISSIAN

COMMERCE CENTER DRIVE OVER CASTAIC CREEK
TOPOGRAPHY

REVIEWED
Steve M. Hemmasi 11/24/97
STRUCTURAL SECTION DATE

BRIDGE NO.: 3794
PROJECT NO.:
SHT.: 2 OF: 15
DWG. NO.: 614611



Note: Pile layout for all Piers are identical to that shown for Pier 4 or Pier 2

PLAN

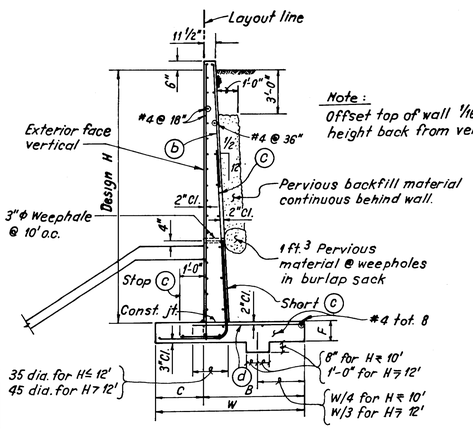
SCALE: 1/8" = 1'-0"

PILE TIP ELEVATION		
LOCATION	MINIMUM	ESTIMATED
ABUT 1	960.00	960.00
ABUT 8	950.00	950.00
PIER 2 & 3	926.00	926.00
PIERS 4,5,6,7	922.00	922.00

NOTE - Unless otherwise indicated:

1. Dimensions shown for pile layout are measured at bottom of footings.
2. Vertical piles are indicated by H.
3. Battered piles are 3:12 at abutments, direction of batter is indicated thus H→.
4. Lugs for steel pile shall be ¾" x 5" plates cut to fit. Welded to each side of web and shall be placed as directed by the Engineer. See Specs.
5. Estimated pile tip elevations as shown on this sheet shall be used for bidding purposes.
6. For pile driving, See Specs.
7. For pile details See Caltrans Std. Plan B2-5.
8. All piles are HP 12x53, with
   - Abuts. 40 ton capacity
   - Piers 70 ton capacity

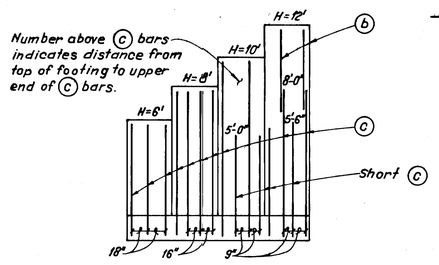
Note: Pile layout for Abut. 8 is identical but opposite hand to that shown for Abut. 1



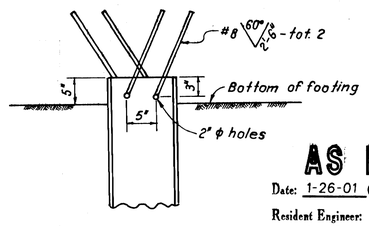
Note: Offset top of wall 1/16" per ft. of height back from vertical.

TYPICAL WINGWALL DETAILS

NO SCALE



Design H	6'	8'	10'	12'
W	4'-2"	5'-2"	6'-2"	7'-2"
C	1'-4"	1'-8"	2'-0"	2'-4"
B	2'-10"	3'-6"	4'-2"	4'-10"
F	1'-2"	1'-2"	1'-2"	1'-2"
(b)	—	—	—	#4@18"
©	#5@18"	#5@16"	#5@9"	#6@9"
(d)	#5@18"	#4@16"	#4@9"	#5@9"



STEEL PILE ANCHOR

NO SCALE

AS BUILT

Date: 1-26-01 Corrections by: G. Pereda

Resident Engineer: Zoven Abrahamian

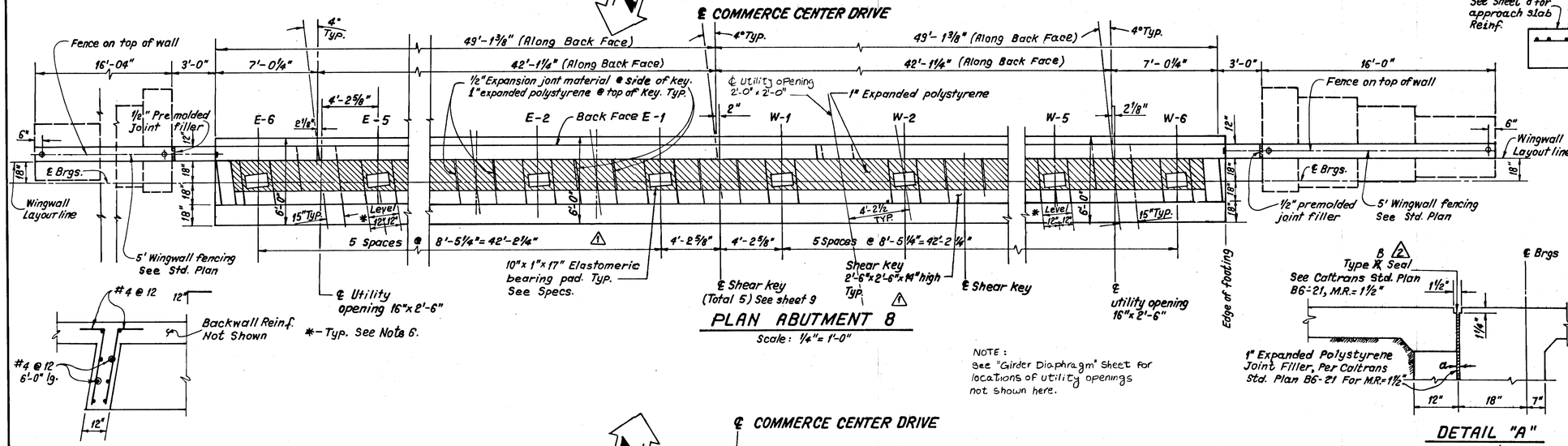
No Changes

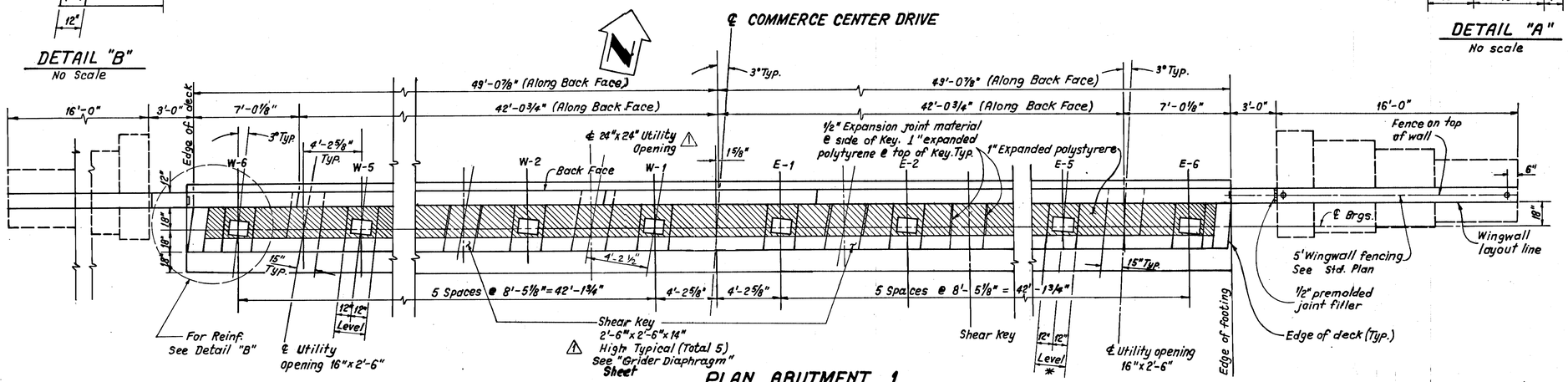
REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 45289 Exp. 3-31-00 CIVIL STATE OF CALIFORNIA

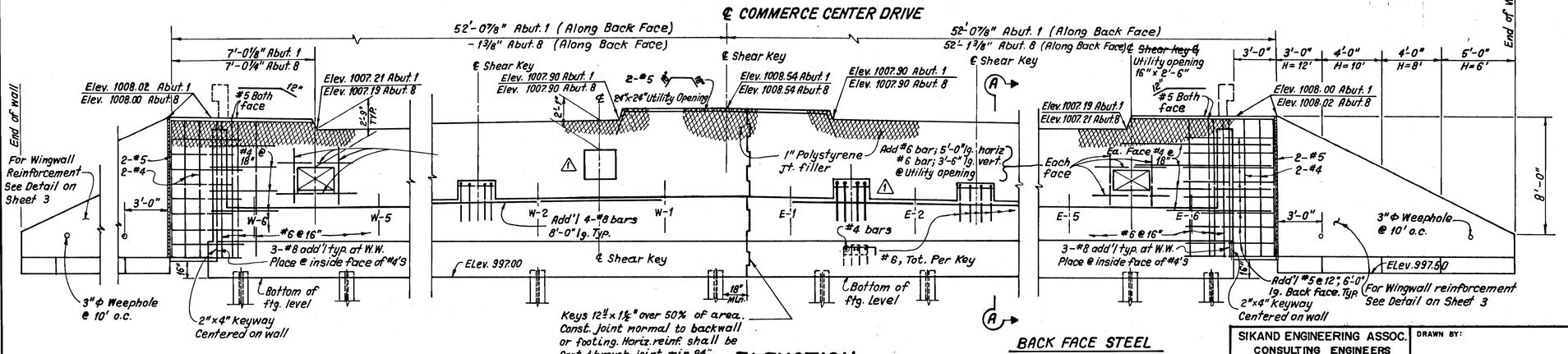
SIKAND ENGINEERING ASSOCIATES CONSULTING ENGINEERS 15230 BURBANK BLVD., VAN NUYS, CALIFORNIA 91411 (818)787-8550	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN DRAWN BY: ALBERT GEVORKIAN PROJECT ENGINEER: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK PILE LAYOUT & WINGWALL DETAILS REVIEWED Steve M. Hennessee 11/24/97 STRUCTURAL SECTION DATE
	BRIDGE NO.: 3794 PROJECT NO.: SHT.: 3 OF: 15 DWG. NO.: 614610

"PB614610"

REVISIONS | CHECKED | DRAWN







BEARING SEAT ELEVATION		
GIRDER	ABUTMENT 1	ABUTMENT 8
E-1	1002.56	1002.56
E-2	1002.39	1002.39
E-3	1002.22	1002.21
E-4	1002.04	1002.04
E-5	1001.87	1001.87
E-6	1001.70	1001.70
W-1	1002.56	1002.56
W-2	1002.39	1002.39
W-3	1002.22	1002.23
W-4	1002.06	1002.06
W-5	1001.89	1001.89
W-6	1001.72	1001.72

NOTE - Unless otherwise indicated:

1. Elevation shown is for back face of abutments and wing walls.
2. Bearing seat elevations are top of concrete and are Located at the intersection of ℄ bearing and ℄ girder.
3. Reinforcing steel shall have 2" cover in walls and 3" cover in footings.
4. Premolded joint filler should be fastened with 8 d galvanized nails @ 12" o.c. staggered.
5. Reinforcing steel shall be continuous through construction joints.
6. Bearing seats shall be parallel to roadway grade and level perpendicular to ℄ girder.

REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 42890 Exp. 9-31-00 CIVIL STATE OF CALIFORNIA

2 JOINT TYPE SEALS CHANGED TO TYPE "B" SEAL

AS BUILT

Date 1-26-01 Corrections by: G. Pereda

Resident Engineer: Zaven Abrahamian

REVISIONS	CHECKED	DRAWN
1 ADDED ABUTMENT UTILITY OPENING & REVISED SHEAR KEY LOCATIONS.		

