**SUBMITTED VIA ACCELA CITIZEN ACCESS ONLINE PORTAL**

August 26, 2022

Mr. Robert Eastwood, Senior Planner
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County of Santa Clara
County Government Center, East Wing, 7th Floor
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San Jose, California 95110-1705
E-Mail: Rob.Eastwood@pln.sccgov.org

Re: Updated 90% Design Plans and Associated Technical Memoranda
Permanente Creek Restoration Project

Dear Mr. Eastwood:

Lehigh Southwest Cement Company ("Lehigh") provides the enclosed updated 90% Design Plans and associated technical memoranda in furtherance of the County of Santa Clara's ("County") ongoing efforts to prepare a Supplemental Environmental Impact Report ("SEIR") for the Permanente Creek Restoration Project ("PCRP"). Specifically, Lehigh is providing:

- Updated 90% Design Basis Technical Memorandum
    - Includes Updated 90% Design Drawings (dated August 26, 2022)
    - Includes Updated Appendices
- Riparian Vegetation Impact Assessment

Since November 2019, when updated project design documents were submitted by Lehigh to the County, the County has engaged in significant discussions with relevant reviewing regulatory agencies regarding the scope of the PCRP, resulting in several iterations of correspondence and information exchange. The purpose of this submittal is to conform the design drawings and associated technical memoranda and documents with the totality of that correspondence, so that the documents utilized for the draft SEIR fully reflect discussions to date. Examples of that correspondence are as follows:

- In February 2022, an administrative draft of the Supplemental EIR was circulated by the County to relevant federal and state administrative agencies for review (*e.g.*, United States Army Corps of Engineers ("Army Corps"), United States Fish & Wildlife Service ("USF&WS") California Department of Fish & Game ("CDFW"), and the San Francisco

Regional Water Quality Control Board ("Regional Water Board")). The County met with those agencies in March 2022, and thereafter, the County provided Lehigh with feedback as to the comments received. The enclosed documents include information responsive to comments received.

- Between April 2021 and November 2021, the County and its consultants sent requests for information to Lehigh seeking additional technical information to support the preparation of the Supplemental EIR after the County solicited comments and feedback from the federal and state reviewing administrative agencies (these were called Requests for Information 1 – 3). Lehigh timely responded to those information requests and the enclosed documents incorporate these responses.

- In May 2021, the County received comments from federal and state reviewing administrative agencies on the Notice of Preparation (NOP) of the SEIR. The enclosed documents incorporate information responsive to comments received.

- In January 2020, the County provided Lehigh with a deemed complete letter associated with Lehigh's Grading Approval application. In Section II of that letter, the County provided comments from state and federal reviewing administrative agencies on elements of the PCRP. The enclosed documents incorporate information responsive to comments received.

Lehigh will be concurrently circulating these updated documents to the state and federal reviewing administrative agencies.

Please do not hesitate to contact me if you have any questions. We look forward to working with you further on the SEIR and this important creek restoration project.

Sincerely,

Carolina D. Addison

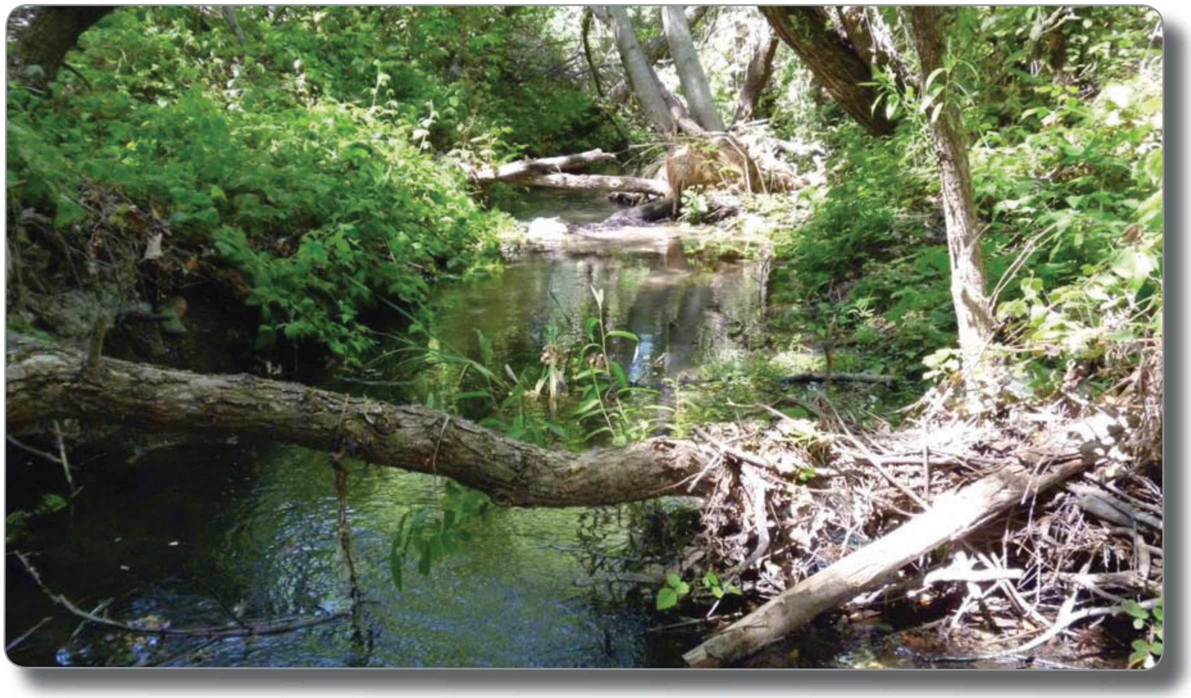
Carolina Addison
Director of Environment Land Resource Development
Lehigh Hanson, Inc.

cc: Nicole Granquist, Downey Brand LLP
Brent Zacharia, Waterways
Cindy Davis, GEI
George Wegmann, Golder
Paul Kos, Stantec

# PERMANENTE CREEK RESTORATION PLAN

## Updated - 90% LEVEL SUBMITTAL

### DESIGN BASIS TECHNICAL MEMORANDUM



*prepared for*

LEHIGH SOUTHWEST CEMENT COMPANY AND HANSON
PERMANENTE CEMENT, INC.

*prepared by*

WATERWAYS
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August 26, 2022

WATERWAYS CONSULTING, INC.

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# 1.0 INTRODUCTION

## 1.1 OBJECTIVES OF THIS MEMORANDUM

This technical memorandum has been prepared to describe stream restoration features presented in the "Permanente Creek Restoration Plan Updated 90% Design, Santa Clara County CEQA Review Submittal" drawings ("90% Designs"), dated August 26, 2022, and to document important design criteria, assumptions, and site constraints that have influenced their development. Sheet C2 of the 90% Designs provides an overview for locating project areas discussed in this memorandum. The August 26, 2022 Updated 90% Design drawings, among other things, update the existing topography surrounding the Rock Pile Area and Material Removal Area to reflect the recent May 2022 aerial survey of these areas, eliminate the need for installation of a retaining wall along the north toe of slope below Pond 1250 due to Lehigh's commitment to relocate Pond 1250 rather than leave it in place and require an extensive retaining structure in the creek and include additional project details responsive to reviewing agency comments on the project to date.

The Designs have been prepared, in part, to fulfill the requirements set forth in an Amended Consent Decree (Decree) between the Sierra Club and Lehigh Southwest Cement Company and Hanson Permanente Cement, Inc., lodged February 22, 2016, and to fulfill other regulatory obligations stemming from a 1999 Cleanup and Abatement Order issued by the San Francisco Regional Water Quality Control Board. The 90% Designs specifically address the Decree requirements under Section VI. "Creek Restoration". This memorandum and the 90% Designs comprise the "Complete 90 Percent Level Restoration Plan".

## 1.2 PROJECT GOALS AND OBJECTIVES

The primary objectives of the work, as set forth in the Decree, include the following:

- Increase quantity and quality of resident rainbow trout habitat through creation of pools, increased channel complexity and cover, and by fish passage through and between reaches consistent with a geomorphically stable, self-sustaining channel unless DFW Restoration Manual hydraulic design criteria cannot be met due to (1) the gradient of the reach, or (2) bedrock grade controls confirmed by an independent geologist;
- Improve riparian habitat, including improvement to channel and stream bank stability and ecological/geomorphic function;
- Remove mining-related fill and sediments in the bed, banks and adjacent slopes;
- Remove or alter man-made structures so as to improve riparian habitat;
- Layback creek banks and adjacent hill slopes to provide stable slopes sufficient to prevent fill from entering the creek;
- Require restoration that is no less stringent than any restoration that is approved or required by any agency, including but not limited to the Santa Clara County Planning Department, the DFW, and the Regional Water Board, and that is to be performed in a period of time no greater than any restoration that is approved or required by any agency, including but not limited to the Santa Clara County Planning Department, the DFW, and the Regional Water Board.

The 90% Designs address these broad objectives and comply with the more detailed reach-specific direction provided within paragraphs 34 through 42 of the Decree. Where feasible, the designs follow fish passage design approaches for resident rainbow trout, consistent with the California Department of Fish & Wildlife's "California Salmonid Stream Habitat Restoration Manual, 4th Edition (Vols. I-II, 2010)" ("DFW Restoration Manual").

It should be noted that the Restoration Plan has evolved considerably as designs have progressed beyond initial concepts. For example, a primary objective of the Restoration Plan as recently as 2014 was to modify Permanente Creek within the quarry property to allow the passage of anadromous salmonids. Following subsequent detailed analysis of existing and historic site constraints and consultation with resource agencies, anadromous fish passage has been removed as a design objective.

### 1.2.1 Introduction to Project Area & Types of Work

Sheets C2 and C4 of the 90% Designs provide an overview of the proposed work area in both plan and profile. For continuity and ease of comparison, we have retained the original reach designations provided in the URS Permanente Creek Long-Term Restoration Plan (URS 2011). However, the project area overview stream stationing has been revised to reflect the results of a more accurate stream centerline survey performed in the summer of 2013.[1] The work is presented in the drawings proceeding from the downstream to upstream limits. There are generally five major component project areas, as shown on Sheet C2, which include:

- Concrete Channel
- Channel Widening Area
- Rock Pile Area (which is included in the Channel Widening Area)
- "Old Crusher Foundation"
- Material Removal Area

Restoration work proposed at each area includes the following design elements and objectives:

Concrete Channel (Sheet L1)

- Encourage development of mature riparian canopy along the southern bank to shade the concrete channel to reduce solar heat gain on instream flow and discourage the establishment of tules;
- Preservation of existing native vegetation;
- Removal of non-native species and suppression of weeds around existing native seedlings and smaller native plants to encourage their establishment; and
- Installation of native vegetation.

Channel Widening Area (Sheets C11-C18)

- Removal of concrete road segments;
- Construction of floodplain bench areas with habitat elements and reduction of access road width;
- Removal of 260 linear feet of culverts, including a road crossing, and daylighting the creek to improve fish passage conditions and ecological complexity;

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[1] Note: Design alignments and stationing at individual project sites differ from the 2013 stream centerline survey because the design alignments have been oriented to the proposed features shown on the drawings.

- Installation of large woody debris (LWD) at the Culvert 7 and Culvert 8 removal sites.
- Removal of old tractor tires along streambanks at a culvert removal site;
- Removal of imported sediment from the bed and banks of a tributary reach;
- Select removal of rock slope protection (RSP) and concrete rubble bank protection at an area that now has adequate mature riparian vegetation that is providing root reinforcement to bank soils;
- Removal of the idled Rock Plant conveyor system and associated infrastructure; and
- Installation of native vegetation.

Rock Pile Area (Sheets C19-C21)

- Removal of concrete road segments and road-related fill material;
- Removal of 930 linear feet of culverts and daylighting of the creek that will help improve fish passage conditions and ecological complexity;
- Construction of a new channel with floodplain bench areas with habitat elements that will help improve fish passage conditions and ecological complexity;
- Removal of Rock Pile, idled Rock Plant conveyor system and associated infrastructure;
- Removal of Pond 13 dam infrastructure;
- Construction of a restored channel through the abandoned Pond 13; and,
- Installation of native vegetation.

"Old Crusher Foundation" (Sheet C22)

- Cutting back the concrete block that is projecting into the channel to better conform to the natural creek bank.

Material Removal Area (Sheets C23-C26)

- Removal of overburden/fill and a relic concrete structure and moving the north toe of slope northward 25 feet along the majority of the project area. Pond 4A is decommissioned. Lehigh will relocate Pond 1250 and the Upper Treatment Facility, as needed.
- Construction of a new channel with floodplain bench areas with habitat elements that will help improve fish passage conditions and ecological complexity, and
- Installation of native vegetation.

## 2.0 BASIS OF DESIGN

There are numerous considerations that contribute to the design of a successful stream restoration project. Initial design efforts typically include researching features of the project setting such as site geology, regional climate, basin hydrology, topographic features, and vegetation. These features and others are considered in light of project goals and objectives to develop opportunities and constraints and design alternatives. As design alternatives gel into a preferred project, calculations begin to inform the project details. The following sections provide an overview of important site features and design criteria that have shaped the project and describe the calculations that have been used to design specific project elements.

## 2.1 HYDROLOGY

### 2.1.1 Peak Flow Hydrology

The determination of design peak flow values is critical to the process of analyzing erosive forces on proposed bed and bank stabilization elements, understanding sediment transport and scour potential, and assisting with the specification of appropriate channel geometry.

Design flows were derived from a hydrologic analysis prepared by the Santa Clara Valley Water District (SCVWD) and presented in a report titled "Santa Clara Valley Water District Stevens and Permanente Creeks Hydrology Report" (Wang et al, 2007). Peak flow values published by the SCVWD for Permanente Creek were developed using a rainfall-runoff model. Rainfall data used in the model were derived from a weighted average of precipitation data collected at gaging stations throughout the area. Other model parameters included loss rates, time of concentration estimates, and routing coefficients.

Design flows were calculated for the four drainage areas at the site (Figure 1) by normalizing SCVWD's published values for Upper Permanente Creek (drainage area = 4.01 sq.mi.) upstream of the confluence with the West Branch Permanente Creek. Normalization was performed using a ratio of the project site's drainage area compared to the total area above the confluence (4.01 sq. mi.) and then relating to the SCVWD's published peak flow values (Table 1). The 1.5-year flow event was calculated by extrapolating values using a log-normal trend-line plotted through the data.

**Table 1. Summary of Peak Flows (cfs)**

| **Recurrence Interval** | **Santa Clara Valley Water District Upper Permanente Creek Peak Flow Rates (Drainage Area = 4.01 sq. mi.)** | **Project Site (Drainage Area A = 3.5 sq.mi.)** | **Project Site (Drainage Area B = 3.01 sq.mi.)** | **Project Site (Drainage Area C = 2.7 sq.mi.)** | **Project Site (Drainage Area D = 2.02 sq.mi.)** |
|---|---|---|---|---|---|
| 1.5-year | N.A. | 284 | 244 | 219 | 164 |
| 2.33-year | 450 | 393 | 338 | 303 | 227 |
| 5-year | 730 | 637 | 548 | 492 | 368 |
| 10-year | 970 | 847 | 728 | 653 | 489 |
| 25-year | 1,300 | 1,135 | 976 | 875 | 656 |
| 50-year | 1,500 | 1,309 | 1,126 | 1,010 | 757 |
| 100-year | 1,700 | 1,484 | 1,276 | 1,145 | 858 |
| **Applicable Stream Reaches** | **Not Applicable** | **R1-R6[1]** | **R6-R8[2]** | **R9-R15** | **R16-18** |

[1] The drainage area extends into a portion of Reach 6, ending at the Concrete Channel downstream of Culvert #2.

[2] The drainage area includes a portion of Reach 6, beginning at Culvert #2.

### 2.1.2 Fish Passage Hydrology

The California Department of Fish and Wildlife (CDFW) prescribe upper and lower fish passage "design flows" for juvenile and adult rainbow trout. The design flows represent flow rates at which certain hydraulic parameters (*e.g.*, depth, velocity) must be met to consider a reach "passable" by fish. Where flow duration data is available or can be modeled, the upper fish passage design flow is equal to the 5% annual exceedance flow for adult rainbow trout (*i.e.,* adult non-anadromous salmonids) and the 10% annual exceedance for all juvenile salmonids. These flows represent the mean daily flow that is likely to be exceeded 5% or 10% of the time, respectively, in an average year. Similarly, the lower fish passage design flow for adult rainbow trout is equal to the greater of either the 90% annual exceedance or 2 cfs. For juveniles, it is the greater of either the 95% annual exceedance or 1 cfs (CDFW 2003).

Flow duration data for the project were developed from mean daily flows recorded at USGS gaging station 11166000 (Matadero Creek at Palo Alto). This gage is located seven miles north of the project site in a watershed with similar topography and average annual precipitation. We evaluated approximately 65 years of mean daily flow data, from October 1952 to August 2017. Exceedance flows calculated for the gage site were normalized by drainage area to estimate the fish passage flows at the project sites (Table 2). Detailed fish passage design flow calculations are included in Appendix A.

**Table 2. Summary of Fish Passage Flows (cfs)**

| **Design Flow / Species and Life Stage** | **Percent Exceedance** | **USGS Gage (11166000)**<br>**Drainage Area =7.26 sq.mi.** | **Project Site**<br>**Drainage Area A = 3.5 sq.mi.** | **Project Site**<br>**Drainage Area B = 3.01 sq.mi.** | **Project Site**<br>**Drainage Area C = 2.7 sq.mi.** | **Project Site**<br>**Drainage Area D= 2.02 sq.mi.** |
|---|---|---|---|---|---|---|
| Low Flow Juvenile Salmonids | 95% | 0 | 1* | 1* | 1* | 1* |
| Low Flow Adult Non-Anadromous Salmonids | 90% | 0 | 2* | 2* | 2* | 2* |
| High Flow Juvenile Salmonids | 10% | 3.5 | 1.7 | 1.5 | 1.3 | 1 |
| High Flow Adult Non-Anadromous Salmonids | 5% | 9.9 | 4.8 | 4.1 | 3.7 | 2.8 |
| **Corresponding Stream Reaches** | **--** | **Not Applicable** | **R1-R6[1]** | **R6-R8[2]** | **R9-R15** | **R16-18** |

* The alternative low fish passage design flows of 2 cfs and 1 cfs were adopted for the adult non-anadromous salmonid and juvenile salmonid fish passage analyses, respectively.

[1] The drainage area extends into a portion of Reach 6, ending at the Concrete Channel downstream of Culvert #2.

[2] The drainage area includes a portion of Reach 6, beginning at Culvert #2.

## 2.2 GEOMORPHIC DESIGN BASIS

Successful channel restoration requires an understanding of suitable channel geometries (*e.g.*, bankfull width and depth), longitudinal gradients, and step and pool spacing and size for a particular geomorphic context and hydraulic regime. Among other things, appropriate channel geometric design helps to ensure sediment transport continuity through constructed reaches and appropriately distributes shear stresses across the channel bed and floodplain areas during floods. It is also important to have a firm understanding of flood hydraulics to size bed and floodplain material appropriately to ensure short-term channel stability while vegetation becomes established, and long-term stability within the active channel where vegetation will be absent.

This project includes the design and reconstruction of the channel bed and banks at multiple locations - Culverts #7 and #8 within the Channel Widening Area, and the Rock Pile and Material Removal Areas. To assist with developing appropriate channel geometry, we evaluated existing datasets for gaged sites located in the Santa Cruz Mountains to help develop relationships for bankfull width and depth as a function of watershed area. We also surveyed and evaluated geometry data from four nearby "reference" channel reaches, where the channel is considered to be "natural". This includes two analog channels (within Swiss Creek and Corte Madera Creek) identified as having watershed and geomorphic characteristics similar to Permanente Creek (URS, 2011) and two channel segments located in the upper Permanente Creek watershed within Reach 20. The channel geometry of the reference reaches was incorporated into the dataset for the regional geometry developed from the gaged sites to refine bankfull channel dimensions for the project area. An overview of how bankfull channel dimensions were developed for the reconstructed channel segments is included in Appendix B, Permanente Creek Restoration – Regional Hydraulic Geometry and Analog Channel Assessment. A summary of the bankfull channel dimensions is included below in Table 3. Minimum and maximum bankfull dimensions are provided for design slope ranges to provide for variability and flexibility during channel construction. The bankfull dimensions have also been included on the appropriate design drawing sheets included in the 90% Designs.

**Table 3. Proposed Channel Dimensions for Constructed Reaches**

| Project Site | Design Slope (%) | Design Slope Range (%) | Proposed Bankfull Width Min (ft) | Proposed Bankfull Width Max (ft) | Proposed Bankfull Depth Min (ft) | Proposed Bankfull Depth Max (ft) | Cross Sectional Area Min ($ft^2$) | Cross Sectional Area Max ($ft^2$) |
|---|---|---|---|---|---|---|---|---|
| Culvert 7 | 4.3% | 4%-8% | 16.5 | 20.5 | 2.1 | 2.5 | 28.2 | 34.2 |
| Culvert 8 | 2.7% | <4% | 18.0 | 22.0 | 1.9 | 2.3 | 28.2 | 34.2 |
| Rock Pile Area | Varies | <4% | 17.5 | 21.5 | 1.8 | 2.2 | 26.9 | 32.9 |
| | | 4%-8% | 16.0 | 20.0 | 2.0 | 2.4 | | |
| | | >8% | 15.5 | 18.5 | 2.4 | 2.8 | | |
| Overburden Removal Area | Varies | <4% | 16.0 | 20.0 | 1.7 | 2.1 | 22.5 | 28.5 |
| | | 4%-8% | 14.5 | 18.5 | 1.9 | 2.3 | | |
| | | >8% | 14.0 | 17.0 | 2.3 | 2.7 | | |

An evaluation of pool and step dimensions and spacing was also conducted. Data from the reference reach channel surveys and the 2013 Permanente Creek channel survey was used to help inform pool design geometry. A review of literature related to channel morphology and bed profile arrangements was used to refine the pool design geometry and incorporate steps into the channel forms at the Rock Pile and Material Removal Areas. A summary of the proposed pool and step dimensions and spacing are included in Table 4. Sheet C34 includes tables with pool and step dimensions and spacing for the Rock Pile and Material Removal Areas. Sheet C34 also includes typical details demonstrating how the pools and steps will be constructed. The Culvert #7 and #8 removal sites are relatively short and include a single pool each. The pool dimensions are shown on the respective culvert removal area design profiles (Sheets C11 and C15).

**Table 4. Pool and Step Dimensions and Spacing**

| **Average Channel Slope** | **Pool Geometry** | | | | | **Step Geometry** | | |
|---|---|---|---|---|---|---|---|---|
| | **Pool Length (ft.)** | **Pool Depth (ft.)** | **Drop Height (ft.)** | **Pool Spacing (ft.)** | **Pool Spacing (bankfull widths)** | **Step Drop (ft.)** | **Step Spacing (ft.)** | **Step Spacing (bankfull widths)** |
| 4% - 8% (Step-Pool Channel) | 10 – 20 | 0.5 - 2 | 0.5 – 1 | 30 – 120 | 2 - 6 | 0.5 – 1 | 8 - 20 | 0.5 - 1 |
| 8% - 12% (Cascade Channel) | 6 - 13 | 0.5 - 2 | 0.5 - 1 | 28 - 75 | 2 - 4 | 0.5 – 1 | 6 - 13 | 0.4 – 0.8 |

## 2.3 HYDRAULIC ASSESSMENT

### 2.3.1 Approach to Fish Passage Evaluation

The improvement of passage conditions for resident rainbow trout is a primary goal of the proposed work. Within the various project reaches, we have attempted to meet this goal through a combination of channel and floodplain enhancements. The nature and extent of these enhancements varies by reach, and each location requires a carefully considered approach to the design and analysis of fish passage elements. Our design basis and methodology are outlined below.

CDFW allows for varying approaches to analyzing fish passage within natural or constructed channels. The "Stream Simulation Method" consists of constructing a channel that mimics geomorphically similar adjacent reference reaches. The Stream Simulation Method works on the premise that a constructed channel that mimics adjacent natural reaches will present no more of an obstacle to passage than the adjacent natural channel.

The "Hydraulic Design" approach allows for construction of a channel geometry that has been proven through modeling to meet specific hydraulic design criteria. For channels designed using Hydraulic Design methods, CDFW provides general guidelines prescribing minimum water depths, maximum velocities, and maximum hydraulic drop heights (Table 5). Projects designed using the Hydraulic Design Method must satisfy these criteria throughout the full range of fish passage design flows.

| Table 5. Fish Passage Design Criteria | | | |
|---|---|---|---|
| Species and Life stage | Minimum Flow Depth (ft) | Maximum Water Velocity (ft/s) | Maximum Drop (ft) |
| Adult Non-Anadromous Salmonids | 0.67 | 2 [1] | 1 |
| Juvenile Salmonids | 0.5 | 1 | 0.5 |

[1] *2 ft/s for culverts or riffles between pools greater than 200 feet long.*

Each of these methods has its limitations. For instance, the Hydraulic Design method is not recommended where profile grades exceed approximately 5%. The Stream Simulation Method is not recommended where adjacent reaches are disturbed or where sediment supply or transport has been significantly altered from natural conditions, which is the case throughout the project area. For these reasons and others, the direct application of these methods has proven difficult at many locations throughout the project area.

Our approach has been to use Hydraulic Design methods to analyze fish passage conditions where the profile gradient is relatively low and where hydraulic design standards for fish passage can be achieved within the recommended range of applicable channel profile gradients. These areas include Reaches 8-10.

Where average profile gradient exceeds that recommended for the Hydraulic Design method (Reaches 11-18), we have designed a channel based upon analogs from less-disturbed reaches within and near to the Permanente Creek Watershed. The objective of channel design within these reaches is the creation of a geomorphically appropriate and stable channel that enhances opportunities for fish passage where feasible. However, the presence of bedrock may ultimately dictate channel geometry and dependent fish passage characteristics at many locations. We have evaluated velocity and depth within these steeper reaches to determine if the Hydraulic Design criteria for fish passage are satisfied, as discussed in the following section.

Although the proposed project does not provide optimal passage opportunities along its entire length, resident rainbow trout passage is still a primary objective of the work. Numerous constraints make it difficult to create optimal fish passage conditions within the project area, or even to meet established minimum performance standards. Some of these constraints include:

- Reaches with historically high gradients prior to development of the quarry (>10%);
- The presence of natural bedrock drops exceeding 6 feet in height; and
- Highly unstable reaches with excessive bed load.

Where these constraints exist, we have done our best to optimize passage and habitat benefits, while considering the need to ensure the following:

- Maintenance of channel, bank, and floodplain stability;
- Maintenance of flood conveyance (where infrastructure is present);
- Protection of public safety;
- Preservation and protection of existing critical infrastructure; and
- Preservation of existing mature riparian vegetation, where feasible.

One of the greatest challenges to the development of the Designs has been a lack of knowledge of the extent to which past anthropogenic disturbances at the site may have altered the original channel geometry, and as a result, fish passage conditions. Within Reaches 11-12 and 17-18, it appears that the channel profile has been altered through the placement of fill. The designs lower the profile in these reaches to remove culverts and/or fill material to establish a profile grade more closely following what existed prior to disturbance, a portion of which will likely follow bedrock. The resulting profile grades are still quite steep, averaging up to 12% in portions of Reach 11 and up to 22.7% in portions of Reach 17.

The design profiles at these locations are based on a best fit to subsurface bedrock locations that were identified through a seismic refraction study (Appendix C), and later refined at the Rock Pile Area based on exploratory borings. In order to avoid alternating steep chutes or drops and low gradient segments, and optimize fish passage potential, the design attempts to follow an average grade that connects the high points of the bedrock profile rather than following it continuously. It is likely that the original channel would have followed a more irregular profile with exposed bedrock at pinch points and steepened reaches, as seen at other less disturbed reaches within the project area (*e.g.,* reaches 15 and 16). A process has been outlined to further evaluate the geometry of bedrock in the field during construction and make field adjustments allowing the proposed channel to conform to uncovered areas of bedrock. For instance, the minimum design profile grade upstream of bedrock controls will be set to 4% and the maximum constructed profile grade between bedrock outcrops will not exceed 12%. For further details, see the “Field Engineering Notes” included on Sheet C40 of the 90% Designs..

Individual project components or areas are discussed in detail within Section 2.7. Within each section, we have provided a summary of the ability of the design to meet recommended fish passage criteria.

#### 2.3.1.1 *Assessment of Fish Passage within Constructed Channel Reaches*

Manning’s equation is the primary method we used to determine depths and average velocities within the constructed channel sections under design fish passage flows to evaluate compliance with the fish passage criteria listed in Table 5[2]. Fish passage was evaluated at the following locations where channel bed modifications or reconstruction is proposed:

- Culvert #7;
- Culvert #8;
- Rock Pile Area; and
- Material Removal Area.

Proposed channel gradients are less than 4% at Culverts #7 and #8. Fish passage design criteria were evaluated using the Hydraulic Design Method at these locations.

The maximum average gradient at which a restored channel segment will be constructed at the Rock Pile and Material Removal Areas is 12%. This maximum gradient has been established by the guidelines included in the Field Engineering Notes (Sheet C40). As discussed above, 12% is considerably steeper than the 5% maximum profile grade that is recommended for application of the Hydraulic Design

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[2] Design fish passage criteria were evaluated within channel sections where the channel bed and lower banks would be modified. The portions of Permanente Creek where only a floodplain bench would be constructed along the main channel (e.g. Channel Widening Area) were not evaluated.

method. We evaluated hydraulic parameters of a 12% channel for comparison to fish passage design criteria established under the Hydraulic Design method to determine if the fish passage design criteria would still be met.

Manning's equation is a universally accepted method for determining relationships between depth, velocity, and channel geometry (*e.g.*, shape, size and roughness of the channel) for open channel flow conditions. Calculations were performed using the "Hydraflow Express" extension of AutoCAD Civil 3D. Parameters used in the equation include:

- Discharge;
- Channel bed slope;
- Hydraulic radius; and
- Manning's roughness coefficient.

The roughness coefficients were estimated using depth-based roughness equations applicable to the proposed channels (Mussetter, 1989). Refer to Appendix E for detailed calculations.

Hydraulic calculations for the constructed channel sections are also presented in detail within Appendix D. The modeled cross section geometry incorporates boulders that will protrude above the channel bed to take into account cracks between rocks that fish can use for moving between reaches. Results indicate that depth and velocity criteria would be satisfied over the range of design fish passage flows described in Section 2.1.2 "Fish Passage Hydrology". It should be noted that within steep (>6-8%) portions of the reconstructed channel, it will be impossible to avoid post-construction channel adjustments and the reorganization and associated formation of steps, chutes, and pools, the geometry of which cannot be accurately predicted. Further, the channel will likely conform to bedrock outcrops in some locations, which may dictate cross section and profile geometry in ways that we cannot anticipate.

Fish passage flows were also modeled using HEC-RAS to generate water surface profiles and velocity profiles for existing and proposed conditions, as requested by the reviewing agencies. This was completed for the two locations where the channel bed will be reconstructed and the Field Engineering Notes (Sheet C40) do not apply - Culvert #7 and Culvert #8 removal areas within the Channel Widening Area. The culverts will be removed and the channel will be reconstructed as shown on the drawings. Reconstruction of the channel at these two locations greatly improves fish passage conditions. See Section 2.3.2.2 below for a summary of model results. Since there is uncertainty regarding the post-project channel profile within the Rock Pile and Material Removal Areas due to the unknown depth to bedrock, it does not seem relevant to present existing versus proposed HEC-RAS results. If bedrock is encountered the constructed profile could be very steep (>12%) and potentially include significant vertical drops of several feet.

Qualitatively, it is apparent that removal of Culverts #10 and #11 at the Rock Pile Area and the construction of an open channel will improve fish passage opportunities within this channel segment. This, of course, assumes that significant drops over bedrock or bedrock chutes are not uncovered once the culvert is removed.[3] Culverts with a low Manning's n value will be replaced with open channels constructed using Engineered Streambed Material (ESM) with increased hydraulic roughness. This

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[3] See the Field Engineering Notes on Sheet C40 of the 90% Designs for a description of how the channel will be constructed if bedrock is encountered.

changed condition will both reduce flow velocities and increase flow depth, along with providing improved habitat and hydraulic complexity. The coarse-grained ESM will provide areas of velocity shadowing behind large boulders, and cracks and small pools between boulders with increased flow depths and resting areas that will provide more conducive conditions for fish passage under proposed conditions. See Section 2.3.2.2 for a discussion of the HEC-RAS model results that predict improved fish passage conditions once Culverts #7 and #8 are removed and the channel bed is reconstructed.

We could not locate a resource that estimates the maximum sustained channel slope that will be a barrier to upstream passage of resident rainbow trout. However, studies show that adult anadromous salmonids can navigate steeper slopes than resident rainbow trout (Coastal Conservancy 2004). Considering this, CDFW has identified a sustained slope of greater than 8% as a barrier to anadromy (CDFW, 2009). Therefore, it is reasonable to assume that sustained slopes of 8% are a barrier to resident rainbow trout passage. The Washington Department of Transportation considers a slope of 12% for >160 meters as the cutoff for anadromous passage. We have provided passage calculations for reaches up to 12% average profile gradient, although extended reaches at this slope are likely too steep for resident rainbow trout to navigate, especially given the likelihood of channel adjustments and bedrock exposures discussed above.

### 2.3.2 Channel Hydraulics

Having a good understanding of channel hydraulics is important for developing designs that will provide the intended instream habitat complexity while also providing channel stability during the first few years following construction, until vegetation becomes established. Peak flood hydraulic modeling was conducted using HEC-RAS 5.0.4 river analysis software, developed by the United States Army Corps of Engineers (USACE). Modeling results were used to confirm that appropriate bankfull channel dimensions have been incorporated into project designs, to assist with sizing surface treatments (*e.g.*, engineered streambed material) to provide channel stability and erosion protection, and to ensure infrastructure and access roads won't be significantly impacted by the 100-year flood.

#### 2.3.2.1 *Peak Flood Modeling (1D HEC-RAS)*

Two separate HEC-RAS models have been developed for the project. One model was prepared for the Channel Widening and Rock Pile Areas since they are integrally connected, and a separate model was developed for the Material Removal Area because it is located more than 3,000 feet upstream of the Rock Pile Area. The existing conditions models were developed using topography from detailed surveys conducted at both areas by Waterways between 2013 and 2015. Proposed condition channel geometry was developed by importing the design grade topography into the existing conditions model and adding additional sections as necessary to model areas where culverts are proposed for removal. The Channel Widening and Rock Pile Area model extends over approximately 6,500 linear feet of channel, beginning just downstream of Culvert #2, and extending approximately 400 feet upstream of Pond 13. The Material Removal Area model extends over approximately 2,900 feet, beginning over 500 feet downstream of the Upper Treatment Facility located on the north bank approximately twenty feet above the channel and extending approximately 400 upstream of the proposed restoration limits. Overview figures have been prepared for each of the models and are included in Appendix E.[4] The first

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[4] The HEC-RAS models extend beyond the limits of the proposed work to account for downstream conditions that could affect hydraulics within the proposed restoration areas. Because of this, design stationing does not match stationing used in the HEC-RAS models. To assist with comparison between HEC-RAS and the design drawings,

two figures show the locations of the cross sections included in the model for the Channel Widening and Rock Pile Areas. The third figure shows the location of the cross sections included in the model for the Material Removal Area.

Roughness values (Manning's n) were chosen from field-based observation of the channel and floodplains for existing conditions. The United States Geological Survey (USGS) "Roughness Characteristics of Natural Channels" report was used to aid in the selection of roughness values for proposed conditions. The report includes descriptive data and photographs for fifty different stream channels for which roughness coefficients have been determined.

Boundary conditions were set using the normal depth method and are included in Appendix E. The upstream and downstream boundary conditions were set to match the slope of the energy grade line at these respective locations, which roughly matches the channel slope.

### 1.5-Year Flood Model

The 1.5-year flood was evaluated to confirm that the bankfull geometry for the Rock Pile and Material Removal Areas developed in the "Permanente Creek Restoration – Regional Hydraulic Geometry and Analog Channel Assessment" included in Appendix B, is appropriate for the constructed channel segments. This modeled flow was also used to assist with determining the channel-side design elevation of the floodplain bench along the Channel Widening Area. Graphical outputs of water surface profiles are included in Appendix E. Results for existing and proposed conditions have been included per the request of the reviewing agencies. The profile outputs include a profile of the channel-side design elevation of the floodplain bench to demonstrate that the design elevations of the floodplain benches are near the 1.5-year water surface elevation. Detailed output tables that include flow depth, velocity, and top width for both existing and proposed conditions have also been included in Appendix E.

### 10-Year Flood Model

The 10-year flood was evaluated to assist with establishing the upper limits of floodplain armor throughout the project area. Floodplain armor will be placed over constructed benches up to approximately the 10-year water surface elevation to provide erosion protection while vegetation becomes established. Results for existing and proposed conditions have been included per the request of the reviewing agencies. Graphical outputs of 10-year water surface profiles are included in Appendix E. Detailed output tables that include flow depth, velocity, and top width for both existing and proposed conditions have also been included in Appendix E.

### 100-Year Flood Model

The 100-year flood was evaluated to assist with designing surface treatments to ensure reconstructed channel areas remain stable, and that floodplain benches remain stable while vegetation becomes established. It was also used to evaluate the potential for erosion above the limits of floodplain armor, which has been set to approximately the 10-year water surface elevation, and whether the proposed angular rock vehicle barrier along the Channel Widening Area would remain stable at locations where bank overtopping will occur. See Section 2.4 below for design details related to surface treatments.

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HEC-RAS stationing for the Channel Widening and Rock Pile Area model includes the design stationing plus 100+00. The Material Removal Area model includes the design stationing plus 10+00.

Graphical outputs of 100-year water surface profiles under existing and proposed conditions are included in Appendix E. Detailed output tables that include flow depth, velocity, and top width for both existing and proposed conditions have also been included in Appendix E.

Angular Rock Vehicle Barrier Assessment

At locations where bank overtopping flows will run along the rock vehicle barrier, the maximum velocity of the overtopping flow was determined to be 5 ft/sec. with a flow depth of approximately 1.2 feet and a maximum shear stress of 4.5 lbs/ft$^2$. This occurs for approximately 50 linear feet near the upstream end of the Channel Widening Area (HEC-RAS Station 144+50) where the proposed floodplain bench narrows and the height of the bank between the bench and access road is reduced.

Overtopping flow that occurs at discrete locations along the Channel Widening Area has velocities that range from 0.3 – 5.0 ft/sec with an average velocity of 2.9 ft/sec. Six-inch diameter cobbles can resist flow velocities up to 10 ft/sec and shear stresses of 2.5 lbs/ft$^2$ (Fischenich 2001). The vehicle barrier will be composed of 4 to 8-inch diameter angular rock along most of its length, which is more stable than sub-rounded to rounded cobble. To protect against mobilization at the area of maximum velocity the vehicle barrier will be composed of 10 to 16-inch dimeter angular rock, which can resist flow velocities up to 13 ft/sec and shear stresses of 5.1 lbs/ft$^2$ (Fischenich 2001). A summary of the overtopping locations, flow depths, and velocities are included in Appendix E. Overtopping flow velocities were determined using the velocity distribution module in HEC-RAS, which provides a graphical output of flow velocities across a given cross section. A cross section velocity output for each section where overtopping occurs is included in Appendix E.

### 2.3.2.2 *Fish Passage Hydraulics at the Culvert #7 and #8 Removal Areas*

Fish passage has been assessed at the Culvert #7 and #8 removal areas within the Channel Widening Area where the channel bed and banks will be reconstructed as shown on Sheets C11 and C15. Results of the modeling effort are included Appendix E. Water surface profiles and velocity profiles for adult and juvenile high and low design flows are presented in the appendix as well. As can be seen, flow depths are increased, and velocities are reduced under proposed versus existing conditions along the length of proposed channel reconstruction. The HEC-RAS results document that flow depths and velocities meet fish passage design criteria along the reconstructed channel segments at all locations within the culvert removal areas, except that flow depths are slightly below the design criteria listed in Table 5 for both adult and juvenile low flows at the upstream end of the Culvert #7 removal area. The adult low flow depth is 0.50 ft. versus 0.67 ft. and the juvenile depth is 0.37 ft. versus 0.5 ft. However, unlike the Manning's at a section calculations (Appendix D), the model does not account for cracks within the boulders that will occur within the engineered streambed material. These cracks will provide additional depth for fish to utilize for passage. Fish passage design criteria are not necessarily met outside the culvert removal areas shown on the profile plots, where active channel geometry reverts to existing conditions.

### 2.3.2.3 *Model Calibration and Sensitivity Analysis*

Model calibration has not been possible because no gauge data correlating water surface elevations to discharge rates is available in the project area for the design peak flood recurrence intervals. Golder Associates (Golder) maintained stream gauges in the project area during the 2017-2018 and 2018-2019 winters. However, measured peak flow rates were well below the 1.5-year recurrence interval flood (35 cfs vs. 284 cfs) during this time period.

The main aspects of the design that the model has been used for are sizing of the various rock materials specified for the project, determining the upper limit of the rock placements, establishing the floodplain bench elevation at the Channel Widening Area and evaluating the 100-year water surface elevation. The design bankfull channel dimensions where complete reconstruction of the channel bed is proposed are based on geomorphic criteria developed through evaluating nearby reference reaches. However, the model was used to confirm the design bankfull dimensions are reasonable relative to expected flows.

As a means to assess the sensitivity of the hydraulic model and evaluate implications for assumptions related to chosen Manning's roughness values we varied n-values by +10/-10 percent. Manning's n-values account for channel roughness due to irregularities in channel bed and bank forms, bed material size and natural debris in the channel, and vegetation. Small changes in n-values have the potential to affect the modeled water surface elevations and flow velocities. As n-values decrease flow depths typically decrease and velocities increase. The opposite is true for increases in n-values.

Chosen n-values for this project have the potential to effect floodplain bench design elevations at the Channel Widening Area, where reconstruction of the bed is not proposed, and criteria from the analog study at nearby references reaches is not relevant. Altering the n-values by +10/-10 percent generally resulted in the change of water surface elevations by less than 0.3 tenths of a foot along the project reaches for the 1.5-, 10-, 100-year peak flows, with the average change in water surface being less than (+/-) 0.1 tenth of a foot. This level of variability is within the tolerance for which the channel features will be constructed and is not considered significant. Results from the sensitivity analysis performed on the Channel Widening to Rock Pile hydraulic model are included in Appendix E.

We found the sensitivity analysis to have a limited effect on the proposed rock sizing. Rock slope protection (RSP), engineered streambed material (ESM), and floodplain armor sizing equations are based on flow velocity, with velocity explicitly included in the RSP calculations and the design flow (Q) over a given channel width (e.g., bankfull width) included in the ESM and floodplain armor calculations (see Appendix F). As expected, decreases in n-values resulted in high flow velocities, which in turn has the potential to result in larger rock sizing if the increase in velocity is significant enough. The opposite is true for increases in n-values. We found that the variation of n-values was not significant regarding RSP sizing, and that the calculations still resulted in rock size classes falling within the size range of the Caltrans Standard Specifications for RSP that were determined using the initial model inputs for channel roughness. We also found that the variation of n-values did not result in any significant differences in ESM or floodplain armor size. We have included the RSP calculations in Appendix F for reference.

### 2.3.3 Sediment Transport

The project has been designed to help maintain sediment transport continuity while creating depositional zones on the extensive floodplain areas that will be constructed as part of project implementation. As discussed above, proposed bankfull channel dimensions at each of the reconstructed reaches have been informed by a reference reach study and would vary as channel slope changes. Appropriately sized bankfull dimensions that adjust with changes in the channel profile slope will assist with sediment transport continuity through the reconstructed channels. See Table 3 for proposed bankfull dimensions based on channel slope. To help maintain sediment transport continuity and channel stability upstream of bedrock controls encountered at the Rock Pile and

Material Removal Areas, the minimum design profile grade at these areas will be set to 4 percent, as outlined in the Field Engineering Notes (Sheet C40).

Constructed floodplain areas will provide depositional zones for fine sediment and smaller coarse material when flood flows occur. Floodplains constructed along the Channel Widening Area will serve as a depositional area for fine sediment that will be mobilized from the Rock Pile and Material Removal Areas during the first couple of years after their construction, as floodplain and riparian vegetation become established.

## 2.4 SURFACE TREATMENTS AND GRADE CONTROL ELEMENTS

Surface treatments and grade control elements have been included throughout the project area to ensure that the channel and newly constructed surfaces remain stable against erosive forces. Surface treatments and grade control elements include:

- Engineered streambed material (ESM) that will be used as channel substrate where the bed is reconstructed.
- Floodplain armor to protect newly constructed floodplain surfaces.
- Vegetated rock slope protection to protect newly constructed streambanks that are steeper than 2H:1V and the area adjacent to the Culvert #6 inlet.
- Boulders sills that will periodically extend across the proposed floodplains to serve as grade control if significant erosion were to occur along floodplain areas.
- Boulder weirs that will be incorporated into the ESM and keyed into the floodplain armor to provide grade control at locations of energy dissipation where channel flow plunges into pools.
- Vegetation, which includes live willow stakes, container plants and seeding to provide rooting strength to help reinforce substrate along the channel, at floodplain and riparian areas, and on newly, constructed creek banks.
- Erosion control BMPs (e.g. fiber rolls).

### 2.4.1 Engineered Streambed Material (ESM)

Throughout the Designs, we have specified the placement of engineered streambed material (ESM) within the bed of the reconstructed portions of the channel. ESM is a term derived from the CDFW Design Guidelines and refers to a well-graded mixture of boulders, cobble, gravel, sand, and fines, proportioned in a way that is stable under design flood flows and still meets habitat enhancement goals. ESM is mixed to the Engineer’s gradation requirements for stability for specific locations, containing sufficient amounts of fine material to ensure that vegetation can establish and that flows do not “sub-out” or move beneath the surface of the mix during times of low flow. Properly specified ESM placed in a geomorphically appropriate location should look and behave like a natural streambed.

At the Rock Pile and Material Removal Areas, ESM sizing may vary depending on the location of bedrock exposures and the constructed channel geometry. The Field Engineering Notes (Sheet C40) will guide channel construction since there is uncertainty regarding the vertical and lateral position of bedrock. ESM sizing will be refined during construction, as needed, to account for conform locations along exposed bedrock where hydraulic forces may be more significant than can be foreseen during the design phase.

Steps and pools will be incorporated into the Rock Pile and Material Removal Areas as shown on the Typical Cascade and Step-Pool Reach Details on Sheet C34. The head of large pools will be reinforced with boulder weirs to promote plunging flow into the pool and provide profile grade control. Boulder weirs will be keyed into adjacent floodplain armor as shown on Sheet C36. The weir boulders will extend five to seven feet into the floodplain armor to protect against flanking. The ESM material has been designed to remain stable during the 100-year recurrence interval flow, with only minor adjustments expected to channel shape in reaches with bed slopes less than approximately 6-8%. In steeper reaches (>6-8%) post-construction channel adjustments are expected, as described above in Section 2.3.1.1. These adjustments may result in changes to constructed pool and step geometry and the formation of new pools and steps in response to flood flows. Detailed ESM sizing calculations are included in Appendix F. Resulting ESM gradations are presented on Sheet C39.

### 2.4.2 Floodplain Armor

Floodplain armor was sized similarly to ESM, using CDFW Design Guidelines for developing a well-graded mixture of boulders, cobble, gravel, sand, and fines. The substrate is proportioned to be stable under design flood flows while providing appropriately sized material to enhance constructed floodplain habitats. Sufficient fine material has been included to ensure that vegetation can establish and the flows do not “sub-out” or move beneath the surface of the mix when floodplains are activated by flood flows. As with the ESM, the floodplain armor has been designed to remain stable during the 100-year recurrence interval flow, with only minor adjustments expected to floodplain shape in reaches with slopes less than approximately 6-8%. Post-construction floodplain adjustments are anticipated in steeper reaches.

Planting pockets have been incorporated throughout proposed floodplain areas to provide locations for planting during project revegetation. Planting pockets are areas 5 to 8 feet in diameter that will be interspersed within the floodplain and filled with a soil mix designed to support container plants. If erosion of planting pocket soils were to occur, the floodplain armor would adjust to fill and protect eroded areas. Boulder sills have also been periodically incorporated across proposed floodplain areas to provide roughness to help reduce overbank flow velocities and serve as grade control if significant erosion were to occur along floodplain areas. Boulders used in the construction of boulder sills will be in the D84 - D100 size range of the respective floodplain armor gradation. The planting pocket and boulder sill details are included on Sheets C35 and C36, respectively.

At the Rock Pile and Material Removal Areas floodplain armor sizing may vary depending on the location of bedrock exposures and the constructed channel geometry. The Field Engineering Notes (Sheet C40) will guide floodplain construction since there is uncertainty regarding the vertical and lateral position of bedrock. Floodplain armor sizing will be refined, as needed, during construction to conform to exposed bedrock. Detailed floodplain armor calculations are included in Appendix F. Resulting floodplain armor gradations are presented on Sheet C39.

### 2.4.3 Vegetated Rock Slope Protection (RSP)

Vegetated rock slope protection (RSP) has been proposed at three locations. Vegetated RSP will be constructed using boulders of a specified gradation with live stakes installed throughout the RSP. Live stakes are live plant cuttings capable of regenerating into mature plants. Live stakes are typically taken from willows. RSP sizing calculations are included in Appendix F.

Vegetated RSP will be used to provide channel stability at the Culvert #7 and #9 removal areas, where the right bank (looking downstream) will be left in an over-steepened condition after culvert removal, and where the floodplain bench conforms to the inlet of Culvert #6 at the downstream end of the

Channel Widening Area. Culvert #7 is an 11.5-foot diameter culvert that will be removed along with the fill placed over the top of the culvert. After culvert removal the right bank side slope will range from 1-2H:1V. Laying back the bank to a consistent slope of 2H:1V is not practical at this location given the extensive vegetation removal and bank grading that would be required due to the steepness of the existing slope, which is 1-1.5H:1V (see Sheet C11). Grading would have to extend approximately 50 vertical feet to the top of slope at the edge of the idled Rock Plant. RSP is required to ensure the over-steepened reconstructed streambank remains stable while vegetation becomes established.

Culvert #9 consists of a 60-inch diameter corrugated metal pipe that is perched in the bank above the channel. The culvert appears to be a relic of an historic crossing. The culvert likely became plugged or the entrance obstructed at some time in the past and the channel cut around it. The right bank side slope will be 1-1.5H:1V after culvert removal. As with Culvert 7, it is not practical to lay back the bank to 2H:1V due to the steepness of the existing valley wall. See Sheet C18 for the existing average bank slope near the creek. Flow velocities are high at the Culvert 9 removal area, as the channel narrows and steepens, requiring large RSP to protect the channel bank.

Flow velocities are relatively low at the entrance to Culvert #6 as this area becomes somewhat backwatered due to the undersized culvert. However, vegetated RSP is required to protect the existing over-steepened slope at the floodplain bench conform to the Culvert #6 inlet (See Appendix F for rock sizing calculations).

### 2.4.4 Vegetation

Vegetation will be an essential component of ensuring short and long-term erosion projection and habitat value on excavated slopes, constructed floodplains and the reconstructed channel banks. All areas disturbed during construction will be revegetated with native species appropriate to the setting. Planting will include live staking, container planting and seeding. Sheets L1-L6 show proposed planting areas, tables identifying proposed species, container sizes, on-center spacings, seed quantities, and installation details. Irrigation details have not been included with this submittal. However, an irrigation system will be designed to maintain installed plantings during their establishment period. The irrigation plan will primarily consist of drip emitters at container plants. Overhead sprinklers may be used to irrigate seed during initial establishment only. A detailed plan will be included with the next design submittal.

Sheet L1 includes details for planting that will occur along the concrete channel. Grading is not proposed along the concrete channel. The planting information on Sheet L1 reflects habitat enhancement specifications included in the Decree.

The remaining landscape sheets include planting information for the areas that will be disturbed by grading activities. Planting tables have been included for each work area (e.g. Rock Pile Area) for both floodplain and riparian areas. A seed mix table has also been included. The seed mix will be applied to all disturbed areas as shown on the Drawings. The seed is expected to provide short-term erosion control through dense establishment of a groundcover including grasses and herbaceous species. Woody species and container plantings will contribute to long-term erosion control and habitat value.

Container plants will be installed in planting pockets and live stakes will be installed throughout the floodplain armor and ESM at floodplain and streambank areas at the spacings shown in the planting tables and relevant details. Live stake trench packs and live willow transplants will also be installed throughout floodplain areas. Refer to relevant details on Sheets C35 and C37 for trench pack and willow transplant installation and spacing information.

For revegetation purposes, the “riparian” planting zone has been defined as the areas extending 10 vertical feet up the channel bank from the toe of slope at the edge of constructed floodplain benches. Riparian areas will be revegetated with container plants and seed mix. Refer to the planting tables for individual component project areas (Sheets L1-L6).

Erosion Protection above the 10-Year Water Surface Elevation

Revegetation will be the primary means of erosion control on slopes above the limits of floodplain armor (i.e. 10-year water surface) Flow velocities along the lateral margin of floodplain areas average less than 3 ft/sec during the 100-year flood. Revegetated soils can resist flow velocities of 4-6 ft/sec (Fischenich 2001). These areas will be seeded and planted. Mulch and/or erosion control fabric will be provided as appropriate pending constructed geometry, with fabric preferred on slopes steeper than 2.5H:1V.

### 2.4.5 Project Best Management Practices (BMPs)

Project designs typically incorporate BMPs to reduce construction-related impacts during and after construction. BMPs may include structural elements (*e.g.,* dewatering of work areas, installation of fiber rolls, sediment barrier fence and revegetation of disturbed areas) and may also include planning measures such as beneficial phasing and scheduling of work or limitations on disturbance areas. Some of these elements are typically shown on the Design Drawings, while others are often presented within a detailed Stormwater Pollution Prevention Plan (SWPPP). A SWPPP is a separate document that provides specifications for implementation as well as monitoring and reporting and is submitted to the Regional Water Quality Control Board for review. At present, a SWPPP has not been prepared for the project. Given the complexity of the project site and the particular challenges associated with work within the streambed, we anticipate a very detailed SWPPP document will be required to address the phasing of the work and the potential variations on final geometry and surface materials (*e.g*., bedrock vs. alluvium in channel banks).

The primary concerns at this site include limiting disturbance to adjacent riparian areas, avoiding episodic or chronic release of sediments to the creek, and quickly reestablishing a dense riparian canopy within disturbed work areas. Some of the principal BMPs currently included in the design are presented below.

Construction fencing will be installed along limits of disturbance prior to commencement of grading activities. Access to project areas will be along existing quarry access roads, as shown on Sheets C27-C28. Equipment will be staged and refueled within established staging areas. Continuous dust control will be provided throughout construction in accordance with the dust control notes shown on Sheet C27 and project permits.

Dewatering will occur at all sites where surface water is present and grading is proposed along the channel bed, or where access across the channel is required (i.e. Culvert #9 removal area). Diversion plans are included on Sheets C29-C32, with a typical dewatering plan and details shown on Sheet C33. Block nets will be installed upstream/downstream of the area to be dewatered, and fish and other aquatic organisms will be removed and relocated by a qualified biologist, prior to the installation of dewatering facilities. Where removal of seepage water is required within an isolated construction area, the water will be pumped to a depression or temporary basin to either infiltrate or be detained until it is routed through a sediment treatment facility, as needed. Any pumping of surface water with the potential to entrain aquatic organisms will be screened using a mesh with a maximum opening size of 5 millimeters. The screen will be checked regularly to ensure it is functioning as intended and that animals are not becoming entrapped. Turbid waters will not be allowed to discharge into Permanente Creek. At the completion of construction, all accumulated sediment will be removed from the work area, characterized, and, if appropriate, placed elsewhere at the Facility in a manner that will not result in erosion or mobilization of sediment to Permanente Creek, and that will be consistent with applicable Waste Discharge Requirements. The final placement location will be determined by the Engineer, in consultation with Lehigh, the Regional Water Board, and the Geotechnical Engineer or Project Geologist at the time of construction.

Fiber rolls will be installed around staging areas and a sediment barrier fence[5] will be installed along the creek-side edge of the proposed floodplain bench excavation areas at the Channel Widening Area. Fiber rolls will be in place to trap mobilized sediment in the event there is rain during construction. The sediment barrier fence will act as a barrier to any loose material during floodplain bench excavation.

Constructed channel areas and bank slopes will be protected from erosion using the specified rock mixtures and/or vegetation as shown on the drawings. Erosion control fabric will be utilized if needed. Fiber rolls will be installed across excavated slopes as shown on Sheets C29 to C32. Prior to revegetating slopes, these areas will be track-walked to ensure drainage in the intended direction and provide smooth transitions to undisturbed sloped. Fiber rolls and container plants will be installed, where specified, and the slopes will be hydroseeded with the seed mix shown on the drawings. The hydroseed mixture will include hydromulch, amendment/fertilizer, and tackifier, to assist with erosion control and seed establishment[6]. Constructed channel and floodplain areas will receive ESM, floodplain armor, and vegetation as discussed above.

All constructed slopes that are steeper than 2H:1V will be evaluated by the Geotechnical Engineer or Project Geologist, and recommendations will be provided, as needed, to ensure geotechnical stability.

## 2.5 FLOODPLAIN LOGS AND LARGE WOODY DEBRIS INSTALLATIONS

### Floodplain Logs

Floodplain logs have been proposed throughout the project. Floodplain logs will consist of both “live logs” and “roughness logs”, as described on Sheet C35. All floodplain logs will be salvaged with rootwads left intact. Live logs will consist of willows that will be removed during project grading. These trees will have all limbs removed to increase the likelihood they will survive and regrow, and they will be partially buried on floodplain areas with the expectation that the majority of them will re-sprout. Roughness logs will consist of all other tree species impacted by project grading. These trees will be partially buried like the live logs, but some limbs will be left intact to add additional roughness and complexity to the floodplain. Calculations have been completed to determine ballasting requirements, and the floodplain logs will be properly ballasted so they will not be moved by flood flows. Ballast calculations are included in Appendix G. Calculations will be adjusted, as necessary, during project implementation to ensure appropriate ballasting for trees of varying dimensions.

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[5] Lehigh will coordinate with USFWS staff during the Section 7 Consultation to identify an appropriate fabric for use as a sediment barrier.

[6] Hydroseeding specifications will be included in the next design submittal.

Large Woody Debris (LWD) Structures

Large woody debris structures have been proposed at each of the pools that will be constructed at the Culvert #7 and Culvert #8 removal areas. Each of the two structures will consist of one log with a rootwad and one log without a rootwad. The Engineer will be present during installation to ensure the LWD structures are installed in accordance with the design intent to promote pool scour and provide cover for aquatic species. The logs will either be Douglas fir or redwood meeting the dimensions shown on Sheet C39. The structures have been designed to remain stable during the 100-Year discharge. Each structure will be ballasted and stabilized by cabling each log to two 4-foot diameter boulders (four boulders total per structure) and cabling the logs to each other. Ballast calculations are included in Appendix G.

## 2.6 GEOTECHNICAL AND GEOLOGIC CONSIDERATIONS

Golder Associates (Golder) and Stantec have provided geologic and geotechnical review of the proposed project. Golder has been involved in the project since the initial concept designs were prepared in 2014. They have reviewed each round of drawings as they have been developed. Stantec has recently been added to the project team to provide additional geotechnical engineering review, evaluation and design support.

Golder prepared a detailed assessment of project area geology and geotechnical considerations in 2019 at the request of the reviewing agencies (Golder 2019). The Technical Memorandum titled: “Geologic and Geomorphic Assessment of Permanente Creek” is included in Appendix H. Design slopes shown on the drawings meet Golder’s recommendations for proposed slopes above the restored creek. Subsurface investigations have been performed to gain an understanding of the materials underlying the project limits at the Material Removal and Rock Pile Areas. However, precise locations of bedrock are not known, including its position (both vertically and laterally) and orientation. Field adjustments and modifications to conform to existing bedrock will likely be required.

In addition to their work developing an estimated bedrock profile beneath the Rock Pile and Material Removal Areas, Golder’s geotechnical assessment focused primarily on evaluating the stability of the final valley slopes within restored reaches. Golder has provided recommendations on allowable slope angles for the different material types that may be encountered within excavations and the project geotechnical engineer or project geologist will be integrally involved with construction at the Rock Pile and Material Removal Areas to inspect excavated areas and provide recommendations, as necessary, to ensure finished slopes meet geotechnical criteria for stability. At both the Rock Pile and Material Removal Areas, excavations on the southern side of Permanente Creek are expected to follow similar slope angles as the existing exposed slope, likely uncovering areas of bedrock. The 90% Designs show a 1.5H:1V side slope at these locations for the two sites. The northern bank of the creek will be initially excavated into fill material and may potentially expose underlying bedrock depending on the depth of excavation. Default design side slopes on the north bank are 2H:1V or flatter. The northern banks may be constructed at a steeper slope if bedrock is uncovered. The project geotechnical engineer or project geologist will inspect the slope below the Rock Pile once it is removed and evaluate the nature and stability of the exposed material. Recommendations will be developed, as necessary, to ensure the slope is geotechnically stable.

In response to comments received from reviewing agencies, Golder prepared a stability assessment of the slope underlying the large aggregate pile at the Rock Pile Area (Golder 2021). Golder’s assessment found the slope will be stable after removal of the rock pile but noted that the underlying slope should be inspected by a qualified professional engineer or geologist to confirm the assumptions used in the analysis. Notes are also included on Sheet C19 of the 90% Designs that require the project geotechnical engineer or project geologist to inspect the slope exposed below the rock pile following its removal and provide recommendations on final stabilization measures. The Golder slope stability analyses report is included in Appendix I.

Most recently, Golder has also prepared a report to assess potential water quality impacts associated with specific project construction elements (Golder 2022). The report is included in Appendix J. The water quality evaluation assesses geologic units (e.g. limestone bedrock) likely to be uncovered in the creekbed by project implementation and found no significant impacts to water quality. The evaluation also determined that the locally available greenstone and graywacke encompassing the majority of the Permanente Creek basin is not detrimental to water quality if used as backfill and that from a water quality perspective can also be used as engineered streambed material and floodplain armor in the restored channel reaches.

Stantec prepared the Permanente Creek Restoration Project (PCRP) Stability Analysis, dated August 26, 2022, to support the updated project design (Stantec 2022). The assessment reevaluated the stability of the proposed slopes at the Rock Pile Area and also assessed the stability of the proposed slopes at the Material Removal Area (Appendix K). The report presents the results of their analysis assessing the most extreme conditions along the north slope of the creek at both sides. The slopes were analyzed under both static and pseudo-static conditions and were found to have acceptable factors of safety.

## 2.7 DESCRIPTION OF INDIVIDUAL PROJECT COMPONENTS

The individual project components are briefly described below, introduced from the downstream to the upstream limits of the proposed work.

### 2.7.1 Concrete Channel (Reach 6, Sheet L1)

Native riparian plantings will be installed along the southern bank of the concrete channel, from the edge of concrete to the top of bank. Installed plantings will infill areas outside of existing mature tree canopy. Existing oak seedlings will be preserved and a 3-foot radius around each seedling will be hand-weeded to reduce competition. The goal of the work is to expand the riparian corridor and increase canopy cover over the channel to lower stream temperature. Shading will also reduce the ability of cattails to established or persist in the channel. Cattails currently block the channel in many locations, thereby reducing sediment transport and flood capacity. They also present a partial barrier to the movement of any fish within the concrete channel.

Fish passage was not evaluated within the concrete channel, as there are not any improvements proposed within the concrete channel.

These proposed improvements meet the conditions outlined in paragraph #40 of the Decree.

### 2.7.2 Channel Widening Area (Reaches 8-12, Sheets C11-C18)

Within Reaches 8 through 10, the north bank will be excavated to form a bench at the estimated bankfull (1.5-year) water surface elevation. The bench width will be maximized by narrowing the existing roadway. The bench will be constructed to leave a maximum roadway width of 20 feet, as measured to the top of the creekside vehicle barrier. Work generally avoids disturbance to the bed of the channel and the south bank, except where large concrete debris or culverts are proposed for removal. Where existing mature riparian trees are present, the bench excavation has been modified to preserve them, where feasible, in the interest of maintaining shade cover and improved habitat.

The floodplain bench will be over-excavated and then lined with a mixture of coarse alluvial materials sized to resist mobilization during floods. Periodic floodplain roughness elements (e.g., floodplain logs and boulder sills) will be incorporated to minimize channel migration into the benches as vegetation becomes well established.

Fish passage was not evaluated where only the construction of a floodplain bench is proposed because work is not proposed within the active channel bed.

These improvements meet the conditions outlined in paragraphs #38-39 of the Decree.

### 2.7.3 Culvert 7 (Reach 8, Sheet C11)

Culvert #7 will be completely removed and the area restored with a floodplain bench incorporated along the northern bank. Biomechanical bank stabilization treatments will be required along the southern bank to support the toe of the hillslope where the culvert and associated fill are proposed for removal. The biomechanical treatment includes the installation of vegetated RSP. A pool that will include the installation of a large woody debris structure has been included to provide habitat and cover for aquatic species.

Fish passage design criteria for both depth and velocity are met when using the “Hydraulic Design” approach.

These improvements meet the conditions outlined in paragraph #39 of the Decree.

### 2.7.4 Culvert 8 (Reach 9, Sheets C14-C15)

Culvert #8 will be completely removed and the area restored with a floodplain bench incorporated along the northern bank. A pool that will include the installation of a large woody debris structure has been included to provide habitat and cover for aquatic species.

Fish passage design criteria for both depth and velocity are met when using the “Hydraulic Design” approach.

These improvements meet the conditions outlined in paragraph #39 of the Decree, although Culvert #8 is not specifically mentioned.

### 2.7.5 Sediment Removal Area (Reach 9, Sheets C14 & C16)

Accumulated sediments and fill materials will be removed as necessary to restore pre-disturbance geometry within the tributary channel and adjacent floodplain area. The access road and existing storage area will be revegetated. Final grades will be dependent upon sub-surface conditions (*i.e.*, the location of bedrock). All disturbed areas will be revegetated with native riparian species.

These improvements meet the conditions outlined in paragraph #39 of the Decree.

### 2.7.6 Culvert #9 Removal Area (Reach 10, Sheet C18)

Stream flow does not pass through Culvert #9. The pipe is perched above the channel in the south bank. There is exposed RSP along the channel margins, as shown on Sheet C18 of the drawings, and cobbles and boulders are present along the channel bed providing sufficient armoring to resist erosion. Mature riparian vegetation is also present along the channel banks providing rooting strength to bank soils. The culvert will be removed and the void will be filled with vegetated RSP (see Section B, Sheet C18). There will be limited impacts to the channel bed and existing vegetation during the culvert removal work. It is expected that some significant vegetation pruning and disturbance of roots will be required, but the native alders and willows along the channel are used to disturbance and will rebound quickly to provide shade and rooting strength to any disturbed bank soils[7].

Culvert #9 will be completely removed from its perched location and the bank will be restored in the vicinity of the work. Biomechanical bank stabilization treatments will likely be required to restore the southern streambank where the culvert is removed unless bedrock is exposed during demolition. Any required biomechanical treatment work will include the installation of vegetated RSP.

Fish passage was not evaluated because there is not any work proposed within the active channel bed.

These improvements meet the conditions outlined in paragraph #39 of the Decree.

### 2.7.7 Culverts #10 & #11, Rock Pile, and Pond 13 (Reaches 11-13, Sheets C19-C21)

Extensive channel realignment and reconstruction is proposed throughout this area, including removal of Culverts #10 & #11, rip rap in the vicinity of the Culvert #10 outlet, and the dam at Pond 13.

As discussed above, the channel profile appears to have been significantly modified in this reach, resulting in a flattened profile downstream of Pond 13 at Culvert #11 (half culvert) and a very steep profile through Culvert #10. The design optimizes fish passage conditions by creating a more uniform grade through the reach. Cuts approximating thirty to forty feet of depth are required to accomplish this. The grading plan reflects the Lower Limit of Potential Design Channel Invert, which includes removal of Pond 13. The Upper Limit of Potential Design Channel Invert shown in profile has been established as a best fit to bedrock elevations that were estimated using a seismic refraction analysis and geotechnical borings. The results of this seismic refraction analysis are attached as Appendix C. Since we cannot know the exact location of all bedrock without extensive subsurface exploration, (*e.g.*, drilling or trenching) final geometry will likely vary somewhat from that shown on the drawings, as necessary to conform to existing bedrock.

The newly excavated floodplain benches will be lined with a mixture of coarse alluvial materials sized to resist mobilization, but able to adjust and reorganize in response to significant flood flows. Floodplain roughness elements (*e.g.*, log structures and/or boulder sills) will be incorporated to minimize channel migration into the benches until vegetation becomes well established.

The dam will be removed at Pond 13 and replaced with a boulder weir grade control structure, if the upper limit of potential design channel invert is constructed. Fine sediment impounded within the pond will be removed so the material is not transported downstream after the restoration project is implemented. The limits and thickness of accumulated sediment have not been surveyed. Accumulated fine sediment occurring below elevation 805.0 will be removed. Removal of fine sediment will occur until alluvial material (*i.e.,* gravel/cobble) or bedrock are encountered. Engineered fill would then be placed to raise grades, where necessary, and a channel conforming to the dimensions shown on the

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[7] During site inspections in 2022 it appeared most of the alders shown on the drawings that were mapped during 2013-2015 have died and been replaced by willow volunteers.

Typical Channel Treatment Detail for the Rock Pile, Sheet C20, would be constructed through the previously ponded area to restore an open channel.

The rock pile and associated infrastructure will be removed to accommodate the lowered and widened channel, as shown on cross sections C and D of Sheet C21. An access road has been incorporated into the design for maintenance of Pond 13B. Newly disturbed upland hillslopes will be vegetated with native species, as will the constructed channel and floodplains. The slope exposed below the Rock Pile will be inspected by the Geotechnical Engineer or Project Geologist to evaluate the nature and stability of the exposed material and provide recommendations, as necessary, to ensure geotechnical stability of the slope and access road.

These improvements meet the conditions outlined in paragraphs #37 & 38 of the Decree.

Fish passage design criteria for both depth and velocity are met when compared to the hydraulic design parameters established under the Hydraulic Design approach, due to the high roughness of the proposed channel substrate. However, it should be noted that the design profile grade of 12% exceeds CDFW's estimated limit to anadromy, which is a sustained slope of over 8%; and studies show that adult anadromous salmonids are able to navigate steeper slopes than resident rainbow trout (Coastal Conservancy 2004). See Section 2.3.1.1 above for a discussion regarding fish passage evaluation in steep reaches.

### 2.7.8 "Old Crusher Foundation" Removal (Reach 17, Sheet C22)

The "old crusher foundation" will be modified to conform to the adjacent banks. The portion of the "old crusher foundation" that is projecting into the creek will be removed. Sheet C22 includes a site plan and cross sections of the proposed work. All work will be completed using hand labor and small equipment with worker safety being the highest priority, given that the foundation is located at the base of a very steep and tall slope. All waste material and spoils will be removed from the creek using hand tools and disposed of. Access is anticipated to be provided by use of a constant rate descender, or similar. Final geometry will be inspected by the Engineer to ensure a smooth hydraulic transition along the portion of the "old crusher foundation" to remain.

These improvements meet the conditions outlined in paragraph #35 of the Decree.

### 2.7.9 Material Removal Area (Reaches 17 & 18, Sheets C23-C26)

This area has been modified by the placement of material within and adjacent to the channel. The exact extent and depth of material is uncertain at this time, due to limited subsurface data. A seismic refraction analysis has been performed to estimate the depth to bedrock, in an effort to gain a clearer understanding of the pre-disturbance site geometry and allow a more informed evaluation of opportunities and constraints to enhancement. The results of this analysis are attached as Appendix C.

The 90% Designs show the area will be excavated to establish a more uniform profile gradient, as shown on Sheets C23 and C24. The grading plan reflects the Upper Limit of Potential Design Channel Invert and has been established as a best fit to bedrock elevations that were estimated using the seismic refraction analysis. The Lower Limit of Potential Design Channel Invert is shown in profile and represents the lowest grade at which the channel invert would be constructed if bedrock is not encountered.[8] Proposed

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[8] Design drawings for the Lower Limit of Potential Design Channel Invert that include a grading plan and cross sections are included on Figures 1-4 in Appendix L.

cuts extend to depths of over thirty feet below existing ground, resulting in profile grades of 7.1% to 22.7%. These grades follow the peaks of the estimated subsurface bedrock profile. Final grades would be determined in the field to best-fit bedrock exposures encountered during excavation. Since we cannot know the exact location of all bedrock without extensive subsurface exploration, (*e.g*., drilling or trenching) final geometry will likely vary somewhat from that shown on the drawings.

The proposed centerline of the creek was established by extending the existing southern hillside slope down at 1.5H: 1V to meet the new profile grade, and then leaving room for a bench that varies in width at bankfull elevation. The existing toe of the slope on the north side of the creek was relocated northward by twenty-five feet, except at the downstream end of the reach where the bench needed to be narrowed slightly to accommodate the Upper Treatment Facility and existing access road. The north bank is sloped at a maximum steepness of 2H:1V. The “relic concrete structures” shown on the Drawings will be removed during site grading. All disturbed areas will be revegetated with native species appropriate to the site.

The newly excavated floodplain benches will be lined with a mixture of coarse alluvial materials sized to resist mobilization, but able to adjust and reorganize in response to significant flood flows. Floodplain roughness elements (*e.g.,* log structures and/or boulder sills) will be incorporated to minimize channel migration into the benches until vegetation becomes well established.

These improvements meet the conditions outlined in paragraph #35 of the Decree. It should be noted, however, that the design profile grade within this reach will likely vary from 7.1% to 22.7% and may have drops over bedrock features. Fish passage will be an objective, but cannot be guaranteed with these site constraints, the majority of which exceed CDFW’s estimated limit to anadromy, which is a sustained slope of over 8%; and studies show that adult anadromous salmonids are able to navigate steeper slopes than resident rainbow trout (Coastal Conservancy 2004). See Section 2.3.1.1 above for a discussion regarding fish passage evaluation in steep reaches.

# 3.0 IMPLEMENTATION

## 3.1 CONSTRUCTION SEQUENCING

There are many considerations when determining the optimal sequencing of a large stream restoration effort. At Permanente, examples include project area diversion and dewatering requirements, temporary impacts to stream and wetland habitat, post-construction sedimentation, quarry operations, and noise and dust. Permit requirements, including the in-stream work window, will also have bearing on the sequence of construction and the amount of construction that is completed in a given season.

In-stream flows can vary from year to year with surface water present in some portions of Permanente Creek and not in others. Although the presence of surface water will not dictate where work occurs in a given year, it will be considered to help simplify construction and reduce potential water quality impacts. Any relocation of the Upper Treatment Facility and associated infrastructure (*e.g.,* Pond 1250) that have been installed to remove selenium from quarry water will also be considered when determining construction sequencing. Work at the Material Removal Area may be sequenced to occur after other portions of the project are constructed if the treatment facilities and Pond 1250 need to remain in their current location at the start of project implementation. These facilities may be relocated in the localized area to accommodate changes to the slope if the facilities are necessary for post-creek restoration project activities associated with quarry dewatering and reclamation.

Ecological impacts from temporary site disturbances are also an important consideration. Of the potential impacts, soil disturbance and riparian vegetation removal are primary concerns. Vegetation removal reduces available cover and habitat for wildlife and shading of Permanente Creek. Soil disturbance associated with channel grading activities will further increase risk of erosion and sedimentation in the short term. Although the constructed features will be designed to ultimately reduce erosion and sedimentation, there will always be some minor erosion that mobilizes fine sediment while vegetation from erosion control seed and installed container plantings are becoming established during the first year following construction. Although the project will ultimately result in a significant expansion of riparian area, the removal of vegetation will temporarily reduce areas of riparian habitat, increase risk of erosion, and reduce shading of the creek until replacement plantings have matured.

In consideration of these short-term impacts, we have planned to stage the work so that the area of impact is limited in any given year, and in a manner that will allow newly constructed floodplains at the downstream limit of the work to treat runoff from the upstream end of the project area that would be disturbed in subsequent years.

We recommend that the initial stream restoration work occur along the Channel Widening Area, extending upstream to the end of Reach 10, where floodplain benches will be created. The benching will provide opportunities for sediment deposition to occur if material is mobilized from the Rock Pile and Material Removal Areas during the initial years after construction. The benches will also provide depositional areas for fine sediment mobilized from the large sediment deposits located within reaches, R14-R16 and R19-R21. In addition to providing this water quality benefit, the Channel Widening Area is also the least complex of the major construction components, allowing the opportunity for the construction team to gain familiarity with the particular challenges of the site (e.g., material processing, dewatering, topsoil salvage, and revegetation) before tackling the upstream reaches where channel grading is more complex.

The second phase of the work is expected to involve the Rock Pile Area. The final stage would include the Material Removal Area.

A final construction schedule will be prepared once all project permits and approvals are received for project construction, in accordance with paragraph #46 of the Decree.

### 3.2 FIELD ENGINEERING – ROCK PILE (REACHES 11-13) AND MATERIAL REMOVAL AREA (17-18)

The design engineers will be closely involved with construction implementation at the Rock Pile and Material Removal Areas. The drawings for each site present an "Upper Limit of Potential Design Channel Invert" and "Lower Limit of Potential Design Channel Invert". The upper limit represents the design grade based on connecting high points on the bedrock profile that were identified during subsurface investigations. The lower limit represents the maximum extent of excavation at locations where bedrock is not encountered during project construction. The likelihood is that the constructed channel will lie somewhere between these two profiles. Sheet C40 includes a description of field engineering parameters that will guide determination of the final profile at the Rock Pile and Material Removal Areas. Final slopes steeper than 2H:1V will be evaluated by the Geotechnical Engineer or Project Geologist and recommendations will be provided, as needed, to ensure geotechnical stability.

# 4.0 ADAPTIVE MANAGEMENT

The project has been designed to restore significant portions of Permanente Creek and greatly expand floodplain and riparian areas along the component project areas. Project designs include elements to provide short-term stability, while also being able to respond to future flooding events and changes in the sediment transport regime. As with most stream restoration projects, it is not possible to predict all future adjustments that may occur, and adaptive management may be required.

The reconstructed channel and floodplains will be protected with engineered streambed material (ESM) and floodplain armor. These substrates have been sized to remain relatively stable while allowing for natural adjustments to flooding events and sediment transport from upstream reaches. Boulder sills have been incorporated throughout the project to reduce the percentage of large boulders used in the ESM and floodplain armor, and to protect against erosion from large flooding events that may occur in the initial years after project construction while vegetation is becoming established. We anticipate that the armoring and sills will perform as designed. However, adjustments or areas of erosion could occur that require attention to ensure the project evolves as intended.

The creation of inset floodplain benches will allow for significant sediment storage within the project reaches, or for the low flow channel to adjust laterally without consequence in most instances. However, sediment mobilized from project areas or from areas outside the influence of project construction may accumulate in undesirable locations within the reconstructed channel segments. Areas of significant aggradation would be evaluated and corrective measures would be proposed. In the initial years after project implementation, it will be important to ensure that sediment/debris does not accumulate at locations that may direct future flood flows in a manner that could affect project stability.

The plants selected for the revegetation effort were chosen based on experience revegetating other areas of the project site. Although a certain percentage of die-off is typical with any native revegetation effort, it is expected that the selected species will do well along the restored project areas. If it is found that the revegetation effort is not meeting project performance standards, the cause will be evaluated and either alternative species will be used, or the species that are performing well be increased to ensure the project meets required performance standards for vegetation establishment.

Each project area should be inspected during the first year after construction after storms delivering 1.5 inches or more of rainfall have occurred. If erosion or sedimentation does occur, the cause of the issue will be evaluated and adaptive management practices will be developed to help stabilize the area. The default approach at areas of erosion will be the installation of additional vegetation where this approach is a viable solution to help halt erosion. If the area of erosion is significant, and the installation of additional vegetation is not a potential solution, an approach will be developed and the resource agencies will be engaged if heavy equipment is involved.

During the permitting process, a Monitoring and Adaptive Management Plan (MAMP) will be prepared for review and approval by the resource agencies. The MAMP will establish monitoring protocols, performance criteria, the monitoring period and reporting requirements. Potential adaptive management strategies and approaches will be discussed. Ultimately the MAMP will be a tool for helping to ensure long-term channel stability and successful establishment of the revegetation effort.

## 5.0 REFERENCES

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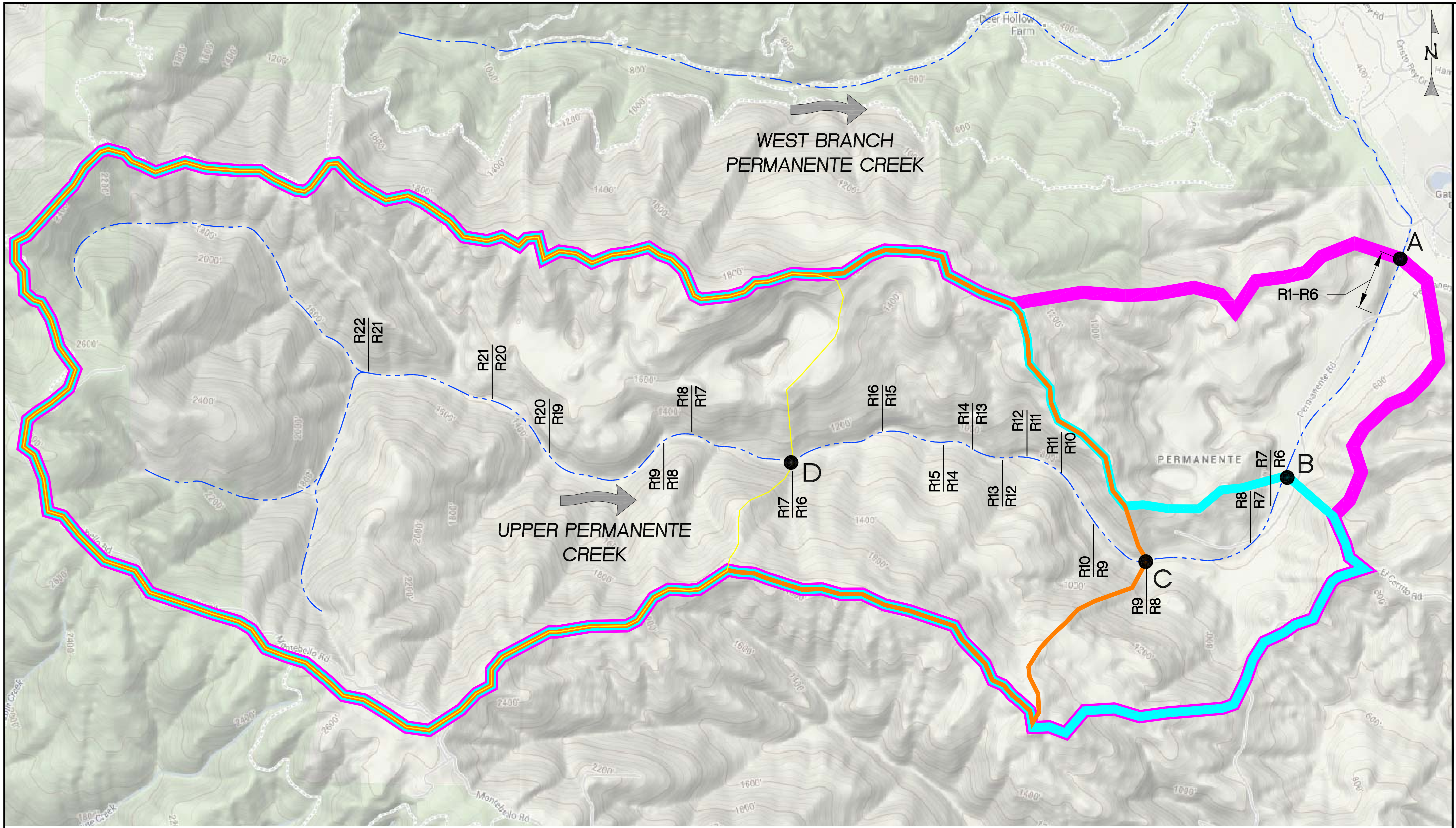


SOURCE: WWW.GOOGLEMAPS.COM

WATERSHED DELINEATION MAP
SCALE: 1"=1300'

LEGEND

● B DRAINAGE AREA POINT OF CONCENTRATION

WATERSHED BOUNDARY

R14 | R13 REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" PREPARED BY URS AND DATED MARCH 11, 2011

WATERWAYS CONSULTING INC.
Santa Cruz, CA | watways.com | Portland, OR

CONCEPT LEVEL SUBMITTAL

DESIGN BASIS TECHNICAL MEMORANDUM

PERMANENTE QUARRY - PERMANENTE CREEK WATERSHED DELINEATION MAP

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0
1"

FIGURE
1.0

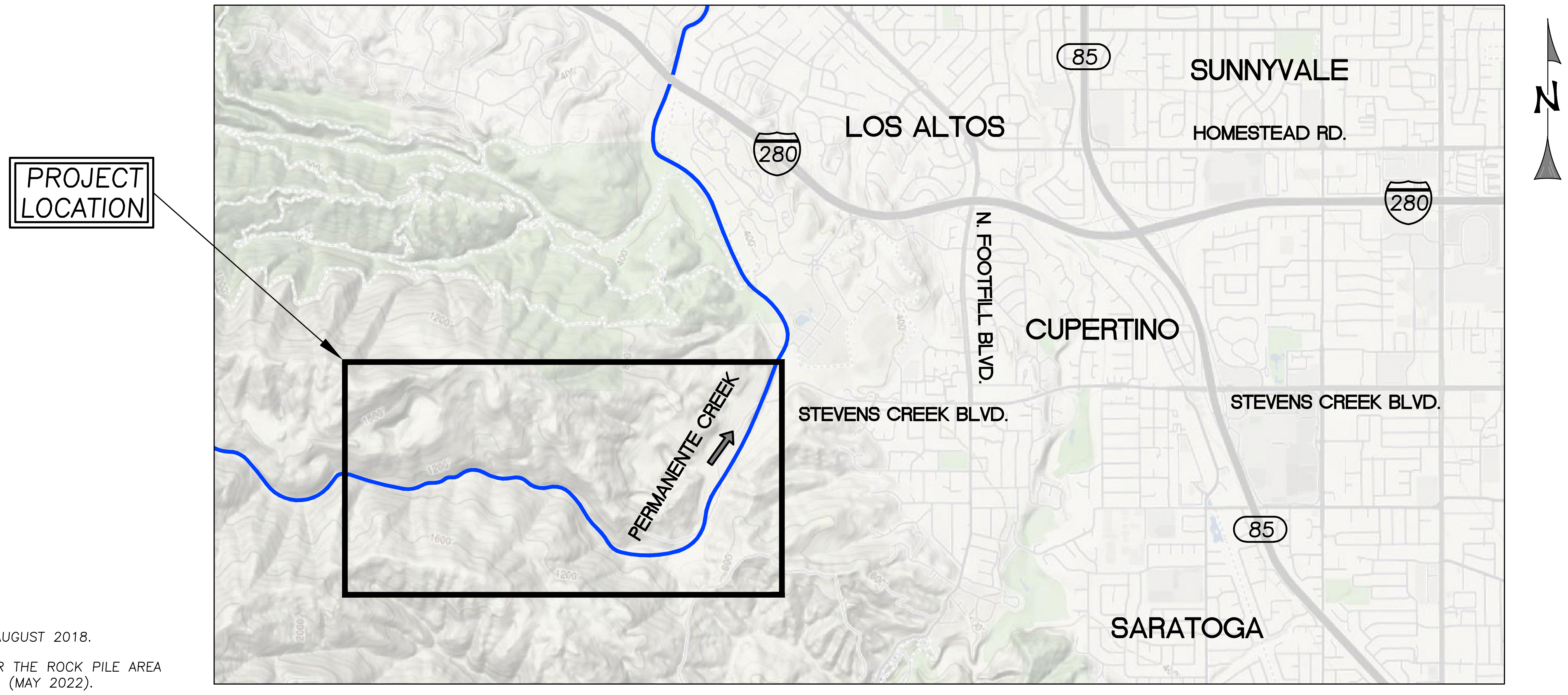
WATERWAYS
CONSULTING, INC.

# ATTACHMENT 1

## Permanente Creek Restoration Plan - Updated 90% Design Drawings

# PERMANENTE CREEK RESTORATION PLAN

## UPDATED 90% DESIGN
## SANTA CLARA COUNTY CEQA REVIEW SUBMITTAL
## AUGUST 26, 2022



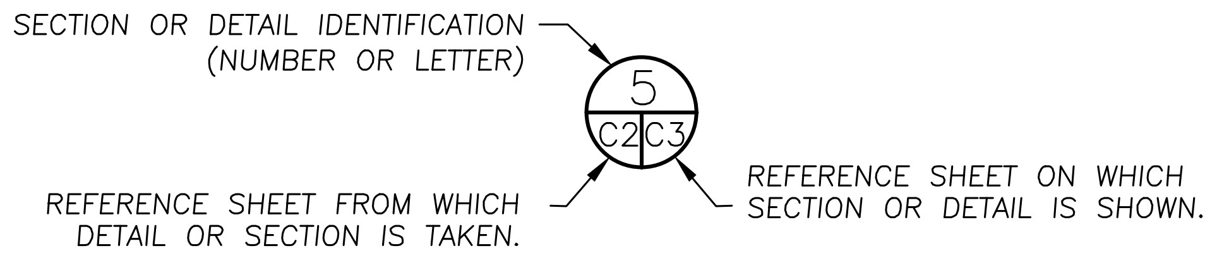
**VICINITY MAP**
N.T.S. (GOOGLE)

## GENERAL NOTES

1. TOPOGRAPHIC MAPPING WAS PERFORMED BY:
   WATERWAYS CONSULTING, INC.
   509 SWIFT STREET, UNIT A
   SANTA CRUZ, CA 95060
   SURVEY DATES; JUNE THROUGH AUGUST 2013,
   FEBRUARY THROUGH MAY 2014, MARCH 2015, AUGUST 2018.
2. AERIAL CONTOURS PROVIDED BY TOWILL, INC. FOR THE ROCK PILE AREA AND THE MATERIAL REMOVAL AREA LiDAR FLIGHT (MAY 2022).
3. ELEVATION DATUM: NAVD88 BASED ON A FIELD TIE TO SANTA CLARA VALLEY WATER DISTRICT BENCHMARK ID: BM198 WITH AN ELEVATION OF 478.22'.
4. HORIZONTAL DATUM: NAD83 CALIFORNIA STATE PLANE, ZONE 3.
5. AERIAL PHOTO SOURCE:
   AERIAL PHOTOMAPPING SERVICES
   2929 LARKIN AVENUE
   CLOVIS, CA 93612
   PHOTOGRAPH DATE: JUNE 2013 AND JUNE 2017
6. ELEVATIONS AND DISTANCES SHOWN ARE IN FEET AND DECIMALS THEREOF. CONTOUR INTERVAL IS 1 FOOT.
7. THIS IS NOT A BOUNDARY SURVEY. PROPERTY LINES, WHERE SHOWN, WERE COMPILED FROM RECORD INFORMATION. THE LOCATION OF THESE LINES IS SUBJECT TO CHANGE, PENDING THE RESULTS OF A COMPLETE BOUNDARY SURVEY.
8. TREE DIMENSIONS: TRUNK DIAMETERS SHOWN REPRESENT DIAMETER AT BREAST HEIGHT (DBH), MEASURED IN INCHES. DBH IS MEASURED 4.5 FT ABOVE GROUND FOR SINGLE TRUNKS AND TRUNKS THAT SPLIT INTO SEVERAL STEMS CLOSE TO THE GROUND. EACH TRUNK IS SHOWN AT MULTI-STEM TREES. ONLY THE LABEL OF THE DBH OF THE LARGEST TRUNK IS SHOWN FOR DRAWING CLARITY. WHERE TREES FORK NEAR BREAST HEIGHT, TRUNK DIAMETER IS MEASURED AT THE NARROWEST PART OF THE MAIN STEM BELOW THE FORK. FOR TREES ON A SLOPE, BREAST HEIGHT IS REFERENCED FROM THE UPPER SIDE OF THE SLOPE. FOR LEANING TREES, BREAST HEIGHT IS MEASURED ON THE SIDE THAT THE TREE LEANS TOWARD. TREES WITH DBH LESS THAN 8" ARE TYPICALLY NOT SHOWN.

   12"P = 12" DBH PINE
9. TREE SPECIES ARE IDENTIFIED WHEN KNOWN. HOWEVER, FINAL DETERMINATION SHOULD BE MADE BY A QUALIFIED BOTANIST. REFER TO THE LEGEND FOR TREE SPECIES SYMBOLS.
10. SURVEYED TREES INCLUDE:
    A. OAKS (QUERCUS SPP.) 5 INCHES OR LARGER DBH
    B. ALL OTHER TREES 12 INCHES OR LARGER DBH
    C. ALL MULTI-STEM TREES WITH A COMBINED DIAMETER OF 24 INCHES OR LARGER DBH
11. TREE MAPPING OCCURRED DURING THE 2013-2015 SURVEYS. SOME TREES SHOWN ON THE DRAWINGS MAY HAVE DIED SINCE THE DATE OF SURVEY. ADDITIONAL TREES MEETING THE SURVEY THRESHOLD USED DURING THE ORIGINAL MAPPING EFFORTS MAY NOW EXIST WITHIN THE MAPPED AREAS AND ARE NOT SHOWN ON THE DRAWINGS.
12. THE DRIPLINES ARE SHOWN AROUND ALL SURVEYED TREES. DRIPLINES ARE BASED ON A UNIFORM CANOPY RADIUS FOR EACH TREE. WHERE CANOPIES OF INDIVIDUAL TREES OVERLAP, THEY WERE JOINED TO SHOW A CONTIGUOUS DRIPLINE. THE DRIPLINES OF SMALL DIAMETER, UNMAPPED TREES ARE NOT SHOWN.

## SECTION AND DETAIL CONVENTION



## ABBREVIATIONS

| | | | |
|---|---|---|---|
| AVG. | AVERAGE | NTS | NOT TO SCALE |
| CC | CONCRETE | O.C. | ON CENTER |
| CY | CUBIC YARDS | O.D. | RELATIVE COMPACTION |
| DBH | DIAMETER BREST HEIGHT | RSP | ROCK SLOPE PROTECTION |
| DIA. | DIAMETER | S | SLOPE |
| E | EXISTING | SD | STORM DRAIN |
| E.G. | EXISTING GROUND | SPK | SPIKE |
| ELEV. | ELEVATION | SQ.FT. | SQUARE FOOT |
| DI | DRAINAGE INLET | TBD | TO BE DETERMINED |
| FG | FINISHED GRADE | TYP | TYPICAL |
| FT | FEET | UNK | UNKNOWN |
| INV | INVERT | WSE | WATER SURFACE ELEVATION |
| N | NEW | YR | YEAR |

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| C33 | DEWATERING DETAILS (1 OF 6) |
| C34 | TYPICAL CASCADE AND STEP-POOL REACH DETAILS (2 OF 6) |
| C35 | TYPICAL FLOODPLAIN ROUGHNESS AND HABITAT PLAN DETAILS (3 OF 6) |
| C36 | TYPICAL BOULDER WEIR, SILL, AND POOL DETAILS (4 OF 6) |
| C37 | TYP WILLOW LIVE STAKE TRENCH PACK & RELOCATION DETAILS (5 OF 6) |
| C38 | DETAILS (6 OF 6) |
| C39 | LOG STRUCTURE DETAILS AND ROCK SPECIFICATIONS |
| C40 | NOTES |
| C41 | CONTROL POINT TABLES |
| L1 | CONCRETE CHANNEL REVEGETATION PLAN |
| L2 | CHANNEL WIDENING REVEGETATION PLAN (1 OF 2) |
| L3 | CHANNEL WIDENING REVEGETATION PLAN (2 OF 2) |
| L4 | ROCKPILE AREA REVEGEATION PLAN |
| L5 | MATERIAL REMOVAL AREA REVEGETATION PLAN |
| L6 | TYPICAL PLANTING LAYOUTS |

## PROJECT DESCRIPTION

THESE DRAWINGS PROVIDE 90% LEVEL DESIGNS FOR THE CONSTRUCTION OF CHANNEL AND FLOODPLAIN ENHANCEMENTS ON PORTIONS OF PERMANENTE CREEK AT THE PERMANENTE QUARRY PROPERTY IN SANTA CLARA COUNTY, CALIFORNIA.

## TREE REMOVAL NOTES

1. SALVAGE MAPPED WILLOWS SHOWN ON THE DRAWINGS FOR REMOVAL AND INCORPORATE THEM INTO THE WORK AS FLOODPLAIN LIVE LOGS, PER DETAIL 3, SHEET C35. ALL UNMAPPED WILLOWS WITHIN THE GRADING LIMITS SHALL BE RESERVED FOR SALVAGE AND TRANSPLANTING, PER THE WILLOW TRANSPLANT DETAIL 2 ON SHEET C37. WILLOWS TO BE SALVAGED FOR TRANSPLANTING WILL BE FLAGGED IN THE FIELD BY THE PROJECT ENGINEER, PRIOR TO THE START OF ANY CLEARING OR GRADING ACTIVITIES.
2. SALVAGE ALL OTHER TREES REMOVED AS PART OF PROJECT CONSTRUCTION AND INCORPORATE THEM INTO THE WORK AS FLOODPLAIN ROUGHNESS LOGS, PER DETAIL 3, SHEET C35.