SIKAND ENGINEERING ASSOC.
CONSULTING ENGINEERS
15230 BURBANK BLVD. VAN NUYS, CALIF. 91411
(818) 787-8550

DESIGNED BY: JORA SARKISSIAN

DRAWN BY: ALBERT GEVORKIAN

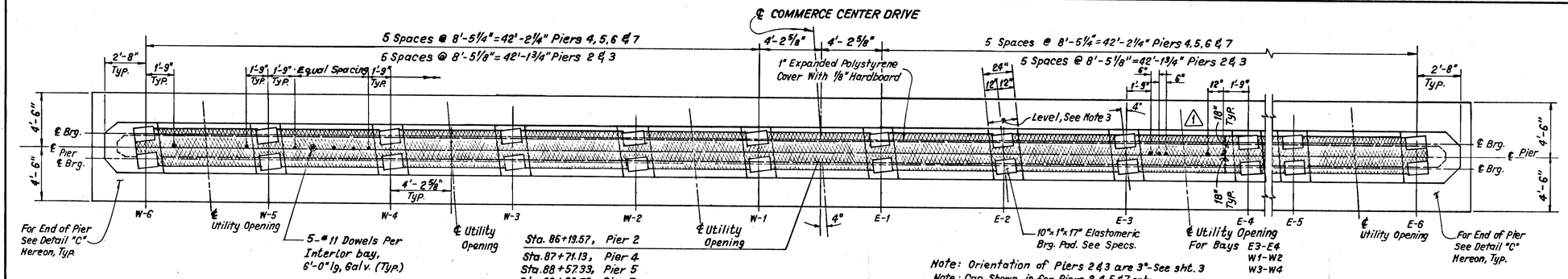
PROJECT ENGINEER: JORA SARKISSIAN

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION
STRUCTURES SECTION

COMMERCE CENTER DRIVE OVER CASTAIC CREEK
ABUTMENTS

REVIEWED
Steve Mikrogeorgis 11/24/97
STRUCTURAL SECTION DATE

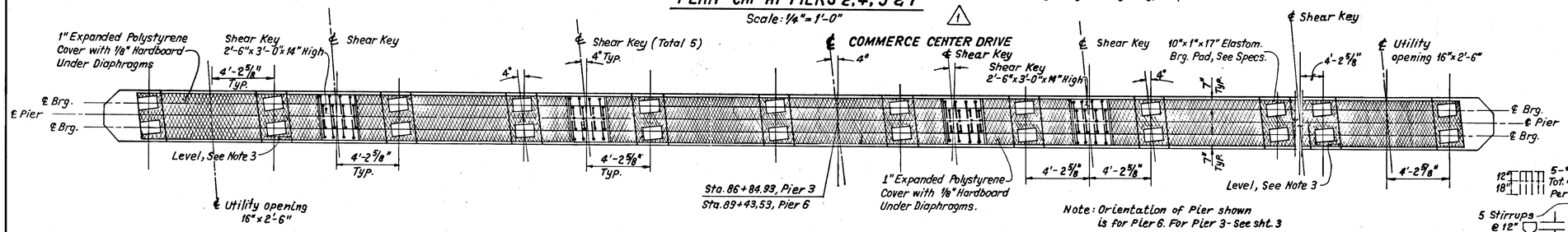
BRIDGE NO.: 3794
PROJECT NO.:
SHT.: 4 OF: 15
DWG. NO.: 614609



Note: Orientation of Piers 2 & 3 are 3°-See sht. 3
Note: Cap Shown is for Piers 2, 4, 5 & 7 only.
Stem footing and girder layout typ. all piers.

PLAN-CAP AT PIERS 2, 4, 5 & 7

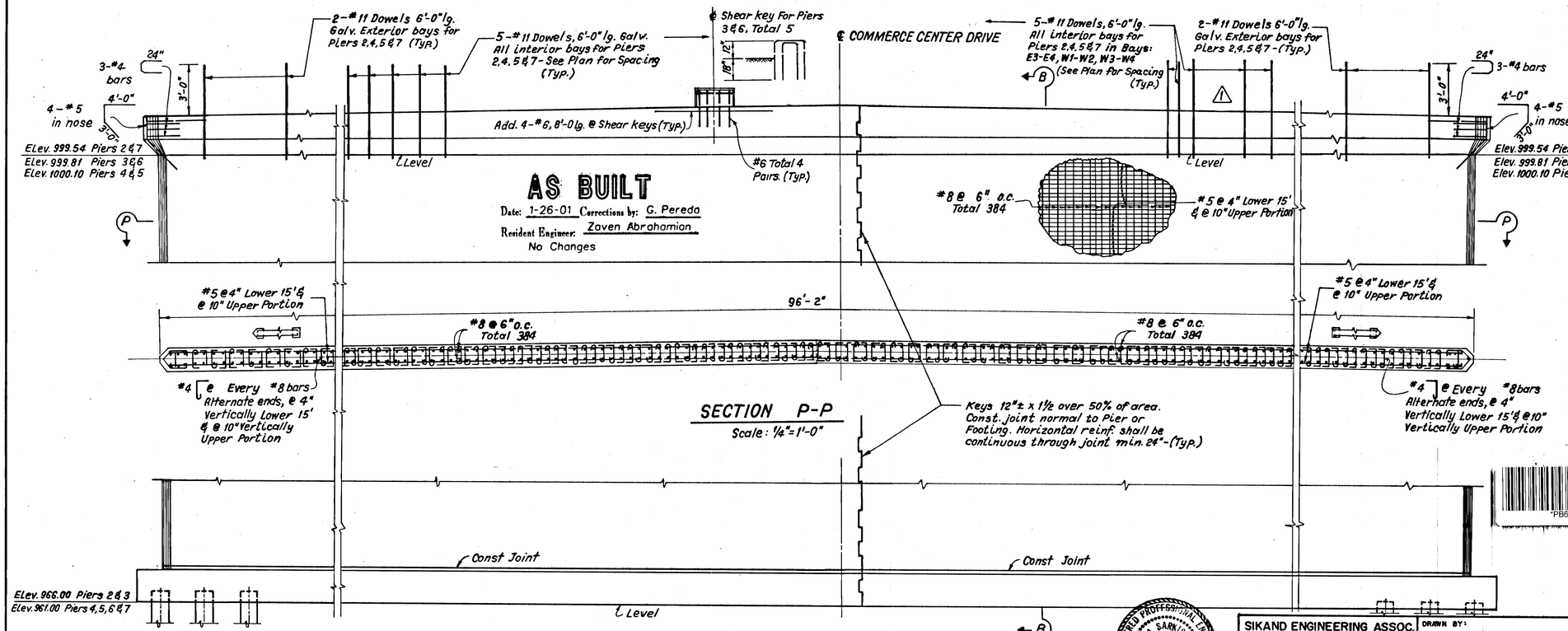
Scale: ¼"=1'-0"



Note: Orientation of Pier shown is for Pier 6. For Pier 3-See sht. 3

PLAN-CAP AT PIERS 3 & 6

Scale: ¼"=1'-0"



AS BUILT
Date: 1-26-01 Corrections by: G. Pereda
Resident Engineer: Zaven Abrahamian
No Changes

SECTION P-P

Scale: ¼"=1'-0"

ELEVATION

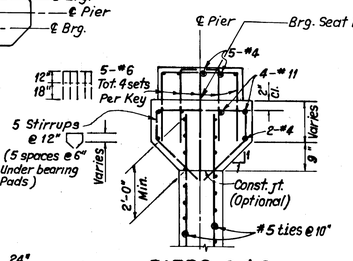
Scale: ¼"=1'-0"

NOTE: Reinforcement Shown is Typ. for both faces of Pier.

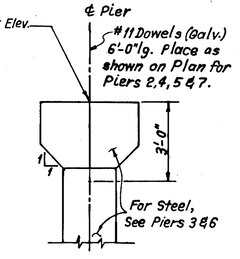
BEARING SEAT ELEVATION						
GIRDER	PIER 2	PIER 3	PIER 4	PIER 5	PIER 6	PIER 7
E-1	1002.81	1003.07	1003.37	1003.42	1003.23	1002.90
E-2	1002.64	1002.89	1003.20	1003.25	1003.07	1002.73
E-3	1002.47	1002.73	1003.03	1003.08	1002.90	1002.55
E-4	1002.29	1002.55	1002.86	1002.91	1002.72	1002.38
E-5	1002.12	1002.38	1002.69	1002.74	1002.55	1002.21
E-6	1001.95	1002.21	1002.52	1002.57	1002.38	1002.04
W-1	1002.81	1003.07	1003.36	1003.42	1003.24	1002.90
W-2	1002.64	1002.90	1003.19	1003.25	1003.07	1002.73
W-3	1002.47	1002.73	1003.02	1003.08	1002.91	1002.57
W-4	1002.31	1002.56	1002.85	1002.91	1002.74	1002.40
W-5	1002.14	1002.40	1002.68	1002.74	1002.57	1002.23
W-6	1001.97	1002.23	1002.51	1002.57	1002.40	1002.06

NOTE: Unless otherwise indicated:

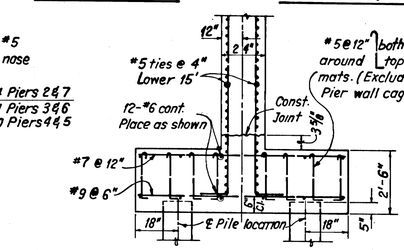
1. Elevations shown in table are at ℄ of pier. See Sect. B-B.
2. Reinforcing steel shall have 2" cover in cap and 3" cover in walls and footing.
3. Finish bearing seats parallel to roadway grade and level transverse to girders.
4. See Sheet 3 for pile layout.



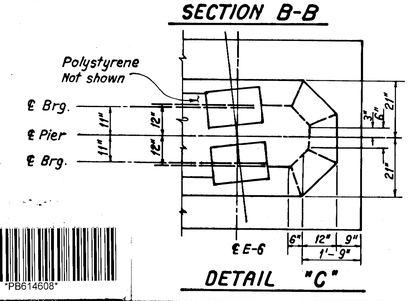
PIERS 3 & 6



PIERS 2, 4, 5 & 7



SECTION B-B



DETAIL "C"

PB614608

REVISED SHEAR KEY LOCATIONS AT PIERS & DOWEL SPACING AT UTILITY OPENINGS.

REVISIONS	CHECKED	DRAWN
△		

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION
STRUCTURES SECTION

COMMERCE CENTER DRIVE
OVER
CASTAIC CREEK
PIERS

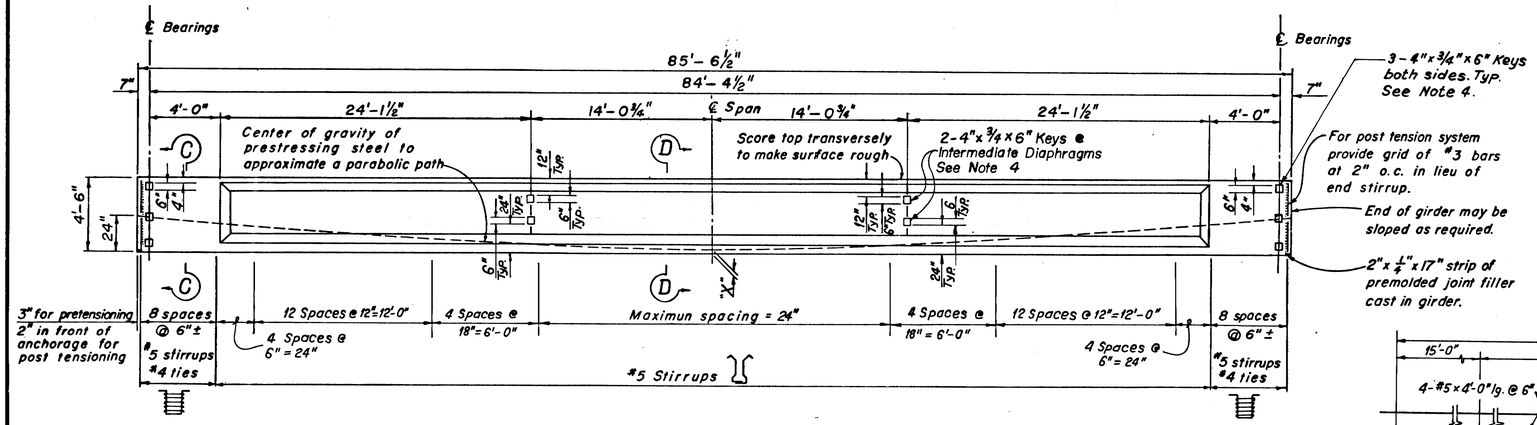
REVIEWED
Steve M. Hennessey 11/24/97
STRUCTURAL SECTION DATE

BRIDGE NO.: 3794
PROJECT NO.:
SHT.: 5 OF: 15
DWG. NO.: 614608

SIKAND ENGINEERING ASSOC.
CONSULTING ENGINEERS
15230 BURBANK BLVD. VAN NUYS, CALIF. 91411
(818) 787-8550

DESIGNED BY: JORA SARKISSIAN
DRAWN BY: ALBERT GEVORKIAN
PROJECT ENGINEER: JORA SARKISSIAN

REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 42690 Exp. 3-31-00 Civil STATE OF CALIFORNIA



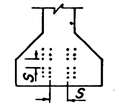
GIRDER ELEVATION FOR PIER 4 TO ABUT. 8

No Scale

CLEARANCES FOR POST TENSIONED UNITS

1. Units may be bundled vertically in groups of 3 max.
2. Horizontal clearance between units equal to 2 1/2" min.
3. Vertical clearance between bundled units equal to 3" min.
4. Any deviation shall be approved by the Engineer.

CLEARANCES FOR PRETENSIONED STRANDS



1. Strands may be bundled in groups consisting of 3 vertically and 2 horizontally, and separated at the ends.
2. The minimum distance "S" between groups or individual strands is 1½" for ⅜" strands, 1¾" for ½" strands and 2" for ⅝" strands.
3. "S" is measured between centers of adjacent strands.
4. Any deviation shall be approved by the Engineer.

GIRDER PRESTRESSING NOTES FOR PIER 4 TO ABUT. 8

"X"	DESIGN STRESSES	Post tension	Pretension
4" 8"	P = Working force, lbs	615,000 700,000	675,000 765,000
	Concrete strength, psi	f'c = 5,000 f'ci = 4,900	f'c = 5,000 f'ci = 4,900

CONCRETE STRENGTH:

f'ci is at time of initial stressing. (Force transfer to conc.) f'c is at 28 days.

WORKING FORCE:

The force remaining per girder after all losses.

CABLE PATH:

Where impractical to obtain cable path shown with a proposed prestressing system, it may vary within limits from 4" to 8" at ℄ girder and from 22" to 26" at the end of the girder subject to the approval of the Engineer. See Specs.

LOSSES:

The stress loss in prestressing steel due to shrinkage, creep, and sequence stressing shall be assumed to be;

pretension steel: 42,000 psi.
post tension steel: 32,000 psi.

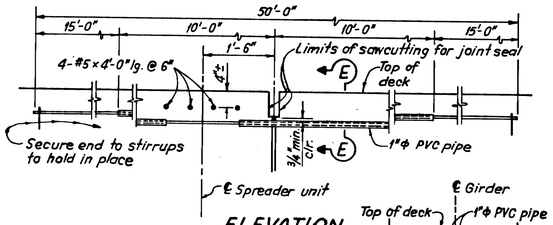
Provision shall be made for any other losses peculiar to the system of prestressing used.

GIRDER DEFLECTIONS: (PRE-TENSION) FOR "X"=4"

Time	Condition		Deflection
Initial	Prestress + D.L.Girder		- 1 3/8"
	Prestress + D.L.Girder		- 2 ¼"
3 months	D.L. Slab	½ pt.	+ 1 5/8"
		¼ pt.	+ 1 1/8"
	Prestress + D.L. Girder + D.L. Slab		- ⅝"
Final	Prestress + D.L. Girder + SD.L. Slab		- ¾"

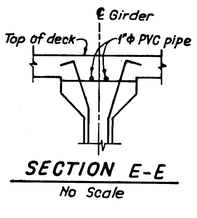
A minus(-) sign indicates upward deflection. Deflections measured at ℄ Span and are based on the assumption that the deck will not be placed on precast girders until 3 months after prestressing. Final deflection is assumed to occur 4 years after initial prestressing.

* Includes other dead loads.



ELEVATION

No Scale



SECTION E-E

No Scale

AS BUILT

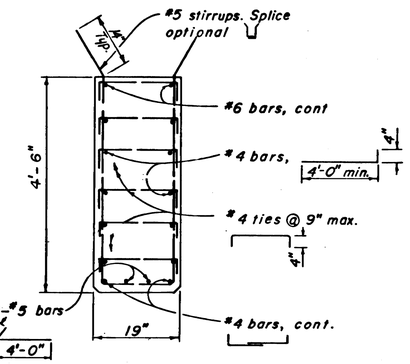
Date: 1-26-01 Corrections by: G. Pereda

Resident Engineer: Zaven Abrahamian

No Changes

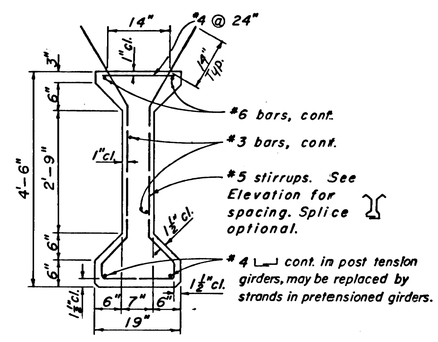
NOTE:

1. Girder length shown is for finished girder. Allowance shall be made for elastic shortening.
2. For dowels cast in girder, see Sht.
3. Extend #4 & #6 longitudinal reinforcing 8" post end of girder at Pier
4. Omit keys on exterior face of girder
5. Ends of girder shall be marked for span location.
6. Contractor shall submit shop drawings indicating location and size of holes for dowel through girders.



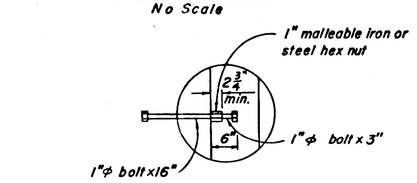
SECTION C-C

No Scale



SECTION D-D

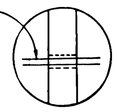
No Scale



ALTERNATE INSERT ASSEMBLY

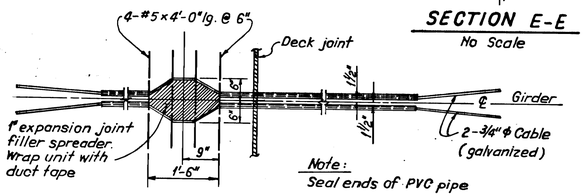
No Scale

"6 dowel 6'-0" long. Place through 1" holes formed in girder. Holes need not be grouted



ALTERNATE DOWEL ASSEMBLY

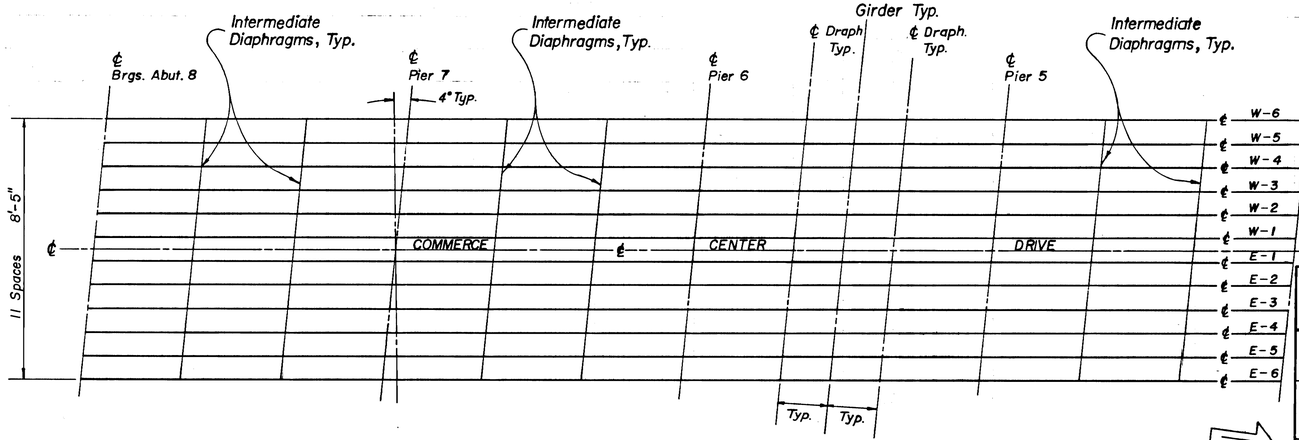
No Scale



Note: Seal ends of PVC pipe

RESTRAINER UNIT DETAIL

No Scale



TYPICAL GIRDER FRAMING PLAN

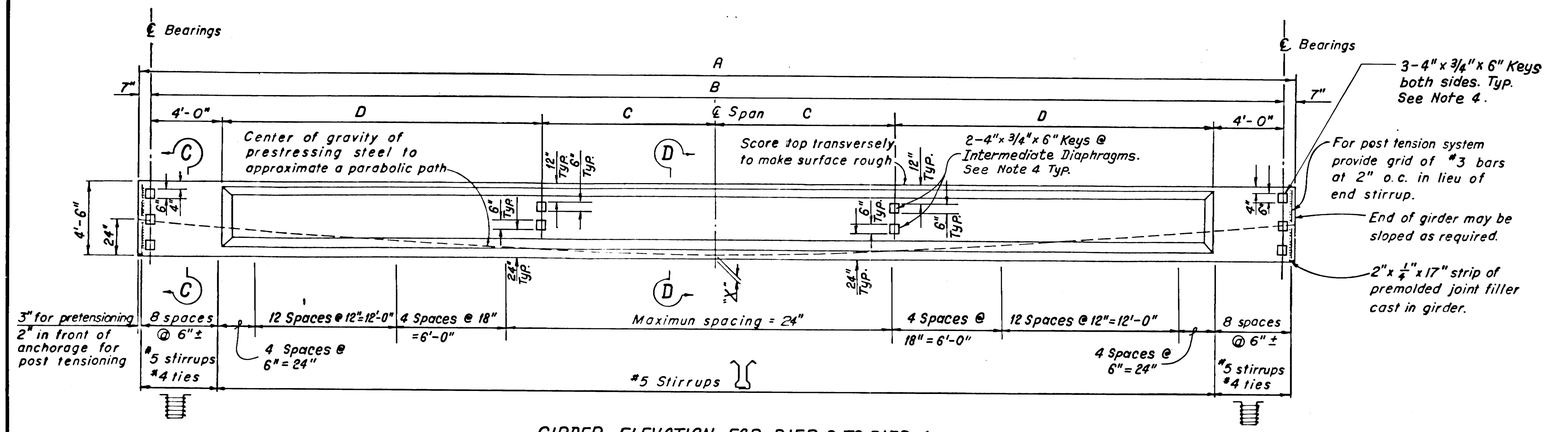
No Scale

PB614607

REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 42890 Exp. 3-31-00 CIVIL STATE OF CALIFORNIA

SIKAND ENGINEERING ASSOC. CONSULTING ENGINEERS 15230 BURBANK BLVD. VAN NUYS, CALIF. (818) 787-8550 91411	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK
DRAWN BY: ALBERT GEVORKIAN	PRESTRESSED GIRDER DETAILS NO. 1
PROJECT ENGINEER: JORA SARKISSIAN	REVIEWED Steve M. Hamasaee 11/24/97 STRUCTURAL SECTION DATE
	BRIDGE NO. 3794 JOB NO. SHT. 6 OF 15 DWG. NO. 614607

K-E ALBANENE® LA 4358



GIRDER ELEVATION FOR PIER 3 TO PIER 4

No Scale

AS BUILT

Date: 1-26-01 Corrections by: G. Pereda

Resident Engineer: Zaven Abrahamian

No Changes

PRESTRESSING FORCES FOR SPAN 3-4

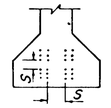
GIRDERS E-2, E-3, E-4, E-5 & E-6			
"X"	DESIGN STRESSES	POST TENSION	PRETENSION
4"	P=WORKING FORCE, lbs	670,000	750,000
8"		765,000	850,00
	CONCRETE STRENGTH, psi	f'c= 5,500	f'c= 5,500
		f'ci= 5,100	f'ci=4,900

GIRDERS E-1, W-1, W-2, W-3, W-4, W-5 & W-6			
"X"	DESIGN STRESSES	POST TENSION	PRETENSION
4"	P=WORKING FORCE, lbs.	615,000	675,000
8"		700,000	765,000
	CONCRETE STRENGTH, psi	f'c= 5,000	f'c= 5,000
		f'ci=4,900	f'ci=4,900

GIRDER DIMENSIONS FOR SPAN 3-4

LOC.	A	B	C	D
W-6	79'-10½"	78'-8½"	13'-1¼"	22'-2¾"
W-5	80'-10⅞"	79'-8⅞"	13'-3½"	22'-7"
W-4	81'-11⅛"	80'-9¼"	13'-5½"	22'-11⅞"
W-3	82'-11½"	81'-9½"	13'-7⅝"	23'-3⅛"
W-2	83'-11⅞"	82'-9⅞"	13'-9⅝"	23'-7⅛"
W-1	85'-0⅛"	83'-10⅛"	13'-11¾"	23'-11⅜"
E-1	86'-0½"	84'-10½"	14'-1¾"	24'-3½"
E-2	87'-0⅞"	85'-10⅞"	14'-3⅞"	24'-7⅝"
E-3	88'-1⅛"	86'-11⅛"	14'-5⅞"	24'-11¾"
E-4	89'-1⅝"	87'-11⅝"	14'-7⅞"	25'-3⅞"
E-5	90'-2"	89'-0"	14'-10"	25'-8"
E-6	91'-2¼"	90'-0¼"	15'-0"	26'-0⅛"

CLEARANCES FOR PRETENSIONED STRANDS



1. Strands may be bundled in groups consisting of 3 vertically and 2 horizontally, and separated at the ends.
2. The minimum distance "S" between groups or individual strands is 1½" for ⅜" strands, 1¾" for ½" strands and 2" for ½" strands.
3. "S" is measured between centers of adjacent strands.
4. Any deviation shall be approved by the Engineer.

PRESTRESSING NOTES FOR SPAN 3-4

"X"	DESIGN STRESSES	Post tension	Pretension
	P = Working force, lbs		
	Concrete strength, psi	f'c = / f'ci =	f'c = / f'ci =

CONCRETE STRENGTH :

f'_{ci} is at time of initial stressing. (Force transfer to conc)
f'_c is at 28 days.

WORKING FORCE :

The force remaining per girder after all losses.