## TREE ABBREVIATIONS

| | |
|---|---|
| A | ALDER |
| B | BAY |
| BK | BUCKEYE |
| M | MAPLE |
| O | OAK |
| SYC | SYCAMORE |
| W | WILLOW |

*** CALL BEFORE YOU DIG ***
CONTACT UNDERGROUND SERVICE ALERT (USA)
PRIOR TO ANY CONSTRUCTION WORK 1-800-227-2600

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PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

COVER
SHEET

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

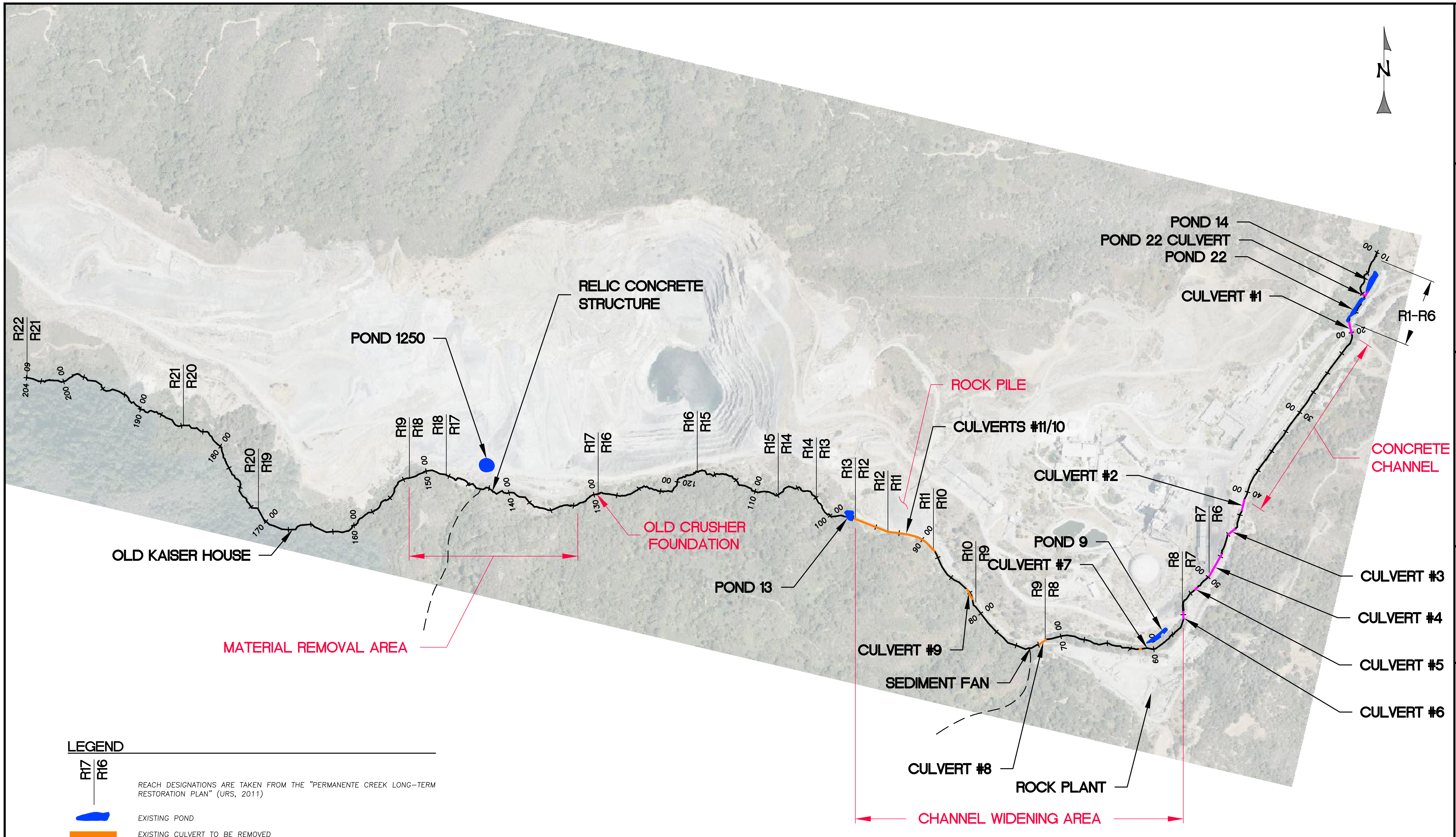
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C1

1
OF
47



## LEGEND

| | |
|---|---|
| R17 \| R16 | REACH DESIGNATIONS ARE TAKEN FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" (URS, 2011) |
| 🟦 | EXISTING POND |
| 🟧 | EXISTING CULVERT TO BE REMOVED |
| 🟪 | EXISTING CULVERT TO REMAIN |
| — — — | TRIBUTARY (RELEVANT TO PROJECT) |
| 70+00 | PERMANENTE CREEK THALWEG ALIGNMENT 2013<br>(NOTE: DESIGN ALIGNMENTS AND STATIONING VARY AT INDIVIDUAL WORK AREAS) |

## PROJECT AREA OVERVIEW

SCALE: 1" = 500'

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GROUP

PROJECT
AREA
OVERVIEW

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
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| | |
|---|---|
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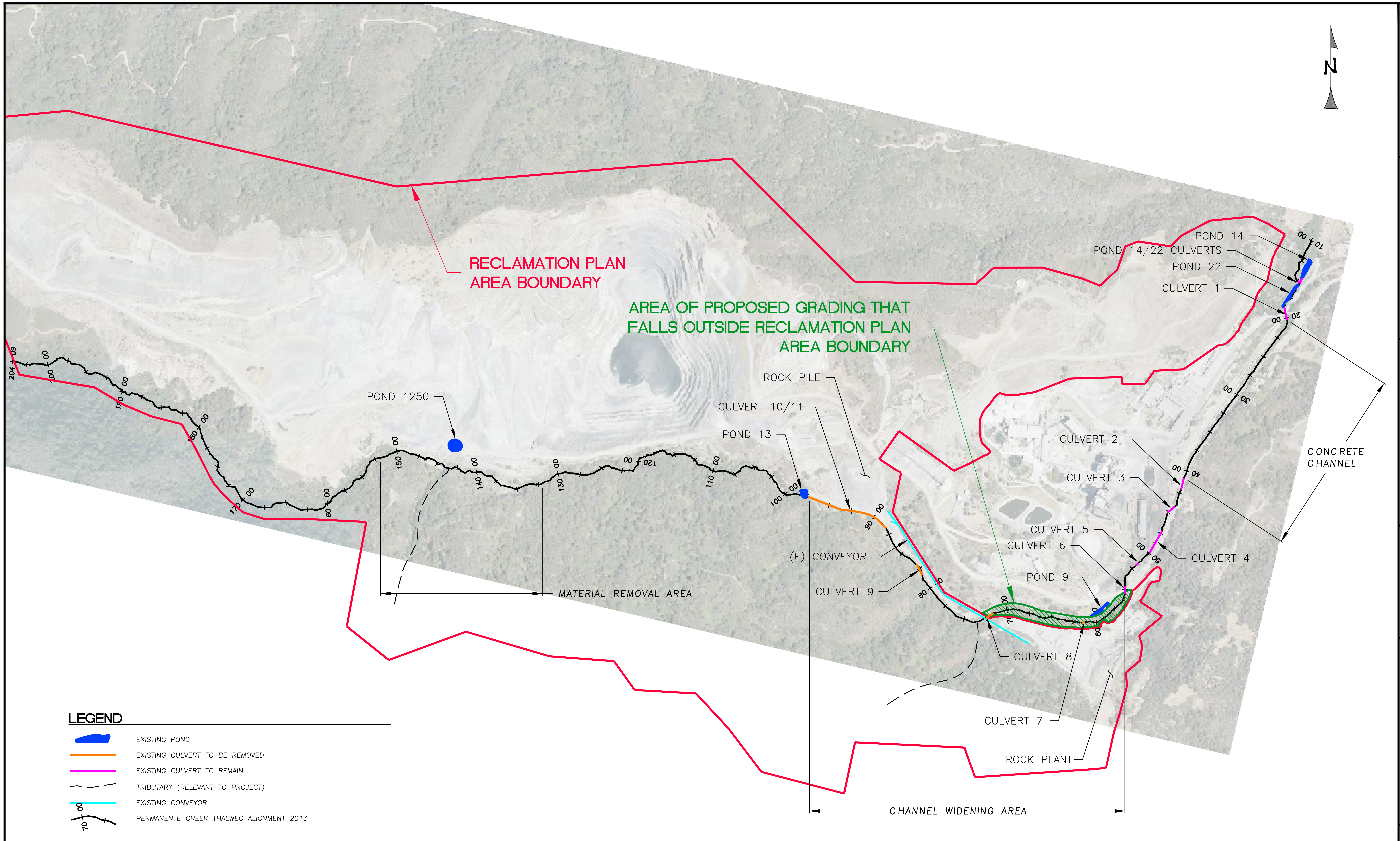
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C2

2 OF 47



## RECLAMATION PLAN AREA OVERVIEW

SCALE: 1" = 500'

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RECLAMATION PLAN AREA OVERVIEW

PERMANENTE CREEK RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.S. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

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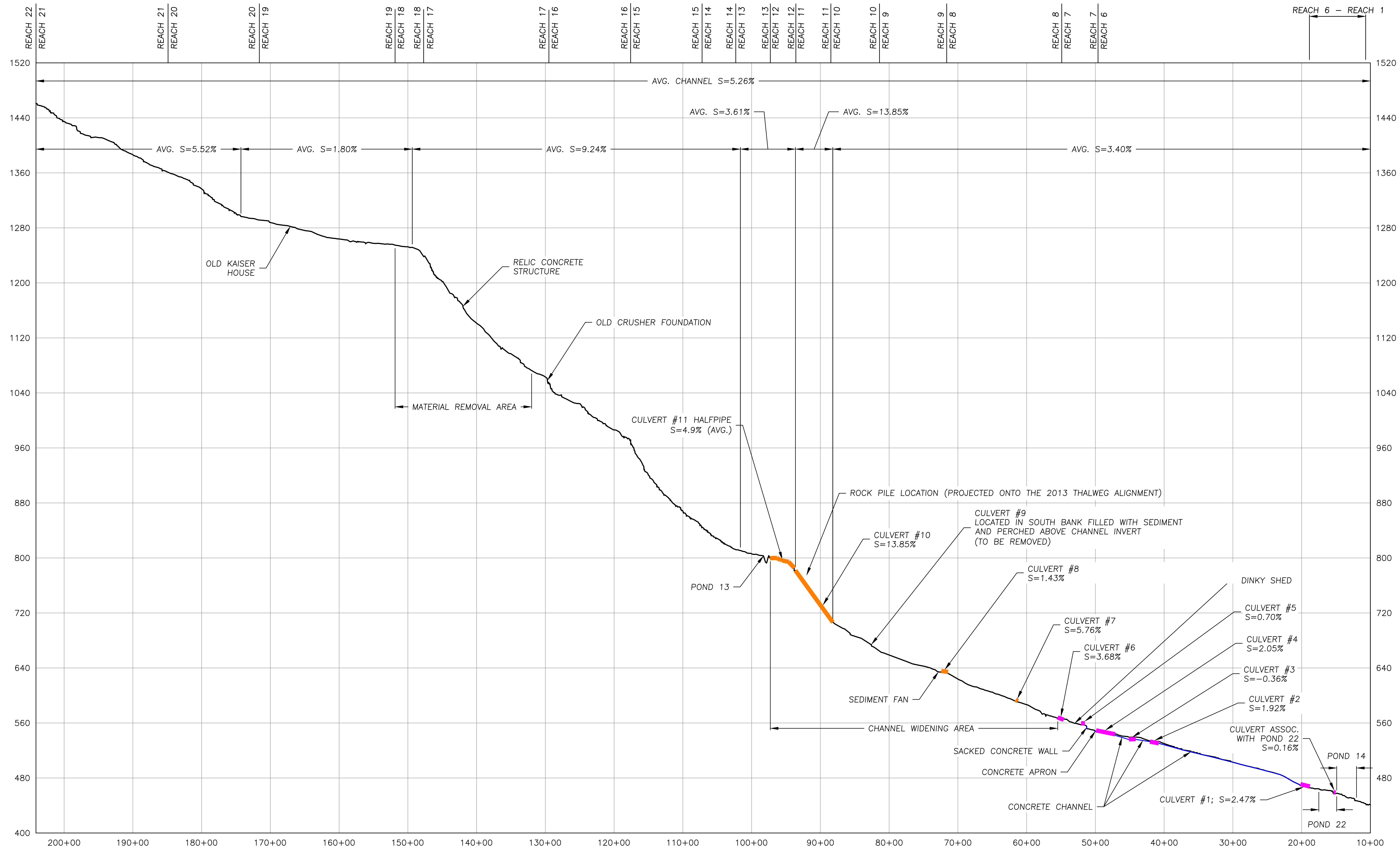
0 1"

C3

3 OF 47



## EXISTING CHANNEL THALWEG PROFILE

SCALE: H: 1" = 800'; V: 1"=80'

## LEGEND

| | |
|---|---|
| REACH 7 \| REACH 6 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| 🟧 | EXISTING CULVERT TO BE REMOVED |
| 🟪 | EXISTING CULVERT TO REMAIN |

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GROUP

EXISTING
CHANNEL
PROFILE

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
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DATE: 8/26/22
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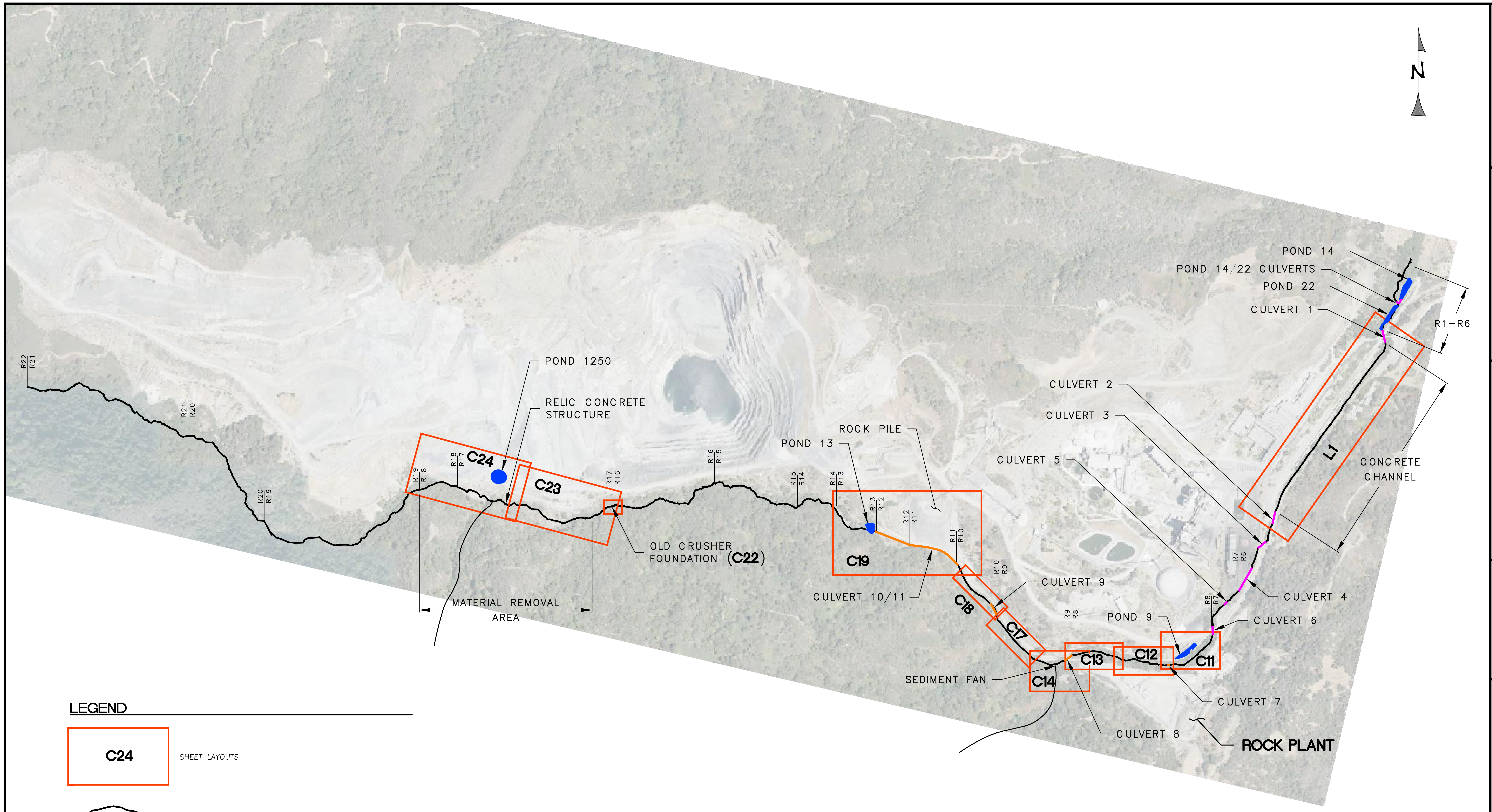
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C4



## LEGEND

| | |
|---|---|
| C24 | SHEET LAYOUTS |
| | PERMANENTE CREEK THALWEG ALIGNMENT 2013 |
| | TRIBUTARY (RELEVANT TO PROJECT) |
| 🟧 | EXISTING CULVERT TO BE REMOVED |
| 🟪 | EXISTING CULVERT TO REMAIN |

## SHEET LAYOUT OVERVIEW

SCALE: 1" = 500'

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GROUP

SHEET
LAYOUT
OVERVIEW

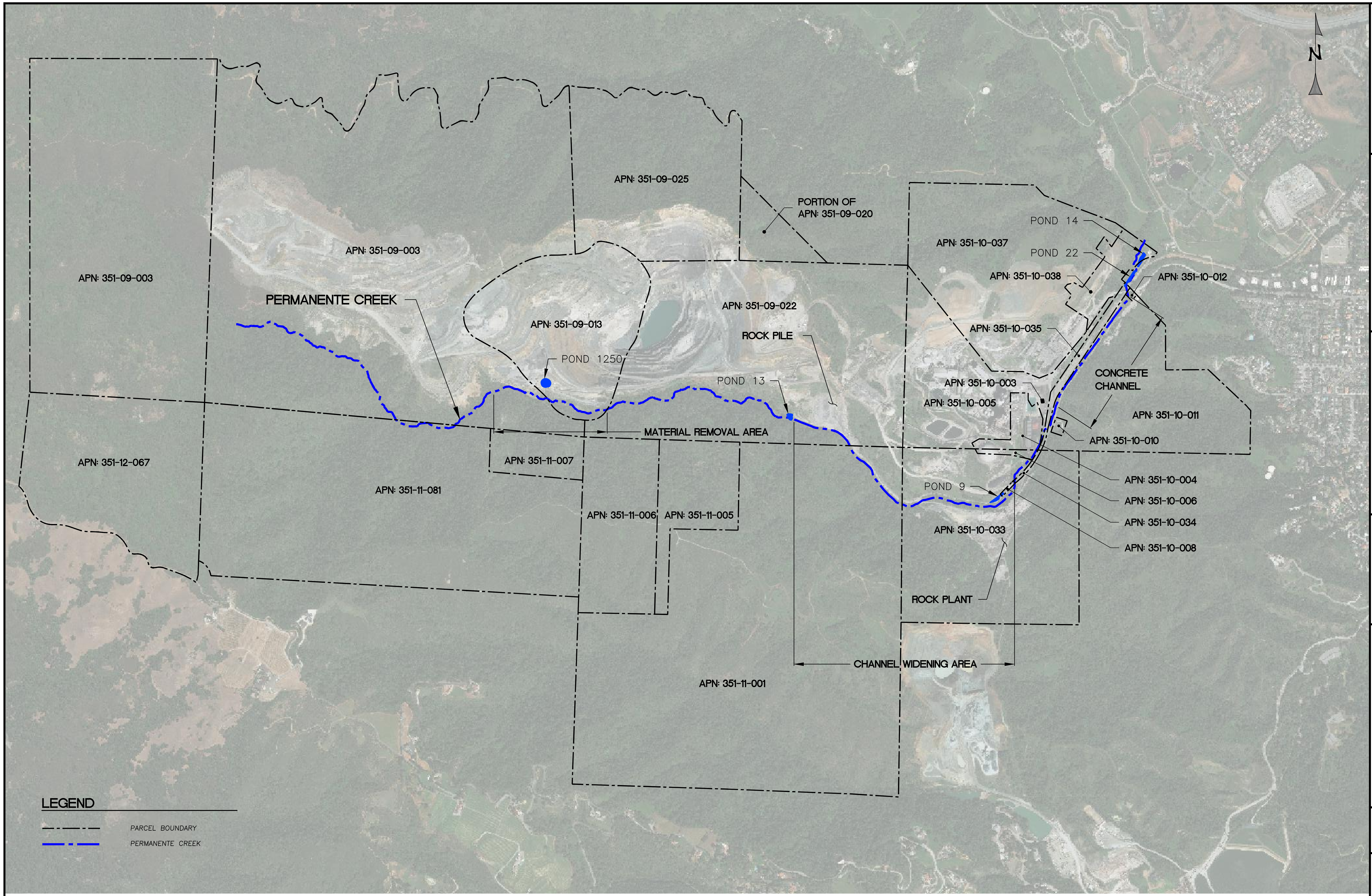
PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: B.M.S.
DRAWN BY: B.M.S.
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13–016

BAR IS ONE INCH ON
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C5

5
OF
47



**LEGEND**

| | |
|---|---|
| ‐ · ‐ · ‐ | PARCEL BOUNDARY |
| ▬ · ▬ · ▬ | PERMANENTE CREEK |

PARCEL BOUNDARY SOURCE:
SANTA CLARA COUNTY GIS WEBSITE (https://ges.sccgov.org/discovergis/sccmap)
DOWNLOADED JUNE 2022

## SITE PARCELS AND RIGHT-OF-WAY OVERLAY

SCALE: 1"=700'

NOTE:
THIS IS NOT A BOUNDARY SURVEY. PROPERTY LINES, WHERE SHOWN, WERE COMPILED FROM RECORD INFORMATION. THE LOCATION OF THESE LINES IS SUBJECT TO CHANGE, PENDING THE RESULTS OF A COMPLETE BOUNDARY SURVEY.

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GROUP

SITE PARCELS
AND
RIGHT-OF-WAY
OVERLAY

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: –
DRAWN BY: –
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13-016

BAR IS ONE INCH ON
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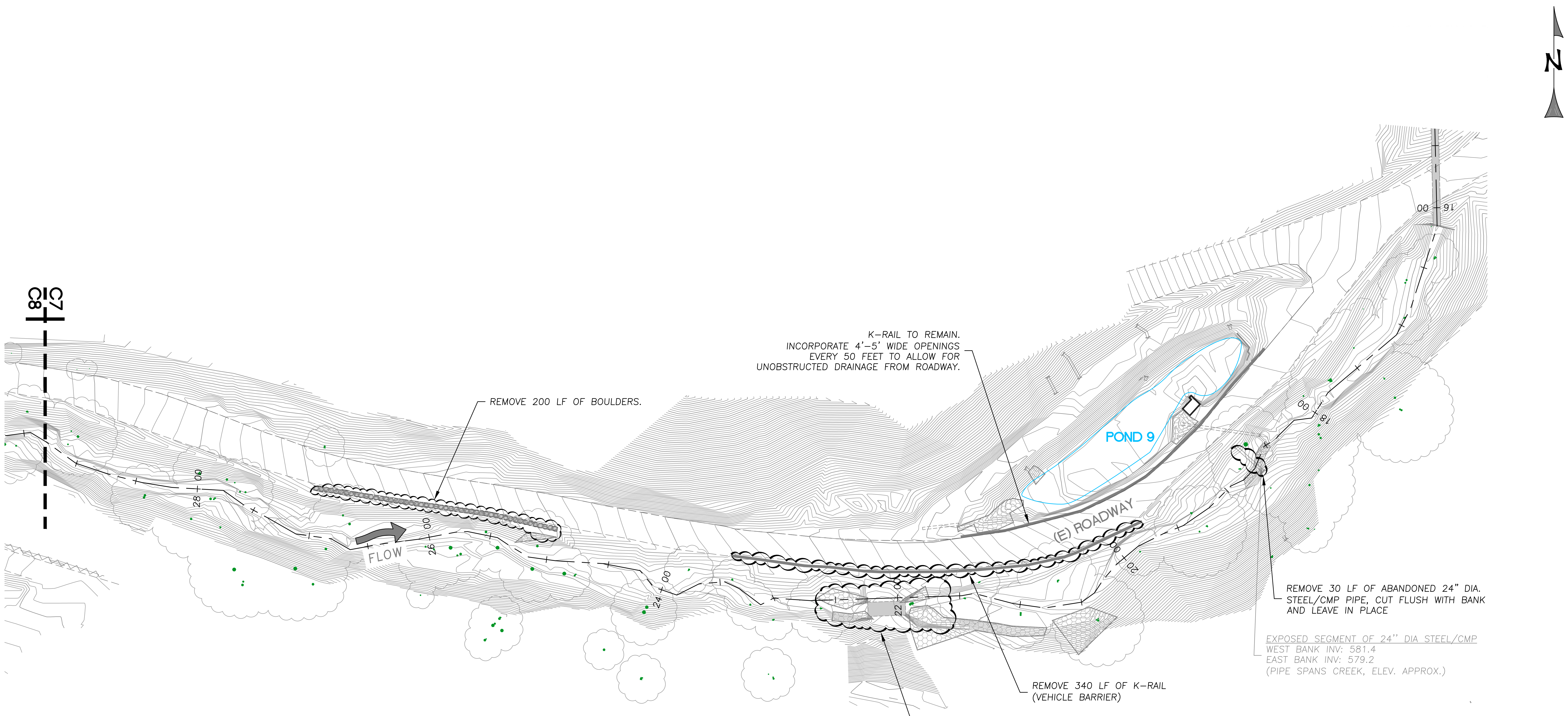
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C6



REMOVE 200 LF OF BOULDERS.

K–RAIL TO REMAIN.
INCORPORATE 4'–5' WIDE OPENINGS
EVERY 50 FEET TO ALLOW FOR
UNOBSTRUCTED DRAINAGE FROM ROADWAY.

REMOVE 30 LF OF ABANDONED 24" DIA.
STEEL/CMP PIPE, CUT FLUSH WITH BANK
AND LEAVE IN PLACE

EXPOSED SEGMENT OF 24" DIA STEEL/CMP
WEST BANK INV: 581.4
EAST BANK INV: 579.2
(PIPE SPANS CREEK, ELEV. APPROX.)

REMOVE 340 LF OF K–RAIL
(VEHICLE BARRIER)

REMOVE 30 LF OF 11.5' DIA. STEEL
CULVERT (CULVERT #7) AND APPROX. 1,100
SF OF ROCK SLOPE PROTECTION (THICKNESS
UNKNOWN) PER SITE PLAN, SHEET C11

## CHANNEL WIDENING DEMOLITION PLAN (1 OF 2)

SCALE: 1" = 50'

## LEGEND

| | |
|---|---|
| ● | (E) TREE |
| ═══ | (E) CONTOURS |
| – – – – – – | (E) EDGE OF ROAD |
| —— W —— | (E) WATER LINE |
| ▨ | (E) EXPOSED ROCK SLOPE PROTECTION |
| ══ ══ ══ | (E) CONVEYOR |
| 22+00 | DESIGN ALIGNMENT |

NOTES:
1. SEE SITE PLANS FOR TREES TO BE REMOVED.
2. REMOVE ALL CONCRETE UNDERLYING ROADWAYS WITHIN THE GRADING LIMITS (SEE SITE PLANS). PLAN EXTENT AND THICKNESS OF CONCRETE IS UNKNOWN.

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GROUP

CHANNEL
WIDENING
DEMOLITION
PLAN (1 OF 2)

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.S. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

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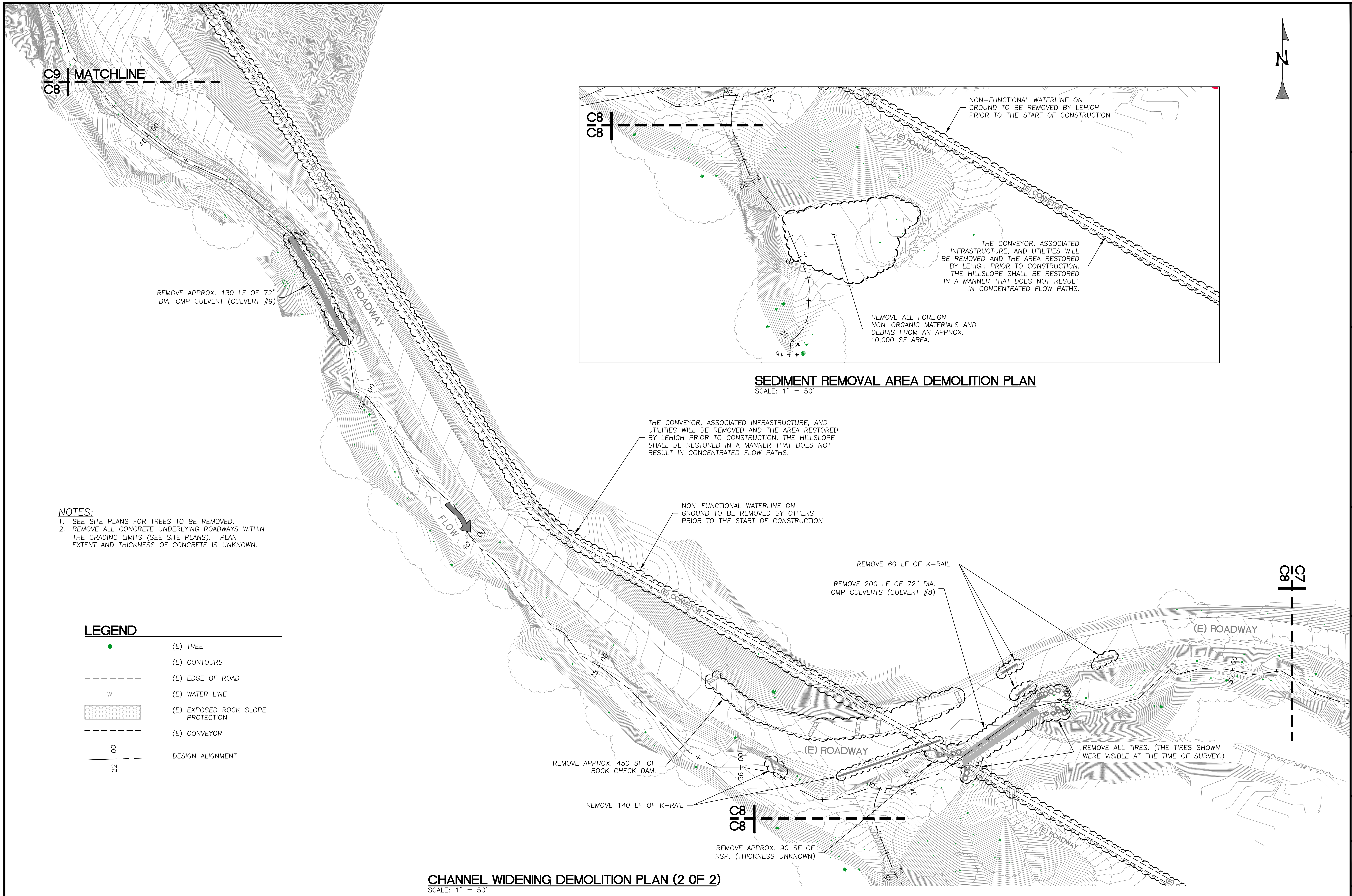
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C7

7
OF
47



REMOVE APPROX. 130 LF OF 72" DIA. CMP CULVERT (CULVERT #9)

THE CONVEYOR, ASSOCIATED INFRASTRUCTURE, AND UTILITIES WILL BE REMOVED AND THE AREA RESTORED BY LEHIGH PRIOR TO CONSTRUCTION. THE HILLSLOPE SHALL BE RESTORED IN A MANNER THAT DOES NOT RESULT IN CONCENTRATED FLOW PATHS.

NON-FUNCTIONAL WATERLINE ON GROUND TO BE REMOVED BY OTHERS PRIOR TO THE START OF CONSTRUCTION

REMOVE 60 LF OF K-RAIL

REMOVE 200 LF OF 72" DIA. CMP CULVERTS (CULVERT #8)

REMOVE ALL TIRES. (THE TIRES SHOWN WERE VISIBLE AT THE TIME OF SURVEY.)

REMOVE APPROX. 450 SF OF ROCK CHECK DAM.

REMOVE 140 LF OF K-RAIL

REMOVE APPROX. 90 SF OF RSP. (THICKNESS UNKNOWN)

NON-FUNCTIONAL WATERLINE ON GROUND TO BE REMOVED BY LEHIGH PRIOR TO THE START OF CONSTRUCTION

THE CONVEYOR, ASSOCIATED INFRASTRUCTURE, AND UTILITIES WILL BE REMOVED AND THE AREA RESTORED BY LEHIGH PRIOR TO CONSTRUCTION. THE HILLSLOPE SHALL BE RESTORED IN A MANNER THAT DOES NOT RESULT IN CONCENTRATED FLOW PATHS.

REMOVE ALL FOREIGN NON-ORGANIC MATERIALS AND DEBRIS FROM AN APPROX. 10,000 SF AREA.

## SEDIMENT REMOVAL AREA DEMOLITION PLAN

SCALE: 1" = 50'

## CHANNEL WIDENING DEMOLITION PLAN (2 OF 2)

SCALE: 1" = 50'

### NOTES:

1. SEE SITE PLANS FOR TREES TO BE REMOVED.
2. REMOVE ALL CONCRETE UNDERLYING ROADWAYS WITHIN THE GRADING LIMITS (SEE SITE PLANS). PLAN EXTENT AND THICKNESS OF CONCRETE IS UNKNOWN.

### LEGEND

| | |
|---|---|
| ● | (E) TREE |
| ══════ | (E) CONTOURS |
| – – – – – – | (E) EDGE OF ROAD |
| —— W —— | (E) WATER LINE |
| ▨ | (E) EXPOSED ROCK SLOPE PROTECTION |
| ═ ═ ═ ═ | (E) CONVEYOR |
| 22 + 00 | DESIGN ALIGNMENT |

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PREPARED AT THE REQUEST OF:

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HEIDELBERG CEMENT
GROUP

CHANNEL
WIDENING
DEMOLITION
PLAN (2 OF 2)

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.S. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

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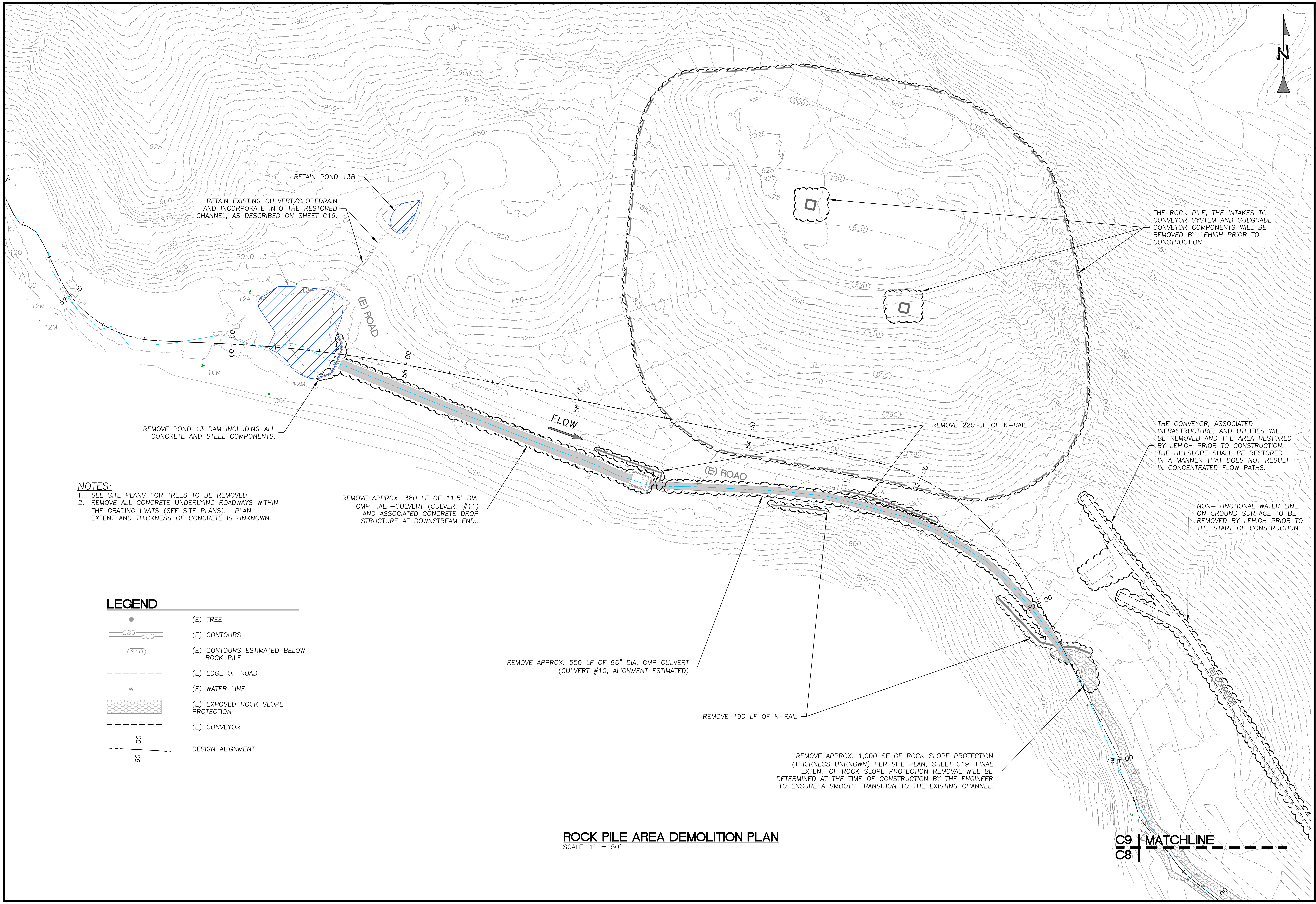
0 1"

C8



RETAIN POND 13B

RETAIN EXISTING CULVERT/SLOPEDRAIN AND INCORPORATE INTO THE RESTORED CHANNEL, AS DESCRIBED ON SHEET C19.

REMOVE POND 13 DAM INCLUDING ALL CONCRETE AND STEEL COMPONENTS.

THE ROCK PILE, THE INTAKES TO CONVEYOR SYSTEM AND SUBGRADE CONVEYOR COMPONENTS WILL BE REMOVED BY LEHIGH PRIOR TO CONSTRUCTION.

REMOVE 220 LF OF K–RAIL

THE CONVEYOR, ASSOCIATED INFRASTRUCTURE, AND UTILITIES WILL BE REMOVED AND THE AREA RESTORED BY LEHIGH PRIOR TO CONSTRUCTION. THE HILLSLOPE SHALL BE RESTORED IN A MANNER THAT DOES NOT RESULT IN CONCENTRATED FLOW PATHS.

NON–FUNCTIONAL WATER LINE ON GROUND SURFACE TO BE REMOVED BY LEHIGH PRIOR TO THE START OF CONSTRUCTION.

REMOVE APPROX. 380 LF OF 11.5' DIA. CMP HALF–CULVERT (CULVERT #11) AND ASSOCIATED CONCRETE DROP STRUCTURE AT DOWNSTREAM END..

REMOVE APPROX. 550 LF OF 96" DIA. CMP CULVERT (CULVERT #10, ALIGNMENT ESTIMATED)

REMOVE 190 LF OF K–RAIL

REMOVE APPROX. 1,000 SF OF ROCK SLOPE PROTECTION (THICKNESS UNKNOWN) PER SITE PLAN, SHEET C19. FINAL EXTENT OF ROCK SLOPE PROTECTION REMOVAL WILL BE DETERMINED AT THE TIME OF CONSTRUCTION BY THE ENGINEER TO ENSURE A SMOOTH TRANSITION TO THE EXISTING CHANNEL.

## NOTES:

1. SEE SITE PLANS FOR TREES TO BE REMOVED.
2. REMOVE ALL CONCRETE UNDERLYING ROADWAYS WITHIN THE GRADING LIMITS (SEE SITE PLANS). PLAN EXTENT AND THICKNESS OF CONCRETE IS UNKNOWN.

## LEGEND

| | |
|---|---|
| ● | (E) TREE |
| —585— —586— | (E) CONTOURS |
| — (810) — | (E) CONTOURS ESTIMATED BELOW ROCK PILE |
| – – – – – – – | (E) EDGE OF ROAD |
| —— W —— | (E) WATER LINE |
| ▨ | (E) EXPOSED ROCK SLOPE PROTECTION |
| ======= | (E) CONVEYOR |
| —·—60+00—·— | DESIGN ALIGNMENT |

## ROCK PILE AREA DEMOLITION PLAN

SCALE: 1" = 50'

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HEIDELBERG CEMENT GROUP

ROCK PILE
AREA
DEMOLITION
PLAN

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: B.M.Z.
DRAWN BY: B.R.S
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13–016

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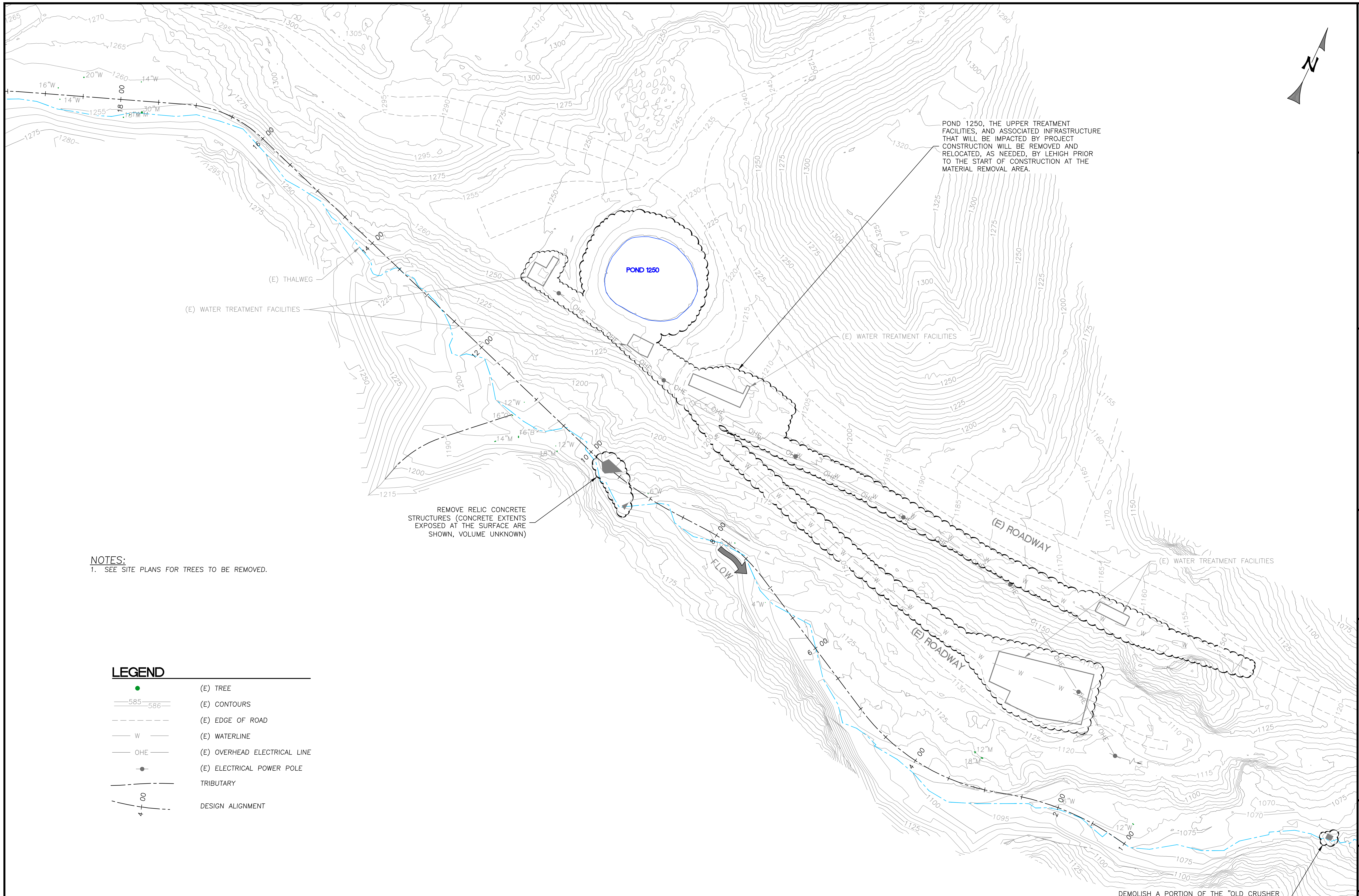
0 1"

C9
9 OF 47



NOTES:
1. SEE SITE PLANS FOR TREES TO BE REMOVED.

## LEGEND

| | |
|---|---|
| ● | (E) TREE |
| 585 586 | (E) CONTOURS |
| — — — | (E) EDGE OF ROAD |
| W | (E) WATERLINE |
| OHE | (E) OVERHEAD ELECTRICAL LINE |
| ● | (E) ELECTRICAL POWER POLE |
| —·—·— | TRIBUTARY |
| 4+00 | DESIGN ALIGNMENT |

## MATERIAL REMOVAL AREA AND "OLD CRUSHER FOUNDATION" DEMOLITION PLAN

SCALE: 1" = 60'

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GROUP

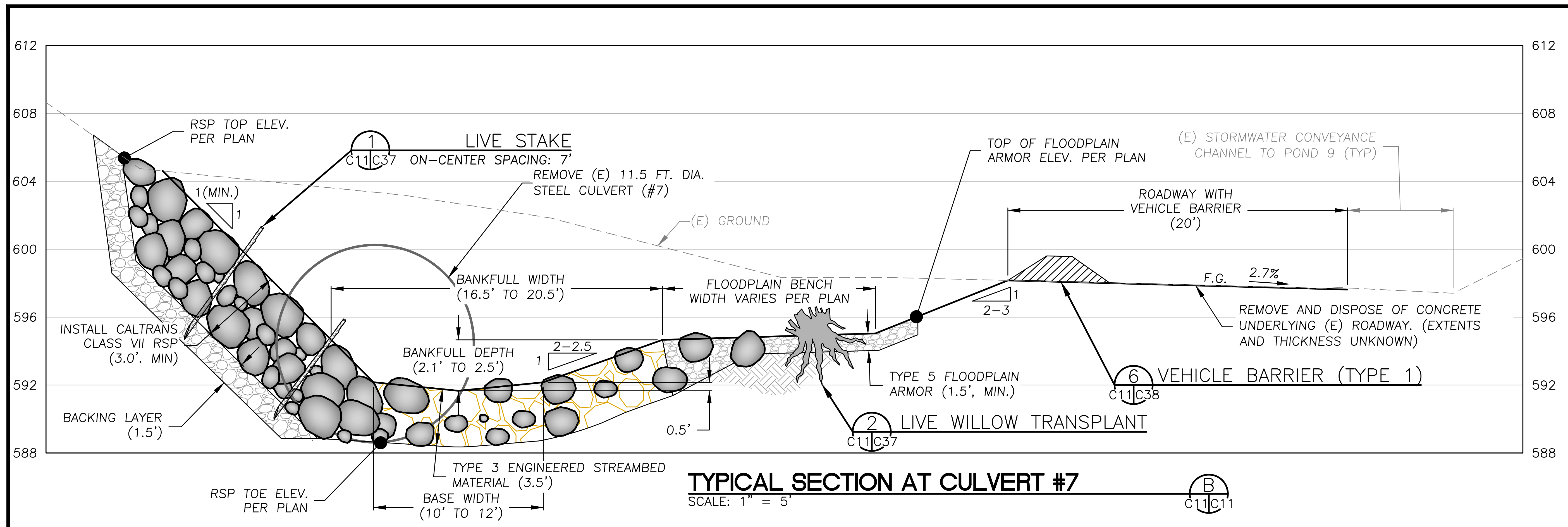
MAT. REMOVAL
AREA AND OLD
CRUSHER
FOUNDATION
DEMO. PLAN

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.Z. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

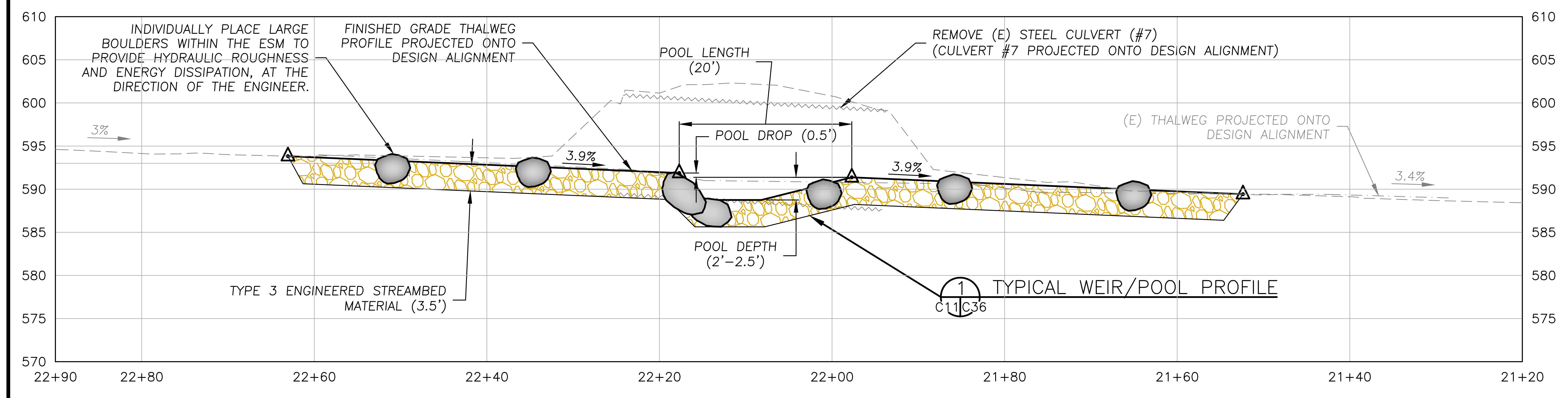
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C10



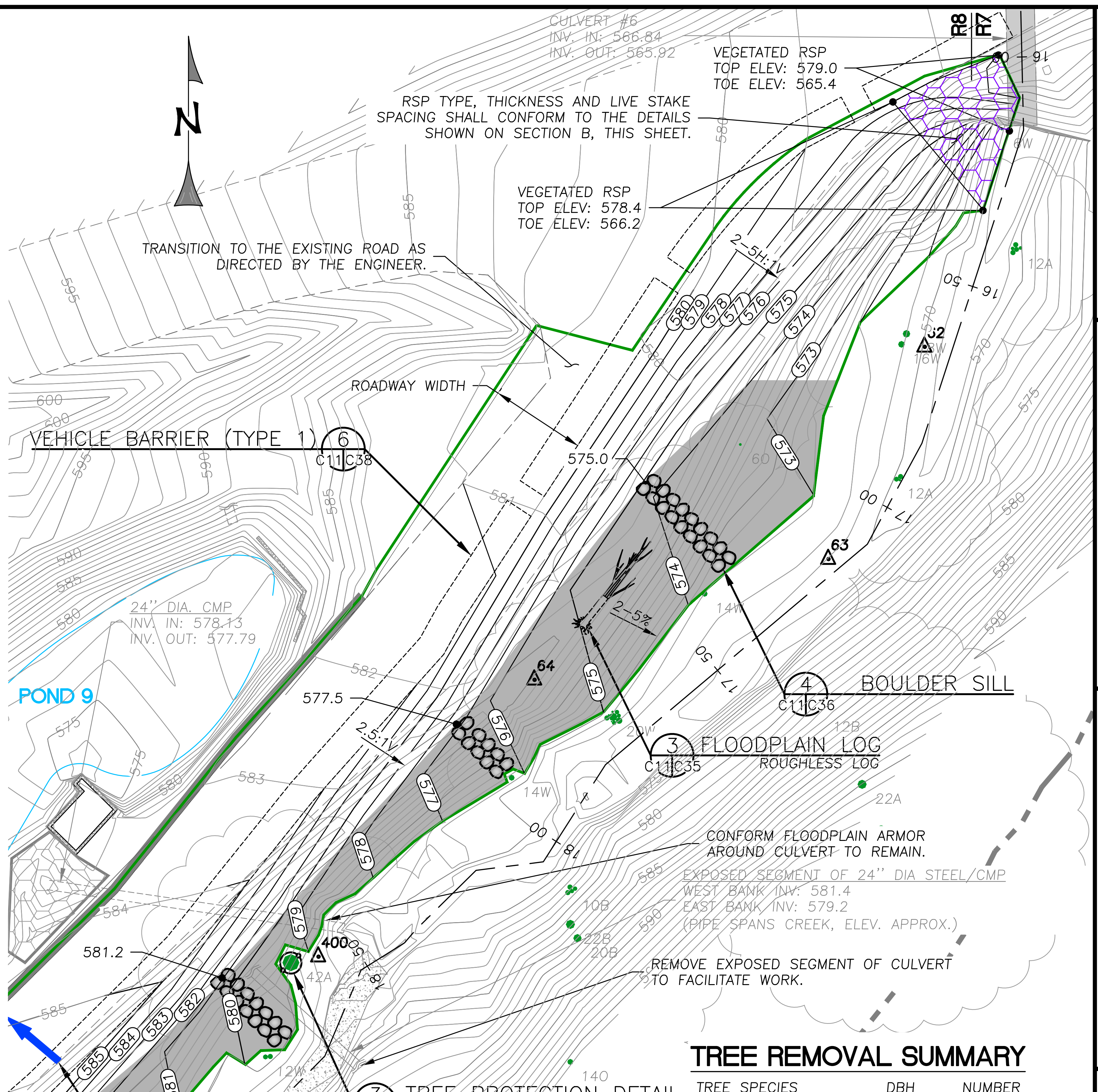
## TYPICAL SECTION AT CULVERT #7

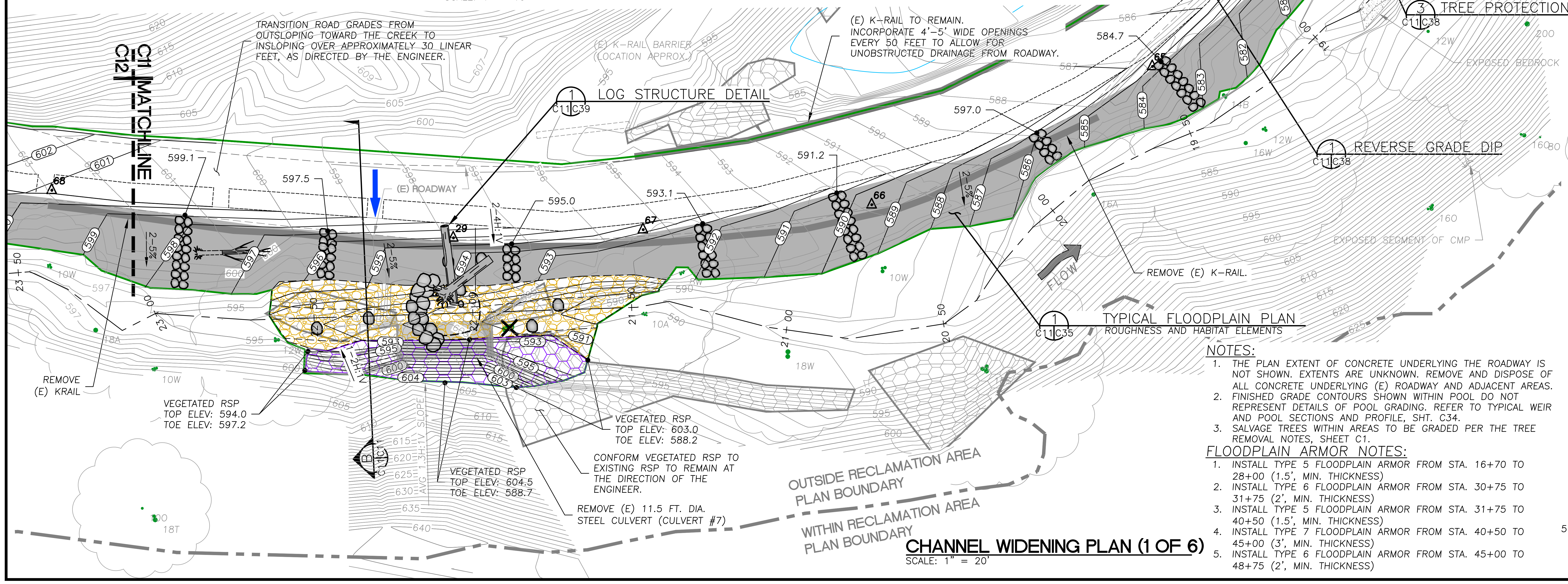
SCALE: 1" = 5'



## CULVERT #7 CHANNEL PROFILE

SCALE: 1" = 10'





## CHANNEL WIDENING PLAN (1 OF 6)

SCALE: 1" = 20'

NOTES:

1. THE PLAN EXTENT OF CONCRETE UNDERLYING THE ROADWAY IS NOT SHOWN. EXTENTS ARE UNKNOWN. REMOVE AND DISPOSE OF ALL CONCRETE UNDERLYING (E) ROADWAY AND ADJACENT AREAS.
2. FINISHED GRADE CONTOURS SHOWN WITHIN POOL DO NOT REPRESENT DETAILS OF POOL GRADING. REFER TO TYPICAL WEIR AND POOL SECTIONS AND PROFILE, SHT. C34.
3. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEET C1.

FLOODPLAIN ARMOR NOTES:

1. INSTALL TYPE 5 FLOODPLAIN ARMOR FROM STA. 16+70 TO 28+00 (1.5', MIN. THICKNESS)
2. INSTALL TYPE 6 FLOODPLAIN ARMOR FROM STA. 30+75 TO 31+75 (2', MIN. THICKNESS)
3. INSTALL TYPE 5 FLOODPLAIN ARMOR FROM STA. 31+75 TO 40+50 (1.5', MIN. THICKNESS)
4. INSTALL TYPE 7 FLOODPLAIN ARMOR FROM STA. 40+50 TO 45+00 (3', MIN. THICKNESS)
5. INSTALL TYPE 6 FLOODPLAIN ARMOR FROM STA. 45+00 TO 48+75 (2', MIN. THICKNESS)

## TREE REMOVAL SUMMARY

| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| ALDER (DOUBLE STEM) | 24" | 1 |

NOTE:
THE TREE REMOVAL SUMMARY IS FOR STA. 16+20 TO STA. 23+50.

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE AND DRIPLINE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| — — | (E) THALWEG ALIGNMENT |
| – – – – | (E) EDGE OF ROAD |
| W | (E) WATER LINE |
| SD | (E) STORM DRAIN LINE |
| ⬡ | (E) EXPOSED ROCK SLOPE PROTECTION |
| — | LIMITS OF GRADING (APPROX.) |
| ▩ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| ⬡ | VEGETATED ROCK SLOPE PROTECTION |
| R9 \| R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" (URS, 2011) |
| — - — | RECLAMATION AREA PLAN BOUNDARY |
| → | REVERSE GRADE DIP |
| 577.5 ● | BOULDER SILL (WITH TOP ELEVATION) |
| ☐ | VEHICLE BARRIER |

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# PRELIMINARY

NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

CHANNEL
WIDENING PLAN
(1 OF 6)

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

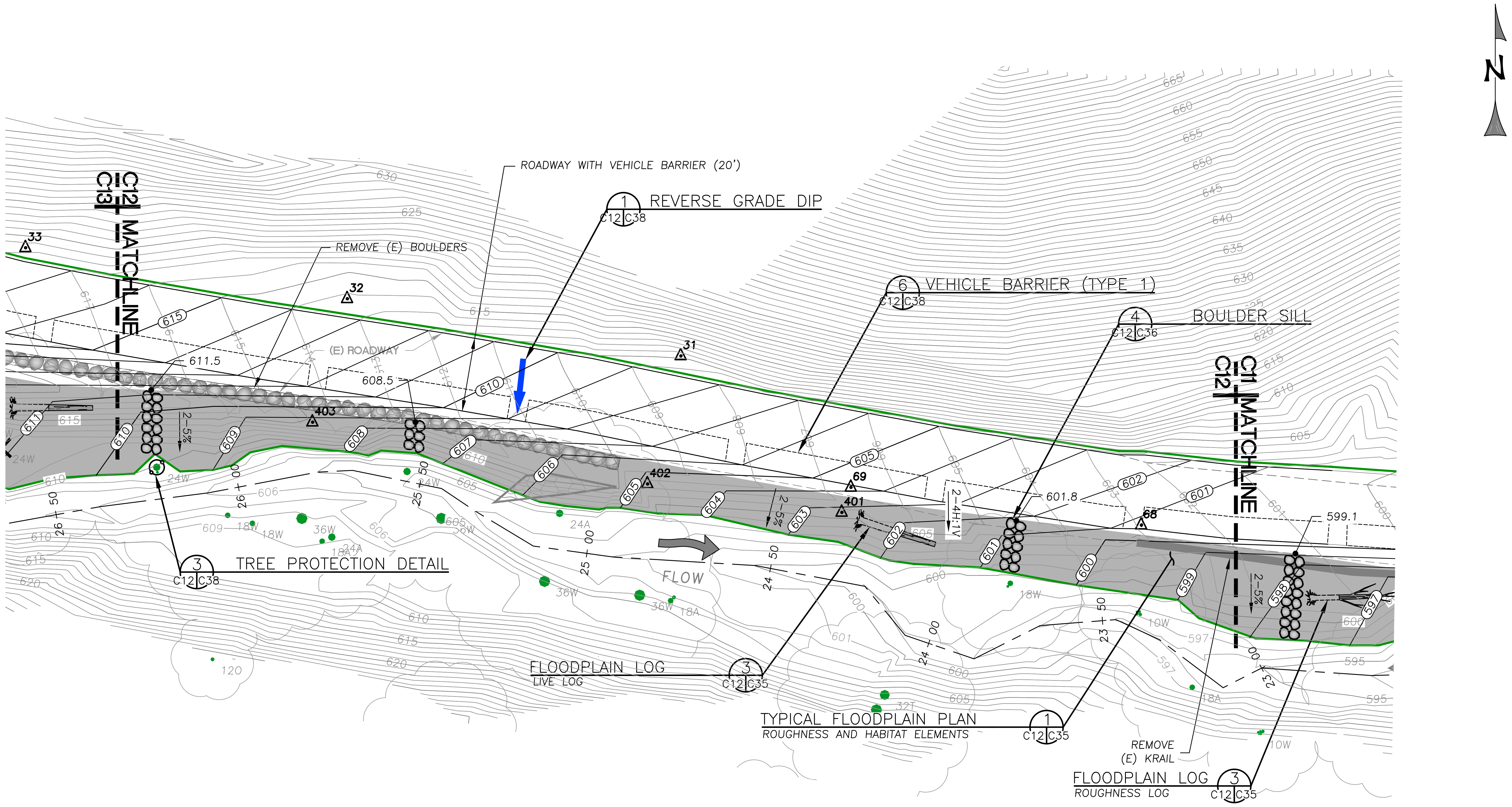
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.Z. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C11

11 OF 47



## CHANNEL WIDENING PLAN (2 OF 6)

SCALE: 1" = 20'

NOTES:

1. THE PLAN EXTENT OF CONCRETE UNDERLYING THE ROADWAY IS NOT SHOWN. EXTENTS ARE UNKNOWN. REMOVE AND DISPOSE OF ALL CONCRETE UNDERLYING (E) ROADWAY AND ADJACENT AREAS.
2. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEET C1.

FLOODPLAIN ARMOR NOTES:

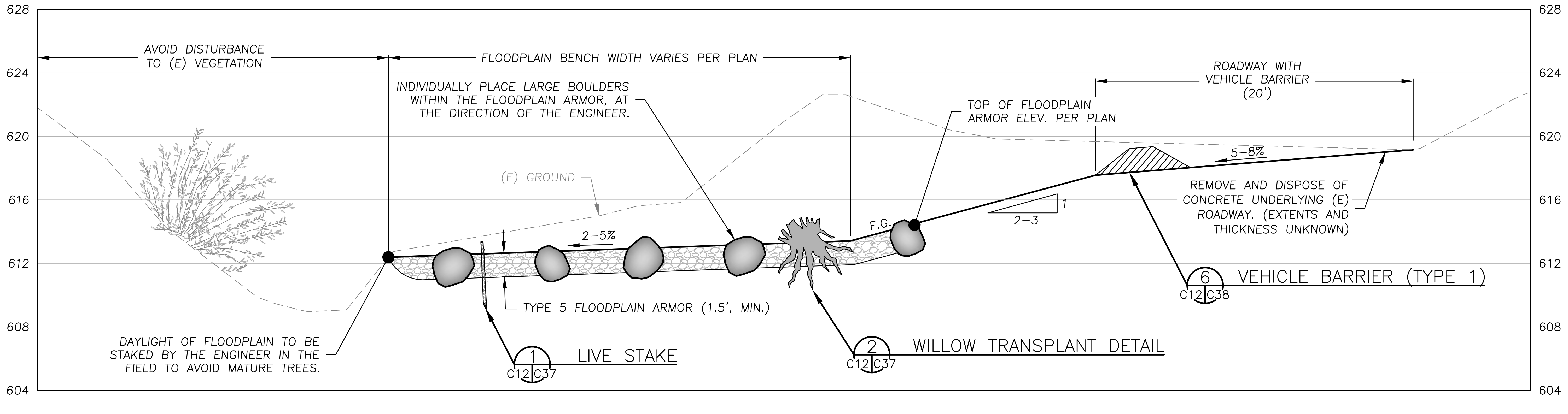
SEE FLOODPLAIN ARMOR NOTES ON SHEET C11 FOR FLOODPLAIN ARMOR TYPE, THICKNESS AND LOCATION.

## TREE REMOVAL SUMMARY

SEE SHEET C11 FOR TREES REMOVED DOWNSTREAM OF STA. 23+50 AND SHEET C13 AND C14 FOR TREES REMOVED UPSTREAM OF STA. 26+50.

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| 8"A | (E) TREE AND DRIPLINE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| — — | (E) THALWEG ALIGNMENT |
| - - - - | (E) EDGE OF ROAD |
| W | (E) WATER LINE |
| SD | (E) STORM DRAIN LINE |
| ▨ | (E) EXPOSED ROCK SLOPE PROTECTION |
| — | LIMITS OF GRADING (APPROX.) |
| ▨ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| ▨ | VEGETATED ROCK SLOPE PROTECTION |
| → | REVERSE GRADE DIP |
| 577.5 ○○○○ | BOULDER SILL (WITH TOP ELEVATION) |



## TYPICAL SECTION

C C13 C12

SCALE: 1" = 5'

NOTES:

SEE REVEGETATION SHEETS (L1–L5) FOR DETAILS REGARDING SPACING OF LIVE STAKES AND WILLOW TRANSPLANTS.

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PRELIMINARY
NOT FOR CONSTRUCTION

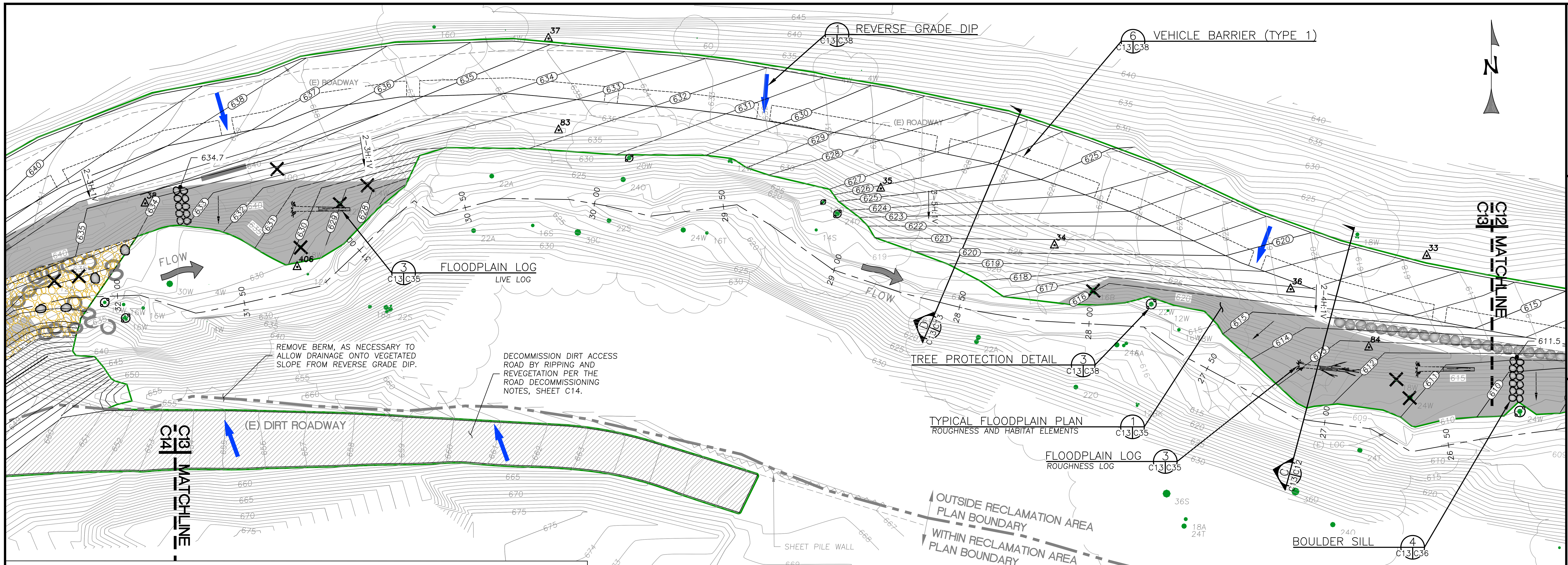
PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

CHANNEL
WIDENING PLAN
(2 OF 6)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.S. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"



## CHANNEL WIDENING PLAN (3 OF 6)

SCALE: 1" = 20'

*NOTES:*

1. THE PLAN EXTENT OF CONCRETE UNDERLYING THE ROADWAY IS NOT SHOWN. EXTENTS ARE UNKNOWN. REMOVE AND DISPOSE OF ALL CONCRETE UNDERLYING (E) ROADWAY AND ADJACENT AREAS.
2. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEET C1.

*FLOODPLAIN ARMOR NOTES:*

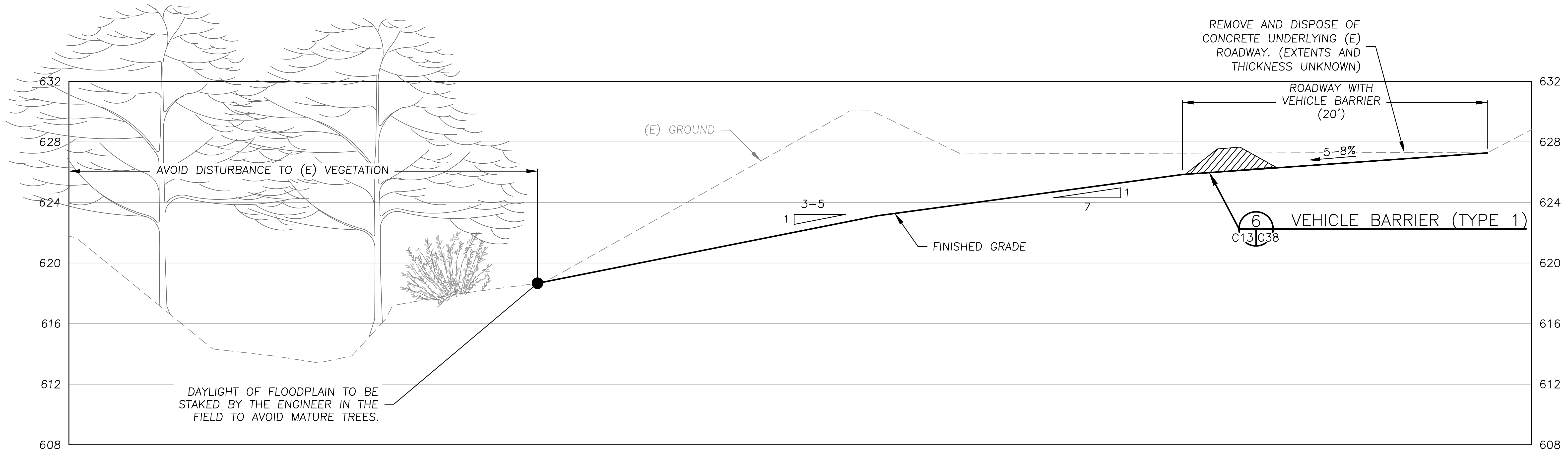
SEE THE FLOODPLAIN ARMOR NOTES ON SHEET C11 FOR FLOODPLAIN ARMOR TYPE, THICKNESS AND LOCATION.

## TREE REMOVAL SUMMARY

| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| WILLOW | 14" | 1 |
| WILLOW | 18" | 2 |
| WILLOW | 24" | 1 |
| WILLOW | 22" | 1 |
| OAK | 10" | 1 |
| BAY | 16" | 1 |

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE AND DRIPLINE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| — – — | (E) THALWEG ALIGNMENT |
| - - - - | (E) EDGE OF ROAD |
| — W — | (E) WATER LINE |
| —SD— | (E) STORM DRAIN LINE |
| ⬡ | (E) EXPOSED ROCK SLOPE PROTECTION |
| — | LIMITS OF GRADING (APPROX.) |
| ▩ | FLOODPLAIN ARMOR |
| ⬡ | ENGINEERED STREAMBED MATERIAL |
| ⬡ | VEGETATED ROCK SLOPE PROTECTION |
| ▨ | ROAD DECOMMISSIONING AREA |
| R9 \| R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| ▬ ▬ ▬ | RECLAMATION AREA PLAN BOUNDARY |
| ➡ | REVERSE GRADE DIP |
| 577.5 ● | BOULDER SILL (WITH TOP ELEVATION) |
| ☐ | VEHICLE BARRIER |



## TYPICAL SECTION

D C13 C13

SCALE: 1" = 5'

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GROUP

CHANNEL
WIDENING PLAN
(3 OF 6)

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.S. |
| DRAWN BY: | B.M.S. |
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| DATE: | 8/26/22 |
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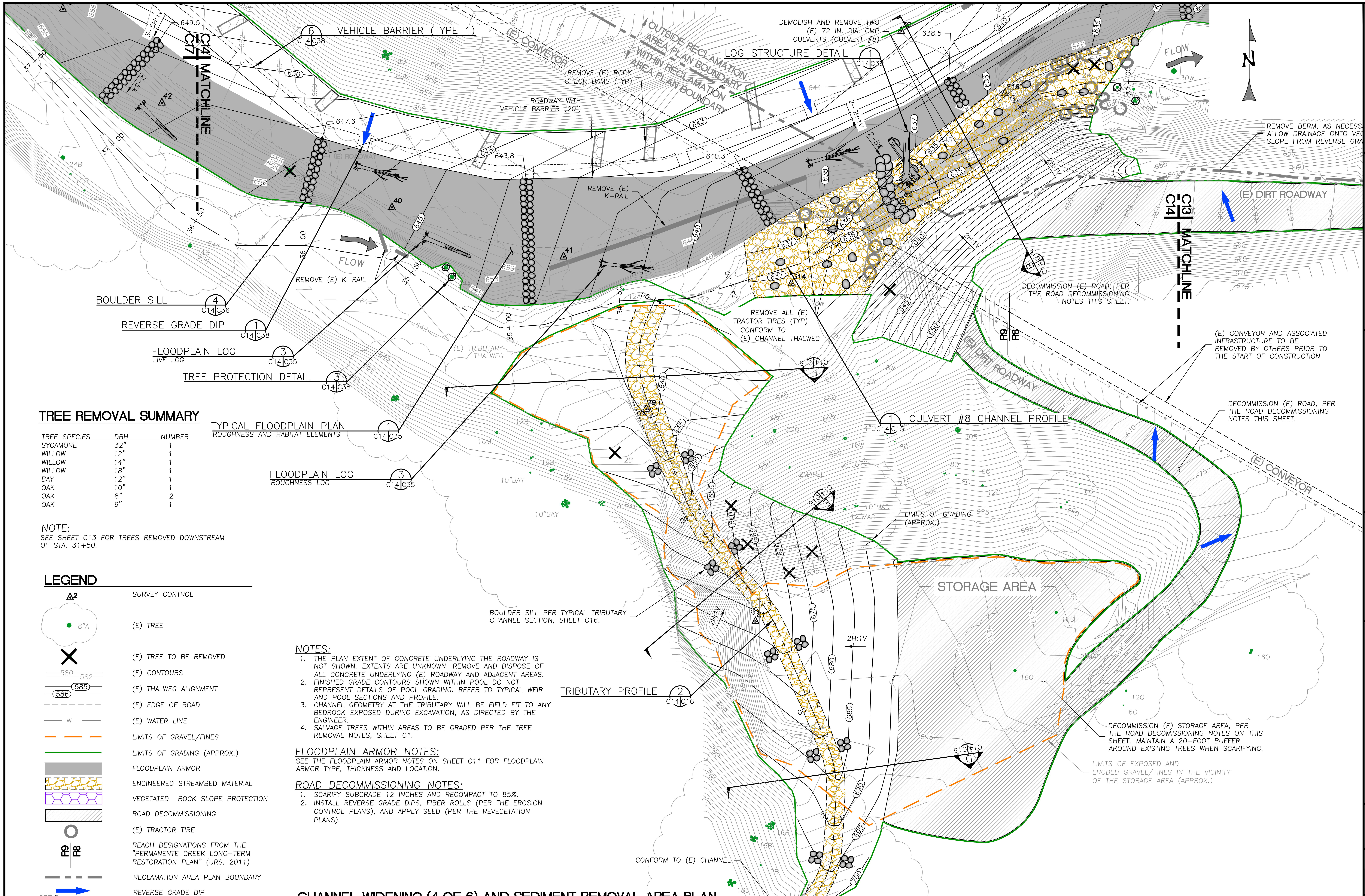
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C13



## TREE REMOVAL SUMMARY

| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| SYCAMORE | 32" | 1 |
| WILLOW | 12" | 1 |
| WILLOW | 14" | 1 |
| WILLOW | 18" | 1 |
| BAY | 12" | 1 |
| OAK | 10" | 1 |
| OAK | 8" | 2 |
| OAK | 6" | 1 |

NOTE:
SEE SHEET C13 FOR TREES REMOVED DOWNSTREAM OF STA. 31+50.

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | (E) THALWEG ALIGNMENT |
| – – – – | (E) EDGE OF ROAD |
| — W — | (E) WATER LINE |
| – – – | LIMITS OF GRAVEL/FINES |
| — | LIMITS OF GRADING (APPROX.) |
| ▬ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| ▨ | VEGETATED ROCK SLOPE PROTECTION |
| ▨ | ROAD DECOMMISSIONING |
| ○ | (E) TRACTOR TIRE |
| R9 \| R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| — – – — | RECLAMATION AREA PLAN BOUNDARY |
| → | REVERSE GRADE DIP |
| 577.5 ●●●● | BOULDER SILL (WITH TOP ELEVATION) |
| ☐ | VEHICLE BARRIER |

NOTES:
1. THE PLAN EXTENT OF CONCRETE UNDERLYING THE ROADWAY IS NOT SHOWN. EXTENTS ARE UNKNOWN. REMOVE AND DISPOSE OF ALL CONCRETE UNDERLYING (E) ROADWAY AND ADJACENT AREAS.
2. FINISHED GRADE CONTOURS SHOWN WITHIN POOL DO NOT REPRESENT DETAILS OF POOL GRADING. REFER TO TYPICAL WEIR AND POOL SECTIONS AND PROFILE.
3. CHANNEL GEOMETRY AT THE TRIBUTARY WILL BE FIELD FIT TO ANY BEDROCK EXPOSED DURING EXCAVATION, AS DIRECTED BY THE ENGINEER.
4. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEET C1.

FLOODPLAIN ARMOR NOTES:
SEE THE FLOODPLAIN ARMOR NOTES ON SHEET C11 FOR FLOODPLAIN ARMOR TYPE, THICKNESS AND LOCATION.

ROAD DECOMMISSIONING NOTES:
1. SCARIFY SUBGRADE 12 INCHES AND RECOMPACT TO 85%.
2. INSTALL REVERSE GRADE DIPS, FIBER ROLLS (PER THE EROSION CONTROL PLANS), AND APPLY SEED (PER THE REVEGETATION PLANS).

## CHANNEL WIDENING (4 OF 6) AND SEDIMENT REMOVAL AREA PLAN

SCALE: 1" = 20'

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PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

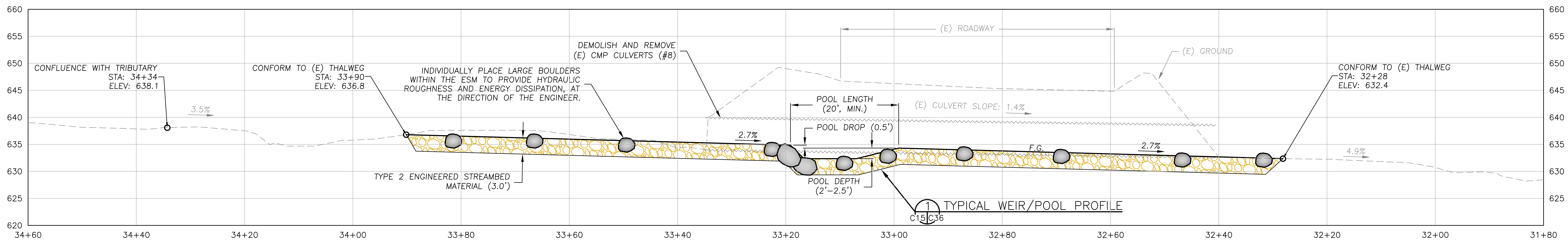
CHANNEL
WIDENING PLAN
(4 OF 6) AND
SEDIMENT
REMOVAL AREA

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

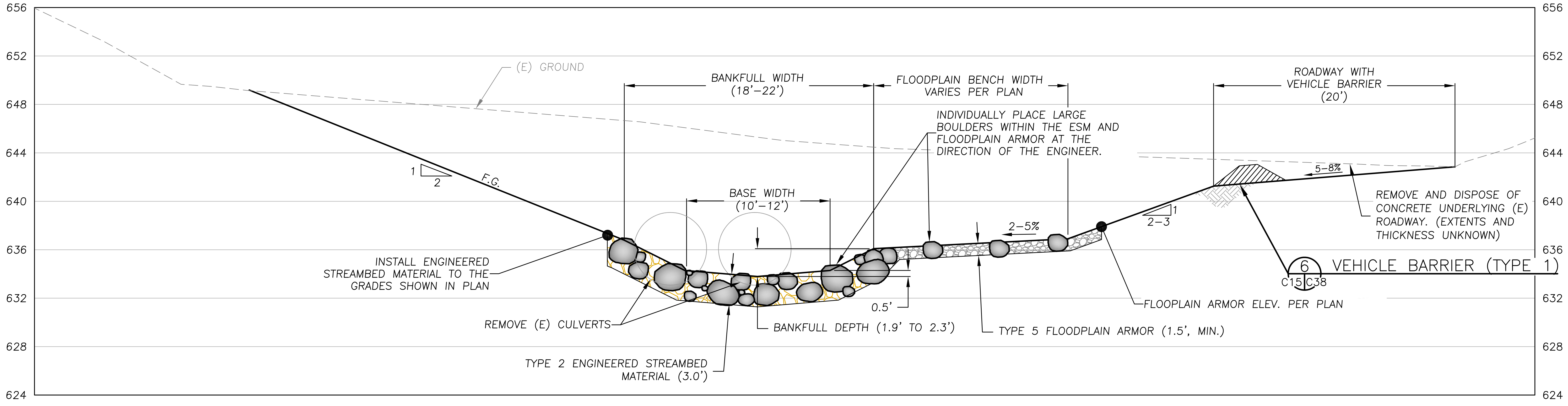
| | |
|---|---|
| DESIGNED BY: | B.Z. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C14
14
OF
47



**CULVERT #8 CHANNEL PROFILE** 1 C14 C15
SCALE: 1" = 10'



**TYPICAL SECTION AT CULVERT #8 SECTION** B C14 C15
SCALE: 1" = 6'

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NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
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HEIDELBERG CEMENT
GROUP

CULVERT #8
PROFILE AND
SECTION

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.Z. |
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| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
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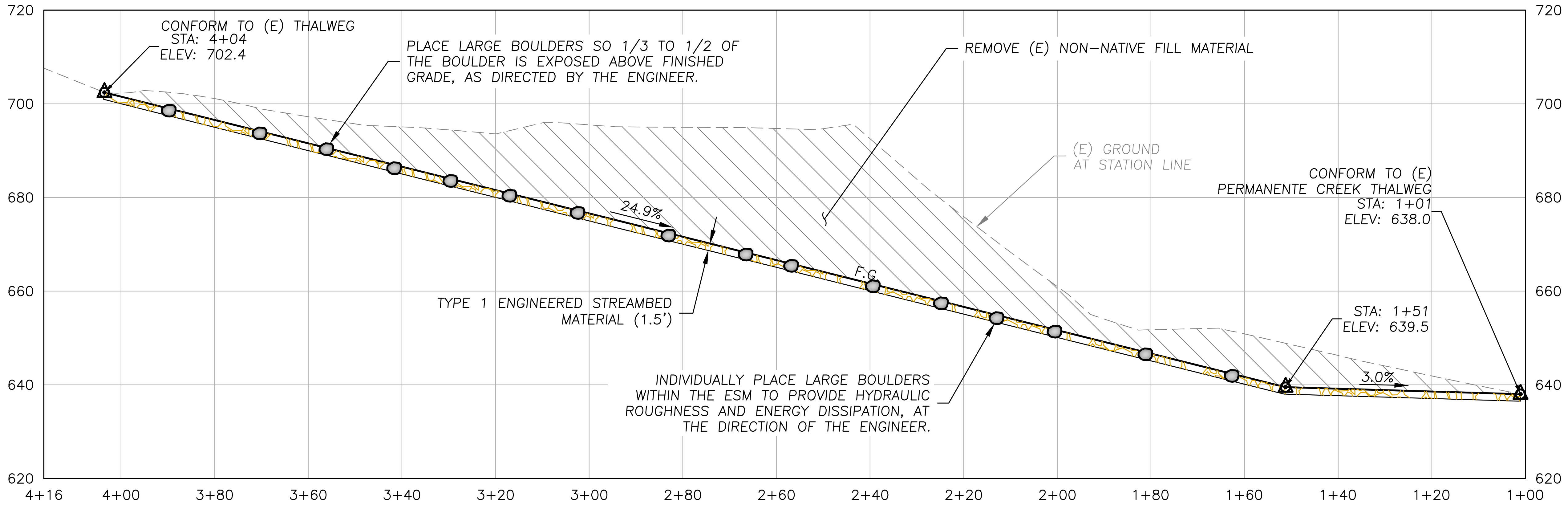
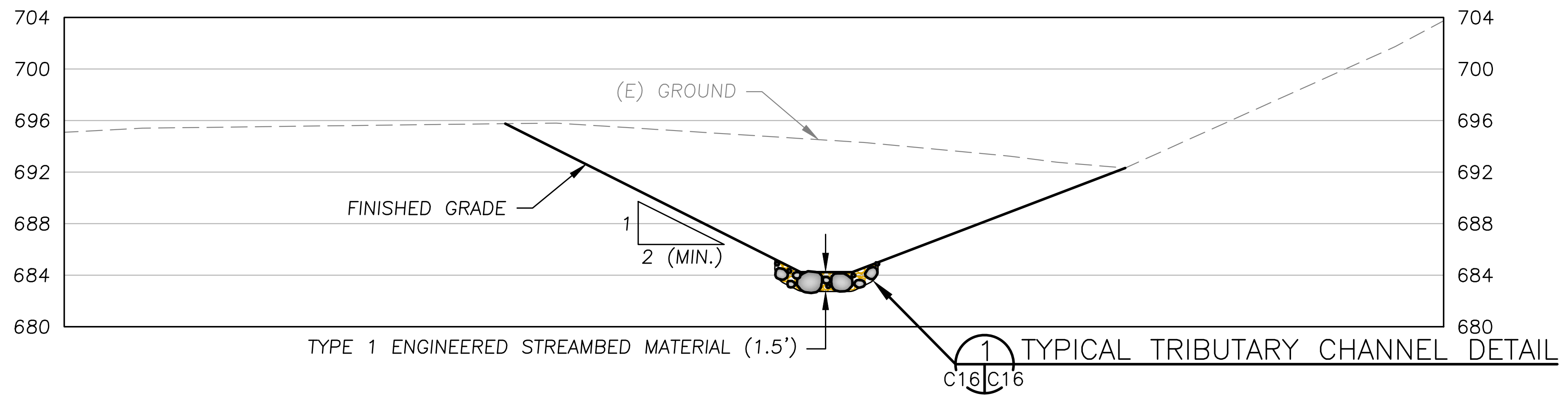
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C15
15 OF 47

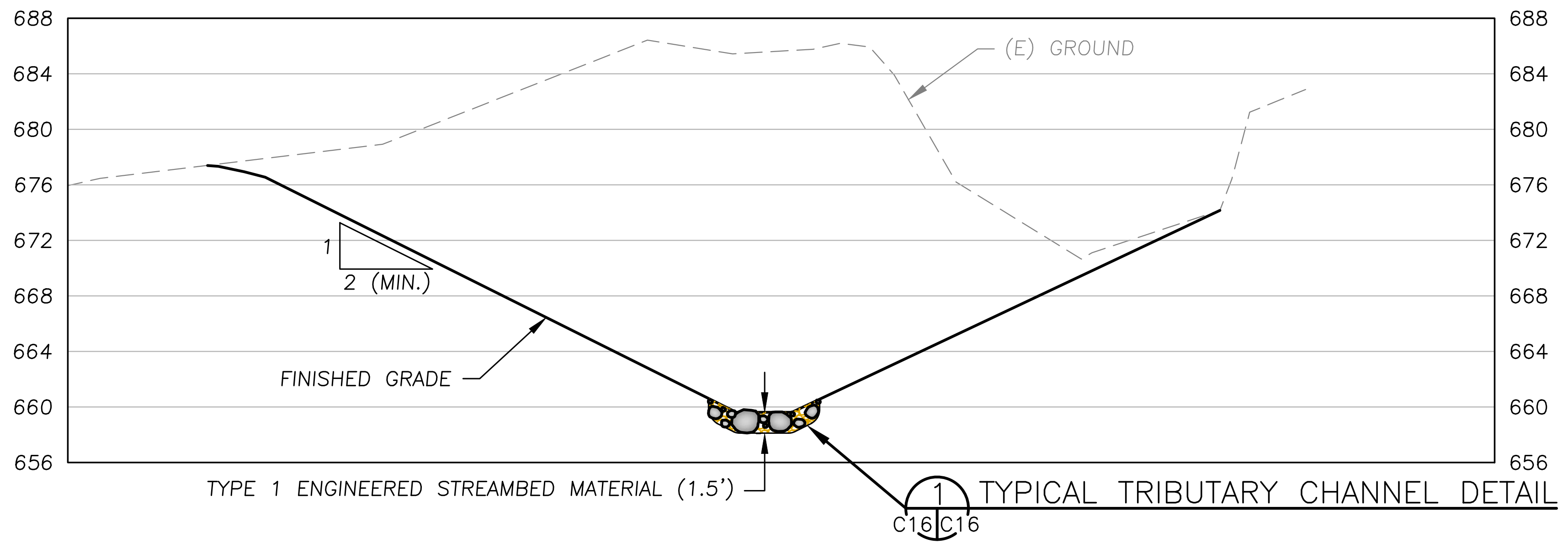


## TRIBUTARY PROFILE (2 / C14|C16)
SCALE: 1" = 20'

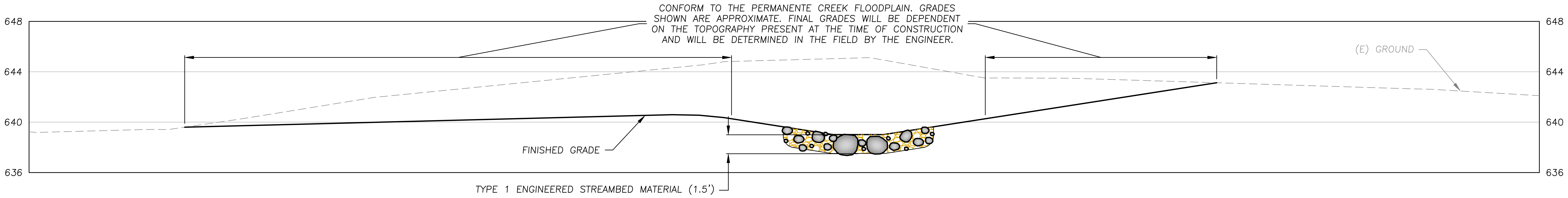
NOTE:
1. FINISHED GRADES SHOWN ARE APPROXIMATE. ALL IMPORTED FILL SHALL BE REMOVED FROM THE CHANNEL BED AND BANKS.
2. CHANNEL GEOMETRY AT THE TRIBUTARY WILL BE FIELD FIT TO ANY BEDROCK EXPOSED DURING EXCAVATION, AS DIRECTED BY THE ENGINEER.
3. CONFORM ENGINEERED STREAMBED MATERIAL TO THE EXISTING CHANNEL AT THE UPSTREAM AND DOWNSTREAM END AS DIRECTED BY THE ENGINEER.



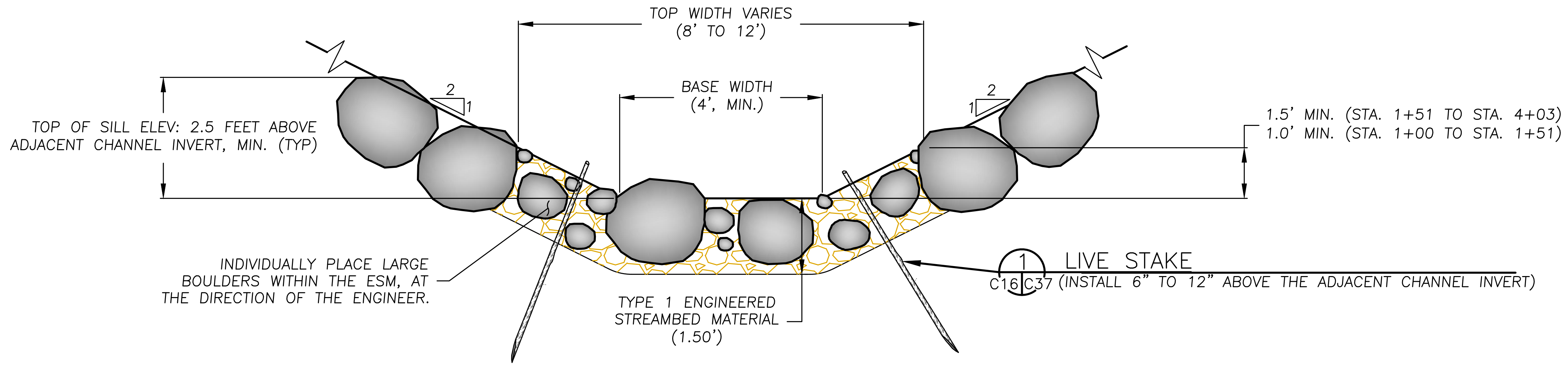
## SECTION (D / C14|C16)
SCALE: 1" = 10'



## SECTION (E / C14|C16)
SCALE: 1" = 10'



## SECTION (F / C14|C16)
SCALE: 1" = 5'



## TYPICAL TRIBUTARY CHANNEL DETAIL (1 / C16|C16)
SCALE: 1" = 2'

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PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT GROUP

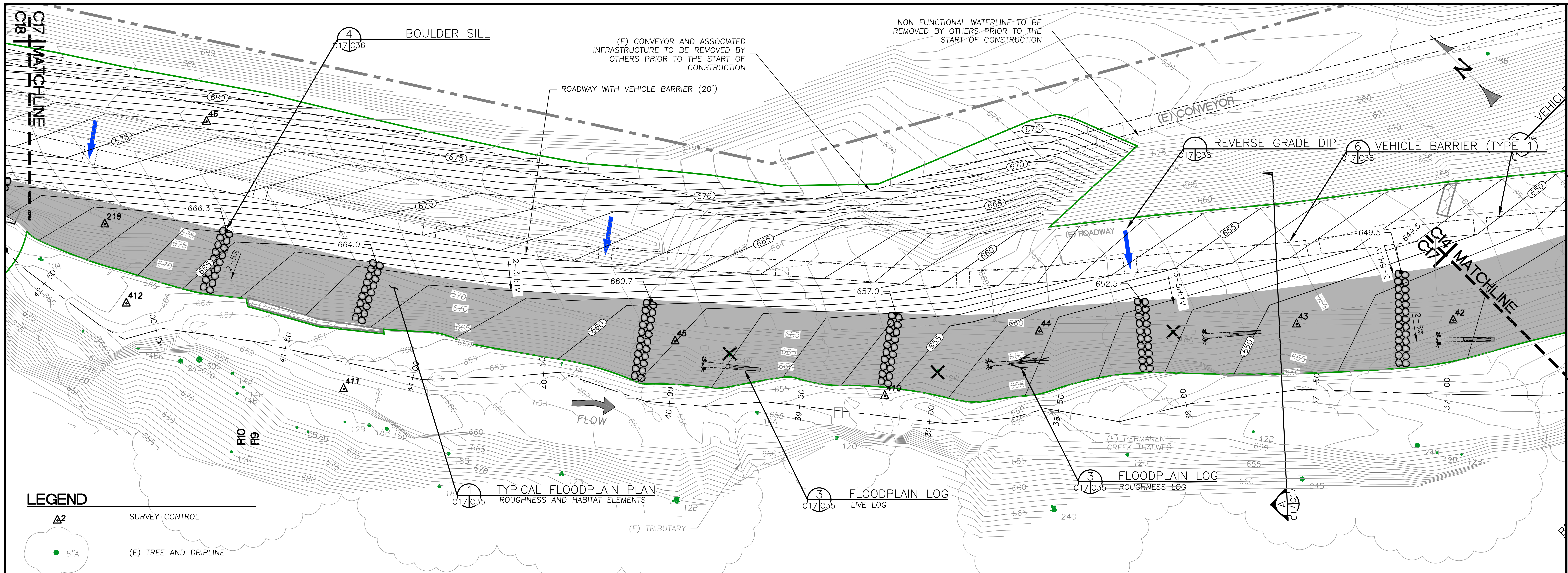
SEDIMENT REMOVAL AREA PROFILE AND SECTIONS

PERMANENTE CREEK RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.Z. |
| DRAWN BY: | B.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C16
16 OF 47



## CHANNEL WIDENING PLAN

SCALE: 1" = 20'

## LEGEND

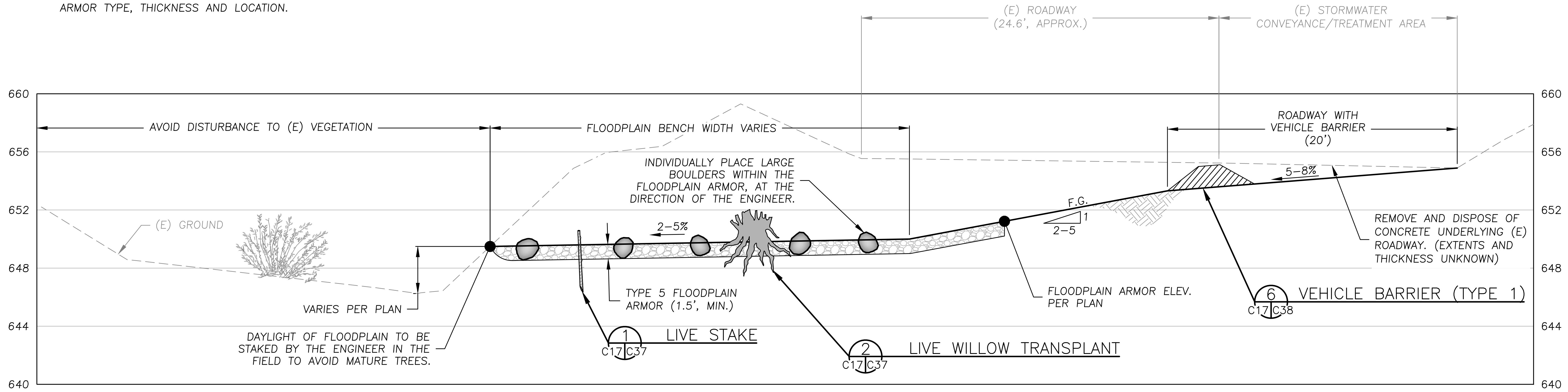
| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE AND DRIPLINE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| — — | (E) THALWEG ALIGNMENT |
| - - - | (E) EDGE OF ROAD |
| — W — | (E) WATER LINE |
| — SD — | (E) STORM DRAIN LINE |
| ▨ | (E) EXPOSED ROCK SLOPE PROTECTION |
| — | LIMITS OF GRADING (APPROX.) |
| ▨ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| R9 R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| — - — | RECLAMATION AREA PLAN BOUNDARY |
| → | REVERSE GRADE DIP |
| 577.5 ●●●● | BOULDER SILL (WITH TOP ELEVATION) |
| ☐ | VEHICLE BARRIER |

## TREE REMOVAL SUMMARY

| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| ALDER | 18" | 1 |
| WILLOW | 12" | 1 |
| WILLOW | 24" | 1 |

NOTES:
1. THE PLAN EXTENT OF CONCRETE UNDERLYING THE ROADWAY IS NOT SHOWN. EXTENTS ARE UNKNOWN. REMOVE AND DISPOSE OF ALL CONCRETE UNDERLYING (E) ROADWAY AND ADJACENT AREAS.
2. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEET C1.