CABLE PATH :

Where impractical to obtain cable path shown with a proposed prestressing system, it may vary within limits from 4" to 8" at ℄ girder and from 22" to 26" at the end of the girder subject to the approval of the Engineer. See Specs.

LOSSES :

The stress loss in prestressing steel due to shrinkage, creep, and sequence stressing shall be assumed to be;

pretension steel: 42,000 psi.
post tension steel: 32,000 psi.

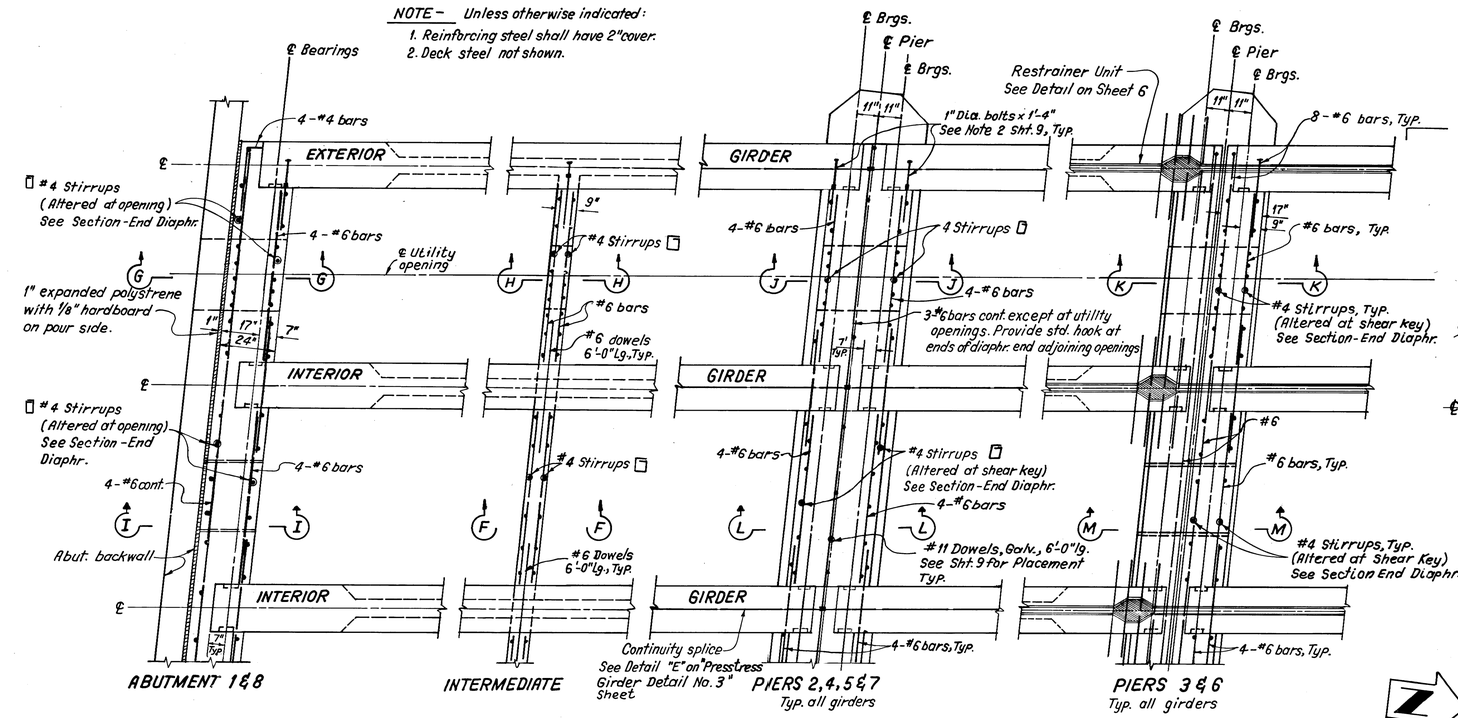
Provision shall be made for any other losses peculiar to the system of prestressing used.

GIRDER DEFLECTIONS: (PRE-TENSION) FOR "X"= 4"

Time	Condition		Deflection
Initial	Prestress † D.L. Girder		- 1¾
3 months	Prestress † D.L. Girder		- 2¼
	D.L. Slab	½ pt.	+ 1½
		¼ pt.	+ 1⅛
	Prestress † D.L. Girder † D.L. Slab		- ¾
Final	Prestress † D.L. Girder † ⅝ D.L. Slab		- ⅞

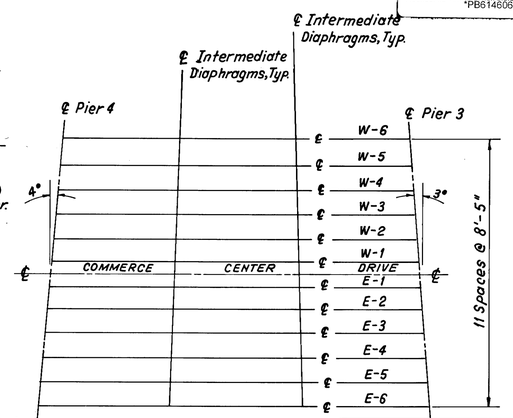
A minus(-) sign indicates upward deflection. Deflections measured at ℄ Span and are based on the assumption that the deck will not be placed on precast girders until 3 months after prestressing. Final deflection is assumed to occur 4 years after initial prestressing.

* Includes other dead loads.



DIAPHRAGM PLAN

Scale: 3/8" = 1'-0"



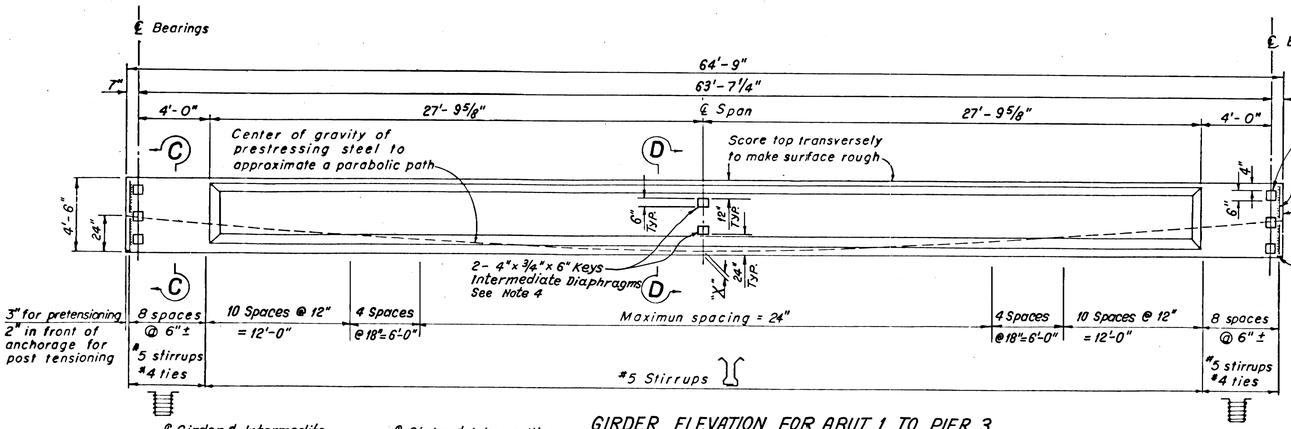
TYPICAL GIRDER FRAMING PLAN FOR SPAN 3-4

REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 42860 Exp. 3-31-00 CIVIL STATE OF CALIFORNIA

SIKAND ENGINEERING ASSOC. CONSULTING ENGINEERS 15230 BURBANK BLVD. VAN NUYS, CALIF. (818) 787-8550 91411	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK
DRAWN BY: ALBERT GEVORKIAN	PRESTRESSED GIRDER DETAILS NO. 2
PROJECT ENGINEER: JORA SARKISSIAN	REVIEWED Steve M. Hennessee 11/24/97 STRUCTURAL SECTION DATE
	BRIDGE NO. 3794 JOB NO.
	SHT. 7 OF 15 DWG. NO. 614606

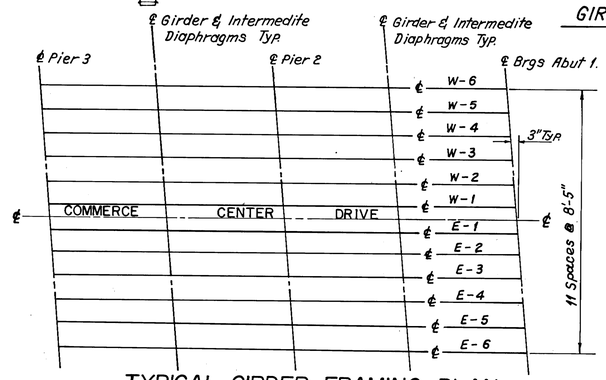
REVISIONS | CHECKED | DRAWN

K-E ALBUQUERQUE LA 4338



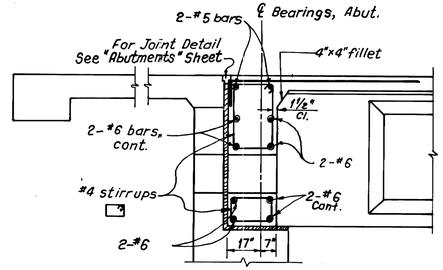
GIRDER ELEVATION FOR ABUT 1 TO PIER 3

No Scale



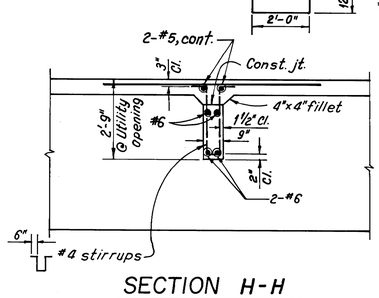
TYPICAL GIRDER FRAMING PLAN

No Scale



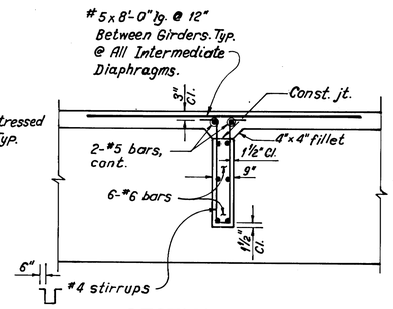
SECTION G-G

Scale: 3/8"= 1'-0"



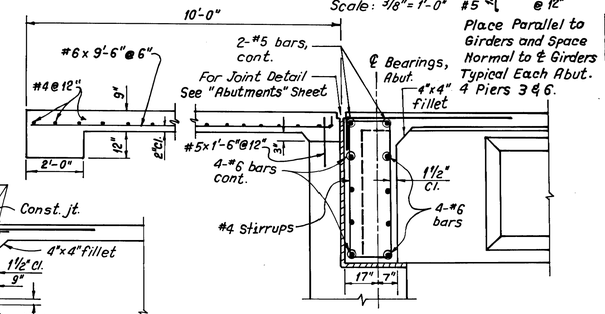
SECTION H-H

Scale: 3/8"= 1'-0"



SECTION F-F

Scale: 3/8"= 1'-0"



SECTION I-I

Scale: 3/8"= 1'-0"

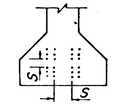
AS BUILT

Date: 1-26-01 Corrections by: G. Pereda

Resident Engineer: Zaven Abrahamian

No Changes

CLEARANCES FOR PRETENSIONED STRANDS



1. Strands may be bundled in groups consisting of 3 vertically and 2 horizontally, and separated at the ends.
2. The minimum distance "S" between groups or individual strands is 1½" for ⅜" strands, 1¾" for 7/16" strands and 2" for ½" strands.
3. "S" is measured between centers of adjacent strands.
4. Any deviation shall be approved by the Engineer.

GIRDER PRESTRESSING NOTES FOR ABUT 1 TO PIER 3

"X"	DESIGN STRESSES	Post tension	Pretension
4"	P = Working force, lbs	370,000	390,000
8"		420,000	445,000
	Concrete strength, psi	f'c = 5,000	f'c = 5,000
		f'ci= 4,000	f'ci= 4,000

CONCRETE STRENGTH:

f'ci is at time of initial stressing. (Force transfer to conc)
f'c is at 28 days.

WORKING FORCE:

The force remaining per girder after all losses.

CABLE PATH:

Where impractical to obtain cable path shown with a proposed prestressing system, it may vary within limits from 4" to 8" at ℄ girder and from 22" to 26" at the end of the girder subject to the approval of the Engineer. See Specs.

LOSSES:

The stress loss in prestressing steel due to shrinkage, creep, and sequence stressing shall be assumed to be;

pretension steel: 42,000 psi.
post tension steel: 32,000 psi.

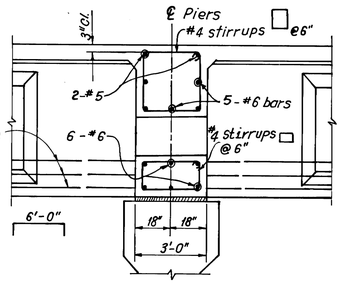
Provision shall be made for any other losses peculiar to the system of prestressing used.

GIRDER DEFLECTIONS: (PRE-TENSION) FOR "X"= 4"

Time	Condition		Deflection
Initial	Prestress † D.L.Girder		- 5/8"
3 months	Prestress † D.L.Girder		- ¾"
	D.L.Slab	½ pt.	+ ½"
		¼ pt.	+ ⅜"
	Prestress † D.L.Girder † D.L.Slab		- 5/8"
Final	Prestress † D.L.Girder † ½ D.L.Slab		-¼"

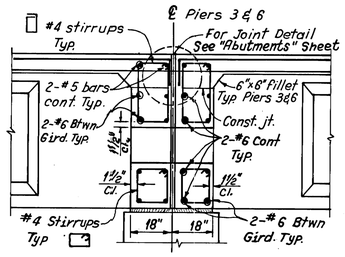
A minus(-) sign indicates upward deflection. Deflections measured at ℄ Span and are based on the assumption that the deck will not be placed on precast girders until 3 months after prestressing. Final deflection is assumed to occur 4 years after initial prestressing.

* Includes other dead loads.



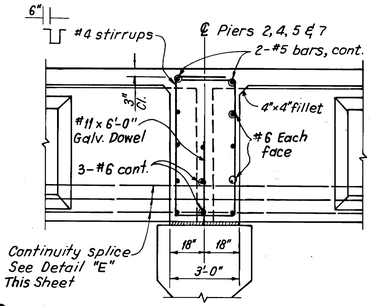
SECTION J-J

Scale: 3/8"= 1'-0"



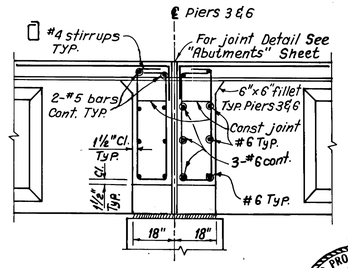
SECTION K-K

Scale: 3/8"= 1'-0"



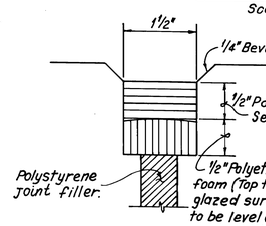
SECTION L-L

Scale: 3/8"= 1'-0"



SECTION M-M

Scale: 3/8"= 1'-0"



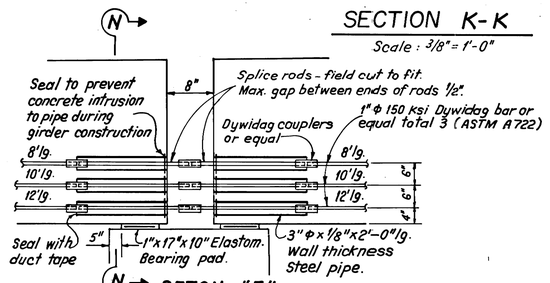
TYPE A SEAL

Full Scale

NOTE: Contractor may propose alternative continuity splice assembly, subject to approval by the Engineer.

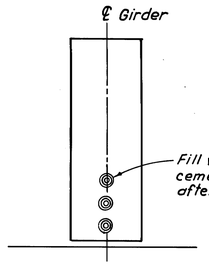
Pipes and rods to be securely wedged and braced in place to prevent displacement during girder concrete pour.

All threads to be oriented correctly.



CONTINUITY SPLICE

No Scale

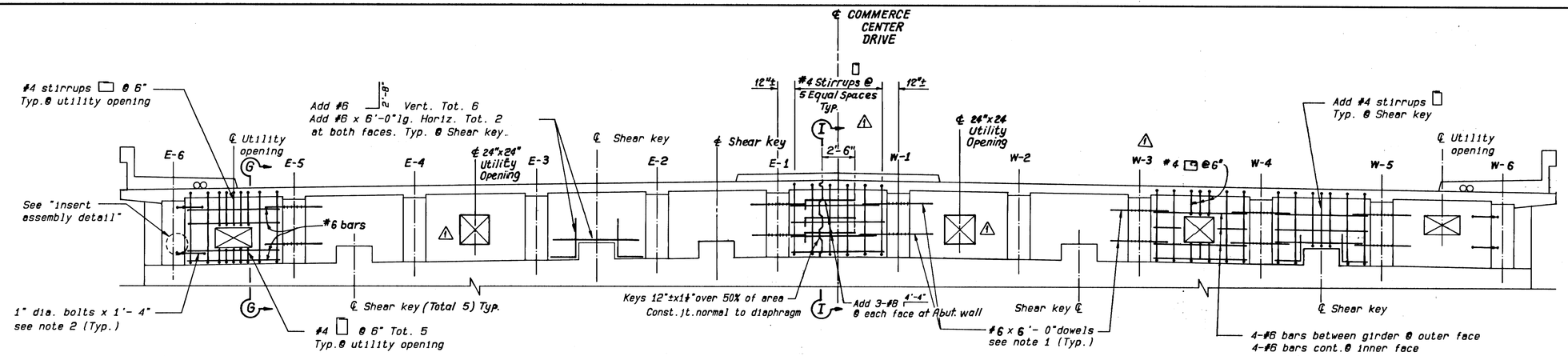


SECTION N-N

No Scale

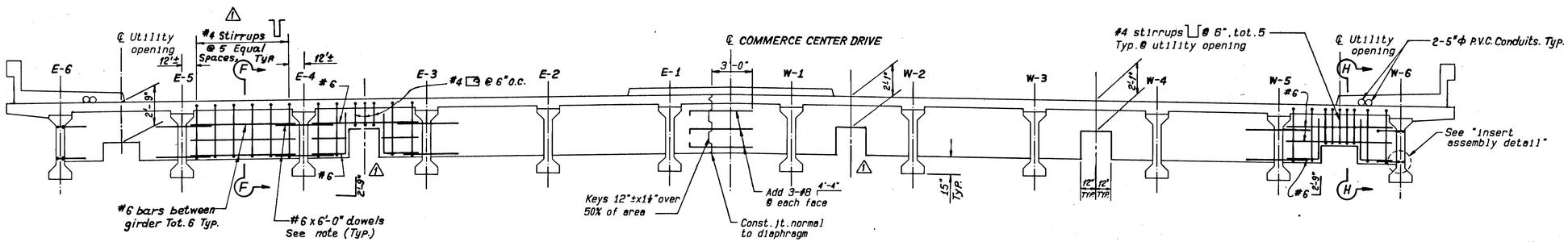
SIKAND ENGINEERING ASSOC. CONSULTING ENGINEERS 15230 BURBANK BLVD. VAN NUYS, CALIF. (818) 787-8550	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK
DRAWN BY: ALBERT GEVORKIAN	PRESTRESSED GIRDER DETAILS NO. 3
PROJECT ENGINEER: JORA SARKISSIAN	REVIEWED: Steve M. Hennessee 11/24/97 STRUCTURAL SECTION DATE
	BRIDGE NO. 3794 JOB NO. SHT. 8 OF 15 DWG. NO. 614605

K-E



NORMAL SECTION - END DIAPHRAGM AT ABUT. 1 & 8

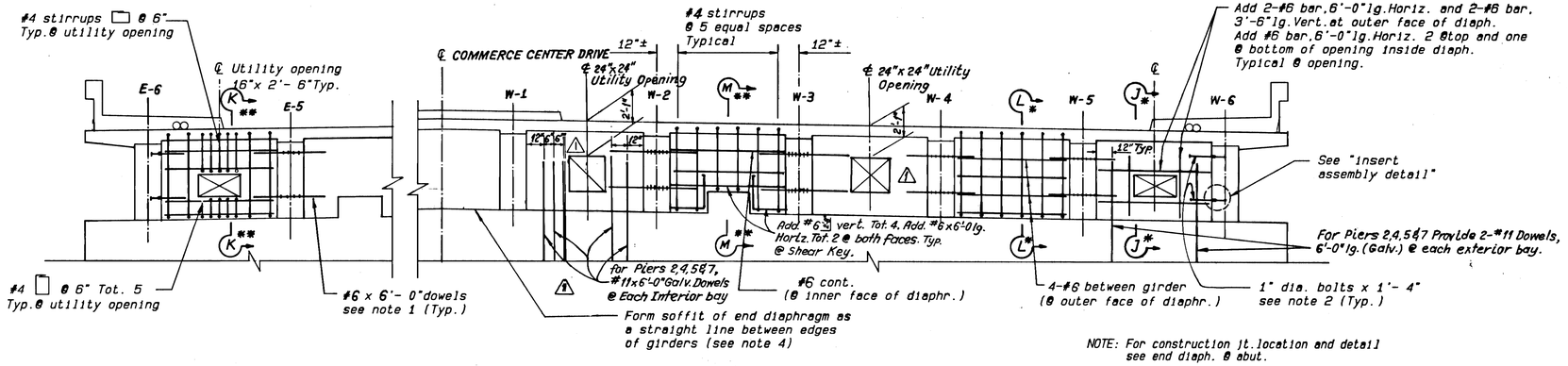
Scale : 1/4" = 1'- 0"



NORMAL SECTION - INTERMEDIATE DIAPHRAGM

Scale : 1/4" = 1'-0"

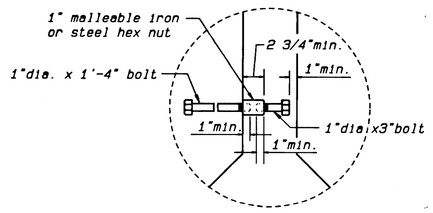
Note: For Joint Seal on Sidewalk at Abut. 1, Pier 3, Pier 6 and Abut. 8, See Caltrans Std. Plan B6-21.



NOTE: For construction jt. location and detail see end diaph. @ abut.

NORMAL SECTION - END DIAPHRAGM AT PIER

Scale : 1/4"= 1'-0"



INSERT ASSEMBLY DETAIL

No Scale

* @ Piers 2,4,5 & 7

** @ Piers 3 & 6

NOTES :

1. #6 x 6'-0" dowels placed through 1 1/2" dia. hole formed in girder, when diaphragms are continuous. Hole need not be grouted.
2. 1"dia. bolts x 1'-4" with insert assemblies when diaphragms are discontinuous. Bolts required for exterior girder.
3. Intermediate and end diaphragms are to be placed 5 days before placing deck.
4. This note certifies forming so as to prevent spalling problems of thin unreinforced concrete under girders.

AS BUILT

Date: 1-26-01 Corrections by: G. Pereda

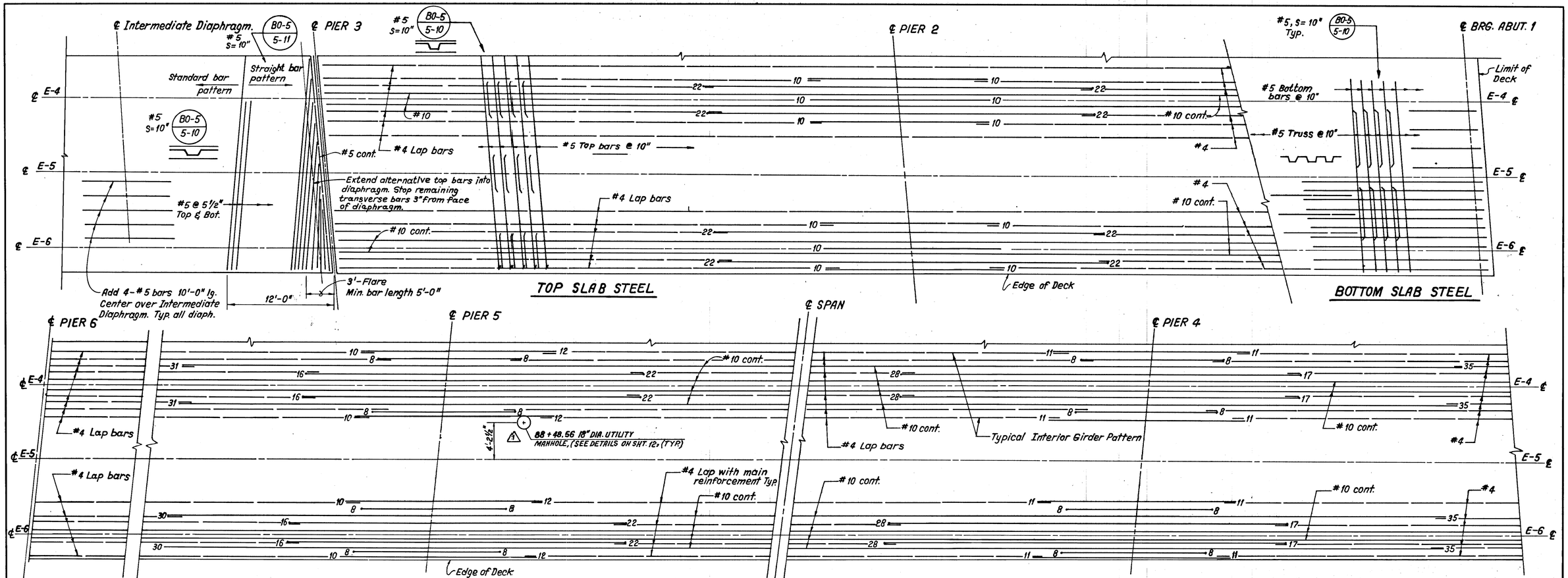
Resident Engineer: Zaven Abrahamian

No Changes

REGISTERED PROFESSIONAL ENGINEER — JORA SARKISSIAN — No. 52896 Exp. 3-31-98 — CIVIL — STATE OF CALIFORNIA

SIKAND ENGINEERING ASSOCIATES CONSULTING ENGINEERS 15230 BURBANK BLVD., VAN NUYS, CALIFORNIA (818)787-8558 91411	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK
DRAWN BY: ALBERT GEVORKIAN	GIRDER DIAPHRAGMS
PROJECT ENGINEER: JORA SARKISSIAN	REVIEWED Steve M. Hennessee 11/24/97 STRUCTURAL SECTION DATE
	BRIDGE NO.: 3794 PROJECT NO.: SHT.: 9 OF: 15 DWG. NO.: 614604

DRAWN	CHECKED	REVISIONS	⚠ ADDED UTILITY OPENING MODIFIED DOWEL SPACING OF UTILITY OPENING.