FLOODPLAIN ARMOR NOTES:
SEE THE FLOODPLAIN ARMOR NOTES ON SHEET C11 FOR FLOODPLAIN ARMOR TYPE, THICKNESS AND LOCATION.



## TYPICAL SECTION

SCALE: 1" = 5' A C17 C17

NOTES:
SEE REVEGETATION SHEETS (L1–L5) FOR DETAILS REGARDING SPACING OF LIVE STAKES AND WILLOW TRANSPLANTS.

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CHANNEL
WIDENING PLAN
(5 OF 6)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
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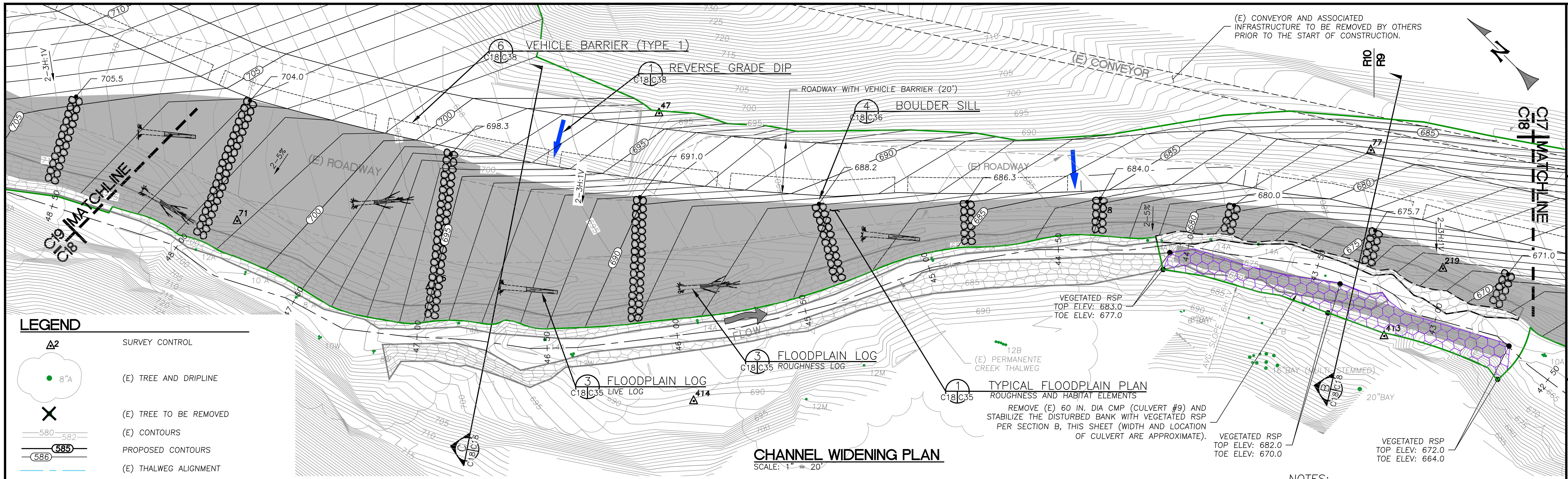
0 1"



## CHANNEL WIDENING PLAN

SCALE: 1" = 20'

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE AND DRIPLINE |
| X | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| — — — | (E) THALWEG ALIGNMENT |
| - - - - | (E) EDGE OF ROAD |
| —W— | (E) WATER LINE |
| —SD— | (E) STORM DRAIN LINE |
| ▨ | (E) EXPOSED ROCK SLOPE PROTECTION |
| —— | LIMITS OF GRADING (APPROX.) |
| ▇ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| ▨ | VEGETATED ROCK SLOPE PROTECTION |
| ▨ | ROAD DECOMMISSIONING AREA |
| R9 \| R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| → | REVERSE GRADE DIP |
| 577.5 ●●●● | BOULDER SILL (WITH TOP ELEVATION) |
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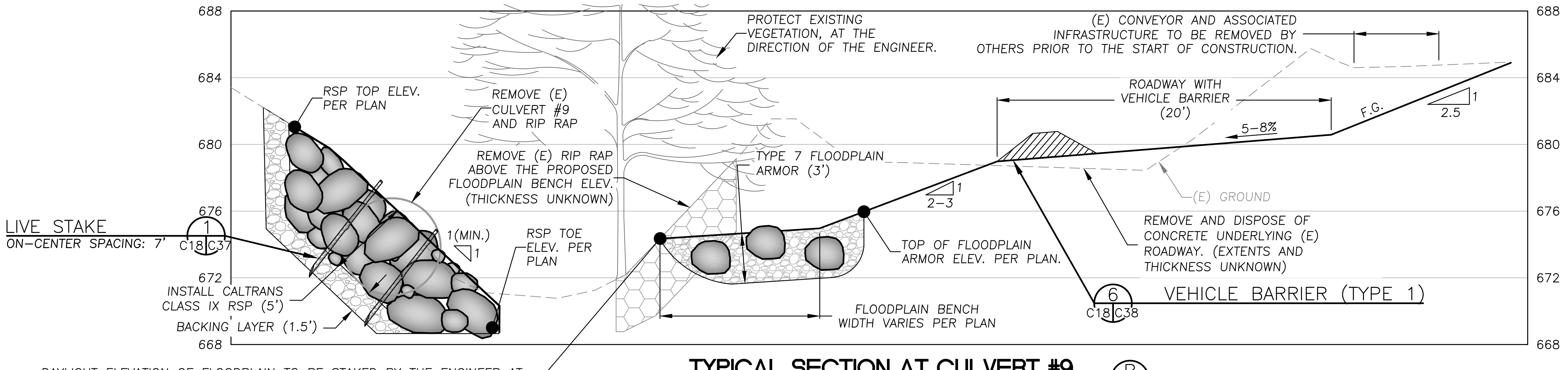


## TYPICAL SECTION AT CULVERT #9

B C18 C18

SCALE: 1" = 5'

NOTES:

1. THE PLAN EXTENT OF CONCRETE UNDERLYING THE ROADWAY IS NOT SHOWN. EXTENTS ARE UNKNOWN. REMOVE AND DISPOSE OF ALL CONCRETE UNDERLYING (E) ROADWAY AND ADJACENT AREAS.
2. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEET C1.

VEGETATED RSP NOTES:

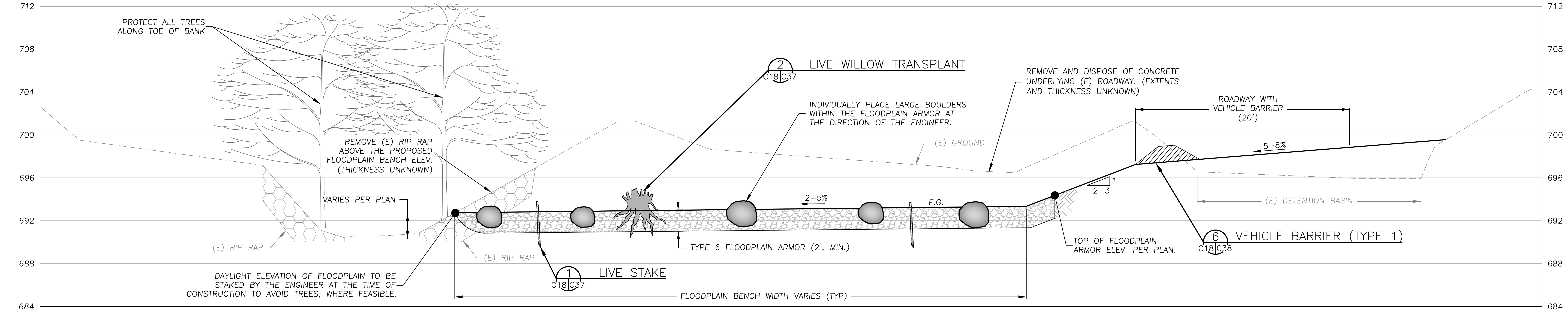
1. THE PROPOSED EXTENT AND TOP AND TOE ELEVATIONS OF THE VEGETATED RSP ARE APPROXIMATE. THE FINAL GEOMETRY WILL BE DETERMINED AT THE TIME OF CONSTRUCTION AND WILL BE BASED ON THE AREA OF BANK DISTURBED FOR THE REMOVAL OF CULVERT #9.

FLOODPLAIN ARMOR NOTES:

SEE THE FLOODPLAIN ARMOR NOTES ON SHEET C11 FOR FLOODPLAIN ARMOR TYPE, THICKNESS AND LOCATION.

## TREE REMOVAL SUMMARY

| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| NONE | N/A | N/A |



## TYPICAL SECTION

C C18 C18

SCALE: 1" = 5'

NOTES:

SEE REVEGETATION SHEETS (L1–L5) FOR DETAILS REGARDING SPACING OF LIVE STAKES AND WILLOW TRANSPLANTS.

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LEHIGH HANSON
HEIDELBERG CEMENT
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CHANNEL
WIDENING PLAN
(6 OF 6)

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.Z. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

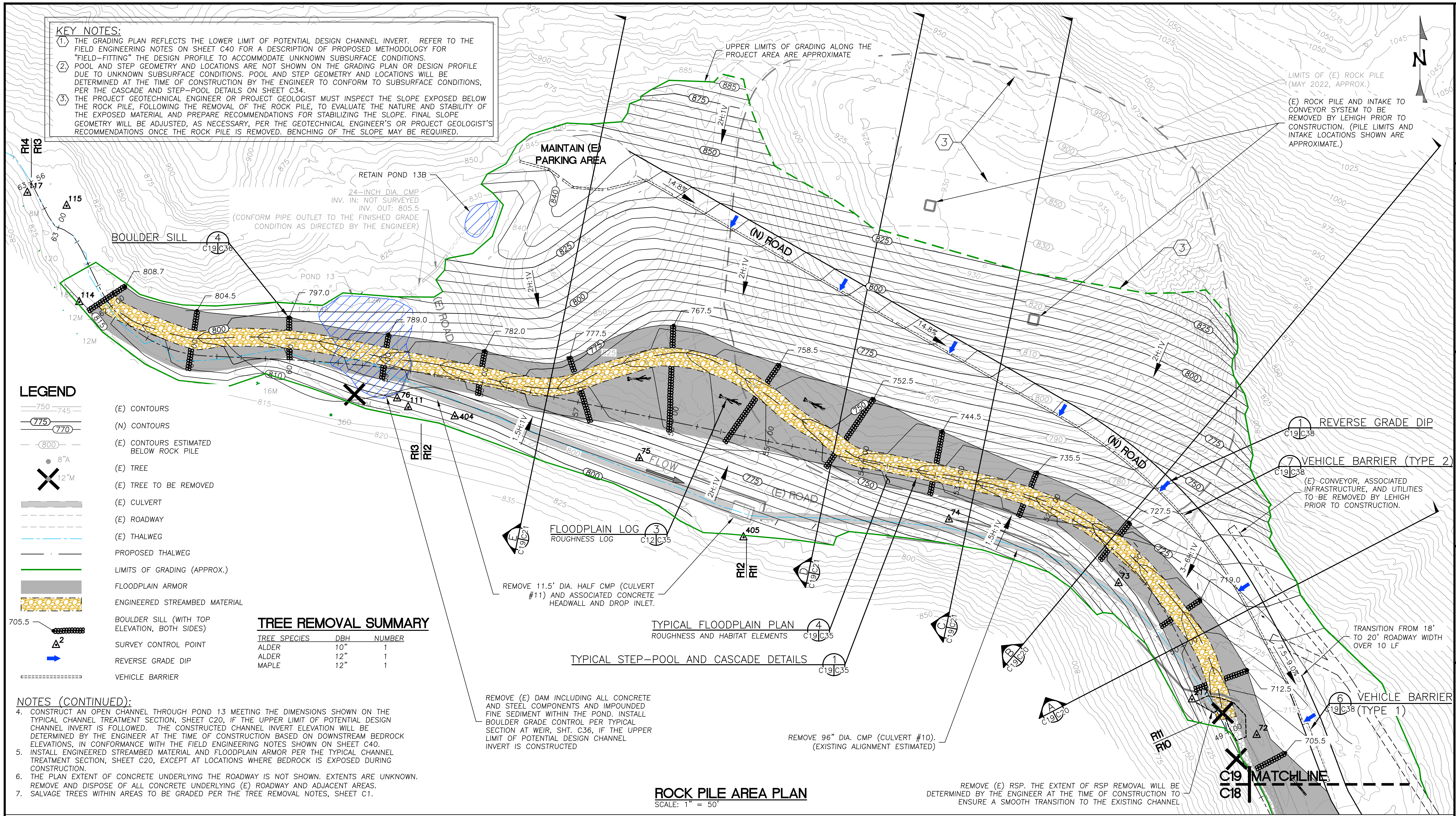
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C18

18 OF 47

## KEY NOTES:

1. THE GRADING PLAN REFLECTS THE LOWER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT. REFER TO THE FIELD ENGINEERING NOTES ON SHEET C40 FOR A DESCRIPTION OF PROPOSED METHODOLOGY FOR "FIELD-FITTING" THE DESIGN PROFILE TO ACCOMMODATE UNKNOWN SUBSURFACE CONDITIONS.
2. POOL AND STEP GEOMETRY AND LOCATIONS ARE NOT SHOWN ON THE GRADING PLAN OR DESIGN PROFILE DUE TO UNKNOWN SUBSURFACE CONDITIONS. POOL AND STEP GEOMETRY AND LOCATIONS WILL BE DETERMINED AT THE TIME OF CONSTRUCTION BY THE ENGINEER TO CONFORM TO SUBSURFACE CONDITIONS, PER THE CASCADE AND STEP-POOL DETAILS ON SHEET C34.
3. THE PROJECT GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST MUST INSPECT THE SLOPE EXPOSED BELOW THE ROCK PILE, FOLLOWING THE REMOVAL OF THE ROCK PILE, TO EVALUATE THE NATURE AND STABILITY OF THE EXPOSED MATERIAL AND PREPARE RECOMMENDATIONS FOR STABILIZING THE SLOPE. FINAL SLOPE GEOMETRY WILL BE ADJUSTED, AS NECESSARY, PER THE GEOTECHNICAL ENGINEER'S OR PROJECT GEOLOGIST'S RECOMMENDATIONS ONCE THE ROCK PILE IS REMOVED. BENCHING OF THE SLOPE MAY BE REQUIRED.



## LEGEND

| | |
|---|---|
| 750 745 | (E) CONTOURS |
| 775 770 | (N) CONTOURS |
| 800 | (E) CONTOURS ESTIMATED BELOW ROCK PILE |
| ● 8"A | (E) TREE |
| ✕ 12"M | (E) TREE TO BE REMOVED |
| ▨ | (E) CULVERT |
| - - - - | (E) ROADWAY |
| — · — | (E) THALWEG |
| —— · —— | PROPOSED THALWEG |
| —— | LIMITS OF GRADING (APPROX.) |
| ▨ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| 705.5 ●●●●●● | BOULDER SILL (WITH TOP ELEVATION, BOTH SIDES) |
| △2 | SURVEY CONTROL POINT |
| ➡ | REVERSE GRADE DIP |
| ========== | VEHICLE BARRIER |

## TREE REMOVAL SUMMARY

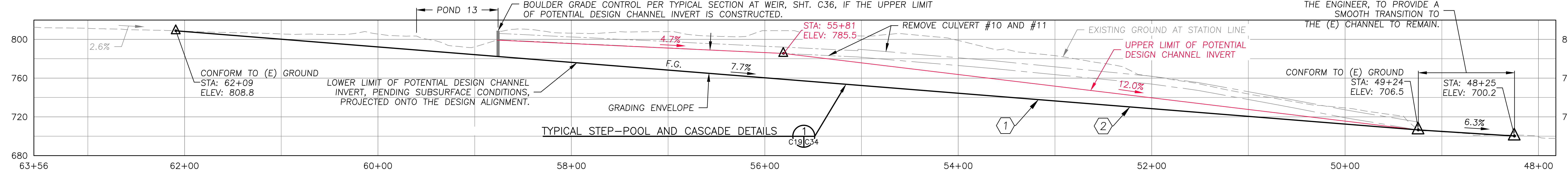
| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| ALDER | 10" | 1 |
| ALDER | 12" | 1 |
| MAPLE | 12" | 1 |

## NOTES (CONTINUED):

4. CONSTRUCT AN OPEN CHANNEL THROUGH POND 13 MEETING THE DIMENSIONS SHOWN ON THE TYPICAL CHANNEL TREATMENT SECTION, SHEET C20, IF THE UPPER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT IS FOLLOWED. THE CONSTRUCTED CHANNEL INVERT ELEVATION WILL BE DETERMINED BY THE ENGINEER AT THE TIME OF CONSTRUCTION BASED ON DOWNSTREAM BEDROCK ELEVATIONS, IN CONFORMANCE WITH THE FIELD ENGINEERING NOTES SHOWN ON SHEET C40.
5. INSTALL ENGINEERED STREAMBED MATERIAL AND FLOODPLAIN ARMOR PER THE TYPICAL CHANNEL TREATMENT SECTION, SHEET C20, EXCEPT AT LOCATIONS WHERE BEDROCK IS EXPOSED DURING CONSTRUCTION.
6. THE PLAN EXTENT OF CONCRETE UNDERLYING THE ROADWAY IS NOT SHOWN. EXTENTS ARE UNKNOWN. REMOVE AND DISPOSE OF ALL CONCRETE UNDERLYING (E) ROADWAY AND ADJACENT AREAS.
7. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEET C1.

## ROCK PILE AREA PLAN

SCALE: 1" = 50'



## CHANNEL PROFILE

SCALE: 1" = 60'

**WATERWAYS** CONSULTING INC.

509A SWIFT ST.
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PH:(831)421-9291 // FAX:(888)819-6847
WWW.WATWAYS.COM

# PRELIMINARY

NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:

LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

ROCK PILE
AREA PLAN

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: B.M.Z.
DRAWN BY: B.R.S
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13-016

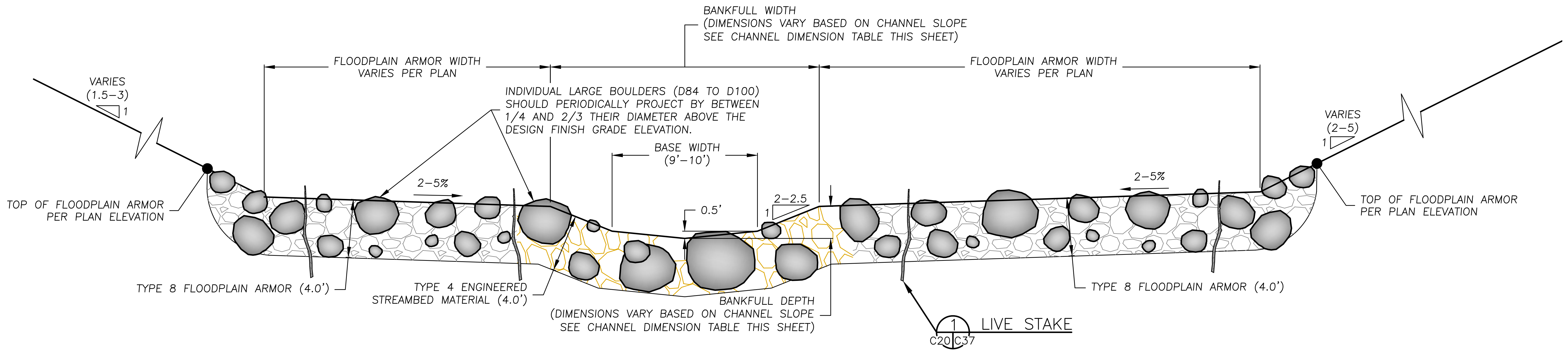
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C19

19 OF 47

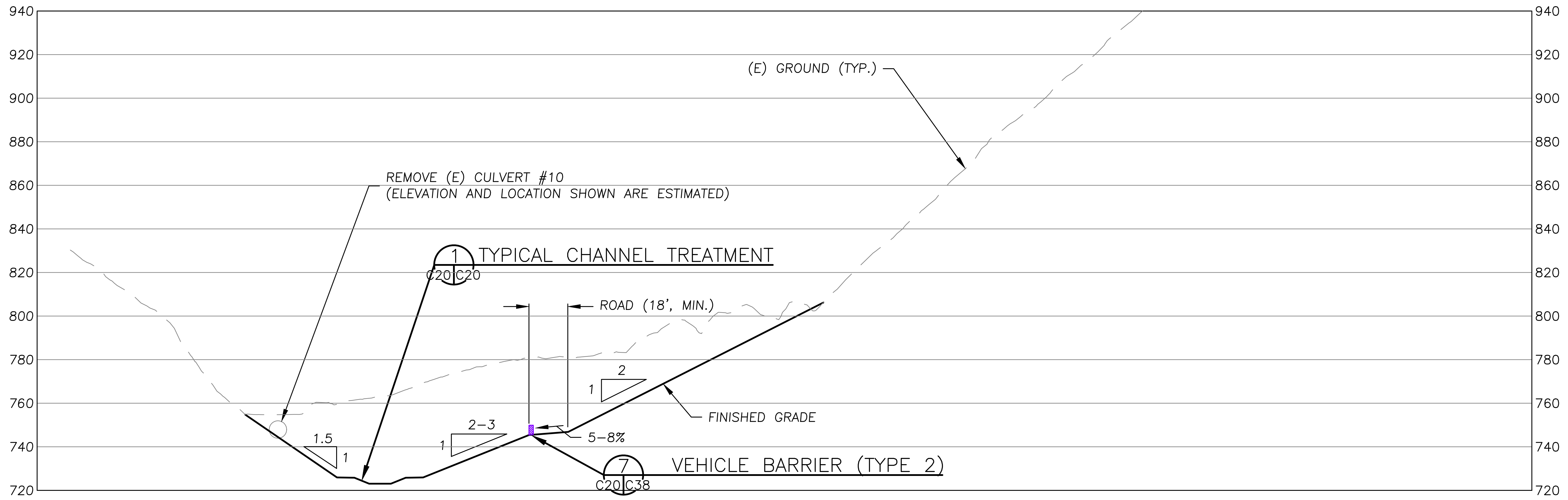
CHANNEL DIMENSIONS FOR ROCKPILE AREA

| DESIGN SLOPE (%) | DESIGN DIMENSIONS | |
|---|---|---|
| | BANKFULL WIDTH | BANKFULL DEPTH |
| <4% | 17.5'–21.5' | 1.8'–2.2' |
| 4%–8% | 16.0'–20.0' | 2.0'–2.4' |
| >8% | 15.5'–18.5' | 2.4'–2.8' |

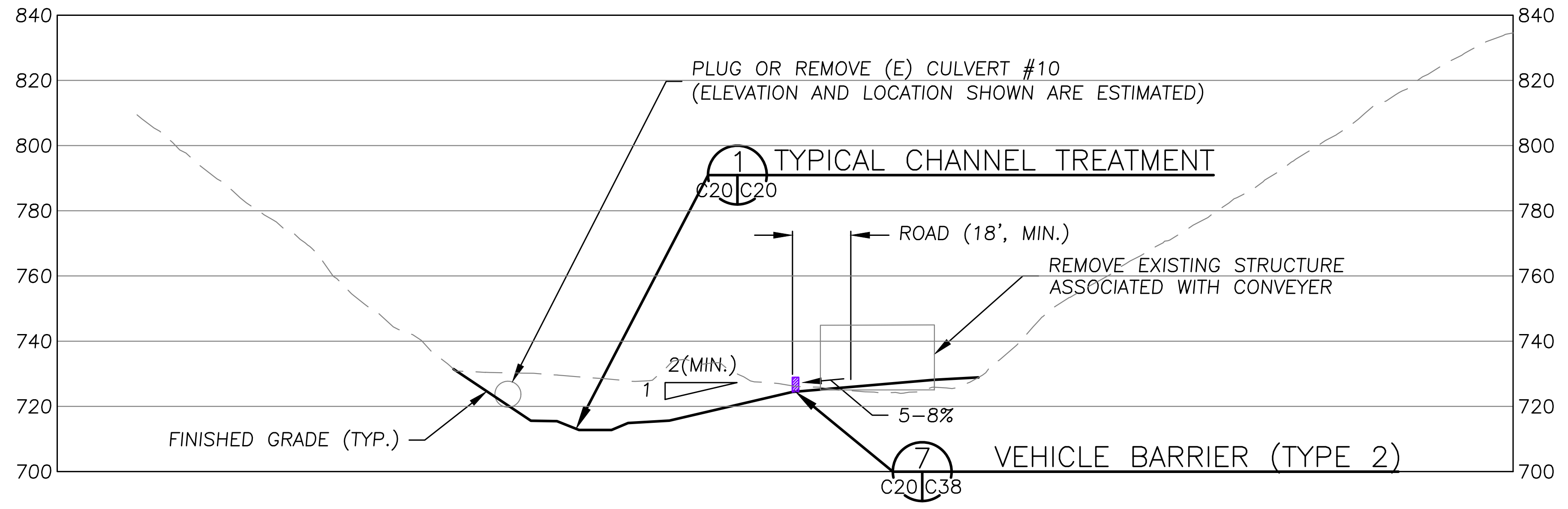


## TYPICAL CHANNEL TREATMENT DETAIL
1
C20,C21 C20
SCALE: 1" = 5'

NOTES:
1. INSTALL TYPE 8 FLOODPLAIN ARMOR FROM STA. 48+75 TO 62+09.
2. INSTALL TYPE 4 ENGINEERED STREAMBED MATERIAL FROM STA 49+15 (APPROX.) TO 62+09.
3. SEE THE TYPICAL FLOODPLAIN ROUGHNESS AND HABITAT PLAN, SHEET C35 FOR INFORMATION REGARDING FEATURES NOT SHOWN ON THE TYPICAL TREATMENT DETAIL.



## TYPICAL SECTION
B
C19 C20
SCALE: 1" = 40'



## TYPICAL SECTION
A
C19 C20
SCALE: 1" = 40'

NOTES:
1. FINISHED GRADE SHOWN REPRESENTS THE LOWER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT.
2. LEAVE 4'–5' WIDE OPENINGS IN K–RAIL EVERY 50–60 FEET TO ALLOW FOR UNOBSTRUCTED DRAINAGE FROM ROADWAY.
3. BACKFILL AREAS WHERE CULVERT REMOVAL OCCURS BELOW FINISHED GRADE BY PLACING TYPE 1 ENGINEERED STREAMBED MATERIAL, AS DIRECTED BY THE ENGINEER.

## LEGEND

EXISTING GROUND AT TIME OF SURVEY
ESTIMATED EXISTING GROUND BELOW ROCK PILE
FINISH GRADE

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PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

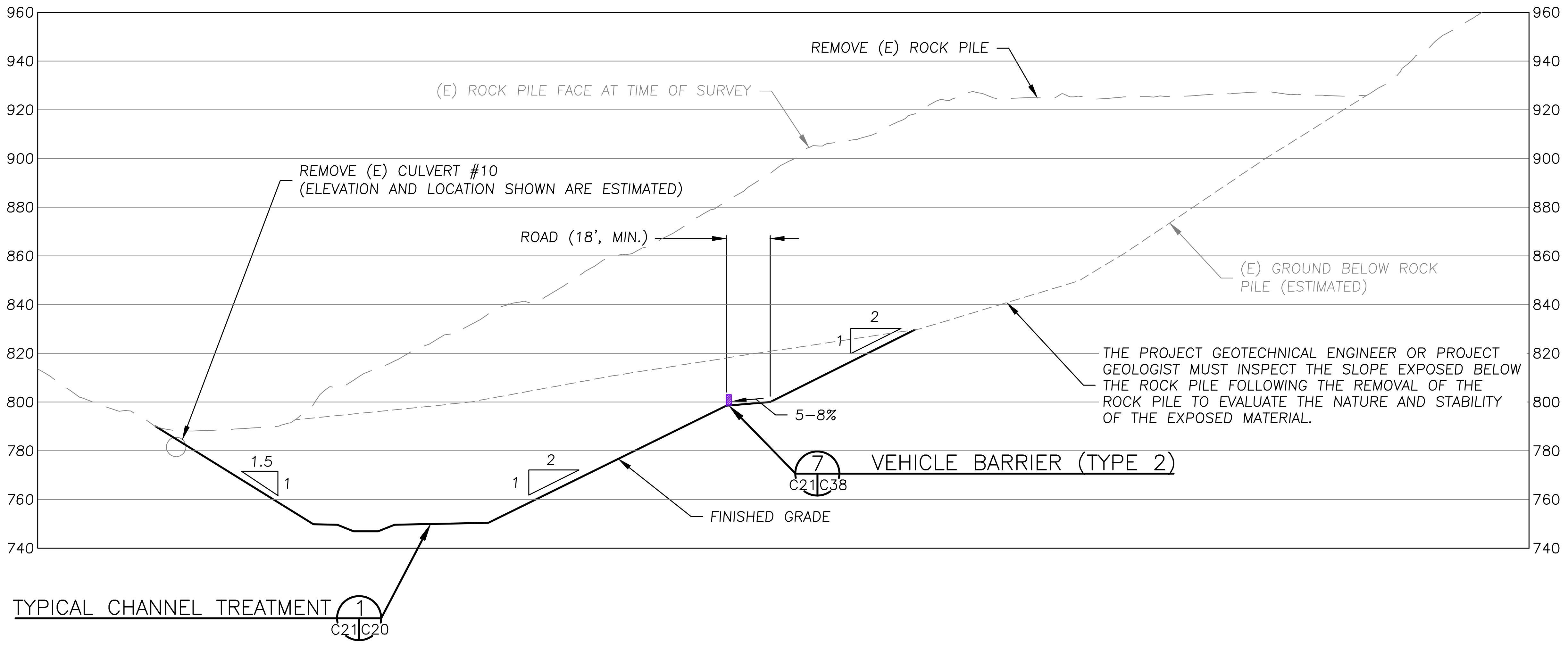
ROCK PILE
AREA
SECTIONS
(1 OF 2)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.Z. |
| DRAWN BY: | B.R.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

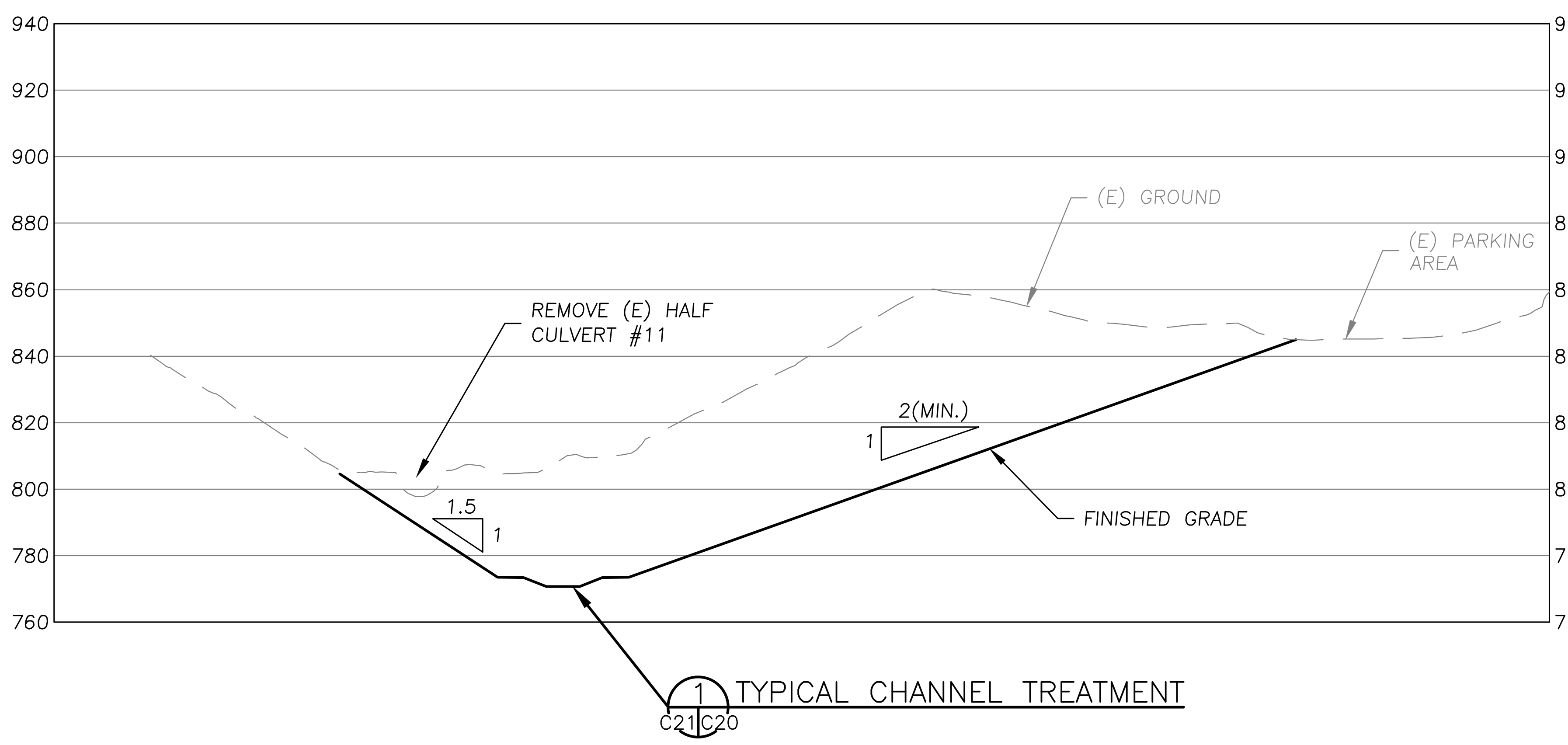
BAR IS ONE INCH ON
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C20
20
OF
47



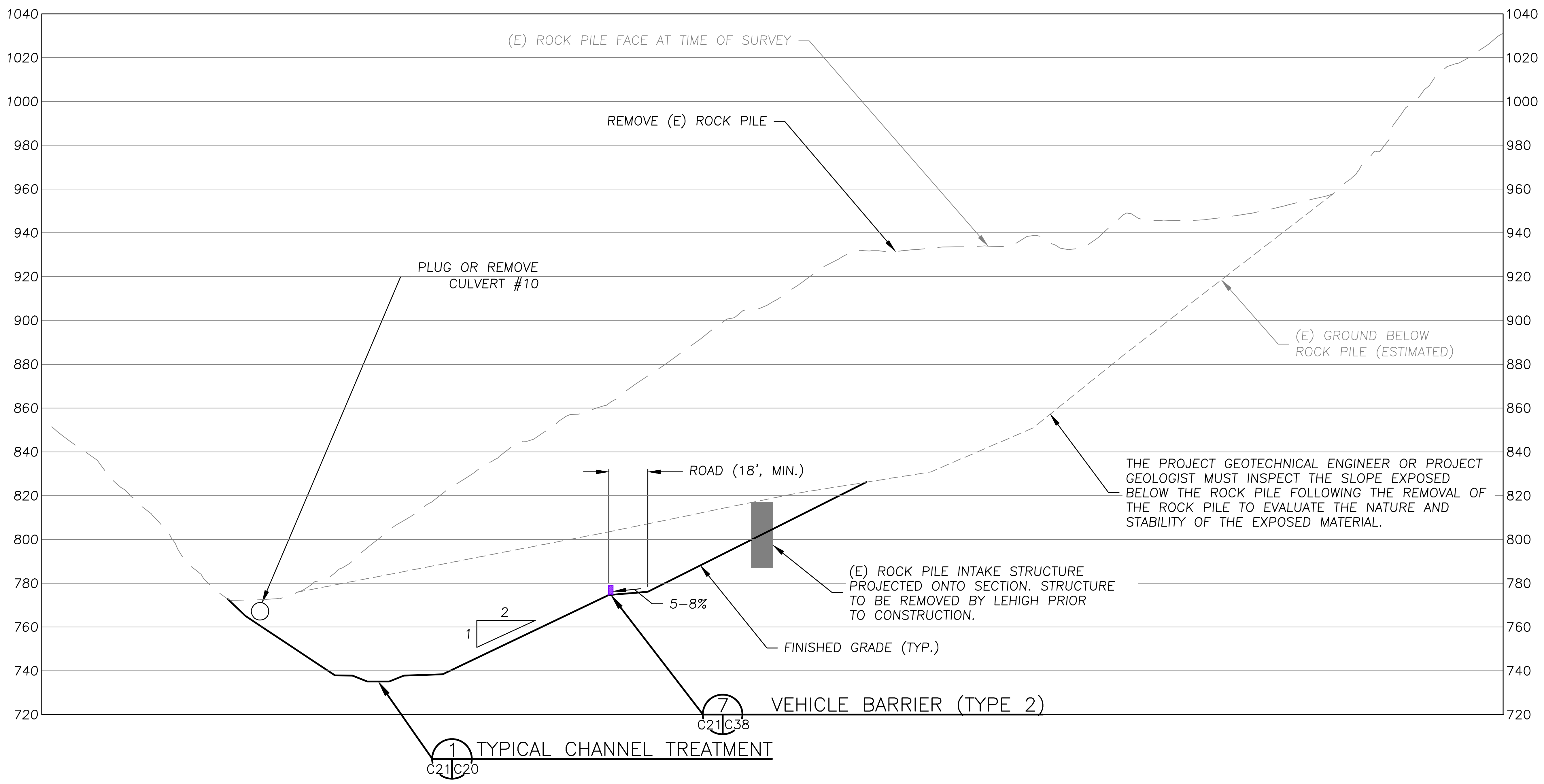
THE PROJECT GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST MUST INSPECT THE SLOPE EXPOSED BELOW THE ROCK PILE FOLLOWING THE REMOVAL OF THE ROCK PILE TO EVALUATE THE NATURE AND STABILITY OF THE EXPOSED MATERIAL.

**TYPICAL SECTION** D
SCALE: 1" = 40'
C19 C21



**TYPICAL SECTION** E
SCALE: 1" = 40'
C19 C21

NOTE:
THE PROJECT GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST MUST INSPECT THE SLOPE EXPOSED BELOW THE ROCK PILE FOLLOWING THE REMOVAL OF THE ROCK PILE TO EVALUATE THE NATURE AND STABILITY OF THE EXPOSED MATERIAL.



THE PROJECT GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST MUST INSPECT THE SLOPE EXPOSED BELOW THE ROCK PILE FOLLOWING THE REMOVAL OF THE ROCK PILE TO EVALUATE THE NATURE AND STABILITY OF THE EXPOSED MATERIAL.

(E) ROCK PILE INTAKE STRUCTURE PROJECTED ONTO SECTION. STRUCTURE TO BE REMOVED BY LEHIGH PRIOR TO CONSTRUCTION.

**TYPICAL SECTION** C
SCALE: 1" = 40'
C19 C21

NOTES:
1. FINISHED GRADE SHOWN REPRESENTS THE LOWER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT.
2. LEAVE 4'–5' WIDE OPENINGS IN K–RAIL EVERY 50–60 FEET TO ALLOW FOR UNOBSTRUCTED DRAINAGE FROM ROADWAY.
3. BACKFILL AREAS WHERE CULVERT REMOVAL OCCURS BELOW FINISHED GRADE BY PLACING TYPE 1 ENGINEERED STREAMBED MATERIAL, AS DIRECTED BY THE ENGINEER.

## LEGEND

| | |
|---|---|
| — — — | EXISTING GROUND AT TIME OF SURVEY |
| - - - - - - | ESTIMATED EXISTING GROUND BELOW ROCK PILE |
| ——— | FINISH GRADE |

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WWW.WATWAYS.COM

PRELIMINARY
NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT GROUP

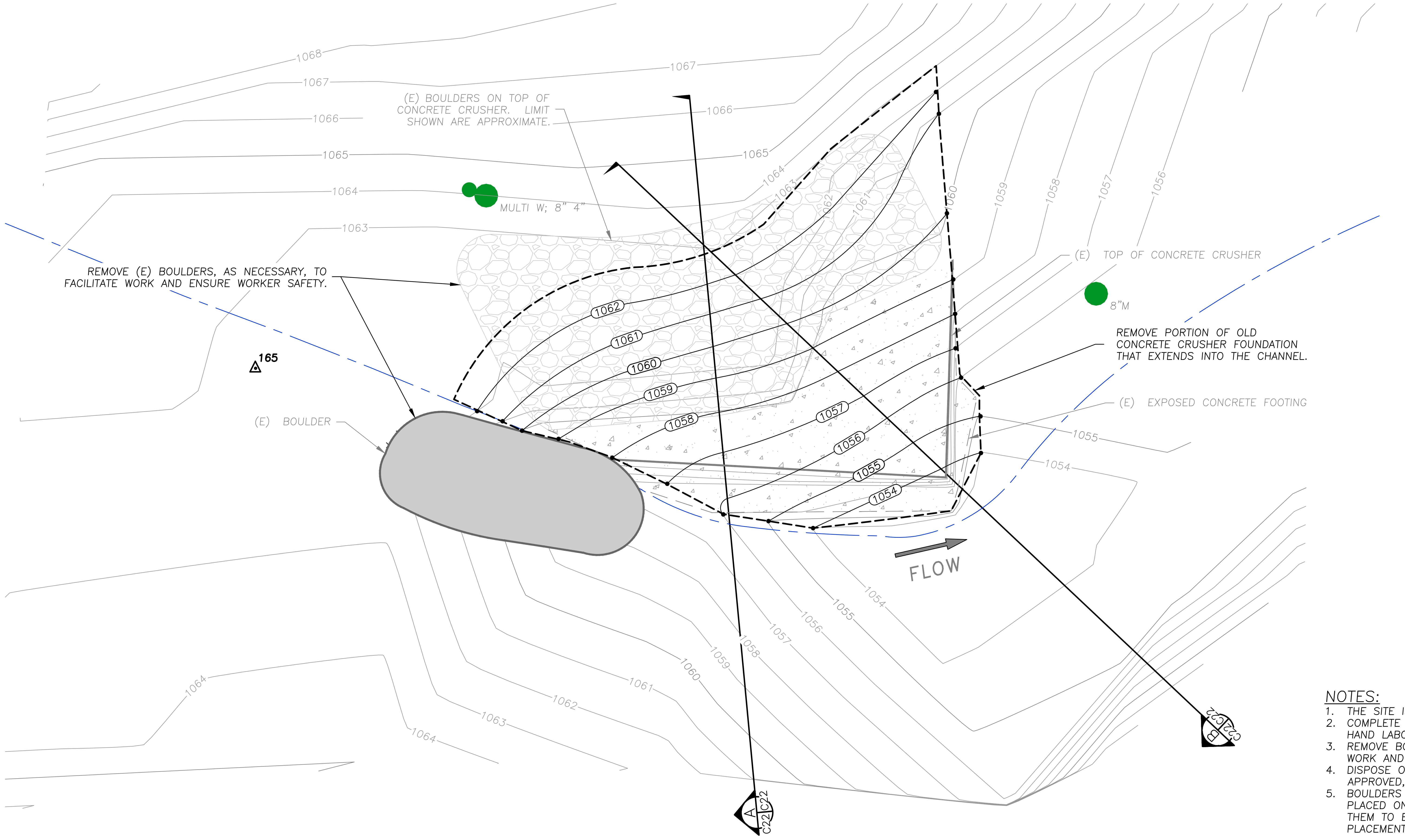
ROCK PILE
AREA
SECTIONS
(2 OF 2)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.Z. |
| DRAWN BY: | B.R.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C21
21 OF 47



## OLD CRUSHER FOUNDATION SITE PLAN

SCALE: 1" = 2'

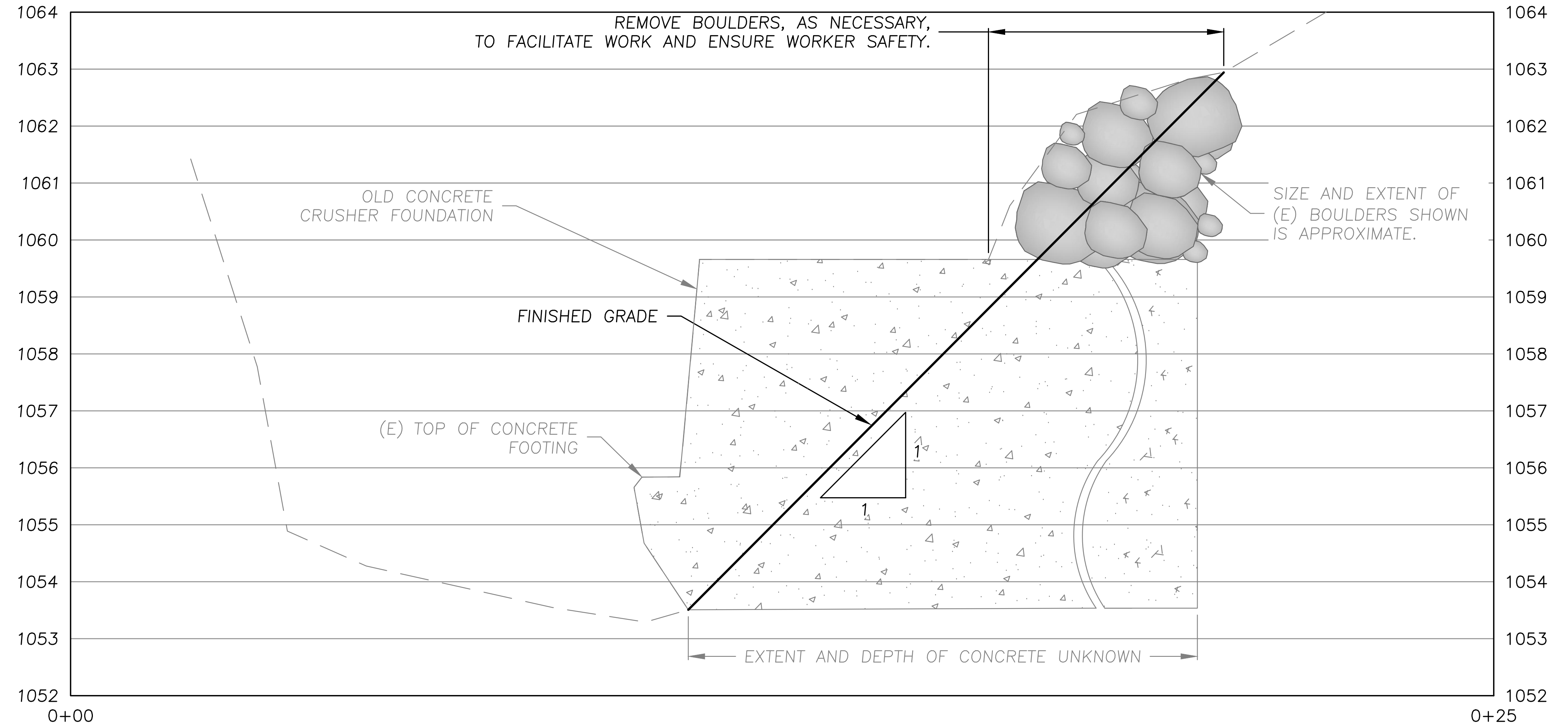
1 C23 C22

## LEGEND

| | |
|---|---|
| 85 86 | EXISTING CONTOURS |
| 100 101 | PROPOSED CONTOURS |
| | EXISTING FLOW LINE |
| △2 | SURVEY CONTROL POINT |
| ● 12"A | EXISTING TREE |

NOTES:

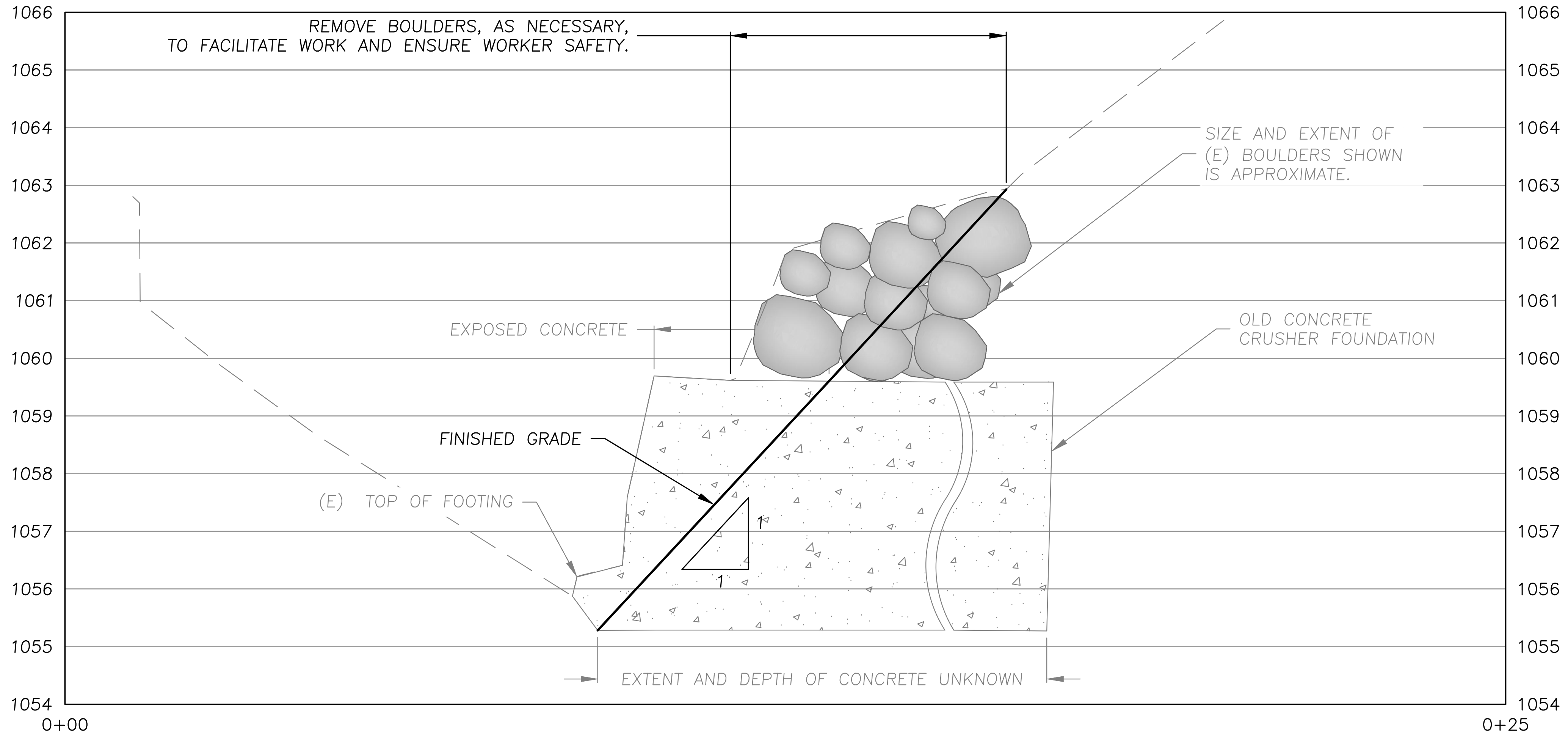
1. THE SITE IS NOT ACCESSIBLE TO VEHICLES.
2. COMPLETE WORK USING SMALL HAND-OPERATED EQUIPMENT AND HAND LABOR.
3. REMOVE BOULDERS AND DEBRIS, AS NECESSARY, TO FACILITATE WORK AND ENSURE WORKER SAFETY.
4. DISPOSE OF ALL REMOVED CONCRETE AND DEBRIS AT AN APPROVED, OFFSITE LOCATION.
5. BOULDERS REMOVED TO FACILITATE CONSTRUCTION MAY BE PLACED ON THE SLOPE IN A MANNER THAT WILL NOT ALLOW THEM TO ENTER THE CREEK. THE LOCATION FOR BOULDER PLACEMENT WILL BE FLAGGED IN THE FIELD BY THE ENGINEER.



## SECTION

SCALE: 1" = 2'

B C22 C22



## SECTION

SCALE: 1" = 2'

A C22 C22

WATERWAYS CONSULTING INC.
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SANTA CRUZ, CA 95060
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WWW.WATWAYS.COM

PRELIMINARY
NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT GROUP

OLD CRUSHER FOUNDATION SITE PLAN

PERMANENTE CREEK RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | C.B.H. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C22

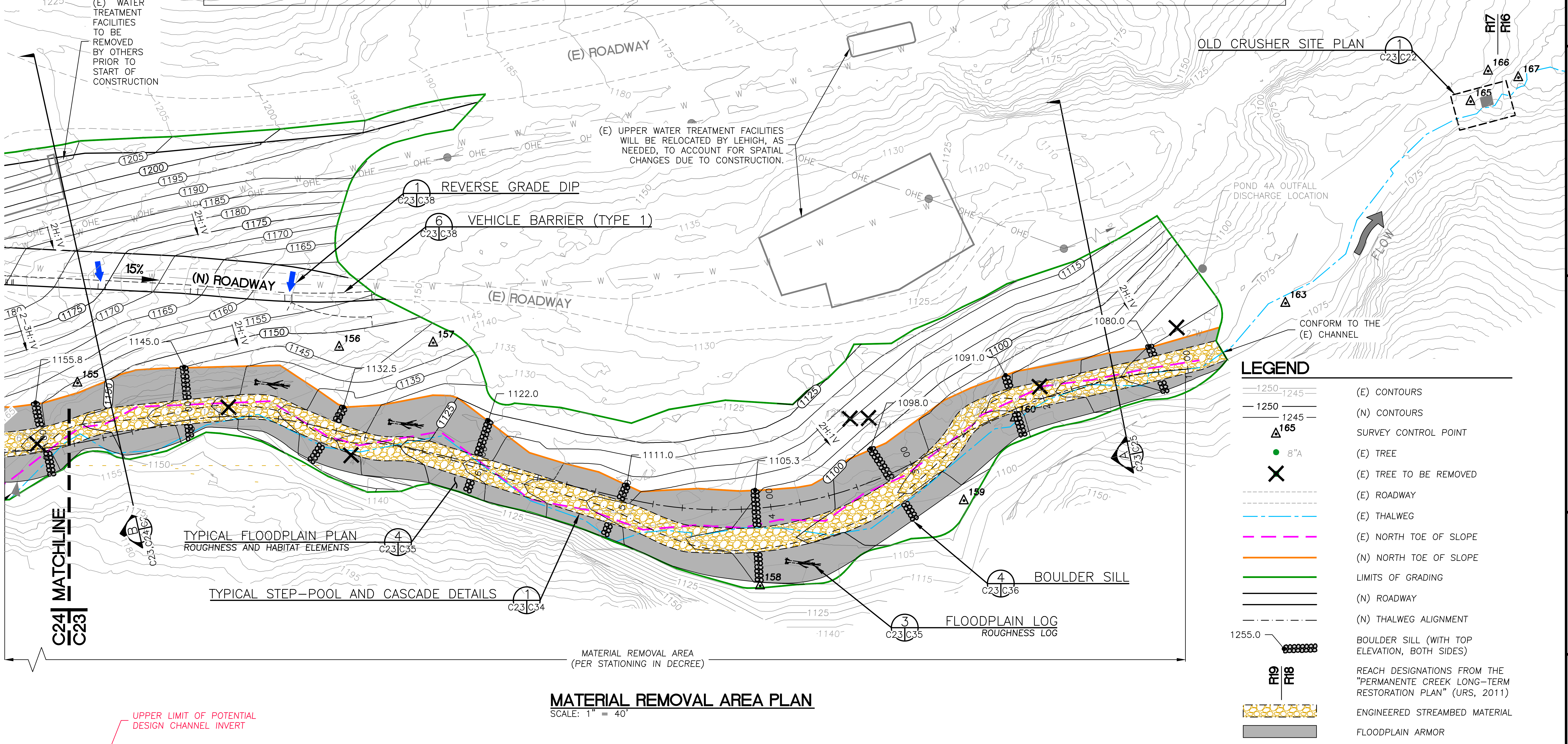
22 OF 47

## TREE REMOVAL SUMMARY

| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| MADRONE | 12" | 1 |
| MADRONE | 18" | 1 |
| WILLOW | 4" | 1 |
| WILLOW | 6" | 2 |
| WILLOW | 10" | 1 |
| WILLOW | 12" | 1 |

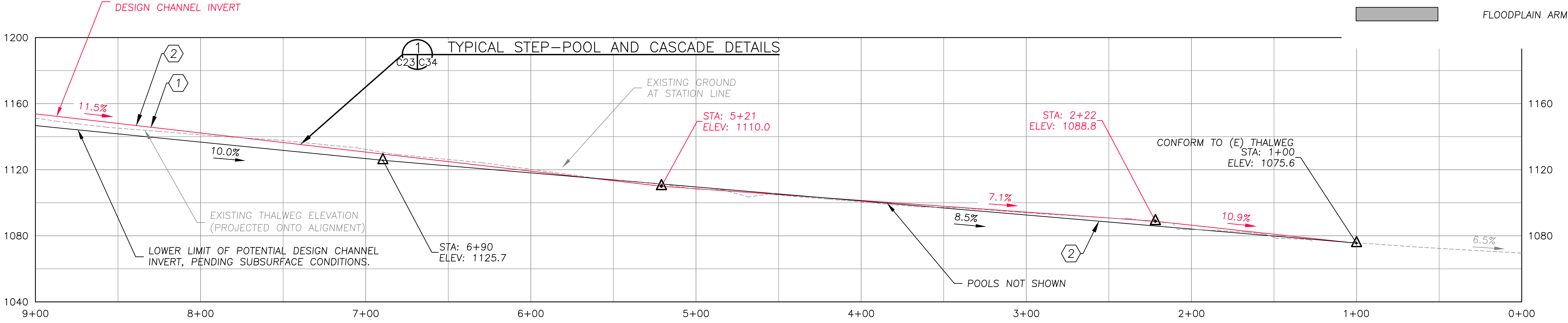
## KEY NOTES:

1. THE GRADING PLAN REFLECTS THE UPPER LIMIT OF POTENTIAL FINISHED GRADE CHANNEL PROFILES. REFER TO THE NOTES ON SHEET C40 FOR A DESCRIPTION OF PROPOSED METHODOLOGY FOR "FIELD–FITTING" THE DESIGN PROFILE TO ACCOMMODATE UNKNOWN SUBSURFACE CONDITIONS.
2. POOL AND STEP GEOMETRY AND LOCATIONS ARE NOT SHOWN ON THE GRADING PLAN OR DESIGN PROFILE DUE TO UNKNOWN SUBSURFACE CONDITIONS. POOL AND STEP GEOMETRY AND LOCATIONS WILL BE DETERMINED AT THE TIME OF CONSTRUCTION BY THE ENGINEER TO CONFORM TO SUBSURFACE CONDITIONS, PER THE TYPICAL CASCADE AND STEP–POOL DETAILS ON SHEET C34.
3. INSTALL ENGINEERED STREAMBED MATERIAL AND FLOODPLAIN ARMOR PER THE TYPICAL CHANNEL TREATMENT SECTION, SHEET C26, EXCEPT AT LOCATIONS WHERE BEDROCK IS EXPOSED DURING CONSTRUCTION.
4. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEETS C1.
5. GRADING WILL NOT EXTEND SOUTH OF THE LIMITS OF GRADING SHOWN ALONG THE SOUTHERN SIDE OF THE WORK AREA. IF BEDROCK IS NOT ENCOUNTERED AT THE UPPER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT SHOWN, AND ADDITIONAL EXCAVATION IS REQUIRED, GRADING SHALL PROJECT DOWN APPROXIMATELY FOLLOWING THE EXISTING SOUTHERN BANK SLOPE TO THE CONSTRUCTED FLOODPLAIN BENCH ELEVATION, SIMILAR TO THE GRADING SHOWN ON SECTION C, SHEET C25, AS DIRECTED BY THE GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST.
6. POND 1250, THE UPPER WATER TREATMENT FACILITIES, AND PORTIONS OF A SITE ACCESS ROAD WILL BE RELOCATED, AS NEEDED, TO ACCOUNT FOR SPATIAL CHANGES DUE TO CONSTRUCTION.



## MATERIAL REMOVAL AREA PLAN

SCALE: 1" = 40'



## MATERIAL REMOVAL AREA CHANNEL PROFILE

SCALE: 1" = 40'

WATERWAYS CONSULTING INC.
509A SWIFT ST.
SANTA CRUZ, CA 95060
PH:(831)421-9291 // FAX:(888)819-6847
WWW.WATWAYS.COM

PRELIMINARY
NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT GROUP

MATERIAL REMOVAL AREA PLAN (1 OF 2)

PERMANENTE CREEK RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY CEQA REVIEW SUBMITTAL

DESIGNED BY: B.M.Z.
DRAWN BY: B.M.S.
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13–016

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C23

## LEGEND

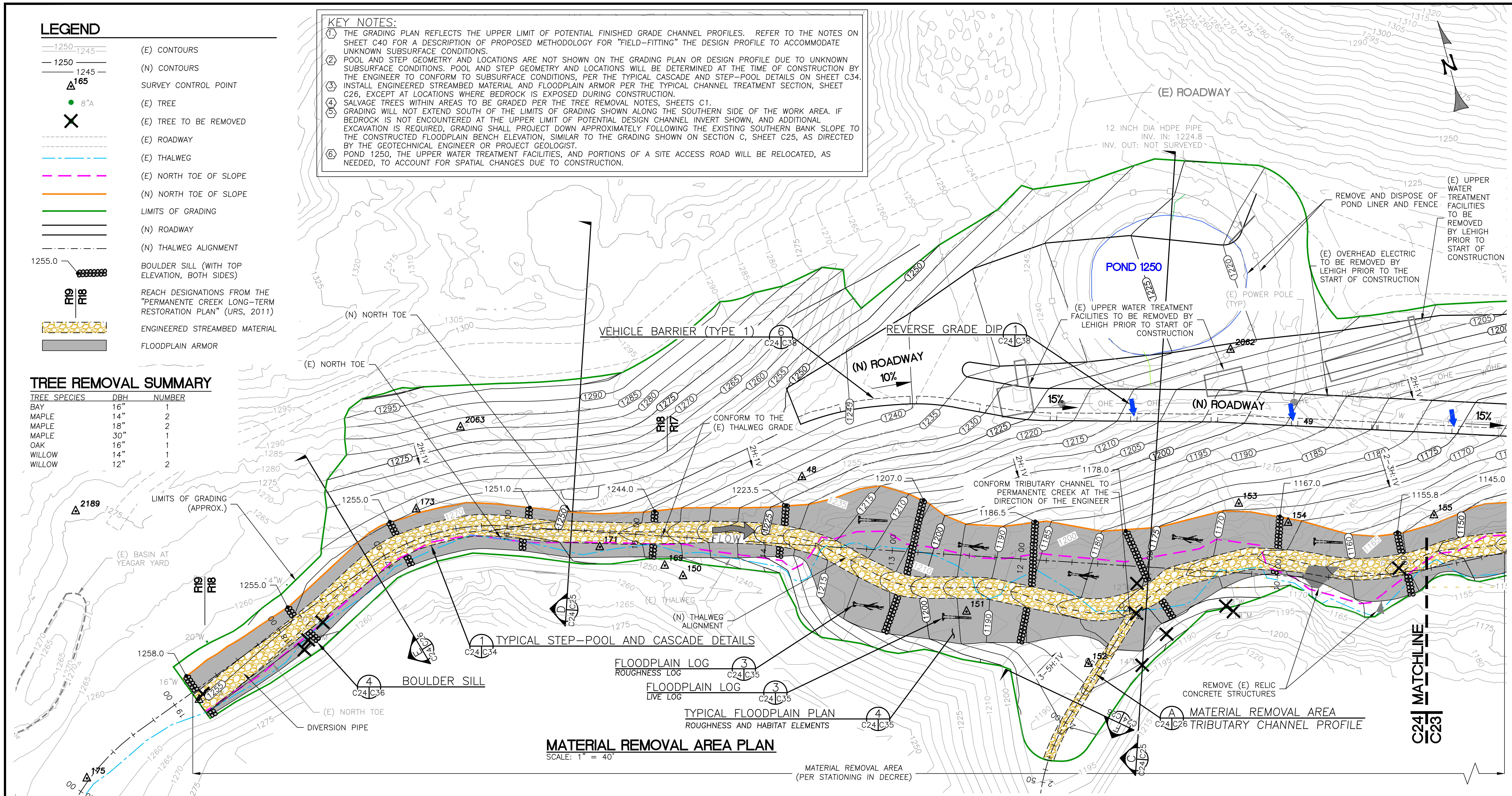
| | |
|---|---|
| 1250 1245 | (E) CONTOURS |
| 1250 1245 | (N) CONTOURS |
| △165 | SURVEY CONTROL POINT |
| ● 8"A | (E) TREE |
| ✕ | (E) TREE TO BE REMOVED |
| - - - - | (E) ROADWAY |
| — · — | (E) THALWEG |
| — — — | (E) NORTH TOE OF SLOPE |
| —— | (N) NORTH TOE OF SLOPE |
| —— | LIMITS OF GRADING |
| ═ | (N) ROADWAY |
| — · — · — | (N) THALWEG ALIGNMENT |
| 1255.0 | BOULDER SILL (WITH TOP ELEVATION, BOTH SIDES) |
| R19 \| R18 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" (URS, 2011) |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| ▨ | FLOODPLAIN ARMOR |

## TREE REMOVAL SUMMARY

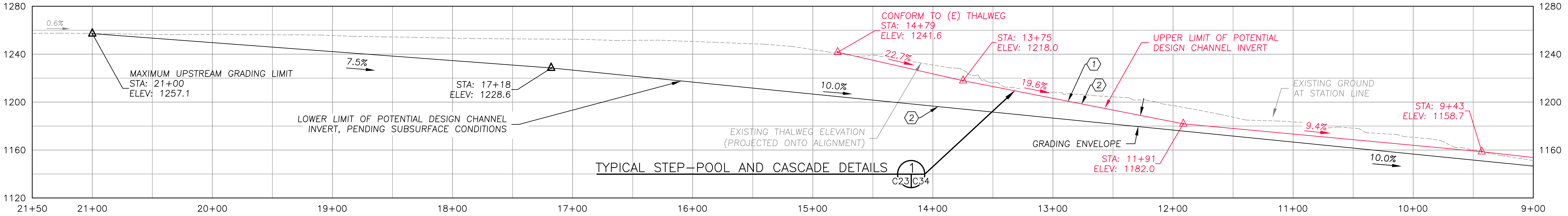
| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| BAY | 16" | 1 |
| MAPLE | 14" | 2 |
| MAPLE | 18" | 2 |
| MAPLE | 30" | 1 |
| OAK | 16" | 1 |
| WILLOW | 14" | 1 |
| WILLOW | 12" | 2 |

KEY NOTES:

1. THE GRADING PLAN REFLECTS THE UPPER LIMIT OF POTENTIAL FINISHED GRADE CHANNEL PROFILES. REFER TO THE NOTES ON SHEET C40 FOR A DESCRIPTION OF PROPOSED METHODOLOGY FOR "FIELD–FITTING" THE DESIGN PROFILE TO ACCOMMODATE UNKNOWN SUBSURFACE CONDITIONS.
2. POOL AND STEP GEOMETRY AND LOCATIONS ARE NOT SHOWN ON THE GRADING PLAN OR DESIGN PROFILE DUE TO UNKNOWN SUBSURFACE CONDITIONS. POOL AND STEP GEOMETRY AND LOCATIONS WILL BE DETERMINED AT THE TIME OF CONSTRUCTION BY THE ENGINEER TO CONFORM TO SUBSURFACE CONDITIONS, PER THE TYPICAL CASCADE AND STEP–POOL DETAILS ON SHEET C34.
3. INSTALL ENGINEERED STREAMBED MATERIAL AND FLOODPLAIN ARMOR PER THE TYPICAL CHANNEL TREATMENT SECTION, SHEET C26, EXCEPT AT LOCATIONS WHERE BEDROCK IS EXPOSED DURING CONSTRUCTION.
4. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEETS C1.
5. GRADING WILL NOT EXTEND SOUTH OF THE LIMITS OF GRADING SHOWN ALONG THE SOUTHERN SIDE OF THE WORK AREA. IF BEDROCK IS NOT ENCOUNTERED AT THE UPPER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT SHOWN, AND ADDITIONAL EXCAVATION IS REQUIRED, GRADING SHALL PROJECT DOWN APPROXIMATELY FOLLOWING THE EXISTING SOUTHERN BANK SLOPE TO THE CONSTRUCTED FLOODPLAIN BENCH ELEVATION, SIMILAR TO THE GRADING SHOWN ON SECTION C, SHEET C25, AS DIRECTED BY THE GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST.
6. POND 1250, THE UPPER WATER TREATMENT FACILITIES, AND PORTIONS OF A SITE ACCESS ROAD WILL BE RELOCATED, AS NEEDED, TO ACCOUNT FOR SPATIAL CHANGES DUE TO CONSTRUCTION.



MATERIAL REMOVAL AREA PLAN
SCALE: 1" = 40'



MATERIAL REMOVAL AREA CHANNEL PROFILE
SCALE: 1" = 50'

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PRELIMINARY
NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

MATERIAL
REMOVAL
AREA PLAN
(2 OF 2)

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

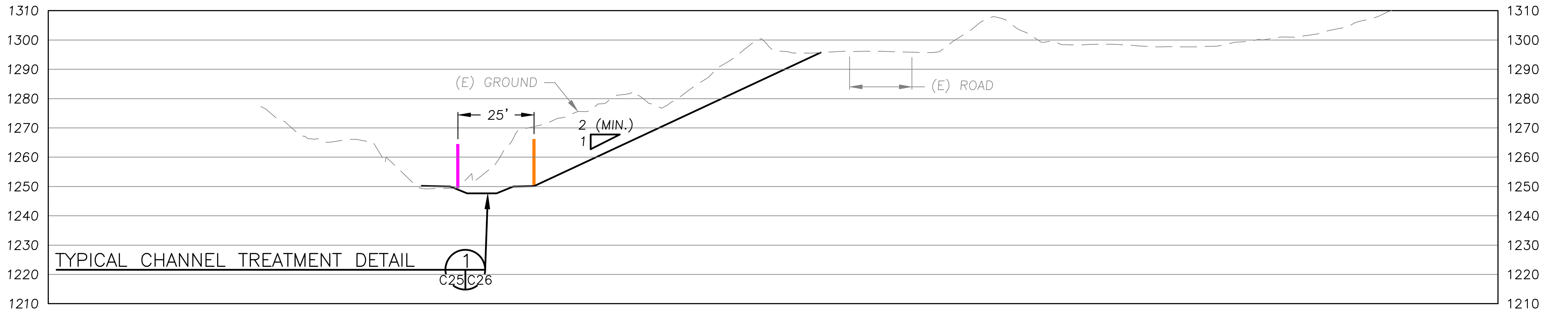
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.Z. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

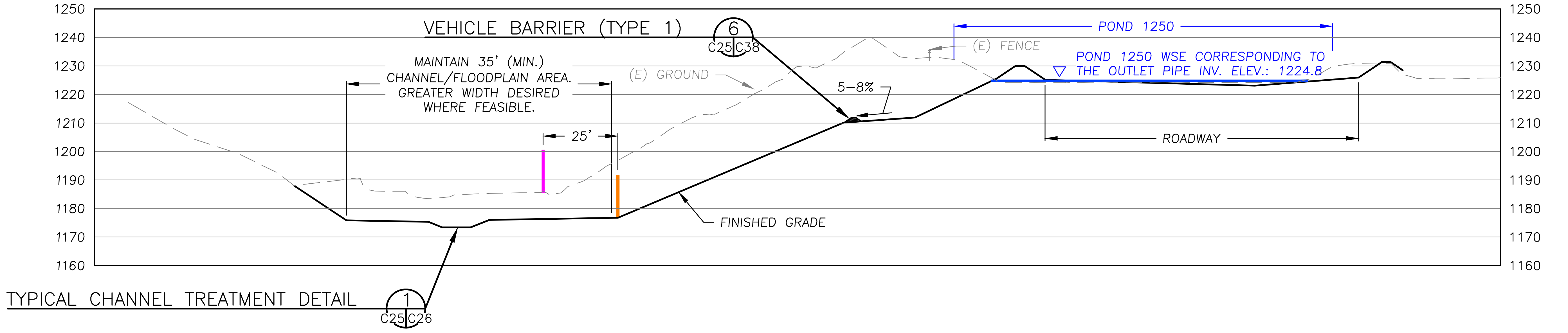
C24

24 OF 47



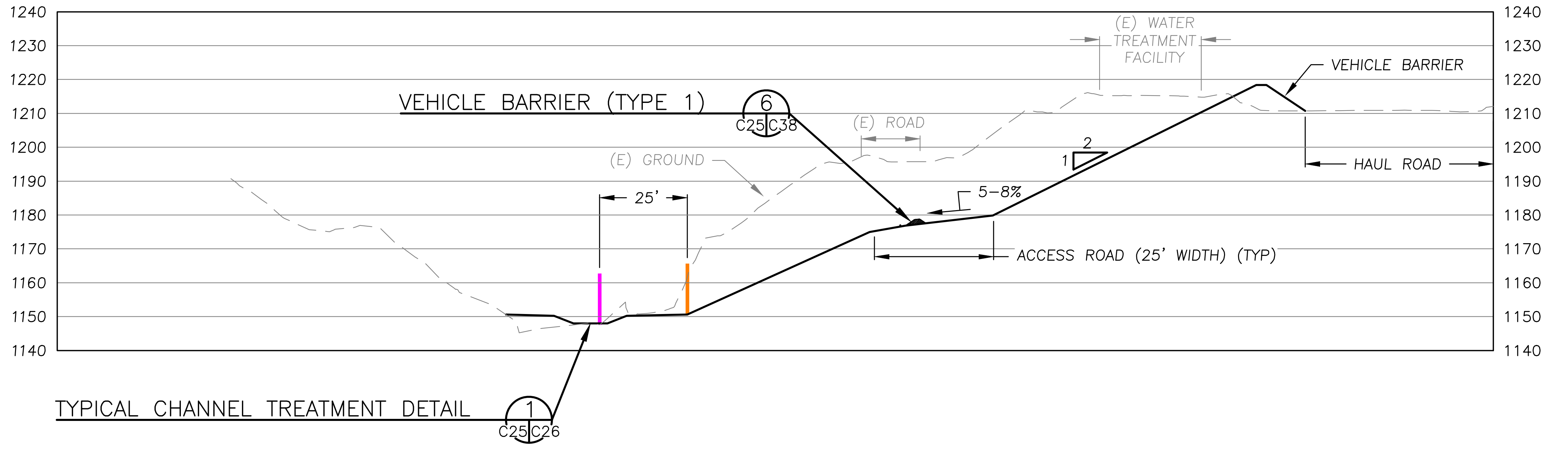
## TYPICAL SECTION D

SCALE: 1" = 30'
C24 C25



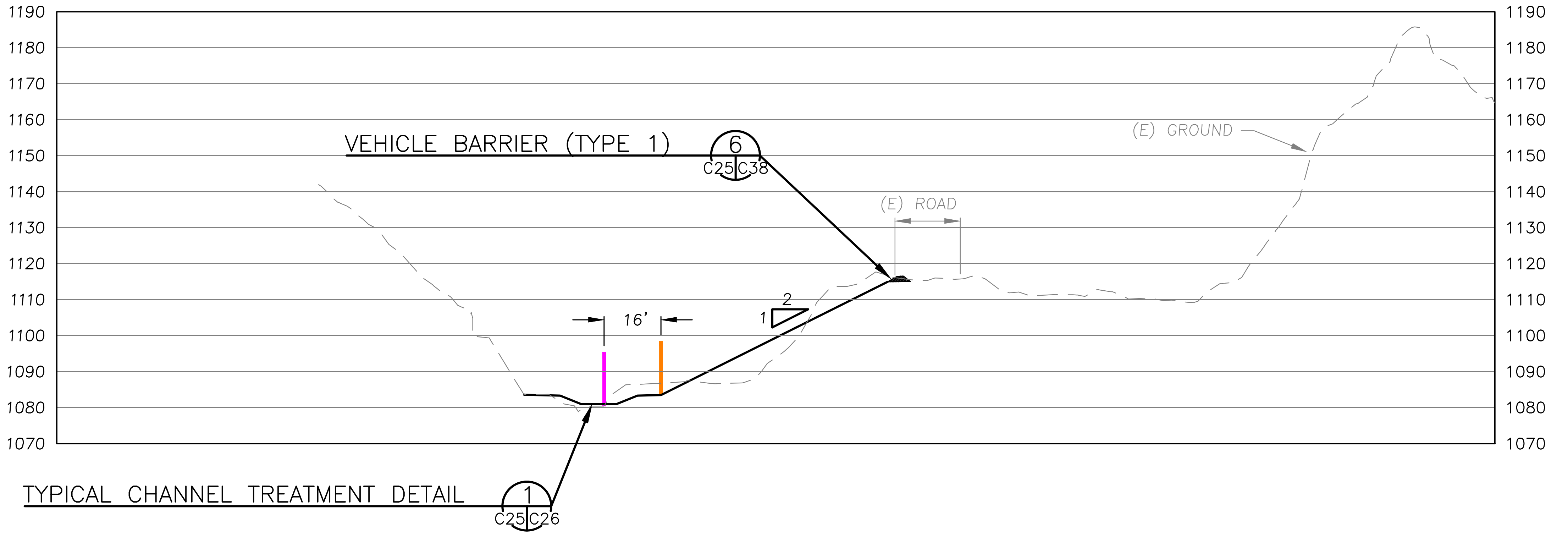
## TYPICAL SECTION C

SCALE: 1" = 30'
C24 C25



## TYPICAL SECTION B

SCALE: 1" = 30'
C23,C24 C25



## TYPICAL SECTION A

SCALE: 1" = 30'
C23 C25

*NOTE:*

1. *FINISHED GRADE SHOWN REPRESENTS THE UPPER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT.*
2. *LEAVE 4'–5' WIDE OPENINGS IN K-RAIL EVERY 50–60 FEET TO ALLOW FOR UNOBSTRUCTED DRAINAGE FROM ROADWAY.*

## LEGEND

| (E) NORTH SLOPE TOE

| PROPOSED NORTH SLOPE TOE

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PRELIMINARY
NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

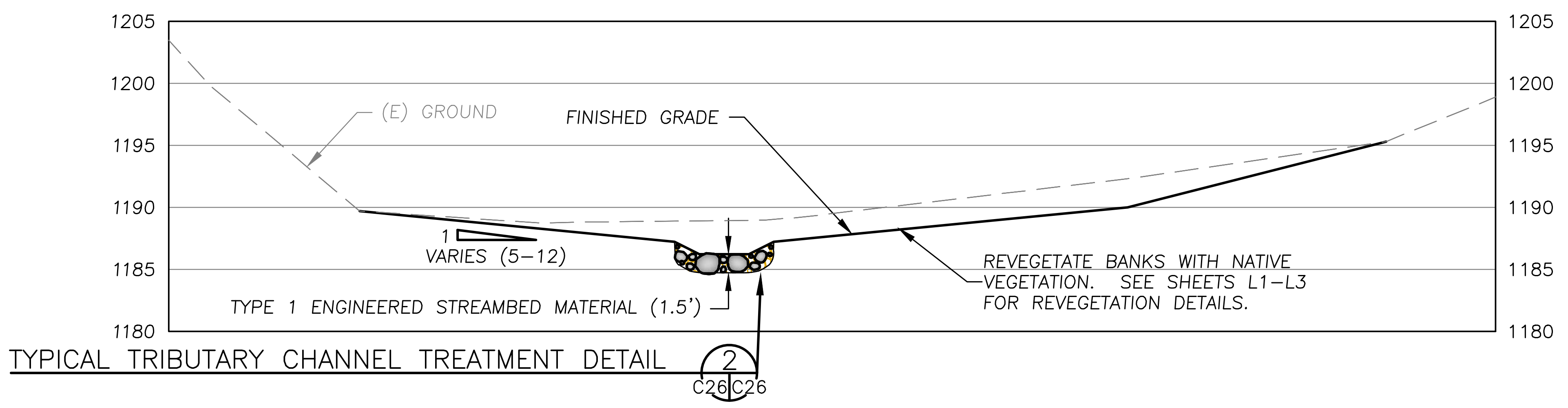
MATERIAL
REMOVAL
AREA
SECTIONS
(1 OF 2)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

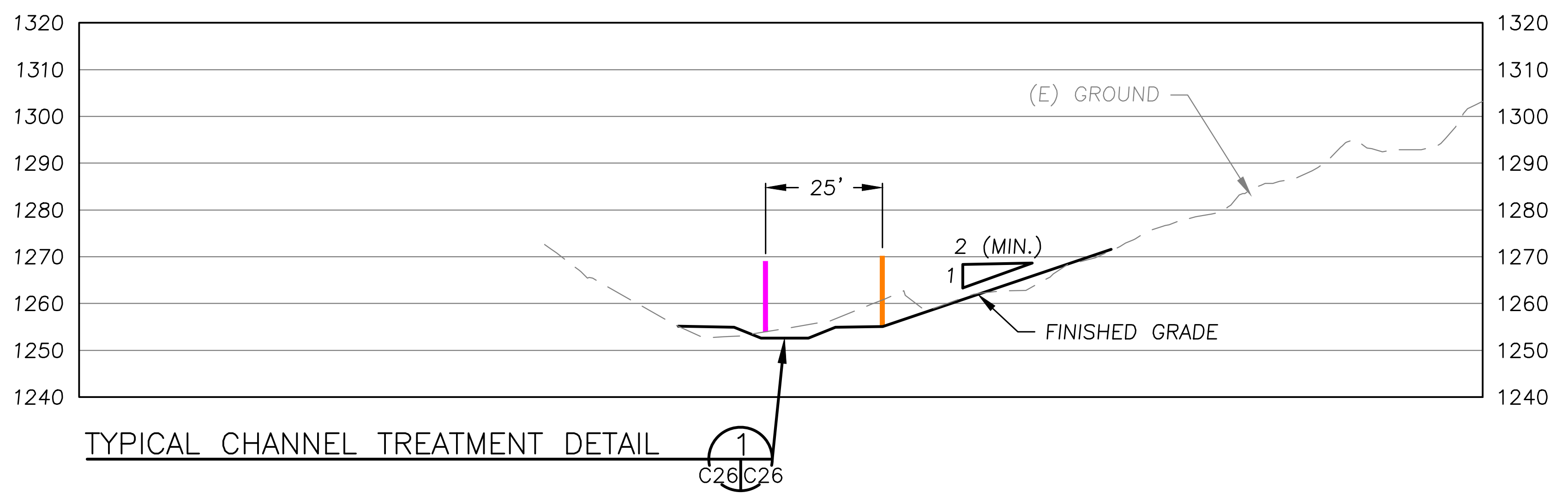
| | |
|---|---|
| DESIGNED BY: | B.M.Z. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C25
25
OF
47



## TYPICAL SECTION
F
SCALE: 1" = 10'
C24 C26



## TYPICAL SECTION
F
SCALE: 1" = 30'
C24 C26

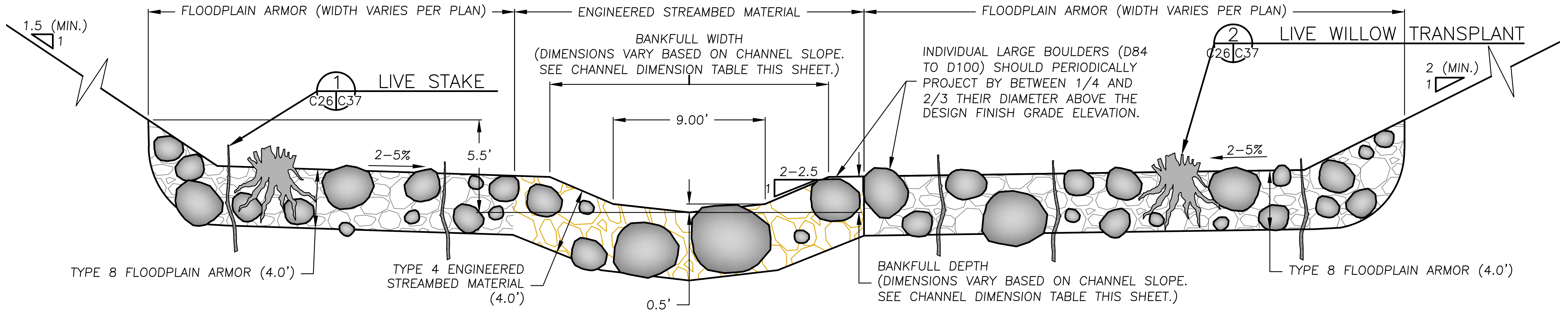
## LEGEND

| | |
|---|---|
| ▌ | (E) NORTH SLOPE TOE |
| ▌ | PROPOSED NORTH SLOPE TC |

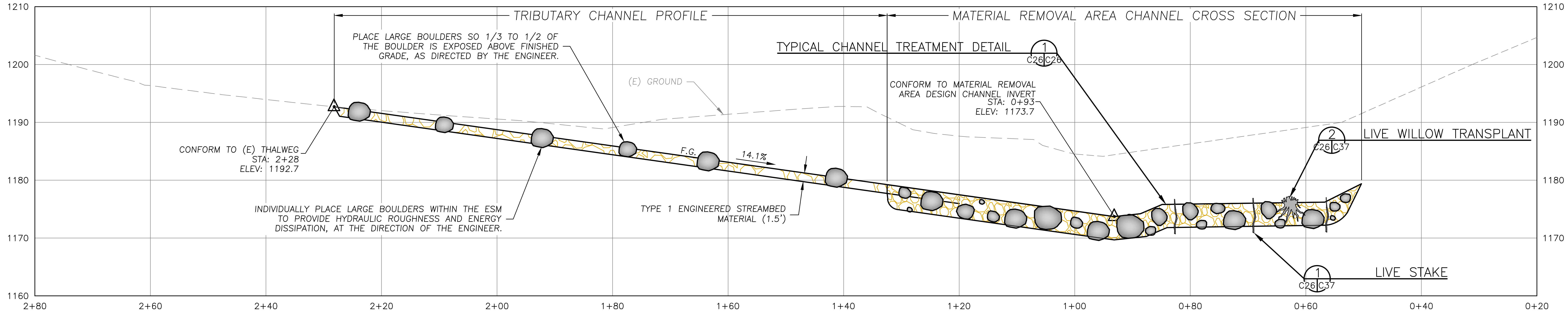
| CHANNEL DIMENSIONS FOR OVERBURDEN REMOVAL AREA | | |
|---|---|---|
| DESIGN SLOPE (%) | DESIGN DIMENSIONS | |
| | BANKFULL WIDTH | BANKFULL DEPTH |
| <4% | 16'–20' | 1.7'–2.1' |
| 4%–8% | 14.5'–18.5' | 1.9'–2.3' |
| >8% | 14'–18' | 2.3'–2.7' |

NOTES:

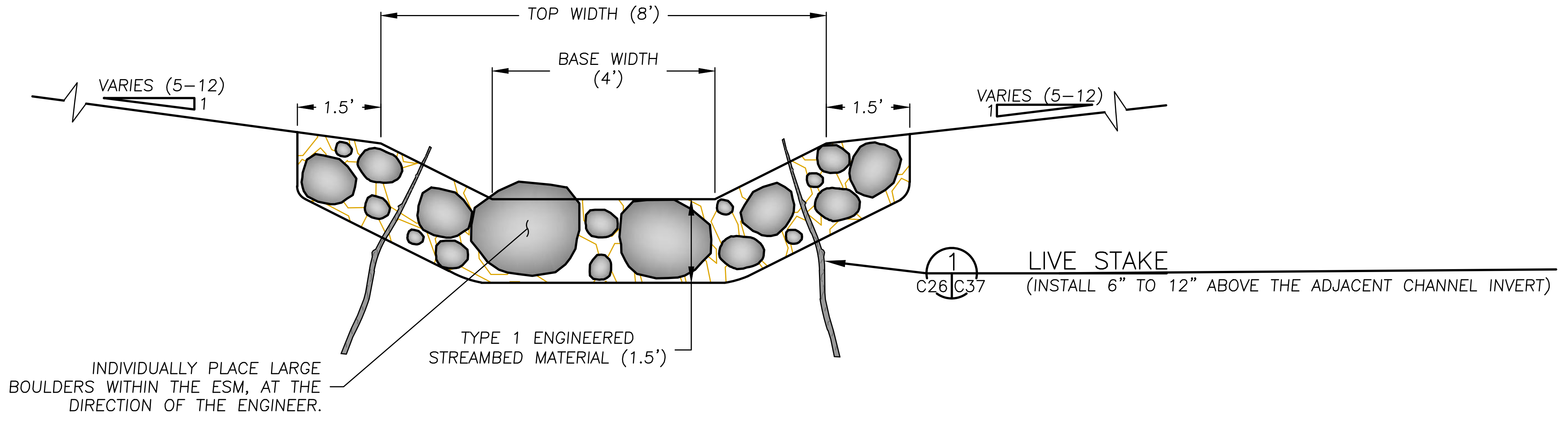
1. INSTALL TYPE 8 FLOODPLAIN ARMOR ALONG THE ENTIRE MATERIAL REMOVAL AREA PROJECT REACH WHERE FLOODPLAIN ARMOR IS SHOWN IN PLAN.
2. INSTALL TYPE 4 ENGINEERED STREAMBED MATERIAL ALONG THE ENTIRE MATERIAL REMOVAL AREA PROJECT REACH WHERE ESM IS SHOWN IN PLAN.
3. SEE THE TYPICAL FLOODPLAIN ROUGHNESS AND HABITAT PLAN, SHEET C35 FOR INFORMATION REGARDING FEATURES NOT SHOWN ON THE TYPICAL TREATMENT DETAIL.
4. FINISHED GRADE SHOWN REPRESENTS THE UPPER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT.



## TYPIAL CHANNEL TREATMENT DETAIL
1
SCALE: 1" = 5'
C25,C26 C26



## MATERIAL REMOVAL AREA TRIBUTARY CHANNEL PROFILE
A
SCALE: 1" = 10'
C24 C26



## TYPICAL TRIBUTARY CHANNEL TREATMENT DETAIL
2
SCALE: 1" = 2'
C26 C26

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LEHIGH HANSON
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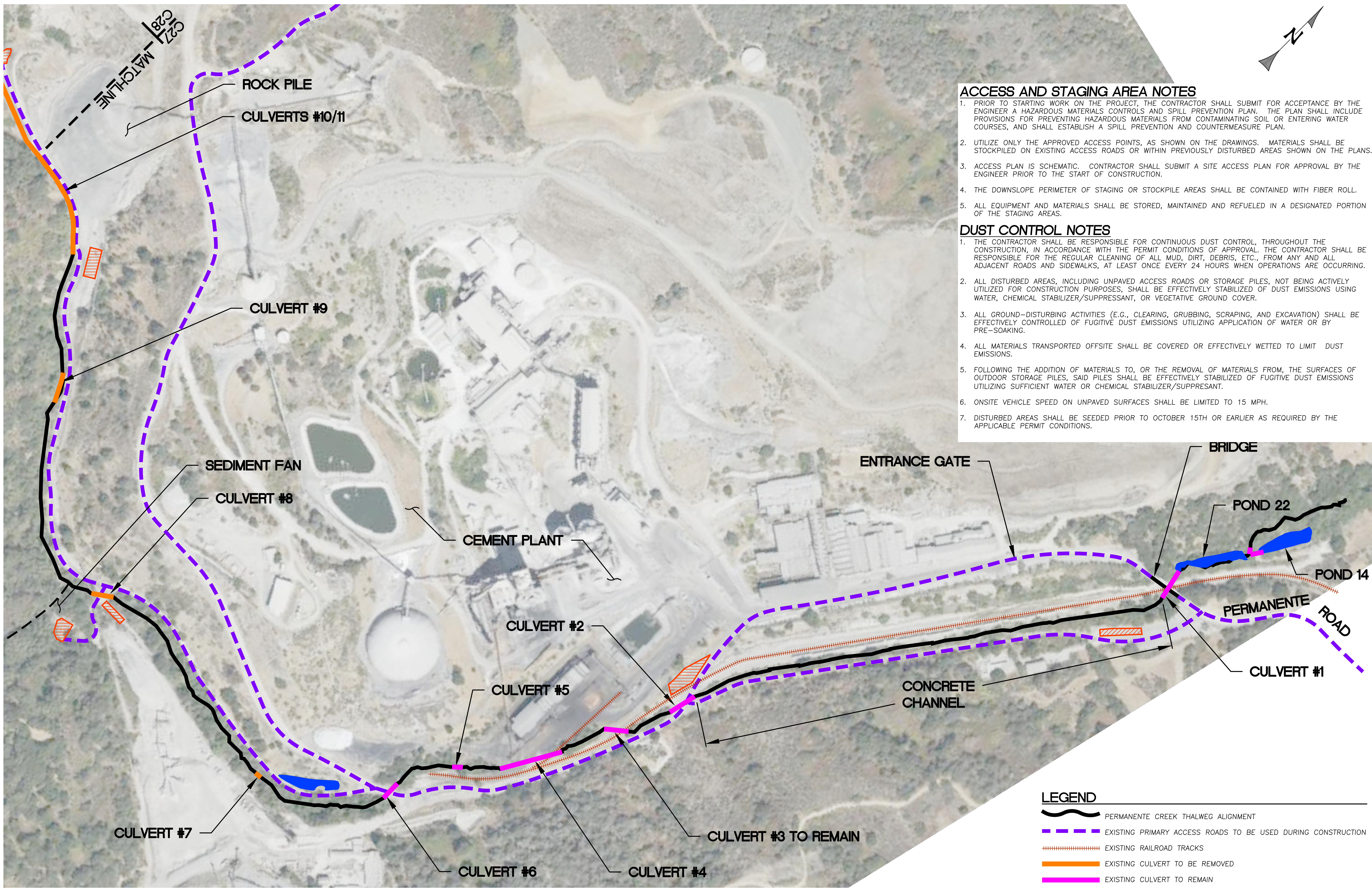
MATERIAL
REMOVAL
AREA
SECTIONS
(2 OF 2)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.Z. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C26



## ACCESS AND STAGING AREA NOTES

1. PRIOR TO STARTING WORK ON THE PROJECT, THE CONTRACTOR SHALL SUBMIT FOR ACCEPTANCE BY THE ENGINEER A HAZARDOUS MATERIALS CONTROLS AND SPILL PREVENTION PLAN. THE PLAN SHALL INCLUDE PROVISIONS FOR PREVENTING HAZARDOUS MATERIALS FROM CONTAMINATING SOIL OR ENTERING WATER COURSES, AND SHALL ESTABLISH A SPILL PREVENTION AND COUNTERMEASURE PLAN.
2. UTILIZE ONLY THE APPROVED ACCESS POINTS, AS SHOWN ON THE DRAWINGS. MATERIALS SHALL BE STOCKPILED ON EXISTING ACCESS ROADS OR WITHIN PREVIOUSLY DISTURBED AREAS SHOWN ON THE PLANS.
3. ACCESS PLAN IS SCHEMATIC. CONTRACTOR SHALL SUBMIT A SITE ACCESS PLAN FOR APPROVAL BY THE ENGINEER PRIOR TO THE START OF CONSTRUCTION.
4. THE DOWNSLOPE PERIMETER OF STAGING OR STOCKPILE AREAS SHALL BE CONTAINED WITH FIBER ROLL.
5. ALL EQUIPMENT AND MATERIALS SHALL BE STORED, MAINTAINED AND REFUELED IN A DESIGNATED PORTION OF THE STAGING AREAS.

## DUST CONTROL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTINUOUS DUST CONTROL, THROUGHOUT THE CONSTRUCTION, IN ACCORDANCE WITH THE PERMIT CONDITIONS OF APPROVAL. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REGULAR CLEANING OF ALL MUD, DIRT, DEBRIS, ETC., FROM ANY AND ALL ADJACENT ROADS AND SIDEWALKS, AT LEAST ONCE EVERY 24 HOURS WHEN OPERATIONS ARE OCCURRING.
2. ALL DISTURBED AREAS, INCLUDING UNPAVED ACCESS ROADS OR STORAGE PILES, NOT BEING ACTIVELY UTILIZED FOR CONSTRUCTION PURPOSES, SHALL BE EFFECTIVELY STABILIZED OF DUST EMISSIONS USING WATER, CHEMICAL STABILIZER/SUPPRESSANT, OR VEGETATIVE GROUND COVER.
3. ALL GROUND–DISTURBING ACTIVITIES (E.G., CLEARING, GRUBBING, SCRAPING, AND EXCAVATION) SHALL BE EFFECTIVELY CONTROLLED OF FUGITIVE DUST EMISSIONS UTILIZING APPLICATION OF WATER OR BY PRE–SOAKING.
4. ALL MATERIALS TRANSPORTED OFFSITE SHALL BE COVERED OR EFFECTIVELY WETTED TO LIMIT DUST EMISSIONS.
5. FOLLOWING THE ADDITION OF MATERIALS TO, OR THE REMOVAL OF MATERIALS FROM, THE SURFACES OF OUTDOOR STORAGE PILES, SAID PILES SHALL BE EFFECTIVELY STABILIZED OF FUGITIVE DUST EMISSIONS UTILIZING SUFFICIENT WATER OR CHEMICAL STABILIZER/SUPPRESANT.
6. ONSITE VEHICLE SPEED ON UNPAVED SURFACES SHALL BE LIMITED TO 15 MPH.
7. DISTURBED AREAS SHALL BE SEEDED PRIOR TO OCTOBER 15TH OR EARLIER AS REQUIRED BY THE APPLICABLE PERMIT CONDITIONS.