AS BUILT

Date: 1-26-01 Corrections by: G. Pereda

Resident Engineer: Zaven Abrahamian

No Changes

NOTE - Unless otherwise indicated:

1. Grade 60 reinforcing steel shall be spliced as follows:
   a. Only one-half of the bars may be spliced within the required lap length.
   b. Minimum lap splices for No. 6 and smaller bars shall be 32 d No. 7, 8 and bars shall be 45 d and No. 10 and 11 bars shall be 60 d.
   c. Splice lengths shall be determined by the diameter, d of the smaller bar joined.
2. Type "A", "B" and "C" bar splices shall be staggered and identical splices of the same type bar shall be spaced at least 3'-0" apart.
3. Reinforcing steel shall have 2" cover.
4. Deck truss bends shall be 45°.
5. Premolded joint filler shall be fastened with 8d galvanized nails at 12" o.c. staggered.
6. For additional notes and details, see sheet No. 9.
7. All bars # 10. Unless otherwise noted.

Note: Splices for # 10 cont. bars shall be located 25' min. from ℄ piers.

Note: Numbers at ends of # 10 bars indicate distance from ℄ pier.

DECK PLAN

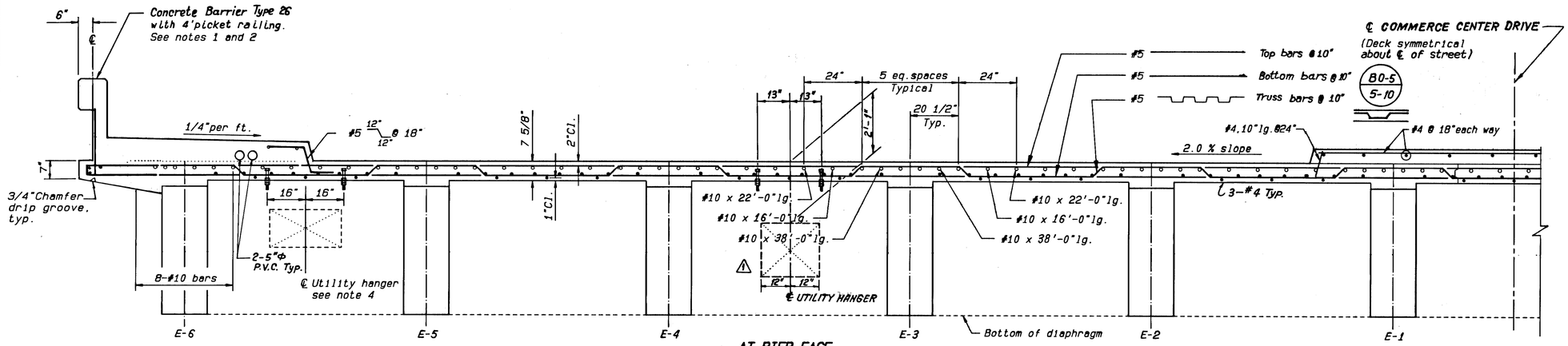
Scale: 3/16" = 1'-0"

SIKAND ENGINEERING ASSOC. CONSULTING ENGINEERS 15230 BURBANK BLVD. VAN NUYS, CALIF. (818) 787-8550 91411	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK
DRAWN BY: ALBERT GEVORKIAN	DECK DETAIL SHEET 1
PROJECT ENGINEER: JORA SARKISSIAN	REVIEWED Steve M Hennegar 11/24/97 STRUCTURAL SECTION DATE
	BRIDGE NO.: 3794 PROJECT NO.:
	SHT.: 10 OF: 15 DWG. NO.: 614603

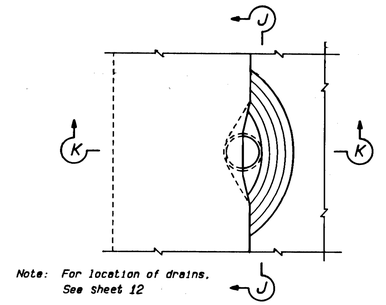
REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 42890 Exp. 3-31-00 CIVIL STATE OF CALIFORNIA

"PB614603"

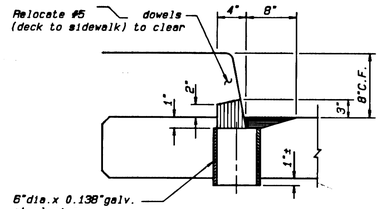
DRAWN | CHECKED | REVISIONS | ⚠ ADDED UTILITY MANHOLE LOCATION.



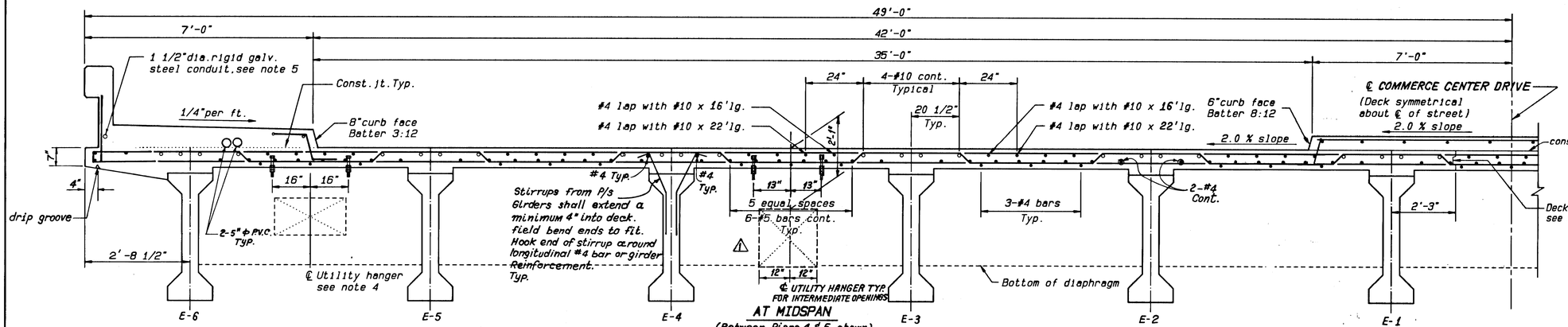
AT PIER FACE
(Pier 5 shown)



DECK DRAIN DETAIL
No Scale

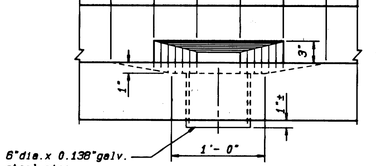


SECTION K-K
No Scale

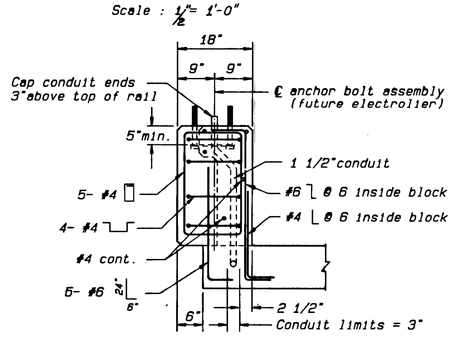


AT MIDSPAN
(Between Piers 4 & 5 shown)

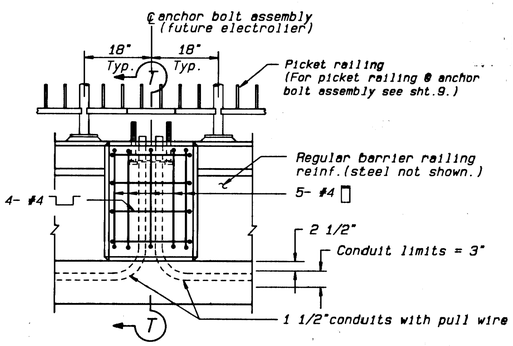
TYPICAL CROSS SECTION
Scale : 1/2"= 1'-0"



SECTION J-J
No Scale

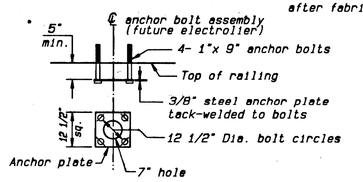


SECTION T-T

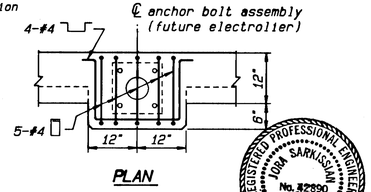


ELEVATION

NOTE: Galvanize anchor bolt assembly after fabrication



BASE DETAILS



PLAN

ANCHOR BOLT ASSEMBLY DETAILS
No Scale

NOTE – Unless otherwise indicated:

1. For Concrete Barrier Type 26, See Caltrans Std. Plan B11-54
2. For 4' picket railing, see L.A.C.D.P.W. Std. Plan 6102-0.
3. Where standard barrier railing expansion joints interfere with picket railing post spacing, joints may be relocated 9"from ℄ post.
4. Utility hangers shall consist of 1"dia.x 9"lg.bolts in pairs @ 10'±. Embed 5"in concrete. Bolt 1"-8UNC-2, thread 6". Furnish 2 nuts per bolt. All parts to be galvanized. See specs.
5. Provide 1 1/2"dia.rigid galvanized steel conduit with pull wire as shown on this plan. Provide expansion fittings at sidewalk joints and abutment per A.P.W.A. Std. Plan 465-0 in Specs.
6. For #5 pull box, see A.P.W.A. Std. Plan 460-0
7. For deck constr.jt, see CALTRANS std.plan B 0-5, bridge detail 5-2.

AS BUILT
Date: 1-26-01 Corrections by: G. Pereda
Resident Engineer: Zaven Abrahamian
No Changes

REVISIONS	CHECKED	DRAWN
⚠ ADDED UTILITY HANGER AND OPENING LOCATIONS.		

SIKAND ENGINEERING ASSOCIATES
CONSULTING ENGINEERS
16236 BURBANK BLVD., VAN NUYS, CALIFORNIA
(818)787-8550 91411

DESIGNED BY: JORA SARKISSIAN
DRAWN BY: ALBERT GEVORKIAN
PROJECT ENGINEER: JORA SARKISSIAN

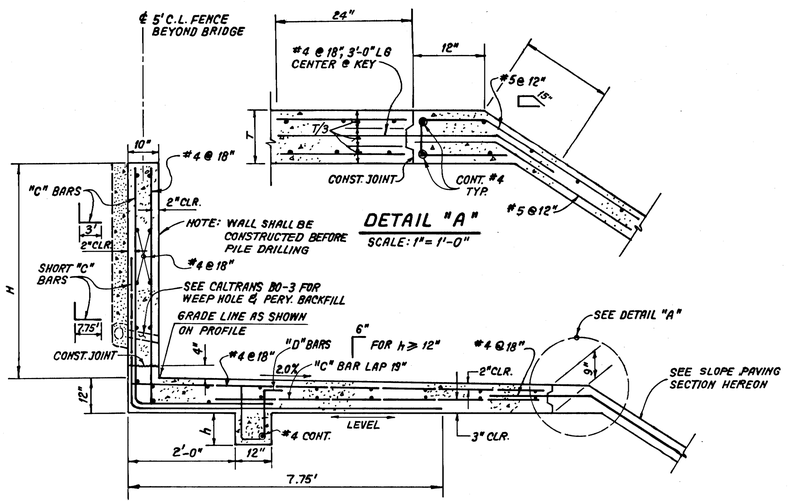
REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 32890 Exp. 2-31-00 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION
STRUCTURES SECTION

COMMERCE CENTER DRIVE
OVER
CASTAIC CREEK
DECK DETAIL SHEET 2

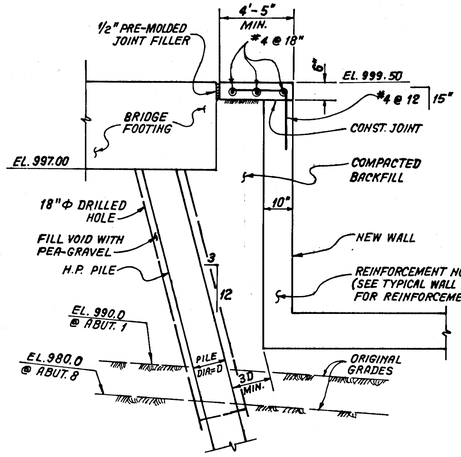
REVIEWED
Steve M. Hennessey 11/24/97
STRUCTURAL SECTION DATE

BRIDGE NO.: 3794
PROJECT NO.:
SHT.: 11 OF: 15
DWG. NO.: 614602



DETAIL "A"
SCALE: 1" = 1'-0"

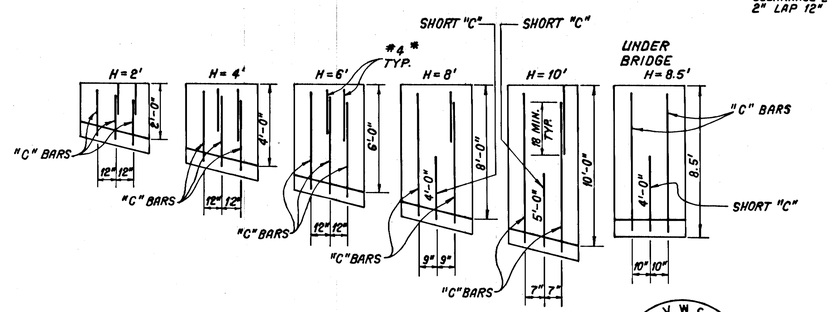
TYPICAL WALL SECTION
SCALE: 1/2" = 1'-0"



CAP CLOSURE UNDER BRIDGE
SCALE: 1/2" = 1'-0"

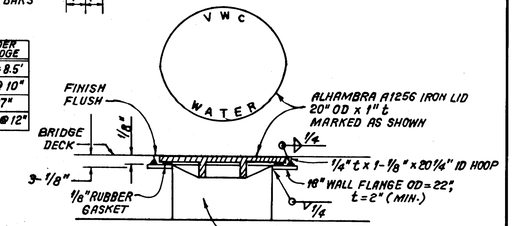
FIGURES AT TOP OF "C" BARS INDICATES DISTANCE FROM TOP OF FOOTING TO UPPER END OF "C" BARS

* * #4 EXTENSION BARS. PROVIDE WHENEVER CLEARANCE EXCEEDS 2" LAP 12"



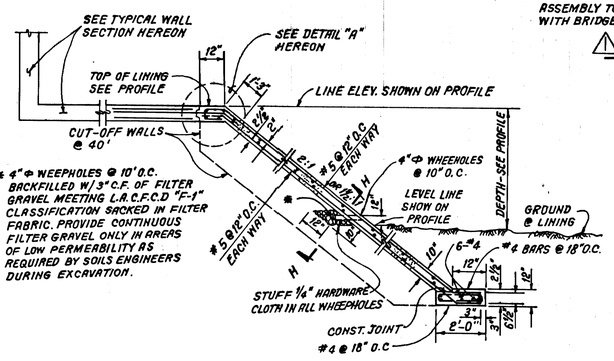
WALL REINFORCING BEYOND BRIDGE					
DESIGN H	2'	4'	6'	8'	10'
"C" BARS	#4 @ 12"	#4 @ 12"	#4 @ 12"	#5 @ 9"	#6 @ 7"
KEY DEPTH	-0-	6"	12"	18"	27"
"D" BARS	—	—	#4 @ 18"	#4 @ 12"	#5 @ 12"

UNDER BRIDGE
H=8.5'
#6 @ 10"
27"
#5 @ 12"

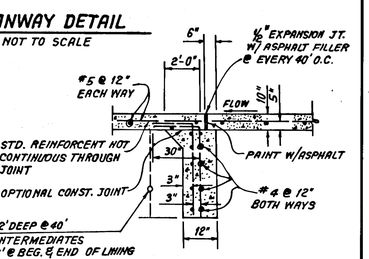


NOTE: SLEEVE AND FLANGE INSERT ASSEMBLY TO BE CAST INTEGRALLY WITH BRIDGE DECK.

⚠ MANWAY DETAIL
NOT TO SCALE

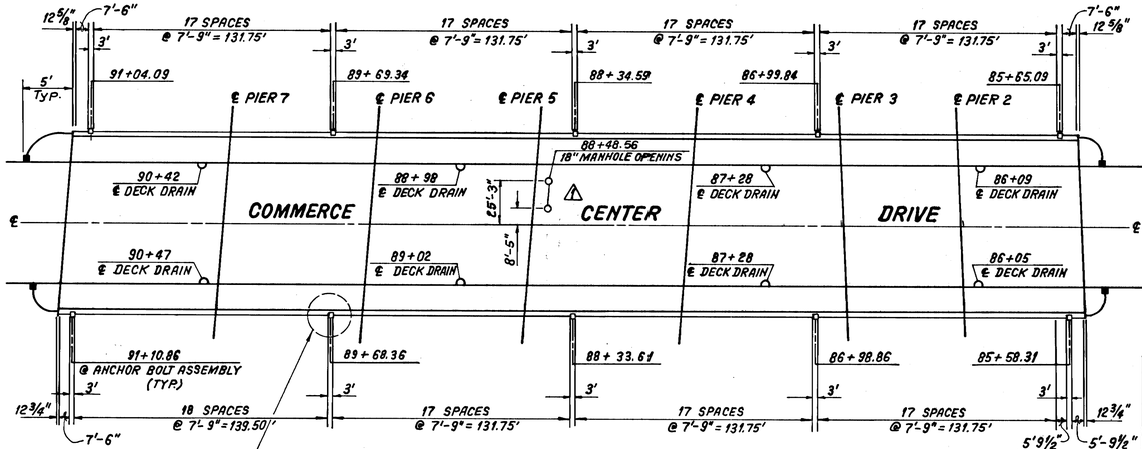


* 4"℄ WEEPHOLES @ 10'0.C. BACKFILLED W/ 3/8" C.F. OF FILTER GRAVEL MEETING L.A.C.F.C.D "F-1" CLASSIFICATION SACKED IN FILTER FABRIC. PROVIDE CONTINUOUS FILTER GRAVEL ONLY IN AREAS OF LOW PERMEABILITY AS REQUIRED BY SOILS ENGINEERS DURING EXCAVATION.

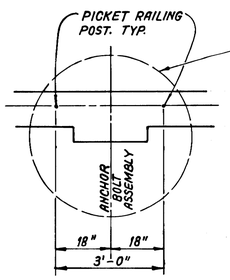


SECTION H-H EXPANSION JOINT
CUT-OFF WALL

NOTE: EXPANSION JOINT SHALL BE SPACED @ 40' INTERVALS



DECK DRAIN LOCATIONS AND PICKET RAILING POST SPACING
SCALE: 1" = 40'



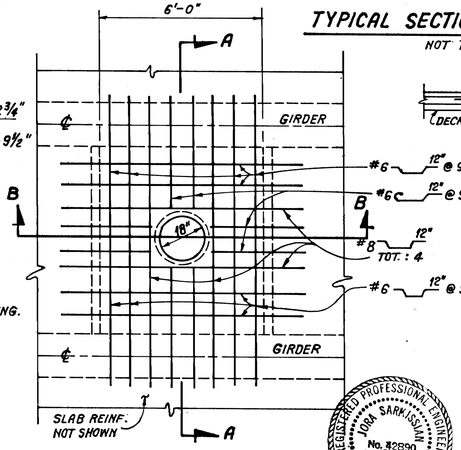
NOTE:

JOINTS SHALL BE PROVIDED IN THE BARRIER RAILINGS AT ABUT. 1, PIER 3, PIER 6 AND ABUT. 8 FOR EXPANSION AND CONTRACTION.
1/2" VERTICAL JOINTS SHALL BE PROVIDED IN THE BARRIER RAILINGS AT PIERS 2,4,5 AND 7.

WALL CONSTRUCTION SEQUENCE

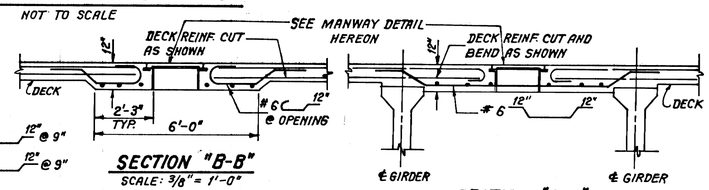
1. REMOVE 5' OF EXISTING SOIL.
2. CONSTRUCT AND COMPACT EMBANKMENT TO BOTTOM OF WALL FOOTING.
3. CONSTRUCT WALL.
4. CONSTRUCT AND COMPACT EMBANKMENT TO 6" ABOVE BOTTOM OF ABUTMENT FOOTING.
5. EXCAVATE TO BOTTOM OF ABUTMENT FOOTING 1 WEEK AFTER COMPLETION OF COMPACTED FILL PLACEMENT.
6. PRE-DRILL FOR PILES TO ORIGINAL GROUND LEVELS AND DRIVE PILES.
7. FILL VOID WITH PEA-GRAVEL AND CONSTRUCT ABUTMENT FOOTING.
8. CONTRACTOR MAY SUBMIT ALTERNATE CONSTRUCTION SEQUENCE FOR APPROVAL BY ENGINEER.

AS BUILT
Date: 1-26-01 Corrections by: G. Pereda
Resident Engineer: Zaven Abrahamian
No Changes



⚠ PLAN
SCALE: 3/8" = 1'-0"

TYPICAL SECTION - SLOPE PAVING
NOT TO SCALE



SECTION "B-B"
SCALE: 3/8" = 1'-0"

SECTION "A-A"
SCALE: 3/8" = 1'-0"

⚠ DECK REINFORCEMENT AT UTILITY OPENING
SCALE: 3/8" = 1'-0"

⚠ ADDED DECK REINFORCEMENT FOR MANWAY OPENING AND ADDED LOCATION OF MANHOLES.

REVISIONS | CHECKED | DRAWN

REGISTERED PROFESSIONAL ENGINEER JORA SARKISSIAN No. 42690 Exp. 2-31-02 CIVIL STATE OF CALIFORNIA

SIKAND ENGINEERING ASSOCIATES CONSULTING ENGINEERS 15230 MINNAMAR BLVD., VAN NUYS, CALIFORNIA 91411 (818)787-8558	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN DRAWN BY: ALBERT GEVORKIAN PROJECT ENGINEER: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK MISCELLANEOUS DETAILS
REVIEWED Steve M. Hennessee 11/24/17 STRUCTURAL SECTION DATE	BRIDGE NO.: 3794 PROJECT NO.: SHT.: 12 OF: 15 DWG. NO.: 614601

"P86146011"

LOG OF BORING 89-025-F6 — BORING NO. WB-F1

SAMPLE NO.	DEPTH	BLOWS	PENETRATION RESISTANCE PCF	MOISTURE CONTENT*	CONSISTENCY DRY DENSITY PCF	WEIGHT**	DEPTH IN FEET	DESCRIPTION
							0	SURFACE CONDITION: Northern side of Castaic Creek. ELEVATION: 979
							SP	SAND: Light brownish gray, slightly silty, gravelly, fine to very coarse
							SP/GP	SAND/GRAVEL: Change to tan, very gravelly, (mostly less than 1/2 inch) no silt
							5	
15		30/10"		13	124		15	
20		54+					20	Gravel increase in size to mostly 1/2 to 1 inch, no cobbles
30		50+					30	Average size of gravel 1/4 to 2 inches, sand alternating fine to medium with fine to very coarse in 6 to 48 inch layers
							35	3 inch silt layer
							40	

LOG OF BORING 89-025-F6 — BORING NO. WB-F1 (Cont'd)

SAMPLE NO.	DEPTH	BLOWS	PENETRATION RESISTANCE PCF	MOISTURE CONTENT*	CONSISTENCY DRY DENSITY PCF	WEIGHT**	DEPTH IN FEET	DESCRIPTION
	40	71+					40	Some cobbles 40 to 42 feet
							SP 45	Decrease in gravel content
							ML	SILT: Gray-brown
							SP/GP 50	SAND: Tan, very gravelly, fine to very coarse, occurs as 6 to 48 inch alternating layers of fine to medium at the top of each layer and grading down into very gravelly, medium to very coarse
							55	
	60	73+					60	
							65	
							70	
							75	
	80	60+					80	End of boring at 80 feet Water at 12 feet - no caving