## ACCESS AND STAGING PLAN

SCALE: 1"=200'

## LEGEND

| | |
|---|---|
| ━ | PERMANENTE CREEK THALWEG ALIGNMENT |
| ╍ | EXISTING PRIMARY ACCESS ROADS TO BE USED DURING CONSTRUCTION |
| ┼┼┼ | EXISTING RAILROAD TRACKS |
| ━ | EXISTING CULVERT TO BE REMOVED |
| ━ | EXISTING CULVERT TO REMAIN |
| ▨ | STAGING AND STOCKPILE AREAS |
| ╌ | TRIBUTARY (RELEVANT TO PROJECT) |

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NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

ACCESS AND
STAGING PLAN
(1 OF 2)

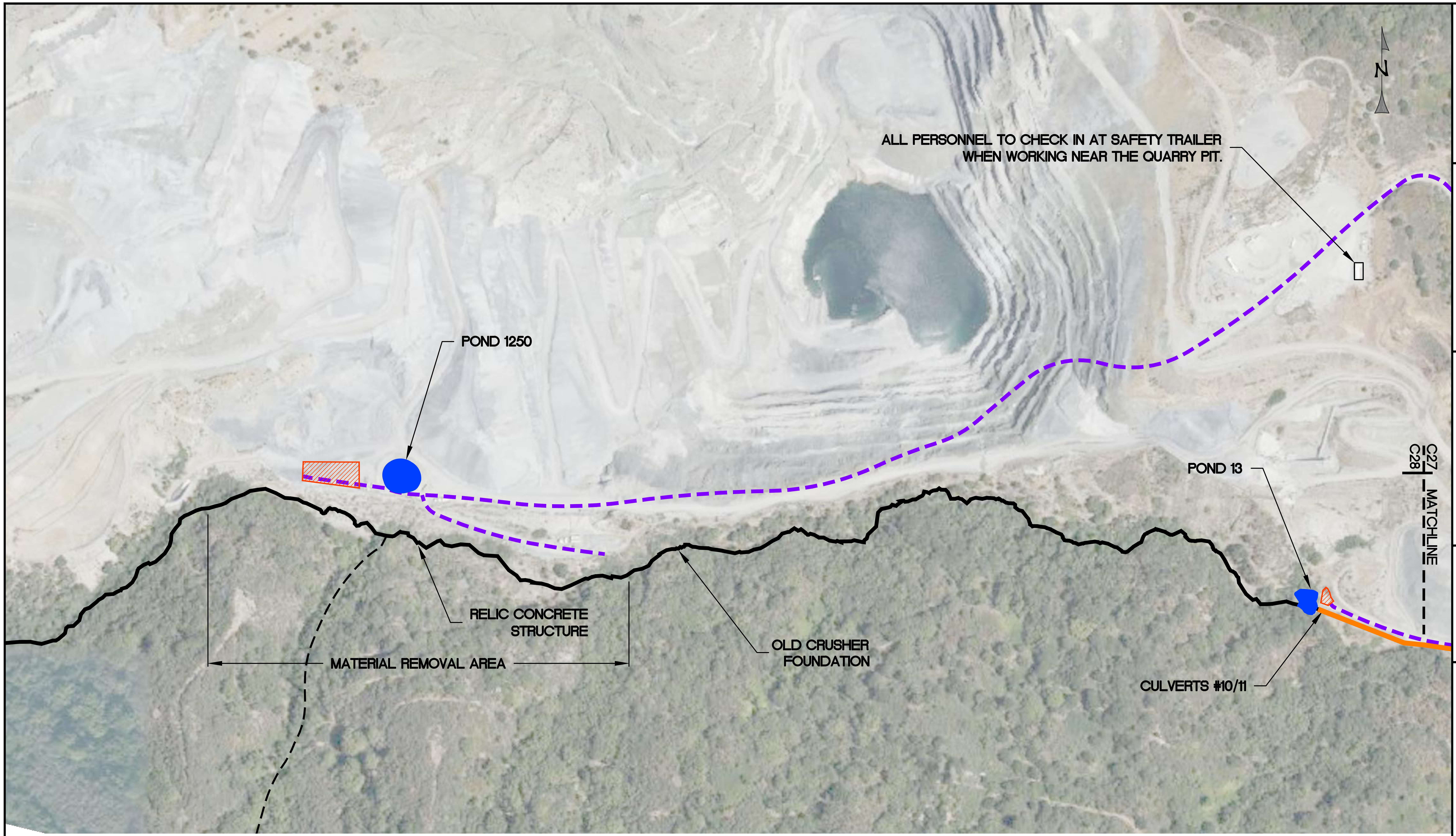
PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.S. |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C27

27
OF
47



## ACCESS AND STAGING PLAN

SCALE: 1" = 200'

### LEGEND

| | |
|---|---|
| 〰 | PERMANENTE CREEK THALWEG ALIGNMENT |
| ▬ ▬ ▬ | EXISTING PRIMARY ACCESS ROADS TO BE USED DURING CONSTRUCTION |
| ▬ | EXISTING CULVERT TO BE REMOVED |
| ▬ | EXISTING CULVERT TO REMAIN |
| ▨ | STAGING AND STOCKPILE AREAS |
| – – – | TRIBUTARY (RELEVANT TO PROJECT) |

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ACCESS AND
STAGING PLAN
(2 OF 2)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
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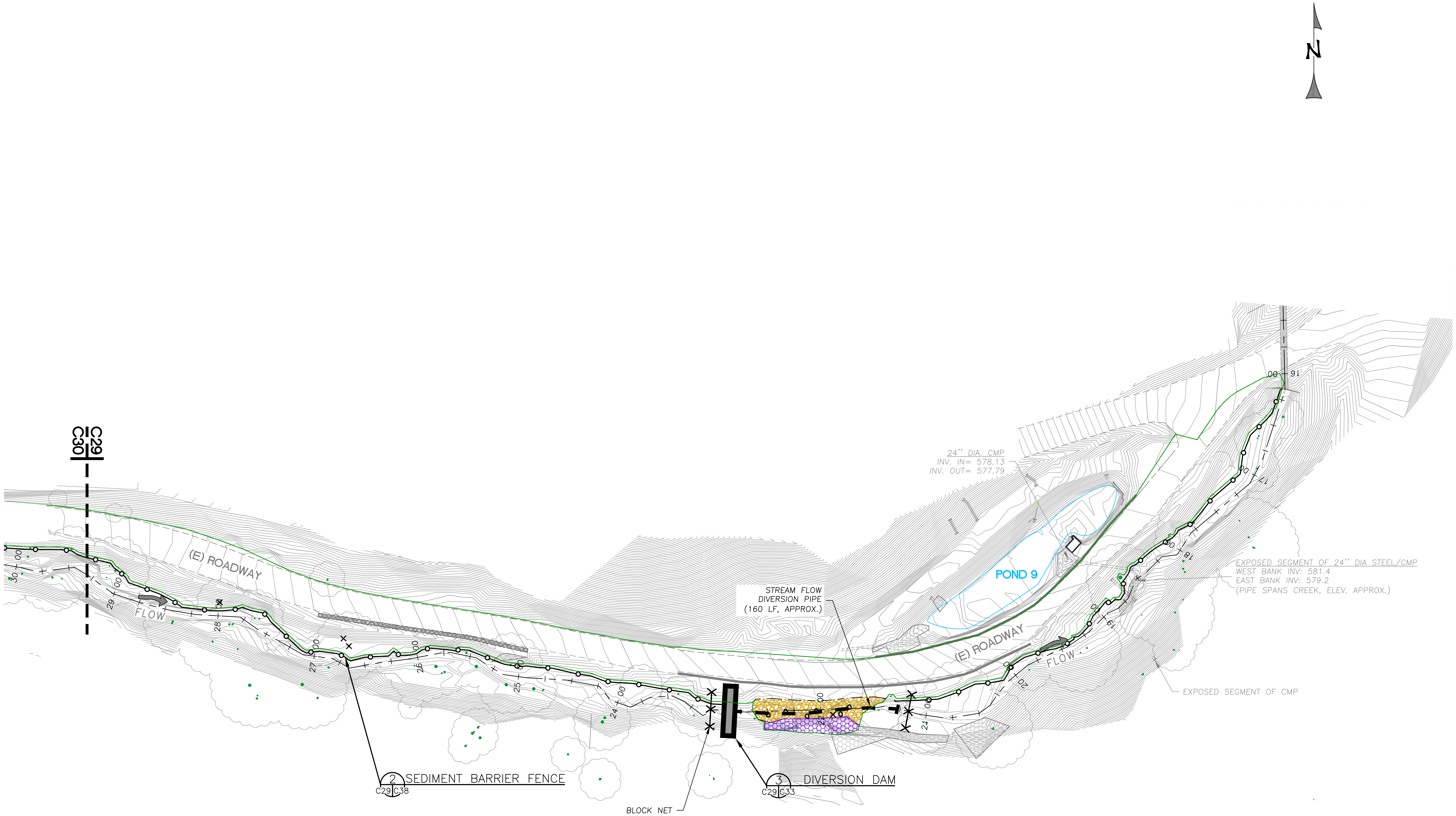
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C28

28 OF 47



## CHANNEL WIDENING DIVERSION AND EROSION CONTROL PLAN (1 OF 2)

SCALE: 1" = 50'

## LEGEND

EXISTING CONTOURS

EXISTING TREE

(E) ROAD

SEDIMENT BARRIER FENCE

PROPOSED FIBER ROLL

LIMITS OF GRADING

30+00 DESIGN ALIGNMENT

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PREPARED AT THE REQUEST OF:

LEHIGH HANSON HEIDELBERG CEMENT GROUP

CHANNEL WIDENING DIVERSION AND EROSION CONTROL PLAN (1 OF 2)

PERMANENTE CREEK RESTORATION PLAN

UPDATED 90% DESIGN

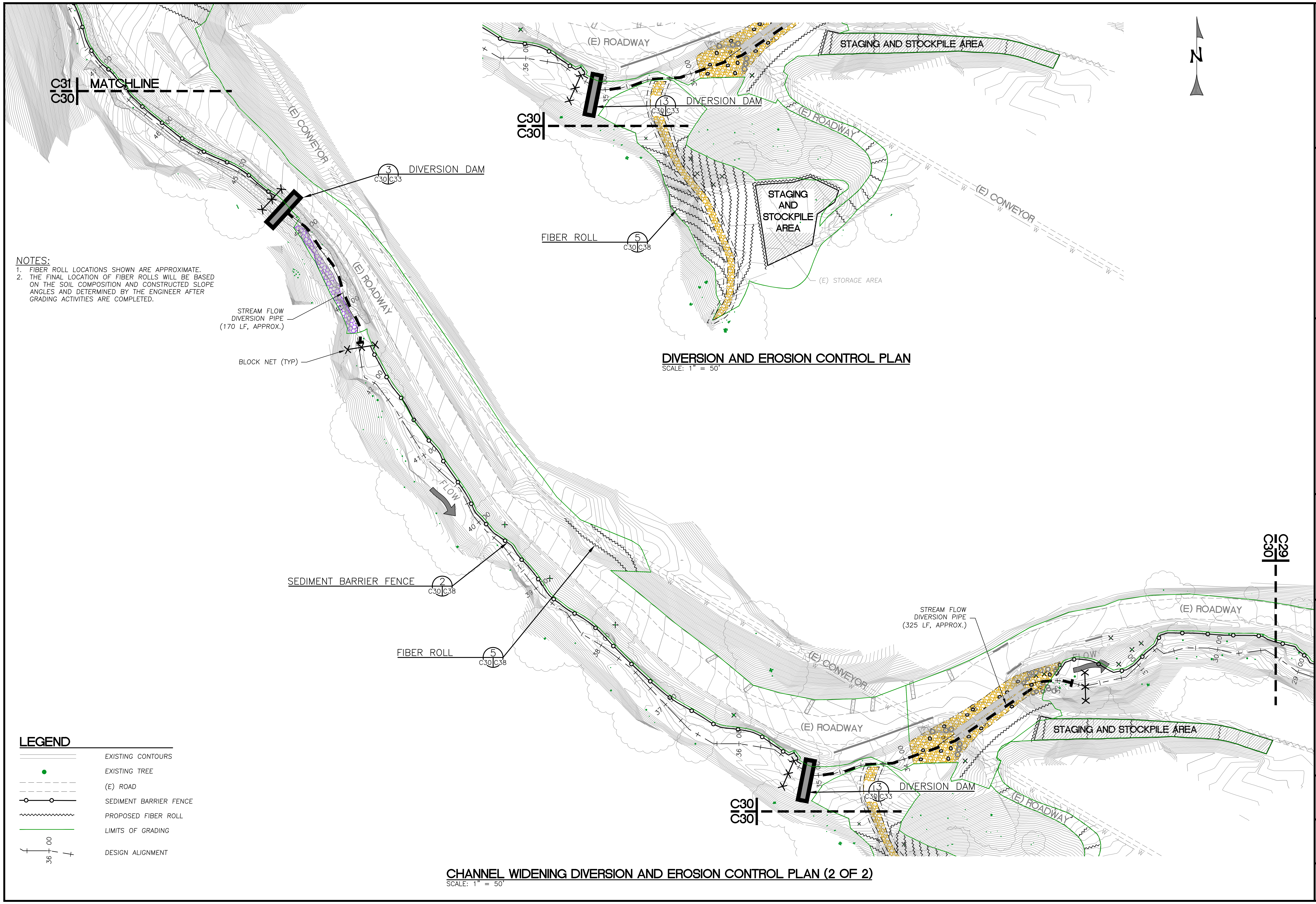
SANTA CLARA COUNTY CEQA REVIEW SUBMITTAL

DESIGNED BY: B.M.S.
DRAWN BY: B.M.S.
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13-016

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C29

29 OF 47



## DIVERSION AND EROSION CONTROL PLAN

SCALE: 1" = 50'

## CHANNEL WIDENING DIVERSION AND EROSION CONTROL PLAN (2 OF 2)

SCALE: 1" = 50'

NOTES:

1. FIBER ROLL LOCATIONS SHOWN ARE APPROXIMATE.
2. THE FINAL LOCATION OF FIBER ROLLS WILL BE BASED ON THE SOIL COMPOSITION AND CONSTRUCTED SLOPE ANGLES AND DETERMINED BY THE ENGINEER AFTER GRADING ACTIVITIES ARE COMPLETED.

LEGEND

| | |
|---|---|
| ═ | EXISTING CONTOURS |
| ● | EXISTING TREE |
| - - - | (E) ROAD |
| —o—o— | SEDIMENT BARRIER FENCE |
| ～～～ | PROPOSED FIBER ROLL |
| —— | LIMITS OF GRADING |
| 36+00 | DESIGN ALIGNMENT |

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HEIDELBERG CEMENT
GROUP

CHANNEL
WIDENING
DIVERSION AND
EROSION
CONTROL
PLAN (2 OF 2)

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: B.M.S.
DRAWN BY: B.M.S.
CHECKED BY: M.W.W.
DATE: 8/26/22
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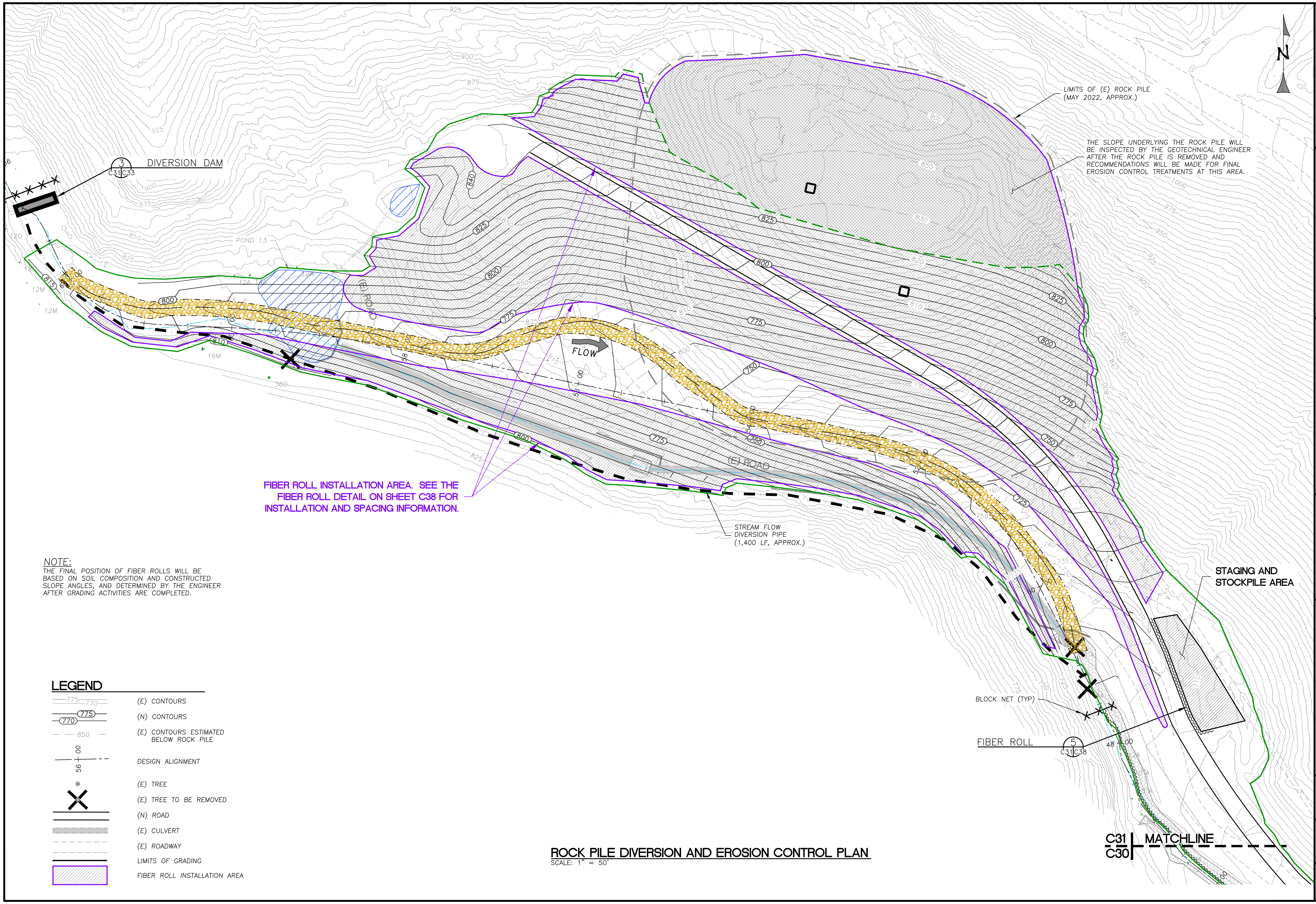
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C30

30
OF
47



NOTE:
THE FINAL POSITION OF FIBER ROLLS WILL BE BASED ON SOIL COMPOSITION AND CONSTRUCTED SLOPE ANGLES, AND DETERMINED BY THE ENGINEER AFTER GRADING ACTIVITIES ARE COMPLETED.

## LEGEND

| | |
|---|---|
| 775 770 | (E) CONTOURS |
| 775 770 | (N) CONTOURS |
| 850 | (E) CONTOURS ESTIMATED BELOW ROCK PILE |
| 56+00 | DESIGN ALIGNMENT |
| ● | (E) TREE |
| ✕ | (E) TREE TO BE REMOVED |
| | (N) ROAD |
| | (E) CULVERT |
| | (E) ROADWAY |
| | LIMITS OF GRADING |
| ▨ | FIBER ROLL INSTALLATION AREA |

## ROCK PILE DIVERSION AND EROSION CONTROL PLAN

SCALE: 1" = 50'

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ROCK PILE
AREA
DIVERSION AND
EROSION
CONTROL PLAN

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
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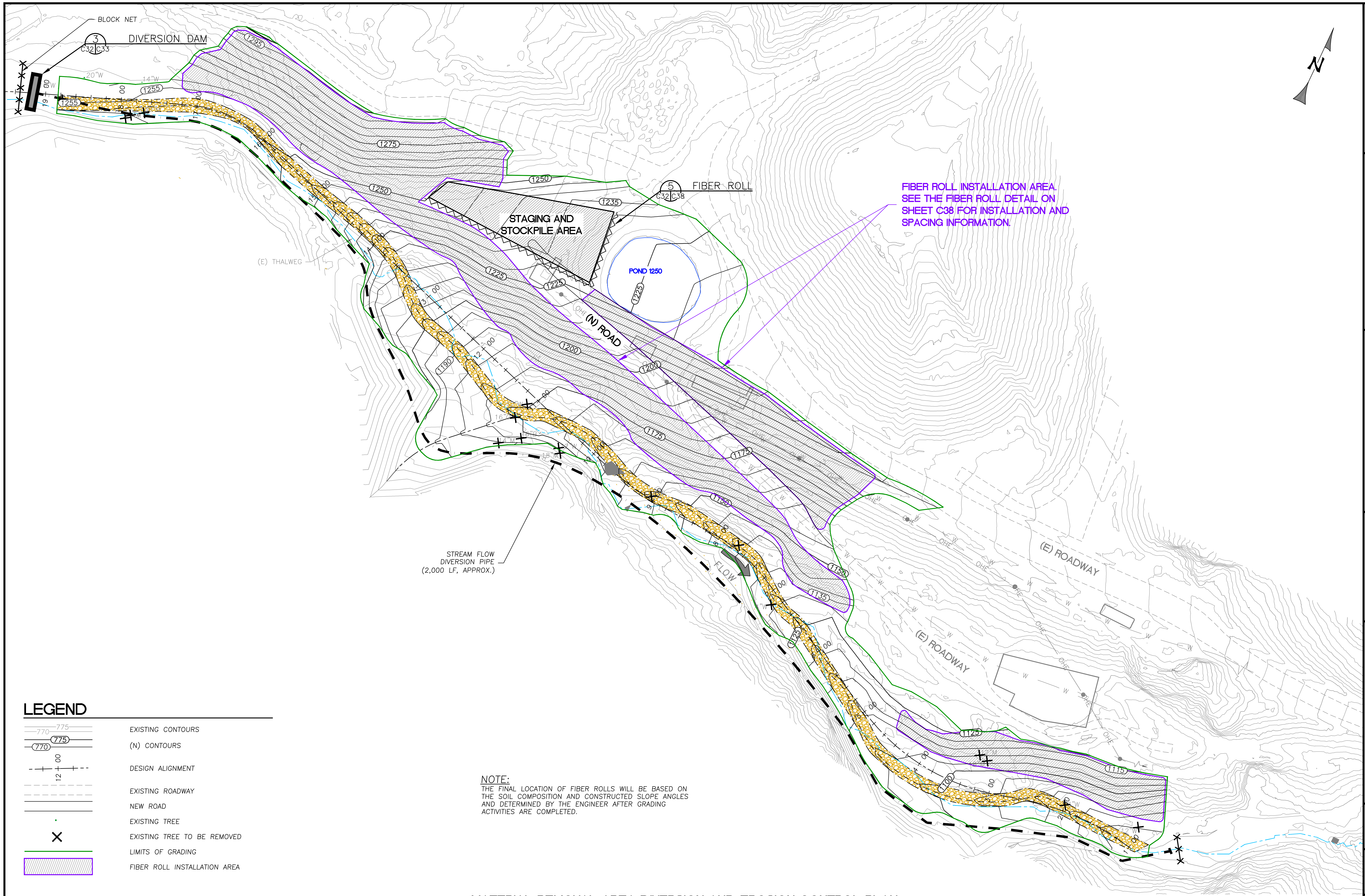
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C31

31
OF
47



## LEGEND

| | |
|---|---|
| 770 775 | EXISTING CONTOURS |
| (770) (775) | (N) CONTOURS |
| 12+00 | DESIGN ALIGNMENT |
| - - - - | EXISTING ROADWAY |
| ―― | NEW ROAD |
| · | EXISTING TREE |
| × | EXISTING TREE TO BE REMOVED |
| ― | LIMITS OF GRADING |
| ▨ | FIBER ROLL INSTALLATION AREA |

*NOTE:*
*THE FINAL LOCATION OF FIBER ROLLS WILL BE BASED ON THE SOIL COMPOSITION AND CONSTRUCTED SLOPE ANGLES AND DETERMINED BY THE ENGINEER AFTER GRADING ACTIVITIES ARE COMPLETED.*

## MATERIAL REMOVAL AREA DIVERSION AND EROSION CONTROL PLAN

SCALE: 1" = 60'

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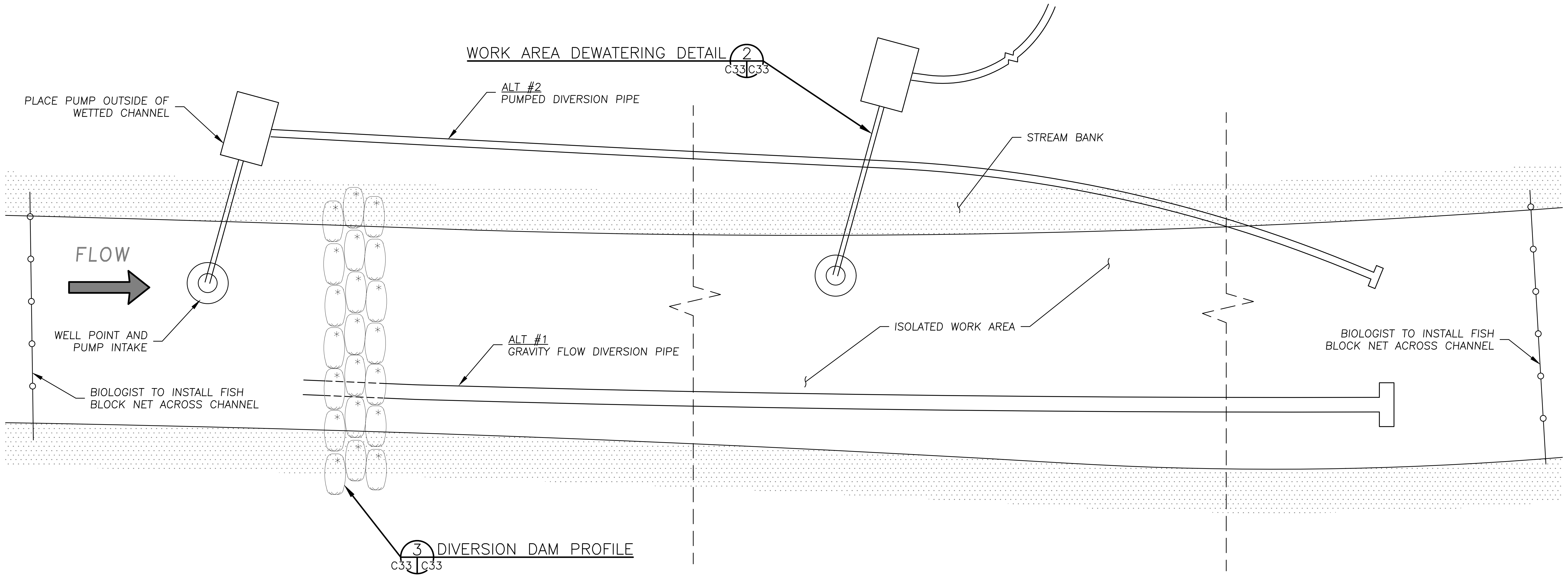
MATERIAL
REMOVAL AREA
DIVERSION AND
EROSION
CONTROL PLAN

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: B.M.Z.
DRAWN BY: B.M.S.
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13-016

BAR IS ONE INCH ON
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C32
32
OF
47



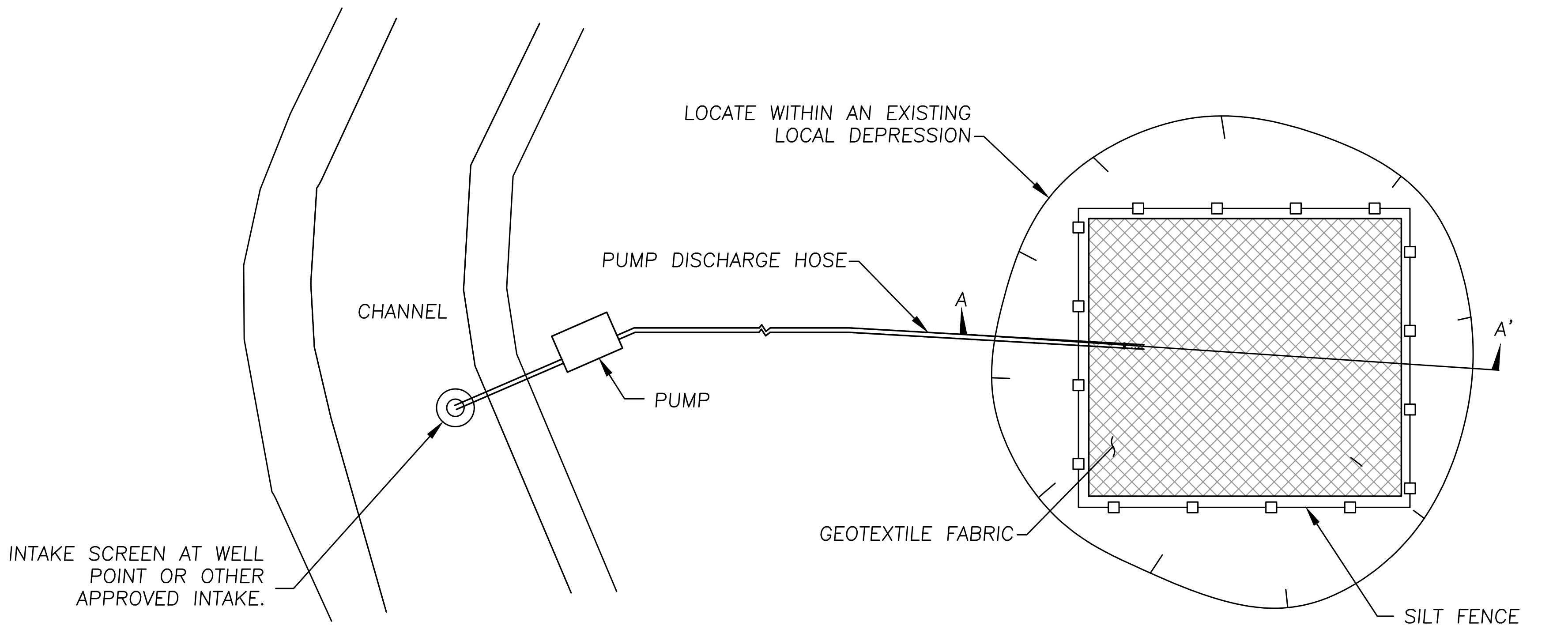
## TYPICAL DEWATERING PLAN
N.T.S.
1 C33 C33

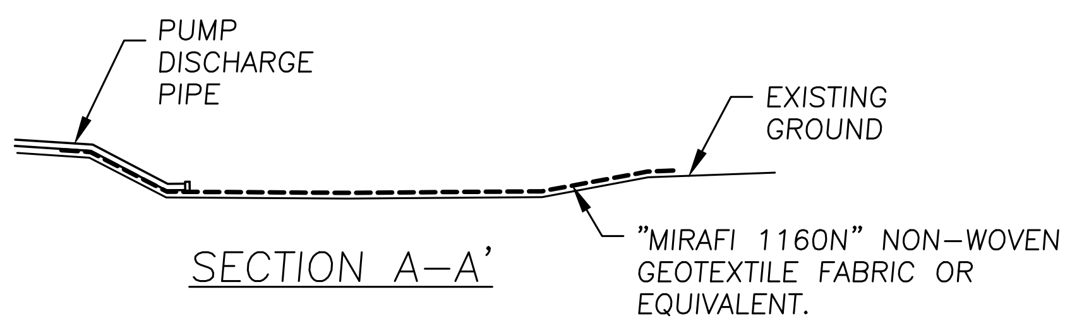
## DIVERSION NOTES CONTINUED

1. GENERAL
  1.1. DIVERSION SYSTEMS SHALL BE INSTALLED TO DEWATER THE INDIVIDUAL PROJECT AREAS TO FACILITATE IN-STREAM CONSTRUCTION AND TO REDUCE THE POTENTIAL IMPACTS TO WATER QUALITY DOWNSTREAM OF THE PROJECT SITES.
  1.2. THE CONTRACTOR SHALL CONFIRM THAT A FAVORABLE LONG TERM WEATHER FORECAST (1 WEEK MIN.) IS OBSERVED PRIOR TO PLACEMENT OF DIVERSION STRUCTURE.
  1.3. PRIOR TO PLACEMENT OF DIVERSION STRUCTURE, FISH SHALL BE REMOVED FROM THE DIVERTED REACH, IN ACCORDANCE WITH SECTION 2.
  1.4. DIVERSION SYSTEM INSTALLATION SHALL NORMALLY BEGIN IN THE DOWNSTREAM AREA AND CONTINUE IN AN UPSTREAM DIRECTION. THE FLOW SHALL BE DIVERTED ONLY WHEN THE DIVERSION CONSTRUCTION IS COMPLETE.
  1.5. THE DIVERSION PLAN SHOWN IS SCHEMATIC. THE DESIGN AND IMPLEMENTATION OF THE DIVERSION DAM IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR PRIOR TO INSTALLATION. THE CONTRACTOR SHALL SUBMIT A DIVERSION PHASING PLAN TO THE ENGINEER FOR REVIEW AND APPROVAL. THE BASIC REQUIREMENTS OF THE DIVERSION PLAN ARE SHOWN.
  1.6. THE TYPICAL DEWATERING PLAN SHOWN DEPICTS TWO ALTERNATIVE TYPES OF DIVERSION STRUCTURES. AN AUTOMATIC BACKUP SYSTEM MUST BE INSTALLED IF ALTERNATIVE #2 (PUMPED DIVERSION) IS THE SOLE METHOD OF DIVERSION.*
  1.7. DIVERSION PIPES MAY BE RELOCATED DURING CONSTRUCTION.
  1.8. FOLLOWING ENGINEER'S APPROVAL OF THE COMPLETED WORK, DIVERSION SHALL BE REMOVED IMMEDIATELY, IN AN UPSTREAM DIRECTION.
2. FISH REMOVAL
  2.1. FISH SHALL BE REMOVED FROM THE DIVERTED REACHES BY A QUALIFIED FISHERIES BIOLOGIST, LICENSED FOR SUCH ACTIVITIES BY THE NATIONAL MARINE FISHERIES SERVICE AND THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE.
  2.2. BLOCK NETS SHALL BE PROVIDED AND INSTALLED BY THE FISHERIES BIOLOGIST. BLOCK NETS SHALL BE MAINTAINED BY THE CONTRACTOR BOTH UPSTREAM AND DOWNSTREAM OF THE WORK AREA, THROUGHOUT THE PERIOD OF CONSTRUCTION. MAINTENANCE INCLUDES PERIODIC REMOVAL OF ACCUMULATED DEBRIS, AS NECESSARY TO ENSURE FUNCTION. BLOCK NETS SHALL BE REMOVED BY THE FISHERIES BIOLOGIST AFTER THE DIVERSION IS REMOVED AND THE IN CHANNEL WORK AREA IS RE-WATERED.
3. DIVERSION SYSTEM
  3.1. THE CONTRACTOR SHALL INSTALL A TEMPORARY SEALED SANDBAG DAM TO CAPTURE AND DIVERT STREAM FLOW UPSTREAM OF THE PROJECT SITE. THE DAM AND METHOD OF SEALING SHALL BE PLACED AT AN APPROPRIATE DEPTH TO CAPTURE SUBSURFACE STREAM FLOW, AS NEEDED TO DEWATER THE STREAMBED.
  3.2. THE CONTRACTOR SHALL MAINTAIN THE DIVERSION DAM DURING THE COURSE OF CONSTRUCTION WORK.
  3.3. IN THE EVENT OF A SIGNIFICANT STORM, THE CONTRACTOR SHALL BE PREPARED TO TAKE NECESSARY MEASURES TO INSURE SAFE PASSAGE OF STORM WATER FLOW THROUGH THE PROJECT AREA, WITHOUT DAMAGE TO EXISTING STRUCTURES, OR INTRODUCTION OF EXCESSIVE SEDIMENT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TEMPORARY EROSION CONTROL B.M.P.'S.
4. DEWATERING OF CONSTRUCTION AREAS
  4.1. ANY DEWATERING ACTIVITIES WHICH MAY BE REQUIRED FOR CONSTRUCTION PURPOSES SHALL BE CONDUCTED IN A MANNER WHICH DOES NOT RESULT IN AN EXCEEDANCE OF ANY WATER QUALITY REQUIREMENTS ESTABLISHED BY THE CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD.
  4.2. DISCHARGE OF WATER FROM THE DEWATERED CONSTRUCTION SITE, EITHER BY GRAVITY OR PUMPING, SHALL BE PERFORMED IN A MANNER TO PREVENT EXCESSIVE TURBIDITY FROM ENTERING THE RECEIVING WATERWAYS AND TO PREVENT SCOUR AND EROSION OUTSIDE OF THE CONSTRUCTION SITE. PUMPED WATER SHOULD BE PRE-FILTERED WITH SAND/GRAVEL PACK AROUND SUMPS FOR SUBSURFACE FLOWS AND A SILT FENCE OR HAY BALES AROUND PUMPS FOR SURFACE FLOW. PUMPED WATER SHALL BE DISCHARGED INTO ISOLATED LOCAL DEPRESSIONS OR TREATMENT FACILITIES, AS NECESSARY TO MEET WATER QUALITY REQUIREMENTS. WHERE WATER TO BE DISCHARGED INTO THE CREEK WILL CREATE EXCESSIVE TURBIDITY, THE WATER SHALL BE ROUTED THROUGH A SEDIMENT INTERCEPTOR OR OTHER FACILITIES TO REMOVE SEDIMENT FROM WATER.
  4.3. CONTRACTOR SHALL SUPPLY ALL NECESSARY PUMPS, PIPING, FILTERS, SHORING, AND OTHER TOOLS AND MATERIALS NECESSARY FOR DEWATERING.

---

*IF AT ANY TIME A PUMP IS USED THAT DRAWS WATER FROM THE SURFACE WHERE AQUATIC ORGANISMS CAN BECOME ENTRAINED, THE PUMP SHALL BE SCREENED USING A MESH WITH A MAXIMUM OPENING SIZE OF 5 MILLIMETERS. CHECK THE SCREEN REGULARLY TO ENSURE IT IS FUNCTIONING AS INTENDED AND THAT ANIMALS ARE NOT BECOMING ENTRAPPED.



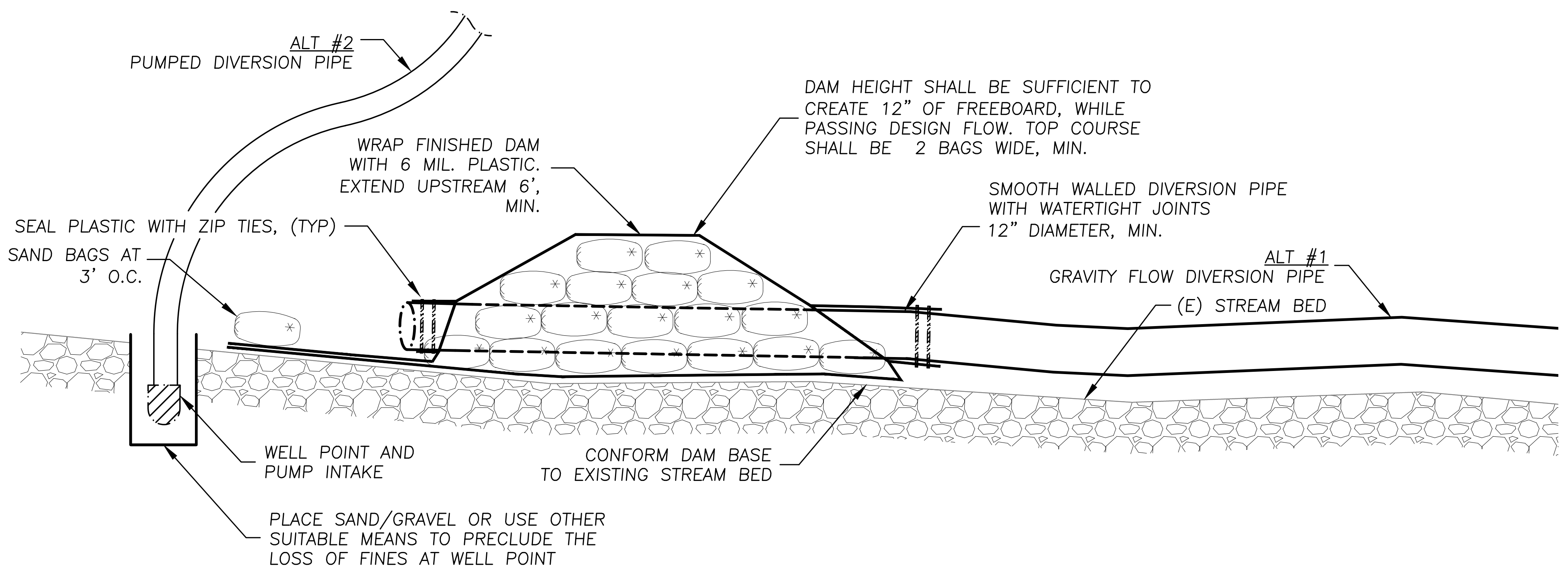


SECTION A-A'

### DEWATERING DISCHARGE AREA NOTES:

1. DEWATERING SHALL COMPLY WITH ALL PROJECT PERMITS.
2. THIS DETAIL REPRESENTS A POTENTIAL OPTION FOR DEWATERING OF WORK AREAS.
3. TURBID WATER RESULTING FROM DEWATERING ACTIVITIES WILL EITHER BE TREATED OR DISCHARGED TO A LOCAL DEPRSSION(S) TO INFILTRATE OR EVAPORATE.
4. TURBID WATERS WILL NOT BE ALLOWED TO DISCHARGE INTO PERMANENTE CREEK.
5. PROPOSED FILTRATION METHODS WILL BE FIELD-FIT TO EXISTING CONDITIONS AT THE TIME OF CONSTRUCTION, AS APPROVED BY THE ENGINEER.
6. REMOVE ACCUMULATED SEDIMENT AT THE COMPLETION OF DEWATERING ACTIVITIES AND DISPOSE OF AT AN APPROVED LOCATION.

## WORK AREA DEWATERING DETAIL
N.T.S.
2 C33 C33



## DIVERSION DAM PROFILE
N.T.S.
3 C29,C30,C33 C33

NOTE: CONTRACTOR MAY USE ALTERNATE DAM DETAIL, SUBJECT TO APPROVAL OF THE ENGINEER AND THE PERMITTING AGENCIES.

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PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

DEWATERING
DETAILS
(1 OF 6)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C33
33 OF 47

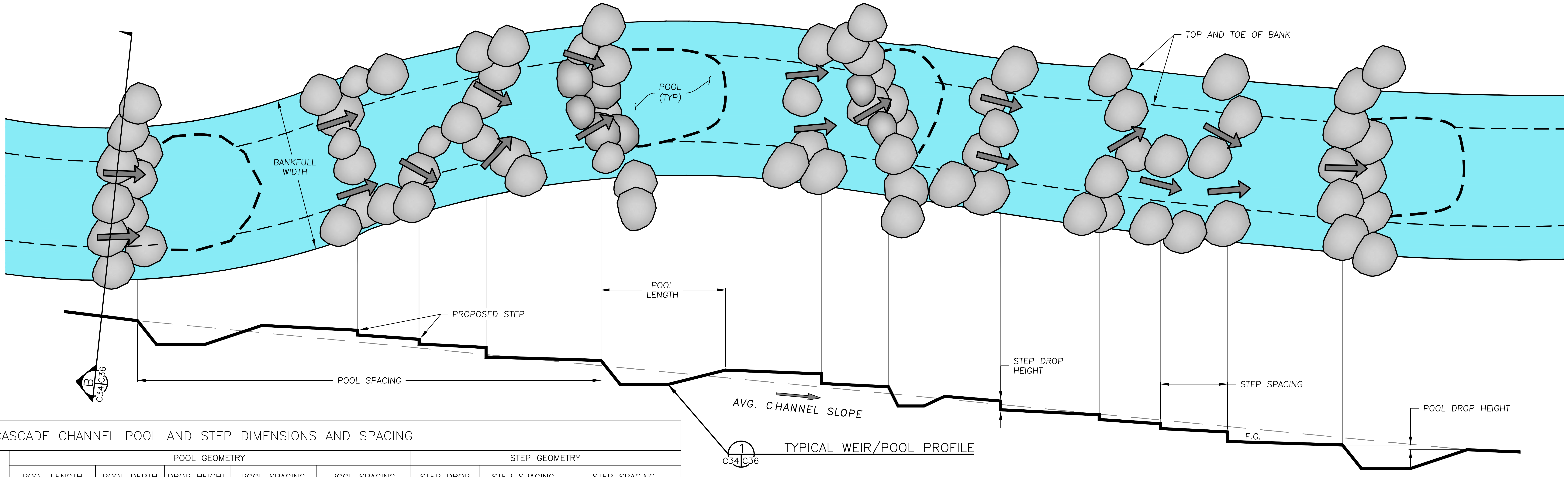


TABLE 1: CASCADE CHANNEL POOL AND STEP DIMENSIONS AND SPACING

| | POOL GEOMETRY | | | | | STEP GEOMETRY | | |
|---|---|---|---|---|---|---|---|---|
| AVERAGE CHANNEL SLOPE | POOL LENGTH (FT.) | POOL DEPTH (FT.) | DROP HEIGHT (FT.) | POOL SPACING (FT.) | POOL SPACING (BANKFULL WIDTHS) | STEP DROP HEIGHT (FT.) | STEP SPACING (FT.) | STEP SPACING (BANKFULL WIDTHS) |
| 8%–12% | 6–13 | 0.5–2 | 0.5–1 | 28–75 | 2–4 | 0.5–1 | 6–13 | 0.4–0.8 |

## TYPICAL CASCADE REACH DETAIL (FOR ROCK PILE AND MATERIAL REMOVAL AREA)

SCALE: 1" = 6'

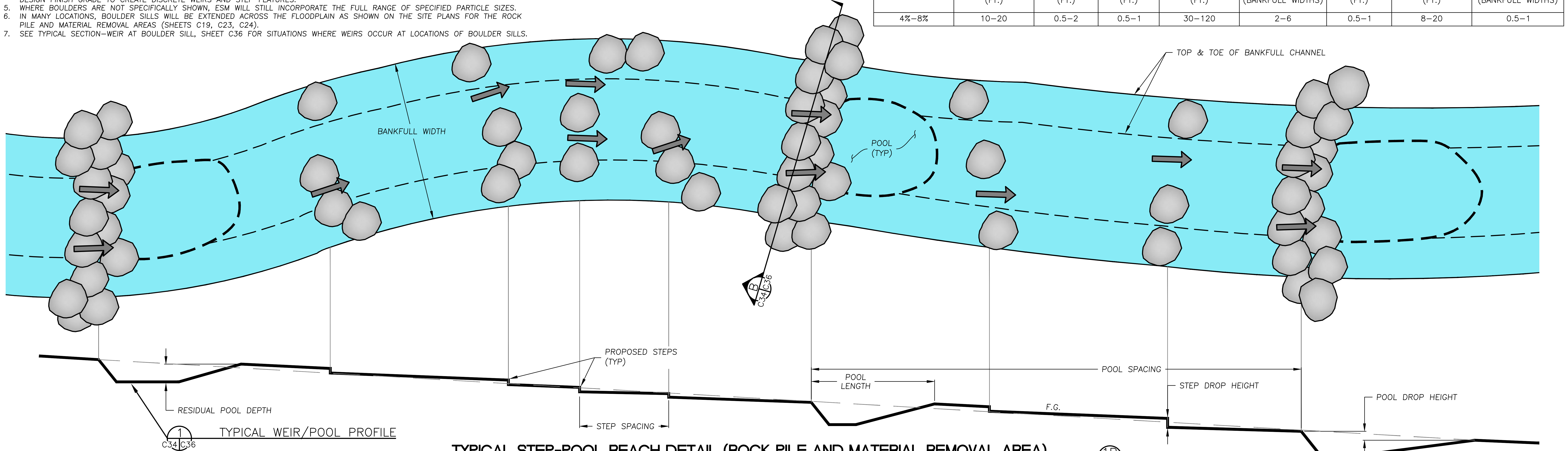
1A C34 C19,C23,C24

## CONSTRUCTION NOTES:

1. THESE DETAILS ARE PROVIDED TO DEMONSTRATE GEOMETRY OF STEPS AND POOLS WITHIN STEP–POOL AND CASCADE REACHES.
2. CHANNEL GEOMETRY WILL BE CONSTRUCTED TO FOLLOW THE GUIDELINES PROVIDED IN TABLES 1 AND 2.
3. INDIVIDUAL POOLS AND STEPS WILL BE INSTALLED AS DIRECTED BY THE ENGINEER DURING INSTALLATION, IN ACCORDANCE WITH THE STANDARD GEOMETRY PROVIDED IN THE TABLES SHOWN HEREON.
4. INDIVIDUAL BOULDERS SHOWN IN PLAN VIEW REPRESENT TYPICAL PLACEMENT OF BOULDERS EXCEEDING THE SPECIFIED D50 DIMENSIONS FOR ENGINEERED STREAMBED MATERIAL, AND SET WITH 1/3 TO 3/4 OF THE BOULDER DIAMETER SET ABOVE THE DESIGN FINISH GRADE TO CREATE DISCRETE WEIRS AND STEP FEATURES.
5. WHERE BOULDERS ARE NOT SPECIFICALLY SHOWN, ESM WILL STILL INCORPORATE THE FULL RANGE OF SPECIFIED PARTICLE SIZES.
6. IN MANY LOCATIONS, BOULDER SILLS WILL BE EXTENDED ACROSS THE FLOODPLAIN AS SHOWN ON THE SITE PLANS FOR THE ROCK PILE AND MATERIAL REMOVAL AREAS (SHEETS C19, C23, C24).
7. SEE TYPICAL SECTION–WEIR AT BOULDER SILL, SHEET C36 FOR SITUATIONS WHERE WEIRS OCCUR AT LOCATIONS OF BOULDER SILLS.

TABLE 2: STEP–POOL CHANNEL: POOL AND STEP DIMENSIONS AND SPACING

| | POOL GEOMETRY | | | | | STEP GEOMETRY | | |
|---|---|---|---|---|---|---|---|---|
| AVERAGE CHANNEL SLOPE | POOL LENGTH (FT.) | POOL DEPTH (FT.) | DROP HEIGHT (FT.) | POOL SPACING (FT.) | POOL SPACING (BANKFULL WIDTHS) | STEP DROP (FT.) | STEP SPACING (FT.) | STEP SPACING (BANKFULL WIDTHS) |
| 4%–8% | 10–20 | 0.5–2 | 0.5–1 | 30–120 | 2–6 | 0.5–1 | 8–20 | 0.5–1 |



## TYPICAL STEP-POOL REACH DETAIL (ROCK PILE AND MATERIAL REMOVAL AREA)

SCALE: 1" = 6'

1B C34 C19,C23,C24

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HEIDELBERG CEMENT GROUP

TYPICAL
CASCADE AND
STEP-POOL
REACH DETAILS
(2 OF 6)

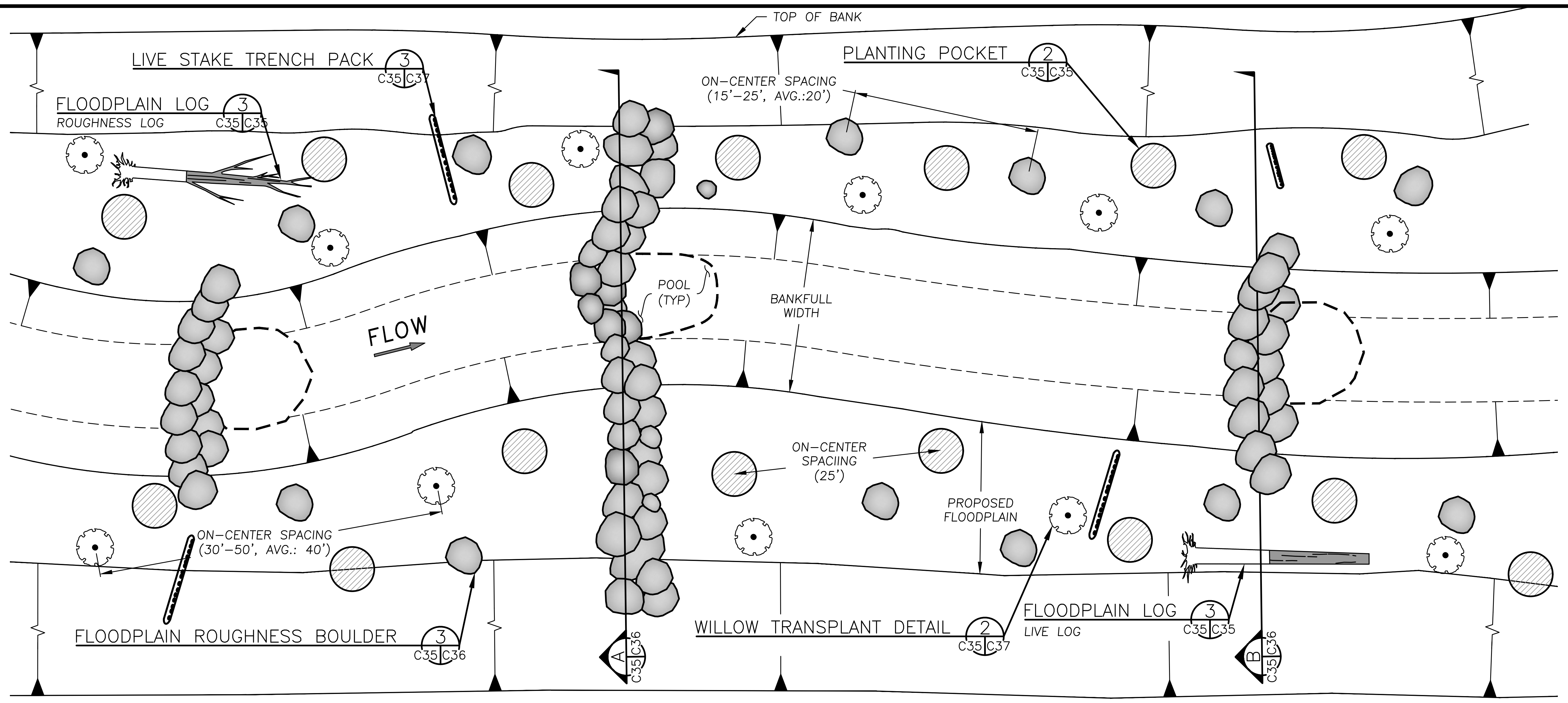
PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C34

34 OF 47



## TYPICAL FLOODPLAIN ROUGHNESS AND HABITAT PLAN (FOR ROCK PILE AND MATERIAL REMOVAL AREA)

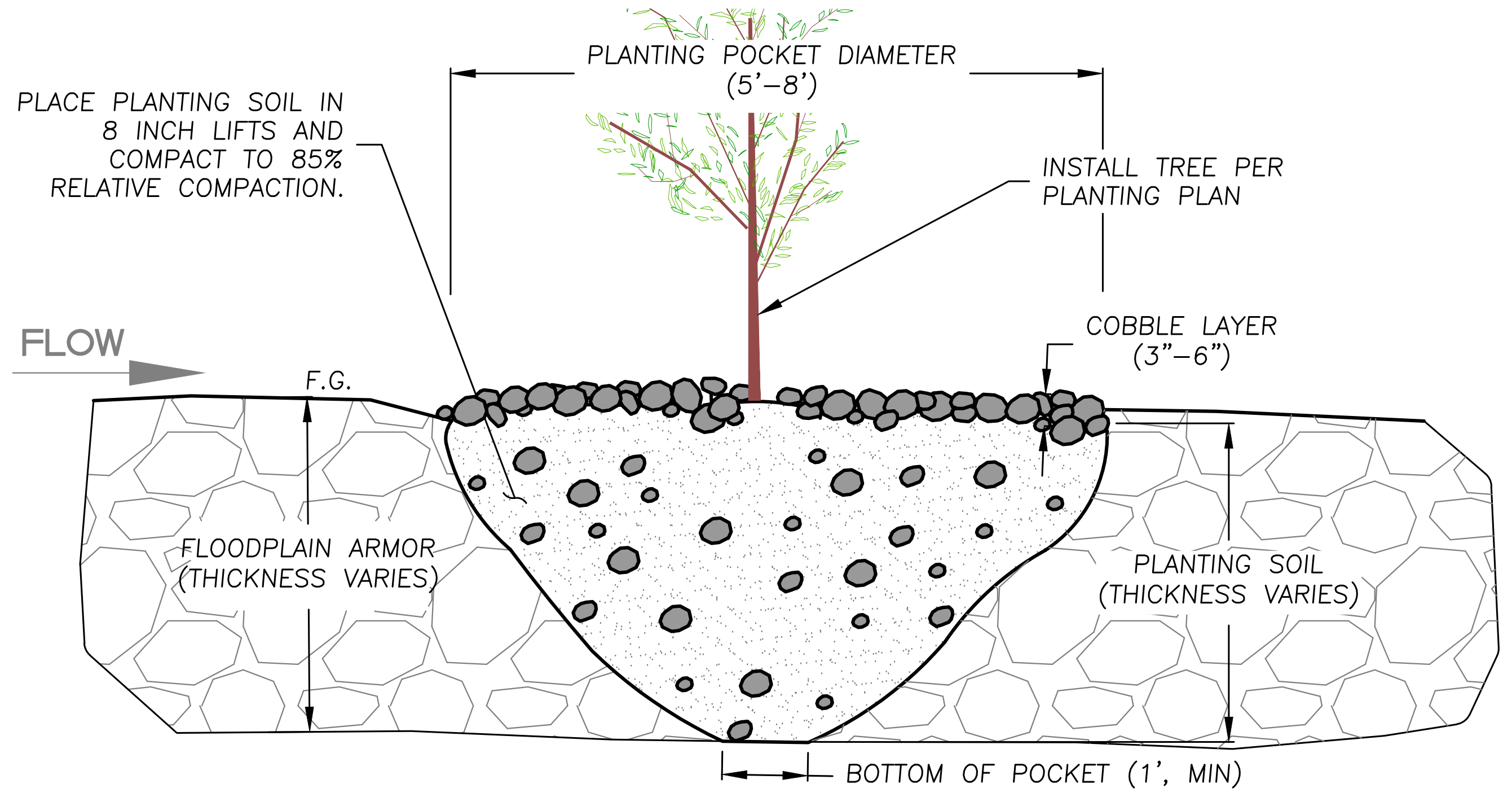
SCALE: 1" = 10'

4 C19,C23,C24 C35

PLANTING SOIL NOTES

1. PLANTING SOIL SHALL CONSIST OF NATIVE SOILS EXCAVATED DURING PROJECT CONSTRUCTION.
2. OBTAIN PLANTING SOIL FROM EXCAVATED AREAS THAT ARE WITHIN 3 FEET OF EXISTING GROUND, PRIOR TO DISTURBANCE.
3. PLANTING SOIL SHALL MEET THE FOLLOWING GRADATION:

| U.S. SIEVE SIZE | PERCENT PASSING (BY WEIGHT) |
|---|---|
| 6" | 100 |
| 3" | 90–95 |
| 1" | 80–90 |
| No.4 | 60–80 |
| No.40 | 30–60 |
| No.100 | 15–30 |



## PLANTING POCKET

SCALE: 1" = 2'

2 C35 C35

FLOODPLAIN LOG NOTES:

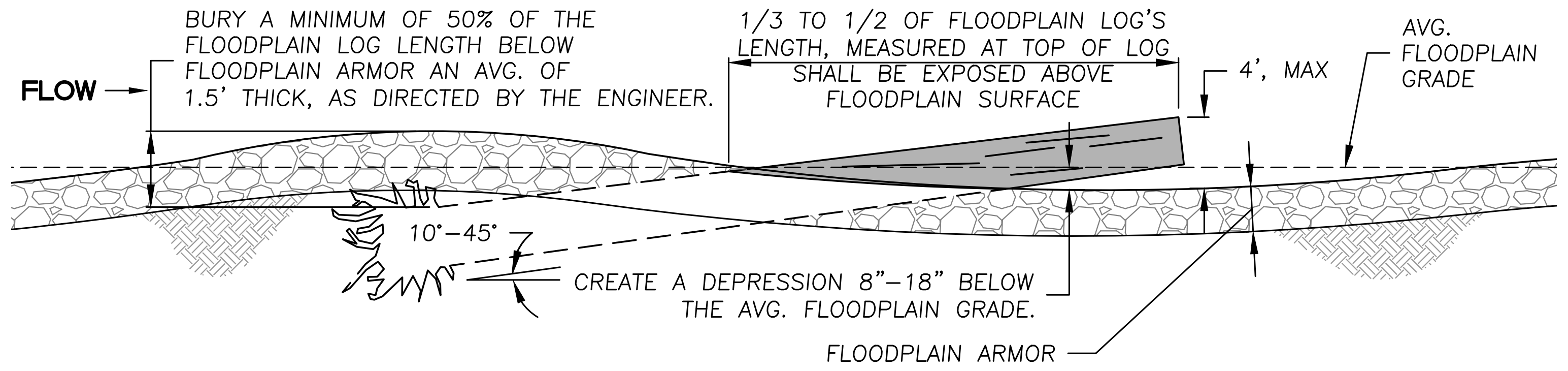
1. FLOODPLAIN LOGS SHALL BE SALVAGED WITH ROOTWADS INTACT.
2. TRIM ROOTS SO THE ROOTWAD DIAMETER IS 3'–5'.
3. FLOODPLAIN LOGS SHALL CONSIST OF BOTH ROUGHNESS LOGS AND LIVE LOGS, AS SHOWN ON RELEVANT SITE PLANS.

LIVE LOGS

1. SALVAGE ALL WILLOWS SHOWN FOR REMOVAL FOR USE AS LIVE LOGS.
2. REMOVAL ALL LIMBS FROM LIVE LOGS, MAKING CLEAN CUTS.

ROUGHNESS LOGS

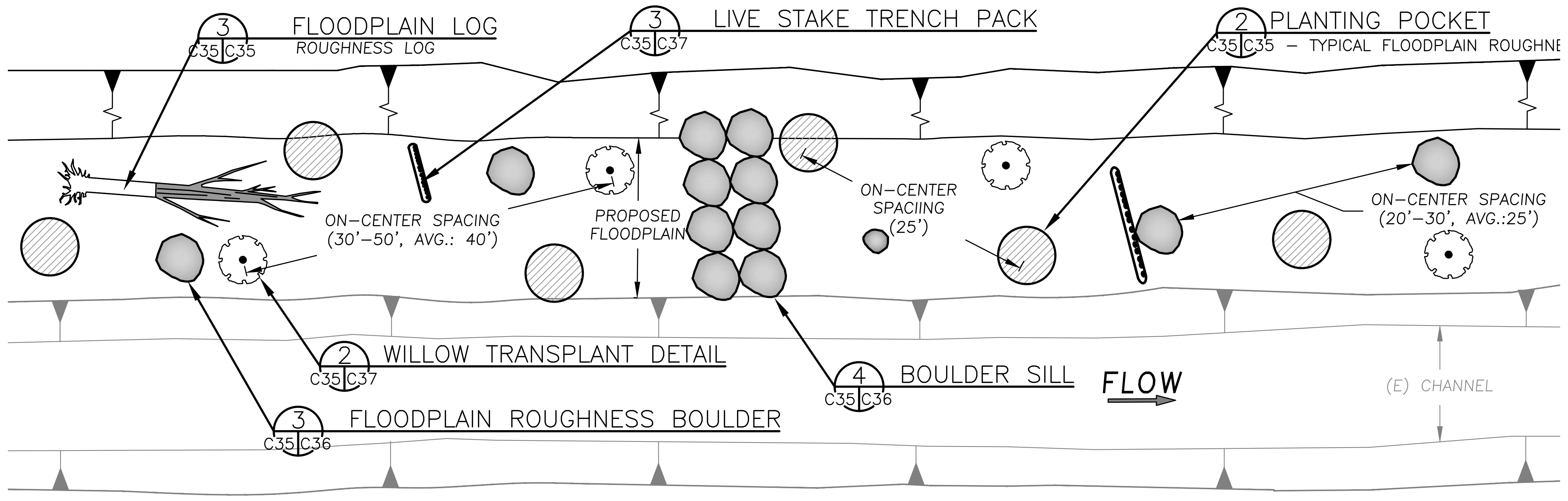
1. ALL SPECIES SHOWN FOR REMOVAL, OTHER THAN WILLOW, SHALL BE SALVAGED FOR USE AS ROUGHNESS LOGS.
2. REMOVE THE LIMBS ALONG THE LOWER HALF OF THE TREE. RETAIN THE LIMBS ALONG THE UPPER HALF TO ADD ADDITIONAL ROUGHNESS AND COMPLEXITY TO THE FLOODPLAIN.



## FLOODPLAIN LOG

SCALE: 1" = 5'

3 C11,C12,C13,C14,C17,C18,C19,C23,C24,C35 C35



## TYPICAL FLOODPLAIN ROUGHNESS AND HABITAT PLAN (FOR CHANNEL WIDENING)

SCALE: 1" = 10'

1 C11,C12,C13,C14,C17,C18 C35

LIVE STAKE TRENCH PACK NOTES:

1. LIVE STAKE TRENCH PACK LOCATIONS SHOWN ARE SCHEMATIC. TRENCH PACK LOCATION WILL BE STAKED IN THE FIELD BY THE ENGINEER.
2. INSTALL 30–50 LF (AVERAGE 40 LF) OF TRENCH PACK FOR EVERY 100 LF OF CONSTRUCTED CHANNEL.

PLANTING POCKET NOTES:

1. INSTALL CONTAINER PLANTS IN THE PLANTING POCKETS PER THE REVEGETATION PLANS SHEETS L4 AND L5.

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PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

TYPICAL
FLOODPLAIN
ROUGHNESS
AND HABITAT
PLAN DETAILS
(3 OF 6)

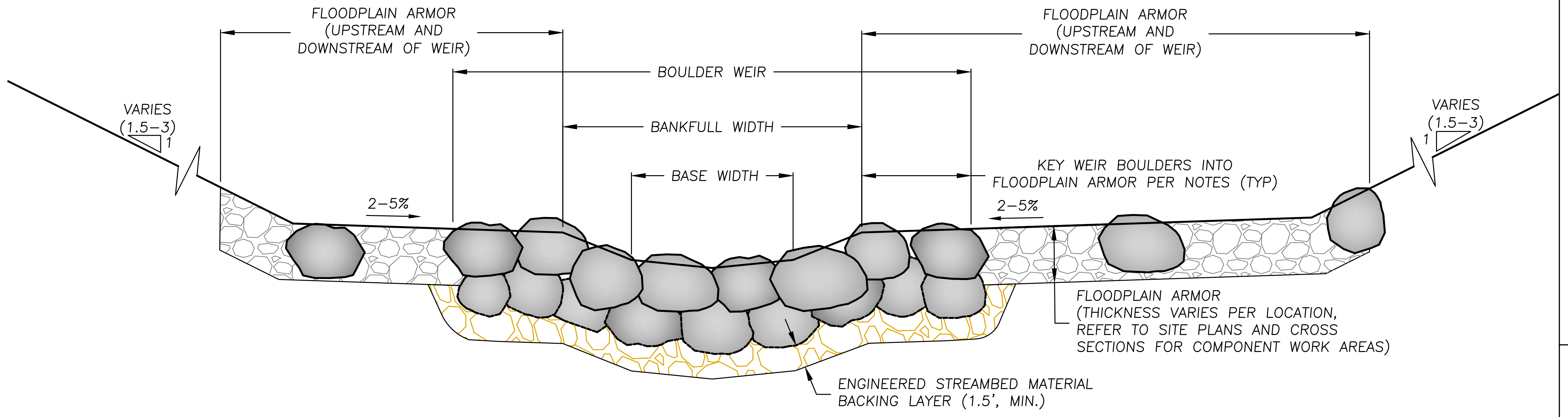
PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C35

35
OF
47



## TYPICAL SECTION AT WEIR

SCALE: 1"=6'

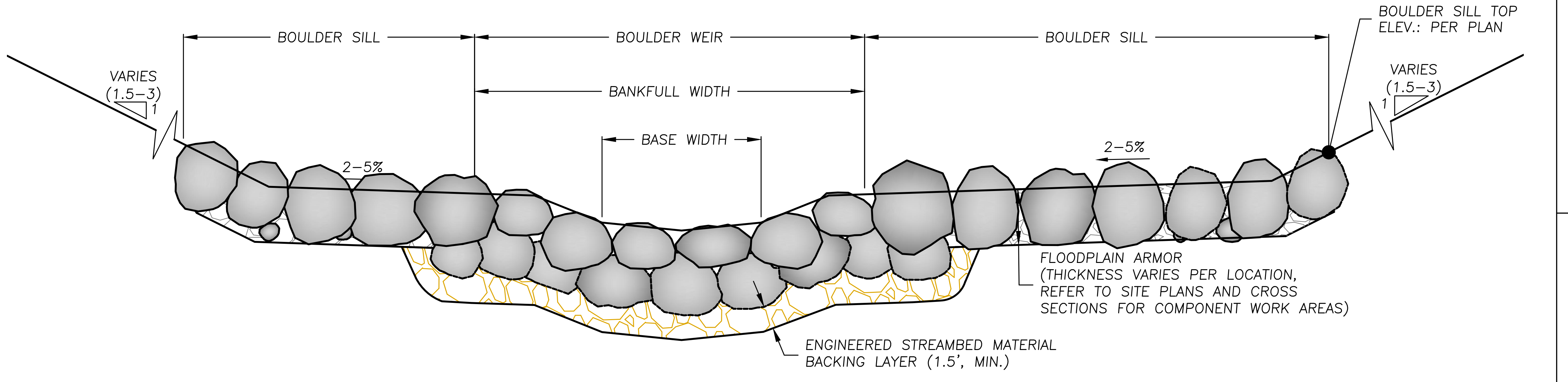
B
C35 C36

NOTES:

1. CULVERT 7 AND 8 REMOVAL AREAS:
WEIR BOULDER SIZE SHALL MEET THE MATERIAL SPECIFICATIONS FOR "WEIR BOULDERS (CULVERT 7 AND 8 REMOVAL AREAS)" SHOWN ON SHEET C39. KEY THE WEIR BOULDERS 3–5 FEET INTO THE ADJACENT FLOODPLAIN ARMOR.

2. ROCK PILE AND MATERIAL REMOVAL AREAS:
WEIR BOULDER SIZE SHALL MEET THE MATERIAL SPECIFICATIONS FOR WEIR AND STEP BOULDERS INCLUDED IN THE "CONSTRUCTION NOTES" ON SHEET C34. KEY THE WEIR BOULDERS AT THE HEAD OF EACH CONSTRUCTED POOL 5–7 FEET INTO THE ADJACENT FLOODPLAIN ARMOR.

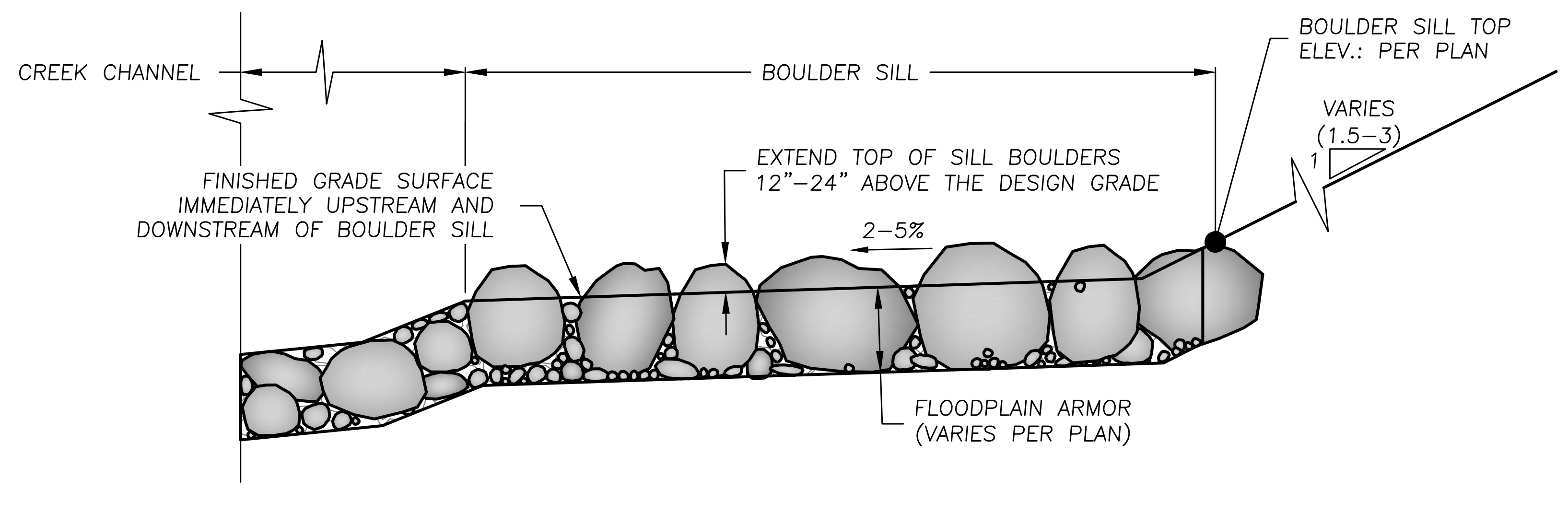
3. REFER TO COMPONENT WORK AREA CROSS SECTIONS FOR BANKFULL AND BASE WIDTH DIMENSIONS.



## TYPICAL SECTION - WEIR AT BOULDER SILL

SCALE: 1"=6'

A
C35 C36



BOULDER SILL NOTE:

SILL WIDTH (MEASURED PARALLEL TO FLOW) SHALL BE 6 FEET.

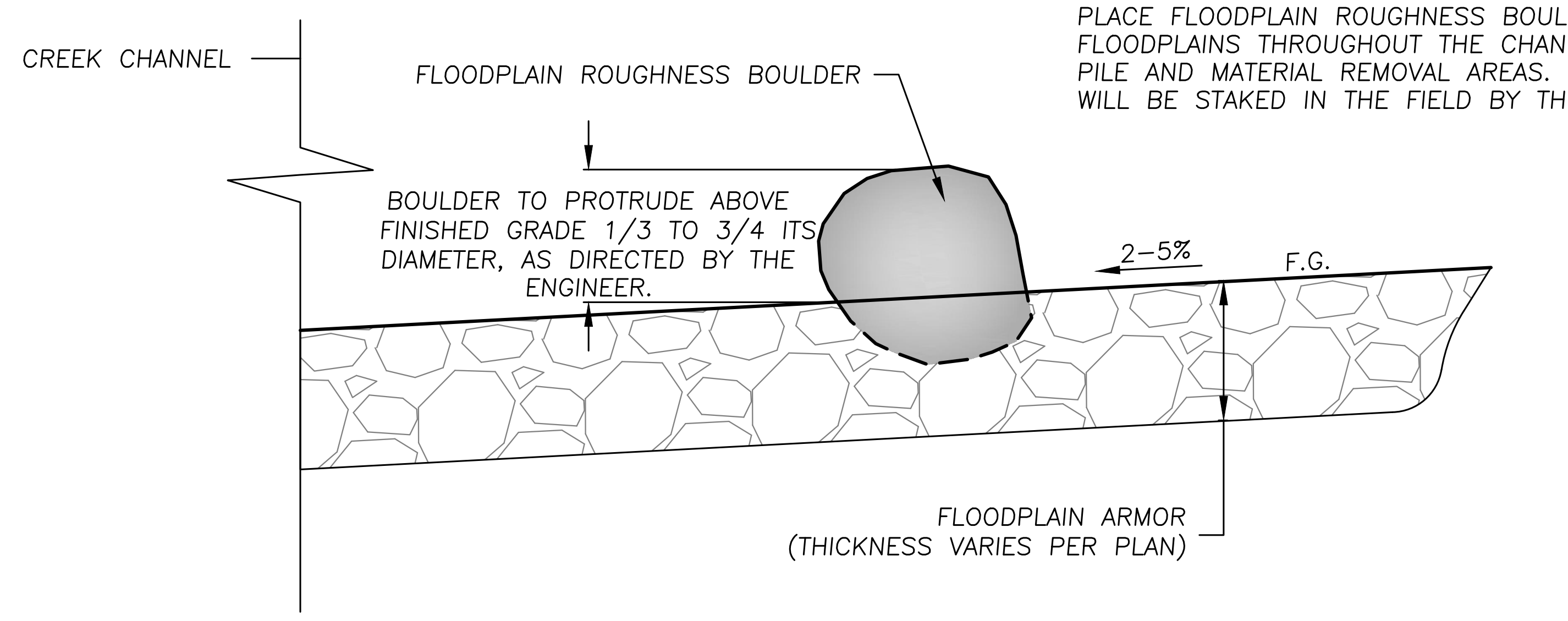
## TYPICAL BOULDER SILL

SCALE: N.T.S.

4
C11,C12,C13,C14,C35 C36

NOTE:

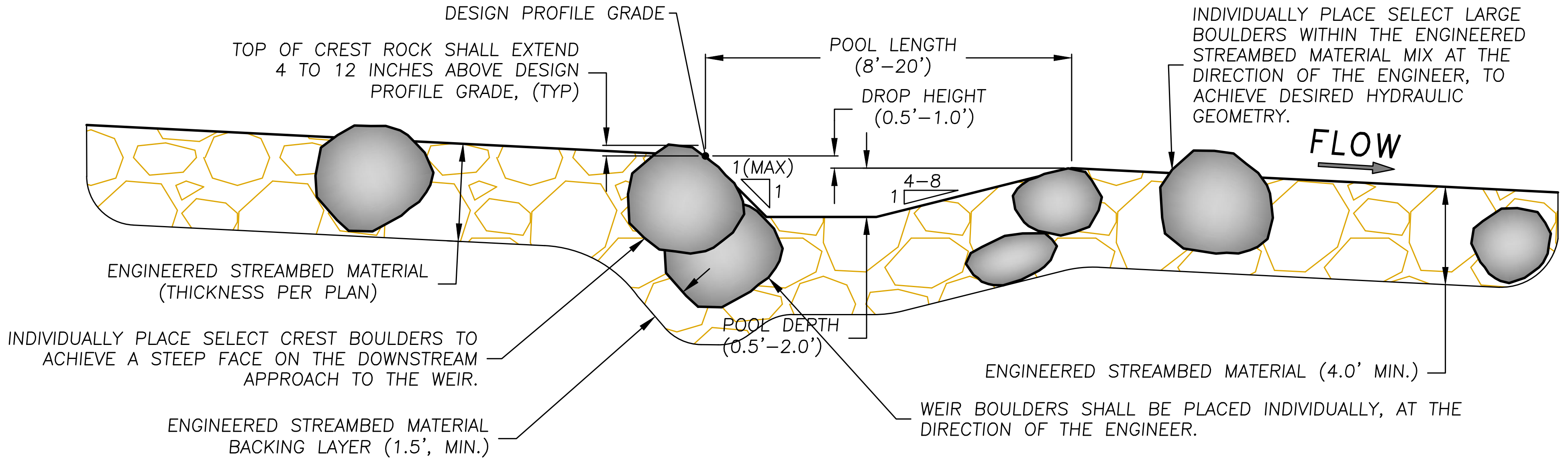
PLACE FLOODPLAIN ROUGHNESS BOULDERS ON THE FLOODPLAINS THROUGHOUT THE CHANNEL WIDENING, ROCK PILE AND MATERIAL REMOVAL AREAS. THE FINAL LOCATIONS WILL BE STAKED IN THE FIELD BY THE ENGINEER.



## FLOODPLAIN ROUGHNESS BOULDER

SCALE: 1"=3'

3
C35 C36



## TYPICAL WEIR/POOL PROFILE

SCALE: 1" = 5'

1
C11,C15 C36

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LEHIGH HANSON HEIDELBERG CEMENT GROUP

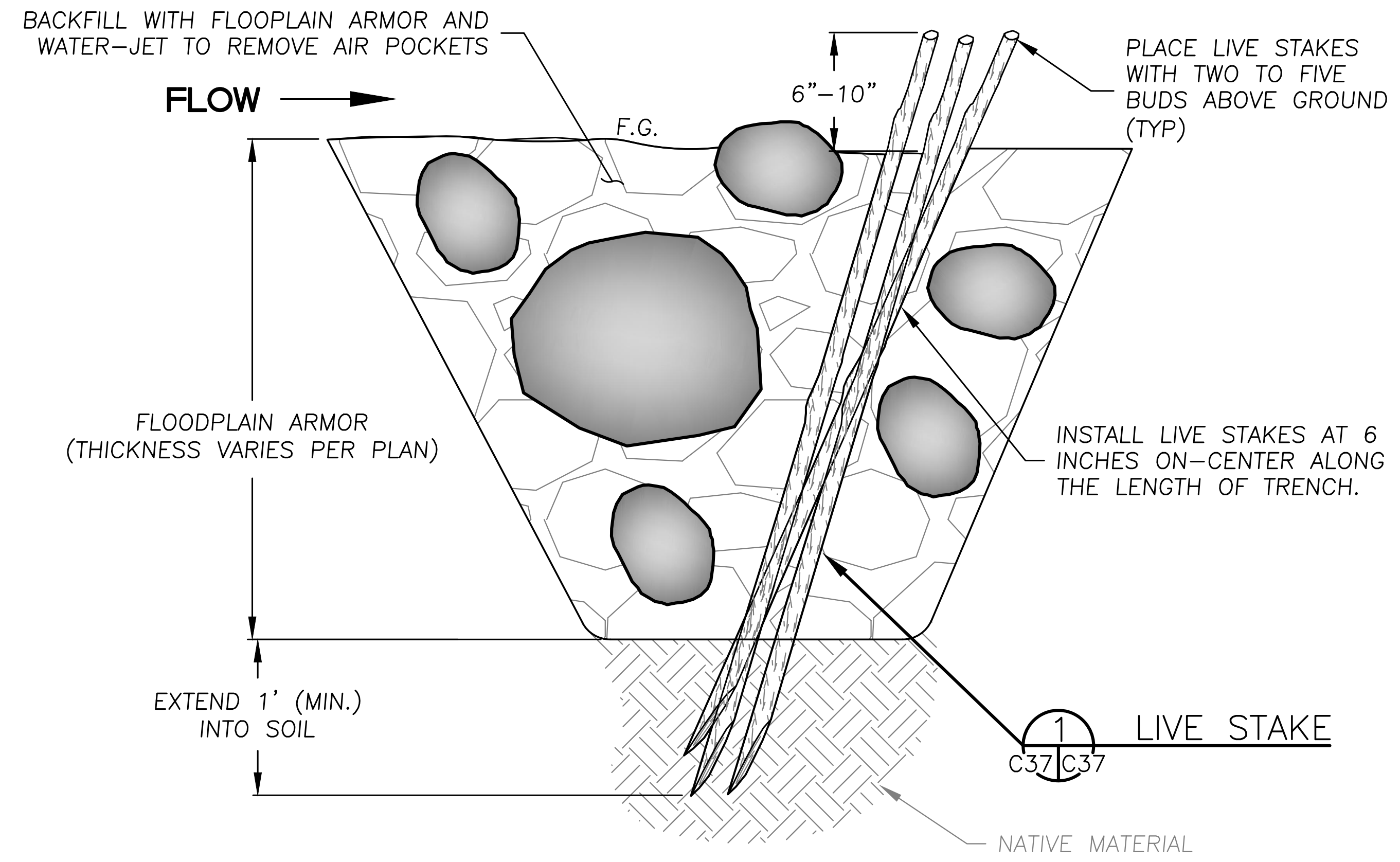
TYPICAL BOULDER WEIR, SILL, AND POOL DETAILS (4 OF 6)

PERMANENTE CREEK RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

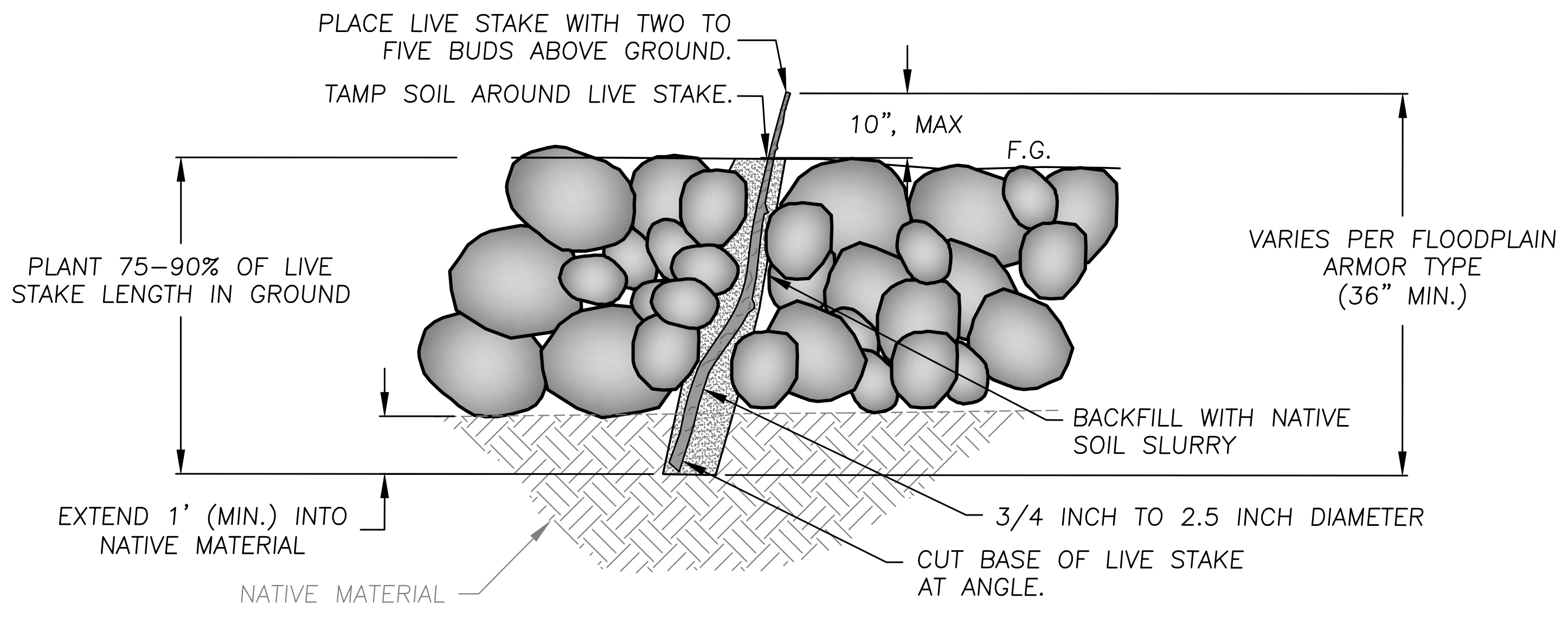
C36



## LIVE STAKE TRENCH PACK

SCALE: N.T.S.

3 C35 | C37



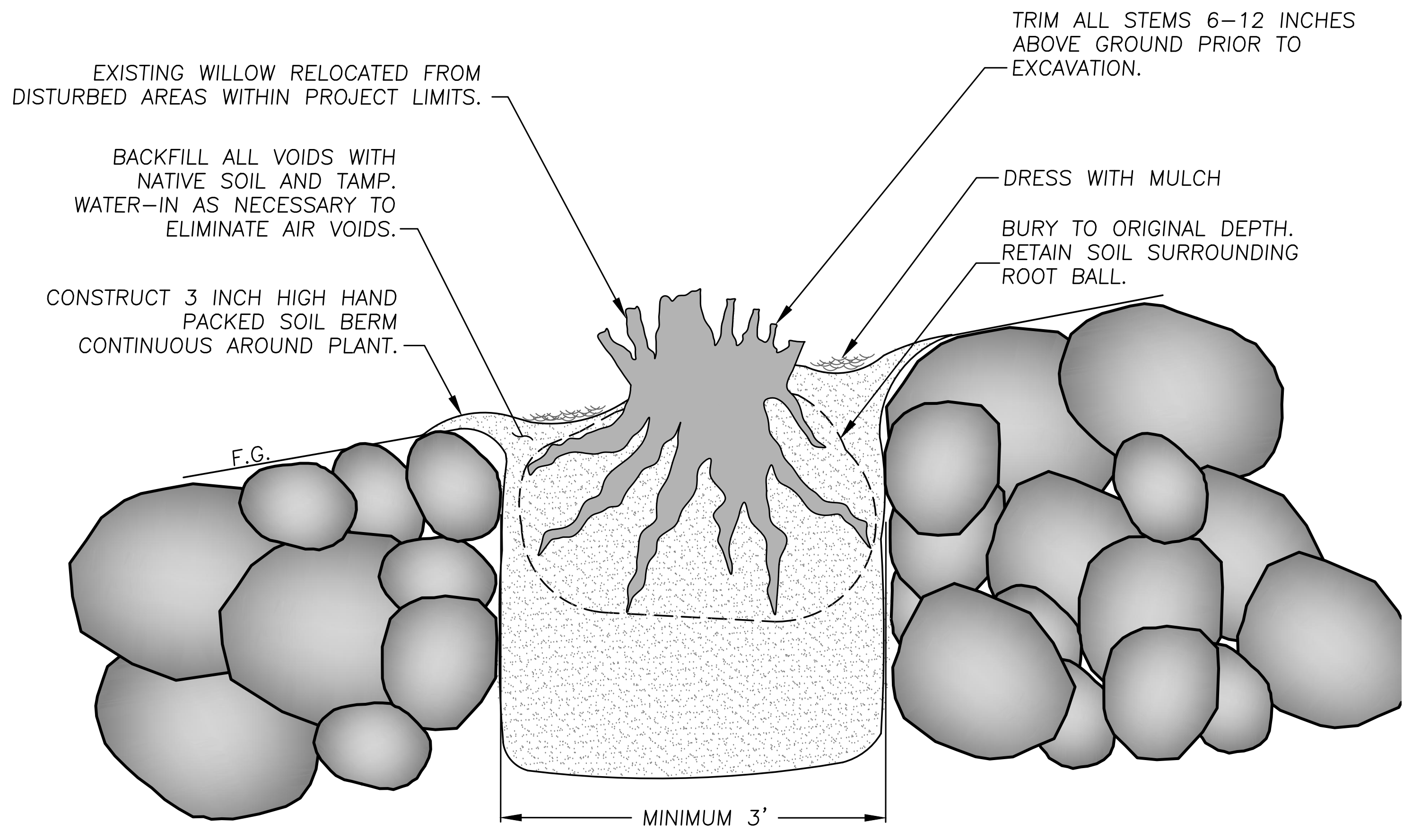
## LIVE STAKE

N.T.S.

1 C11,C12,C37 | C37

*LIVE STAKE NOTES:*

1. INSTALL LIVE STAKES WITHIN ENGINEERED STREAMBED MATERIAL, FLOODPLAIN ARMOR AND RSP.
2. EXTEND LIVE STAKES THROUGH SPECIFIED ROCK MATERIAL TO CONTACT SOIL.
3. CUT TOP ENDS OF STAKES BLUNT AND BASAL ENDS ANGLED AT 45 DEGREES.
4. AFTER PLACEMENT, BACKFILL AND WATER–JET ALL VOIDS AROUND LIVE STAKES TO REMOVE AIR POCKETS.
5. AFTER INSTALLATION CLEANLY CUT EACH STAKE TO LEAVE 6–10 INCHES EXPOSED.



## WILLOW TRANSPLANT DETAIL

SCALE: N.T.S.

2 C11,C12,C35 | C37

*WILLOW TRANSPLANT NOTES:*

1. GENERAL
   - 1.1. SEE THE TREE REMOVAL NOTES ON SHEET C1 AND THE TYPICAL FLOODPLAIN AND HABITAT PLANS ON SHEET C35 FOR WILLOW TRANSPLANT INSTALLATION LOCATIONS.
2. SALVAGE:
   - 2.1. LIVE SHRUBS TO BE SALVAGED FOR TRANSPLANTING WILL BE FLAGGED IN THE FIELD BY THE ENGINEER.
   - 2.2. PRIOR TO REMOVAL, CUT BRANCHES TO 6–12 INCHES ABOVE THE ROOT CROWN, USING SHARP, CLEAN TOOLS.
   - 2.3. REMOVE THE ROOTWAD AND A MINIMUM EIGHTEEN INCH LAYER (AT SIDES AND BASE) OF ROOTS AND SOIL FROM THE GROUND AND EITHER TRANSPORT DIRECTLY TO THE PROPOSED LOCATION FOR INSTALLATION, OR STORE AS OUTLINED BELOW. PERFORM SALVAGE AND RELOCATION IN SUCH A MANNER AS TO MINIMIZE HANDLING AND ASSOCIATED DISTURBANCE TO THE SOIL BOUND BY THE ROOTS.
   - 2.4. IMMEDIATELY COVER LIVE SHRUBS WITH A SINGLE LAYER OF SATURATED BURLAP TO PREVENT DESICCATION OF THE ROOTS, AND PLACE UNDER SHADE COVERING IF THE LIVE SHRUB IS NOT PLANTED WITHIN FIFTEEN MINUTES OF SALVAGE. MAINTAIN SATURATION OF THE BURLAP AND SOIL MASS UNTIL PLANTED.
   - 2.5. DO NOT STACK LIVE SHRUBS ON TOP OF ONE ANOTHER DURING STORAGE.
   - 2.6. IN NO EVENT SHALL SALVAGED ROOTWADS BE STORED FOR PERIODS EXCEEDING 72 HOURS, WITHOUT PRIOR WRITTEN PERMISSION OF THE ENGINEER.
3. INSTALLATION
   - 3.1. PLACE THE EXCAVATED ROOTWAD IN A PRE–PREPARED HOLE. FILL THE HOLE WITH WATER IMMEDIATELY PRIOR TO PLANTING. SCARIFY THE SIDES OF THE PLANTING HOLE PRIOR TO PLANTING.
   - 3.2. REMOVE BURLAP PRIOR TO PLANTING. BACKFILL THE HOLE HALF WAY WITH NATIVE SOIL AND JET WITH WATER TO REMOVE VOIDS AFTER PLACEMENT. CONTINUE TO ADD SOIL AND WATER UNTIL THE SATURATED BACKFILL MATERIAL COVERS THE TOP OF THE ROOT CROWN TO THE APPROXIMATE ORIGINAL DEPTH OF SOIL, PRIOR TO SALVAGE.

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HEIDELBERG CEMENT
GROUP

TYP WILLOW LIVE
STAKE TRENCH
PACK +
RELOCATION
DETAILS (5 OF 6)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: –
DRAWN BY: B.M.S.
CHECKED BY: M.W.W.
DATE: 8/26/22
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BAR IS ONE INCH ON
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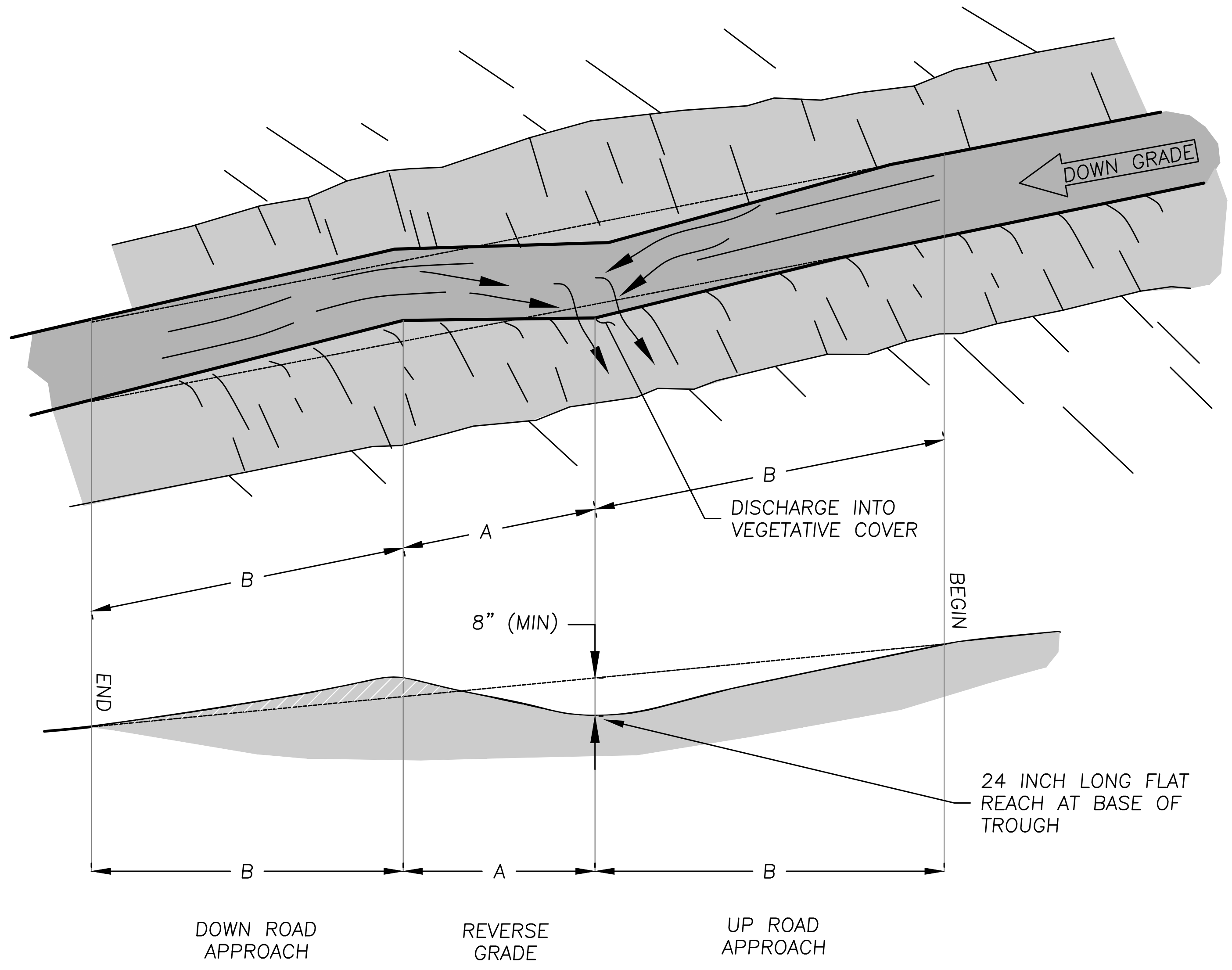
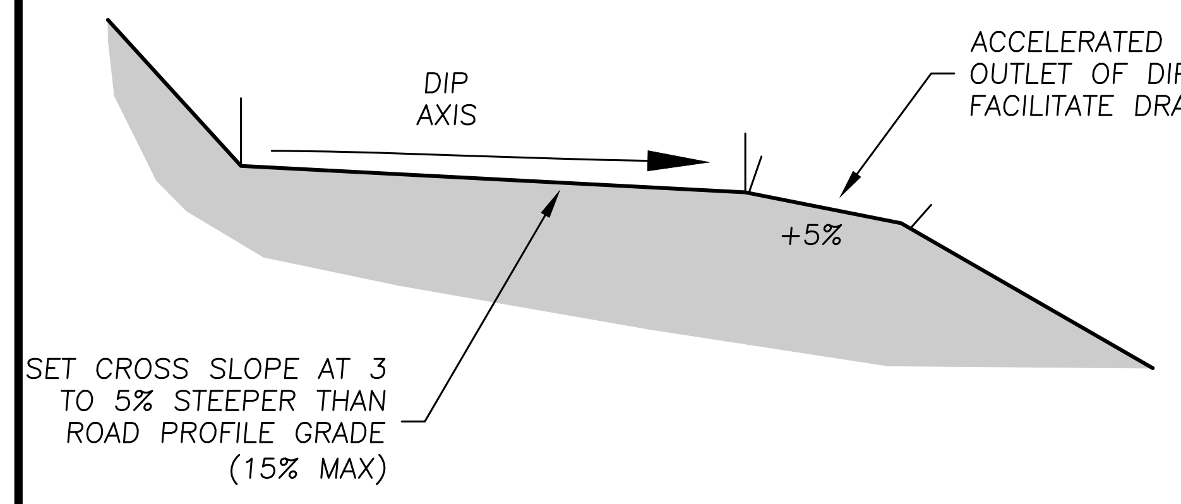
0 1"

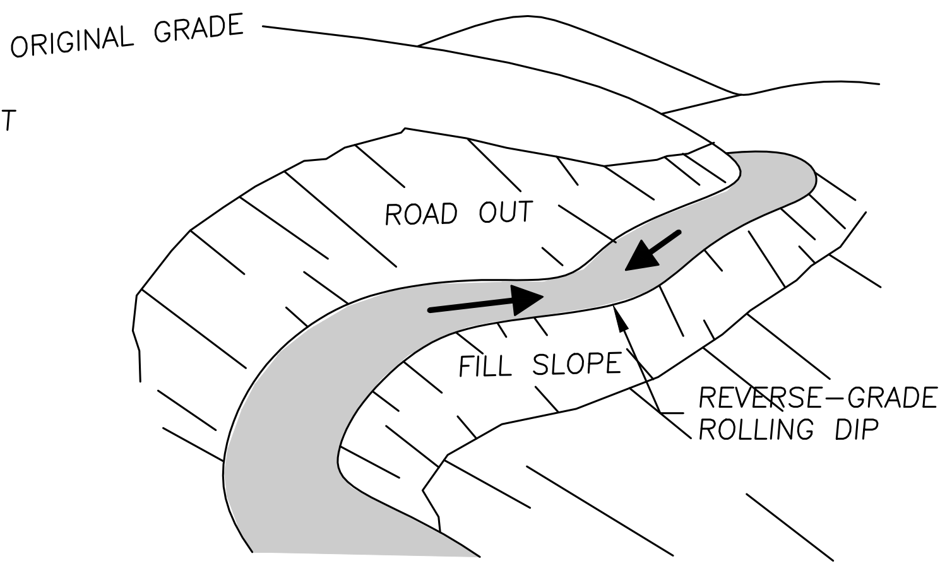
C37



REVERSE GRADE DIP OVERVIEW



ROAD SECTION



OBLIQUE VIEW

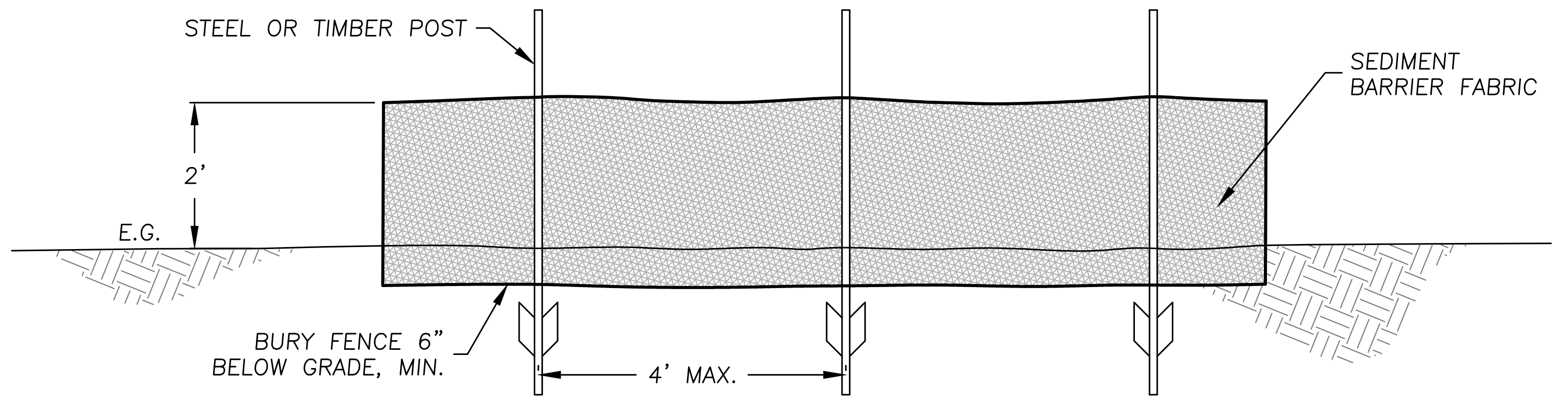
| ROAD GRADE (%) | TROUGH | A: REVERSE GRADE | B: UP ROAD APPROACH DOWN ROAD TRAIL | |
|---|---|---|---|---|
| | MINIMUM DEPTH BELOW DONWSLOPE CREST | MINIMUM DISTANCE AND GRADE FROM TROUGH AXIS TO DOWNROAD CREST (FT) | DISTANCE FROM UP–ROAD START OF ROLLING DIP TO TROUGH AXIS (FT) | GRADE (%) |
| <5 | 8 INCHES | 15 FEET AT 5% | 17 | 10 |
| 5 TO 10 | | | 30 | 15 |
| 10 TO 15 | | | 60 | 20 |
| >15 | | 7 FEET AT 10% | 60 | 25 |

NOTES

1. CUT DIP INTO THE ROAD WITH THE DOWN ROAD APPROACH BUILT UP ON COMPACTED FILL.
2. CONSTRUCT DIP TO A MINIMUM OF 8 INCHES DEEP AND INCORPORATE A 2 FOOT LONG FLAT REACH AT THE BASE OF THE TROUGH (UNLESS OTHERWISE DIRECTED).
3. SLOPE THE DOWNROAD REVERSE GRADE AT 5% FOR A MINIMUM OF 7 FEET, TO 10% FOR MINIMUM OF 15 FEET, TO FORM THE MINIMUM 8 INCH DEEP DIP. ON ROADS STEEPER THAN 15% A STEEPER REVERSE–GRADE DIP MAY BE REQUIRED.
4. OUTSLOPE DIP AXIS 3–5% GREATER THAN ROAD GRADE TO MAXIMUM 15%. DIP AXIS MAY BE SKEWED DOWN ROAD AT 30 DEGREES TO FACILITATE INSTALLATION OF DIPS ON STEEPER GRADES.
5. DO NOT PUSH MATERIAL OVER THE EDGE OF SLOPE. ALL EXCAVATED MATERIAL SHALL BE USED TO CONSTRUCT THE DOWN ROAD APPROACH.
6. DIP LOCATIONS SHOWN ON THE DRAWINGS ARE APPROXIMATE. FINAL LOCATIONS WILL BE STAKED IN THE FIELD BY THE ENGINEER.
7. ON EXISTING ROADS BUILD DOWNSLOPE LIP WITH COMPACTED FILL

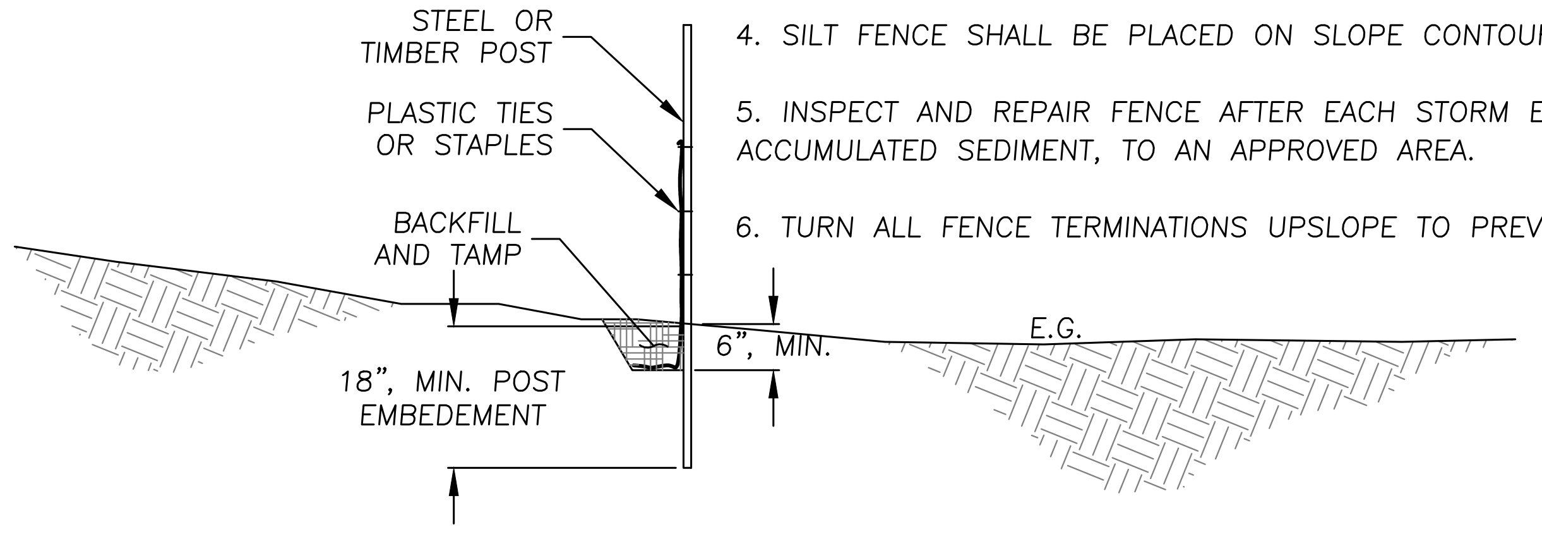
## REVERSE GRADE ROLLING DIP (1 / C38)

SCALE: N.T.S. C11,C12,C13,C14,C17,C18,C19,C19,C23,C24



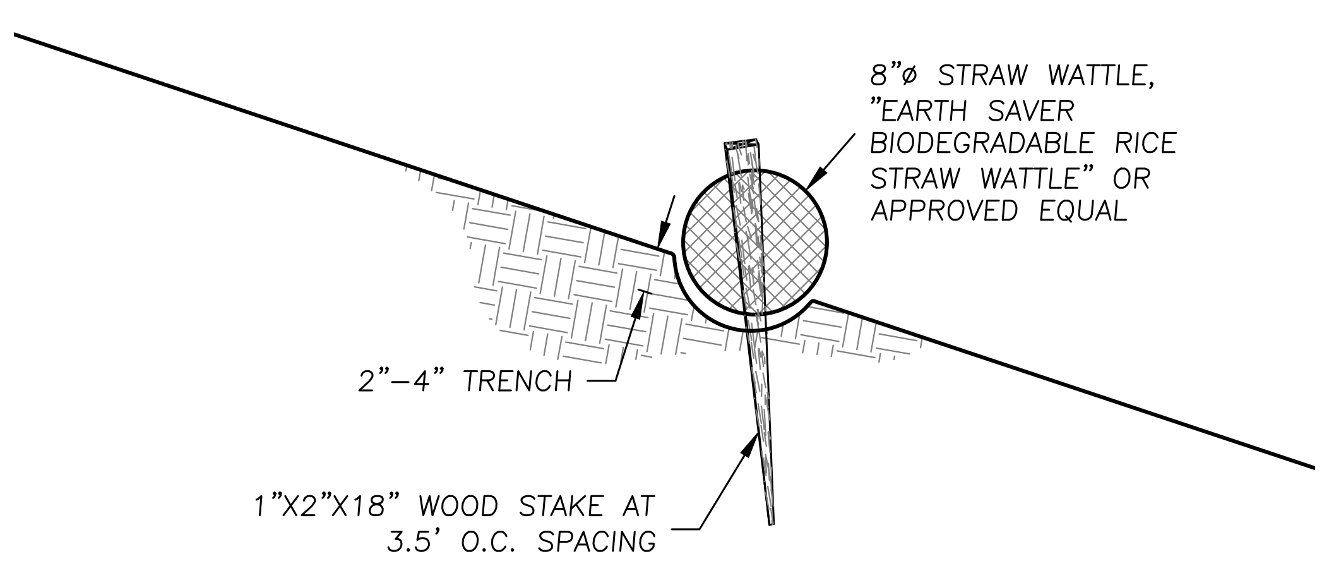
SEDIMENT BARRIER FENCE NOTES

1. LEHIGH WILL COORDINATE WITH USFWS STAFF DURING THE SECTION 7 CONSULTATION TO IDENTIFY AN APPROPRIATE FABRIC FOR USE AS A SEDIMENT BARRIER.
2. DIG TRENCH FIRST, THEN ERECT FENCE IN TRENCH. BACKFILL AND COMPACT SOIL TO SECURE FABRIC.
3. PROVIDE 1' MINIMUM OVERLAP AT FENCE SPLICES.
4. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS.
5. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE ACCUMULATED SEDIMENT, TO AN APPROVED AREA.
6. TURN ALL FENCE TERMINATIONS UPSLOPE TO PREVENT FLANKING.



## SEDIMENT BARRIER FENCE (2 / C38)

SCALE: 1"=2' C29,C30



## FIBER ROLL (5 / C38)

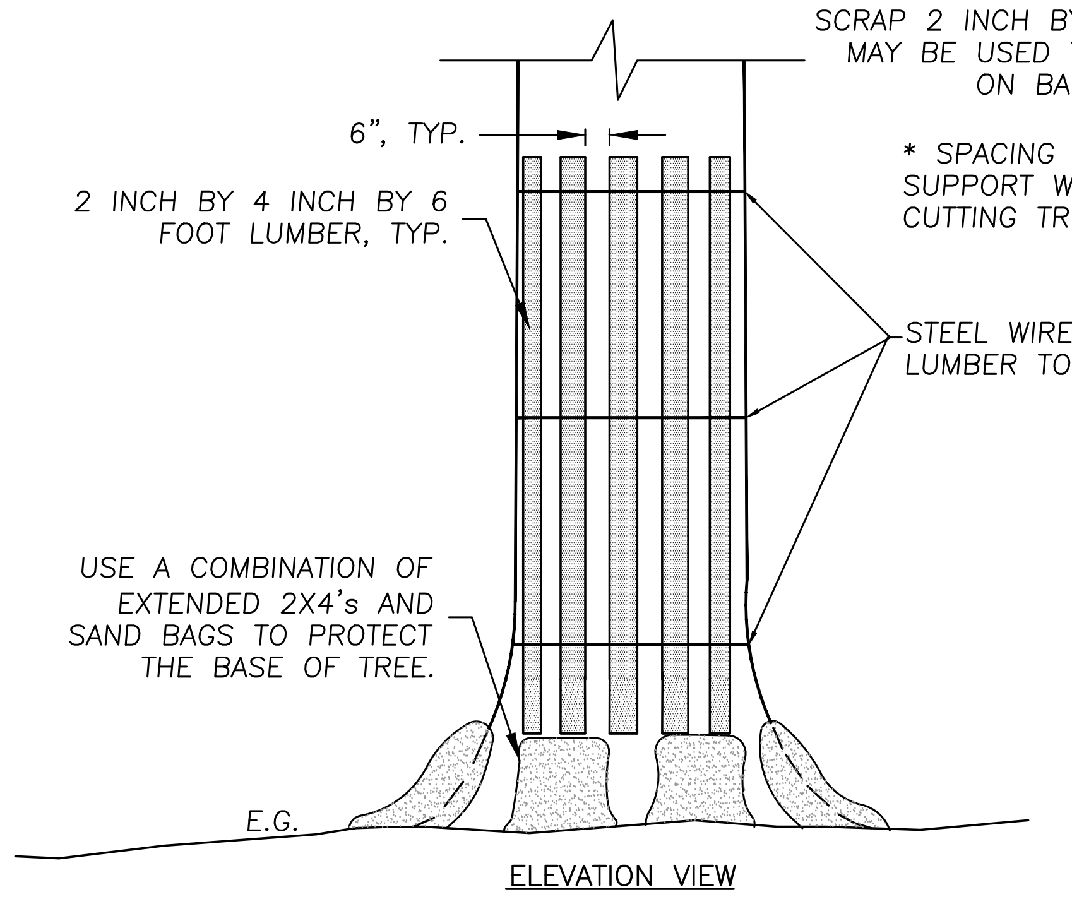
SCALE: 1"=1' C30

FIBER ROLL NOTES:

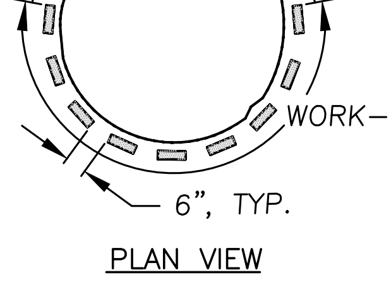
1. INSTALL FIBERS WITH THE SPACING SHOWN IN TABLE 2.
2. CLEAR THE BOTTOM OF TRENCH OF OBSTRUCTIONS INCLUDING ROCKS, CLODS, AND DEBRIS GREATER THAN ONE INCH IN DIAMETER BEFORE FIBER ROLL INSTALLATION.
3. INSTALL FIBER ROLLS PARALLEL TO THE SLOPE CONTOUR. ANGLE THE TERMINUS OF ROWS UP–SLOPE AT 45 DEGREES FOR A DISTANCE OF THREE FEET. WHERE FIBER ROLLS MEET, PROVIDE AN OVERLAP OF 1.5 FEET, WITH ADJACENT ROLLS TIGHTLY ABUTTING EACH OTHER.

TABLE 2: FIBER ROLL SPACING

| SLOPE INCLINATION | SPACING ALONG SLOPE |
|---|---|
| 2H:1V AND STEEPER | 10 FEET |
| 4H:1V TO 2H:1V | 15 FEET |
| 10H:1V TO 4H:1V | 20 FEET |
| FLATTER THAN 10H:1V | MAX. 50 FEET |



ELEVATION VIEW



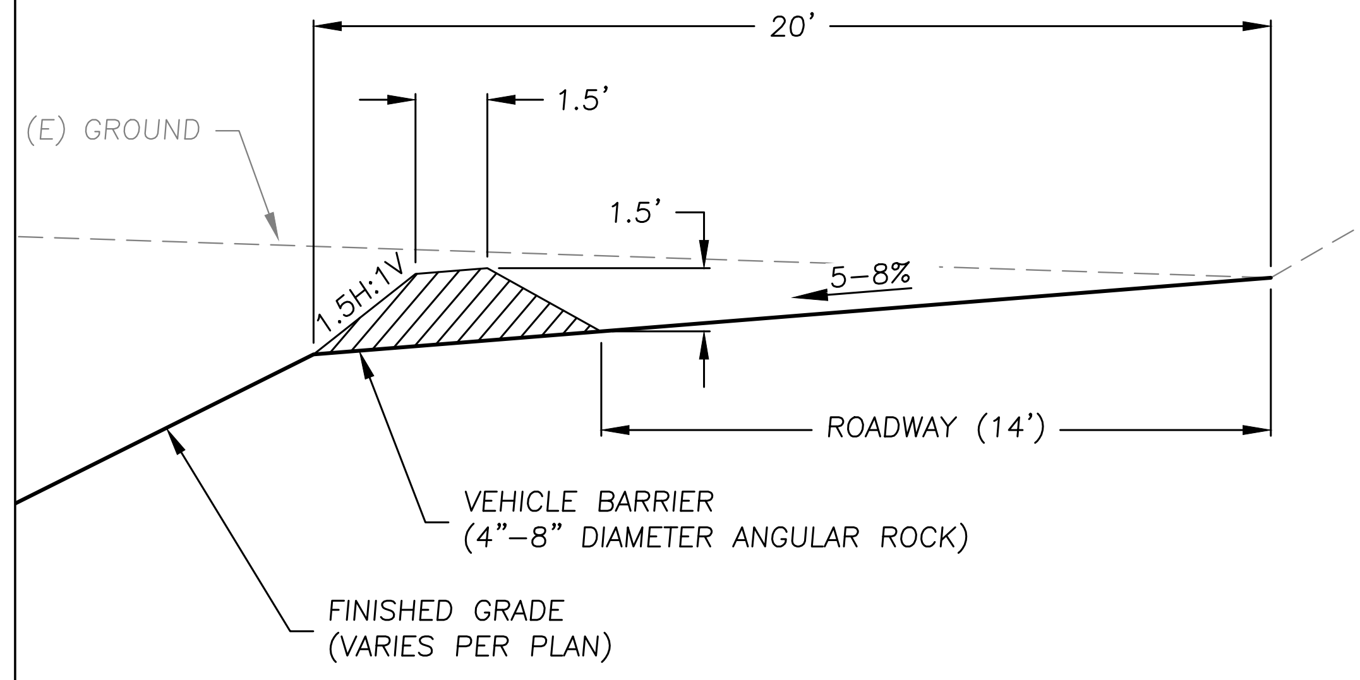
PLAN VIEW

TREE PROTECTION NOTES:

1. THE INTENT OF THIS DETAIL IS TO PROTECT EXISTING TREES FROM DAMAGE DURING CONSTRUCTION.
2. THIS DETAIL SHALL BE USED WHEN WORKING WITHIN 10' OF AN EXISTING TREE TO REMAIN, AS DIRECTED BY THE ENGINEER.
3. DO NOT DAMAGE OR REMOVE TREES UNLESS NOTED OTHERWISE ON THE PLANS OR AS DIRECTED BY THE ENGINEER.
4. LUMBER, WIRE, AND SANDBAGS MAY BE REUSED AT OTHER TREES, AS WORK PROGRESSES.

## TREE PROTECTION DETAIL (3 / C38)

SCALE: 1"=2' C11,C12,C13,C14

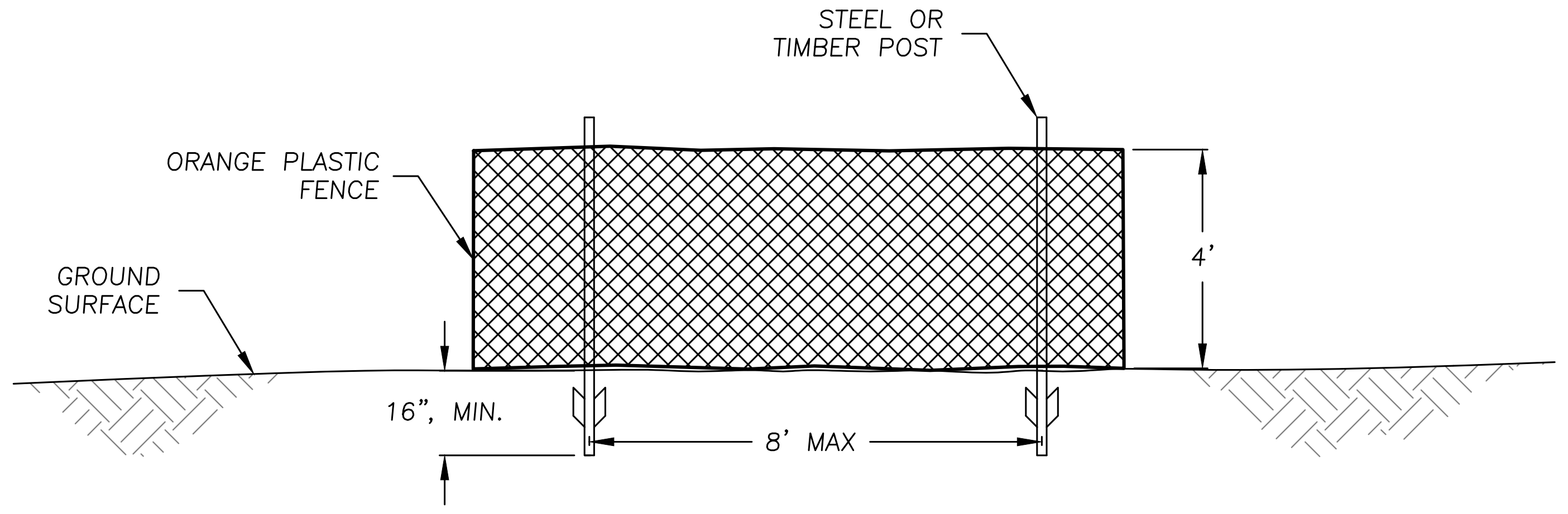


NOTES:

1. VEHICLE BARRIERS ARE DESIGNED FOR VEHICLES WITH A MAXIMUM AXLE HEIGHT OF 1.5 FEET FROM THE GROUND SURFACE.
2. LEAVE 4 TO 5 FOOT WIDE OPENINGS IN VEHICLE BARRIER EVERY 50–60 FEET TO ALLOW FOR UNOBSTRUCTED DRAINAGE FROM ROADWAY.
3. CONSTRUCTION VEHICLE BARRIER OF 10" – 16" DIAMETER ANGULAR ROCK FROM STA. 44+25 TO 44+75 AT THE CHANNEL WIDENING AREA.

## VEHICLE BARRIER (TYPE 1) (6 / C38)

SCALE: 1"=5' C11,C12,C13,C14

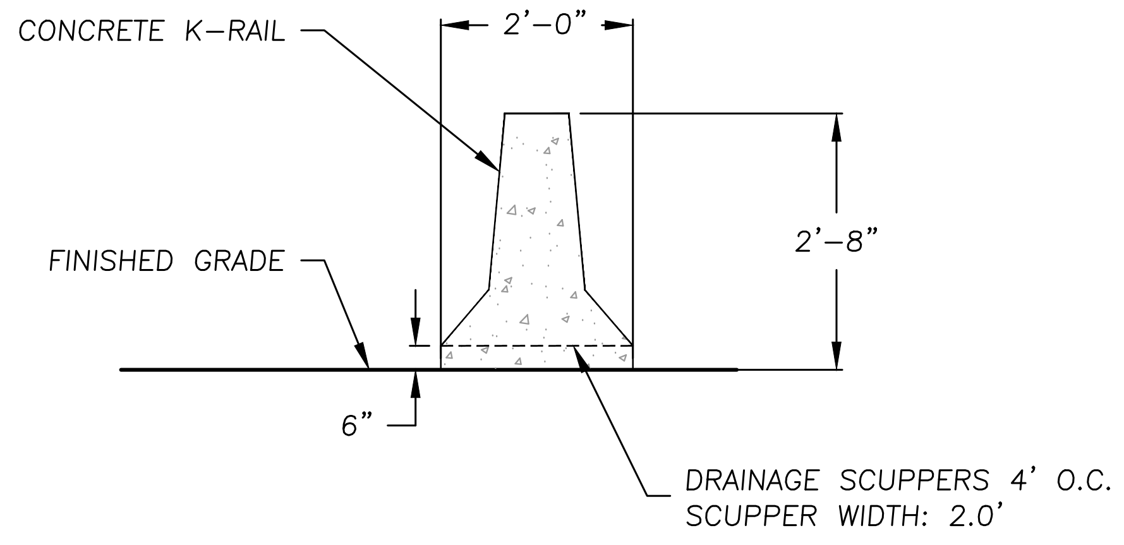


## BOUNDARY FENCE DETAIL (4 / C38)

SCALE: 1"=3' –

NOTES:

LEAVE 4'–5' WIDE OPENINGS IN VEHICLE BARRIER EVERY 50–60 FEET TO ALLOW FOR UNOBSTRUCTED DRAINAGE FROM ROADWAY.



## VEHICLE BARRIER (TYPE 2) (7 / C38)

SCALE: 1"=2' C19,C20,C21

WATERWAYS CONSULTING INC.
509A SWIFT ST.
SANTA CRUZ, CA 95060
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PRELIMINARY
NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

DETAILS
(6 OF 6)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: –
DRAWN BY: B.M.S.
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13–016

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C38
38 OF 47

# ROCK SPECIFICATIONS

THERE ARE EIGHT CLASSES OF ROCK SPECIFIED ON THIS PROJECT;
- (1) – ENGINEERED STREAMBED MATERIAL
- (2) – FLOODPLAIN ARMOR
- (3) – ROCK SLOPE PROTECTION (RSP)
- (4) – WEIR BOULDERS
- (5) – SILL BOULDERS
- (6) – FLOODPLAIN ROUGHNESS BOULDERS
- (7) – BACKING LAYER
- (8) – STREAM SUBSTRATE

ALL ROCK SHALL CONFORM TO THE FOLLOWING QUALITY REQUIREMENTS:

1) RESISTANT TO WEATHERING AND WATER ACTION AND FREE OF ORGANIC OR OTHER UNSUITABLE MATERIAL. DO NOT USE SHALE, ROCK WITH SHALE SEAMS, OR OTHER FISSILE OR FISSURED ROCK THAT MAY BREAK INTO SMALLER PIECES IN THE PROCESS OF HANDLING AND PLACING.
2) SUB–ROUNDED TO ANGULAR IN SHAPE.
3) GRANITE OR HAVE A SPECIFIC GRAVITY EQUAL TO OR GREATER THAN THAT OF GRANITE.
4) COLOR AND TEXTURE CONSTANT THROUGHOUT THE STOCKPILE.

PROVIDE SAMPLES OF EACH GRADATION SPECIFIED FOR APPROVAL BY THE ENGINEER, PRIOR TO STOCKPILING AT INDIVIDUAL PROJECT AREAS.

INDIVIDUAL ROCK CLASSES AND PLACEMENT METHODS ARE FURTHER DEFINED AS FOLLOWS:

## 1 – ENGINEERED STREAMBED MATERIAL

ENGINEERED STREAMBED MATERIAL SHALL CONSIST OF SANDS, GRAVELS, COBBLES, AND BOULDERS FREE OF ORGANIC MATTER, AND MEETING THE FOLLOWING GRADATION SPECIFICATIONS (REFER TO DRAWINGS FOR TYPE LOCATIONS):

### TYPE 1 GRADATION:

| PERCENT OF MIX (BY WEIGHT) | SIZE RANGE (INCHES) |
|---|---|
| 20 | 12–24 |
| 30 | 6–12 |
| 30 | 2–6 |
| 12 | 0.08–2 |
| 8 | <0.08 |

### TYPE 2 GRADATION:

| PERCENT OF MIX (BY WEIGHT) | SIZE RANGE (INCHES) |
|---|---|
| 20 | 24–36 |
| 30 | 16–24 |
| 20 | 6–16 |
| 10 | 2–6 |
| 12 | 0.08–2 |
| 8 | <0.08 |

### TYPE 3 GRADATION:

| PERCENT OF MIX (BY WEIGHT) | SIZE RANGE (INCHES) |
|---|---|
| 20 | 30–42 |
| 30 | 16–30 |
| 20 | 6–16 |
| 10 | 2–6 |
| 12 | 0.08–2 |
| 8 | <0.08 |

### TYPE 4 GRADATION:

| PERCENT OF MIX (BY WEIGHT) | SIZE RANGE (INCHES) |
|---|---|
| 20 | 48–60 |
| 30 | 24–48 |
| 20 | 10–24 |
| 10 | 2–10 |
| 12 | 0.08–2 |
| 8 | <0.08 |

A) PLACE ENGINEERED STREAMBED MATERIAL TO THE LINES, GRADES AND THICKNESSES SHOWN ON THE DRAWINGS, OR AS DIRECTED BY THE ENGINEER. UNIFORMLY DISTRIBUTE LARGE STONES TO PRODUCE THE REQUIRED GRADATION OF ROCK. PREVENT CONTAMINATION OF ROCK MATERIALS BY EXCAVATION AND/OR EARTH MATERIALS.

B) FOLLOWING PLACEMENT, WATER–JET VOIDS WITHIN ROCK TO IMPROVE COMPACTION AND EMBED THE FINES WITHIN THE MIX. START JETTING AT THE UPSTREAM LIMITS OF PLACEMENT AND PROGRESS DOWNSTREAM. CONTINUE JETTING UNTIL THE TURBIDITY LEVELS OF RUNOFF PRODUCED FROM THE JETTING PROCESS HAVE REACHED AN ACCEPTABLE LEVEL AS DETERMINED BY THE ENGINEER. RETAIN ALL SEDIMENT–LADEN RUNOFF GENERATED BY THE JETTING OPERATIONS SO ENTRAINED SEDIMENT CAN SETTLE OUT OR BE PUMPED TO A SETTLING TANK OR SIMILAR DEVICE TO REDUCE TURBIDITY TO ACCEPTABLE LEVELS, IN COMPLIANCE WITH PERMIT CONDITIONS, PRIOR TO DISCHARGE TO THE CREEK. DISPOSE OF ALL CAPTURED SEDIMENT AT AN APPROVED LOCATION.

## 2 – FLOODPLAIN ARMOR

FLOODPLAIN ARMOR MATERIAL SHALL CONSIST OF SANDS, GRAVELS, COBBLES, AND BOULDERS FREE OF ORGANIC MATTER, AND MEETING THE FOLLOWING GRADATION SPECIFICATIONS (REFER TO DRAWINGS FOR TYPE LOCATIONS):

### TYPE 5 GRADATION:

COMPLY WITH THE ENGINEERED STREAMBED MATERIAL TYPE 1 GRADATION.

### TYPE 6 GRADATION:

| PERCENT OF MIX (BY WEIGHT) | SIZE RANGE (INCHES) |
|---|---|
| 20 | 16–30 |
| 30 | 10–16 |
| 20 | 4–10 |
| 10 | 2–4 |
| 12 | 0.08–2 |
| 8 | <0.08 |

### TYPE 7 GRADATION:

COMPLY WITH THE ENGINEERED STREAMBED MATERIAL TYPE 3 GRADATION.

### TYPE 8 GRADATION:

COMPLY WITH THE ENGINEERED STREAMBED MATERIAL TYPE 4 GRADATION.

A) PLACE FLOODPLAIN ARMOR MATERIAL TO THE LINES, GRADES AND DEPTHS SHOWN ON THE DRAWINGS, OR AS DIRECTED BY THE ENGINEER. UNIFORMLY DISTRIBUTE LARGE STONES TO PRODUCE THE REQUIRED GRADATION OF ROCK. PREVENT CONTAMINATION OF ROCK MATERIALS BY EXCAVATION AND/OR EARTH MATERIALS.

B) FOLLOWING PLACEMENT, WATER–JET VOIDS WITHIN ROCK TO IMPROVE COMPACTION AND EMBED THE FINES WITHIN THE MIX. START JETTING AT THE UPSTREAM LIMITS OF PLACEMENT AND PROGRESS DOWNSTREAM. CONTINUE JETTING UNTIL THE TURBIDITY LEVELS OF RUNOFF PRODUCED FROM THE JETTING PROCESS HAVE REACHED AN ACCEPTABLE LEVEL AS DETERMINED BY THE ENGINEER. RETAIN ALL SEDIMENT–LADEN RUNOFF GENERATED BY THE JETTING OPERATIONS SO ENTRAINED SEDIMENT CAN SETTLE OUT OR BE PUMPED TO A SETTLING TANK OR SIMILAR DEVICE TO REDUCE TURBIDITY TO ACCEPTABLE LEVELS, IN COMPLIANCE WITH PERMIT CONDITIONS, PRIOR TO DISCHARGE TO THE CREEK. DISPOSE OF ALL CAPTURED SEDIMENT AT AN APPROVED LOCATION.

## 3 – ROCK SLOPE PROTECTION

A) ROCK SLOPE PROTECTION (RSP) SHALL CONFORM TO SECTION 72–2.02 MATERIALS OF THE STANDARD SPECIFICATIONS AND MEET THE MATERIAL GRADATIONS SHOWN ON THE DRAWINGS WHERE PROPOSED RSP IS SHOWN.

B) BACKFILL VOIDS WITHIN THE ROCK SLOPE PROTECTION USING STREAM SUBSTRATE. NATIVE STREAMBED MATERIAL MAY BE USED AS STREAM SUBSTRATE IF IT MEETS THE GRADATION REQUIREMENTS FOR STREAM SUBSTRATE.

C) PLACE BACKFILL MATERIAL TO MATCH THE FINISHED SURFACE OF THE RSP AND WATER–JET TO FILL ALL VOIDS, AS DIRECTED BY THE ENGINEER.

ROCK SLOPE PROTECTION FABRIC
1. PLACE GEOTEXTILE FABRIC BELOW ROCK SLOPE PROTECTION.
2. USE NON–WOVEN, GEOTEX 1601, AS MANUFACTURED BY SYNTHETIC INDUSTRIES; OR MIRAFI 1160N, AS MANUFACTURED BY TC MIRAFI; OR APPROVED EQUAL.

INSTALLATION
1. PREPARE SURFACE TO RECEIVE THE GEOTEXTILE TO A RELATIVELY SMOOTH CONDITION, FREE OF OBSTRUCTIONS, DEPRESSIONS, DEBRIS, AND SOFT OR LOW DENSITY POCKETS OF MATERIAL.
2. PLACE AND SECURE A LAYER OF GEOTEXTILE FABRIC BELOW THE FIRST ROCK LAYER. AT THE TIME OF INSTALLATION, THE GEOTEXTILE WILL BE REJECTED IF IT HAS DEFECTS, RIPS, HOLES, FLAWS, DETERIORATION, OR DAMAGE INCURRED DURING MANUFACTURE, TRANSPORTATION, OR STORAGE.
3. PLACE GEOTEXTILE WITH THE LONG DIMENSION PARALLEL TO FLOW AND LAID SMOOTH AND FREE OF TENSION, STRESS, FOLDS, WRINKLES, OR CREASES.

## 4 – WEIR BOULDERS (CULVERT 7 AND 8 REMOVAL AREAS)

A) WEIR BOULDERS SHALL HAVE A MINIMUM Y–AXIS DIMENSION OF 4 FEET AND A MINIMUM WEIGHT OF 3 TONS.

## 5 – SILL BOULDERS

A) SILL BOULDERS SHALL BE BETWEEN THE D84–D100 OF THE SPECIFIED FLOODPLAIN ARMOR GRADATION AT THE LOCATION OF THE SILL.

## 6 – FLOODPLAIN ROUGHNESS BOULDERS

A) FLOODPLAIN ROUGHNESS BOULDERS SHALL MEET THE D84 (MIN.) OF THE SPECIFIED FLOODPLAIN ARMOR GRADATION AT THE LOCATION OF THE FLOODPLAIN ROUGHNESS BOULDER.

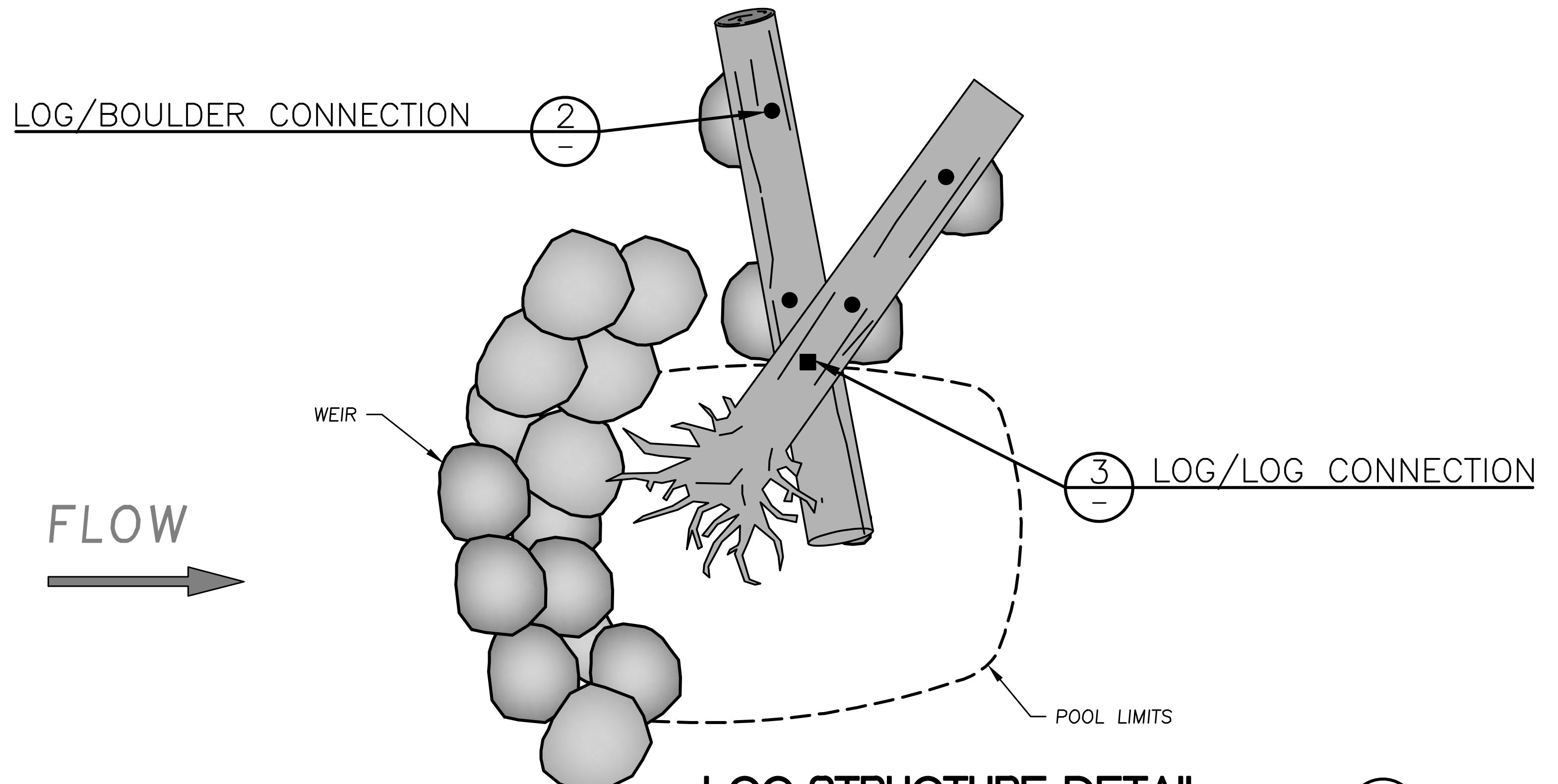
## 7 – BACKING LAYER

A) THE BACKING LAYER SHALL CONSIST OF A 50/50 MIX OF CALTRANS CLASS III RSP AND STREAM SUBSTRATE.

## 8 – STREAM SUBSTRATE

A) NATIVE STREAMBED MATERIAL CAN BE USED AS STREAM SUBSTRATE IF IT MEETS THE FOLLOWING MATERIAL GRADATION. FINAL DETERMINATION WILL BE MADE BY THE ENGINEER.

| US SIEVE SIZE | PERCENT PASSING |
|---|---|
| 12" | 100% |
| 6" | 50–70% |
| 3" | 20–40% |
| No. 10 | 5–10% |



## LOG STRUCTURE DETAIL

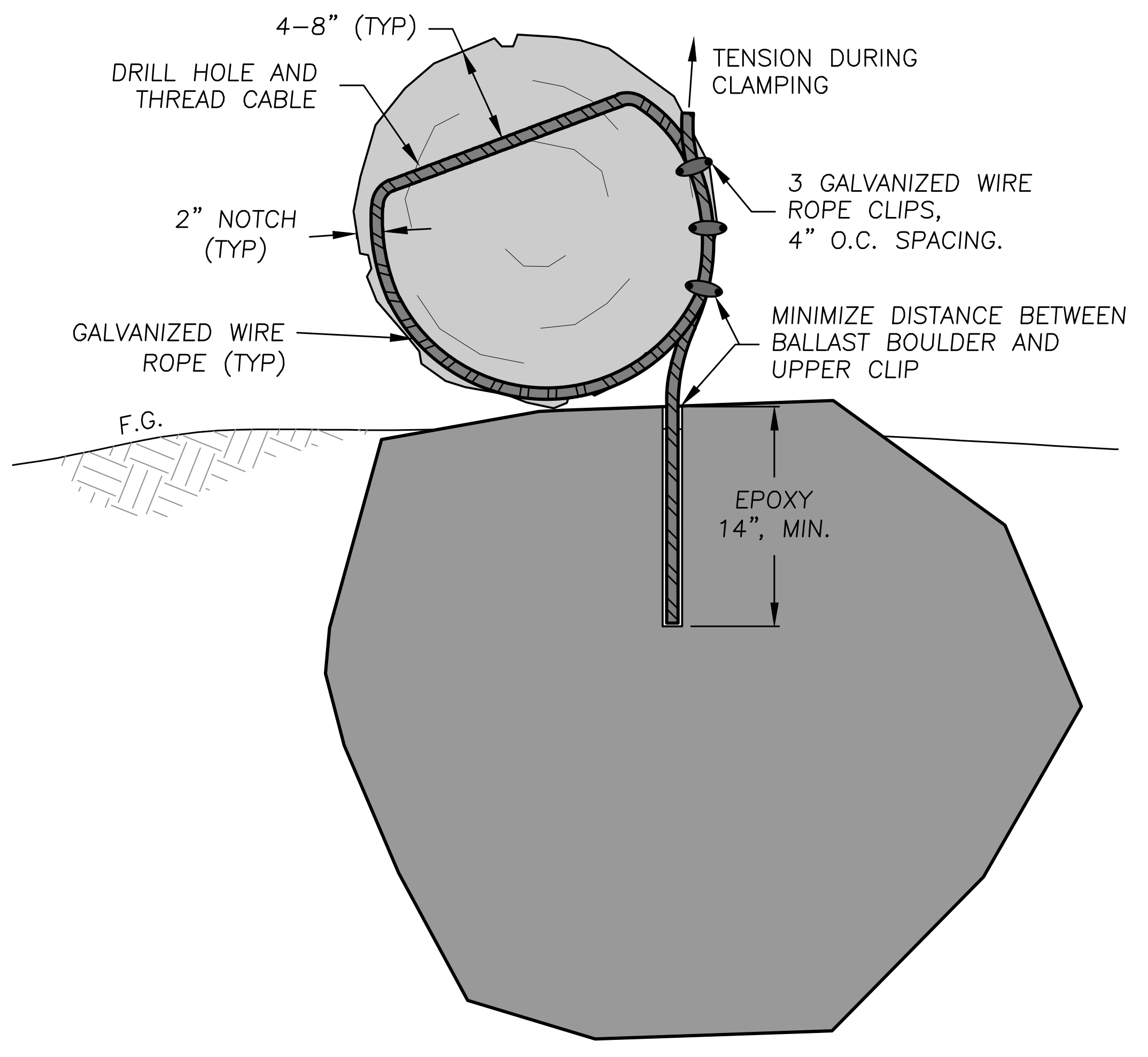
SCALE: NOT TO SCALE

1
C11,C14 C39

### LOG STRUCTURE NOTES:

1. PLACEMENT LOCATIONS: LOG AND BOULDER LOCATIONS SHOWN ON DRAWINGS ARE APPROXIMATE. EXACT LOCATIONS SHALL BE AS DIRECTED BY THE ENGINEER.
2. CONNECTIONS: CONNECTIONS SHALL CONSIST OF TWO (2) LOG/BOULDER CONNECTIONS AND ONE (1) LOG/LOG CONNECTION PER LOG, AS SHOWN ON DETAILS 2 AND 3, THIS SHT.. OR AS DIRECTED BY THE ENGINEER. TENSION ALL CONNECTIONS PRIOR TO CLAMPING TO REMOVE SLACK AND MINIMIZE MOVEMENT. ALL CONNECTIONS SHALL BE PLACED TO MINIMIZE VISUAL IMPACT.
3. LOGS: LOGS SHALL BE REDWOOD OR FIR. EACH LOG STRUCTURE SHALL CONSIST OF ONE LOG WITH ROOTWAD ATTACHED AND ONE LOG WITHOUT ROOTWAD. ALL LOGS SHALL BE SOUND AND FREE OF SIGNIFICANT DECAY, MEETING THE FOLLOWING CRITERIA:
   - A. DIAMETER: 24 – 36 INCH (MIN. 24 INCHES AT ANY POINT)
   - B. LENGTH: 20 – 30 FEET
4. BALLAST BOULDERS: BALLAST BOULDERS WILL BE SUB–ROUNDED TO SUB–ANGULAR WITH A MINIMUM WEIGHT OF 2.5 TONS (5,000 POUNDS). PLACE TWO BALLAST BOULDERS PER LOG, MINIMUM.
5. CABLE: ALL CABLE SHALL BE 5/8" GALVANIZED WIRE ROPE WITH A MINIMUM BREAKING STRENGTH OF 25,000 LBS. ALL CABLE TO BE SECURED WITH A MINIMUM OF THREE GALVANIZED WIRE ROPE CLIPS AT EACH END, WITH 4", MIN. SPACING BETWEEN CLAMPS AND 2", MIN. DISTANCE TO CABLE ENDS. CABLE SHALL BE THOROUGHLY CLEANED WITH A SOLUTION OF MURIATIC ACID OR WITH ACETONE TO REMOVE ALL GREASE OR OIL FROM BONDED LENGTH. CABLES SHALL BE TENSIONED PRIOR TO CLAMPING TO REMOVE ALL SLACK FROM CABLE, AFTER EPOXY IS ALLOWED TO SET UP OVERNIGHT PER THE EPOXY NOTES BELOW.
6. HOLE PLACEMENT/PREPARATION: HOLES FOR ANCHORING INTO BOULDERS/ROCK FACE SHALL BE DRILLED WHERE ROCK IS SOUND, WHERE NO FAULTS OR FRACTURES ARE VISIBLE. HOLE DIAMETER SHALL BE NOT MORE THAN 1/8" GREATER THAN THAT OF THE ANCHOR/CABLE. HOLES SHALL BE DRILLED TO ALIGN WITH FINAL ORIENTATION OF TENSILE FORCES IN THE ANCHOR/CABLE, TO MINIMIZE BENDING AT THE ROCK SURFACE. HOLES SHALL BE PROPERLY CLEANED OF ALL DUST AND DEBRIS USING COMPRESSED AIR PRIOR TO INSTALLATION OF CABLE/ANCHOR. THE ENGINEER SHALL INSPECT AND APPROVE ALL HOLES PRIOR TO EPOXY PLACEMENT.
7. EPOXY: FILL THE HOLE APPROXIMATELY 2/3 WITH EPOXY BEFORE INSERTING THE CABLE TO THE BOTTOM OF THE HOLE. ALLOW ADHESIVE TO SET UP OVERNIGHT BEFORE APPLYING TENSION TO CABLE.

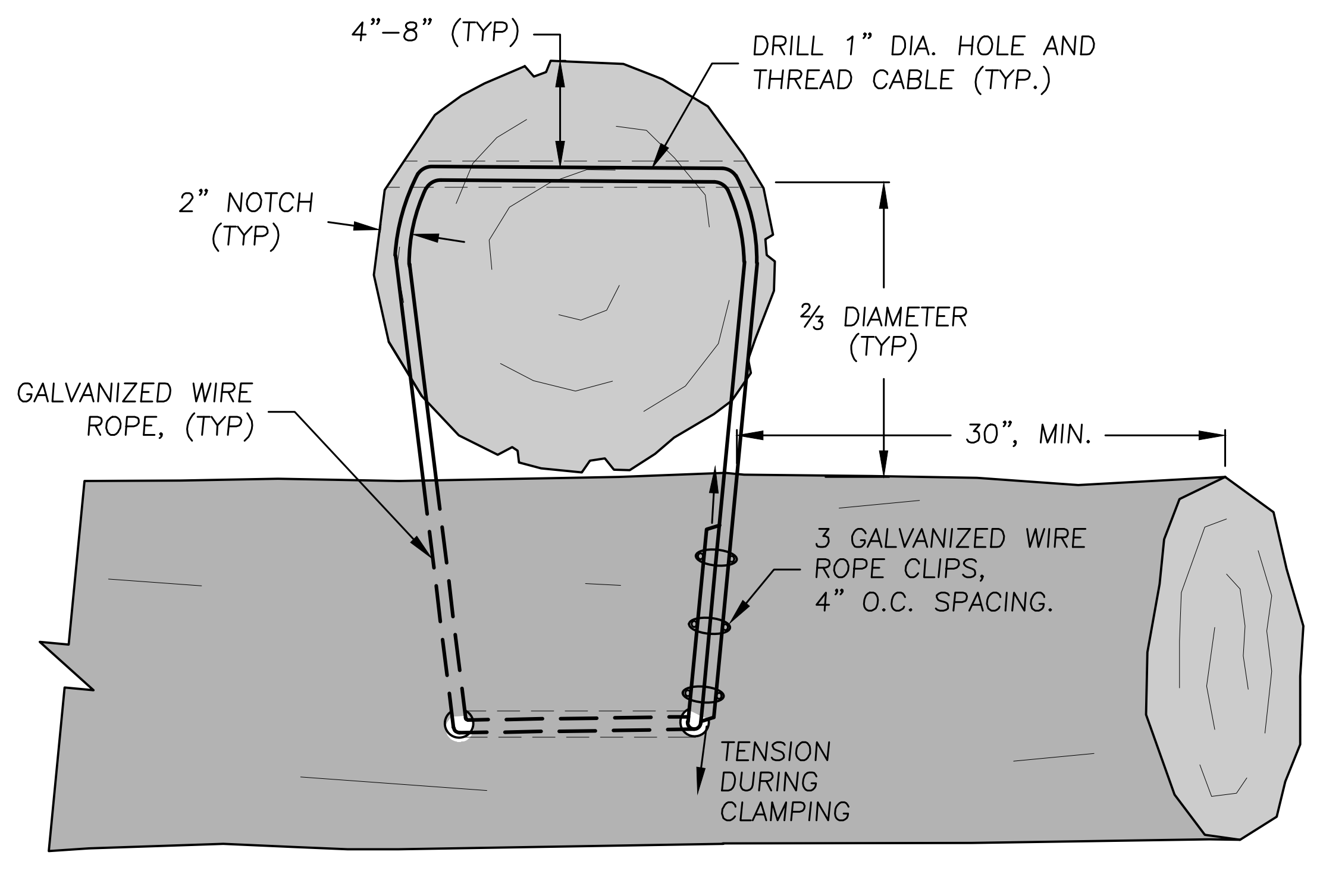
   ANCHORING ADHESIVE SHALL BE A TWO–COMPONENT 100% SOLIDS EPOXY BASED SYSTEM SUPPLIED IN MANUFACTURER'S STANDARD CARTRIDGE AND DISPENSED THROUGH A STATIC–MIXING NOZZLE SUPPLIED BY THE MANUFACTURER. EPOXY SHALL MEET THE MINIMUM REQUIREMENTS OF ASTM C–881 SPECIFICATION FOR TYPE I, II, IV, AND V, GRADE 3, CLASS B AND C AND MUST DEVELOP MINIMUM 12,650 PSI COMPRESSIVE YIELD STRENGTH AFTER 7 DAY CURE. EPOXY MUST HAVE A HEAT REFLECTION TEMPERATURE OF A MINIMUM 136 DEGREES FAHRENHEIT (58 DEGREES CELSIUS). ADHESIVE SHALL BE EPOXY–TIE SET FROM SIMPSON STRONG–TIE, DUBLIN, CA, OR APPROVED EQUIVALENT. FILL THE HOLE APPROXIMATELY 2/3 WITH POLYESTER EPOXY RESIN BEFORE INSERTING CABLE TO THE BOTTOM OF THE HOLE. TAKE CARE TO ENSURE HIGH BOND STRENGTH, AND AVOID CONTAMINATION. ALLOW ADHESIVE TO SET UP OVERNIGHT BEFORE APPLYING TENSION TO CABLE.
8. LOG STRUCTURE DESIGNS ARE SHOWN CONCEPTUALLY DUE TO THE INHERENT VARIABILITY OF MATERIAL PROPERTIES. THE DESIGN REQUIRES THAT THE ENGINEER WILL OBSERVE CONSTRUCTION OF THE LOG STRUCTURES TO ENSURE THE INTENT OF THE DESIGN IS MET. OBSERVATIONS MUST INCLUDE LOG AND BOULDER SELECTION, PLACEMENT, AND BACKFILLING. ANY LOG STRUCTURES CONSTRUCTED WITHOUT THE ENGINEER PRESENT ON–SITE MAY RESULT IN REJECTION OF THE WORK BY THE ENGINEER.



## LOG/BOULDER CONNECTION

SCALE: 1" = 1'

2
–



## LOG/LOG CONNECTION

SCALE: 1" = 1'

3
–

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PRELIMINARY
NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

LOG STRUCTURE
DETAILS AND
ROCK
SPECIFICATIONS

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | B.M.Z. |
| DRAWN BY: | B.M.Z. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C39

39 OF 47

## GENERAL NOTES CONTINUED

1. ALL CONSTRUCTION AND MATERIALS SHALL CONFORM TO THE 2015 EDITION OF THE STATE OF CALIFORNIA STANDARD SPECIFICATIONS, ISSUED BY THE DEPARTMENT OF TRANSPORTATION (HEREAFTER REFERRED TO AS "STANDARD SPECIFICATIONS").

2. NOTIFY THE ENGINEER AT LEAST 48 HOURS PRIOR TO CONSTRUCTION. THE ENGINEER OR A DESIGNATED REPRESENTATIVE SHALL MONITOR THE CONSTRUCTION PROCESS, AS NECESSARY, TO ENSURE PROPER INSTALLATION PROCEDURES.

3. EXISTING UNDERGROUND UTILITY LOCATIONS:

    A. PRIOR TO BEGINNING WORK, CONTACT ALL UTILITIES COMPANIES WITH REGARD TO WORKING OVER, UNDER, OR AROUND EXISTING FACILITIES AND TO OBTAIN INFORMATION REGARDING RESTRICTIONS THAT ARE REQUIRED TO PREVENT DAMAGE TO THE FACILITIES.

    B. LOCATIONS SHOWN ARE COMPILED FROM INFORMATION SUPPLIED BY THE APPROPRIATE UTILITY AGENCIES AND FROM FIELD MEASUREMENTS TO ABOVE GROUND FEATURES READILY VISIBLE AT THE TIME OF SURVEY. LOCATIONS SHOWN ARE APPROXIMATE. THE CONTRACTOR IS CAUTIONED THAT ONLY ACTUAL EXCAVATION WILL REVEAL THE DIMENSIONS, SIZES, MATERIALS, LOCATIONS, AND DEPTH OF UNDERGROUND UTILITIES.

    C. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE LOCATION AND/OR PROTECTION OF ALL EXISTING AND PROPOSED PIPING, UTILITIES, TRAFFIC SIGNAL EQUIPMENT (BOTH ABOVE GROUND AND BELOW GROUND), STRUCTURES, AND ALL OTHER EXISTING IMPROVEMENTS THROUGHOUT CONSTRUCTION.

    D. PRIOR TO COMMENCING FABRICATION OR CONSTRUCTION, DISCOVER OR VERIFY THE ACTUAL DIMENSIONS, SIZES, MATERIALS, LOCATIONS, AND ELEVATIONS OF ALL EXISTING UTILITIES AND POTHOLE THOSE AREAS WHERE POTENTIAL CONFLICTS ARE LIKELY OR DATA IS OTHERWISE INCOMPLETE.

    E. CONTRACTOR SHALL TAKE APPROPRIATE MEASURES TO PROTECT EXISTING UTILITIES DURING CONSTRUCTION OPERATIONS, AND SHALL BE SOLELY RESPONSIBLE FOR THE COST OF REPAIR/REPLACEMENT OF ANY EXISTING UTILITIES DAMAGED DURING CONSTRUCTION. CONTRACTOR TO CALL UNDERGROUND SERVICE ALERT (1-800-642-2444) TO LOCATE ALL UNDERGROUND UTILITY LINES PRIOR TO COMMENCING CONSTRUCTION.

    F. UPON LEARNING OF THE EXISTENCE AND/OR LOCATIONS OF ANY UNDERGROUND FACILITIES NOT SHOWN OR SHOWN INACCURATELY ON THE PLANS OR NOT PROPERLY MARKED BY THE UTILITY OWNER, IMMEDIATELY NOTIFY THE UTILITY OWNER AND THE CITY BY TELEPHONE AND IN WRITING.

    G. UTILITY RELOCATIONS REQUIRED FOR THE CONSTRUCTION OF THE PROJECT FACILITIES WILL BE PERFORMED BY THE UTILITY COMPANY, UNLESS OTHERWISE NOTED.

12. SHOULD THE CONTRACTOR DISCOVER ANY DISCREPANCIES BETWEEN THE CONDITIONS EXISTING IN THE FIELD AND THE INFORMATION SHOWN ON THESE DRAWINGS, NOTIFY THE ENGINEER PRIOR TO PROCEEDING WITH CONSTRUCTION.

13. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO BE FULLY INFORMED OF AND TO COMPLY WITH ALL LAWS, ORDINANCES, CODES, REQUIREMENTS AND STANDARDS WHICH IN ANY MANNER AFFECT THE COURSE OF CONSTRUCTION OF THIS PROJECT, THOSE ENGAGED OR EMPLOYED IN THE CONSTRUCTION AND THE MATERIALS USED IN THE CONSTRUCTION.

14. ANY TESTS, INSPECTIONS, SPECIAL OR OTHERWISE, THAT ARE REQUIRED BY THE BUILDING CODES, LOCAL BUILDING DEPARTMENTS, OR THESE PLANS, SHALL BE DONE BY AN INDEPENDENT INSPECTION COMPANY. JOB SITE VISITS BY THE ENGINEER DO NOT CONSTITUTE AN OFFICIAL INSPECTION. OBSERVATION AND TESTING SERVICES ARE REQUIRED BY THE GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST AS OUTLINED IN THE GEOTECHNICAL REPORT. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE THAT THE WORK IS COORDINATED WITH THE GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST AND THAT REQUIRED TESTS AND INSPECTIONS ARE PERFORMED.

15. PROJECT SCHEDULE: PRIOR TO COMMENCEMENT OF WORK, CONTRACTOR SHALL PROVIDE ENGINEER A DETAILED CONSTRUCTION SCHEDULE FOR APPROVAL. THE CONTRACTOR SHALL NOT BEGIN ANY CONSTRUCTION WORK UNTIL THE PROJECT SCHEDULE AND WORK PLAN IS APPROVED BY THE ENGINEER. ALL CONSTRUCTION SHALL BE CLOSELY COORDINATED WITH THE ENGINEER SO THAT THE QUALITY OF WORK CAN BE CHECKED FOR APPROVAL. THE CONTRACTOR SHALL PURSUE WORK IN A CONTINUOUS AND DILIGENT MANNER TO ENSURE A TIMELY COMPLETION OF THE PROJECT.

16. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN, PERMITTING, INSTALLATION, AND MAINTENANCE OF ANY AND ALL TRAFFIC CONTROL MEASURES DEEMED NECESSARY.

17. THE CONTRACTOR SHALL BE RESPONSIBLE FOR GENERAL SAFETY DURING CONSTRUCTION. ALL WORK SHALL CONFORM TO PERTINENT SAFETY REGULATIONS AND CODES. THE CONTRACTOR SHALL BE SOLELY AND COMPLETELY RESPONSIBLE FOR FURNISHING, INSTALLING, AND MAINTAINING ALL WARNING SIGNS AND DEVICES NECESSARY TO SAFEGUARD THE GENERAL PUBLIC AND THE WORK, AND PROVIDE FOR THE PROPER AND SAFE ROUTING OF VEHICULAR AND PEDESTRIAN TRAFFIC DURING THE PERFORMANCE OF THE WORK. THE CONTRACTOR SHALL BE SOLELY AND COMPLETELY RESPONSIBLE FOR COMPLIANCE WITH ALL APPLICABLE PROVISIONS OF OSHA IN THE CONSTRUCTION PRACTICES FOR ALL EMPLOYEES DIRECTLY ENGAGED IN THE CONSTRUCTION OF THIS PROJECT.

18. CONSTRUCTION CONTRACTOR AGREES THAT IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, CONSTRUCTION CONTRACTOR WILL BE REQUIRED TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL BE MADE TO APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS, AND CONSTRUCTION CONTRACTOR FURTHER AGREES TO DEFEND, INDEMNIFY AND HOLD DESIGN PROFESSIONAL HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTION LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF DESIGN PROFESSIONAL. NEITHER THE PROFESSIONAL ACTIVITIES OF CONSULTANT NOR THE PRESENCE OF CONSULTANT OR HIS OR HER EMPLOYEES OR SUB-CONSULTANTS AT A CONSTRUCTION SITE SHALL RELIEVE THE CONTRACTOR AND ITS SUBCONTRACTORS OF THEIR RESPONSIBILITIES INCLUDING, BUT NOT LIMITED TO, CONSTRUCTION MEANS, METHODS, SEQUENCE, TECHNIQUES OR PROCEDURES NECESSARY FOR PERFORMING, SUPERINTENDING OR COORDINATING ALL PORTIONS OF THE WORK OF CONSTRUCTION IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND APPLICABLE HEALTH OR SAFETY REQUIREMENTS OF ANY REGULATORY AGENCY OR OF STATE LAW.

19. THE CONTRACTOR SHALL MAINTAIN A CURRENT, COMPLETE, AND ACCURATE RECORD OF ALL AS-BUILT DEVIATIONS FROM THE CONSTRUCTION AS SHOWN ON THESE DRAWINGS AND SPECIFICATIONS, FOR THE PURPOSE OF PROVIDING THE ENGINEER OF RECORD WITH A BASIS FOR THE PREPARATION OF RECORD DRAWINGS.

20. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE SITE IN A NEAT AND ORDERLY MANNER THROUGHOUT THE CONSTRUCTION PROCESS. ALL MATERIALS SHALL BE STORED WITHIN APPROVED STAGING AREAS.

21. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION AND PRESERVATION OF ALL SURVEY MONUMENTS OR PROPERTY CORNERS. DISTURBED MONUMENTS SHALL BE RESTORED BACK TO THEIR ORIGINAL LOCATION AND SHALL BE CERTIFIED BY A REGISTERED CIVIL ENGINEER OR LAND SURVEYOR AT THE EXPENSE OF THE CONTRACTOR.

## DEMOLITION NOTES

1. THE REMOVAL OF EXISTING IMPROVEMENTS SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 15 OF THE STANDARD SPECIFICATIONS.

2. EXISTING IMPROVEMENTS, ADJACENT PROPERTY, TREES AND PLANTS, UTILITIES AND OTHER FACILITIES THAT ARE NOT REMOVED SHALL BE PROTECTED FROM INJURY OR DAMAGE RESULTING FROM THE CONTRACTOR'S OPERATIONS IN ACCORDANCE WITH SECTION 15.1 OF THE STANDARD SPECIFICATIONS.

## EARTHWORK NOTES

1. GRADING SUMMARY:

<u>OUTSIDE RECLAMATION AREA PLAN BOUNDARY</u>
CHANNEL WIDENING AREA:
CUT VOLUME = 8,300 CY
FILL VOLUME= 200 CY
NET (CUT)= 8,100 CY

<u>WITHIN RECLAMATION AREA PLAN BOUNDARY</u>
CHANNEL WIDENING AREA:
CUT VOLUME = 14,000 CY
FILL VOLUME= 1,400 CY
NET (CUT)= 12,600 CY

SEDIMENT FAN AREA:
CUT VOLUME = 5,000 CY
FILL VOLUME= 0 CY
NET (CUT)= 5,000 CY

ROCK PILE AREA:
CUT VOLUME = 420,000 CY
FILL VOLUME= 1,600 CY
NET (CUT)= 418,400 CY

MATERIAL REMOVAL AREA:
CUT VOLUME = 141,000 CY
FILL VOLUME= 1,000 CY
NET (CUT)= 140,000 CY

PROJECT TOTAL
CUT VOLUME = 580,000 CY
FILL VOLUME= 4,000 CY
NET (CUT)= 576,000 CY

THE ABOVE QUANTITIES ARE APPROXIMATE IN-PLACE VOLUMES CALCULATED AS THE DIFFERENCE BETWEEN EXISTING GROUND AND THE PROPOSED FINISH GRADE, PREPARED FOR PERMITTING PURPOSES ONLY. EXISTING GROUND IS DEFINED BY THE TOPOGRAPHIC CONTOURS AND/OR SPOT ELEVATIONS ON THE PLAN. PROPOSED FINISH GRADE IS DEFINED AS THE DESIGN SURFACE ELEVATION OF EARTH TO BE CONSTRUCTED, AS SHOWN ON THE DRAWINGS. THE QUANTITIES HAVE NOT BEEN FACTORED TO INCLUDE ALLOWANCES FOR BULKING, CLEARING AND GRUBBING, SUBSIDENCE, SHRINKAGE, OVER EXCAVATION, AND RECOMPACTION, UNDERGROUND UTILITY AND SUBSTRUCTURE SPOILS AND CONSTRUCTION METHODS. QUANTITIES ARE SUBJECT TO CHANGE, PENDING EXCAVATION AND INSPECTION OF SUBSURFACE CONDITIONS AT THE "ROCK PILE" AND "OVERBURDEN REMOVAL" AREAS, WHICH WILL ULTIMATELY DETERMINE FINISH GRADE AT THESE TWO AREAS.

THE CONTRACTOR SHALL PERFORM AN INDEPENDENT EARTHWORK ESTIMATE FOR THE PURPOSE OF PREPARING BID PRICES FOR EARTHWORK. THE BID PRICE SHALL INCLUDE COSTS FOR ANY NECESSARY IMPORT AND PLACEMENT OF EARTH MATERIALS OR THE EXPORT AND PROPER DISPOSAL OF EXCESS OR UNSUITABLE EARTH MATERIALS.

2. ALL EXCESS SOILS WILL BE USED ON SITE, AS APPROPRIATE, FOR RECLAMATION PURPOSES AS DIRECTED BY THE GEOTECHNICAL ENGINEER OR PROJECT GEOLOGIST.

3. CLEARING AND GRUBBING, SUBGRADE PREPARATION AND EARTHWORK SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 19 OF THE STANDARD SPECIFICATIONS, THESE DRAWINGS, AND THE TECHNICAL SPECIFICATIONS.

4. UNSUITABLE SOIL OR MATERIALS, NOT TO BE INCLUDED IN THE WORK INCLUDE:

    A. ORGANIC MATERIALS SUCH AS PEAT, MULCH, ORGANIC SILT OR SOD.
    B. SOILS CONTAINING EXPANSIVE CLAYS.
    C. MATERIAL CONTAINING EXCESSIVE MOISTURE.
    D. POORLY GRADED COURSE MATERIAL, PARTICLE SIZE IN EXCESS OF 6 INCHES.
    E. MATERIAL WHICH WILL NOT ACHIEVE SPECIFIED DENSITY OR BEARING.

5. FINE GRADING ELEVATIONS AND SLOPES NOT SHOWN SHALL BE DETERMINED BY THE CONTRACTOR IN THE FIELD TO OBTAIN DRAINAGE IN THE DIRECTION INDICATED. ALL FINAL GRADING SHALL BE SUBJECT TO APPROVAL OF THE ENGINEER.

6. THE TOP 6" OF SUBGRADE UNDER ALL PAVED SURFACES SUBJECT TO VEHICULAR USE SHALL BE COMPACTED TO A MINIMUM OF 95% RELATIVE COMPACTION, IN ACCORDANCE WITH ASTM-D1557 STANDARD. ALL OTHER FILL TO BE COMPACTED TO A MINIMUM OF 90% MAXIMUM DENSITY AS DETERMINED BY ASTM-D1557 AND SO CERTIFIED BY TESTS AND REPORTS FROM THE ENGINEER IN CHARGE OF THE GRADING CERTIFICATION.

7. FILL MATERIAL SHALL BE SPREAD IN LIFTS OF APPROXIMATELY 8 INCHES, MOISTENED OR DRIED TO NEAR OPTIMUM MOISTURE CONTENT AND RECOMPACTED. THE MATERIALS FOR ENGINEERED FILL SHALL BE APPROVED BY A REGISTERED GEOTECHNICAL ENGINEER OR PROFESSIONAL GEOLOGIST. ANY IMPORTED MATERIALS MUST BE APPROVED BEFORE BEING BROUGHT TO THE SITE. THE MATERIALS USED SHALL BE FREE OF ORGANIC MATTER AND OTHER DELETERIOUS MATERIALS.

8. ALL CONTACT SURFACES BETWEEN ORIGINAL GROUND AND RECOMPACTED FILL SHALL BE EITHER HORIZONTAL OR VERTICAL. ALL ORGANIC MATERIAL SHALL BE REMOVED AND THE REMAINING SURFACE SCARIFIED TO A DEPTH OF AT LEAST 12 INCHES, UNLESS DEEPER EXCAVATION IS REQUIRED BY THE ENGINEER.

## GENERAL EROSION CONTROL NOTES

1. A DETAILED EROSION AND SEDIMENT CONTROL PLAN WILL BE PREPARED BY THE ENGINEER, PRIOR TO FINALIZATION OF THE CONSTRUCTION DOCUMENTS.

2. CONTRACTOR SHALL BE FAMILIAR WITH THE CONDITIONS OF APPROVAL OF ALL REQUIRED PROJECT PERMITS AND SHALL IMPLEMENT ALL REQUIRED BMP'S PRIOR TO COMMENCING GRADING OPERATIONS

3. CONTRACTOR SHALL UTILIZE ONLY THE APPROVED HAUL ROADS AND ACCESS POINTS (AS SHOWN ON THE DRAWINGS) FOR TRANSPORT OF MATERIALS AND EQUIPMENT.

4. BETWEEN OCTOBER 15 AND APRIL 15, EXPOSED SOIL SHALL BE PROTECTED FROM EROSION AT ALL TIMES. DURING CONSTRUCTION SUCH PROTECTION MAY CONSIST OF MULCHING AND/OR PLANTING OF NATIVE VEGETATION OF ADEQUATE DENSITY. BEFORE COMPLETION OF THE PROJECT, ANY EXPOSED SOIL ON DISTURBED SLOPES SHALL BE PERMANENTLY PROTECTED FROM EROSION.

5. REMAIN AVAILABLE AT ALL TIMES FOR EMERGENCY WORK THAT MAY BE REQUIRED DURING THE RAINY SEASON (OCTOBER 15 THROUGH APRIL 15). NECESSARY MATERIALS SHALL BE AVAILABLE AND STOCKPILED AT CONVENIENT LOCATIONS TO FACILITATE RAPID CONSTRUCTION OF TEMPORARY DEVICES.

6. CONSTRUCT TEMPORARY EROSION CONTROL MEASURES AS SHOWN ON THE DRAWINGS AND/OR AS DIRECTED BY THE ENGINEER TO CONTROL DRAINAGE WHICH HAS BEEN AFFECTED BY GRADING AND/OR TRENCHING OPERATIONS.

7. CONSTRUCT AND MAINTAIN EROSION CONTROL MEASURES TO PREVENT THE DISCHARGE OF EARTHEN MATERIALS TO THE CREEK FROM DISTURBED AREAS UNDER CONSTRUCTION AND FROM COMPLETED CONSTRUCTION AREAS.

8. INSTALL ALL PROTECTIVE DEVICES AT THE END OF EACH WORK DAY WHEN THE FIVE-DAY RAIN PROBABILITY EQUALS OR EXCEEDS 50 PERCENT AS DETERMINED FROM THE NATIONAL WEATHER SERVICE FORECAST OFFICE: WWW.SRH.NOAA.GOV.

9. AFTER A RAINSTORM REMOVE ACCUMULATED SEDIMENT AND DEBRIS FROM ALL EROSION CONTROL MEASURES.

10. KEEP IN FORCE ALL EROSION CONTROL DEVICES AND MODIFY THOSE DEVICES AS SITE PROGRESS DICTATES.

11. MONITOR THE EROSION CONTROL DEVICES DURING STORMS AND MODIFY THEM IN ORDER TO PREVENT PROGRESS OF ANY ONGOING EROSION.

12. CONTACT THE ENGINEER IN THE EVENT THAT THE EROSION CONTROL PLAN AS DESIGNED REQUIRES ANY SUBSTANTIAL REVISIONS.

## FIELD ENGINEERING NOTES

### (FOR ROCK PILE AREA AND MATERIAL REMOVAL AREA CONSTRUCTION)

1. GENERAL

THESE DRAWINGS WERE DEVELOPED WITH THE GOAL OF CREATING MORE NATURAL CONDITIONS, WHILE MAINTAINING A RELATIVELY UNIFORM PROFILE GRADIENT WITHIN THE PROPOSED LIMITS OF DISTURBANCE TO IMPROVE CHANNEL STABILITY AND ENHANCE ECOLOGICAL FUNCTION. THE DRAWINGS WERE PREPARED WITHOUT FULL KNOWLEDGE OF SUBSURFACE CONDITIONS, INCLUDING THE ELEVATION OF UNDERLYING BEDROCK OR ALLUVIAL MATERIALS THAT WOULD INDICATE THE LOCATION OF THE PRE-DISTURBANCE CHANNEL PROFILE IN REACHES 18-17 AND 13-11. THE DESIGN APPROACH FOR THESE REACHES WILL EMPLOY FIELD ENGINEERING AND A FIELD DIRECTED CONSTRUCTION APPROACH TO MAXIMIZE CHANNEL STABILITY, WHILE AVOIDING EXCAVATION INTO NATIVE BEDROCK. THE FINAL CONSTRUCTED GEOMETRY WILL BE DIRECTED BY THE ENGINEER IN THE FIELD, PENDING SUBSURFACE CONDITIONS, AS DESCRIBED BELOW.

1.1. THE ROCK PILE AREA (REACHES 13-11) IS EXPECTED TO BE CONSTRUCTED PRIOR TO THE MATERIAL REMOVAL AREA. EXPERIENCE GAINED FROM THE FIELD DIRECTED CONSTRUCTION APPROACH AT THE ROCK PILE AREA WILL BE USED TO REFINE THE DESIGN FOR THE MATERIAL REMOVAL AREA.

2. PROFILE

2.1. GENERAL. THE FINISHED GRADE ELEVATION OF THE FLOWLINE WILL GENERALLY FALL BETWEEN THE UPPER AND LOWER LIMITS SHOWN ON THE DRAWINGS, DEFINED THERE AS THE "GRADING ENVELOPE," EXCEPT WHERE THE LOCATION OF EXISTING BEDROCK REQUIRES DEVIATION. THE LOWER LIMIT OF THE ENVELOPE IS THE OPTIMUM "STRAIGHT GRADE" UNIFORM PROFILE WITHIN THE PROPOSED LIMITS OF WORK. THE UPPER LIMIT OF THE ENVELOPE IS A BEST-FIT LINE BETWEEN IDENTIFIED POINTS OF BEDROCK CONTROL, AS ESTIMATED FROM RECENT SUBSURFACE INVESTIGATIONS. THE CONSTRUCTION WILL ATTEMPT TO FOLLOW THE LOWER LIMIT OF THE ENVELOPE, SUBJECT TO THE CONSTRAINTS SET FORTH BELOW.

2.2. BEDROCK.

A. GENERAL. THE QUALIFICATION OF MATERIAL AS "BEDROCK" WILL BE PERFORMED INITIALLY BY THE PROJECT GEOTECHNICAL ENGINEER. IF THE PROJECT GEOTECHNICAL ENGINEER DETERMINES THAT EXCAVATION TO BEDROCK HAS OCCURRED PRIOR TO REACHING THE LOWEST ELEVATION AT ANY LOCATION WITHIN THE GRADING ENVELOPE, AN INDEPENDENT PROFESSIONAL GEOLOGIST WILL ASSESS AND MAKE THE FINAL DETERMINATION OF THE EXISTENCE AND EXTENT OF ANY SUCH BEDROCK.
B. WHERE BEDROCK IS ENCOUNTERED ABOVE THE LOWER LIMIT OF THE GRADING ENVELOPE, THE PROFILE WILL NOT BE EXCAVATED INTO THE BEDROCK. AN INSPECTION TRENCH WILL BE CONSTRUCTED ACROSS THE CHANNEL, WITHIN THE POTENTIAL CROSS SECTION LIMITS (BETWEEN THE ADJACENT HILL SLOPES), TO ENSURE THAT BEDROCK IS CONTINUOUS. THE CHANNEL ALIGNMENT WILL FOLLOW THE LOW POINT OF THE BEDROCK, TO THE EXTENT THAT THIS IS FEASIBLE WHILE MAINTAINING A GEOMORPHICALLY APPROPRIATE PLANFORM ALIGNMENT, AND WHILE REMAINING WITHIN THE LATERAL LIMITS DESCRIBED BELOW. UPSTREAM OF BEDROCK CONTROL POINTS, THE LOWER LIMIT OF THE PROFILE WILL BE SUBJECT TO THE MINIMUM DESIGN PROFILE GRADIENT, AS SPECIFIED BELOW.
C. MINIMUM DESIGN PROFILE GRADIENT. UPSTREAM OF BEDROCK CONTROLS, THE MINIMUM DESIGN PROFILE GRADE WILL BE SET TO 4%, TO HELP MAINTAIN SEDIMENT TRANSPORT CONTINUITY AND CHANNEL STABILITY.
D. THE CONSTRUCTED PROFILE GRADIENT BETWEEN BEDROCK OUTCROPS WILL NOT EXCEED 12.0%.
E. ALLUVIAL MATERIALS. WHERE THE ORIGINAL "PRE-DISTURBANCE" STREAMBED IS IDENTIFIED BY THE PRESENCE OF SIGNIFICANT ALLUVIAL DEPOSITS, THE DESIGN PROFILE WILL NOT BE CONSTRUCTED BELOW THE ELEVATION OF THESE DEPOSITS, PROVIDED THE SPECIFIED MINIMUM AND MAXIMUM PROFILE GRADE CRITERIA ARE MET. TEMPORARY EXCAVATIONS WILL NOT EXTEND BELOW THE DESIGN PROFILE ANY MORE THAN IS NECESSARY TO CONSTRUCT THE ENGINEERED STREAMBED MATERIAL SHOWN ON THE DESIGN DRAWINGS.

3. CROSS SECTION GEOMETRY

A. ACTIVE CHANNEL. THE LOW FLOW CROSS SECTION GEOMETRY WILL BE INFORMED BY REGIONAL ANALOGS AND REFINED BASED ON THE LOCAL PROFILE GRADIENT WITHIN EACH CONSTRUCTED REACH. CROSS SECTION DETAILS WILL CLOSELY RESEMBLE THE RANGE OF TYPICAL SECTIONS SHOWN ON THE DRAWINGS, EXCEPT WHERE INFLUENCED BY THE PRESENCE OF BEDROCK AS DISCUSSED ABOVE.
B. FLOODPLAIN. THE FLOODPLAIN WIDTHS WILL BE MAXIMIZED WITHIN THE CONSTRAINT OF MAINTAINING THE STABILITY OF THE ADJACENT HILLSIDE AND THE NEED TO ACCOMMODATE ROADS SHOWN ON THE DRAWINGS. THE STABLE DESIGN SLOPE OF THE ADJACENT HILLSIDE WILL BE DETERMINED BY THE GEOTECHNICAL ENGINEER, AND WILL LIKELY VARY BETWEEN 2H:1V AND 1.5H:1V, AS SHOWN ON THE DRAWINGS. EXPOSED BEDROCK MAY ALLOW FOR STEEPER SLOPES, SUBJECT TO APPROVAL OF THE GEOTECHNICAL ENGINEER. WHERE THE FINAL DESIGN PROFILE APPROACHES THE LOWER LIMIT OF THE GRADING ENVELOPE, THE STABILITY OF ADJACENT HILLSIDES WILL DICTATE A NARROWER FLOODPLAIN WIDTH. SLOPE BENCHING MAY BE INCORPORATED TO REDUCE SLOPE LENGTH, CONTROL SURFACE RUNOFF AND HELP PROTECT SLOPES FROM SURFACE EROSION WHILE VEGETATION BECOMES ESTABLISHED.
C. WHERE BEDROCK OUTCROPS CONSTRAIN THE FLOODPLAIN WIDTH, UPSTREAM AND DOWNSTREAM FLOODPLAINS WILL TRANSITION RAPIDLY TO CONFORM TO THOSE RESTRICTIONS AND THEN RETURN TO THE STANDARD FLOODPLAIN WIDTHS AS DESCRIBED ABOVE.

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WWW.WATWAYS.COM

PRELIMINARY
NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

NOTES

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: -
DRAWN BY: B.M.S.
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13-016

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

C40

40 OF 47

## ROCKPILE AREA CONTROL POINTS

| POINT # | DESCRIPTION | ELEV | NORTHING | EASTING |
|---|---|---|---|---|
| 72 | CP SET SPK | 716.22 | 1941334.47 | 6096793.81 |
| 75 | CP SET SPK | 803.09 | 1941619.31 | 6096158.88 |
| 76 | CP SET RBR | 808.85 | 1941680.82 | 6095909.82 |
| 111 | CP SET RBR | 806.80 | 1941671.67 | 6095921.21 |
| 114 | CP SET RBR | 816.20 | 1941779.90 | 6095582.76 |
| 115 | CP SET RBR | 812.88 | 1941879.05 | 6095569.80 |
| 117 | CP SET RBR | 819.89 | 1941892.45 | 6095529.40 |
| 217 | CP SET RBR | 724.29 | 1941371.11 | 6096727.29 |
| 404 | SPK | 806.27 | 1941662.30 | 6095969.08 |
| 405 | RBR | 796.09 | 1941537.79 | 6096266.02 |

## CONCRETE CHANNEL CONTROL POINTS

| POINT # | DESCRIPTION | ELEV | NORTHING | EASTING |
|---|---|---|---|---|
| 10 | MAG NAIL | 510.38 | 1943483.74 | 6101146.44 |
| 12 | 1" IRON PIPE | 529.20 | 1942175.05 | 6099969.01 |
| 17 | REBAR | 485.24 | 1943557.06 | 6100979.06 |
| 18 | REBAR | 490.06 | 1943435.52 | 6100870.89 |
| 19 | REBAR | 498.09 | 1943198.66 | 6100699.22 |
| 20 | REBAR | 508.54 | 1942872.53 | 6100467.68 |
| 21 | MAG NAIL | 521.46 | 1942467.45 | 6100151.60 |
| 22 | SPIKE | 551.31 | 1941760.87 | 6099823.75 |
| 51 | MONUMENT | 478.22 | 1943592.65 | 6101044.38 |
| 52 | REBAR | 483.41 | 1943590.24 | 6101025.98 |
| 53 | REBAR | 515.91 | 1942632.18 | 6100296.75 |
| 54 | SPIKE | 521.30 | 1942452.03 | 6100170.82 |
| 193 | REBAR | 476.72 | 1943711.46 | 6100983.49 |

## OLD CRUSHER FOUNDATION CONTROL POINTS

| POINT # | DESCRIPTION | ELEV | NORTHING | EASTING |
|---|---|---|---|---|
| 165 | CP SET RBR | 1063.33 | 1941953.01 | 6093263.23 |

## CHANNEL WIDENING AREA CONTROL POINTS

| POINT # | DESCRIPTION | ELEV | NORTHING | EASTING |
|---|---|---|---|---|
| 27 | REBAR | 593.54 | 1940695.05 | 6099210.37 |
| 28 | REBAR | 596.51 | 1940561.90 | 6099071.25 |
| 29 | MAG NAIL | 598.00 | 1940385.77 | 6098868.13 |
| 30 | REBAR | 601.51 | 1940365.48 | 6098858.92 |
| 31 | REBAR | 610.23 | 1940446.61 | 6098616.89 |
| 32 | REBAR | 613.75 | 1940462.10 | 6098526.45 |
| 33 | REBAR | 618.26 | 1940475.93 | 6098439.20 |
| 34 | REBAR | 628.65 | 1940479.92 | 6098296.99 |
| 35 | REBAR | 632.45 | 1940501.64 | 6098230.63 |
| 36 | MAG NAIL | 620.81 | 1940463.13 | 6098387.20 |
| 37 | REBAR | 635.48 | 1940558.97 | 6098103.67 |
| 38 | REBAR | 641.70 | 1940495.95 | 6097949.58 |
| 40 | MAG NAIL | 648.83 | 1940405.35 | 6097615.83 |
| 41 | MAG NAIL | 646.63 | 1940383.67 | 6097691.16 |
| 42 | REBAR | 656.48 | 1940451.30 | 6097514.85 |
| 43 | REBAR | 657.09 | 1940492.55 | 6097471.45 |
| 44 | REBAR | 660.96 | 1940560.15 | 6097400.04 |
| 45 | REBAR | 668.01 | 1940655.83 | 6097298.98 |
| 46 | SPIKE | 680.15 | 1940841.82 | 6097231.78 |
| 62 | SPIKE | 569.70 | 1940615.33 | 6099288.05 |
| 63 | SPIKE | 570.71 | 1940570.68 | 6099267.81 |
| 64 | REBAR | 584.77 | 1940545.28 | 6099205.98 |
| 65 | REBAR | 590.89 | 1940439.65 | 6099088.09 |
| 66 | MAG NAIL | 591.86 | 1940396.17 | 6098999.78 |
| 67 | MAG NAIL | 595.38 | 1940388.34 | 6098927.84 |
| 68 | MAG NAIL | 602.87 | 1940400.72 | 6098741.75 |
| 69 | MAG NAIL | 606.61 | 1940410.97 | 6098663.01 |
| 79 | SPIKE | 646.21 | 1940316.73 | 6097727.47 |
| 81 | SPIKE | 694.63 | 1940223.55 | 6097775.38 |
| 82 | REBAR | 649.67 | 1940408.23 | 6097839.94 |
| 83 | REBAR | 637.23 | 1940523.90 | 6098107.56 |
| 84 | REBAR | 621.56 | 1940440.92 | 6098417.10 |
| 215 | REBAR | 646.91 | 1940455.35 | 6097884.82 |
| 218 | REBAR | 677.67 | 1940841.54 | 6097176.51 |
| 219 | REBAR | 680.66 | 1940900.16 | 6097145.81 |
| 314 | REBAR | 637.77 | 1940371.89 | 6097791.16 |
| 400 | REBAR | 576.85 | 1940487.04 | 6099160.53 |
| 401 | REBAR | 607.02 | 1940404.17 | 6098660.54 |
| 402 | REBAR | 609.64 | 1940411.88 | 6098607.86 |
| 403 | REBAR | 615.06 | 1940428.64 | 6098517.03 |
| 406 | REBAR | 629.80 | 1940471.66 | 6098007.66 |
| 410 | REBAR | 653.73 | 1940584.46 | 6097340.83 |
| 411 | REBAR | 661.24 | 1940732.49 | 6097196.50 |
| 412 | REBAR | 664.95 | 1940814.37 | 6097160.96 |
| 413 | REBAR | 683.39 | 1940897.81 | 6097111.72 |

## MATERIAL REMOVAL AREA CONTROL POINTS

| POINT # | DESCRIPTION | ELEV | NORTHING | EASTING |
|---|---|---|---|---|
| 48 | CP SET RBR | 1261.52 | 1942178.50 | 6091840.78 |
| 49 | CP SET RBR | 1227.82 | 1942114.42 | 6092223.57 |
| 150 | CP SET RBR | 1248.81 | 1942121.40 | 6091732.54 |
| 151 | CP SET RBR | 1209.33 | 1942037.70 | 6091938.21 |
| 152 | CP SET RBR | 1193.37 | 1941973.93 | 6092019.31 |
| 153 | CP SET RBR | 1206.00 | 1942064.01 | 6092164.43 |
| 154 | CP SET RBR | 1203.50 | 1942039.62 | 6092197.65 |
| 155 | CP SET RBR | 1174.15 | 1942015.96 | 6092308.67 |
| 156 | CP SET RBR | 1156.71 | 1941993.50 | 6092485.97 |
| 157 | CP SET RBR | 1146.54 | 1941979.84 | 6092548.12 |
| 158 | CP SET RBR | 1107.87 | 1941764.00 | 6092719.31 |
| 159 | CP SET RBR | 1096.94 | 1941783.90 | 6092867.43 |
| 160 | CP SET RBR | 1090.73 | 1941829.03 | 6092915.18 |
| 163 | CP SET RBR | 1071.81 | 1941856.46 | 6093112.11 |
| 165 | CP SET RBR | 1063.33 | 1941953.01 | 6093263.23 |
| 166 | CP SET RBR | 1069.37 | 1941972.57 | 6093285.20 |
| 169 | CP SET RBR | 1247.35 | 1942132.95 | 6091720.89 |
| 171 | CP FD SPK | 1248.13 | 1942159.92 | 6091675.87 |
| 174 | CP SET RBR | 1257.05 | 1942125.94 | 6091344.28 |
| 175 | CP SET SPK | 1256.76 | 1942089.48 | 6091244.14 |

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NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

CONTROL
POINT
TABLES

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

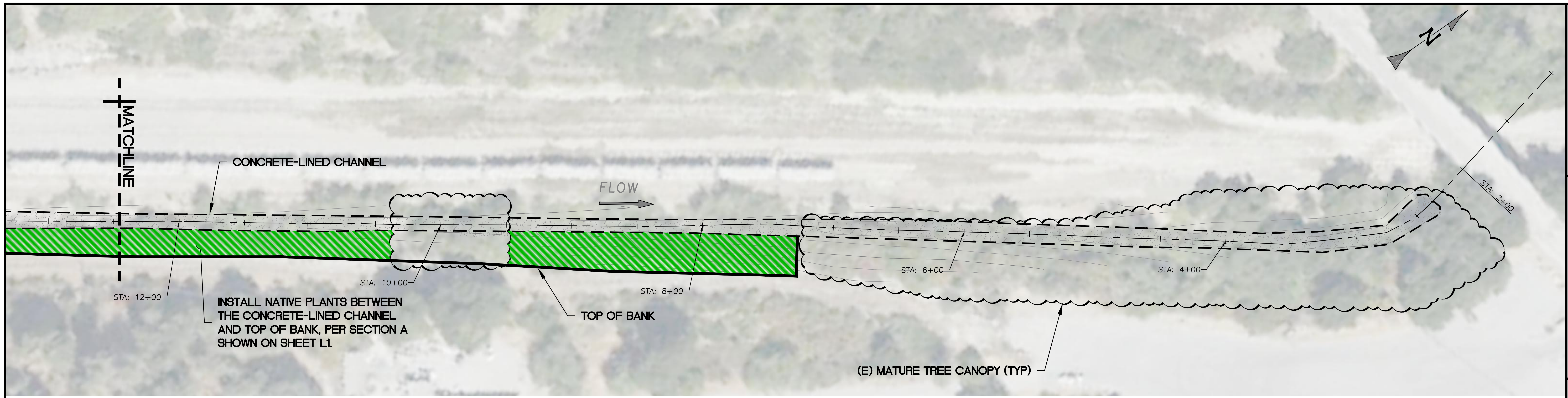
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | B.M.S. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

C41

41
OF
47



## CONCRETE-LINED CHANNEL SOUTHERN BANK PLANTING PLAN

SCALE: 1" = 40'

### SUPPLEMENTAL PLANTING NOTES:

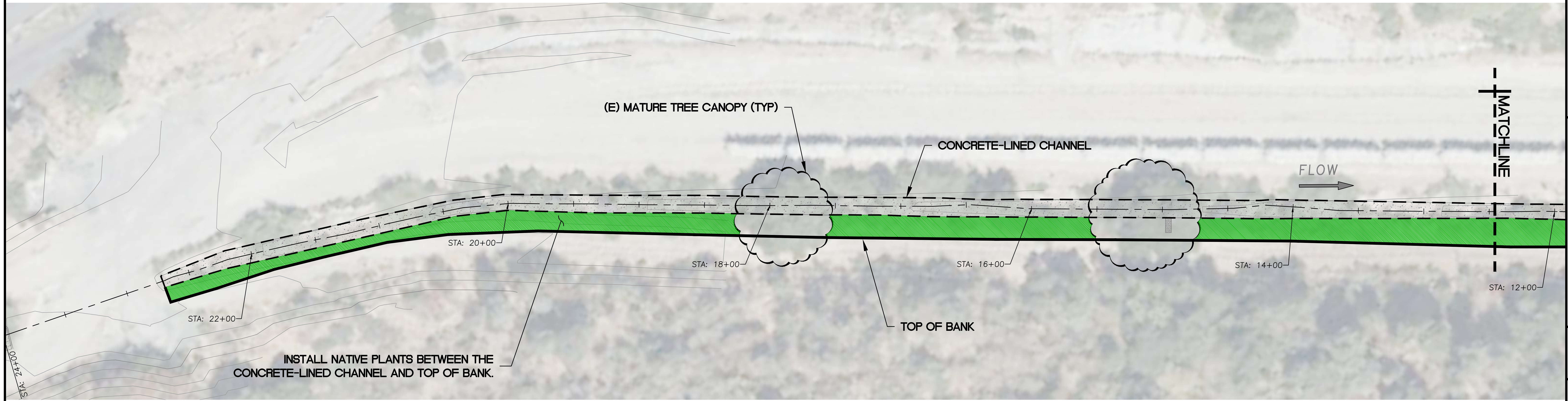
1. PROTECT IN PLACE ALL EXISTING NATIVE TREES AND SHRUBS, INCLUDING EXISTING OAK SEEDLINGS.
2. A QUALIFIED REVEGETATION SPECIALIST SHALL CONFIRM EACH PROPOSED PLANTING LOCATION PRIOR TO EXCAVATION OF PLANTING PITS.
3. PROPOSED PLANT SPECIES CONTAINER SIZE AND SPACING SHALL CONFORM TO TABLE 1. CONCRETE CHANNEL – RIPARIAN PLANTING.
4. CLEAR AND GRUB A THREE-FOOT DIAMETER AREA AT EACH PROPOSED PLANTING LOCATION.
5. PLANTING EXCAVATION SHALL NOT OCCUR WITHIN THE DRIP LINE OF EXISTING SHRUBS OR TREES, WITHIN TEN FEET FROM THE TRUNKS OF EXISTING ESTABLISHED TREES, OR WITHIN FIVE FEET OF EXISTING OAK SEEDLINGS.
6. INSTALL PLANTINGS, BROWSE PROTECTION AND IRRIGATION IN ACCORDANCE WITH THE CONTAINER PLANTING DETAIL ON SHEET L2
7. DEPENDING ON THE CONDITION OF EXISTING SOILS, SOIL EXCAVATED FOR PLANTING MAY REQUIRE AMENDMENT, AS DETERMINED BY THE REVEGETATION SPECIALIST. USE EXCESS SOIL TO FORM A WATERING WELL AROUND THE INSTALLED PLANT.
8. PLACE THREE TO FOUR INCHES OF MULCH AND/OR WEED MATS IN THE CLEARED AND GRUBBED AREA AROUND EACH INSTALLED PLANT OR OAK SEEDLING FOR WEED CONTROL AND MOISTURE RETENTION.

**TABLE 1. CONCRETE CHANNEL - RIPARIAN PLANTING**

| COMMON NAME | SCIENTIFIC NAME | CONTAINER SIZE | ON-CENTER SPACING (FT) | QUANTITY |
|---|---|---|---|---|
| California Buckeye | *Aesculus Californica* | Treepot 4 (TP4) | 15 | Container plant quantities will be dependent on the location of existing native species and will be determined at the time of construction. |
| Coast Live Oak | *Quercus Agrifolia* | Treepot 4 (TP4) | 12 | |
| Blue Elderberry | *Sambucus Nigra, SSP. Caerulea* | Treepot 4 (TP4) | 10 | |
| Hollyleaf Cherry | *Prunus Ilicifolia* | Deepot 40 (D-40) | 10 | |
| Coyote Brush | *Baccharis Pillularis* | Deepot 40 (D-40) | 8 | |
| Black Sage | *Salvia Mellifera* | Deepot 60 (D-60) | 5 | |
| California Sagebrush | *Artemisia Californica* | Deepot 40 (D-40) | 3 | |

### LEGEND

| | |
|---|---|
| 🟩 | RIPARIAN PLANTING ZONE (CONCRETE CHANNEL) |
| + – – – + STA: 4+00 | DESIGN ALIGNMENT |
| – – – – | CONCRETE LINED CHANNEL |



## CONCRETE-LINED CHANNEL SOUTHERN BANK PLANTING PLAN

SCALE: 1" = 40'

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GROUP

CONCRETE
CHANNEL
REVEGETATION
PLAN

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

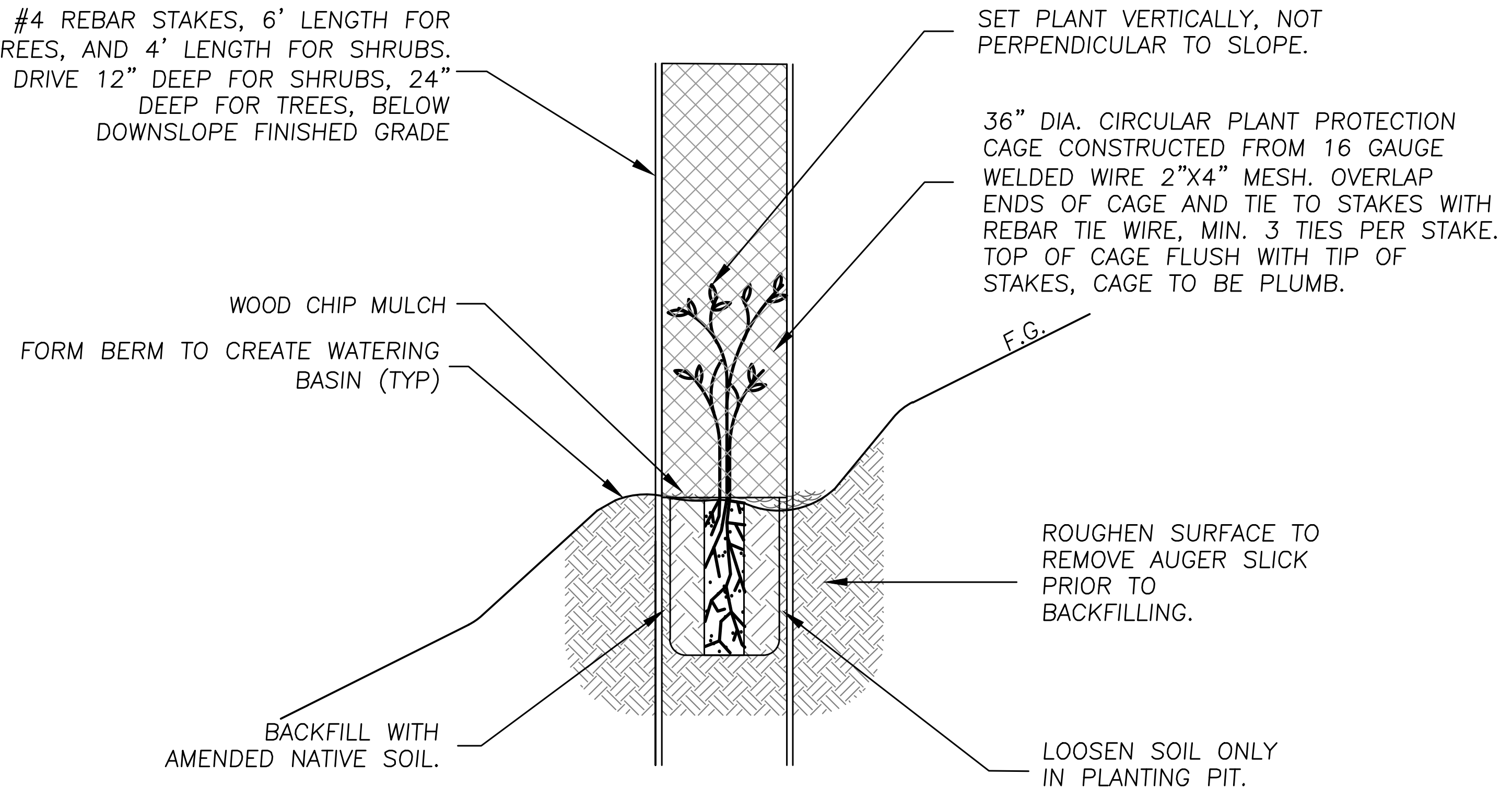
DESIGNED BY: B.M.Z.
DRAWN BY: B.M.Z.
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13-016

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

L1

## TREE AND SHRUB REPLACEMENT NOTES:

TREE AND SHRUB REPLACEMENT RATIONS WILL CONFORM TO THE REPLACEMENT RATIOS INCLUDED IN THE LAKE AND STREAMBED ALTERATION AGREEMENT.