LOG OF BORING 89-025-F6 — BORING NO. WB-F2

SAMPLE NO.	DEPTH	BLOWS	PENETRATION RESISTANCE PCF	MOISTURE CONTENT*	CONSISTENCY DRY DENSITY PCF	WEIGHT**	DEPTH IN FEET	DESCRIPTION
							0	SURFACE CONDITION: Center of concrete batch plant access road ELEVATION: 981
							Af	FILL: 3/4 inch gravel cap with gravelly sand base
							SP	SAND: Light gray, gravelly, fine to very coarse, pebbles at 6 and 16 feet
							5	
	15	30	15		111		15	
	20	38+					20	
							ML/CL	SILT/CLAY: Medium gray-brown, very clayey silt
							SP 25	SAND: Light tan, gravelly, fine to coarse gravel, mostly less than 1 inch size
							SP/GP 30	SAND/GRAVEL: Grades to very gravelly, fine to very coarse
	30	48+					35	
							ML	SILT: Medium brown
							SP/GP	SAND: Tan, very gravelly, fine to very coarse
							40	

LOG OF BORING 89-025-F6 — BORING NO. WB-F2 (Cont'd)

SAMPLE NO.	DEPTH	BLOWS	PENETRATION RESISTANCE PCF	MOISTURE CONTENT*	CONSISTENCY DRY DENSITY PCF	WEIGHT**	DEPTH IN FEET	DESCRIPTION
	40	73+					40	
							45	
							SP 50	SAND: Change to gravelly fine to medium, abundant mica
	60	71+					60	SAND: Tan, some fine gravel, abundant mica, fine to medium
							65	
							70	Grades to gravelly
							SP/GP 75	Grades to very gravelly, mostly less than 1/2 inch size
							GP/SP	GRAVEL: Very sandy, mostly to 1/2 inch size and maximum of 1 inch
	80	130+					80	Coarse gravel in sampler End of boring at 80 feet Water at 13 feet

* Percent
** Pounds per cubic foot
\+ SPT

AS BUILT
Date: 1-26-01 Corrections by: G. Pereda
Resident Engineer: Zaven Abrahamian
No Changes

REGISTERED PROFESSIONAL ENGINEER — JORA SARKISSIAN — No. 42890 Exp. 3-31-02 — CIVIL — STATE OF CALIFORNIA

REVISIONS | CHECKED | DRAWN

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

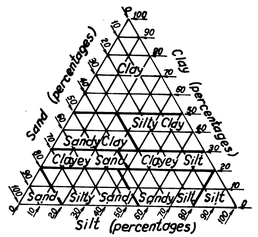


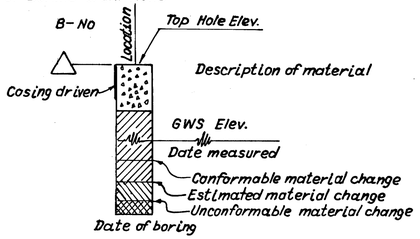
Diagram showing the basis for estimates of grade size distribution used in determination of class names.
If gravel is present in appreciable amounts the term "gravelly" may be added to the class name, via, "gravelly sand." The terms "coorse", "medium" and "fine" when used to describe sand, silt and gravel refer to standard grade size limits.

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Sandy Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock

LEGEND OF BORING OPERATIONS

- Plan of any boring
- Rotary boring (wet)
- Auger boring (dry)
- Closed bottom bucker
- Test pit



PB614600

SIKAND ENGINEERING ASSOCIATES CONSULTING ENGINEERS 15239 BERDARE BLVD., VAN NUYS, CALIFORNIA 91411 (818)787-8550	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN DRAWN BY: ALBERT GEVORKIAN PROJECT ENGINEER: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK LOG OF TEST BORINGS SHT. 1
REVIEWED: Steve M Wenmoore 11/24/97 STRUCTURAL SECTION DATE	BRIDGE NO.: 3794 PROJECT NO.: SHT.: 13 OF: 15 DWG. NO.: 614600

LOG OF BORING 89-025-F6 — BORING NO. WB-F3

SAMPLER	DEPTH	BLOWS	PCF	MOISTURE	CONTENT*	DRY DEN*	WET DEN**	DEPTH	IN FEET	DESCRIPTION
										SURFACE CONDITION: Plowed field, proposed bridge abutment
										ELEVATION: 990
								0		
									SM	SAND: Light grayish brown, very silty, gravelly, fine to very coarse gap graded
									SP	Grades to no silt
5	13		5.4		118			5		
									SP/GP	Grades to very gravelly
								10		
									SP	Change to less gravel
15	23+							15		
								20		
									SP/GP	Increase in 1/2 to 1 inch size gravel content
25	100+							25		2 inches of 3/4 inch gravel recovered in sampler
								30		
35	63+							35	GP/SP	Increase in gravel content, size mostly less than 2 inches
								40		Some caving at 38 to 40 feet depth

LOG OF BORING 89-025-F6 — BORING NO. WB-F3 (Cont'd)

SAMPLER	DEPTH	BLOWS	PCF	MOISTURE	CONTENT*	DRY DEN*	WET DEN**	DEPTH	IN FEET	DESCRIPTION
								40		Some coarse gravel 40 to 46 feet
								45		
									SP/GP	SAND/GRAVEL: Increase in fine to medium sand
		50	68+					50		Some coarse gravel
									GP/SP	GRAVEL/SAND: Increase in gravel, some cobbles
								55		6 inch silt layer
								60	SP	SAND: Change to gravelly, fine to coarse
		65	106+					65		End of boring at 65 feet Water at 21 feet - Caving at 38 to 40 feet
								70		
								75		
								80		

LOG OF BORING 89-025-F6 — BORING NO. WB-F4

SAMPLER	DEPTH	BLOWS	PCF	MOISTURE	CONTENT*	DRY DEN*	WET DEN**	DEPTH	IN FEET	DESCRIPTION
										SURFACE CONDITION: Edge of plowed field, southern abutment of Backer Road Bridge over Castaic Creek
										ELEVATION: 986
								0		
									SM	SAND: Light brown to tan, silty, some gravel, fine to coarse gap graded
									SP	No silt, change to gravelly
5	35		8		122			5		
									SP/GP	SAND/GRAVEL: Change to very gravelly
								10		
15	59+							15		Sampler contained 2 inches of 1/2 to 3/4 inch size gravel, bit plugged by 2 inch gravel
								20		
									SP	Change to less gravel
25	39+							25		Gravel confined to a few thin sandy gravel layers
								30		
35	51+							35		
								40		

LOG OF BORING 89-025-F6 — BORING NO. WB-F4 (Cont'd)

SAMPLER	DEPTH	BLOWS	PCF	MOISTURE	CONTENT*	DRY DEN*	WET DEN**	DEPTH	IN FEET	DESCRIPTION
								40	SP/GP	SAND/GRAVEL: Grades to very gravelly
									SP	SAND: Change to gravel in thin layers separated by 1 to 4 foot layers of fine to coarse sand
45	82+							45		
								50		Change to some disseminated gravel
								55		
									SP/GP	SAND/GRAVEL: Grading more gravel
								60	SP	SAND: Less gravel
									SP/GP	SAND/GRAVEL: Change to very gravelly
									ML	SILT: Grayish-brown
65	106+							65	SP/GP	SAND: Tan, very gravelly, fine to very coarse
										End of boring at 65 feet Water at 18 feet - no caving
								70		
								75		
								80		

AS BUILT

Date: 1-26-01 Corrections by: G. Pereda

Resident Engineer: Zaven Abrahamian

No Changes

* Percent
** Pounds per cubic foot
\+ SPT

REGISTERED PROFESSIONAL ENGINEER — JORA SARKISSIAN — No. 42890 — Exp. 3-31-00 — CIVIL — STATE OF CALIFORNIA

SIKAND ENGINEERING ASSOCIATES CONSULTING ENGINEERS 16230 BURBANK BLVD., VAN NUYS, CALIFORNIA 91406 (818)787-8550	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS DESIGN DIVISION STRUCTURES SECTION
DESIGNED BY: JORA SARKISSIAN	COMMERCE CENTER DRIVE OVER CASTAIC CREEK
DRAWN BY: ALBERT GEVORKIAN	LOG OF TEST BORINGS SHT. 2
PROJECT ENGINEER: JORA SARKISSIAN	REVIEWED: Steve M. Hennessee 11/24/97 STRUCTURAL SECTION DATE
	BRIDGE NO.: 3794 PROJECT NO.: SHT.: 14 OF: 15 DWG. NO.: 614599

"PB614599"

REVISIONS | CHECKED | DRAWN

LOG OF BORING 89-025-F6 BORING NO. WB-F5

SAMPLE DEPTH	BLOWS PER FOOT	MOISTURE CONTENT *	DRY UNIT WT **	WASH DEPTH	IN FEET	DESCRIPTION
					0	SURFACE CONDITION: Located in center of road ELEVATION: 980
					Af	FILL: Road surfaced with 3/4 inch gravel, base is locally derived sand and gravel
					SP	SAND: Tan, gravelly, fine to very coarse, graded layers 1 to 4 feet thick
					5	
					10	
					15	
					20	

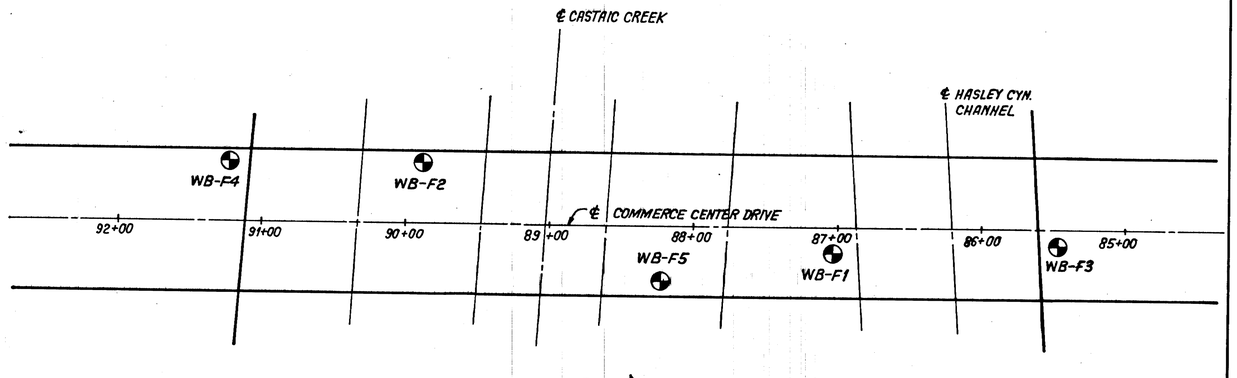
LOG OF BORING 89-025-F6 BORING NO. WB-F5

SAMPLE DEPTH	BLOWS PER FOOT	MOISTURE CONTENT *	DRY UNIT WT **	WASH DEPTH	IN FEET	DESCRIPTION
					40	Grades to gravelly
					45	
					ML	SILT: Medium brown
					SP	SAND: Tan, gravelly, fine to very coarse, weakly graded layers to 4 feet
					50	
					55	
60	64+				60	End of boring at 60 feet Water at 12 feet - no caving

LOG OF BORING 89-025-F6 BORING NO. WB-F5 (Cont'd)

SAMPLE DEPTH	BLOWS PER FOOT	MOISTURE CONTENT *	DRY UNIT WT **	WASH DEPTH	IN FEET	DESCRIPTION
20	30	12	115		20	
					ML 25	SILT: Reddish brown, clayey silt
					SP	SAND: Tan, gravelly to very gravelly, fine to very coarse in graded 1 to 5 foot layers
30	56+				30	
					35	
					GP/SP	GRAVEL/SAND: Change to cobbley, fine to medium
40	53+				SP 40	SAND: Change to minor gravel

* Percent
** Pounds per cubic foot
\+ SPT



APPROXIMATE LOCATION OF BORINGS

SCALE: 1"=50'

GEOTECHNICAL INVESTIGATION CONDUCTED BY

R.T. FRANKIAN AND ASSOCIATES
234 SOUTH BUENA VISTA STREET
P.O. BOX 7762
BURBANK, CALIFORNIA 91510-7762

AS BUILT

Date: 1-26-01 Corrections by: G. Pereda
Resident Engineer: Zaven Abrahamian
No Changes

PB614598

REVISIONS | CHECKED | DRAWN

SIKAND ENGINEERING ASSOCIATES
CONSULTING ENGINEERS
15230 BURBANK BLVD., VAN NUYS, CALIFORNIA
(818)787-8550 91411

DESIGNED BY: JORA SARKISSIAN
DRAWN BY: ALBERT GEVORKIAN
PROJECT ENGINEER: JORA SARKISSIAN

REGISTERED PROFESSIONAL ENGINEER — JORA SARKISSIAN — No. 42890 Exp. 3-31-00 — CIVIL — STATE OF CALIFORNIA

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION
STRUCTURES SECTION

COMMERCE CENTER DRIVE OVER CASTAIC CREEK

LOG OF TEST BORINGS SHT. 3

REVIEWED
Steve M. Hennessee 1/24/97
STRUCTURAL SECTION DATE

BRIDGE NO.: 3794
PROJECT NO.:
SHT.: 15 OF: 15
DWG. NO.: 614598