### CONTAINER PLANTING DETAIL

SCALE: N.T.S.

1

## SPECIES TO RECEIVE BROWSE PROTECTION CAGES:

| COMMON NAME | SCIENTIFIC NAME |
|---|---|
| CALIFORNIA BUCKEYE | AESCULUS CALIFORNICA |
| MADRONE | ARBUTUS MENZIESII |
| CALIFORNIA SAGE | ARTEMISIA CALIFORNICA |
| HOLLYLEAF CHERRY | PRUNIS ILICIFOLIA |
| COASTAL LIVE OAK | QUERCUS ARGIFOLIA |
| BLUE ELDERBERRY | SAMBUCUS NIGRA SSP. CAERULA |

NOTE: BROWSE PROTECTION CAGES WILL NOT BE INSTALLED AROUND PLANTINGS IN FLOODPLAIN AREAS DUE TO THE LIKELIHOOD THAT CAGES MAY BE INUNDATED AND DAMAGED BY FLOOD FLOWS.

## IRRIGATION NOTES:

ALL CONTAINER PLANTINGS WILL RECEIVE DRIP IRRIGATION. IRRIGATION DETAILS ARE NOT INCLUDED IN THIS DRAWINGS SET AND WILL BE INCLUDED IN THE NEXT DESIGN SUBMITTAL.

## TABLE 2a. FLOODPLAIN PLANTING SEED MIX

**Floodplain Seeding Area:**

**Channel Widening and Rockpile Area (acres):** 2.53

**Material Removal Area (acres):** 1.44

| COMMON NAME | SCIENTIFIC NAME | PLS LBS / ACRE |
|---|---|---|
| California Brome | *Bromus Carinatus* | 10.0 |
| Blue Wildrye | *Elymus Glaucus* | 8.0 |
| Creeping Wildrye | *Elymus Triticoides* | 6.0 |
| Small Fescue | *Festuca Microstachys* | 8.0 |
| Meadow Barley | *Hordeum Brachyantherum* | 6.0 |
| Blue-Eyed Grass | *Sisyrinchium Bellum* | 1.0 |
| Purple Needlegrass | *Stipa Bellum* | 5.0 |
| Tomcat Clover | *Trifolium Willdenovii* | 5.0 |
| Regreen (sterile wheat grass) | *Triticum aestivum* | 40.0 |
| | **TOTAL** | **89.0** |

*Seed mix to be applied to the Floodplain Planting Zones at all project sites where rock is not used as a surface treatment*

## TABLE 2b. UPLAND AND RIPARIAN PLANTING SEED MIX

**Upland Seeding Area:**

**Channel Widening and Rockpile Area (acres):** 5.57

**Material Removal Area (acres):** 2.18

**Riparian Seeding Area:**

**Channel Widening and Rockpile Area (acres):** 2.43

**Material Removal Area (acres):** 1.25

| COMMON NAME | SCIENTIFIC NAME | PLS LBS / ACRE |
|---|---|---|
| California Sagebrush | *Artemisia Californica* | 0.5 |
| California Brome | *Bromus Carinatus* | 12.0 |
| Blue Wildrye | *Elymus Glaucus* | 10.0 |
| California Poppy | *Eschscolzia Californica* | 2.0 |
| Deerweed | *Lotus Scoparius* | 3.0 |
| Purple Needlegrass | *Nasella Pulchra* | 5.0 |
| Three Weeks Fescue | *Festuca Microstachys* | 6.0 |
| Tomcat clover | *Trifolium willdenovii* | 5.0 |
| Lupine | *Lupinus Nanus* | 4.0 |
| Regreen (sterile wheat grass) | *Triticum aestivum* | 40.0 |
| | **TOTAL** | **87.5** |

*Seed mix to be applied to the Upland Seedings Zones and the Riparian Planting Zones at all project sites.*

## TABLE 3. CHANNEL WIDENING/SEDIMENT REMOVAL AREA - FLOODPLAIN PLANTING (TYPE 1)

**Area (acres):** 1.51

| COMMON NAME | SCIENTIFIC NAME | CONTAINER SIZE | ON-CENTER SPACING (FT) | TOTAL QUANTITY |
|---|---|---|---|---|
| Big Leaf Maple | *Acer Macrophylum* | Treepot 4 (TP4) | 25 | 90 |
| White Alder | *Alnus Rhombifolia* | Treepot 4 (TP4) | 20 | 110 |
| Red/Arroyo Willow (Floodplain) | *Salix Laevigata/lasiolepis* | Live Stake | 15 | 290 |
| Red/Arroyo Willow (Vegetated RSP) | *Salix Laevigata/lasiolepis* | Live Stake | 7 | 60 |
| Red/Arroyo Willow (Sed. Removal Area) | *Salix Laevigata/lasiolepis* | Live Stake | 7 | 90 |
| | | | **Total** | **640** |

*Spacing is approximate. Quantity will govern.

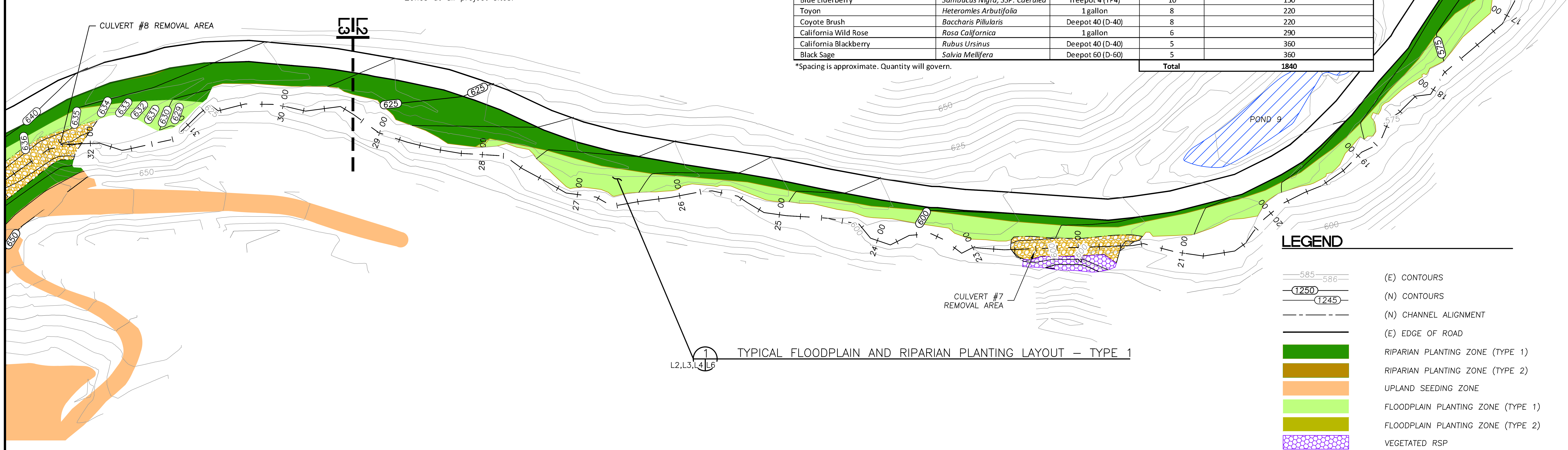
Install Live Willow Stakes at the spacing shown within the vegetated RSP, per Section B, Sheet C11, and Section B, Sheet C18, and within the Engineered Streambed Material at the Sediment Removal Area tributary reach per Detail 1, Sheet C16.

## TABLE 4. CHANNEL WIDENING/SEDIMENT REMOVAL AREA - RIPARIAN PLANTING (TYPE 1)

**Area (acres):** 1.37

| COMMON NAME | SCIENTIFIC NAME | CONTAINER SIZE | ON-CENTER SPACING (FT) | TOTAL QUANTITY |
|---|---|---|---|---|
| California Buckeye | *Aesculus Californica* | Treepot 4 (TP4) | 15 | 110 |
| Coast Live Oak | *Quercus Agrifolia* | Treepot 4 (TP4) | 12 | 130 |
| Blue Elderberry | *Sambucus Nigra, SSP. Caerulea* | Treepot 4 (TP4) | 10 | 150 |
| Toyon | *Heteromles Arbutifolia* | 1 gallon | 8 | 220 |
| Coyote Brush | *Baccharis Pillularis* | Deepot 40 (D-40) | 8 | 220 |
| California Wild Rose | *Rosa Californica* | 1 gallon | 6 | 290 |
| California Blackberry | *Rubus Ursinus* | Deepot 40 (D-40) | 5 | 360 |
| Black Sage | *Salvia Mellifera* | Deepot 60 (D-60) | 5 | 360 |
| | | | **Total** | **1840** |

*Spacing is approximate. Quantity will govern.



## LEGEND

| | |
|---|---|
| 585 586 | (E) CONTOURS |
| 1250 1245 | (N) CONTOURS |
| — - — - — | (N) CHANNEL ALIGNMENT |
| ▬ | (E) EDGE OF ROAD |
| 🟩 | RIPARIAN PLANTING ZONE (TYPE 1) |
| 🟫 | RIPARIAN PLANTING ZONE (TYPE 2) |
| 🟧 | UPLAND SEEDING ZONE |
| 🟩 | FLOODPLAIN PLANTING ZONE (TYPE 1) |
| 🟨 | FLOODPLAIN PLANTING ZONE (TYPE 2) |
| ▨ | VEGETATED RSP |
| ▨ | ENGINEERED STREAM MATERIAL (ESM) |

### CHANNEL WIDENING REVEGETATION PLAN

SCALE: 1" = 50'

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NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

CHANNEL
WIDENING
REVEGETATION
PLAN (1 OF 2)

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

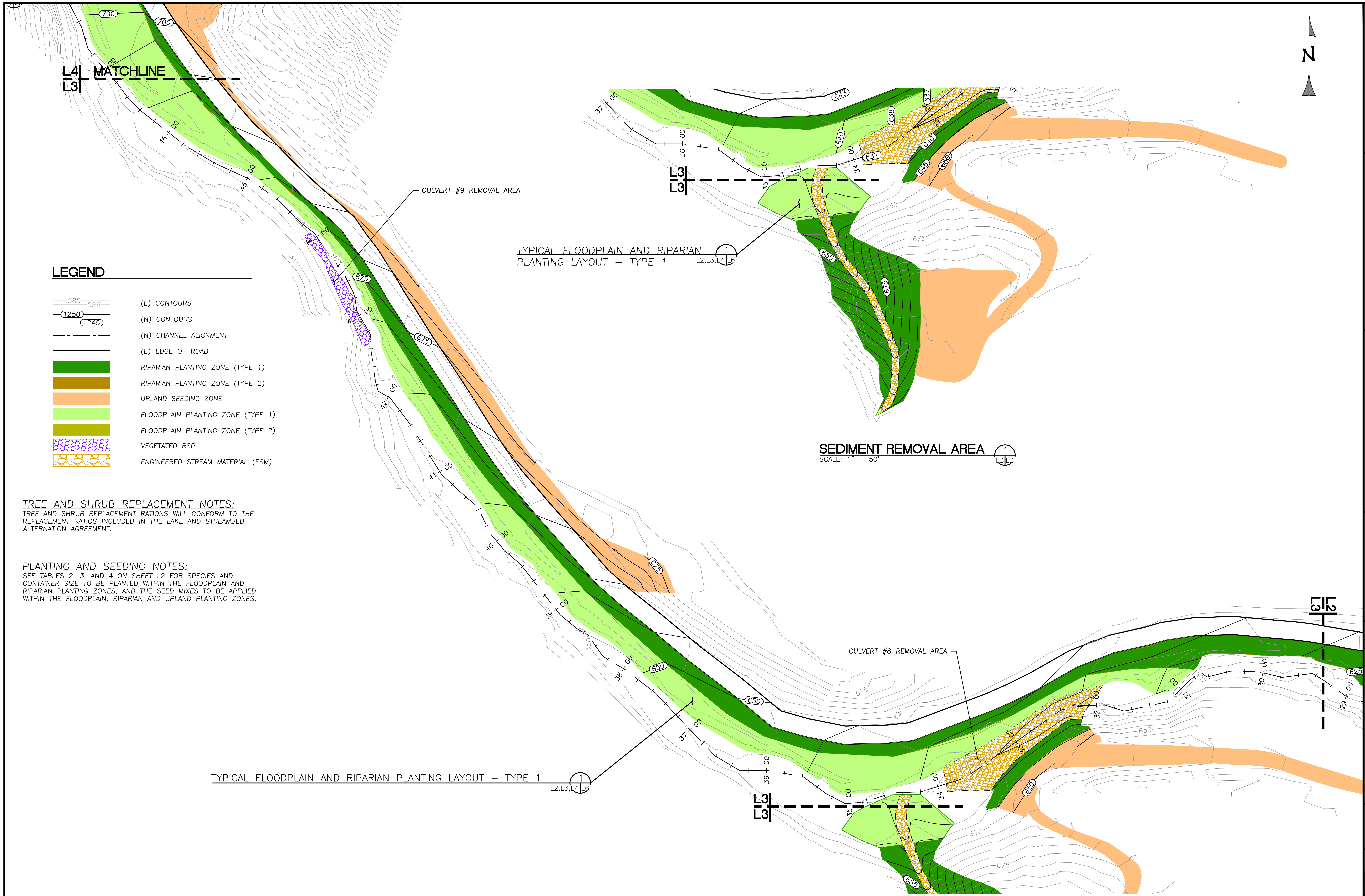
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | C.B.H. |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

L2

43
OF
47



## SEDIMENT REMOVAL AREA

SCALE: 1" = 50'

1 L3 L3

## CHANNEL WIDENING REVEGATION PLAN

SCALE: 1" = 50'

## LEGEND

| | |
|---|---|
| 585 586 | (E) CONTOURS |
| 1250 1245 | (N) CONTOURS |
| — · — · — | (N) CHANNEL ALIGNMENT |
| ——— | (E) EDGE OF ROAD |
| 🟩 | RIPARIAN PLANTING ZONE (TYPE 1) |
| 🟫 | RIPARIAN PLANTING ZONE (TYPE 2) |
| 🟧 | UPLAND SEEDING ZONE |
| 🟩 | FLOODPLAIN PLANTING ZONE (TYPE 1) |
| 🟨 | FLOODPLAIN PLANTING ZONE (TYPE 2) |
| ▨ | VEGETATED RSP |
| ▨ | ENGINEERED STREAM MATERIAL (ESM) |

### TREE AND SHRUB REPLACEMENT NOTES:

TREE AND SHRUB REPLACEMENT RATIONS WILL CONFORM TO THE REPLACEMENT RATIOS INCLUDED IN THE LAKE AND STREAMBED ALTERNATION AGREEMENT.

### PLANTING AND SEEDING NOTES:

SEE TABLES 2, 3, AND 4 ON SHEET L2 FOR SPECIES AND CONTAINER SIZE TO BE PLANTED WITHIN THE FLOODPLAIN AND RIPARIAN PLANTING ZONES, AND THE SEED MIXES TO BE APPLIED WITHIN THE FLOODPLAIN, RIPARIAN AND UPLAND PLANTING ZONES.

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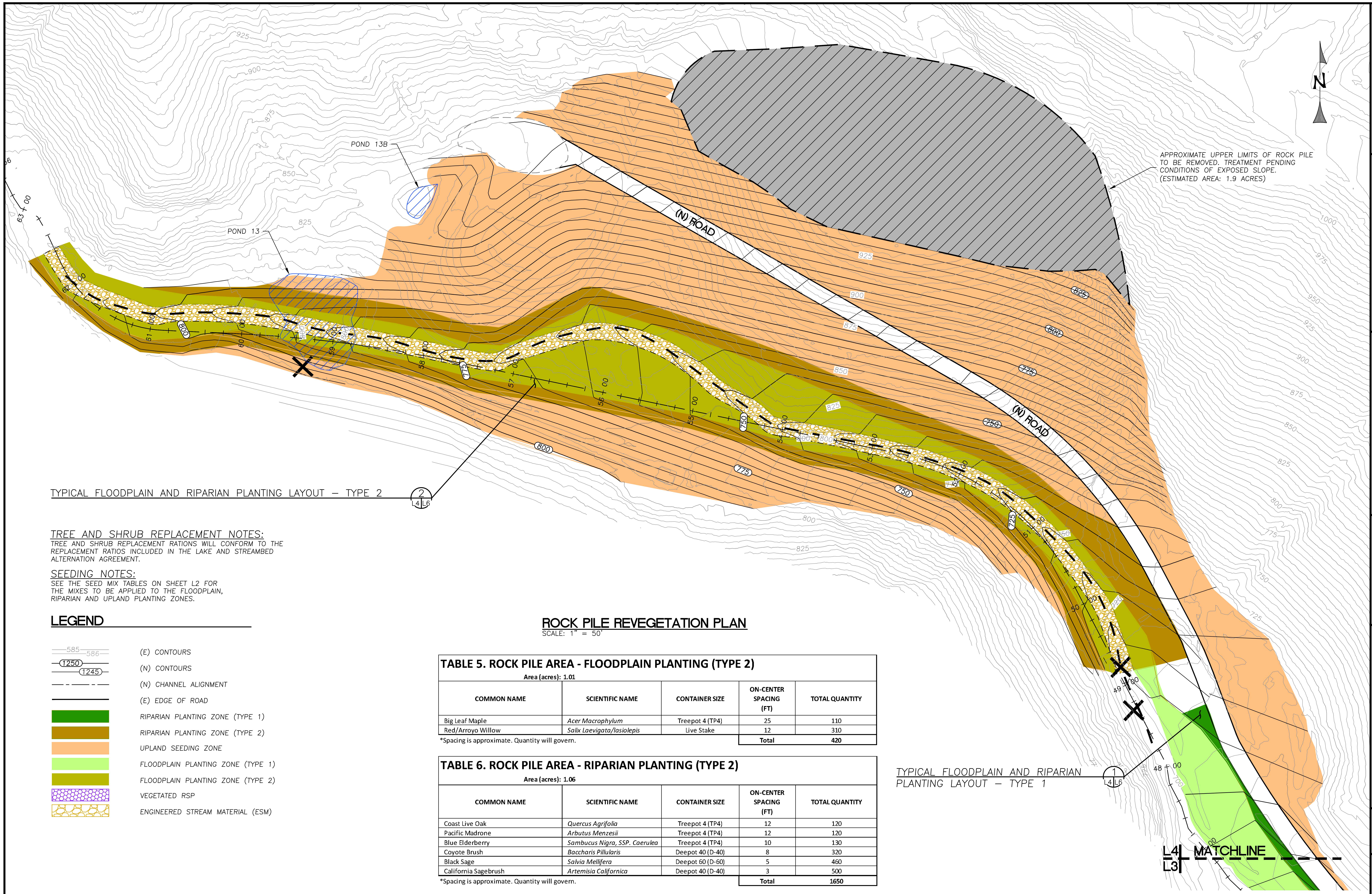
CHANNEL
WIDENING
REVEGETATION
PLAN (2 OF 2)

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | – |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

L3



TYPICAL FLOODPLAIN AND RIPARIAN PLANTING LAYOUT – TYPE 2 (2 / L6)

TYPICAL FLOODPLAIN AND RIPARIAN PLANTING LAYOUT – TYPE 1 (1 / L6)

## TREE AND SHRUB REPLACEMENT NOTES:

TREE AND SHRUB REPLACEMENT RATIONS WILL CONFORM TO THE REPLACEMENT RATIOS INCLUDED IN THE LAKE AND STREAMBED ALTERNATION AGREEMENT.

## SEEDING NOTES:

SEE THE SEED MIX TABLES ON SHEET L2 FOR THE MIXES TO BE APPLIED TO THE FLOODPLAIN, RIPARIAN AND UPLAND PLANTING ZONES.

## LEGEND

| | |
|---|---|
| 585 586 | (E) CONTOURS |
| 1250 1245 | (N) CONTOURS |
| — · — · — | (N) CHANNEL ALIGNMENT |
| —— | (E) EDGE OF ROAD |
| 🟩 | RIPARIAN PLANTING ZONE (TYPE 1) |
| 🟫 | RIPARIAN PLANTING ZONE (TYPE 2) |
| 🟧 | UPLAND SEEDING ZONE |
| 🟩 | FLOODPLAIN PLANTING ZONE (TYPE 1) |
| 🟨 | FLOODPLAIN PLANTING ZONE (TYPE 2) |
| 🟪 | VEGETATED RSP |
| 🟨 | ENGINEERED STREAM MATERIAL (ESM) |

## ROCK PILE REVEGETATION PLAN

SCALE: 1" = 50'

### TABLE 5. ROCK PILE AREA - FLOODPLAIN PLANTING (TYPE 2)

**Area (acres): 1.01**

| COMMON NAME | SCIENTIFIC NAME | CONTAINER SIZE | ON-CENTER SPACING (FT) | TOTAL QUANTITY |
|---|---|---|---|---|
| Big Leaf Maple | *Acer Macrophylum* | Treepot 4 (TP4) | 25 | 110 |
| Red/Arroyo Willow | *Salix Laevigata/lasiolepis* | Live Stake | 12 | 310 |
| | | | **Total** | **420** |

*Spacing is approximate. Quantity will govern.

### TABLE 6. ROCK PILE AREA - RIPARIAN PLANTING (TYPE 2)

**Area (acres): 1.06**

| COMMON NAME | SCIENTIFIC NAME | CONTAINER SIZE | ON-CENTER SPACING (FT) | TOTAL QUANTITY |
|---|---|---|---|---|
| Coast Live Oak | *Quercus Agrifolia* | Treepot 4 (TP4) | 12 | 120 |
| Pacific Madrone | *Arbutus Menzesii* | Treepot 4 (TP4) | 12 | 120 |
| Blue Elderberry | *Sambucus Nigra, SSP. Caerulea* | Treepot 4 (TP4) | 10 | 130 |
| Coyote Brush | *Baccharis Pillularis* | Deepot 40 (D-40) | 8 | 320 |
| Black Sage | *Salvia Mellifera* | Deepot 60 (D-60) | 5 | 460 |
| California Sagebrush | *Artemisia Californica* | Deepot 40 (D-40) | 3 | 500 |
| | | | **Total** | **1650** |

*Spacing is approximate. Quantity will govern.

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HEIDELBERG CEMENT
GROUP

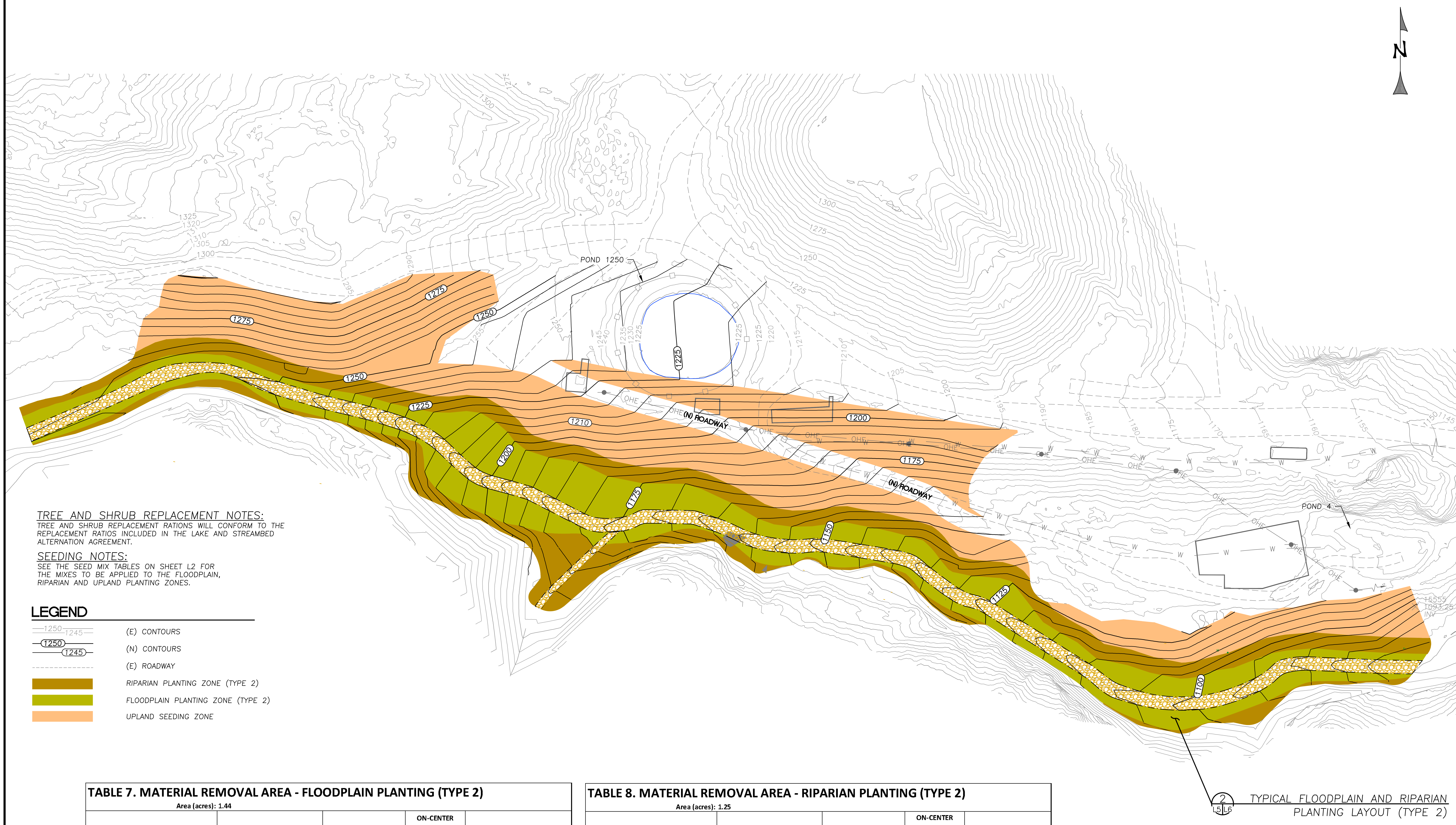
ROCKPILE AREA
REVEGEATION
PLAN

PERMANENTE CREEK
RESTORATION PLAN
UPDATED 90% DESIGN
SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | – |
| DRAWN BY: | – |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13–016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

L4



TYPICAL FLOODPLAIN AND RIPARIAN PLANTING LAYOUT (TYPE 2)

## TREE AND SHRUB REPLACEMENT NOTES:

TREE AND SHRUB REPLACEMENT RATIONS WILL CONFORM TO THE REPLACEMENT RATIOS INCLUDED IN THE LAKE AND STREAMBED ALTERNATION AGREEMENT.

## SEEDING NOTES:

SEE THE SEED MIX TABLES ON SHEET L2 FOR THE MIXES TO BE APPLIED TO THE FLOODPLAIN, RIPARIAN AND UPLAND PLANTING ZONES.

## LEGEND

| | |
|---|---|
| 1250 1245 | (E) CONTOURS |
| 1250 1245 | (N) CONTOURS |
| - - - - | (E) ROADWAY |
| 🟫 | RIPARIAN PLANTING ZONE (TYPE 2) |
| 🟩 | FLOODPLAIN PLANTING ZONE (TYPE 2) |
| 🟧 | UPLAND SEEDING ZONE |

### TABLE 7. MATERIAL REMOVAL AREA - FLOODPLAIN PLANTING (TYPE 2)

**Area (acres): 1.44**

| COMMON NAME | SCIENTIFIC NAME | CONTAINER SIZE | ON-CENTER SPACING (FT) | TOTAL QUANTITY |
|---|---|---|---|---|
| Big Leaf Maple | *Acer Macrophylum* | Treepot 4 (TP4) | 25 | 150 |
| Red/Arroyo Willow | *Salix Laevigata/lasiolepis* | Live Stake | 12 | 440 |
| Red/Arroyo Willow (Tributary) | *Salix Laevigata/lasiolepis* | Live Stake | 7 | 40 |
| | | | **Total** | **590** |

*Spacing is approximate. Quantity will govern.

### TABLE 8. MATERIAL REMOVAL AREA - RIPARIAN PLANTING (TYPE 2)

**Area (acres): 1.25**

| COMMON NAME | SCIENTIFIC NAME | CONTAINER SIZE | ON-CENTER SPACING (FT) | TOTAL QUANTITY |
|---|---|---|---|---|
| Coast Live Oak | *Quercus Agrifolia* | Treepot 4 (TP4) | 12 | 140 |
| Pacific Madrone | *Arbutus Menzesii* | Treepot 4 (TP4) | 12 | 140 |
| Blue Elderberry | *Sambucus Nigra, SSP. Caerulea* | Treepot 4 (TP4) | 10 | 150 |
| Coyote Brush | *Baccharis Pillularis* | Deepot 40 (D-40) | 8 | 380 |
| Black Sage | *Salvia Mellifera* | Deepot 60 (D-60) | 5 | 540 |
| California Sagebrush | *Artemisia Californica* | Deepot 40 (D-40) | 3 | 590 |
| | | | **Total** | **1940** |

*Spacing is approximate. Quantity will govern.

## MATERIAL REMOVAL AREA REVEGETATION PLAN

SCALE: 1" = 60'

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HEIDELBERG CEMENT
GROUP

MATERIAL
REMOVAL AREA
REVEGETATION
PLAN

PERMANENTE CREEK
RESTORATION PLAN

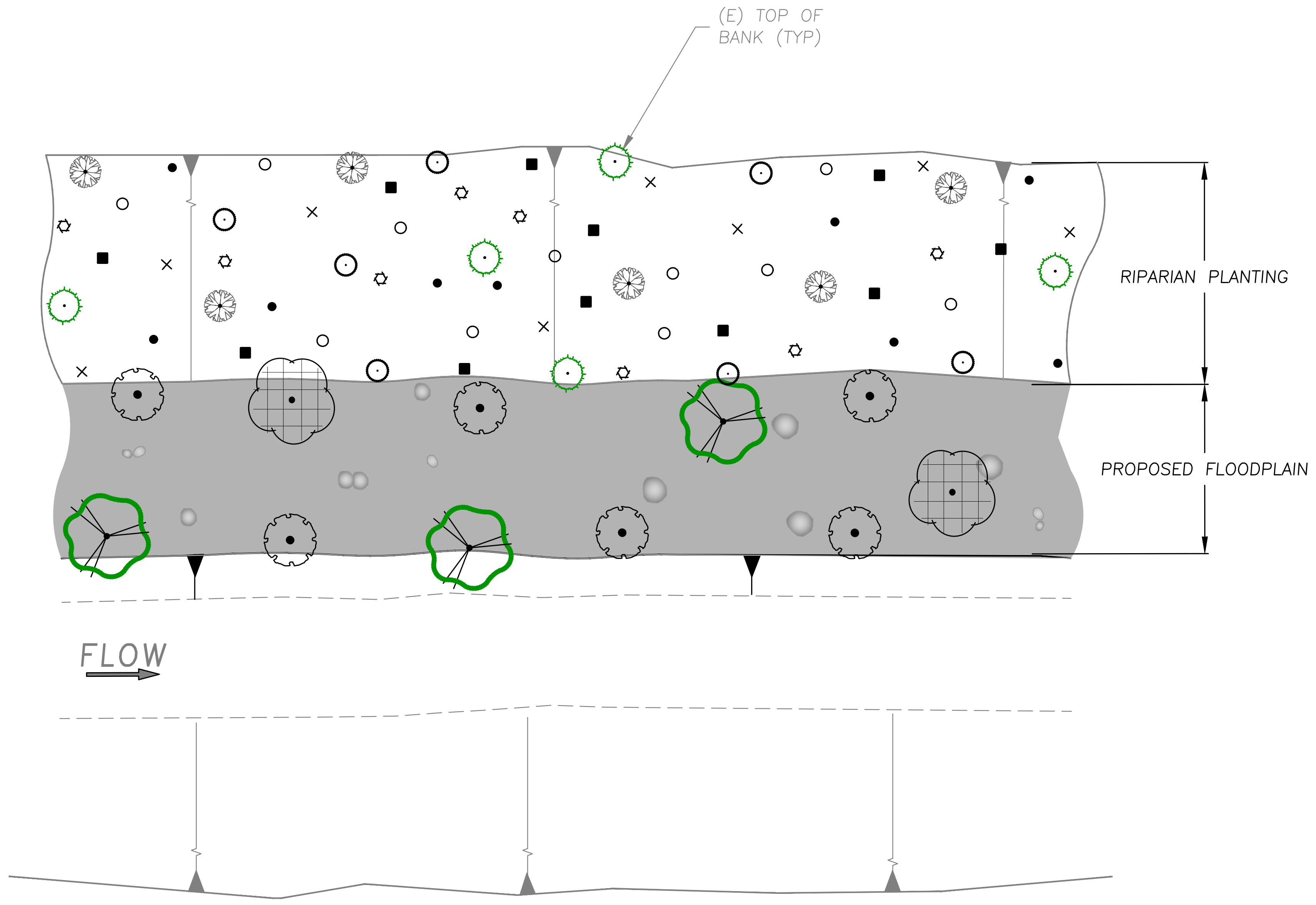
UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

DESIGNED BY: –
DRAWN BY: –
CHECKED BY: M.W.W.
DATE: 8/26/22
JOB NO.: 13–016

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

L5

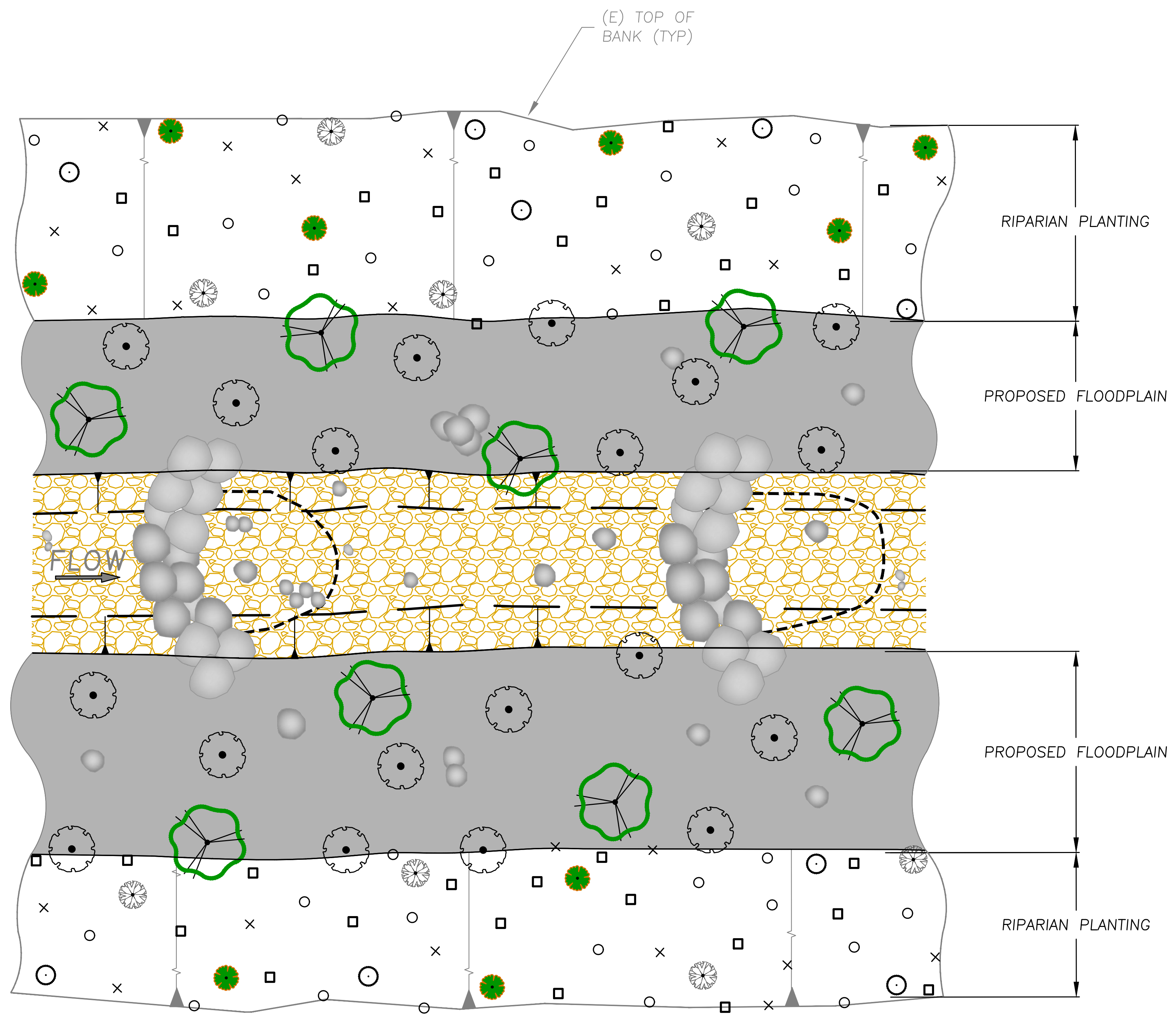


## TYPICAL FLOODPLAIN AND RIPARIAN PLANTING LAYOUT - TYPE 1

SCALE: 1" = 10'

(CHANNEL WIDENING AREA)

1
L2,L3,L4,L6



## TYPICAL FLOODPLAIN AND RIPARIAN PLANTING LAYOUT - TYPE 2

SCALE: 1" = 10'

(ROCK PILE AND MATERIAL REMOVAL AREAS)

2
L4,L5,L6

## PLANTING LEGEND - TYPE 1

FLOODPLAIN PLANTING

| | BOTANICAL / COMMON NAME |
|---|---|
| ✿ | ACER MACROPHYLLUM/BIG LEAF MAPLE |
| ▦ | ALNUS RHOMBIFOLIA/WHITE ALDER |
| ⊙ | SALIX LAEVIGATA/RED WILLOW |

RIPARIAN PLANTING

| | |
|---|---|
| ⊙ | AESCULUS CALIFORNICA/CALIFORNIA BUCKEYE |
| ❂ | QUERCUS AGRIFOLIA/COAST LIVE OAK |
| ◯ | SAMBUCUS NIGRA, SSP. CAERULEA/BLUE ELDERBERRY |
| ✿ | HETEROMLES ARBUTIFOLIA/TOYON |
| × | BACCHARIS PILLULARIS/COYOTE BRUSH |
| ● | ROSA CALIFORNICA/CALIFORNIA WILD ROSE |
| ■ | RUBUS URSINUS/CALIFORNIA BLACKBERRY |
| ○ | SALVIA MELLIFERA/BLACK SAGE |

## PLANTING LEGEND - TYPE 2

FLOODPLAIN PLANTING

| | BOTANICAL / COMMON NAME |
|---|---|
| ✿ | ACER MACROPHYLLUM/BIG LEAF MAPLE |
| ⊙ | SALIX LAEVIGATA/RED WILLOW |

RIPARIAN PLANTING

| | |
|---|---|
| ❂ | QUERCUS AGRIFOLIA/COAST LIVE OAK |
| ● | ARBUTUS MENZESII/PACIFIC MADRONE |
| ◯ | SAMBUCUS NIGRA, SSP. CAERULEA/BLUE ELDERBERRY |
| × | BACCHARIS PILLULARIS/COYOTE BRUSH |
| ○ | SALVIA MELLIFERA/BLACK SAGE |
| □ | ARTEMESIA CALIFORNICA/CALIFORNIA SAGEBRUSH |

*NOTE:*
SEE SHEETS L2 TO L5 FOR THE LOCATION OF PLANTING ZONES AND PLANTING/SEEDING TABLES WITH ON CENTER SPACING, CONTAINER SIZE AND THE NUMBER OF EACH SPECIES TO BE INSTALLED.

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PREPARED AT THE REQUEST OF:
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GROUP

TYPICAL
PLANTING
LAYOUTS

PERMANENTE CREEK
RESTORATION PLAN

UPDATED 90% DESIGN

SANTA CLARA COUNTY
CEQA REVIEW SUBMITTAL

| | |
|---|---|
| DESIGNED BY: | - |
| DRAWN BY: | - |
| CHECKED BY: | M.W.W. |
| DATE: | 8/26/22 |
| JOB NO.: | 13-016 |

BAR IS ONE INCH ON
ORIGINAL DRAWING,
ADJUST SCALES FOR
REDUCED PLOTS
0 1"

L6

WATERWAYS
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# APPENDIX A

## Fish Passage Design Flow Calculations

WATERWAYS
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Project: Permanente Quarry
Project #: 13-016
Date: 8/29/2017
Calculated by: M.L.B/B.R.S.
Checked by: B.M.Z.

## Exceedence Probability Values for Mean Daily Flows at USGS Gages Near Cupertino

| Percent Exceedence | Annual Exceedance Discharge (cfs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gage #11166575 | | Gage #11166578 | | Gage #11169500 | | Gage #11164500 | | Gage #11166000 | |
| | Permanente Creek | | West Fork Permanente Creek | | Saratoga Creek | | San Francisquito Creek | | Matadero Creek | |
| | Real Flows (cfs) | Normalized Flows (cfs/sq.mi.) | Real Flows (cfs) | Normalized Flows (cfs/sq.mi.) | Real Flows (cfs) | Normalized Flows (cfs/sq.mi.) | Real Flows (cfs) | Normalized Flows (cfs/sq.mi.) | Real Flows (cfs) | Normalized Flows (cfs/sq.mi.) |
| **95** | 0.00 | 0.00 | 0.00 | 0.00 | 0.36 | 0.04 | 0.15 | 0.00 | 0.00 | 0.00 |
| **90** | 0.00 | 0.00 | 0.00 | 0.00 | 0.49 | 0.05 | 0.29 | 0.01 | 0.00 | 0.00 |
| **10** | 4.00 | 1.04 | 0.82 | 0.27 | 18.00 | 1.95 | 45.00 | 1.20 | 3.50 | 0.48 |
| **5** | 7.30 | 1.89 | 3.49 | 1.17 | 38.80 | 4.21 | 112.75 | 3.01 | 9.90 | 1.36 |

| | Gage #11166575 | Gage #11166578 | Gage #11169500 | Gage #11164500 | Gage #11164500 |
|---|---|---|---|---|---|
| **Drainage Area (sq.mi.)** | 3.86 | 2.98 | 9.22 | 37.4 | 7.26 |

| Site Name | Location | | Drainage Area (mi$^2$) | Record Length (yrs) | Normalized Exceedance Flows | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 95% (cfs/mi$^2$) | 90% (cfs/mi$^2$) | 10% (cfs/mi$^2$) | 5% (cfs/mi$^2$) |
| PERMANENTE C NR MONTE VISTA CA - 11166575 | 37°20'00" | 122°05'13" | 3.86 | 3 | 0.00 | 0.00 | 1.04 | 1.89 |
| WF PERMANENTE C NR MONTE VISTA CA - 11166578 | 37°19'59" | 122°05'58" | 2.98 | 3 | 0.00 | 0.00 | 0.27 | 1.17 |
| SARATOGA C A SARATOGA CA - 11169500 [1] | 37°15'16" | 122°02'18" | 9.22 | 20 | 0.04 | 0.05 | 1.95 | 4.21 |
| SAN FRANCISQUITO C A STANFORD UNIVERSITY CA - 11164500 [2] | 37°25'24" | 122°11'18" | 37.4 | 20 | 0.00 | 0.01 | 1.20 | 3.01 |
| MATADERO CREEK A PALO ALTO CA 11166000 [3] | 37°25'18" | 122°08'04" | 7.26 | 65 | 0.00 | 0.00 | 0.48 | 1.36 |
| | | | | Average = | 0.01 | 0.01 | 0.99 | 2.33 |

[1] Water is diverted 0.7 miles upstream of gage for municipal use by San Jose Water Works

[2] Flow Slightly regulated by Searsville Lake. Diversions upstream from gage to Los Trancos and Lagunita Canal for irrigation on Stanford Universit

[3] No know regulation or diversion upstream of site

Note: Use the Matadero Creek gage to calculate fish passage design flows because it has an extensive period of record (65 years) and is unregulated. The CDFW, California Salmonid Stream Habitat Restoration Manual requires a gage to have at least 5 years of recorded daily average flows, and preferably more than 10 years for use in calulcating fish passage design flows.

| Legend - Fish Passage Design Flows | |
|---|---|
| Juvenile Salmonid Fish Passage - Low | 🟧 |
| Adult Non-Anadromous Salmonid Fish Passage - Low | 🟨 |
| Juvenile Salmonid Fish Passage - High | 🟩 |
| Adult Non-Anadramous Salmonid Fish Passage - High | 🟦 |

| Permanente Quarry Watershed Fish Passage Design Flows | | | | |
|---|---|---|---|---|
| Drainage Area (mi$^2$) = | | 3.50 | | |
| Juvenile Low | Adult Non-Anadramous Low | Juvenile High | Adult Non-Adadromous High | |
| 95% (cfs) | 90% (cfs) | 10% (cfs) | 5% (cfs) | |
| 0.00 | 0.00 | 1.69 | 4.77 | Using Matadero Creek Gage |
| 0.00 | 0.00 | 2.09 | 5.16 | Average of 3 unregulated gages |
| 0.03 | 0.04 | 3.46 | 8.15 | Average of all 5 gages |

Location: Pond 14 Bypass Channel through the Concrete Channel

| Permanente Quarry Watershed Fish Passage Design Flows | | | |
|---|---|---|---|
| Drainage Area (mi$^2$) = | | 3.01 | |
| Juvenile Low | Adult Non-Anadromous Low | Juvenile High | Adult Non-Anadromous High |
| 95% (cfs) | 90% (cfs) | 10% (cfs) | 5% (cfs) |
| 0.00 | 0.00 | 1.45 | 4.10 |

Location: Culverts #2 - #7

| Permanente Quarry Watershed Fish Passage Design Flows | | | |
|---|---|---|---|
| Drainage Area (mi$^2$) = | | 2.70 | |
| Juvenile Low | Adult Non-Anadromous Low | Juvenile High | Adult Non-Anadromous High |
| 95% (cfs) | 90% (cfs) | 10% (cfs) | 5% (cfs) |
| 0.00 | 0.00 | 1.30 | 3.68 |

Location: Culvert #8 - Pond 13

| Permanente Quarry Watershed Fish Passage Design Flows | | | |
|---|---|---|---|
| Drainage Area (mi$^2$) = | | 2.02 | |
| Juvenile Low | Adult Non-Anadromous Low | Juvenile High | Adult Non-Anadromous High |
| 95% (cfs) | 90% (cfs) | 10% (cfs) | 5% (cfs) |
| 0.00 | 0.00 | 0.97 | 2.75 |

Location: Materials Removal Area

# APPENDIX B

## Permanente Creek Restoration – Regional Hydraulic Geometry and Analog Channel Assessment Technical Memorandum

WATERWAYS CONSULTING, INC.
Ecological Restoration Design ~ Civil Engineering ~ Natural Resource Management

# TECHNICAL MEMORANDUM - REVISED for 90% DESIGN

| | |
|---|---|
| *Prepared by:* | Waterways Consulting, Inc. |
| *Date:* | October 30, 2018 |
| *Re:* | Permanente Creek Restoration – Regional Hydraulic Geometry and Analogue Channel Assessment |

## Introduction

Waterways Consulting, Inc. (Waterways) is developing engineering drawings to restore portions of Permanente Creek that flow through the Permanente Quarry (Quarry) property and have been impacted by past mining activities. The proposed approach at two locations (the Rock Pile Area and Material Removal Area[1]) focuses on restoring the channel form to an approximation of the pre-mining channel geometry and providing suitable aquatic habitat for local species, including resident rainbow trout. The Quarry is situated on lands owned by Lehigh Hanson Heidelberg Cement Group on the east side of the Santa Cruz Mountains to the west of Cupertino. Quarry operations over the past century have resulted in significant channelization, the installation of numerous culverts and sedimentation basins, and considerable sediment inputs to Permanente Creek. The altered channel form and high sediment loads resulted in the degradation of the instream aquatic habitat.

The proposed restoration will remove overburden sediment and several culverts, rebuild the affected channel reaches, and restore impacted riparian and aquatic habitats. Restoring Permanente Creek at the Rock Pile and Material Removal Areas requires a complete reconstruction of the streambed. Consequently, there is a need to estimate the appropriate channel morphology to support the restoration design, including active channel widths, depths and pool geometries and spacing.

Regional curves, relating channel dimensions to drainage area, exist for the San Francisco Bay region (Dunne and Leopold 1978) (Figure 1). However, these curves are regional in nature, incorporating data from a range of landscape settings and channel morphologies. For example, channel geometries of the low gradient bottomlands of the Santa Clara Valley will vary from bedrock-controlled streams in the Santa Cruz Mountains that are higher gradient and more influenced by hillslope processes. Given that much of the proposed restoration activities are in higher gradient, confined reaches of Permanente Creek, the appropriateness of the regional curves can be improved by focusing the data on sites with a similar geomorphic setting. Focusing the dataset on sites in the Santa Cruz Mountains could greatly improve the use of the hydraulic geometry curves to constrain expected channel morphologies in the impacted reaches of Permanente Creek. Furthermore, field-based measurements of channel geometry within less impacted reaches of Permanente Creek and in adjacent watersheds that exhibit similar characteristics to Permanente Creek could both provide a test for and improve the quality of the developed relationships.

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[1] Although the analogue study was developed to support design efforts for the Rockpile and Material Removal Areas of the Permanente Restoration Project, the results are applicable to other locations within the project area including Culverts #7 and #8 within the Channel Widening Area.

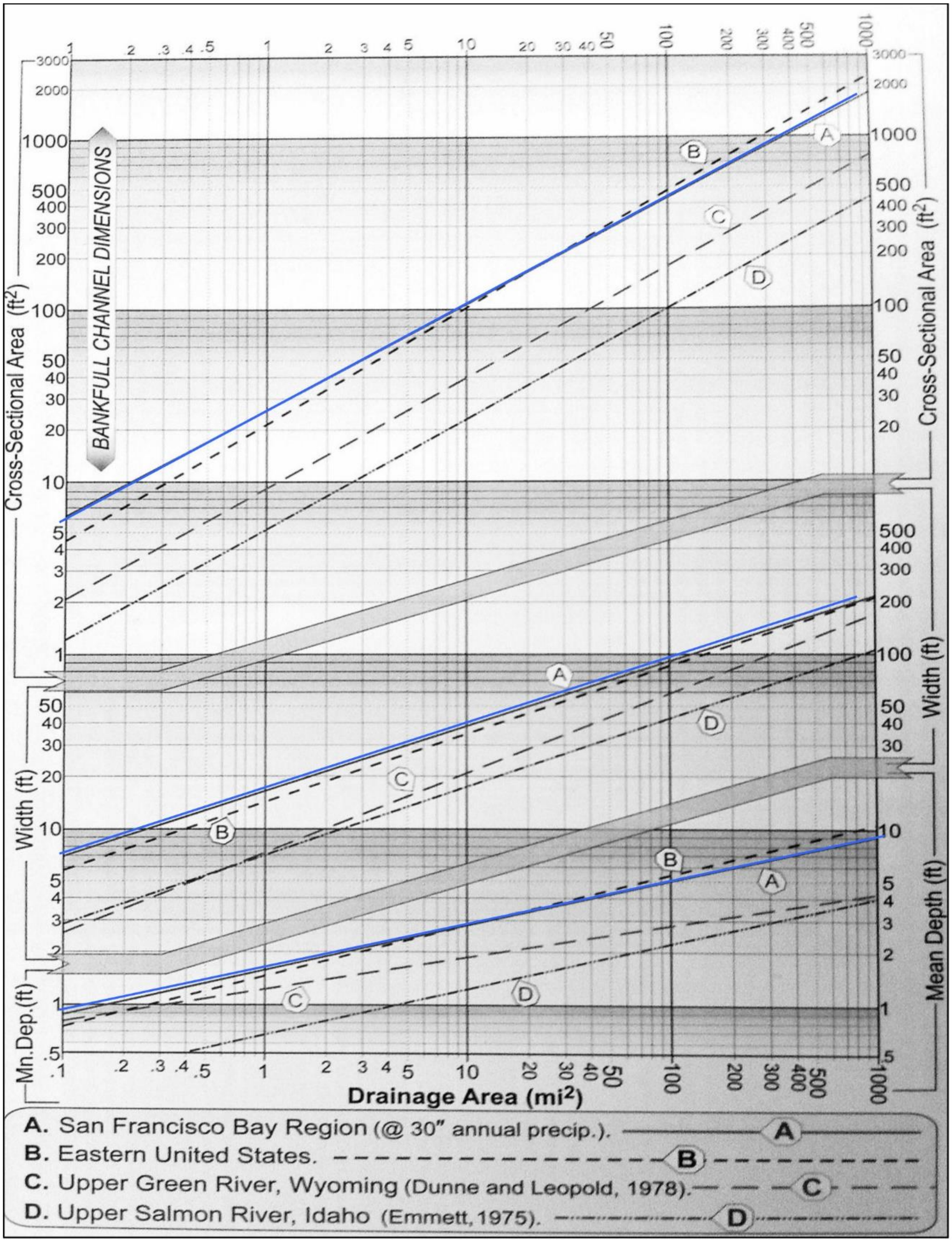

**Figure 1. Regional hydraulic geometry curves produced by Dunne and Leopold (1978) relating drainage area to bankfull depth, width and cross-sectional area. The blue lines highlight the regional curves for the San Francisco Bay Area.**

To create more site-specific curves, Waterways compiled data for the Santa Cruz Mountain sites that were included in the Dunne and Leopold (1978) curves for the San Francisco Bay region, surveyed two analogue stream channels close to the project area that were previously identified as having similar watershed and geomorphic characteristics as Permanente Creek (URS 2011)[2], and surveyed two segments of Reach 20 on Permanente Creek in what was considered a less impacted reach. These data were used to define reach-specific channel dimensions for the restoration effort. In addition, a longitudinal profile surveyed along portions of Permanente Creek where the channel morphology was determined to be more representative of natural conditions, was used to identify an appropriate size and spacing for pools to support the engineering design. This memorandum summarizes the findings of this work.

## Study Area

### *Santa Cruz Mountains*

The Santa Cruz Mountains have a complex geologic history, resulting in areas dominated by sandstone, limestone, igneous rocks (e.g., basalt), or metamorphic rocks (e.g., serpentine). The variable geologies result in different rates of erosion and the presence of different types of channel-forming sediment among streams that can be spatially close to each other. For example, Permanente Creek has abundant limestone that forms calcium carbonate precipitates that can bind rocks along the channel bed and banks. On the other hand, Stevens Creek is approximately one and one-half miles southeast of Permanente Creek and does not have limestone, and thus does not exhibit calcium carbonate precipitates.

Santa Cruz Mountain streams tend to be small headwater channels at the higher elevations and larger, alluvial streams at the lower elevations. The higher and mid-elevation streams generally flow through narrow valleys with steep hillslopes that restrict lateral channel movement. The steep hillslopes are susceptible to landslides and debris flows, especially following wildfire events. Entire reaches can be transformed during a debris flow and associated mudflow event. Debris flows can result in mobilization and deposition of sediment and debris across an entire valley bottom, leaving an aggraded valley consisting of an unsorted mix of materials. Subsequent high flows following a debris flow event reworks the aggraded material, with the active channel incising into the relatively uniform post-debris flow floodplain surface. Large roughness elements, including boulders and logs, become exposed as the channel incises into the debris flow surface, influencing the planform of the channel and providing local grade control for both the channel and floodplain. In higher gradient reaches, pools and riffles form in response to randomly spaced roughness elements. Along Permanente creek, debris flows prior to mining operations likely provided large wood and boulders that were incorporated into steep step-pool reaches and lower gradient riffle-pool reaches.

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[2] The URS Plan was prepared to comply with the July 27, 1999 Cleanup and Abatement Order – 99-018 issued by the San Francisco Bay Regional Water Quality Control Board by preparation of a report that documented a field reconnaissance of Permanente Creek throughout the quarry facility identifying areas requiring stabilization, prioritizing stabilization activities at candidate sites, and preparing an implementation schedule.

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Map identifying the location of the surveyed reference reaches for Permanente Creek.

FIGURE

2

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WWW.WATWAYS.COM

## Field Sites

Waterways reviewed the URS Plan and studied published literature on the Santa Cruz Mountains to determine suitable reference reaches for Permanente Creek. We determined that a reach along Swiss Creek and a reach along Corte Madera Creek were the most appropriate reference reaches for Permanente Creek (Figure 2 and Table 1). The URS Plan described Corte Madera Creek and Swiss Creek as similar in drainage area, slope, and valley shape to Permanente Creek. Both creeks are in the Santa Cruz Mountains, relatively close to Cupertino, with precipitation regimes similar to the Permanente Creek watershed. Corte Madera Creek flows west and Swiss Creek flows east through confined, steep stream valleys, constrained on both sides by steep hillslopes prone to mass wasting and debris flow events. Both reference reaches are bedrock-controlled with a step-pool channel pattern formed by large boulders and other recently delivered colluvial deposits. Swiss Creek exhibited calcium carbonate precipitates within the active channel, similar to the calcium carbonate formations identified in Permanente Creek. In addition to the reference reaches in adjacent watersheds, a less impacted reach (Reach 20) within Permanente Creek was chosen to further support development of regional hydraulic geometries in support of the engineering design effort.

**Table 1. Basin Characteristics for the Field Sites and Permanente Creek.**

| | Swiss Creek | Corte Madera Creek | Permanente Creek |
|---|---|---|---|
| **Average annual precipitation (in)** | 33.8 | 38.6 | 34.2 |
| **Mean basin elevation (ft)** | 1,842 | 1,917 | 1,957 |
| **Dominant geology** | limestone, sandstone | sandstone, shale | limestone, sandstone |
| **Dominant hillslope process** | landslide/debris flow | landslide/debris flow | landslide/debris flow |
| **Average channel slope (%)** | 10.72 | 8.39 | 3.4 - 13.85 |
| **Drainage area (sq. miles)** | 0.8 | 1.4 | 2.7 |

## Analysis Approach

To develop the regional hydraulic geometry relationships, information from the USGS streamflow gage database was compiled for streams in the Santa Cruz Mountains. The focus of this data mining effort was the 1.5-year[3] recurrence discharge because it approximates the channel forming, or bankfull, discharge (Dunne and Leopold, 1978). To evaluate the performance of the curve and provide data for smaller watersheds, which was missing from the USGS dataset, we collected field data from the two adjacent watersheds and within Reach 20 of Permanente Creek with a specific focus on measuring channel geometries at bankfull indicators that were identified in the field.

### Hydraulic Geometry using existing USGS gage data

Waterways identified 33 USGS stream gages in the Santa Cruz Mountains, but only 14 of the 33 had sufficient peak flow records to be used in the hydraulic geometry analysis (Table 2). Ideally the gage sites would be limited to the eastern Santa Cruz Mountains near Cupertino and Santa Clara. However, since there are a limited number of gages with sufficient data, the 14 gages Waterways assessed are

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[3] Previous iterations of this study focused efforts on the 2-year event. Results of that effort identified disparities between the gage-based analysis and the field-based analysis with the field-based analysis consistently under predicted bankfull widths and depths. This suggested that field-based bankfull indicators occurred at a discharge approximating the 1.5-year event rather than the 2-year event. These results, combined with comments from the reviewers prompted us to redo the analysis with a focus on the 1.5-year event rather than the 2-year event.

**Table 2. USGS gage sites used to develop regional hydraulic geometry curves.**

| Site Name | Location | Period of Record | Drainage Area (sq. miles) | 1.5-Year Flood Discharge (Bankfull) (cfs) | Estimated Bankfull Width (feet) | Estimated Bankfull Cross Sectional Area (sq. feet) | Estimated Bankfull Depth (feet) |
|---|---|---|---|---|---|---|---|
| **Llagas Cr above Chesbro Reservoir** | 37.1483, -121.7672 | 1971-1982, 2004-2010 | 9.6 | 390 | 25.0 | 132.5 | 5.3 |
| **Aptos Creek near Aptos** | 37.0020, -121.9050 | 1972-1983 | 10.2 | 185 | 29.3 | 68.7 | 2.3 |
| **San Lorenzo River near Boulder Creek** | 37.2067, -122.1439 | 1969-1992, 1997 | 6.2 | 105 | 24.7 | 32.9 | 1.3 |
| **Bear Creek at Boulder Creek** | 37.1278, -122.1158 | 1978-1992, 1997 | 16.0 | 540 | 33.8 | 122.5 | 3.6 |
| **Boulder Creek at Boulder Creek** | 37.1267, -122.1217 | 1977-1992, 1997 | 11.3 | 680 | 47.4 | 305.2 | 6.4 |
| **Zayante Creek at Zayante** | 37.0861, -122.0458 | 1958-1992, 1997 | 11.1 | 480 | 28.0 | 103.0 | 3.7 |
| **San Lorenzo River at Big Trees** | 37.0444, -122.0714 | 1937-2017 | 106.0 | 3700 | 87.5 | 682.0 | 7.8 |
| **Carbonera Creek at Scotts Valley** | 37.0506, -122.0125 | 1985-2007 | 3.6 | 505 | 26.5 | 117.4 | 4.4 |
| **Scott Creek above Little Creek** | 37.0642, -122.2283 | 1937-1941, 1959-1973, 1982 | 25.1 | 600 | 43.5 | 145.0 | 3.3 |
| **Pescadero Creek near Pescadero** | 37.2608, -122.3278 | 1952-2017 | 45.9 | 1350 | 53.0 | 291.5 | 5.5 |
| **San Gregorio Creek at San Gregorio** | 37.3258, -122.3856 | 1955, 1970-2017 | 50.9 | 1900 | 61.5 | 402.5 | 6.5 |
| **Pilarcitos Creek at Half Moon Bay** | 37.4666, -122.4331 | 1967-2017 | 27.8 | 450 | 33.0 | 139.0 | 4.2 |
| **Redwood Creek at Redwood City** | 37.4494, -122.2325 | 1960-1997 | 1.8 | 170 | 13.0 | 41.5 | 3.2 |
| **San Francisquito Creek at Stanford University** | 37.4233, -122.1883 | 1931-1941, 1951-2017 | 37.4 | 1000 | 45.5 | 198.5 | 4.4 |
| **Saratoga Creek at Saratoga** | 37.2544, -122.0383 | 1934-2017 | 9.2 | 255 | 25.6 | 40.2 | 1.6 |

located throughout the eastern and western Santa Cruz Mountains. Despite the slightly wider than ideal geographic range, our gage analysis improves upon the current regional analyses by focusing on a smaller area and limiting gage sites to the Santa Cruz Mountains.

Waterways compiled the existing information available at each of the selected gaging sites, including drainage area, discharge, field measurements of channel width and cross-sectional area, and local channel slope near the gage. We imported the discharge data into HEC-SSP (U.S. Army Corps of Engineers 2010) and developed flood frequency curves (USGS, Bulletin 17b, 1982) for each gage site to estimate the 1.5-year recurrence interval discharge. We then reviewed measurements of channel width and cross-sectional area at each gage site to find measurements that were taken during a high flow event that approximated the 1.5-year recurrence interval discharge. Four of the gaging sites did not have channel width and cross-sectional area data recorded during a 1.5-year event, so we extrapolated based on the available data. We then estimated bankfull depth at each gage site by dividing channel cross-sectional area by channel width. Banfull width, bankfull depth, and the 1.5-year flood discharge were plotted separately against drainage area. One outlier was identified and removed from the study.

## *Analogue Site Assessment*

Waterways surveyed a 200-foot reach of Corte Madera Creek, located downstream of the Alpine Road Trail culvert, a 171-foot reach of Swiss Creek, located approximately 500 feet upstream from the Peacock Court bridge, and two segments within Reach 20 of Permanente Creek totaling over 300 feet of channel. We chose reach locations that were beyond the influence of instream structures (e.g., culverts, bridges) and were representative of conditions within the reach. We used an auto-level to survey four channel cross section profiles at Corte Madera Creek, three channel cross section profiles at Swiss Creek, two sets of three channel cross-section profiles at Permanente Creek and a longitudinal profile at all four sites. Each channel cross section profile included the expanse of the valley floor and the identification of significant geomorphic features using field indicators, such as bankfull. In most cases, the field indicator used to estimate the bankfull width and depth was the base of mature trees.

Using the survey data, Waterways calculated the bankfull channel width and plotted each cross section to calculate their cross-sectional areas. We then divided each cross-sectional area by the surveyed bankfull width to determine average bankfull depth. We estimated drainage area for each field site using StreamStats (USGS 2012) and calculated channel slopes using the surveyed longitudinal profiles. Channel widths and hydraulic depths were determined for each cross-section and then averaged for each reach, or reach segment, to obtain a single channel width and depth for each creek at the estimated bankfull discharge. Two separate segments were surveyed in Reach 20 of Permanente Creek to identify differences in channel geometry based on differences in local channel slope with one segment having a local channel slope of 4.6% and the other a local channel slope of 8.2%.

## *Hydraulic Geometry Analysis*

Waterway combined the USGS gage site data with the field survey data to determine trends in channel geometry as a function of drainage area. We developed relationships between drainage area and bankfull width, bankfull depth, and the 1.5-year recurrence interval discharge. Trend lines were fit to the data to provide a predictive tool to estimate these parameters at specific restoration sites, most specifically the Rock Pile and Material Removal Areas (Figures 3, 4, and 5). Using the equation for each trend line, we solved for the predicted channel width and depth for specific restoration areas within Permanente Creek based on a drainage area of 2.7 square miles (Culverts 7 and 8), 2.54 square miles (Rock Pile), and 2.02 square miles (Material Removal Area). Table 3 summarizes the results of this analysis.

**Table 3. Channel Dimensions Calculated Using Hydraulic Geometry Relationships**

| Project Site | Drainage Area ($mi^2$) | Predicted Bankfull Width (ft) | Predicted Bankfull Depth (ft) | Cross Sectional Area ($ft^2$) |
|---|---|---|---|---|
| Culvert 7 | 2.70 | 17.9 | 2.3 | 31 |
| Culvert 8 | 2.70 | 17.9 | 2.3 | 31 |
| Rock Pile | 2.54 | 17.5 | 2.3 | 29 |
| Material Removal Area | 2.02 | 16.0 | 2.1 | 25 |

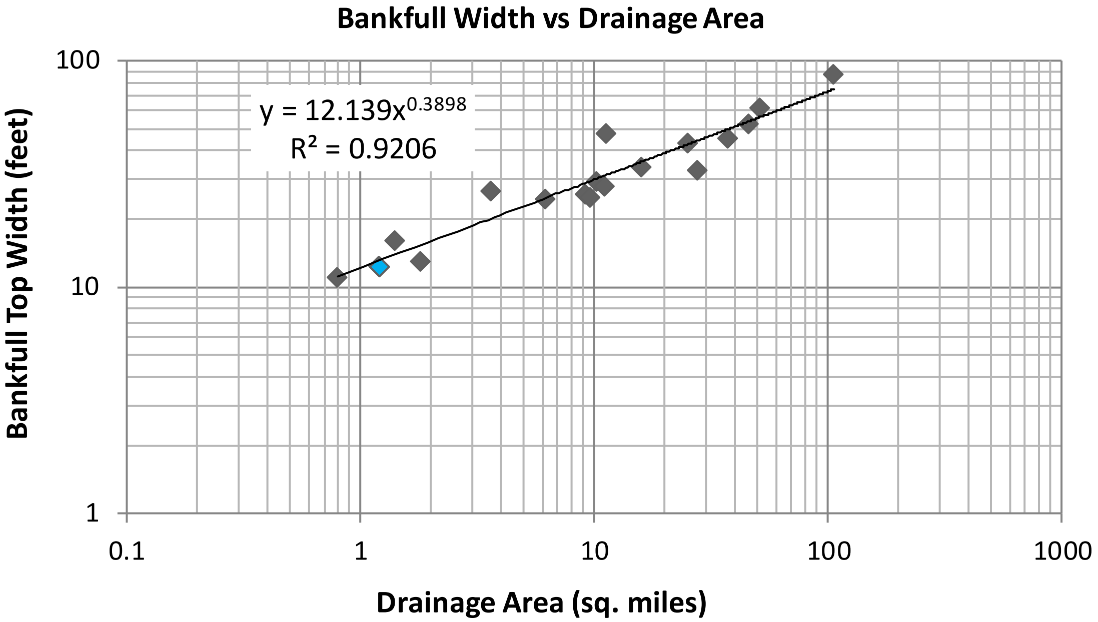

**Figure 3. Bankfull Top Width as a Function of Drainage Area for the Santa Cruz Mountains. The blue marker represents the sites on Permanente Creek in Reach 20.**

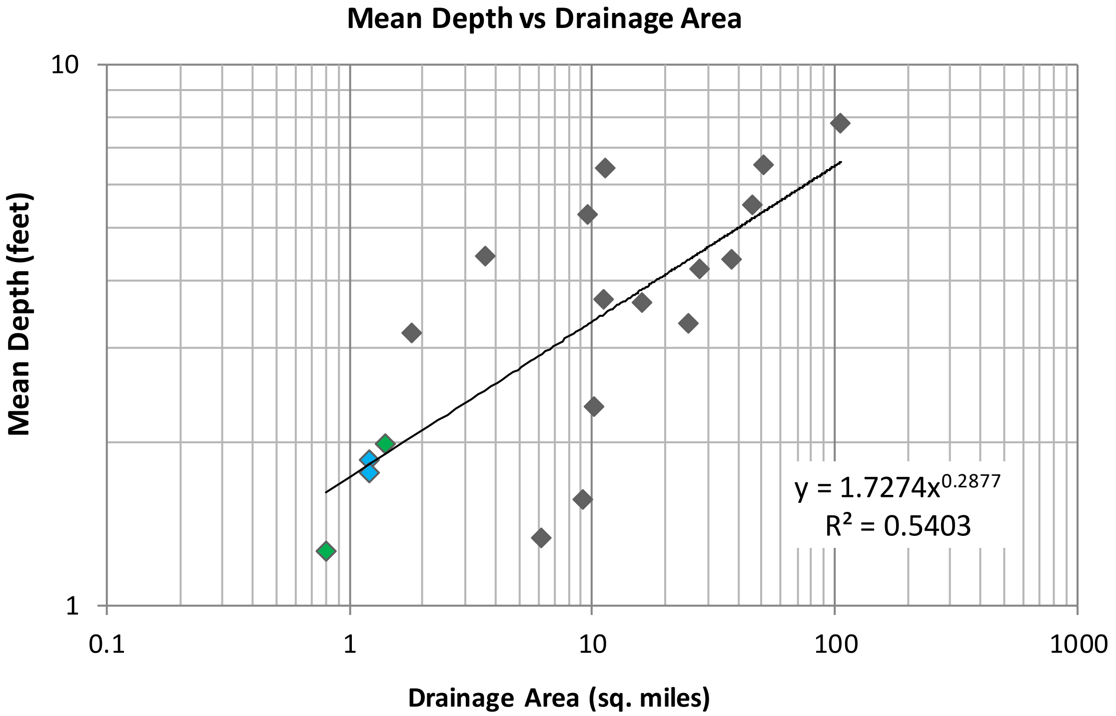

**Figure 4. Bankfull Depth as a Function of Drainage Area for the Santa Cruz Mountains. The green data points are Swiss and Corte Madera Creeks. The blue data points are the sites on Permanente Creek.**

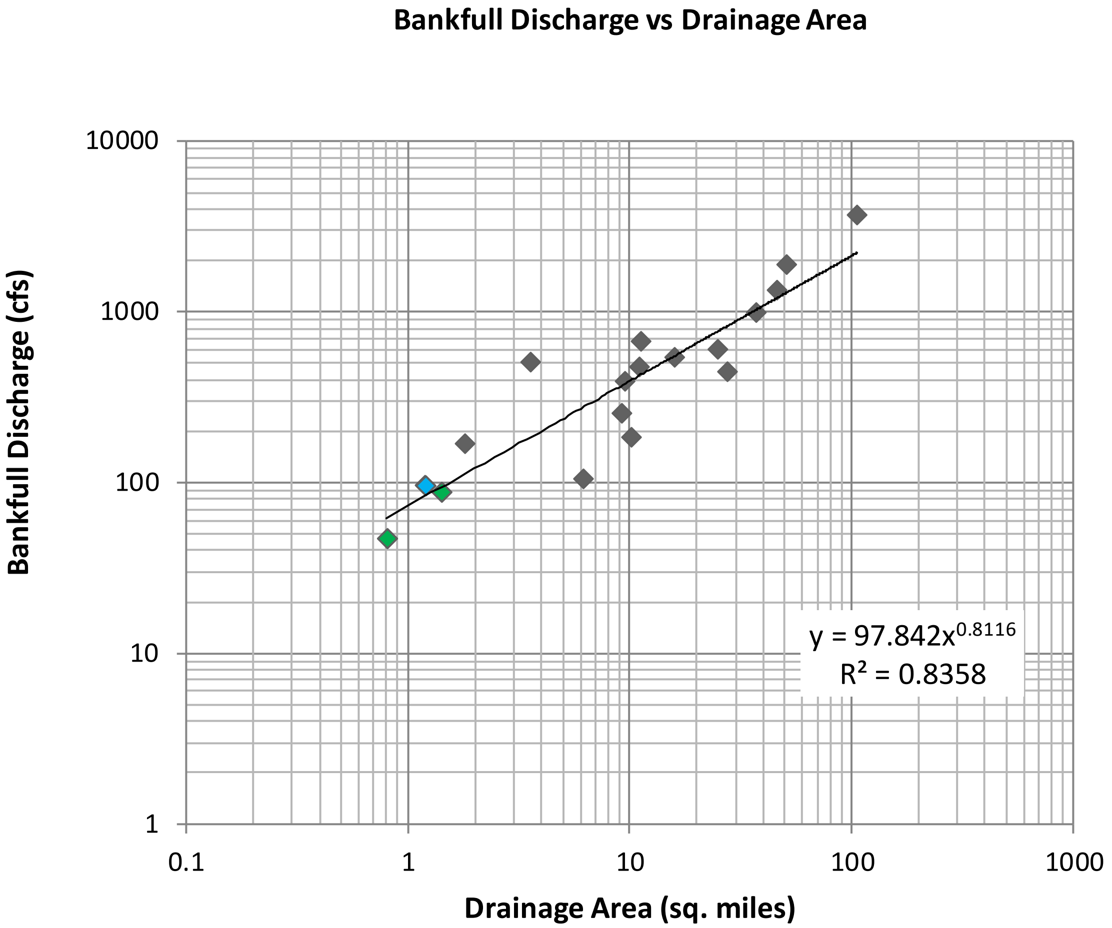

**Figure 5. Bankfull Discharge as a Function of Drainage Area for the Santa Cruz Mountains. The green data points are Swiss and Corte Madera Creeks. The blue data points are the sites on Permanente Creek.**

## *Pool Geometry*

An important design parameter for reach-scale restoration of Permanente Creek is pool length and pool spacing. Despite the legacy of impacts to Permanente Creek, it was determined that several reaches (R14-R16 and R20-R21) continued to exhibit naturally formed pool and riffle geometries that encompass a range of channel slopes. These conditions provided an opportunity to measure pool and riffle geometries, locally, to support the design effort, rather than measuring those parameters in other adjacent watersheds which may lack specific characteristics found in Permanente Creek such as the prevalence of calcium carbonate precipitates. Given the inherent variability in pool geometries associated with the debris flow morphology of the channel, it was important to collect data along entire reaches and summarize the information to convey averages and ranges of natural conditions. To convey the range of natural variability, longitudinal profile data was collected along the entire length of the identified reaches within Permanente Creek to calculate pool length and spacing in relation to reach-scale channel gradients (Table 4). These data were then used to calculate pool statistics for each site-specific restoration area.

**Table 4. Statistics on Pool Length, Depth and Spacing (in feet) By Reach of Permanente Creek.**

| Reach # | Reach Avg Slope | Avg Pool Length (ft) | Median Pool Length (ft) | St. Dev Pool Length (ft) | Avg Pool Depth (ft) | Median Pool Depth (ft) | St. Dev Pool Depth (ft) | Avg Pool Spacing (ft) | Median Pool Spacing (ft) | St. Dev Pool Spacing (ft) |
|---|---|---|---|---|---|---|---|---|---|---|
| **21** | 5.1% | 13.6 | 11.6 | 6.3 | 0.6 | 0.6 | 0.3 | 211 | 150 | 212 |
| **20** | 5.2% | 11.4 | 11.0 | 4.1 | 0.9 | 1.0 | 0.4 | 106 | 92 | 57 |
| **16** | 7.1% | 15.4 | 14.4 | 6.1 | 0.8 | 0.8 | 0.4 | 76 | 65 | 69 |
| **15** | 11.6% | 10.5 | 9.4 | 2.5 | 0.7 | 0.7 | 0.4 | 58 | 39 | 50 |
| **14** | 6.4% | 8.8 | 8.0 | 3.8 | 0.6 | 0.6 | 0.3 | 31 | 19 | 27 |
|  | **4-8% Reaches** | **12.0** | **10.3** | **5.7** | **0.7** | **0.7** | **0.4** | **94** | **55** | **124** |
|  | **8-12% Reaches** | **10.5** | **9.4** | **2.5** | **0.7** | **0.7** | **0.4** | **58** | **31** | **50** |

## Results/Discussion

Dunne and Leopold's (1978) regional curves provide a predictive tool to estimate bankfull channel dimensions for Permanente Creek. Use of the Dunne and Leopold regional curves for the entire Bay Area estimated a bankfull width for the Permanente project area of approximately 17 to 25 feet and a bankfull depth of approximately 1.5 to 2.0 feet. Because these curves are regional and include a significant number of gage locations that are in a geomorphic setting that are different from the project area, regional curves that are more specific to the Permanente Creek project area were developed. Utilizing the more focused data set, which includes the USGS sites within the Santa Cruz Mountains and the field-based assessments sites on Permanente, Corte Madera and Swiss Creek, the curves predicted a bankfull width of 17.9 feet for Culverts 7 and 8, 17.5 feet for the Rock Pile Area, and 16.0 feet for the Material Removal Area and a bankfull depth of approximately 2.3 feet for Culverts 7 and 8, 2.3 feet for the Rock Pile Area and 2.1 feet for the Material Removal Area prior to mining-related impacts (Table 3). As expected, the Dunne and Leopold (1978) curves describe a wider and flatter channel, most likely due to the inclusion of lower gradient, unconfined, alluvial channels in the analysis. Table 5 includes ranges of bankfull channel dimensions for the areas where the channel will be reconstructed to provide for some variability and flexibility during construction since large non-uniform materials will be used in channel construction.

Measured channel slopes for Corte Madera and Swiss Creek, 8.4% and 10.7% respectively, are in the range of the design slopes at the Rock Pile and Material Removal Areas along Permanente Creek. Field observations of a step-pool channel morphology at these channel gradients suggest that Permanente Creek likely had a step-pool channel pattern in the steeper reaches prior to mining. This is supported by the observed conditions in the reaches of Permanente Creek that were identified as having pool and riffle geometry that were representative of natural conditions.

The pool analysis, utilizing the surveyed longitudinal profiles along the more intact reaches of Permanente Creek, suggest that there is an inverse relationship between pool length and spacing relative to channel gradient (Table 4). Furthermore, lower gradient reaches exhibit higher overall pool length and spacing variability than higher gradient reaches. This supports the idea that higher gradient reaches (>8% channel slope) are more characterized by a step-pool morphology, whereas lower gradient reaches (4% to 8% channel slope) exhibit more of a pool-riffle morphology. Pool depth was fairly consistent across all of the evaluated reaches with pools ranging between 0.5 and 2 feet, independent of channel slope. This is likely due to the fact that pool depth may be more a function of the presence of localized roughness elements, and the fact that there are limited opportunities to scour deeper pools due to the composition of the bed material and associated natural armoring.

**Table 5. Proposed Channel Dimensions for Constructed Reaches**

| Project Site | Design Slope (%) | Design Slope Range (%) | Proposed Bankfull Width Min (ft) | Proposed Bankfull Width Max (ft) | Proposed Bankfull Depth Min (ft) | Proposed Bankfull Depth Max (ft) | Cross Sectional Area Min ($ft^2$) | Cross Sectional Area Max ($ft^2$) |
|---|---|---|---|---|---|---|---|---|
| **Culvert 7** | 4.3% | 4%-8% | 16.5 | 20.5 | 2.1 | 2.5 | 28.2 | 34.2 |
| **Culvert 8** | 2.7% | <4% | 18.0 | 22.0 | 1.9 | 2.3 | 28.2 | 34.2 |
| **Rock Pile Area** | Varies | <4% | 17.5 | 21.5 | 1.8 | 2.2 | 26.9 | 32.9 |
| | | 4%-8% | 16.0 | 20.0 | 2.0 | 2.4 | | |
| | | >8% | 15.5 | 18.5 | 2.4 | 2.8 | | |
| **Material Removal Area** | Varies | <4% | 16.0 | 20.0 | 1.7 | 2.1 | 22.5 | 28.5 |
| | | 4%-8% | 14.5 | 18.5 | 1.9 | 2.3 | | |
| | | >8% | 14.0 | 17.0 | 2.3 | 2.7 | | |

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WATERWAYS
CONSULTING, INC.

# APPENDIX C

## Seismic Refraction Survey (Bedrock Analysis)

NORCAL GEOPHYSICAL CONSULTANTS, INC.
NORCAL

May 22, 2014

Golder Associates, Inc.
425 Lakeside Drive
Sunnyvale, CA 94085

Subject: Seismic Refraction Survey
Sites 4 and 11
Permanente Quarry
Cupertino, California

NORCAL Job #14-245.15B

Attention: George Wegmann,

This report presents the findings of seismic surveys performed by NORCAL Geophysical Consultants, Inc. for Golder Associates, Inc. at Permanente Quarry in Cupertino, California. The surveys were performed during the period March 4 through 11th, 2014 by NORCAL Professional Geophysicist William J. Henrich, PGp 893. Geologist Jeff Linder and Field Technician Dave Walter of Golder Associates, Inc. provided field assistance throughout the duration of the survey.

## 1.0 SITE DESCRIPTION AND PURPOSE

The seismic surveys were conducted at two locations referred to as Area 11 and Area 4, as shown on Plates 1A and 1B, respectively. Both areas encompass sections of Permanente Creek which drains in a general west to east direction. The area north of the creek has been subjected to accumulations of overburden materials related to quarrying operations. Particle sizes of the mine wastes ranged from sand and gravel size up to boulders that, on the surface, were several feet across. The local bedrock consisted of greywacke (sandstone), greenstone and limestone belonging to the Franciscan Complex.

The purpose of the seismic survey was to determine the thickness of alluvium and alluvium-rock fills at accessible select areas within the stream channel, along parallel haul roads and areas north of the stream channel. This data will be used by others to assess volumes of unconsolidated materials needed to be removed for restoration to the original stream channel grade and configuration as part of a reclamation plan for the quarry.

## 2.0 METHODOLOGY

We collected seismic data using two methods known as seismic refraction (SR) and multi-channel analysis of surface waves (MASW). The SR method was used to determine the compressional (P-) wave velocity of subsurface materials. The P-wave velocity (Vp) of fill, sediments, and rock are dependent on physical properties such as compaction, density, hardness, and induration. However, other factors such as bedding, fracturing, and saturation also affect Vp.

Typically, low Vp is indicative of loose, dry soils, poorly compacted fill material, poorly to semi-consolidated sediments, or alternatively, deeply weathered and/or highly fractured rock. Moderate Vp usually indicates dense and highly compacted or saturated sedimentary deposits or fill, and/or moderately weathered and fractured sedimentary rock. High Vp typically represent un-weathered sedimentary (i.e., sandstone, conglomerate, meta-sandstone or basalt) bedrock. A more detailed description of the SR methodology is provided in Appendix A.

The MASW method was used to determine both the P-wave and the shear (S-) wave velocity of subsurface materials in areas where limited access precluded the use of the SR method. S-waves typically propagate through earth materials at roughly one-half the velocity of P-waves. However, S-wave velocities are more directly related to the strength of fill, sediments, and rock than P-waves. Furthermore, unlike Vp, S-wave velocity (Vs) is not affected by saturation. Typically, low Vs is indicative of loose, dry soils, poorly compacted fill material, poorly to semi-consolidated sediments, or alternatively, deeply weathered and/or highly fractured rock. Moderate Vs usually indicates dense and highly compacted sedimentary deposits or fill, and/or moderately weathered and fractured sedimentary rock. High Vs typically represent un-weathered sedimentary (i.e., sandstone, conglomerate, meta-sandstone or basalt) bedrock. A more detailed description of the MASW method is provided in Appendix B.

## 3.0 DATA ACQUISITION

SR surveys were conducted in two locations referred to as the Rock Pile Area (Area 11) and the Material Removal Area (Area 4). The SR surveys were conducted according to the procedures described in Appendix A. MASW soundings were conducted in Area 11 according to the procedures described in Appendix B. The salient features of the data acquisition procedures used in each area are described in the following sections.

### 3.1 AREA 11

In Area 11 we collected SR data from 8-lines ranging in length from 75- to 250-ft. The locations of these lines, labeled Line 1 through Line 8, are shown on Plate 1A. We also conducted two MASW soundings. The locations of the soundings, labeled MASW-9 and MASW-10 are also shown on Plate 1A. Where possible, the SR lines and MASW soundings were located within the stream channel. However, there were some areas where the lines had to be placed on adjacent compacted gravel roads because of the presence of dense vegetation, concrete linings or steel culverts within the channel.

## 3.2 AREA 4

In Area 4, we acquired SR data from 13-lines ranging in length from 125- to 250-ft. The locations and orientations of the SR lines are shown on Plate 1B. The SR lines were positioned within the stream channel and on the northern portions (hill slopes, access roads and parking area) of the site.

## 4.0 DATA PROCESSING

## 4.1 SEISMIC REFRACTION (SR)

The refraction data were processed as described in Appendix A. Elevation data were provided by Waterways Consultants, Inc. at each shot point location within every seismic line. These elevation data were incorporated into the final processed seismic models. Further information regarding specific data input and sample compilations can be found in Appendix A.

## 4.2 MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)

The MASW data were processed according to the procedures described in Appendix B.

## 5.0 RESULTS

The results of the seismic refraction survey are illustrated by the seismic velocity cross-sections (profiles) shown on Plates 2 through 8. On each profile the vertical axis represents elevation above mean sea level (MSL) and the horizontal axis represents draped survey distance (Station) along each line. Color shaded areas represent the lateral and vertical extent of the seismic layers comprising each profile. Modelled layer depths (thicknesses) as described in the Appendix A were determined beneath each geophone. These data were interpolated/extrapolated beneath each shot point. The relationship between color and seismic velocity is indicated by the color scales plotted to the right of each seismic refraction profile. In order to indicate how velocity varies from line to line within each survey area, the same scale was used for every profile. The results obtained in each area are described in the following sections. Specific results are presented for areas where two or more seismic refraction profiles either cross each other or are in a local proximity. It was useful to group seismic lines in this manner because of common characteristics involving of topography, location or surface conditions.

## 5 .1 AREA 11

### 5.1.1 Lines 1 and 2 (Plate 2)

Lines 1 and 2 were located within the stream channel, just west of a retention pond, as shown on Plate 1A. During the survey, water from remote pumping was actively being discharged to the stream channel above the seismic lines. The profile for Line 1 indicates velocities (Vp) ranging from 1200- to 7200-ft/sec. Our interpretation of the data resolves this range into two seismic layers labeled V1 and V2 in order of increasing depth and velocity. We interpret V1as representing unconsolidated stream deposits and V2 as representing bedrock. The depth to rock ranged from 18- to 25-ft. The Profile for Line 2 indicates velocities (Vp) ranging from 1150- to 2550-ft/sec. Our interpretation of the data resolves this range into two seismic layers labeled V1 and V2 in order of increasing depth and velocity. Given the low velocities of these layers, we interpret both as representing unconsolidated stream deposits. The difference in velocity between the two layers is related to their relative degree of compaction. V2 has a higher velocity than V1 because it is more highly compacted, probably because of the overbearing weight of V1. Line 2 did not detect bedrock because it was a relatively short line length which limited the depth of exploration.

### 5.1.2 Line 3 – 6, MASW Soundings 9 and 10 (Plate 3)

Lines 3 through 5 were located on access roads that parallel the stream channel, as shown on Plate 1A. Line 6 was situated in open, gravel packed area that ranged from 40 to 60-ft north of a subsurface diversion channel. The profiles for Lines 3-6 indicate velocities (Vp) ranging from 2300- to 7800-ft/sec. Our interpretation of the data resolves this range into two seismic layers designated as V1 and V2 in order of increasing depth and velocity. We interpret V1 as representing unconsolidated materials, e.g. road fill and/or alluvium. Given the high velocity range of V2 (6850- to7800-ft/sec) we interpret it as representing bedrock. The depths to bedrock ranged from 8- to 35-ft bgs.

MASW Soundings 9 and 10 were located north of Seismic Refraction Line 3, as shown on Plate 1A. The MASW soundings were acquired for the purpose of assessing possible near surface high velocity layers and providing depth to bedrock information further north of the stream channel. The 1D MASW Velocity Models (9 and 10) shown at the top of Plate 3 indicate a near surface high velocity layer (Vs=1500- to 2000-ft/sec) that is 8- to 16-ft thick. We interpret this high velocity layer as representing compacted (by very heavy vehicle loads) road fill. The materials underlying the compacted fill have lower velocities (Vs=500- to1000-fps) and thus constitute a velocity inversion. This velocity inversion, which is typically about 8- to 9-ft thick, is characteristic of alluvium. It is underlain, at depths of 17- to 26-ft bgs by velocities (Vs) of about 1800-ft/sec. We interpret these velocities as being indicative of consolidated bedrock. The bedrock depth indicated by the MASW-9 model (about 17-ft) is more shallow than the depth indicated by the Line 3 profile (23-ft) at its point of closest approach. Conversely, the bedrock depth indicated by the MASW-10 model (26-ft) is significantly greater than the 5- to 10-ft depth indicated by the Line 3 and Line 4 profiles at their points of closest approach to MASW-10. These factors highlight the erratic nature of the bedrock surface and can be, in part, attributed to the fact that MASW-9 and MASW-10 are 25-ft north of Lines 3 and 4.

Additionally, the MASW soundings were undertaken to provide a constraint on the seismic refraction results in the general area (Seismic Refraction Lines 3 and 4) as the MASW techniques can accommodate shallow velocity inversions in processing. The MASW bedrock depths (17- to 26-ft bgs) derived from MASW analysis thus formed an approximate magnitude range of values. Our seismic refraction results indicated that bedrock depths ranged from 5- to 35-ft bgs which is in the same order of magnitude as the MASW estimate of depths to bedrock in the general area.

### 5.1.3 Lines 7, 8 and 11(Plate 4)

Lines 7, 8 and 11 trend northward, away from the stream channel, as shown on Plate 1A. Lines 7 and 8 cross an uphill section of accumulated mine waste and packed surficial gravel. The local topography was highly variable and steep. Line 11 crosses a gently sloping, open, gravel packed area from the edge of a metal culvert up to point 50-ft distant from the rock discharge pile (Rock Pile). The profiles for Lines 7, 8 and 11indicate velocities ranging from 1850- to 5700-ft/sec. Our interpretation of the data resolves this range into two seismic layers designated as V1 and V2, in order of increasing depth and velocity. Because of its relatively low velocity and highly variable thickness, we interpret V1 as representing mine wastes and/or alluvium. We interpret V2 as representing bedrock. Beneath Lines 7 and 8, the depth to rock ranges from less than 10- to over 50-ft. The Time-Distance plot for Line 11 indicated a relatively high velocity V1 layer associated with the road bed. No characteristic higher V2 bedrock velocity layer was detected. Therefore, no modeling results are presented for this line.

## 5.2 AREA 4

### 5.2.1 Lines 12, 13, 14 and 15 (Plate 5)

Lines 12, 13 and 14 were situated within a relative wide section of the stream channel, as shown on Plate 1B. Line 15 was located along a man-made bench that parallels the stream channel, about 20-ft upslope from the channel. The profiles for the four lines indicate velocities (Vp) ranging from about 900- to 3550-ft/sec. Our interpretation of the refraction data resolves this velocity range into three layers labeled V1 through V3 in order of increasing depth and velocity. We interpret the V1 and V2 layers as representing unconsolidated stream deposits and V3 as representing weathered bedrock. The depth to rock (V2/V3 interface) ranges from 7- to 23-ft bgs.

The relatively low velocity of V3 (2800- to 3450-ft/sec) suggests that it comprises a very weak rock like a meta-shale. The profile for Line 15 indicates that bedrock deepens to the east (downstream), reaching a maximum depth of 36-ft-bgs at the east end of the line. This puts it at an elevation of 1190-1192-ft MSL, which corresponds to the bedrock elevations at the west end of Line 12 and the east end of Line 13.

### 5.2.2. Lines 16 and 17 (Plate 6)

Lines 16 and 17 were situated on top of a gravel packed, level parking area, as shown on Plate 1B. The profiles for both lines indicate velocities (Vp) ranging from 1150- to 6200-ft/sec. Our interpretation of the Line 16 and Line 17 data resolves this range into two seismic layers labeled V1 and V2 in order of increasing depth and velocity. We interpret V1 as representing fill and alluvium and V2 as representing bedrock. The depth to rock ranges from17- to 23-ft bgs.

### 5.2.3 Lines 18, 19, 20 and 21 (Plate 7)

Lines 18 through 20 were located within the active stream channel, as shown on Plate 1B. However, there was no water in the channel at the time the survey was conducted. Line 21 extended north and upslope from the west end of Line 19. The profiles for these lines indicate velocities (Vp) ranging from 1100- to 4150-ft/sec. Our interpretation of the data resolves this range into three layers labeled V1 through V3 in order of increasing depth and velocity. V2 is absent beneath Line 18 and V3 is absent beneath Line 19. We interpret the combined V1 and V2 layers, with velocities ranging from 1050- to 2650-ft/sec, as representing unconsolidated stream and slope deposits. However, below Lines 19 and 20, the V2 layer could represent decomposed bedrock or dense gravel deposits. In addition, our field observations indicate that, beneath Line 21, V2 could represent mining waste that contains a high percentage of boulder size fill. We interpret theV3 layer as representing bedrock with velocities, where defined, ranging from 3400- to 4150-ft/sec. The depth to rock ranges from about 8- to 32-ft.

### 5.2.4 Lines 22, 23 and 24 (Plate 8)

Line 22 and Line 23 were located on an access road, as shown on Plate 1B. This road leads to Pond 4 (not shown). Line 24 extended southeast and down slope, from the access road towards the stream channel. The profiles for the three lines indicate velocities (Vp) ranging from 1200- to 6700-ft/sec. Our interpretation of the data resolves the velocity range into two layers labeled V1 and V2 in order of increasing depth and velocity. We interpret V1 as representing unconsolidated stream deposits. We interpret V2 as representing bedrock. Beneath Lines 22 and 23, the computed depths to bedrock ranged from 18- to 30-ft bgs. Beneath Line 24, the depths to bedrock decrease in the down slope direction; ranging from 18-ft bgs near the access road to only 8-ft bgs at the southeast edge of the profile.

## 6.0 STANDARD CARE

The scope of NORCAL's services for this project consisted of using geophysical methods to characterize the subsurface. The accuracy of our findings is subject to specific site conditions and limitations inherent to the techniques used. We performed our services in a manner consistent with the standard of care ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

We appreciate having the opportunity to provide you with this information.

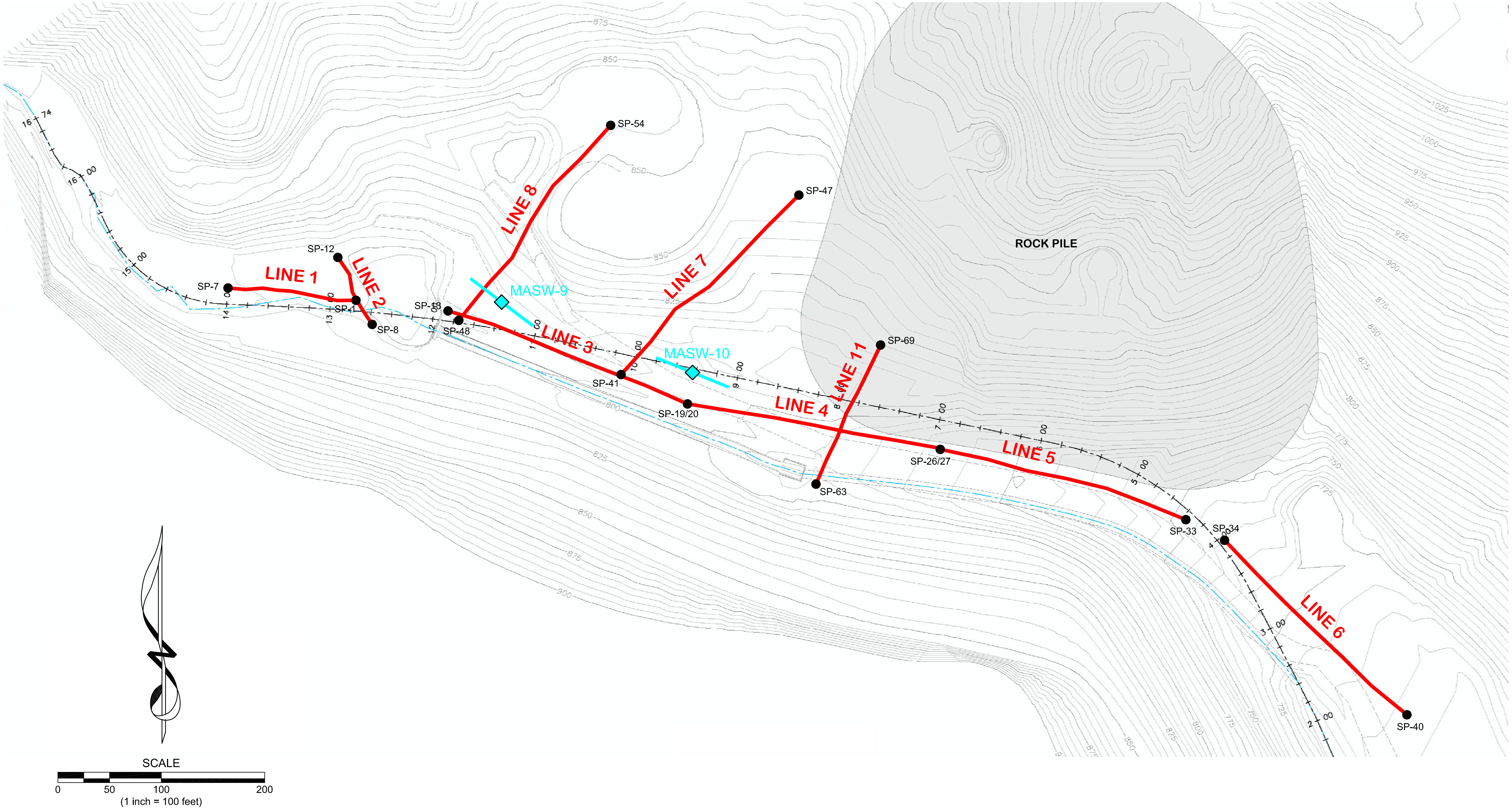
Respectfully,

NORCAL Geophysical Consultants, Inc.

William J Henrich
Professional Geophysicist PGp 893

WEB/tlt

Enclosures: Plates 1A, 1B and 2 through 8
Appendix A - Seismic Refraction (SR)
Appendix B – Multi-channel Analysis of Surface Waves (MASW)



## LEGEND

| | |
|---|---|
| 🟥 | SEISMIC REFRACTION LINE |
| ● SP-1 | SHOT POINT LOCATION |
| ◆ | CENTER POINT OF MASW LINE |

NOTE: BASE MAP PROVIDED BY WATERWAYS CONSULTING, INC.

NORCAL

SITE LOCATION MAP
PERMANENTE QUARRY AREA 11
SEISMIC REFRACTION SURVEY

LOCATION: CUPERTINO, CALIFORNIA

CLIENT: GOLDER ASSOCIATES, INC.

JOB #: 14-245.15B

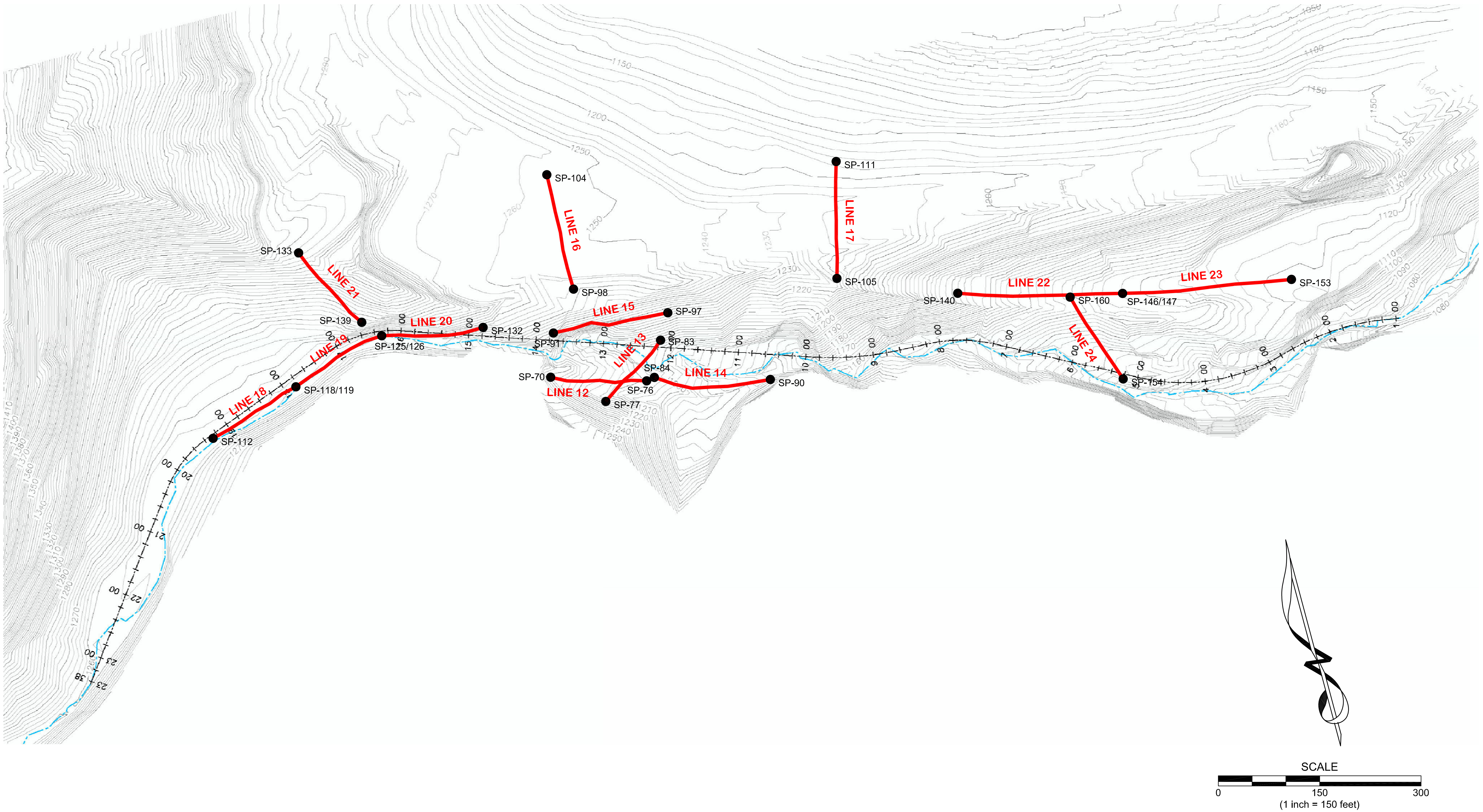
NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: MAY 2014

DRAWN BY: G.RANDALL

APPROVED BY: WJH

PLATE
1A



| LEGEND | |
|---|---|
| ▬ | SEISMIC REFRACTION LINE |
| ● SP-1 | SHOT POINT LOCATION |

NOTE: BASE MAP PROVIDED BY WATERWAYS CONSULTING, INC.

NORCAL

SITE LOCATION MAP
PERMANENTE QUARRY AREA 4
SEISMIC REFRACTION SURVEY

LOCATION: CUPERTINO, CALIFORNIA

CLIENT: GOLDER ASSOCIATES, INC.

JOB #: 14-245.15B

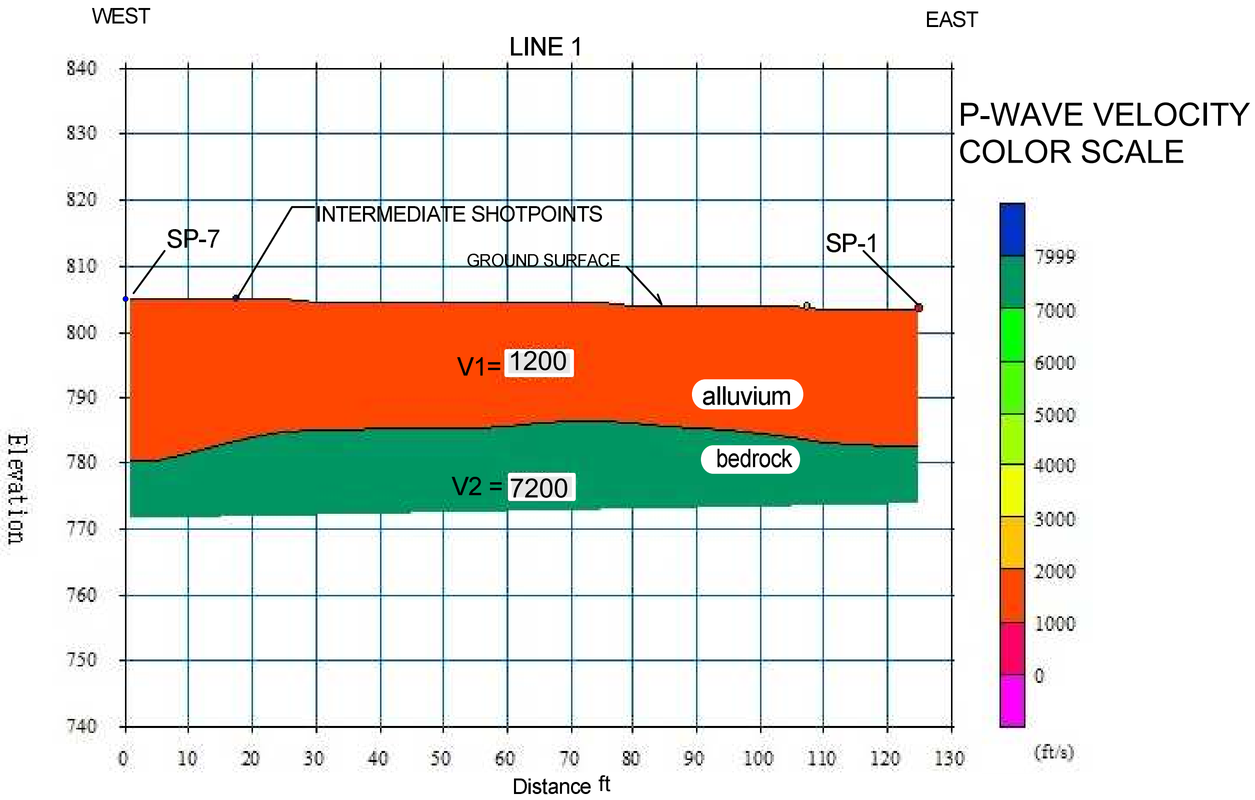
NORCAL GEOPHYSICAL CONSULTANTS INC.

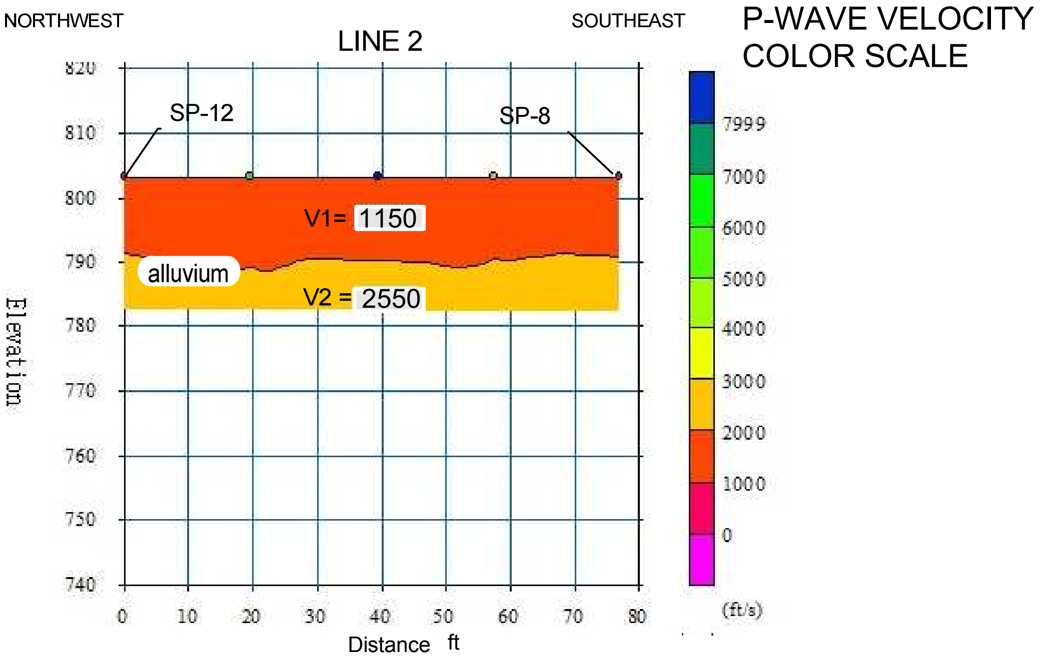
DATE: MAY 2014

DRAWN BY: G.RANDALL

APPROVED BY: WJH

PLATE
1B





EXPLANATION

**V2 = 7200** Velocity Layer in ft/sec

Horizontal/Vertical Scale 1' = 30 feet

NORCAL

## SEISMIC REFRACTION PROFILES LINES 1 AND 2

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA

CLIENT: GOLDER ASSOCIATES, INC.

JOB #: 14-245.15B

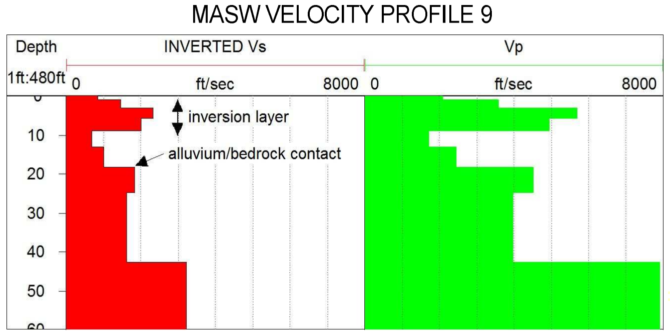
NORCAL GEOPHYSICAL CONSULTANTS INC.

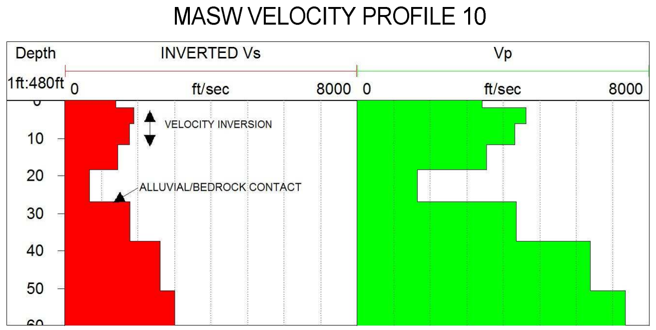
DATE: APRIL, 2014

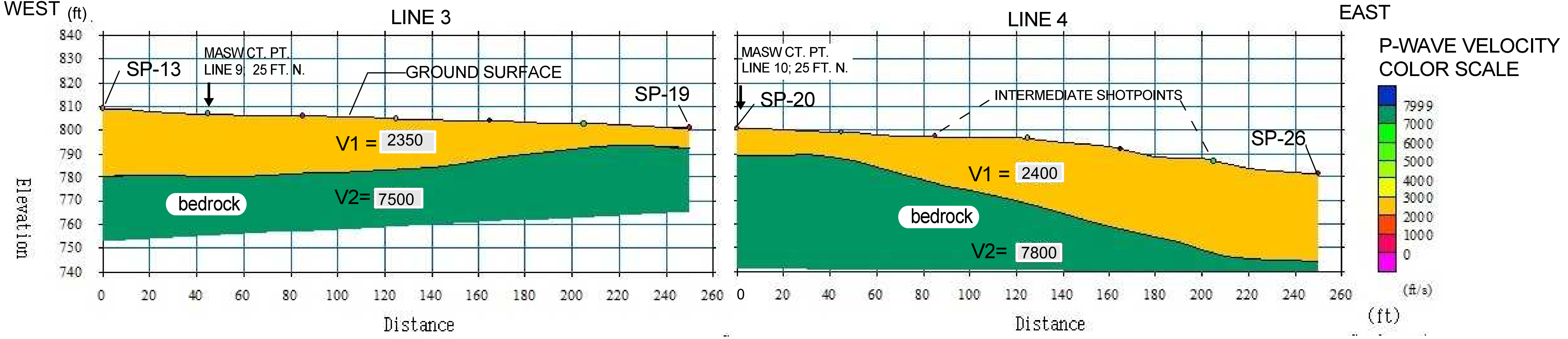
DRAWN BY: W HENRICH

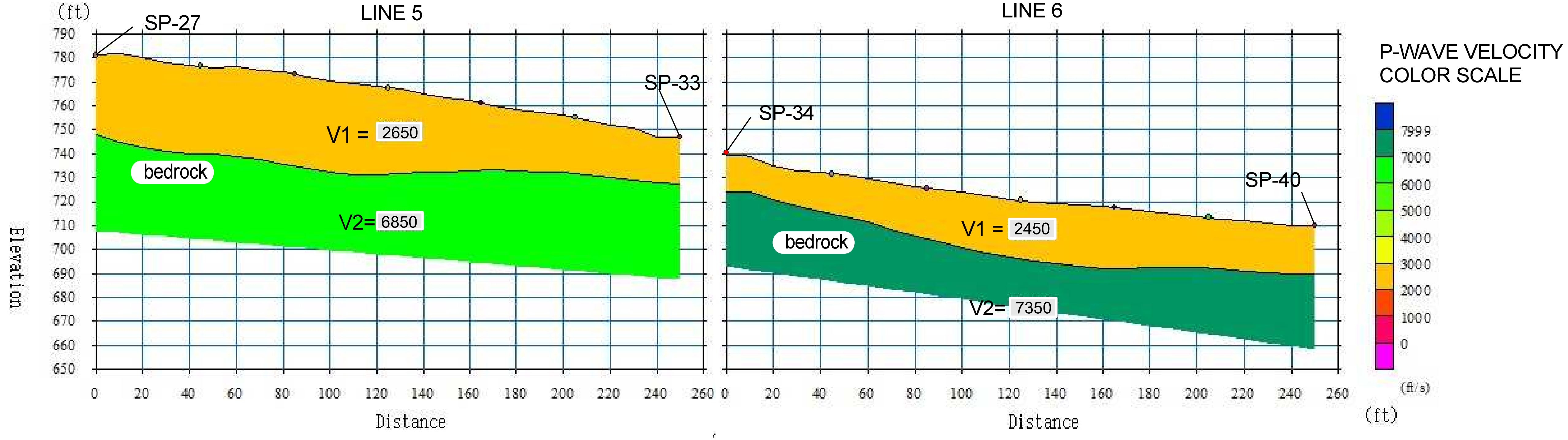
APPROVED BY: WJH

PLATE 2









EXPLANATION

🟩 V2 = 7200 Velocity Layer in ft/sec

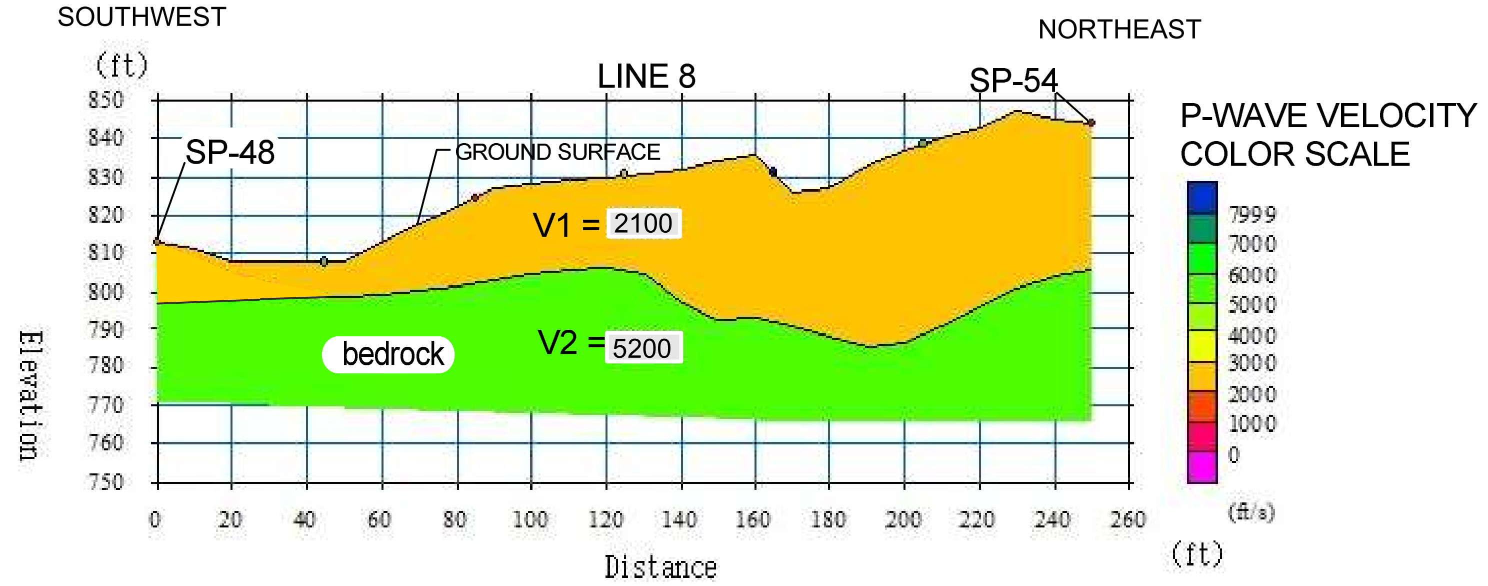
HORIZONTAL/VERTICAL SCALE: 1" APPROX. EQUALS 50 FEET

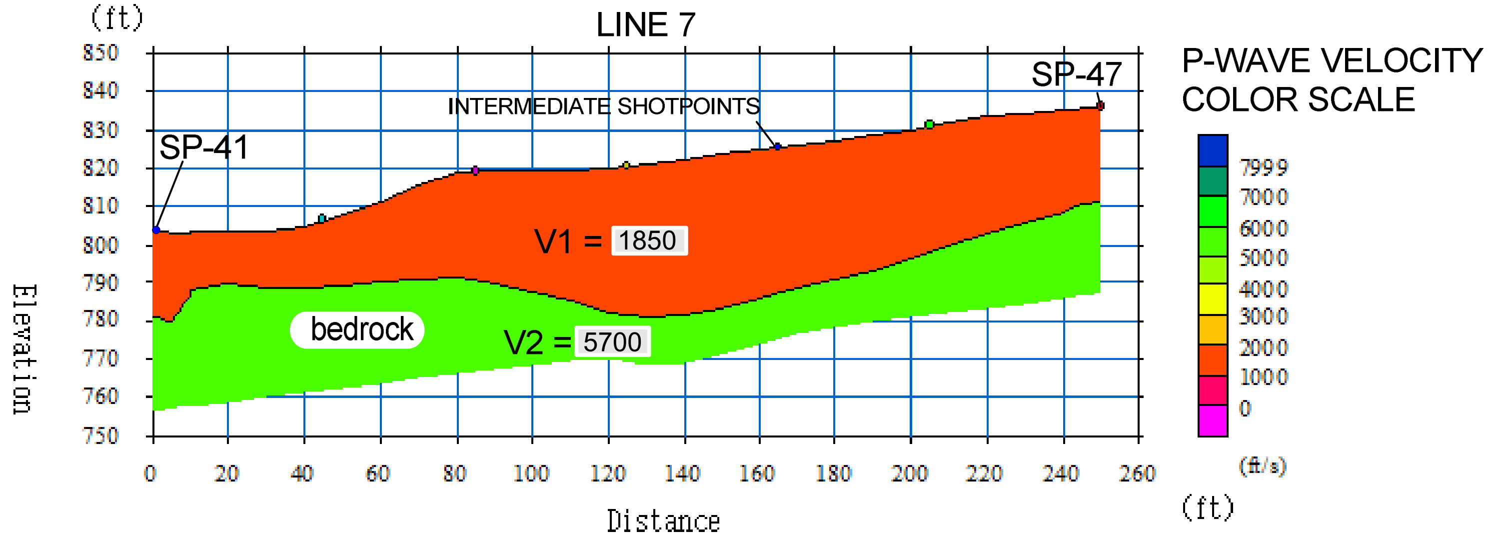
NORCAL

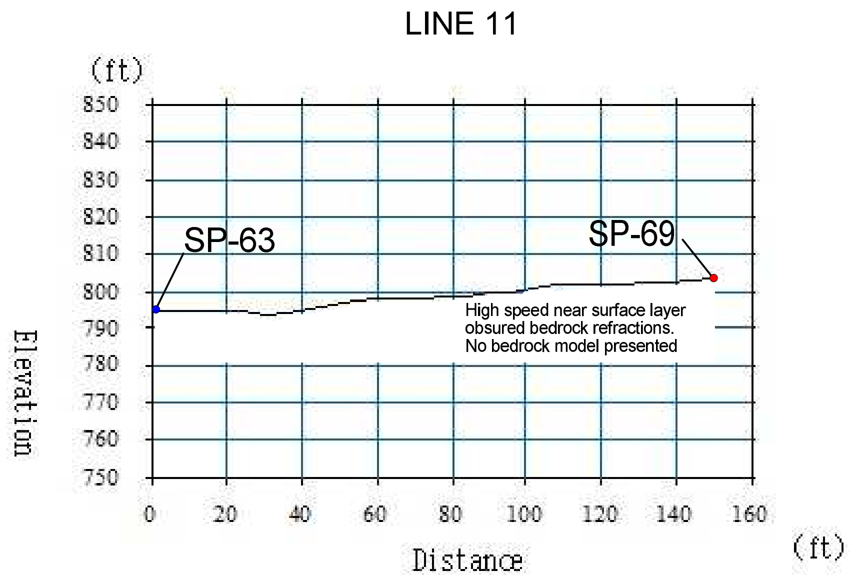
## SEISIMC REFRACTION PROFILES
## LINES 3, 4, 5 AND 6;
## MASW PROFILES 9 AND 10

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA
CLIENT: GOLDER ASSOCIATES, INC
NORCAL GEOPHYSICAL CONSULTANTS INC.
JOB #: 14-245.15B
DATE: APRIL, 2014
DRAWN BY: W. HENRICH
APPROVED BY: WJH

PLATE
3







EXPLANATION

**V2 = 7200** Velocity Layer in ft/sec

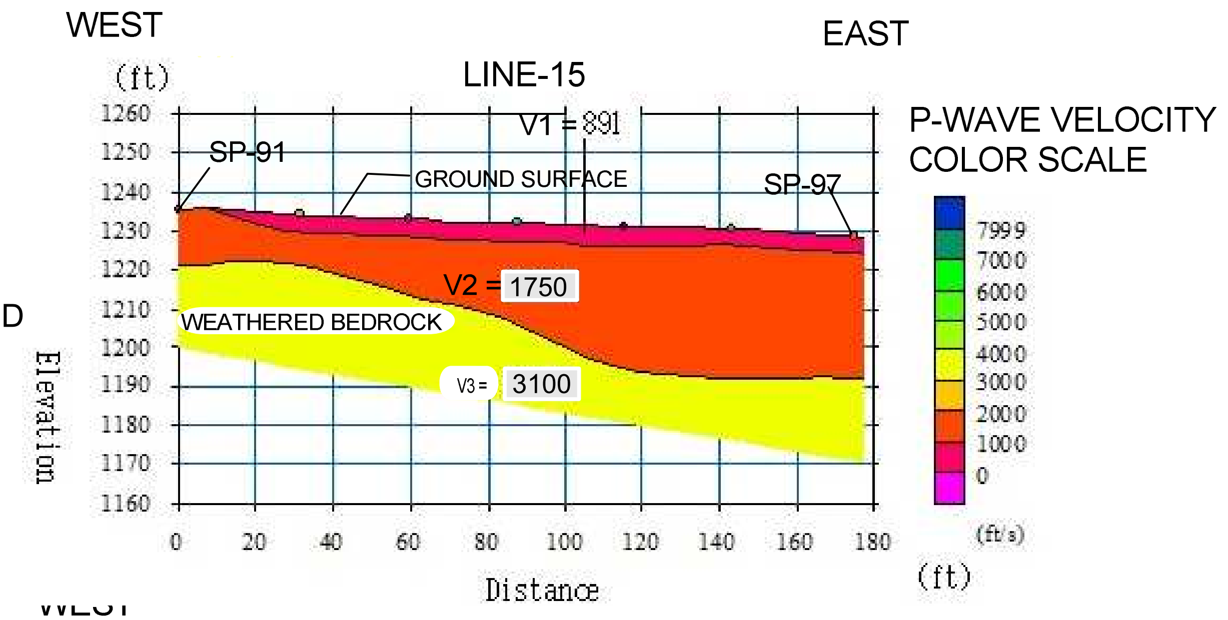
HORIZONTAL/VERTICAL SCALE: ONE INCH APPROX. EQUAL 50 FEET

NORCAL

SEISIMC REFRACTION PROFILES
LINES 7, 8, AND 11

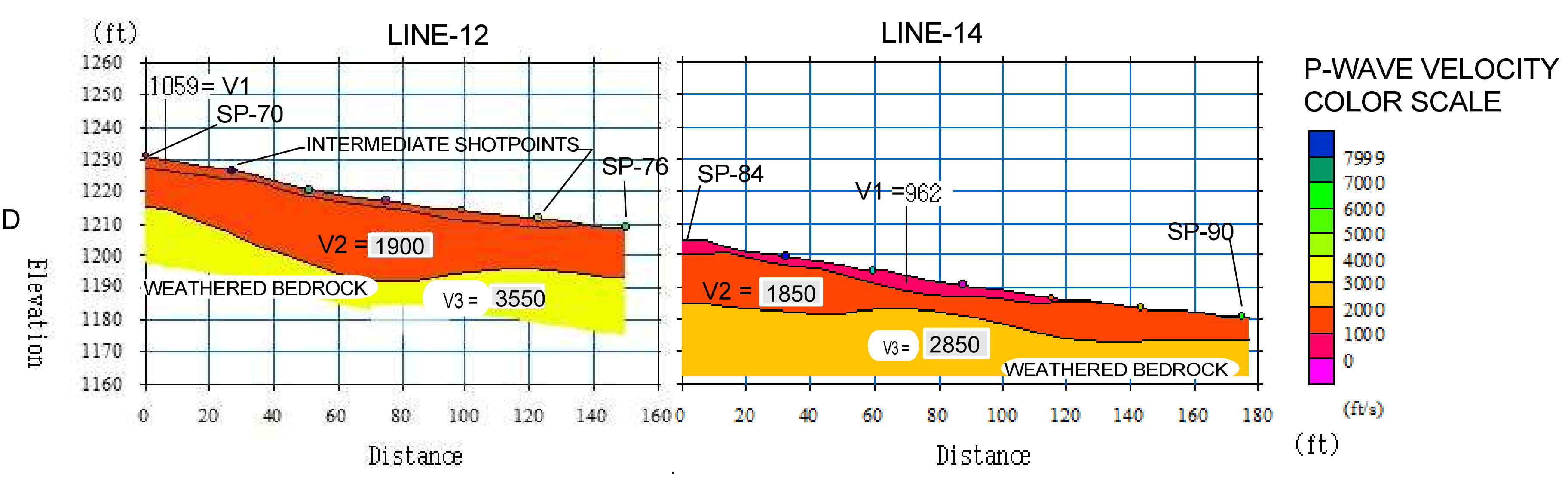
| | | |
|---|---|---|
| | LOCATION: PERMANENTE QUARRY, CUPERTINO, CA | |
| | CLIENT: GOLDER ASSOCIATES, INC | PLATE 4 |
| JOB #: 14-245.15B | NORCAL GEOPHYSICAL CONSULTANTS INC. | |
| DATE: APRIL, 2014 | DRAWN BY: W. HENRICH / APPROVED BY: WJH | |

UPSLOPE
OF STREAM BED

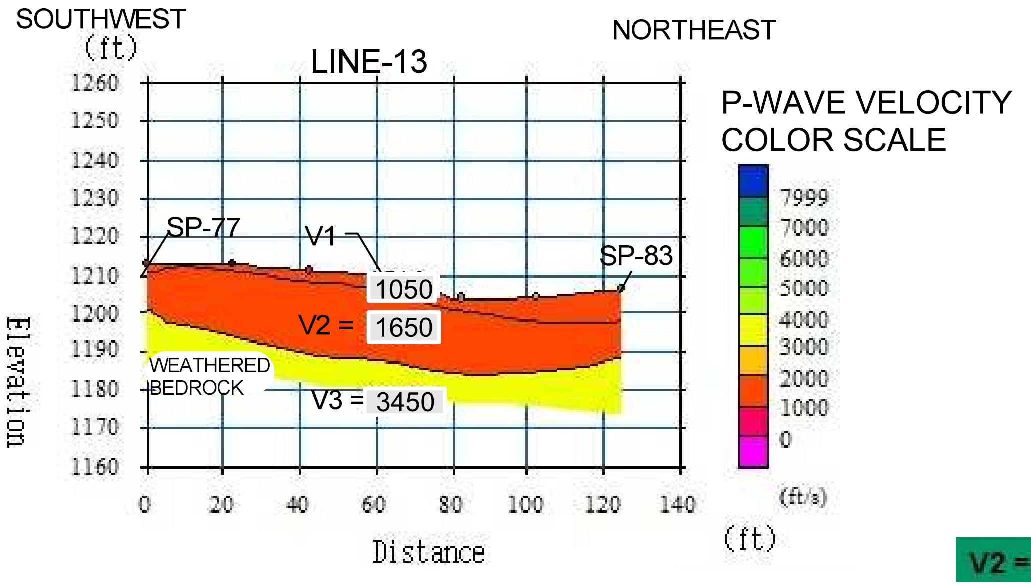


ALONG
STREAMBED

DOWN STREAM



CROSS LINE
INTERSECTS
LINE 12



EXPLANATION

**V2 = 7200** Velocity Layer in ft/sec

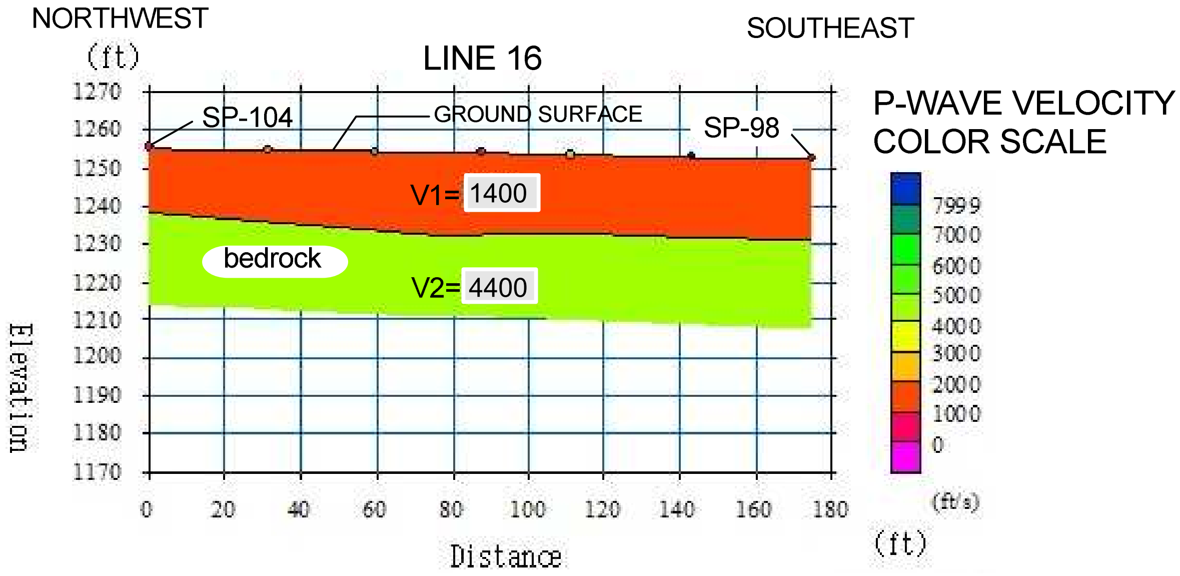
HORIZONTAL/VERTICAL SCALE: ONE INCH APPROX. EQUAL TO 50 FEET

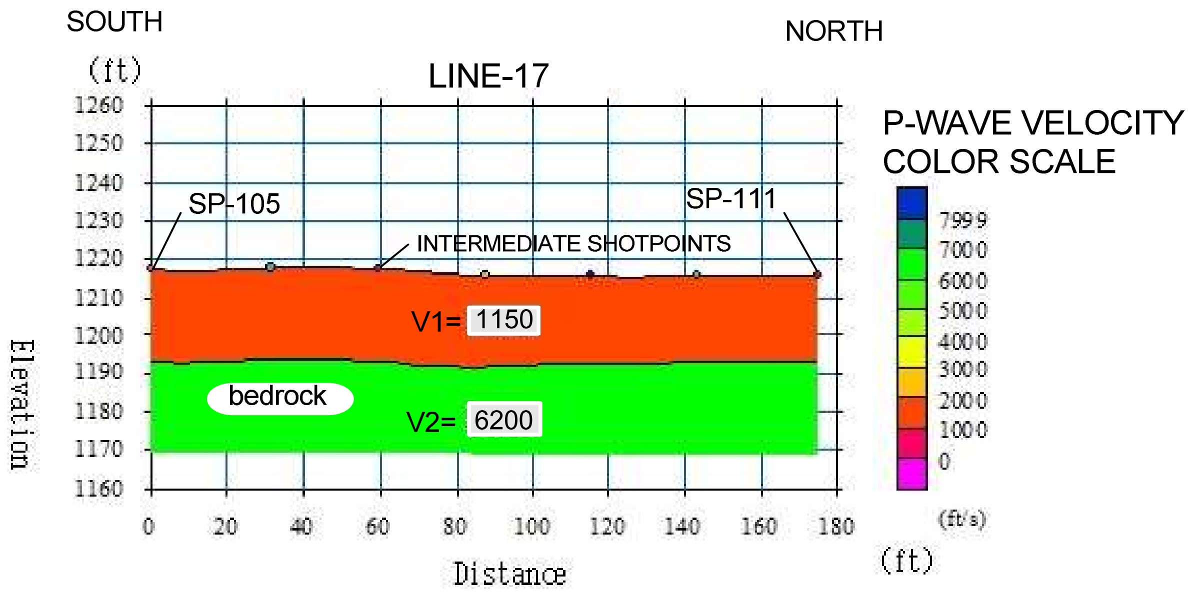
NORCAL

SEISIMC REFRACTION PROFILES
LINES 12, 13, 14, AND 15

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA
CLIENT: GOLDER ASSOCIATES, INC
NORCAL GEOPHYSICAL CONSULTANTS INC.
JOB #: 14-245.15B
DATE: APRIL, 2014
DRAWN BY: W. HENRICH
APPROVED BY: WJH

PLATE
5





## EXPLANATION

**V2 =** 7200 Velocity Layer in ft/sec

HORIZONTAL/VERTICAL SCALE: ONE INCH APPROX. EQUAL TO 50 FEET

NORCAL

SEISMIC REFRACTION
PROFILES LINES 16 AND 17

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA

CLIENT: GOLDER ASSOCIATES, INC.

JOB #: 14-245.15B

NORCAL GEOPHYSICAL CONSULTANTS INC.

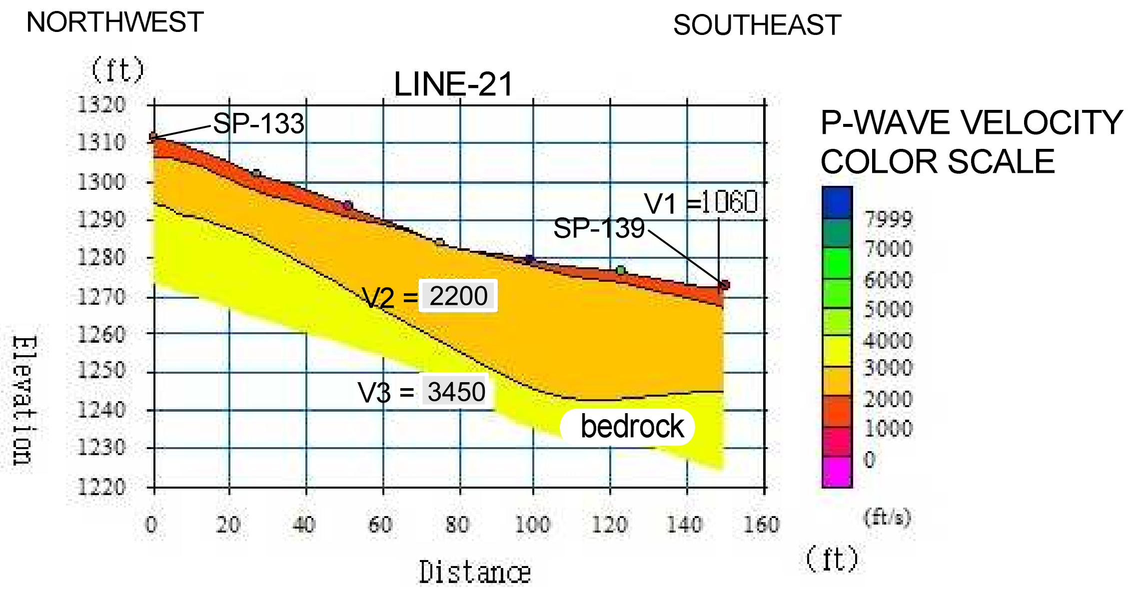
DATE: APRIL, 2014

DRAWN BY: W HENRICH

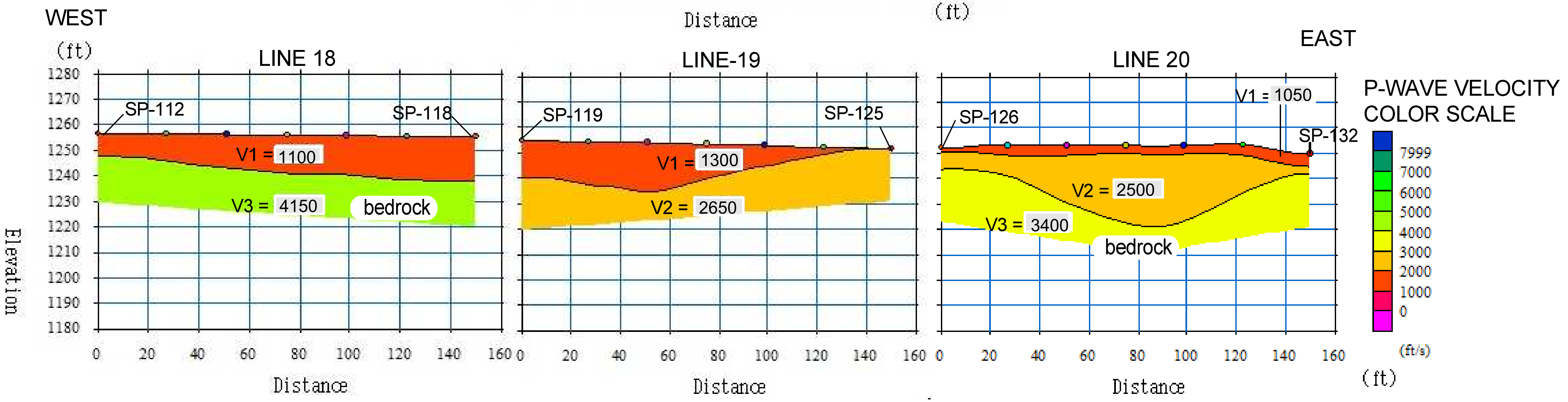
APPROVED BY: WJH

PLATE
6

UPSLOPE OF STREAM BED



SEISMIC LINES ALONG STREAM BED



DOWNSTREAM →

EXPLANATION

**V2 = 7200** Velocity Layer in ft/sec

HORIZONTAL/VERTICAL SCALE: ONE INCH APPROX. EQUAL 50 FEET

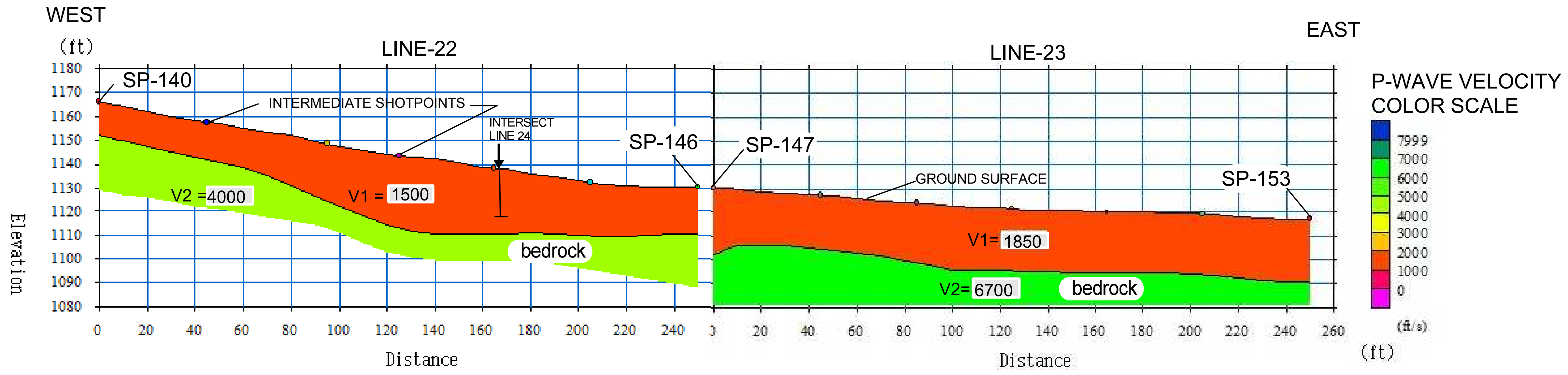
NORCAL

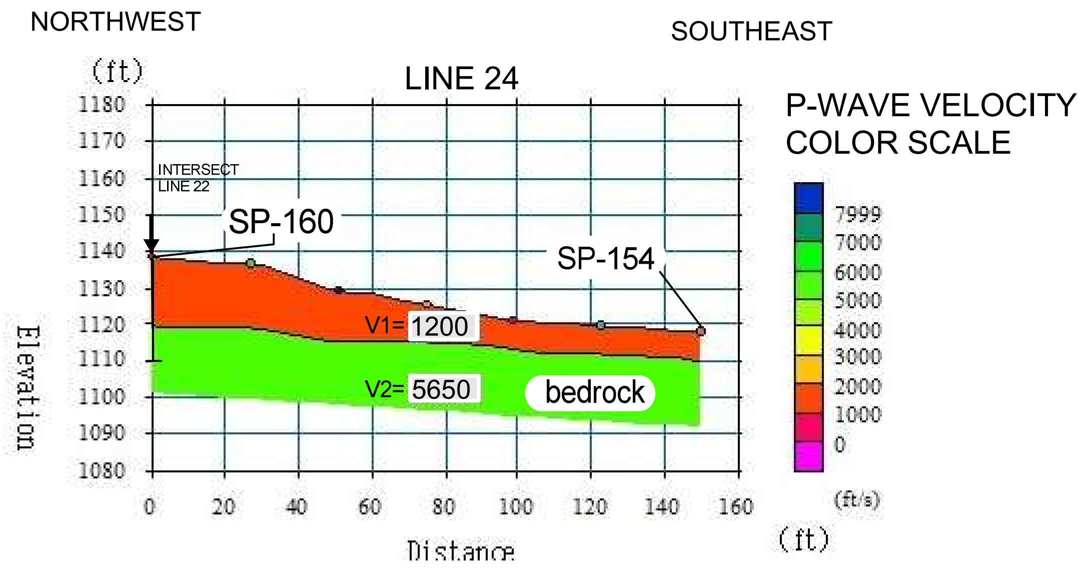
SEISIMC REFRACTION PROFILES
LINES 18, 19, 20 AND 21

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA
CLIENT: GOLDER ASSOCIATES, INC
JOB #: 14-245.15B
NORCAL GEOPHYSICAL CONSULTANTS INC.
DATE: APRIL, 2014
DRAWN BY: W. HENRICH
APPROVED BY: WJH

PLATE
7

V1=





EXPLANATION

**V2 = 7200** Velocity Layer in ft/sec

NORCAL

## SEISIMC REFRACTION PROFILES LINES-22, -23 and -24

LOCATION: PERMANENTE QUARRY, CUPERTINO, CA
CLIENT: GOLDER ASSOCIATES, INC
JOB #: 14-245.15B
NORCAL GEOPHYSICAL CONSULTANTS INC.
DATE: APRIL, 2014
DRAWN BY: W. HENRICH
APPROVED BY: WJH

PLATE 8

# Appendix A

# SEISMIC REFRACTION (SR)

## SEISMIC REFRACTION (SR)

## 1.0 METHODOLOGY

The seismic refraction method provides information regarding the seismic velocity structure of the subsurface. An impulsive (mechanical or explosive) source is used to produce compressional (P) wave seismic energy. The P-waves propagate into the earth and are refracted along interfaces caused by an increase in velocity. A portion of the P-wave energy is refracted back to the surface where it is detected by sensors (geophones) that are coupled to the ground surface in a collinear array (spread). The detected signals are recorded on a multi-channel seismograph and are analyzed to determine the shot point-to-geophone travel times. These data can be used along with the corresponding shot point-to-geophone distances to determine the depth, thickness, and velocity of subsurface seismic layers.

The seismic refraction technique is based on several assumptions. Paramount among these are that seismic velocity:

1) Increases with depth, and,
2) Is uniform within each layer over the length of the given spread.

In cases where these assumptions do not hold, the accuracy of the technique decreases. For example, if a low velocity layer occurs between two layers of higher velocity, the low velocity layer will not be detected and the depth to the underlying high velocity layer will be erroneously large. Also, if the velocity of a seismic layer varies laterally within a spread, those variations will be interpreted as fluctuations in the elevation of the underlying seismic layer.

## 2.0 DATA ACQUISITION/INSTRUMENTATION

Each SR line consisted of 24-geophones and 7-shot points distributed in a collinear array (spread). In most areas, the geophones were coupled to the ground surface by metal spike affixed to the bottom of each geophone case. In areas where the ground surface was too hard to penetrate (e.g. the road) the geophones were mounted on weighted pedestals that coupled them to the ground by their weight. The geophone intervals ranged from 3- to 10-ft depending on access. For each spread, the two end shot points were located one-geophone spacing beyond the end geophone at both ends of the spread. The remaining five shot points were evenly spaced along the spread. This distribution of shot points and geophones yielded total draped line lengths (end-geophone to end-geophone) ranging from 77- to 250-ft. The SR survey was designed to target the upper 15 to 50 feet of geologic material beneath each line, generally consisting of native soil, fill (mine waste) alluvium/stream deposits, weathered and un-weathered bedrock.

Data acquisition was initiated along each SR line by producing seismic energy using a mechanical source. Seismic energy was produced by impacting a metal strike plate on the ground surface with a 12-16 pound sledge hammer. The resulting seismic waveforms are recorded using a Geometrics ***Geode*** 24-channel engineering distributed array seismograph and Mark Products geophones with a natural frequency of 8-Hz. The seismic waveforms were digitized, processed and amplified by the Geode and transmitted via a ruggedized Ethernet cable to a field computer. There the data were archived for subsequent processing and displayed on the computers LCD screen in the form of seismograms. These were subsequently used to determine the time required for P-waves to travel from each shot point to each geophone in a given array (spread).

## 3.0 DATA ANALYSIS

The recorded seismic data were processed using the software package ***SeisImager*** which was written by Oyo Corporation (Japan) and distributed by Geometrics Inc. The first stage of seismic processing included compilation (7 shot points per line) and identification of first arriving P-wave energy. This process was conducted using ***Pickwin, Version 3.2.0.1*** (2004), which is part of the ***SeisImager*** package. A second interactive program ***Plotrefa, Version 2.8.0.1*** (2006) was used to assign geophone travel times, geophone/shot point surface elevations and velocity layer assignments to compute a 2D seismic velocity model based on these inputs. Example Time-Distance graph from a 7 shot point refraction line and inverted seismic layer model are presented in the following figures.

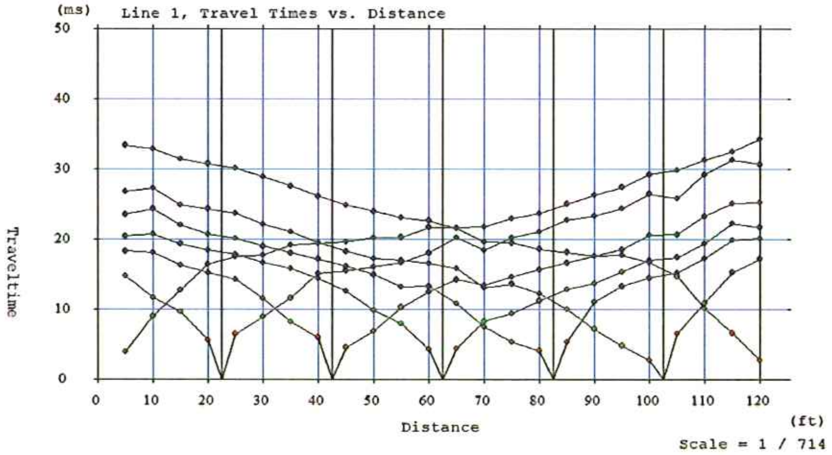


Figure 1 Example SR Time-Distance Graph, 24-geophones; 7 equal spaced shot points

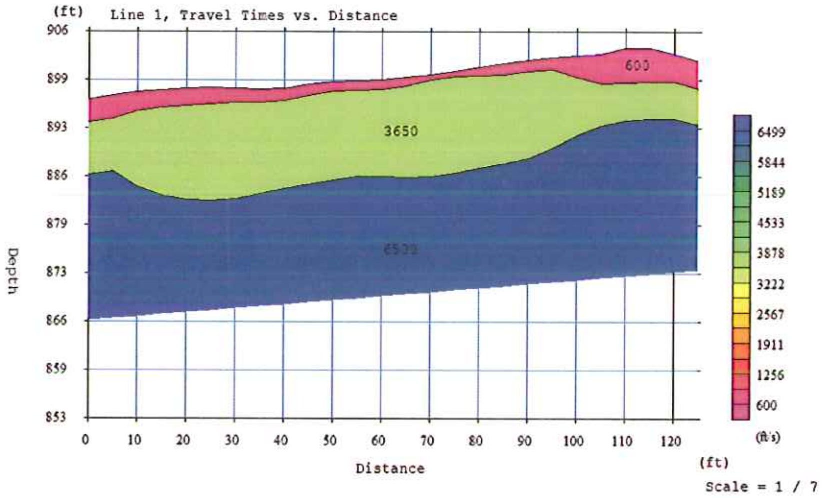


Figure 2 Time-Term Inverted Seismic Velocity Model

For this survey we have chosen an inversion routine that is based on the time-term method. The time-term method employs a combination of linear least squares and delay time analysis to invert the first arrivals into a velocity model. The model can consist of two or three velocity layers depending on the presence of significant line slopes that can be fitted to the first arrival times. Depths to the tops of the velocity layers are calculated below each geophone. For end and interior shot points the depths are extrapolated from the nearest geophone. This inversion as described above produces simplified velocity layers that, though generalized, will provide an adequate, useable characterization of the depth to bedrock.

## 4.0 LIMITATIONS

In general, there are limitations unique to the SR method. These limitations are primarily based on assumptions that are made by the data analysis routine. First, the data analysis routine assumes that the velocities along the length of each spread are uniform. If there are localized zones within each layer where the velocities are higher or lower than indicated, the analysis routine will interpret these zones as changes in the surface topography of the underlying layer. A zone of higher velocity material would be interpreted as a low in the surface of the underlying layer. Zones of lower velocity material would be interpreted as a high in the underlying layer.

Second, the data analysis routine assumes that the velocity of subsurface materials increase with depth. Therefore, if a layer exhibits velocities that are slower than those of the material above it, the slower layer will not be resolved. Also, a velocity layer may simply be too thin to be detected. Due to these and other limitations inherent to the SR method, the results of the SR survey should be considered only as approximations of the subsurface conditions. The actual conditions may vary locally. Other independent data (e.g., surface and borehole geology) should be integrated with SR data to enhance the subsurface interpretation.

# Appendix B

# MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)

## MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)

### 1.0 METHODOLOGY

When seismic energy is generated at or near the ground surface, seismic waves are produced. Those that travel along the ground surface are referred to as ground roll or surface waves. Those that propagate into the earth are referred to as body waves. When a vertical impact seismic energy source is used, the resulting surface waves account for more than two-thirds of the energy that is produced. As a result, surface waves are the most prominent signal on multi-channel seismic records. In addition, surface waves have dispersion properties that body waves lack. That is, different wavelengths have different penetration depths and, therefore, propagate at different velocities. This is referred to as dispersion. Since surface waves travel at 0.9 times the velocity of S-waves, it is possible to determine subsurface Vs by analyzing the dispersion of surface waves. Furthermore, since S-wave velocities are directly proportional to shear modulus, this provides a direct indication in the variation of stiffness (or rigidity) of subsurface materials.

Computer software and processing techniques developed by researchers at the University of Kansas have made it possible to analyze surface waves using a large number of shot points and geophones. This is referred to as multi-channel analysis of surface waves (MASW). Surface wave data are gathered in much the same way as high resolution seismic reflection data. Seismic energy generated by vertical impacts on the ground surface is detected by an array of closely spaced geophones (spread). The energy source and the geophones are sequentially moved along a profile as the survey progresses.

The data gathered from each shot point are analyzed to determine the variation in surface wave velocity versus frequency (dispersion curve). Computer software then inverts the dispersion curve to determine the variation in Vs versus depth. The data gathered from multiple shot points and geophone locations can be collated to produce a two dimensional (2D) cross-section showing the variation in Vs with depth and distance beneath a line.

### 2.0 DATA ACQUISITION/INSTRUMENTATION

Soundings MASW-9 and -10 each comprised an array of 24-geophones distributed at 3-ft intervals in a collinear array (spread). Seismic energy was produced at four shot points on each spread through multiple impacts with a 12-pound sledge hammer against a metal strike plate placed on the ground surface. The shot points were positioned at distances of 3- and 12-ft beyond the end geophones at both ends of each spread. The resulting seismic waveforms were recorded using a Geometrics ***Geode*** 24-channel distributed array seismograph and Oyo ***Geospace*** geophones with a natural frequency of 8-Hz. The seismograph was networked to a field computer where the data were displayed on a LCD screen for QA/QC review and archived for subsequent processing.

## 3.0 DATA ANALYSIS

The MASW data were processed using the software package ***SurfSeis 2.05*** which was developed by the Kansas Geological Survey. Using this software, the data acquired from each shot point were processed to develop an overtone display. This is a color contoured plot that depicts phase velocity as a function of frequency and signal amplitude. The overtone display serves as a guide in nominating the dispersion curve that is used by the inversion routine. However, prior to nominating the dispersion curve, the four overtones were merged into one in order to increase the signal to noise ratio and maximize the continuity of the display. The merged and enhanced overtone was then used as a guide in nominating the dispersion curve used in the inversion process. At the onset of the inversion routine the software created a 1D model comprising 10-layers. Starting values of depth, thickness, Vp, Vs and Poisson's ratio ($\alpha$) were assigned to each layer. The program then proceeded to refine the starting model through an iterative procedure in order to develop a 1D model that provided the best fit to the dispersion curve. In so doing, it was necessary that either Vp or $\alpha$ remain fixed during the inversion process. In this case, we opted to have $\alpha$ remain fixed, at a value of 0.4, so that the final model would provide the best indication of both Vp and Vs as a function of depth. The value of 0.4 was used for $\alpha$ because it is typical of most near surface earth materials.

WATERWAYS
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# APPENDIX D

## Fish Passage Calculations

## Manning's Roughness & Channel Hydraulics using Manning's Equation at a Station

# Manning's Roughness Calculations

Project: Permanente Quarry
Project #: 13-016
Date: 10/30/2018
Calculated by: B.M.Z.
Checked by: B.M.S.

Instructions: Enter variables in RED cells only

**Design equations to determine roughness coefficient of typical roughened channel section at adult fish passage design flows.**

**Culvert #7 Replacement Area Slope = 3.9%**

**Fish Passage Low Flows (Q=2 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.039
R = 0.32 ft
d = 0.38 ft
$D_{84}$ = 2.3 ft
$D_{50}$ = 1.2 ft
$d/D_{84}$ = 0.17

n= 0.22

**Fish Passage High Flow (Q=4.1 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.039
R = 0.3 ft
d = 0.36 ft
$D_{84}$ = 2.3 ft
$D_{50}$ = 1.2 ft
$d/D_{84}$ = 0.16

n= 0.22

**Culvert #8 Replacement Area Slope = 2.7%**

**Fish Passage Low Flows (Q=2 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.027
R = 0.32 ft
d = 0.38 ft
$D_{84}$ = 2 ft
$D_{50}$ = 1 ft
$d/D_{84}$ = 0.19

n= 0.18

**Fish Passage High Flow (Q=4.1 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.027
R = 0.42 ft
d = 0.49 ft
$D_{84}$ = 2 ft
$D_{50}$ = 1 ft
$d/D_{84}$ = 0.25

n= 0.17

**Rock Pile/Material Removal Area Slope = 12%**

**Fish Passage Low Flows (Q=2 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.12
R = 0.34 ft
d = 0.41 ft
$D_{84}$ = 3 ft
$D_{50}$ = 1.5 ft
$d/D_{84}$ = 0.14

n= 0.39

Use roughness of 0.25 (max from literature)

**Fish Passage High Flow (Q=2.8 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.12
R = 0.36 ft
d = 0.43 ft
$D_{84}$ = 3 ft
$D_{50}$ = 1.5 ft
$d/D_{84}$ = 0.14

n= 0.38

Note:
Julien (2002) reports typical boulder bed stream n-values ranging from 0.25 to 0.04

1.) Bathurst, J.C., 1985, Flow resistance estimation in mountain rivers, Journal of Hydraulic Engineering, ASCE, Vol. 111, No.4

2.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

3.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.

4.) Julien, P.Y. 2002. River Mechanics. Cambridge University Press, Cambridge, United Kingdon

# Manning's Roughness Calculations

Project: Permanente Quarry
Project #: 13-016
Date: 10/30/2018
Calculated by: B.M.Z.
Checked by: B.M.S.

Instructions: Enter variables in RED cells only

**Design equations to determine roughness coefficient of typical roughened channel section at <u>juvenile</u> fish passage design flows.**

**Culvert #7 Replacement Area Slope = 3.9%**

**Fish Passage Low Flows (Q=1 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.039
R = 0.28 ft
d = 0.35 ft
$D_{84}$ = 2.3 ft
$D_{50}$ = 1.2 ft
$d/D_{84}$ = 0.15

n= 0.22

**Fish Passage High Flow (Q=1.5 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.039
R = 0.32 ft
d = 0.38 ft
$D_{84}$ = 2.3 ft
$D_{50}$ = 1.2 ft
$d/D_{84}$ = 0.17

n= 0.22

**Culvert #8 Replacement Area Slope = 2.7%**

**Fish Passage Low Flows (Q=1 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.027
R = 0.26 ft
d = 0.32 ft
$D_{84}$ = 2 ft
$D_{50}$ = 1 ft
$d/D_{84}$ = 0.16

n= 0.19

**Fish Passage High Flow (Q=1.5 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.027
R = 0.29 ft
d = 0.36 ft
$D_{84}$ = 2 ft
$D_{50}$ = 1 ft
$d/D_{84}$ = 0.18

n= 0.19

**Rock Pile/Material Removal Area Slope = 12%**

**Fish Passage Low Flows (Q=1 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.12
R = 0.28 ft
d = 0.34 ft
$D_{84}$ = 3 ft
$D_{50}$ = 1.5 ft
$d/D_{84}$ = 0.11

n= 0.41

Use roughness of 0.25 (max from literature)

**Fish Passage High Flow (Q=1 cfs)**

**Mussetter (1989)**

Equation for steep, boulder conditions

$(8/f)^{0.5} = 1.11\ (d/D_{84})^{0.46}(D_{84}/D_{50})^{-0.85}\ S^{-0.39}$

$n = 0.0926\ R^{1/6}\ f^{1/2}$

Therefore: $\mathbf{n = 0.236\ R^{1/6}\ (d/D_{84})^{-0.46}\ (D_{84}/D_{50})^{0.85}\ S^{0.39}}$

d = hydraulic depth Area/Top Width
S = slope
R = hydraulic radius

Equation developed for:
$d/D_{84}$ range (0.24 to 3.72)
$D_{50}$ range (0.1 to 2.1 feet)
S range (0.54 to 16.8 percent)

S = 0.12
R = 0.28 ft
d = 0.34 ft
$D_{84}$ = 3 ft
$D_{50}$ = 1.5 ft
$d/D_{84}$ = 0.11

n= 0.41

Note:
Julien (2002) reports typical boulder bed stream n-values ranging from 0.25 to 0.04

1.) Bathurst, J.C., 1985, Flow resistance estimation in mountain rivers, Journal of Hydraulic Engineering, ASCE, Vol. 111, No.4
2.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.
3.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.
4.) Julien, P.Y. 2002. River Mechanics. Cambridge University Press, Cambridge, United Kingdon

# Channel Report

## Adult High Flow at Culvert #7 - Typical Channel (10'-12' Base Width, 3.9% Slope)

**User-defined**

Invert Elev (ft) = 0.02
Slope (%) = 3.90
N-Value = 0.200

**Calculations**

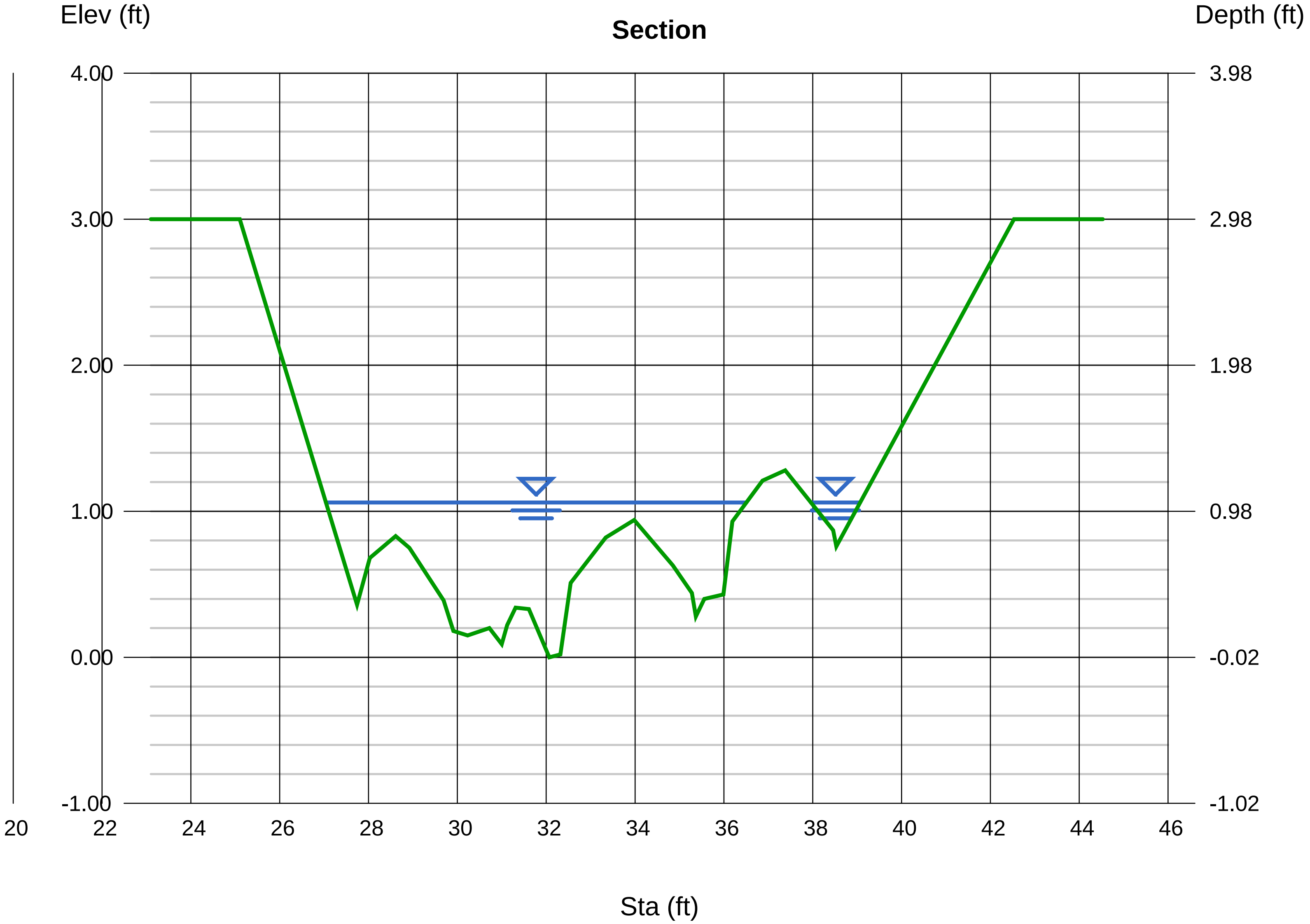
Compute by: Known Q
Known Q (cfs) = 4.10

**Highlighted**

Depth (ft) = 1.04
Q (cfs) = 4.100
Area (sqft) = 5.13
Velocity (ft/s) = 0.80
Wetted Perim (ft) = 12.56
Crit Depth, Yc (ft) = 0.57
Top Width (ft) = 10.57
EGL (ft) = 1.05

**(Sta, El, n)-(Sta, El, n)...**

( 25.10, 3.00)-(27.74, 0.36, 0.200)-(28.03, 0.68, 0.200)-(28.61, 0.83, 0.200)-(28.92, 0.75, 0.200)-(29.69, 0.39, 0.200)-(29.91, 0.18, 0.200)
-(30.23, 0.15, 0.200)-(30.72, 0.20, 0.200)-(31.00, 0.09, 0.200)-(31.12, 0.22, 0.200)-(31.31, 0.34, 0.200)-(31.61, 0.33, 0.200)-(32.32, 0.02, 0.200)
-(32.55, 0.51, 0.200)-(33.34, 0.82, 0.200)-(33.98, 0.94, 0.200)-(34.85, 0.63, 0.200)-(35.28, 0.44, 0.200)-(35.37, 0.28, 0.200)-(35.56, 0.40, 0.200)
-(35.99, 0.43, 0.200)-(36.19, 0.93, 0.200)-(36.87, 1.21, 0.200)-(37.38, 1.28, 0.200)-(38.46, 0.87, 0.200)-(38.53, 0.76, 0.200)-(42.53, 3.00, 0.200)



# Channel Report

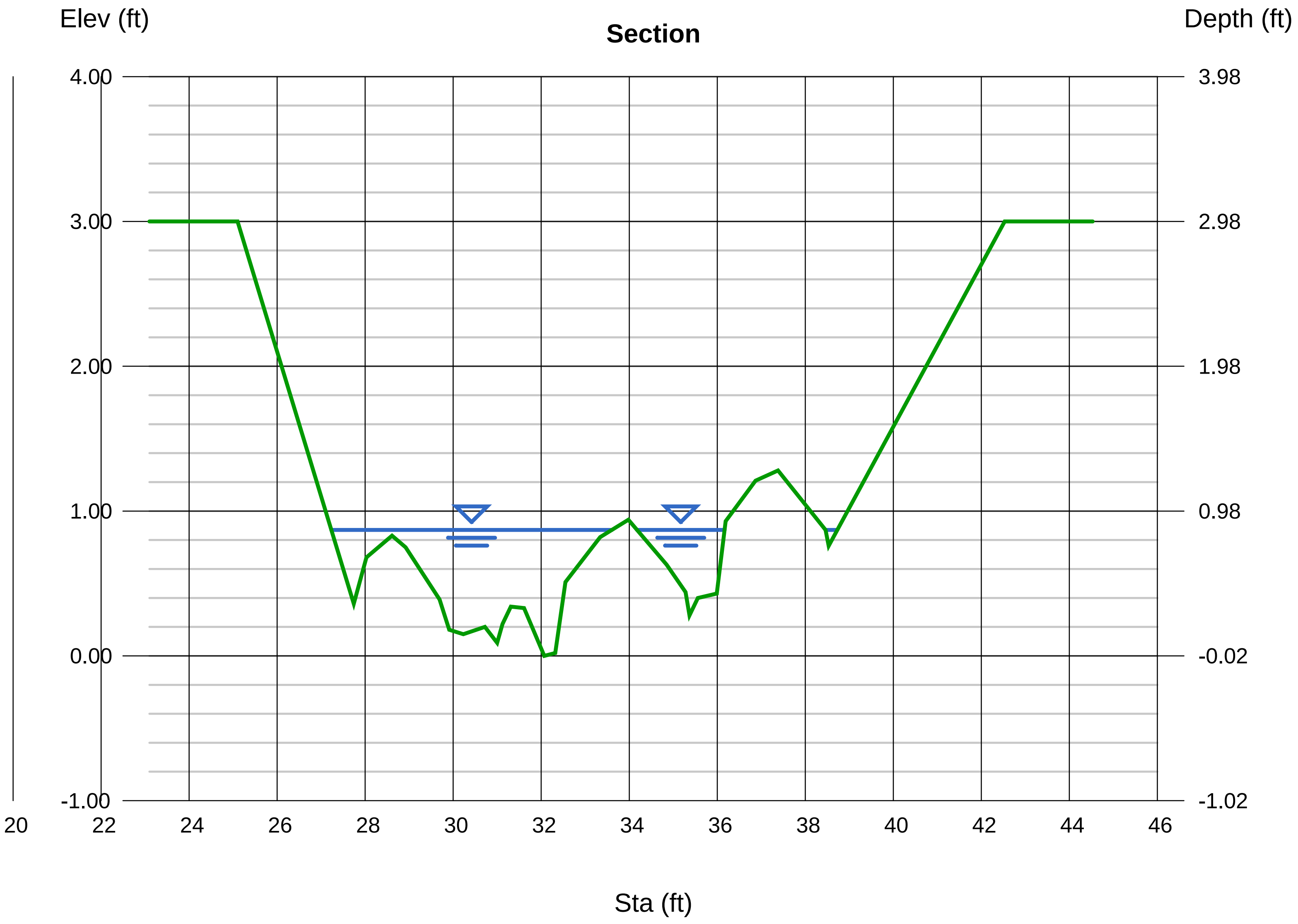
## Adult Low Flow at Culvert #7 - Typical Channel (10'-12' Base Width, 3.9% Slope)

**User-defined**
Invert Elev (ft) = 0.02
Slope (%) = 3.90
N-Value = 0.220

**Calculations**
Compute by: Known Q
Known Q (cfs) = 2.00

**Highlighted**
Depth (ft) = 0.85
Q (cfs) = 2.000
Area (sqft) = 3.28
Velocity (ft/s) = 0.61
Wetted Perim (ft) = 10.38
Crit Depth, Yc (ft) = 0.43
Top Width (ft) = 8.63
EGL (ft) = 0.86

**(Sta, El, n)-(Sta, El, n)...**
( 25.10, 3.00)-(27.74, 0.36, 0.220)-(28.03, 0.68, 0.220)-(28.61, 0.83, 0.220)-(28.92, 0.75, 0.220)-(29.69, 0.39, 0.220)-(29.91, 0.18, 0.220)
-(30.23, 0.15, 0.220)-(30.72, 0.20, 0.220)-(31.00, 0.09, 0.220)-(31.12, 0.22, 0.220)-(31.31, 0.34, 0.220)-(31.61, 0.33, 0.220)-(32.32, 0.02, 0.220)
-(32.55, 0.51, 0.220)-(33.34, 0.82, 0.220)-(33.98, 0.94, 0.220)-(34.85, 0.63, 0.220)-(35.28, 0.44, 0.220)-(35.37, 0.28, 0.220)-(35.56, 0.40, 0.220)
-(35.99, 0.43, 0.220)-(36.19, 0.93, 0.220)-(36.87, 1.21, 0.220)-(37.38, 1.28, 0.220)-(38.46, 0.87, 0.220)-(38.53, 0.76, 0.220)-(42.53, 3.00, 0.220)



# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 2 2018

## Juvenile High Flow at Culvert #7 - Typical Channel (10'-12' Base Width, 3.9% Slope)

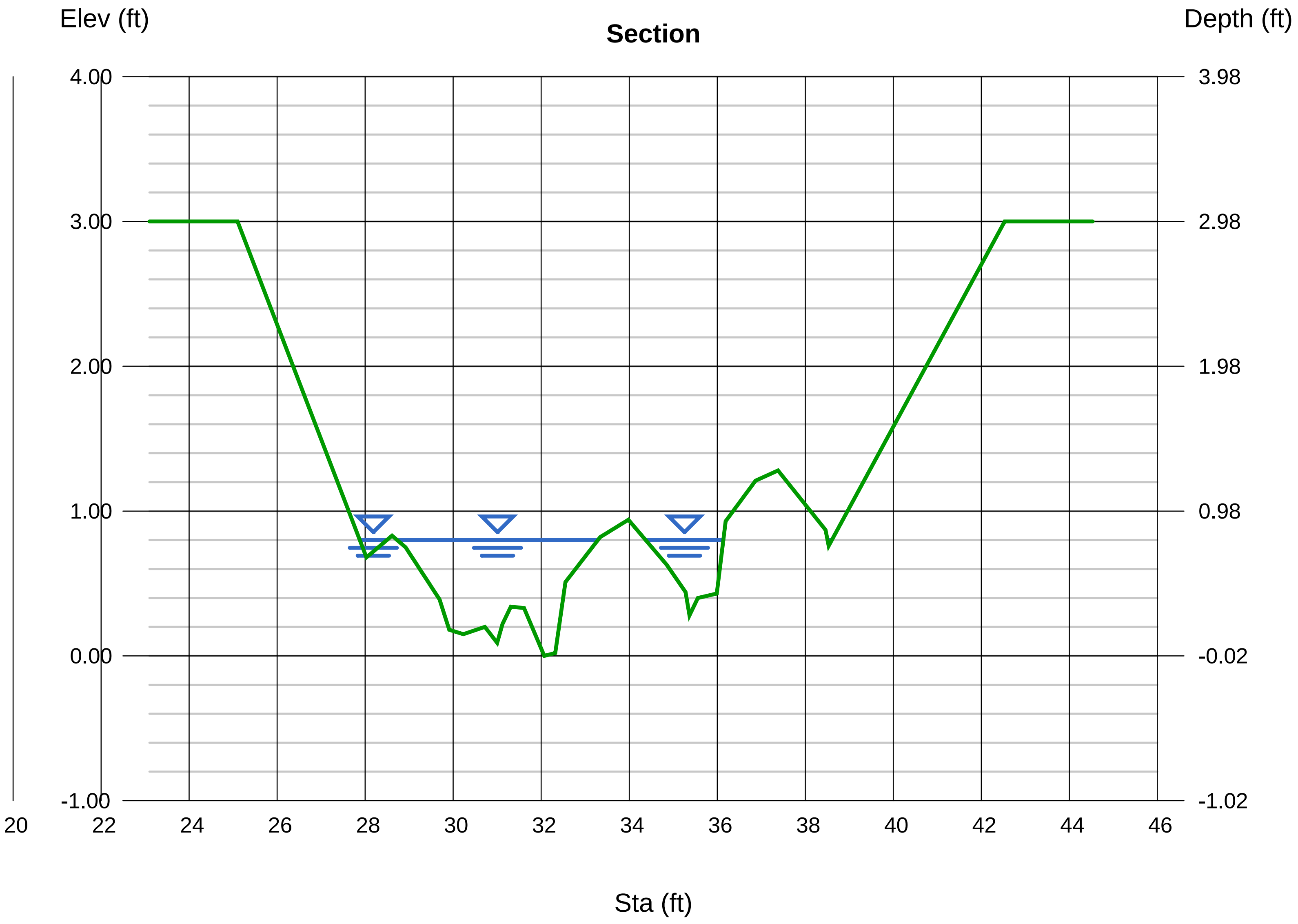
**User-defined**
Invert Elev (ft) = 0.02
Slope (%) = 3.90
N-Value = 0.220

**Calculations**
Compute by: Known Q
Known Q (cfs) = 1.50

**Highlighted**
Depth (ft) = 0.78
Q (cfs) = 1.500
Area (sqft) = 2.54
Velocity (ft/s) = 0.59
Wetted Perim (ft) = 8.34
Crit Depth, Yc (ft) = 0.38
Top Width (ft) = 7.04
EGL (ft) = 0.79

**(Sta, El, n)-(Sta, El, n)...**

( 25.10, 3.00)-(28.03, 0.68, 0.220)-(28.61, 0.83, 0.220)-(28.92, 0.75, 0.220)-(29.69, 0.39, 0.220)-(29.91, 0.18, 0.220)-(30.23, 0.15, 0.220)
-(30.72, 0.20, 0.220)-(31.00, 0.09, 0.220)-(31.12, 0.22, 0.220)-(31.31, 0.34, 0.220)-(31.61, 0.33, 0.220)-(32.32, 0.02, 0.220)-(32.55, 0.51, 0.220)
-(33.34, 0.82, 0.220)-(33.98, 0.94, 0.220)-(34.85, 0.63, 0.220)-(35.28, 0.44, 0.220)-(35.37, 0.28, 0.220)-(35.56, 0.40, 0.220)-(35.99, 0.43, 0.220)
-(36.19, 0.93, 0.220)-(36.87, 1.21, 0.220)-(37.38, 1.28, 0.220)-(38.46, 0.87, 0.220)-(38.53, 0.76, 0.220)-(42.53, 3.00, 0.220)



# Channel Report

## Juvenile Low Flow at Culvert #7 - Typical Channel (10'-12' Base Width, 3.9% Slope)

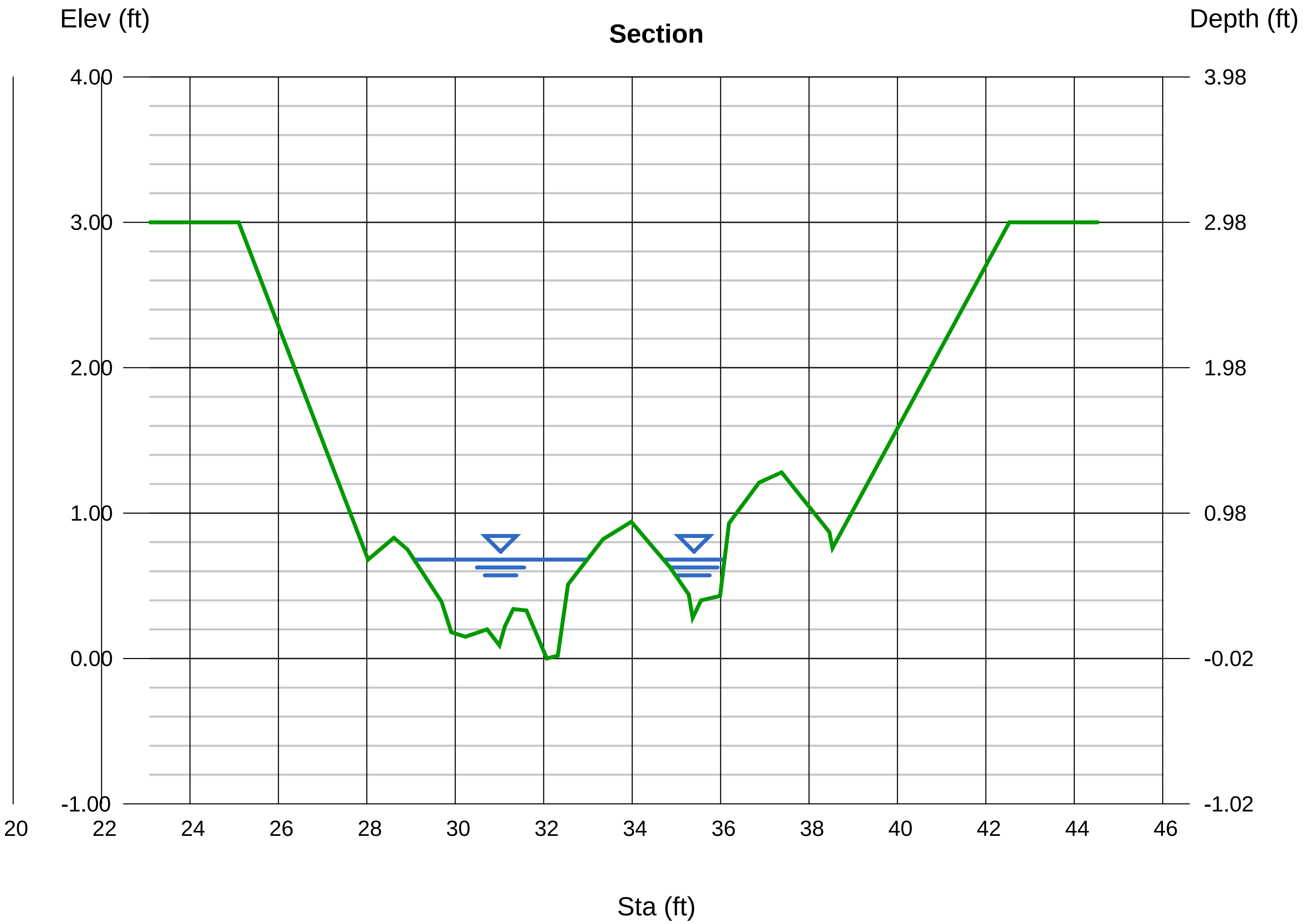
**User-defined**
Invert Elev (ft) = 0.02
Slope (%) = 3.90
N-Value = 0.220

**Calculations**
Compute by: Known Q
Known Q (cfs) = 1.00

**Highlighted**
Depth (ft) = 0.66
Q (cfs) = 1.000
Area (sqft) = 1.80
Velocity (ft/s) = 0.55
Wetted Perim (ft) = 6.36
Crit Depth, Yc (ft) = 0.33
Top Width (ft) = 5.29
EGL (ft) = 0.66

**(Sta, El, n)-(Sta, El, n)...**

( 25.10, 3.00)-(28.03, 0.68, 0.220)-(28.61, 0.83, 0.220)-(28.92, 0.75, 0.220)-(29.69, 0.39, 0.220)-(29.91, 0.18, 0.220)-(30.23, 0.15, 0.220)
-(30.72, 0.20, 0.220)-(31.00, 0.09, 0.220)-(31.12, 0.22, 0.220)-(31.31, 0.34, 0.220)-(31.61, 0.33, 0.220)-(32.32, 0.02, 0.220)-(32.55, 0.51, 0.220)
-(33.34, 0.82, 0.220)-(33.98, 0.94, 0.220)-(34.85, 0.63, 0.220)-(35.28, 0.44, 0.220)-(35.37, 0.28, 0.220)-(35.56, 0.40, 0.220)-(35.99, 0.43, 0.220)
-(36.19, 0.93, 0.220)-(36.87, 1.21, 0.220)-(37.38, 1.28, 0.220)-(38.46, 0.87, 0.220)-(38.53, 0.76, 0.220)-(42.53, 3.00, 0.220)



# Channel Report

## Adult High Flow at Culvert #8 - Typical Channel (10'-12' Base Width, 2.7% Slope)

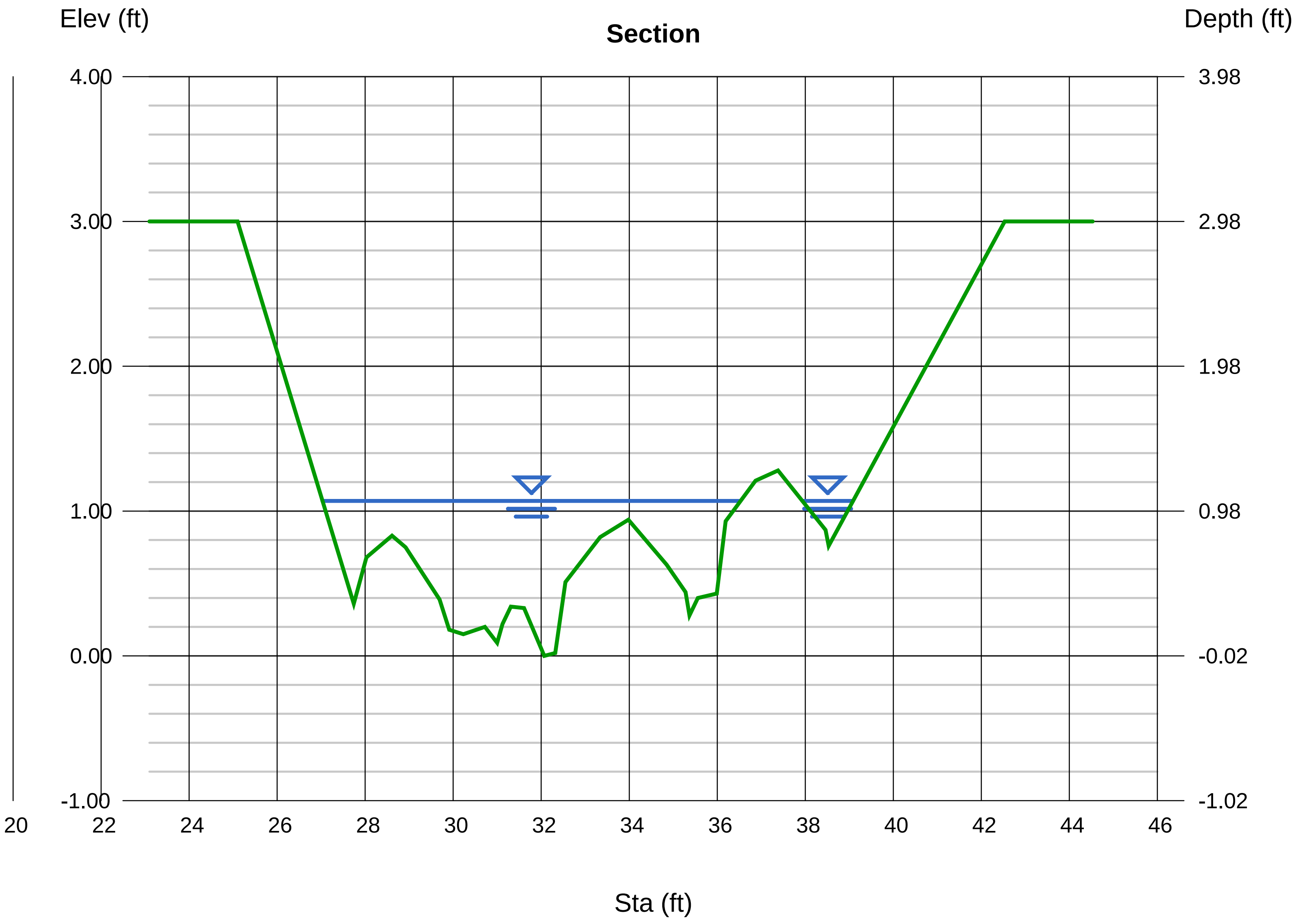
**User-defined**
Invert Elev (ft) = 0.02
Slope (%) = 2.70
N-Value = 0.170

**Calculations**
Compute by: Known Q
Known Q (cfs) = 4.10

**Highlighted**
Depth (ft) = 1.05
Q (cfs) = 4.100
Area (sqft) = 5.23
Velocity (ft/s) = 0.78
Wetted Perim (ft) = 12.65
Crit Depth, Yc (ft) = 0.57
Top Width (ft) = 10.65
EGL (ft) = 1.06

**(Sta, El, n)-(Sta, El, n)...**

( 25.10, 3.00)-(27.74, 0.36, 0.170)-(28.03, 0.68, 0.170)-(28.61, 0.83, 0.170)-(28.92, 0.75, 0.170)-(29.69, 0.39, 0.170)-(29.91, 0.18, 0.170)
-(30.23, 0.15, 0.170)-(30.72, 0.20, 0.170)-(31.00, 0.09, 0.170)-(31.12, 0.22, 0.170)-(31.31, 0.34, 0.170)-(31.61, 0.33, 0.170)-(32.32, 0.02, 0.170)
-(32.55, 0.51, 0.170)-(33.34, 0.82, 0.170)-(33.98, 0.94, 0.170)-(34.85, 0.63, 0.170)-(35.28, 0.44, 0.170)-(35.37, 0.28, 0.170)-(35.56, 0.40, 0.170)
-(35.99, 0.43, 0.170)-(36.19, 0.93, 0.170)-(36.87, 1.21, 0.170)-(37.38, 1.28, 0.170)-(38.46, 0.87, 0.170)-(38.53, 0.76, 0.170)-(42.53, 3.00, 0.170)



# Channel Report

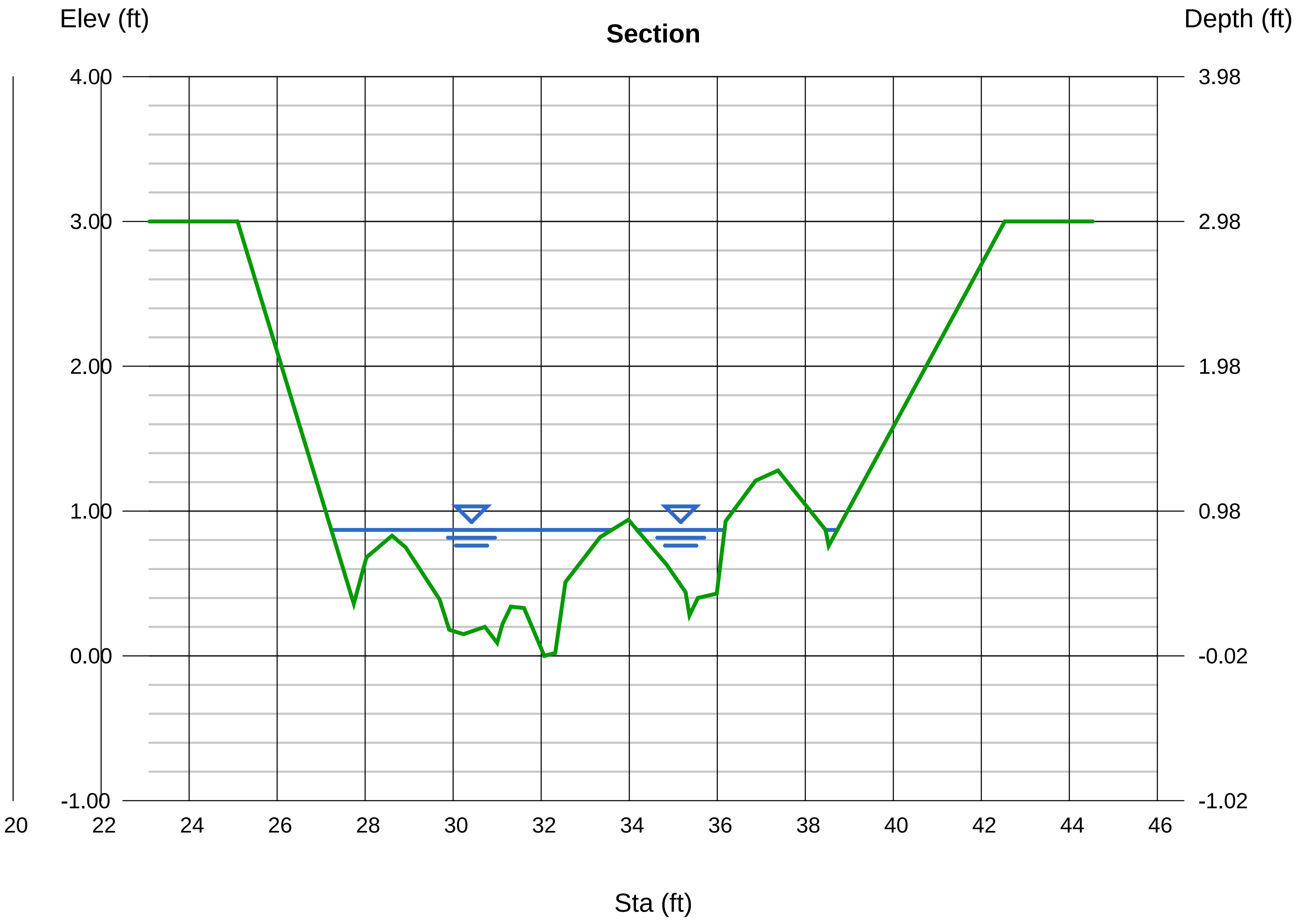
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 2 2018

## Adult Low Flow at Culvert #8 - Typical Channel (10'-12'  Base Width, 2.7% Slope)

| **User-defined** | | **Highlighted** | |
|---|---|---|---|
| Invert Elev (ft) | = 0.02 | Depth (ft) | = 0.85 |
| Slope (%) | = 2.70 | Q (cfs) | = 2.000 |
| N-Value | = 0.180 | Area (sqft) | = 3.28 |
| | | Velocity (ft/s) | = 0.61 |
| **Calculations** | | Wetted Perim (ft) | = 10.38 |
| Compute by: | Known Q | Crit Depth, Yc (ft) | = 0.43 |
| Known Q (cfs) | = 2.00 | Top Width (ft) | = 8.63 |
| | | EGL (ft) | = 0.86 |

**(Sta, El, n)-(Sta, El, n)...**

( 25.10, 3.00)-(27.74, 0.36, 0.180)-(28.03, 0.68, 0.180)-(28.61, 0.83, 0.180)-(28.92, 0.75, 0.180)-(29.69, 0.39, 0.180)-(29.91, 0.18, 0.180)
-(30.23, 0.15, 0.180)-(30.72, 0.20, 0.180)-(31.00, 0.09, 0.180)-(31.12, 0.22, 0.180)-(31.31, 0.34, 0.180)-(31.61, 0.33, 0.180)-(32.32, 0.02, 0.180)
-(32.55, 0.51, 0.180)-(33.34, 0.82, 0.180)-(33.98, 0.94, 0.180)-(34.85, 0.63, 0.180)-(35.28, 0.44, 0.180)-(35.37, 0.28, 0.180)-(35.56, 0.40, 0.180)
-(35.99, 0.43, 0.180)-(36.19, 0.93, 0.180)-(36.87, 1.21, 0.180)-(37.38, 1.28, 0.180)-(38.46, 0.87, 0.180)-(38.53, 0.76, 0.180)-(42.53, 3.00, 0.180)



# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 2 2018

## Juvenile High Flow at Culvert #8 - Typical Channel (10'-12'  Base Width, 2.7% Slope)

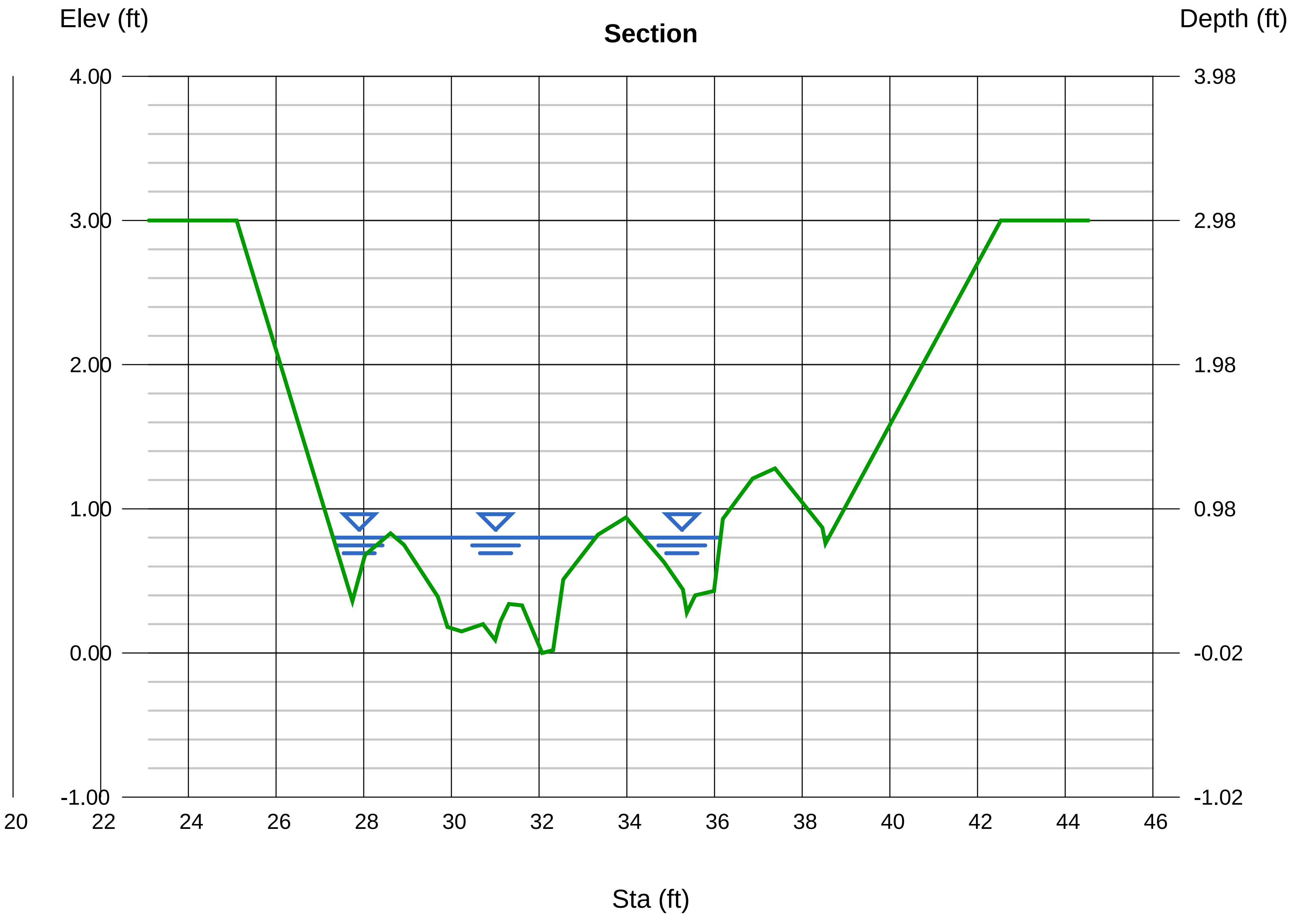
**User-defined**
Invert Elev (ft) = 0.02
Slope (%) = 2.70
N-Value = 0.190

**Calculations**
Compute by: Known Q
Known Q (cfs) = 1.50

**Highlighted**
Depth (ft) = 0.78
Q (cfs) = 1.500
Area (sqft) = 2.71
Velocity (ft/s) = 0.55
Wetted Perim (ft) = 9.20
Crit Depth, Yc (ft) = 0.38
Top Width (ft) = 7.62
EGL (ft) = 0.78

**(Sta, El, n)-(Sta, El, n)...**

( 25.10, 3.00)-(27.74, 0.36, 0.190)-(28.03, 0.68, 0.190)-(28.61, 0.83, 0.190)-(28.92, 0.75, 0.190)-(29.69, 0.39, 0.190)-(29.91, 0.18, 0.190)
-(30.23, 0.15, 0.190)-(30.72, 0.20, 0.190)-(31.00, 0.09, 0.190)-(31.12, 0.22, 0.190)-(31.31, 0.34, 0.190)-(31.61, 0.33, 0.190)-(32.32, 0.02, 0.190)
-(32.55, 0.51, 0.190)-(33.34, 0.82, 0.190)-(33.98, 0.94, 0.190)-(34.85, 0.63, 0.190)-(35.28, 0.44, 0.190)-(35.37, 0.28, 0.190)-(35.56, 0.40, 0.190)
-(35.99, 0.43, 0.190)-(36.19, 0.93, 0.190)-(36.87, 1.21, 0.190)-(37.38, 1.28, 0.190)-(38.46, 0.87, 0.190)-(38.53, 0.76, 0.190)-(42.53, 3.00, 0.190)



# Channel Report

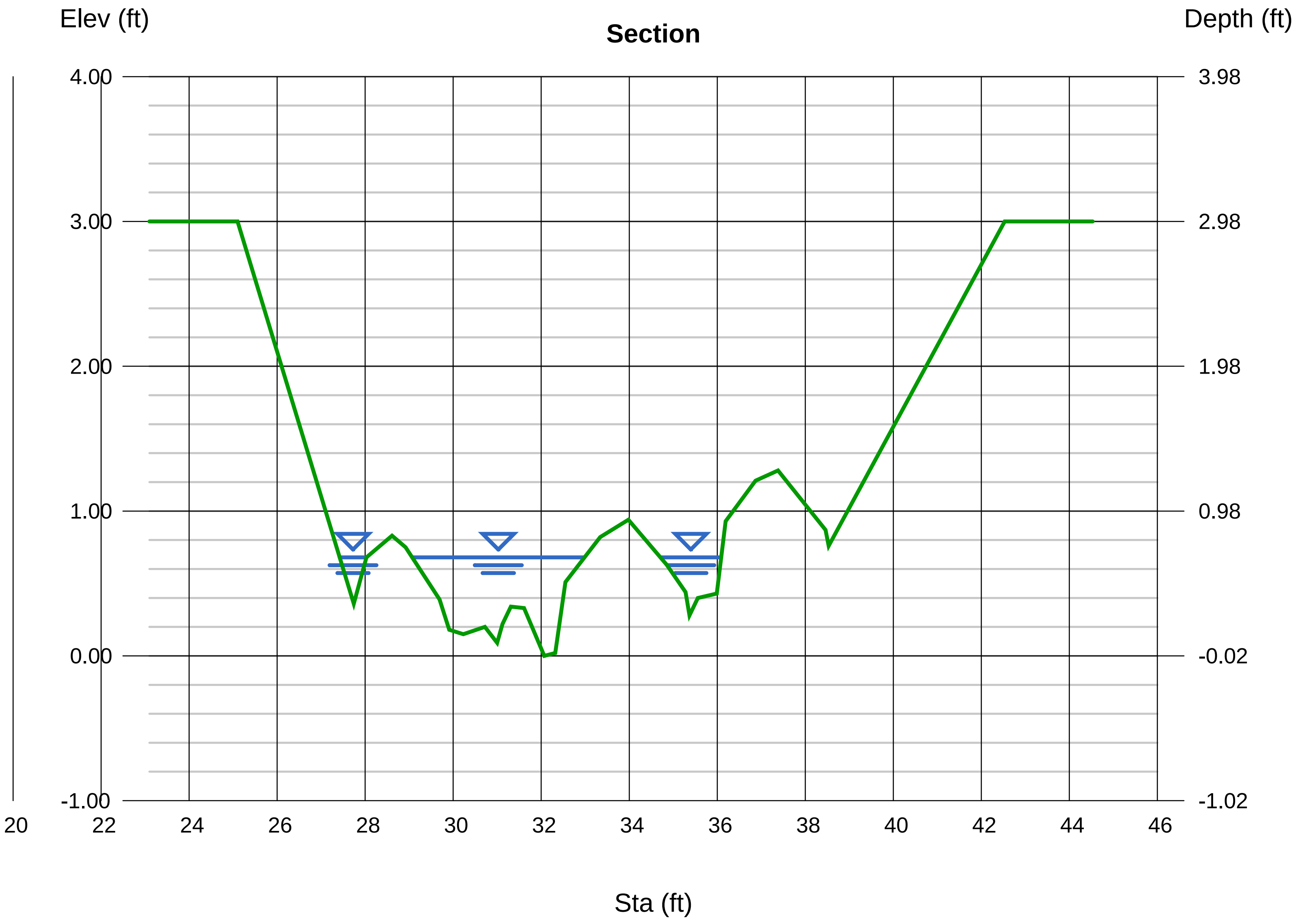
## Juvenile Low Flow at Culvert #8 - Typical Channel (10'-12' Base Width, 2.7% Slope)

**User-defined**
Invert Elev (ft) = 0.02
Slope (%) = 2.70
N-Value = 0.190

**Calculations**
Compute by: Known Q
Known Q (cfs) = 1.00

**Highlighted**
Depth (ft) = 0.66
Q (cfs) = 1.000
Area (sqft) = 1.90
Velocity (ft/s) = 0.53
Wetted Perim (ft) = 7.24
Crit Depth, Yc (ft) = 0.33
Top Width (ft) = 5.90
EGL (ft) = 0.66

**(Sta, El, n)-(Sta, El, n)...**
( 25.10, 3.00)-(27.74, 0.36, 0.190)-(28.03, 0.68, 0.190)-(28.61, 0.83, 0.190)-(28.92, 0.75, 0.190)-(29.69, 0.39, 0.190)-(29.91, 0.18, 0.190)
-(30.23, 0.15, 0.190)-(30.72, 0.20, 0.190)-(31.00, 0.09, 0.190)-(31.12, 0.22, 0.190)-(31.31, 0.34, 0.190)-(31.61, 0.33, 0.190)-(32.32, 0.02, 0.190)
-(32.55, 0.51, 0.190)-(33.34, 0.82, 0.190)-(33.98, 0.94, 0.190)-(34.85, 0.63, 0.190)-(35.28, 0.44, 0.190)-(35.37, 0.28, 0.190)-(35.56, 0.40, 0.190)
-(35.99, 0.43, 0.190)-(36.19, 0.93, 0.190)-(36.87, 1.21, 0.190)-(37.38, 1.28, 0.190)-(38.46, 0.87, 0.190)-(38.53, 0.76, 0.190)-(42.53, 3.00, 0.190)



# Channel Report

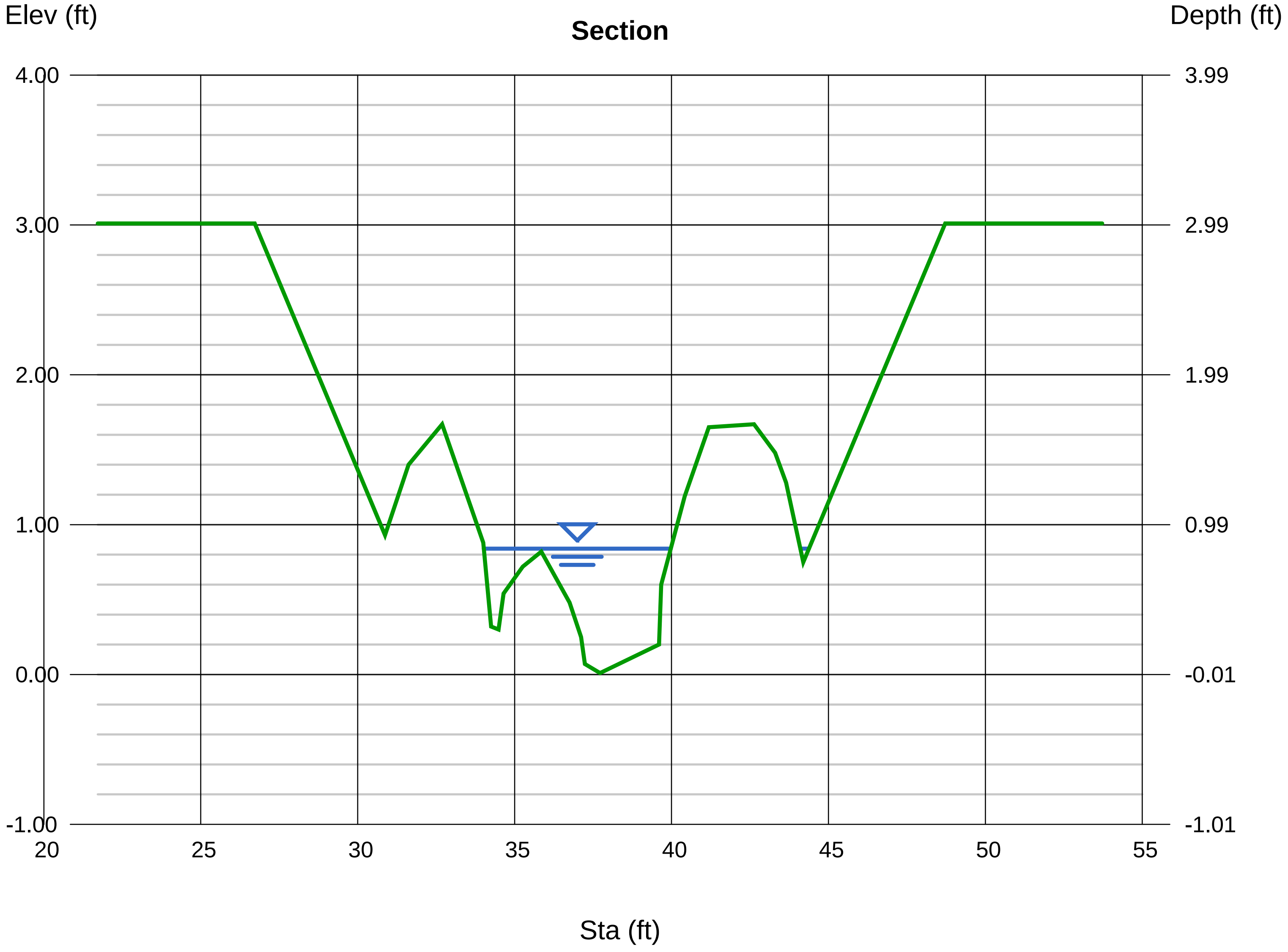
## Adult High Flow at Rock Pile/Mat. Rem. Area - Typ. Chnl (9'-10' Base Width, 12% Slope)

**User-defined**
Invert Elev (ft) = 0.01
Slope (%) = 12.00
N-Value = 0.250

**Calculations**
Compute by: Known Q
Known Q (cfs) = 2.80

**Highlighted**
Depth (ft) = 0.83
Q (cfs) = 2.800
Area (sqft) = 2.70
Velocity (ft/s) = 1.04
Wetted Perim (ft) = 7.45
Crit Depth, Yc (ft) = 0.43
Top Width (ft) = 6.23
EGL (ft) = 0.85

**(Sta, El, n)-(Sta, El, n)...**
( 26.72, 3.01)-(30.87, 0.93, 0.250)-(31.62, 1.40, 0.250)-(32.69, 1.67, 0.250)-(34.00, 0.88, 0.250)-(34.25, 0.32, 0.250)-(34.49, 0.30, 0.250)
-(34.65, 0.54, 0.250)-(35.26, 0.72, 0.250)-(35.85, 0.82, 0.250)-(36.75, 0.48, 0.250)-(37.12, 0.25, 0.250)-(37.24, 0.07, 0.250)-(37.72, 0.01, 0.250)
-(39.60, 0.20, 0.250)-(39.67, 0.60, 0.250)-(40.42, 1.19, 0.250)-(41.19, 1.65, 0.250)-(42.63, 1.67, 0.250)-(43.30, 1.48, 0.250)-(43.65, 1.28, 0.250)
-(44.20, 0.75, 0.250)-(48.72, 3.01, 0.250)



# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 2 2018

## Adult Low Flow at Rock Pile/Mat. Rem. Area - Typ. Chnl (9'-10' Base Width, 12% Slope)

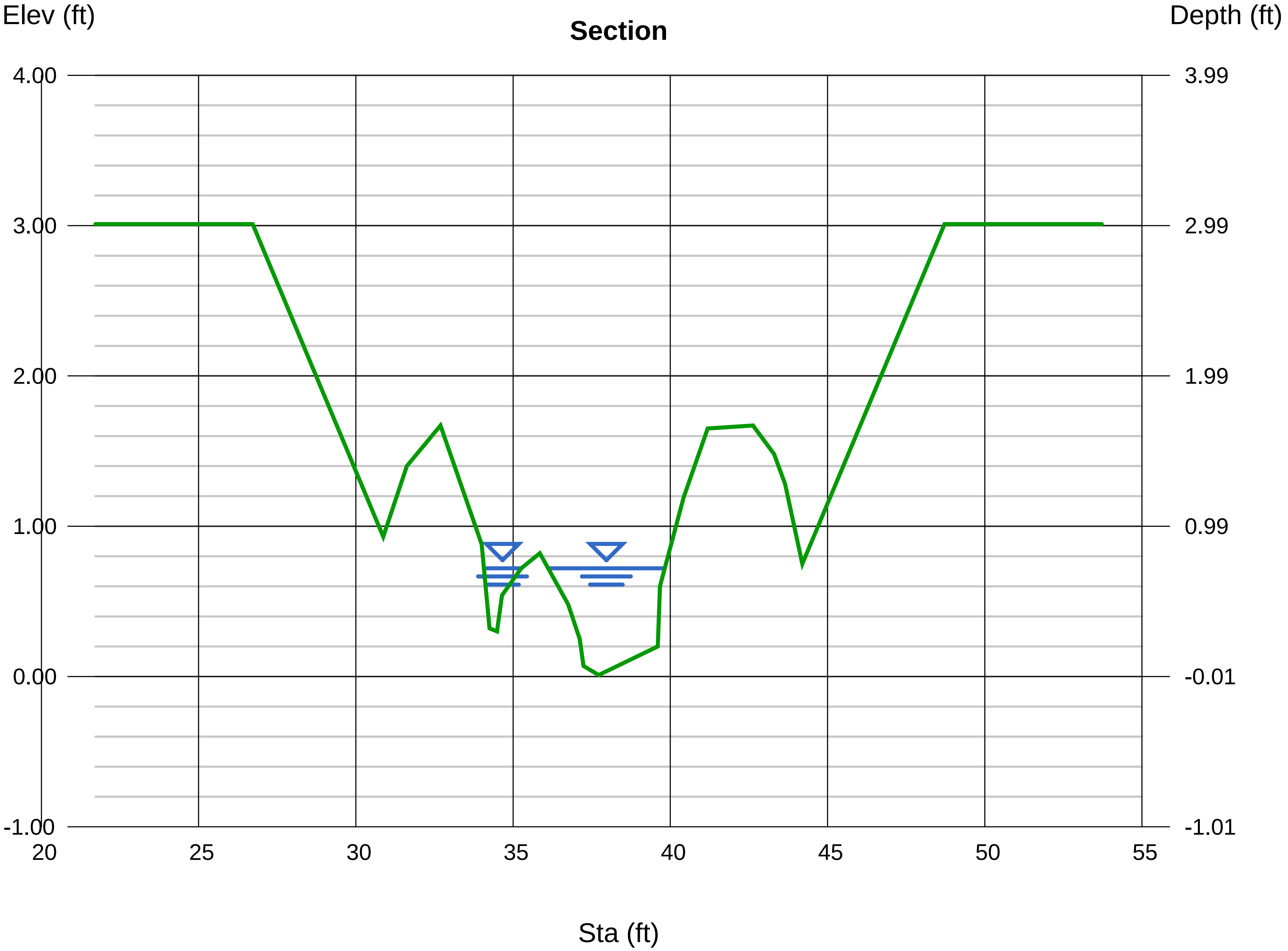
**User-defined**
Invert Elev (ft) = 0.01
Slope (%) = 12.00
N-Value = 0.250

**Calculations**
Compute by: Known Q
Known Q (cfs) = 2.00

**Highlighted**
Depth (ft) = 0.71
Q (cfs) = 2.000
Area (sqft) = 2.03
Velocity (ft/s) = 0.99
Wetted Perim (ft) = 5.91
Crit Depth, Yc (ft) = 0.37
Top Width (ft) = 4.90
EGL (ft) = 0.73

**(Sta, El, n)-(Sta, El, n)...**

( 26.72, 3.01)-(30.87, 0.93, 0.250)-(31.62, 1.40, 0.250)-(32.69, 1.67, 0.250)-(34.00, 0.88, 0.250)-(34.25, 0.32, 0.250)-(34.49, 0.30, 0.250)
-(34.65, 0.54, 0.250)-(35.26, 0.72, 0.250)-(35.85, 0.82, 0.250)-(36.75, 0.48, 0.250)-(37.12, 0.25, 0.250)-(37.24, 0.07, 0.250)-(37.72, 0.01, 0.250)
-(39.60, 0.20, 0.250)-(39.67, 0.60, 0.250)-(40.42, 1.19, 0.250)-(41.19, 1.65, 0.250)-(42.63, 1.67, 0.250)-(43.30, 1.48, 0.250)-(43.65, 1.28, 0.250)
-(44.20, 0.75, 0.250)-(48.72, 3.01, 0.250)



# Channel Report

## Juvenile High/Low Flow at Rock Pile/Mat. Rem. Area-Typ. Chnl (9'-10'  Base Width, 12%

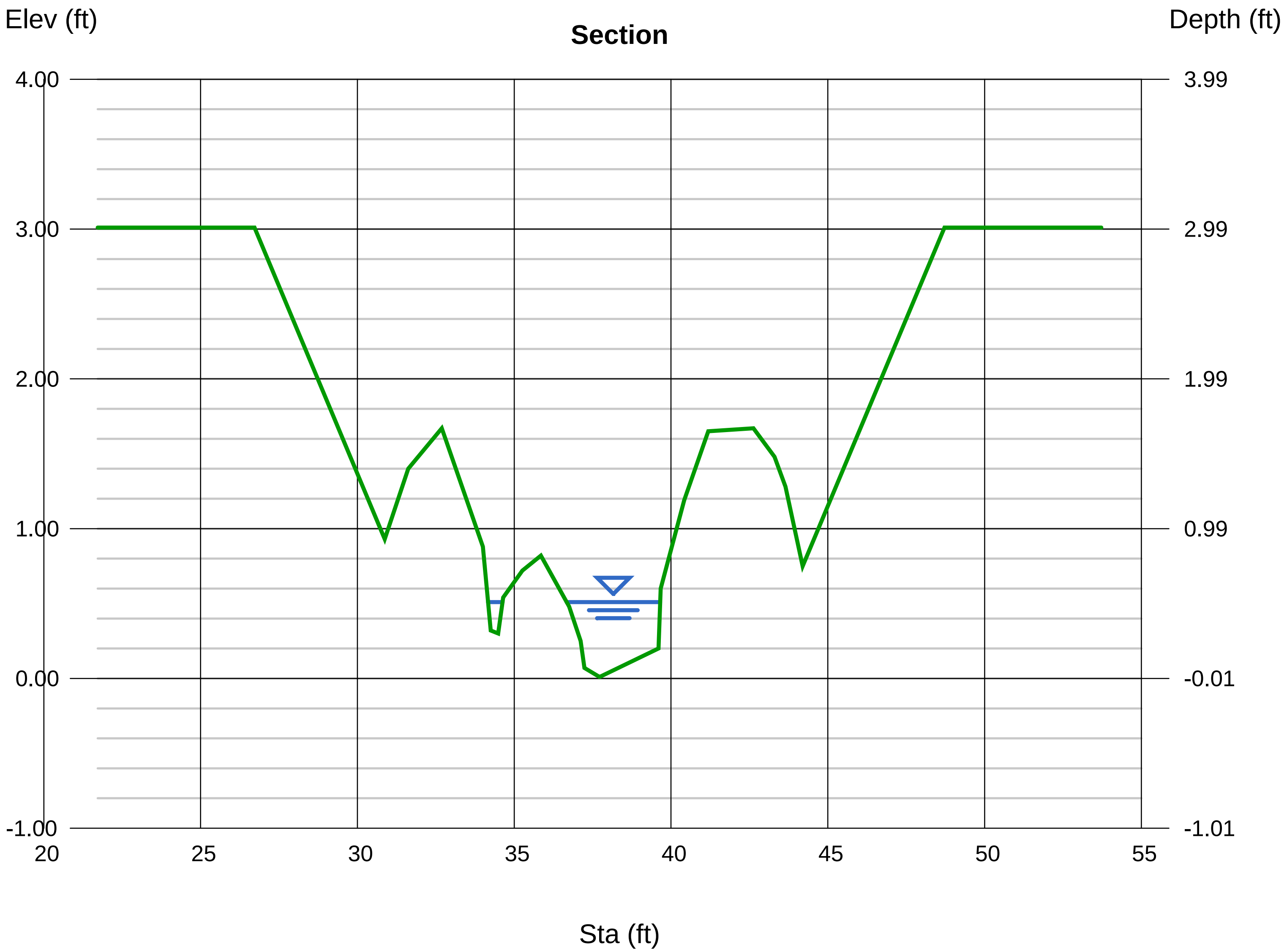
**User-defined**
Invert Elev (ft) = 0.01
Slope (%) = 12.00
N-Value = 0.250

**Calculations**
Compute by: Known Q
Known Q (cfs) = 1.00

**Highlighted**
Depth (ft) = 0.50
Q (cfs) = 1.000
Area (sqft) = 1.16
Velocity (ft/s) = 0.86
Wetted Perim (ft) = 4.13
Crit Depth, Yc (ft) = 0.26
Top Width (ft) = 3.45
EGL (ft) = 0.51

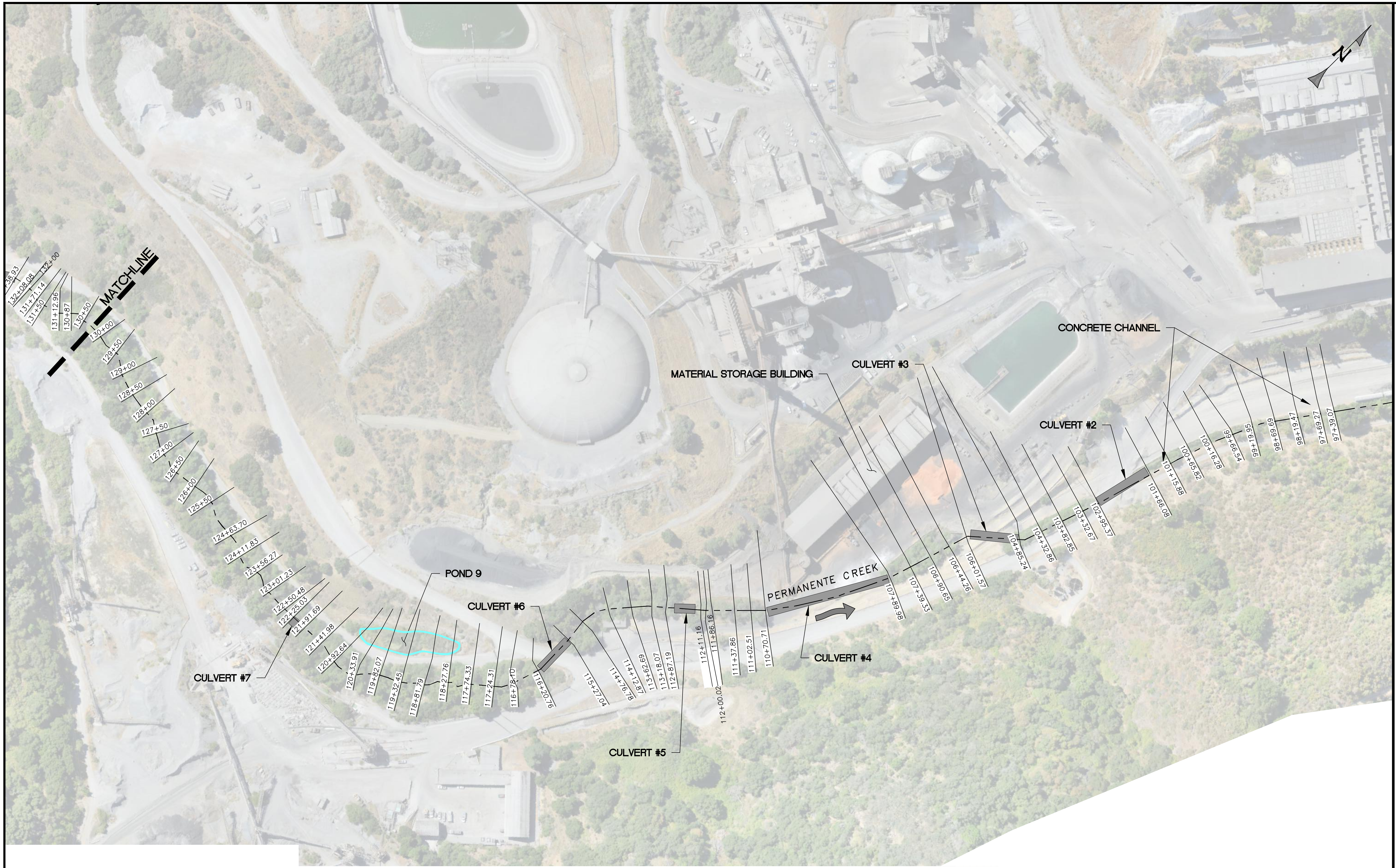
**(Sta, El, n)-(Sta, El, n)...**

( 26.72, 3.01)-(30.87, 0.93, 0.250)-(31.62, 1.40, 0.250)-(32.69, 1.67, 0.250)-(34.00, 0.88, 0.250)-(34.25, 0.32, 0.250)-(34.49, 0.30, 0.250)
-(34.65, 0.54, 0.250)-(35.26, 0.72, 0.250)-(35.85, 0.82, 0.250)-(36.75, 0.48, 0.250)-(37.12, 0.25, 0.250)-(37.24, 0.07, 0.250)-(37.72, 0.01, 0.250)
-(39.60, 0.20, 0.250)-(39.67, 0.60, 0.250)-(40.42, 1.19, 0.250)-(41.19, 1.65, 0.250)-(42.63, 1.67, 0.250)-(43.30, 1.48, 0.250)-(43.65, 1.28, 0.250)
-(44.20, 0.75, 0.250)-(48.72, 3.01, 0.250)



# APPENDIX E

## HEC-RAS Model Results



**LEGEND**

— — — HEC–RAS ALIGNMENT

132+00 HEC–RAS CROSS SECTION LOCATION

**HEC-RAS CROSS SECTION OVERVIEW**

SCALE: 1"=200'

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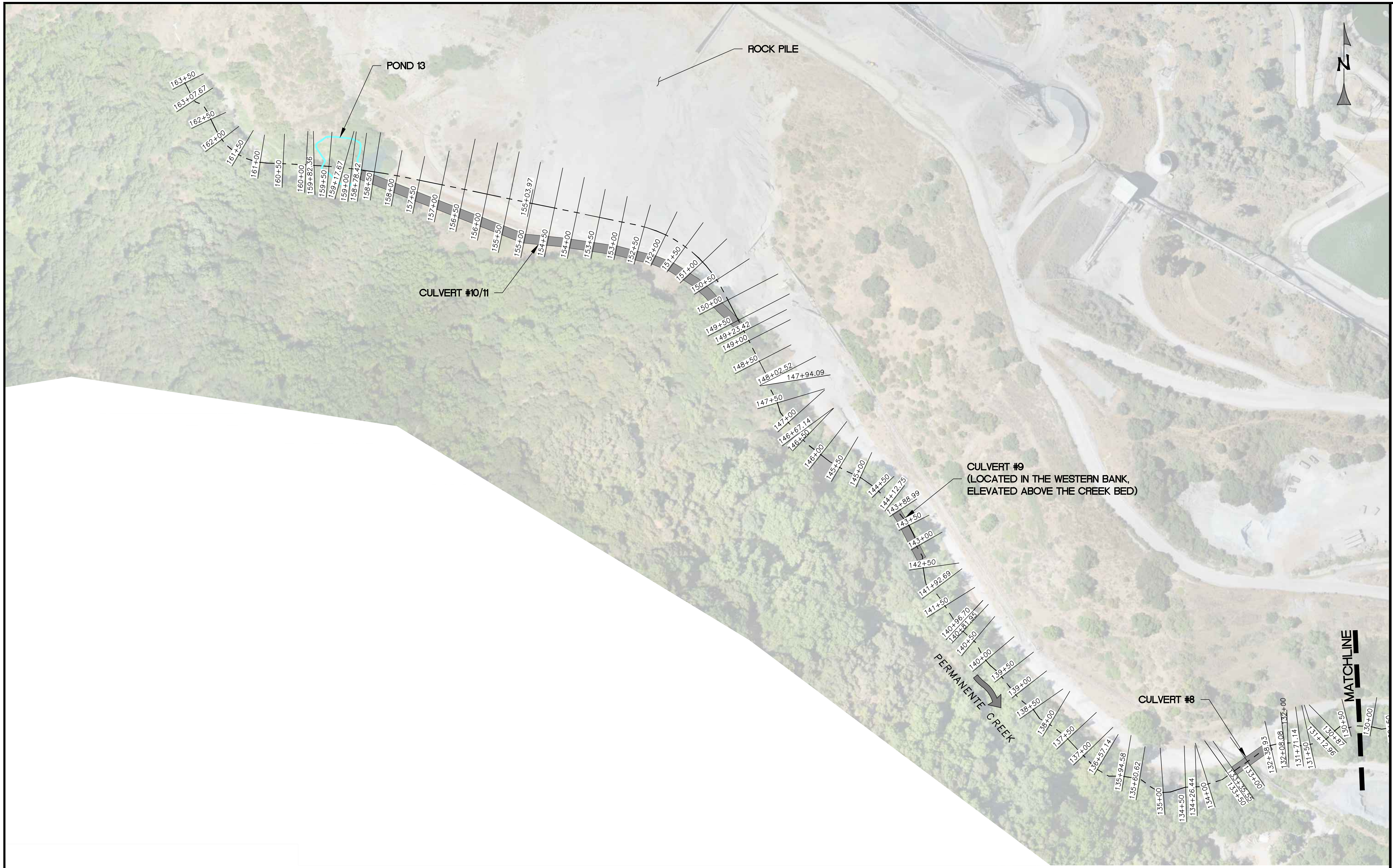
# CHANNEL WIDENING TO ROCK PILE AREA
# HEC-RAS CROSS SECTION OVERVIEW (1 OF 2)

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS

0 1"

FIGURE

1.0



## HEC-RAS CROSS SECTION OVERVIEW

SCALE: 1"=200'

**LEGEND**

| | |
|---|---|
| — — — — | HEC–RAS ALIGNMENT |
| 132+00 ——— | HEC–RAS CROSS SECTION LOCATION |

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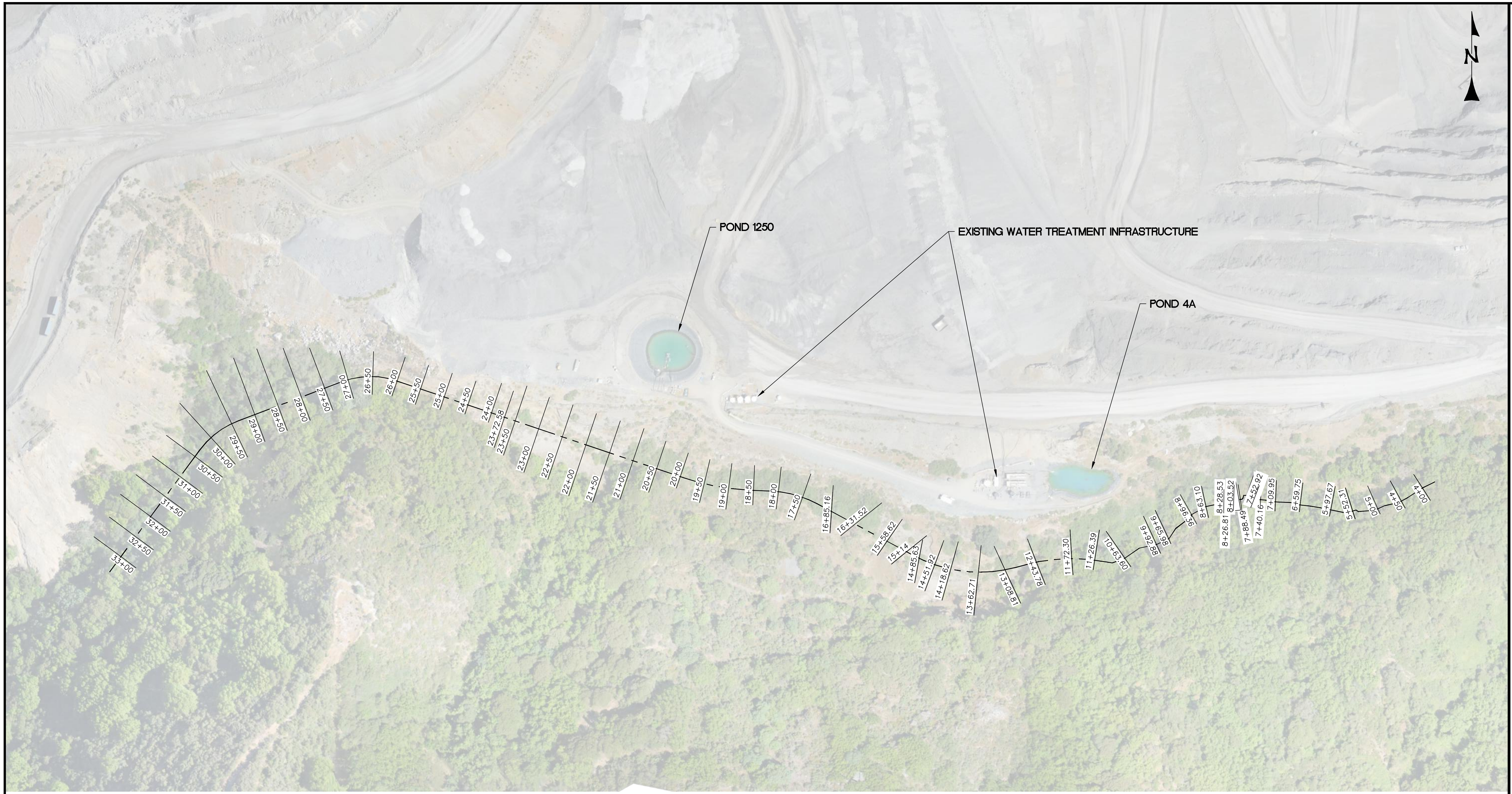
CHANNEL WIDENING TO ROCK PILE AREA
HEC-RAS CROSS SECTION OVERVIEW (2 OF 2)

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS

0 1"

FIGURE

2.0



## HEC-RAS CROSS SECTION OVERVIEW

SCALE: 1" = 200'

## LEGEND

| | |
|---|---|
| — — — | HEC-RAS ALIGNMENT |
| 6+40.16 | HEC-RAS CROSS SECTION LOCATION |

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# OVERBURDEN REMOVAL AREA
# HEC-RAS CROSS SECTION OVERVIEW

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS

0 1"

FIGURE

3.0

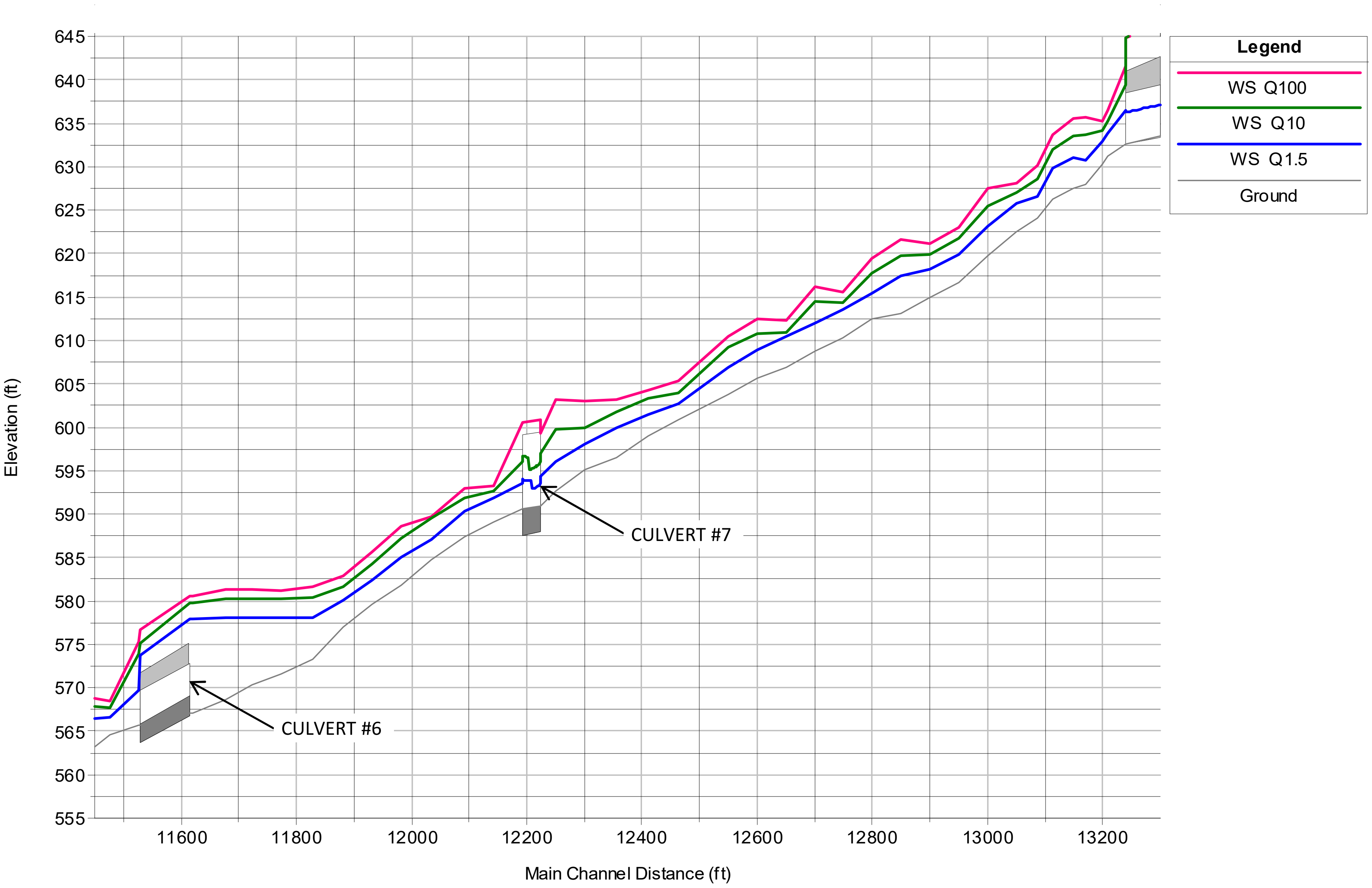
## APPENDIX F. HEC-RAS OUTPUT
## PERMANENTE CREEK RESTORATION PLAN
## LIST OF FIGURES AND TABLES

# HEC-RAS MODEL RESULTS

## Existing Conditions

## Channel Widening and Rock Pile Areas

## Material Removal Area



**FIGURE**

**F1**

**CHANNEL WIDENING TO ROCK PILE AREAS (EXISTING CONDITIONS)**

1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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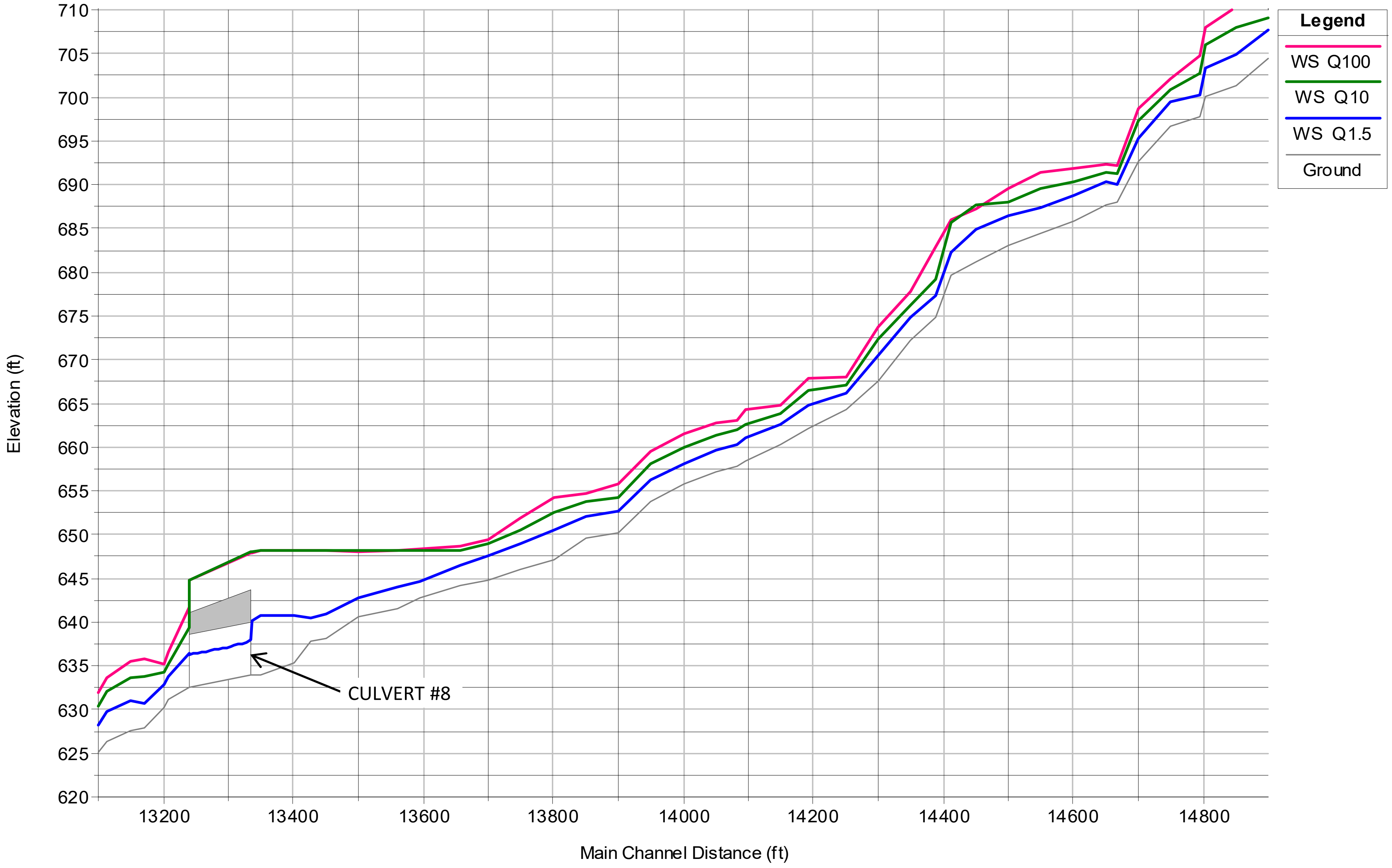

**FIGURE**

**F2**

**CHANNEL WIDENING TO ROCK PILE AREAS (EXISTING CONDITIONS)**
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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CONSULTING, INC.
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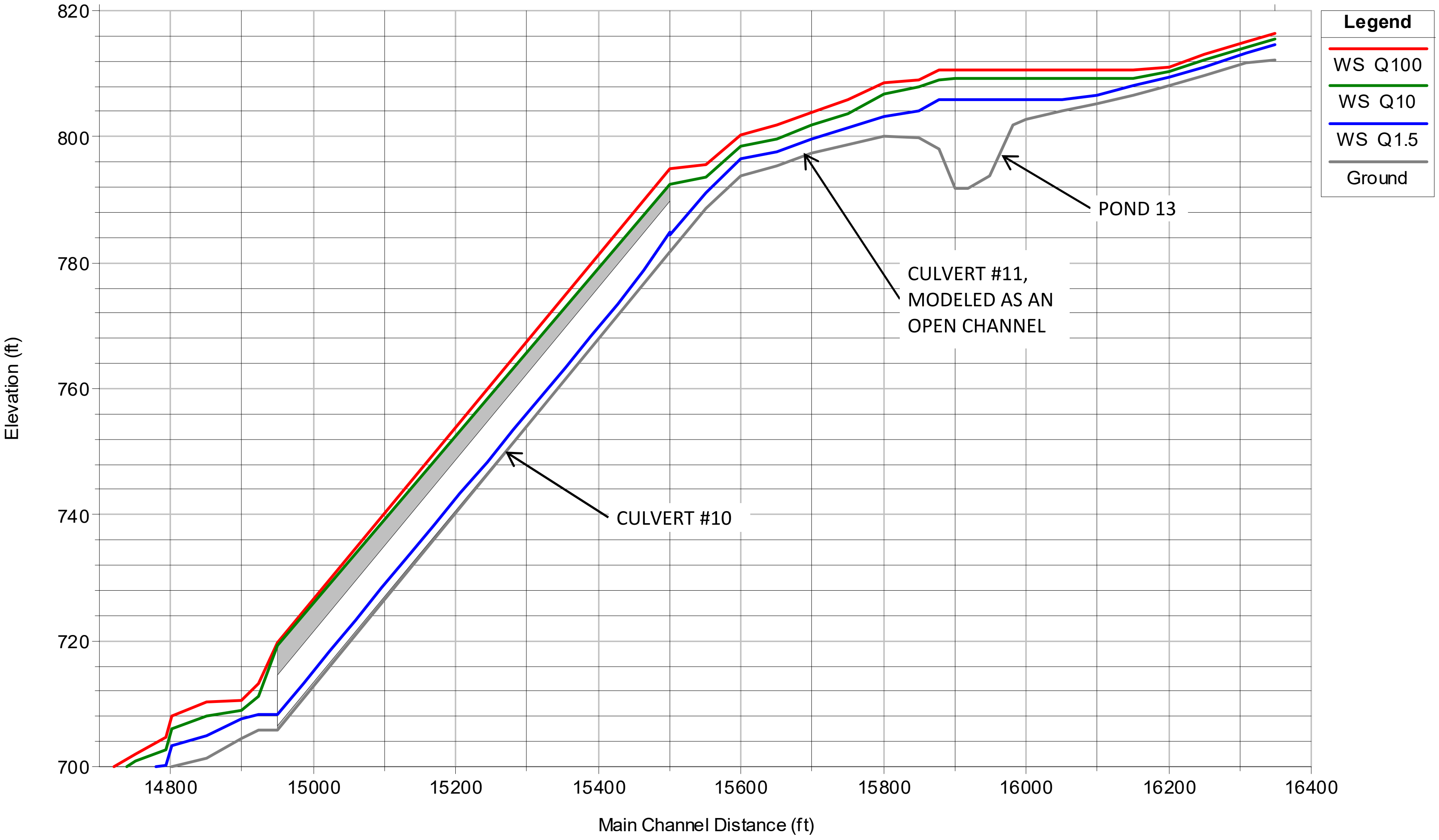

**FIGURE**

**F3**

**CHANNEL WIDENING TO ROCK PILE AREAS (EXISTING CONDITIONS)**
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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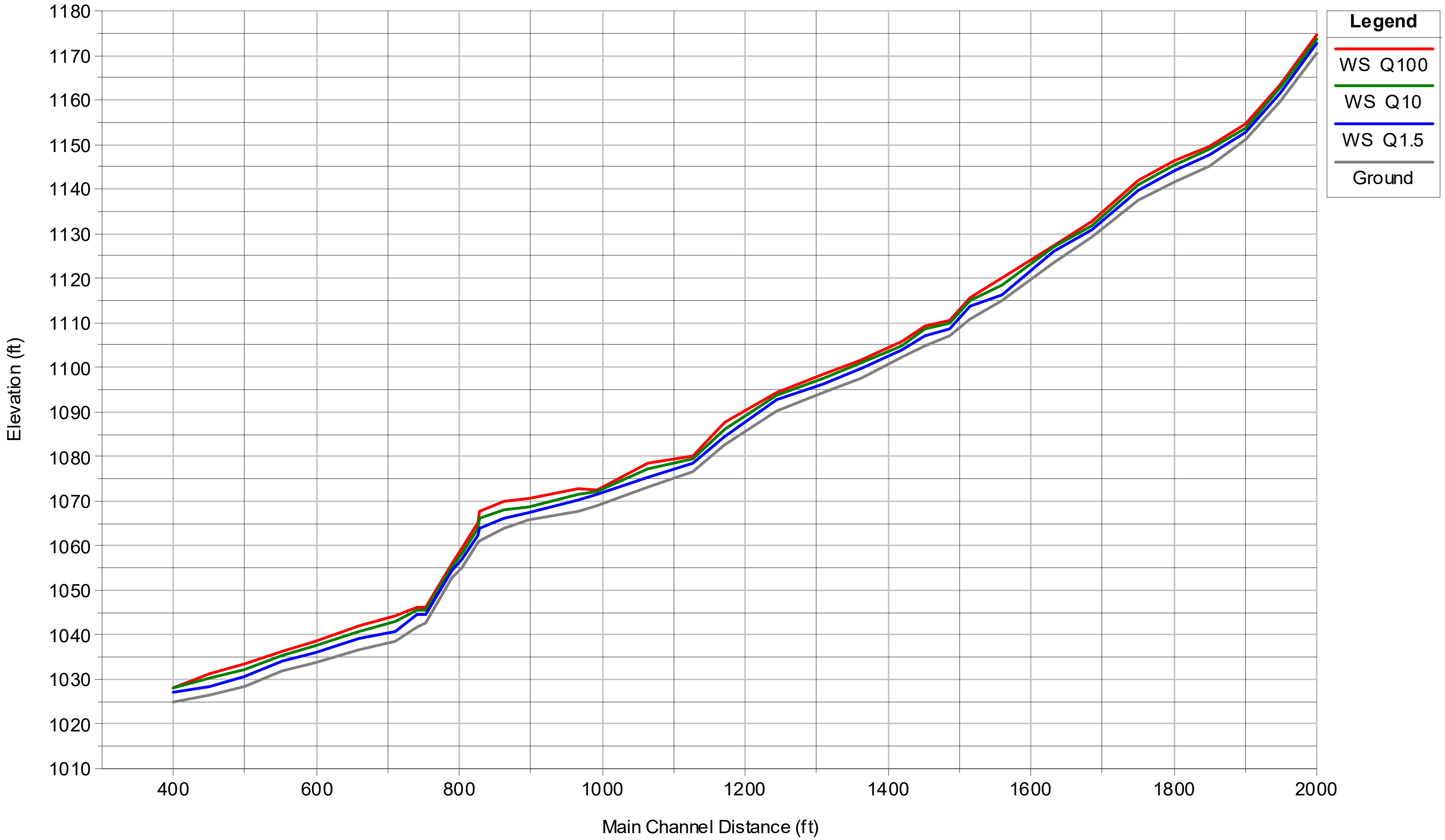

**FIGURE**

**F4**

**MATERIAL REMOVAL AREA (EXISTING CONDITIONS)**
1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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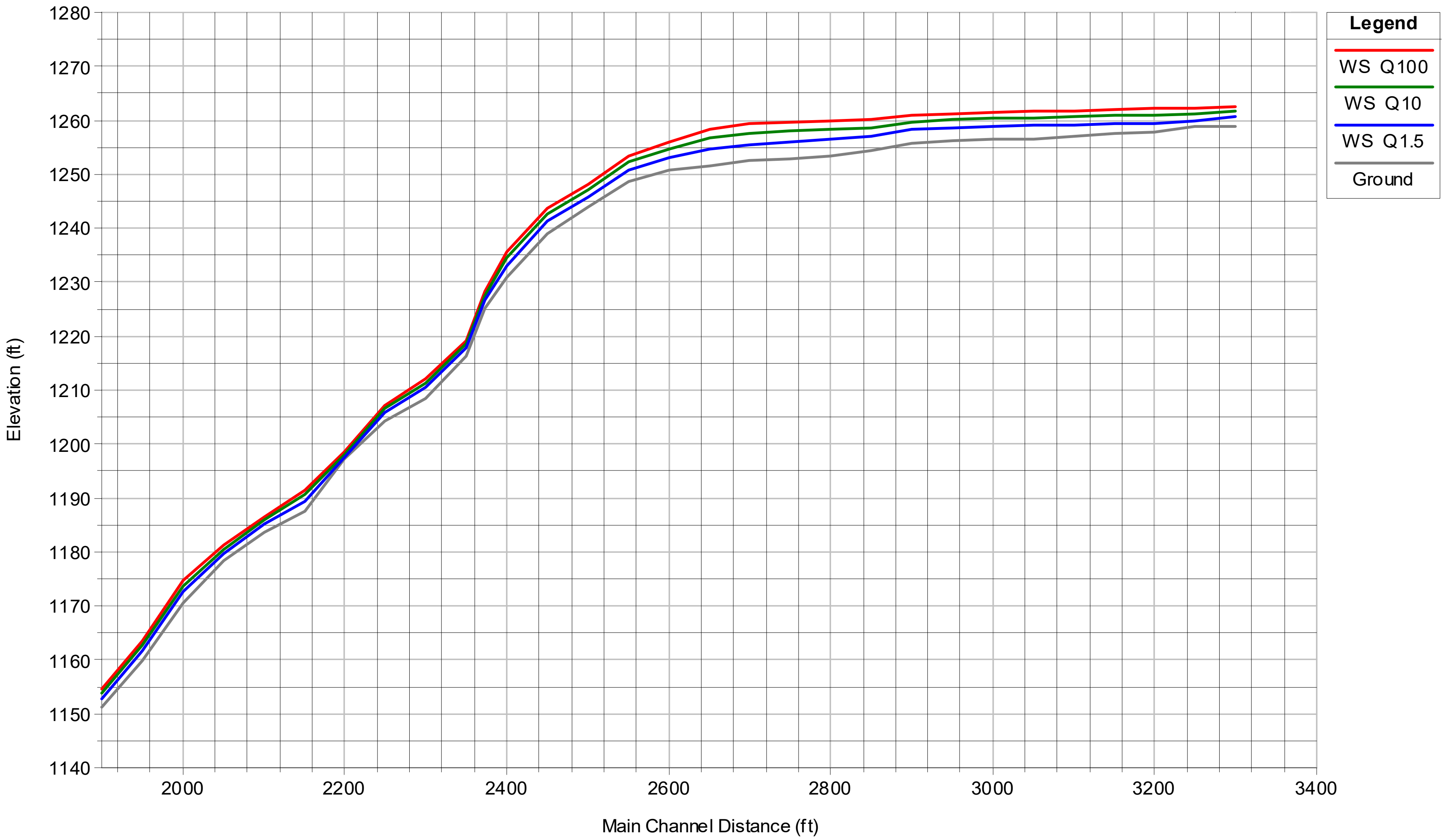

**FIGURE**

**F5**

**MATERIAL REMOVAL AREA (EXISTING CONDITIONS)**

1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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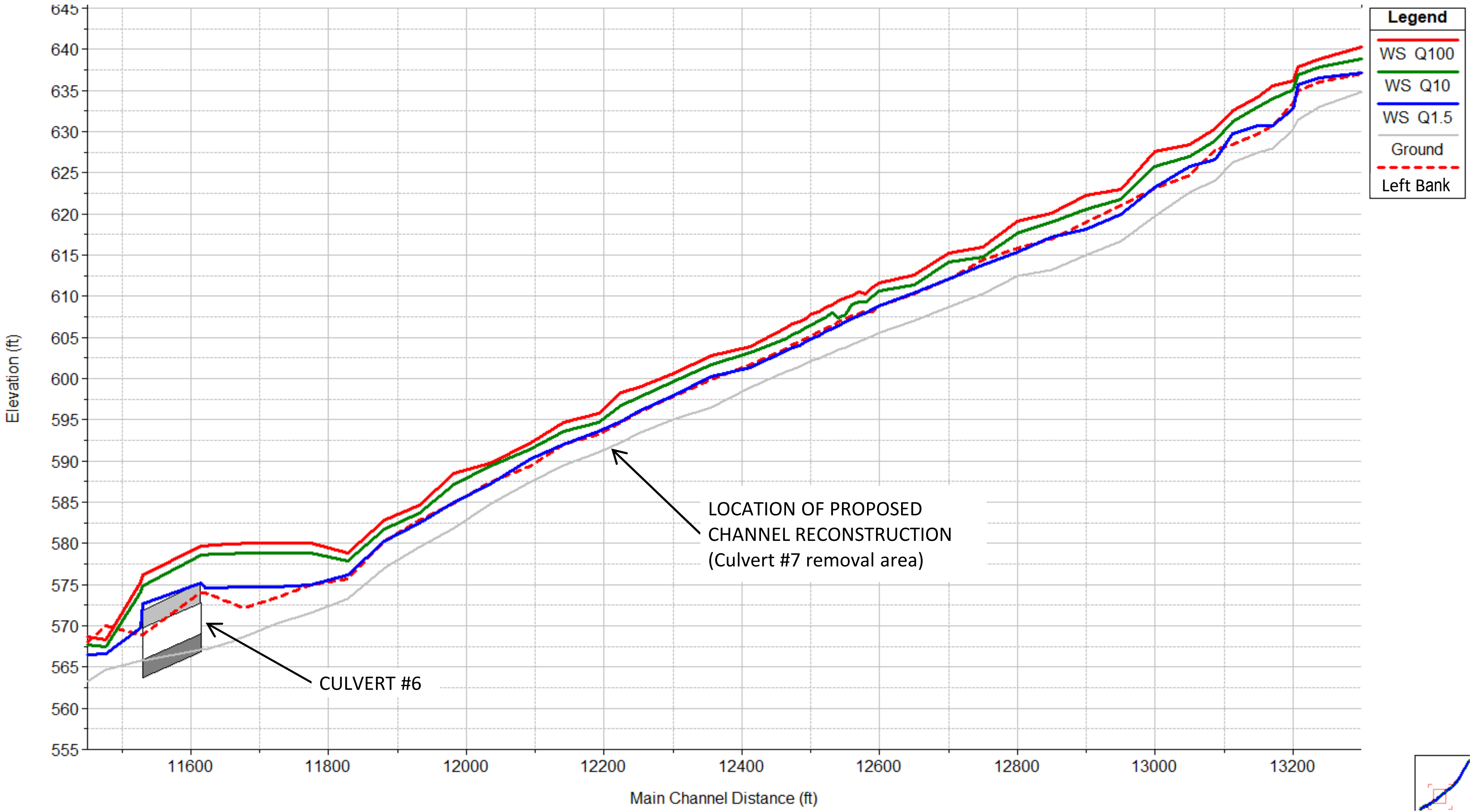
WATERWAYS
CONSULTING, INC.

# HEC-RAS MODEL RESULTS

## <u>Proposed Conditions</u>

## Channel Widening and Rock Pile Areas

## Material Removal Area



LOCATION OF PROPOSED
CHANNEL RECONSTRUCTION
(Culvert #7 removal area)

CULVERT #6

NOTES: Channel reconstruction is proposed from station 121+80 to 123+00 where Culvert #7 is removed. Left bank is floodplain design elevation.

**FIGURE**

**F6**

**CHANNEL WIDENING TO ROCK PILE AREAS (PROPOSED CONDITIONS)**

1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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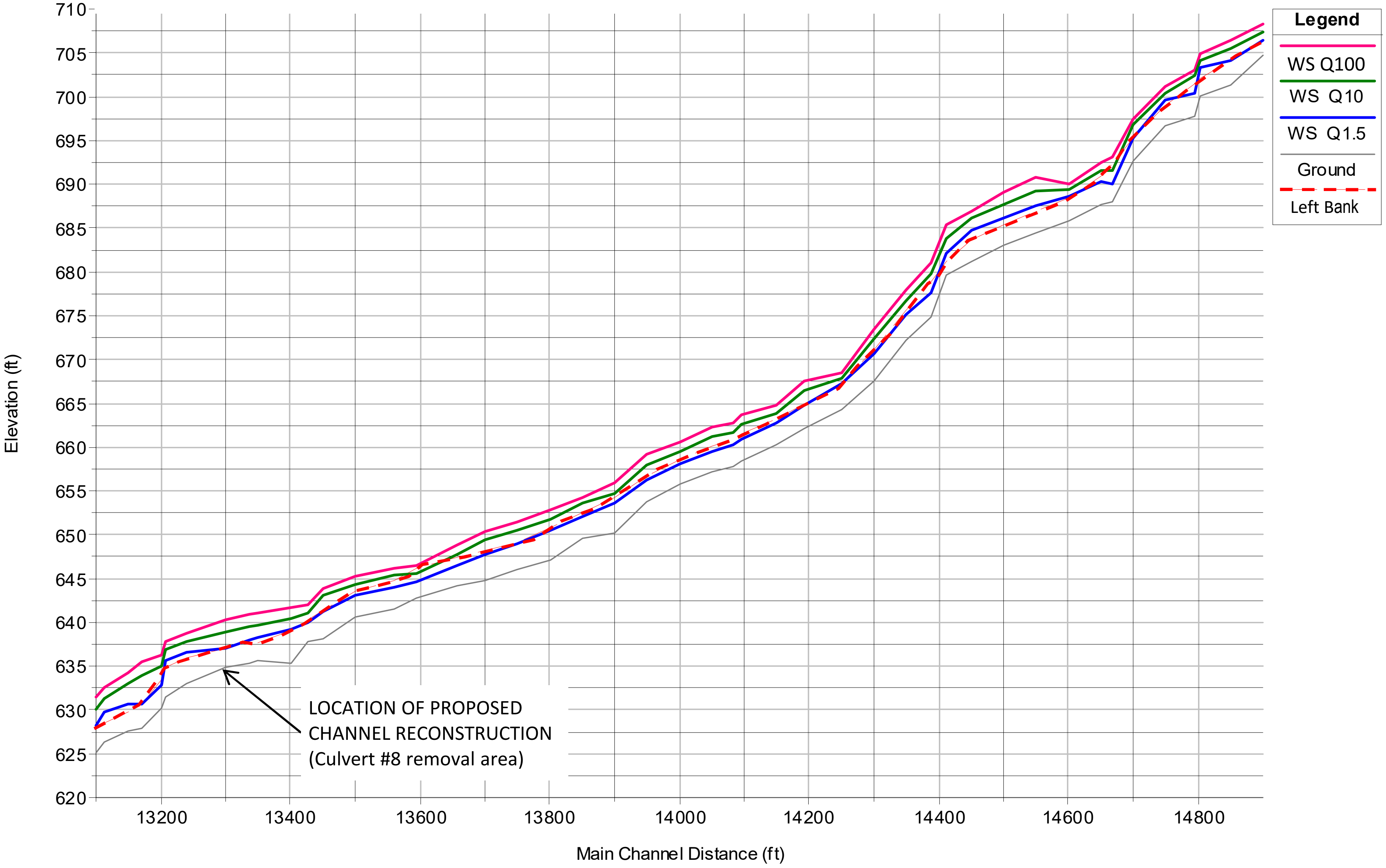

NOTES: Channel reconstruction is proposed from station 132+00 to 134+00 where Culvert #8 is removed. Left bank is floodplain design elevation.

**FIGURE**

**F7**

**CHANNEL WIDENING TO ROCK PILE AREAS (PROPOSED CONDITIONS)**

1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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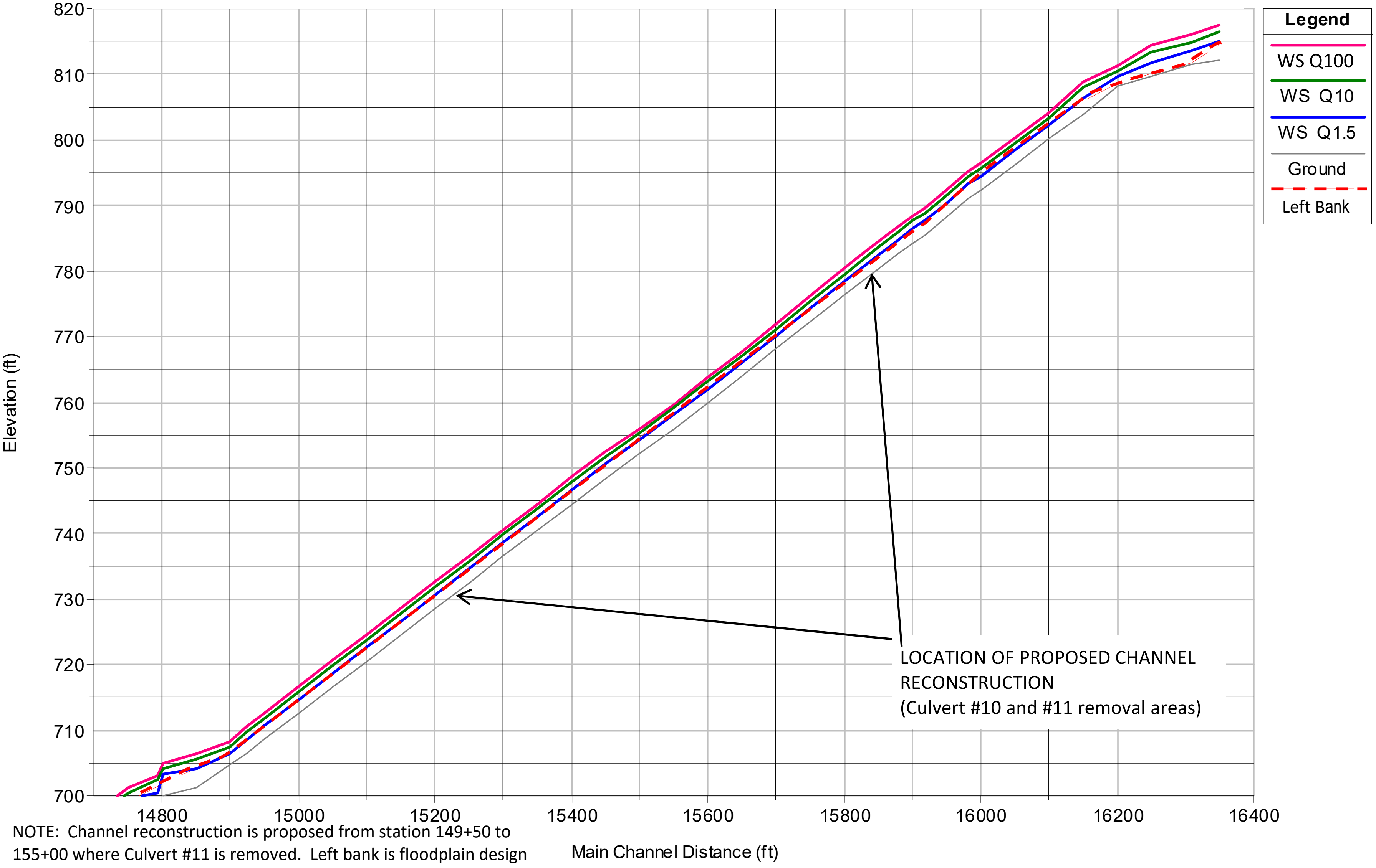
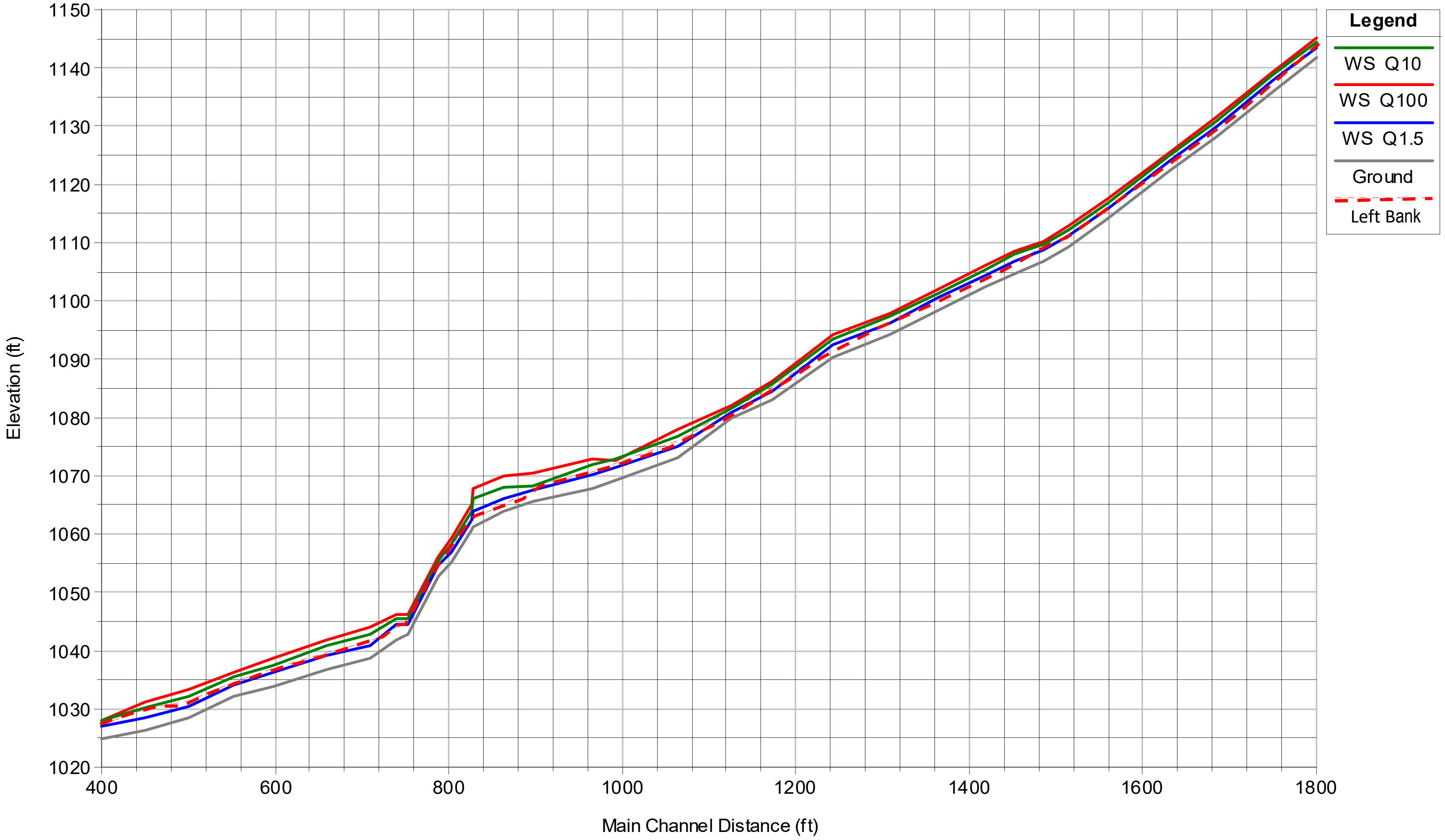


LOCATION OF PROPOSED CHANNEL RECONSTRUCTION
(Culvert #10 and #11 removal areas)

NOTE: Channel reconstruction is proposed from station 149+50 to 155+00 where Culvert #11 is removed. Left bank is floodplain design elevation.

| | | | |
|---|---|---|---|
| FIGURE<br>**F8** | **CHANNEL WIDENING TO ROCK PILE AREAS (PROPOSED CONDITIONS)**<br>1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES | PERMANENTE CREEK<br>90% SUBMITTAL | WATERWAYS CONSULTING, INC.<br>Santa Cruz, CA · watways.com · Portland, OR |



NOTE: Left bank is floodplain design elevation.

**FIGURE**

**F9**

**MATERIAL REMOVAL AREA (PROPOSED CONDITIONS)**

1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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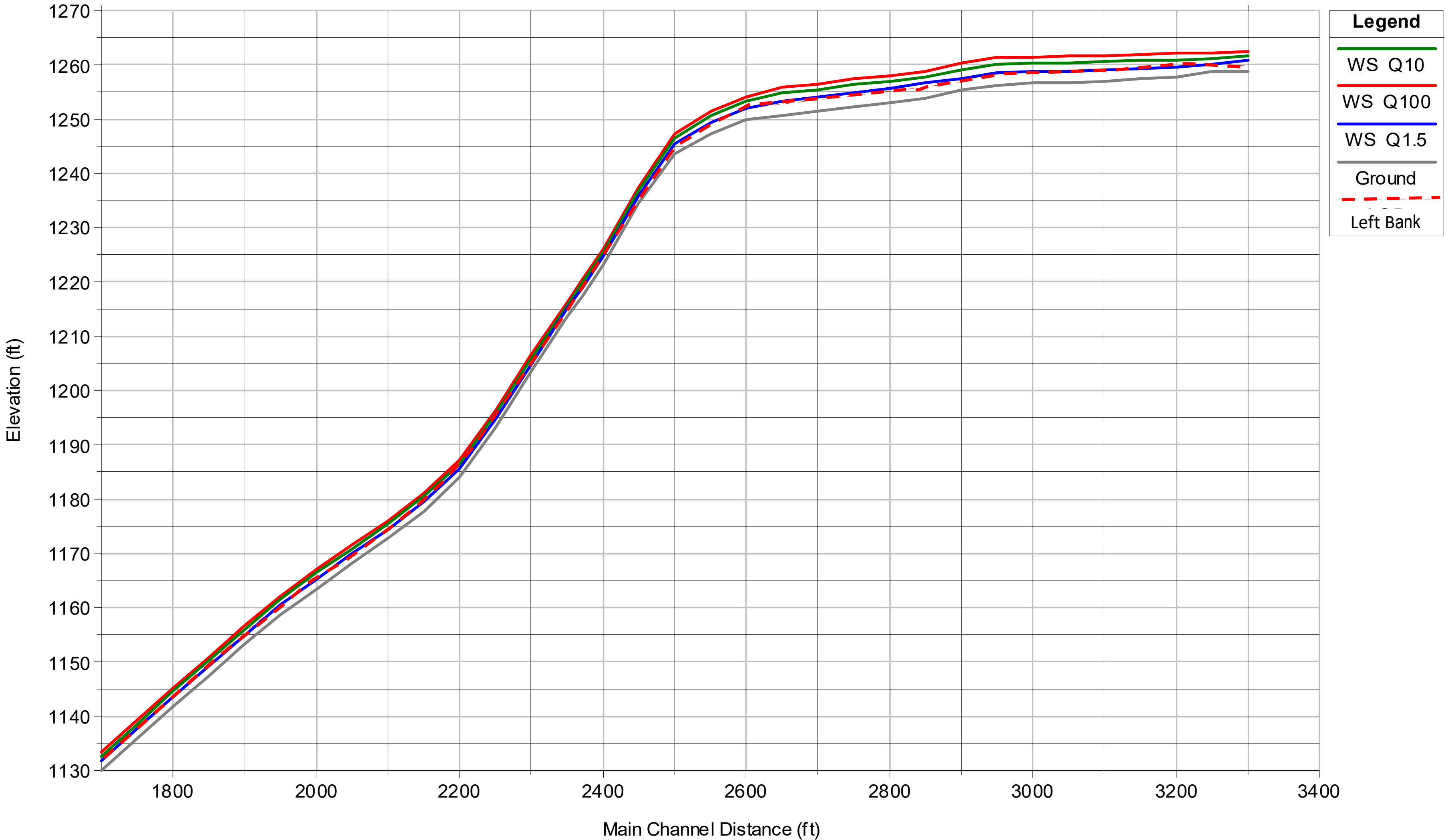

NOTE: Left bank is floodplain design elevation.

**FIGURE**

**F10**

**MATERIAL REMOVAL AREA (PROPOSED CONDITIONS)**

1.5-YEAR, 10-YEAR, & 100-YEAR WATER SURFACE PROFILES

PERMANENTE CREEK

90% SUBMITTAL

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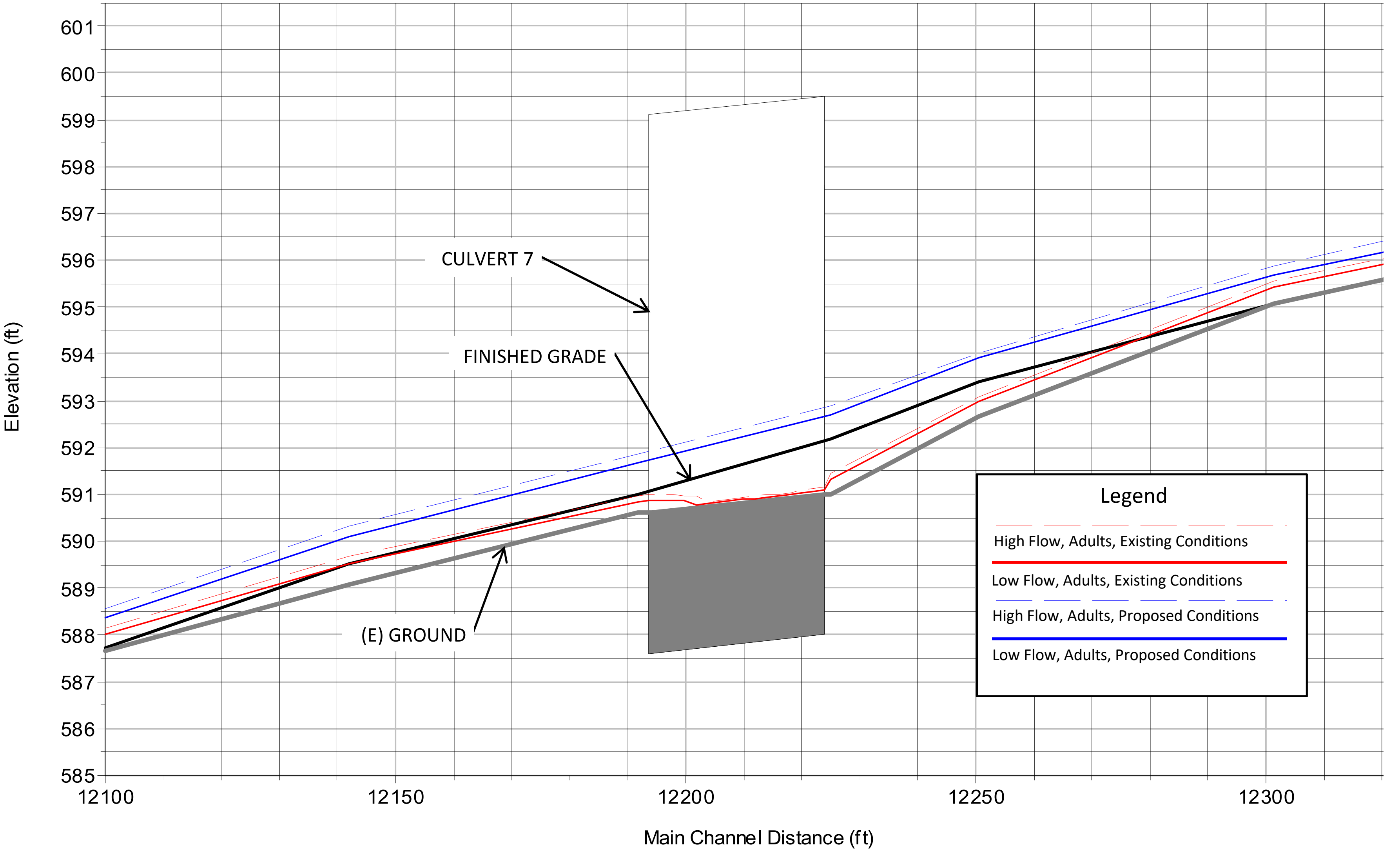
# HEC-RAS MODEL RESULTS

## Fish Passage for Existing and Proposed Conditions

## Culvert #7 and Culvert #8



**FIGURE**

**F11**

WATER SURFACE PROFILES FOR ADULT NON-ANADROMOUS SALMONID
FISH PASSAGE FLOWS AT CULVERT #7, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

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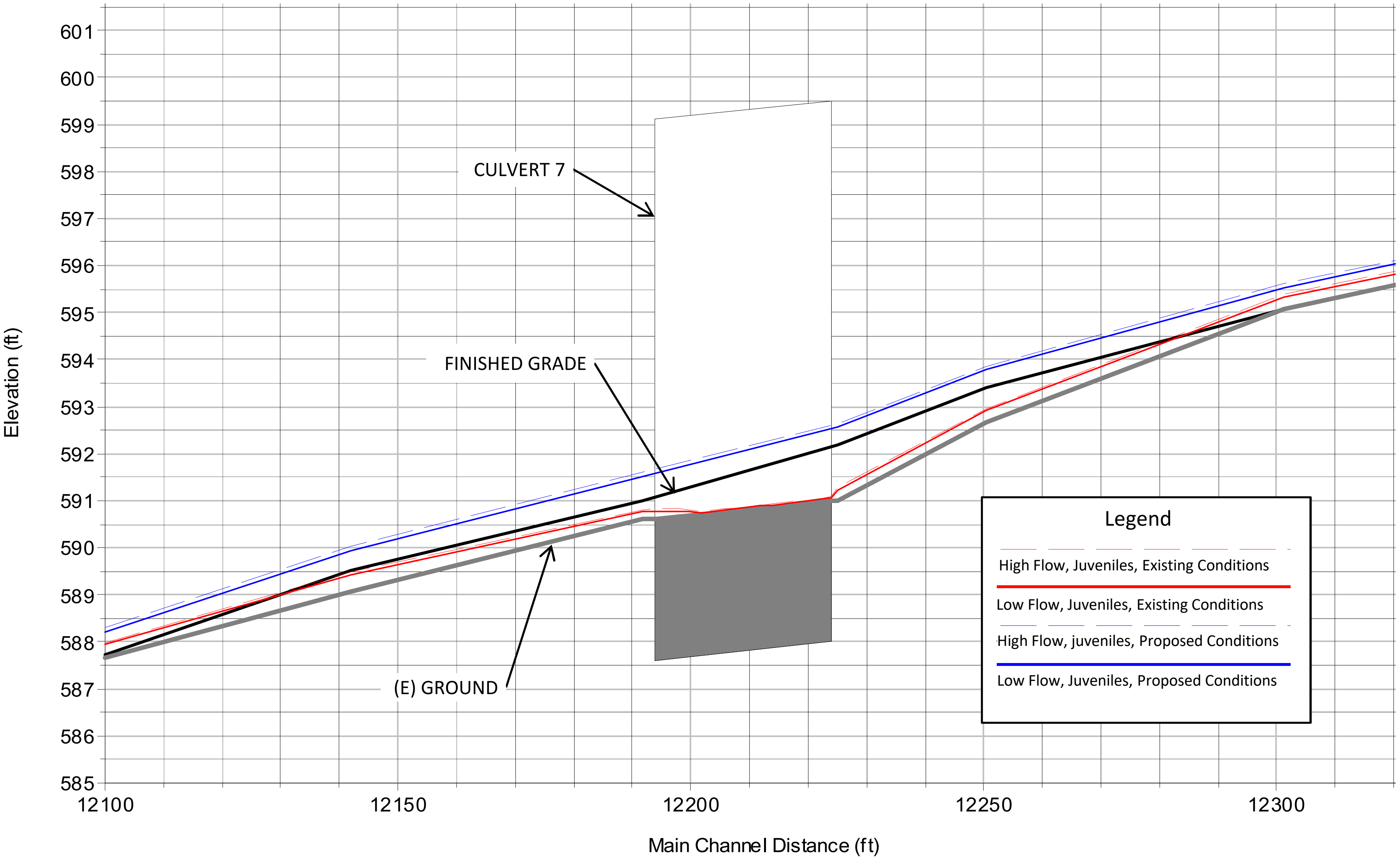

**FIGURE**

**F12**

WATER SURFACE PROFILES FOR JUVENILE NON-ANADROMOUS SALMONID
FISH PASSAGE FLOWS AT CULVERT #7, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

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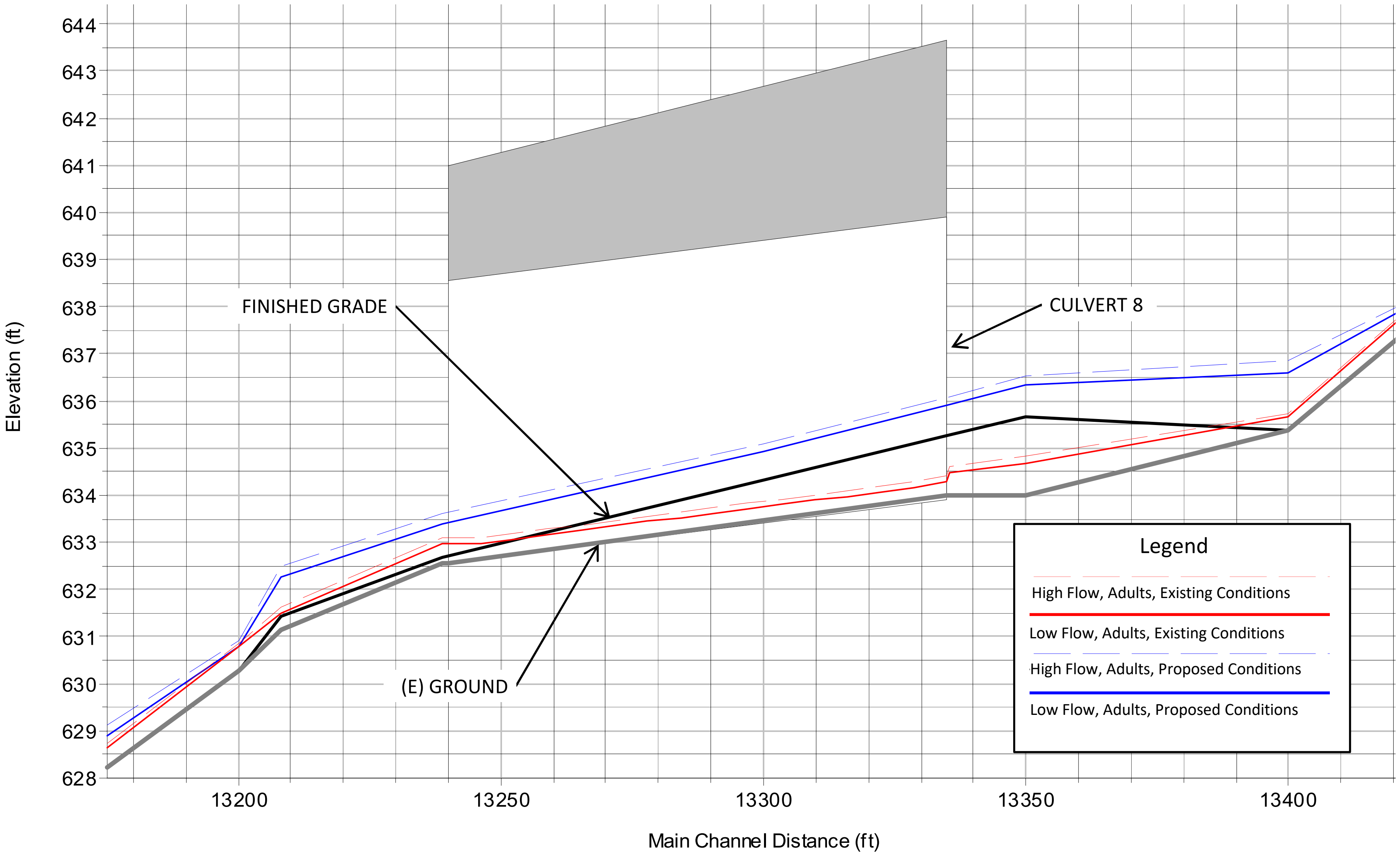

**FIGURE**

**F13**

WATER SURFACE PROFILES FOR ADULT NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #8, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

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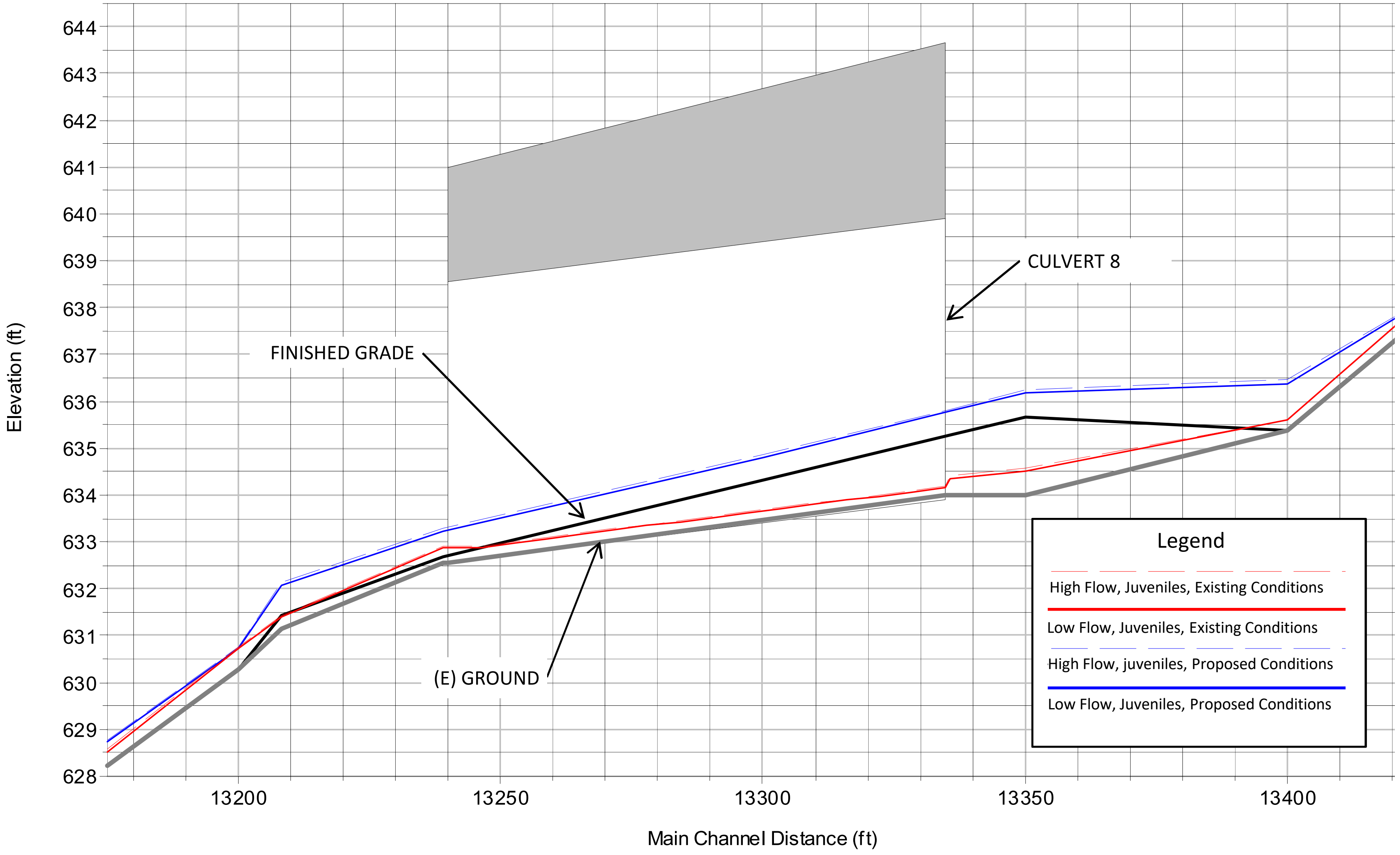

**FIGURE**

**F14**

WATER SURFACE PROFILES FOR JUVENILE NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #8, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

WATERWAYS
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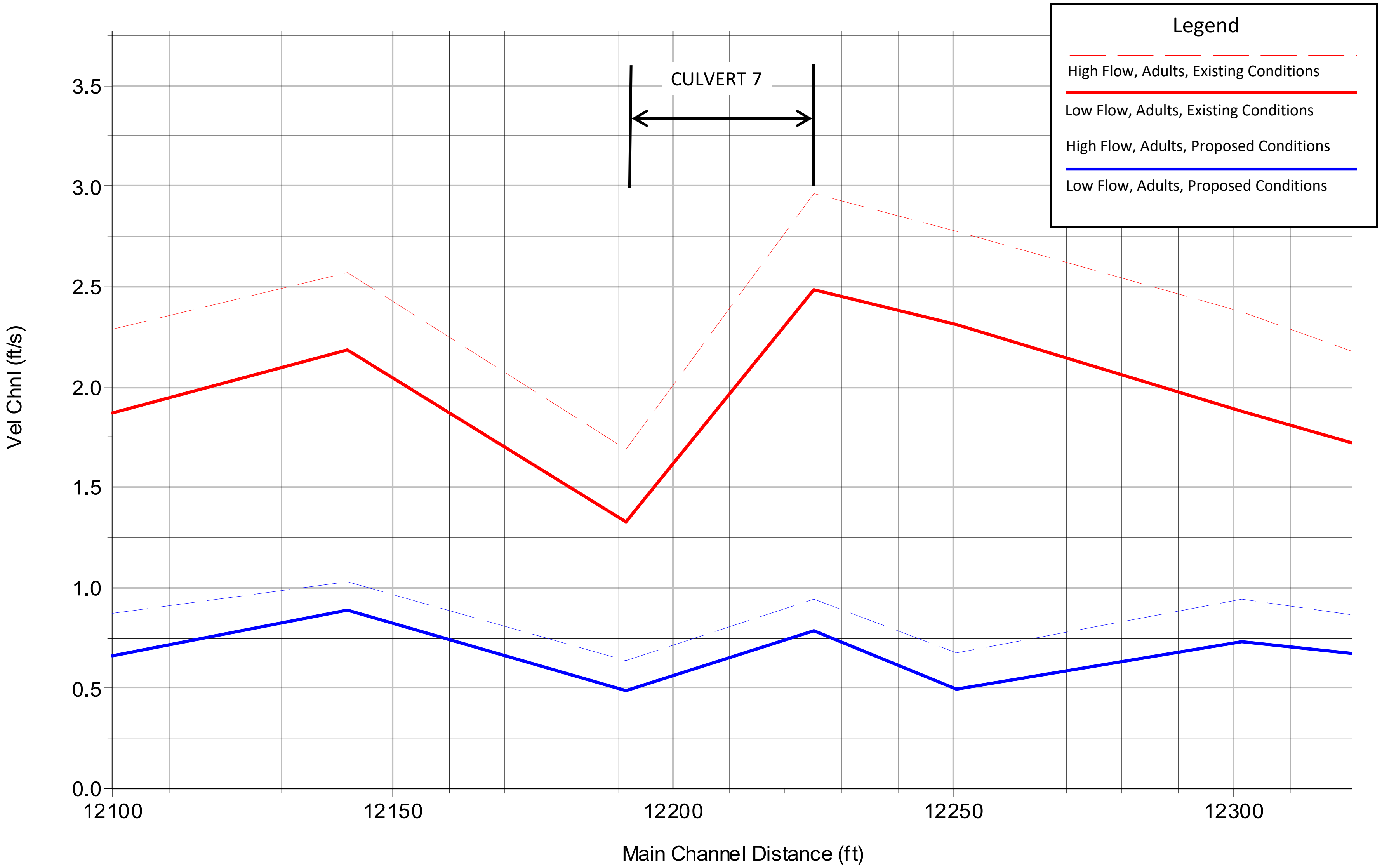

NOTE: Channel reconstruction is proposed from station 121+50 to 122+65 where Culvert #7 is removed.

**FIGURE**

**F15**

VELOCITY PROFILES FOR ADULT NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #7, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

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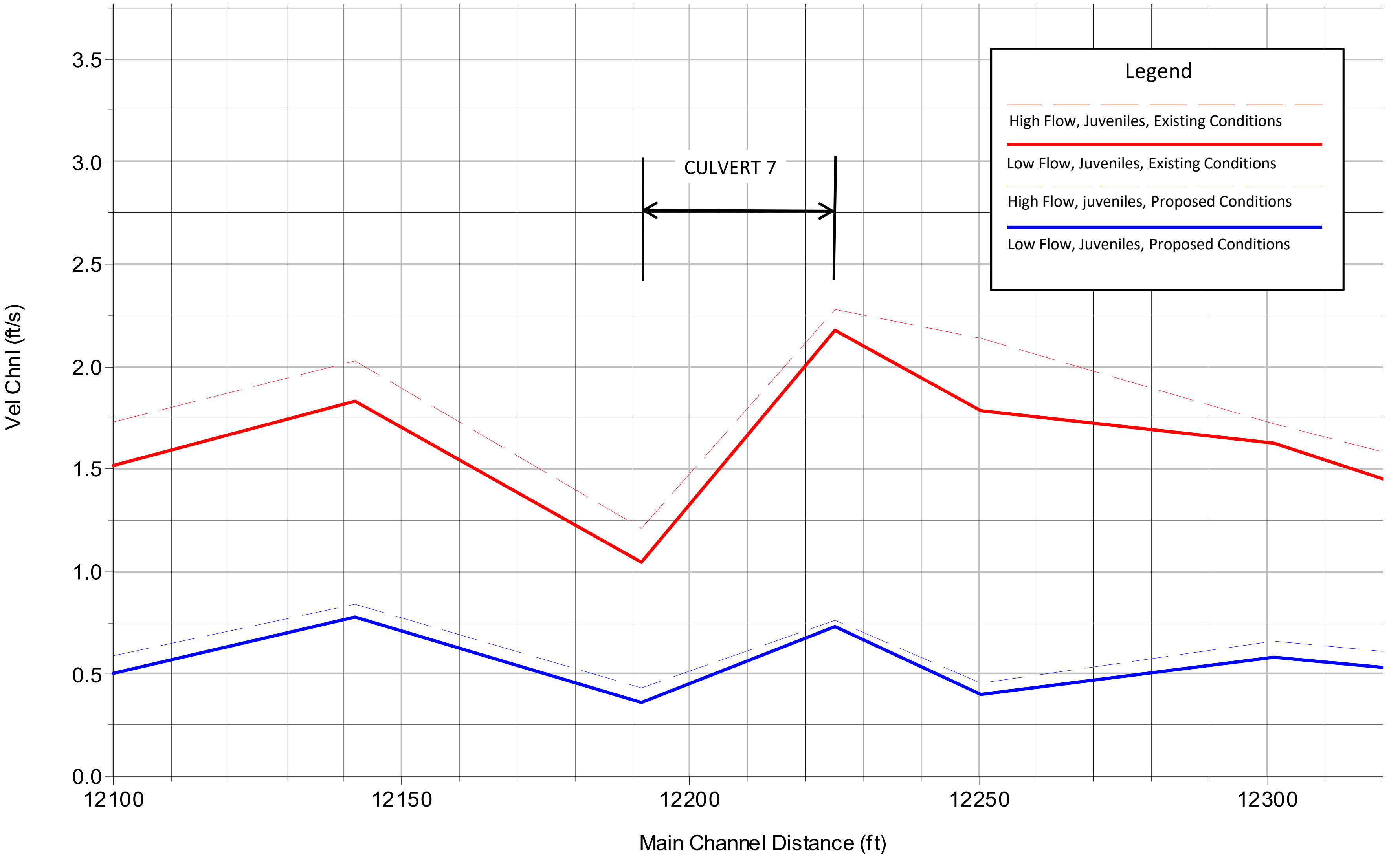

**FIGURE**

**F16**

VELOCITY PROFILES FOR JUVENILE NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #7, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

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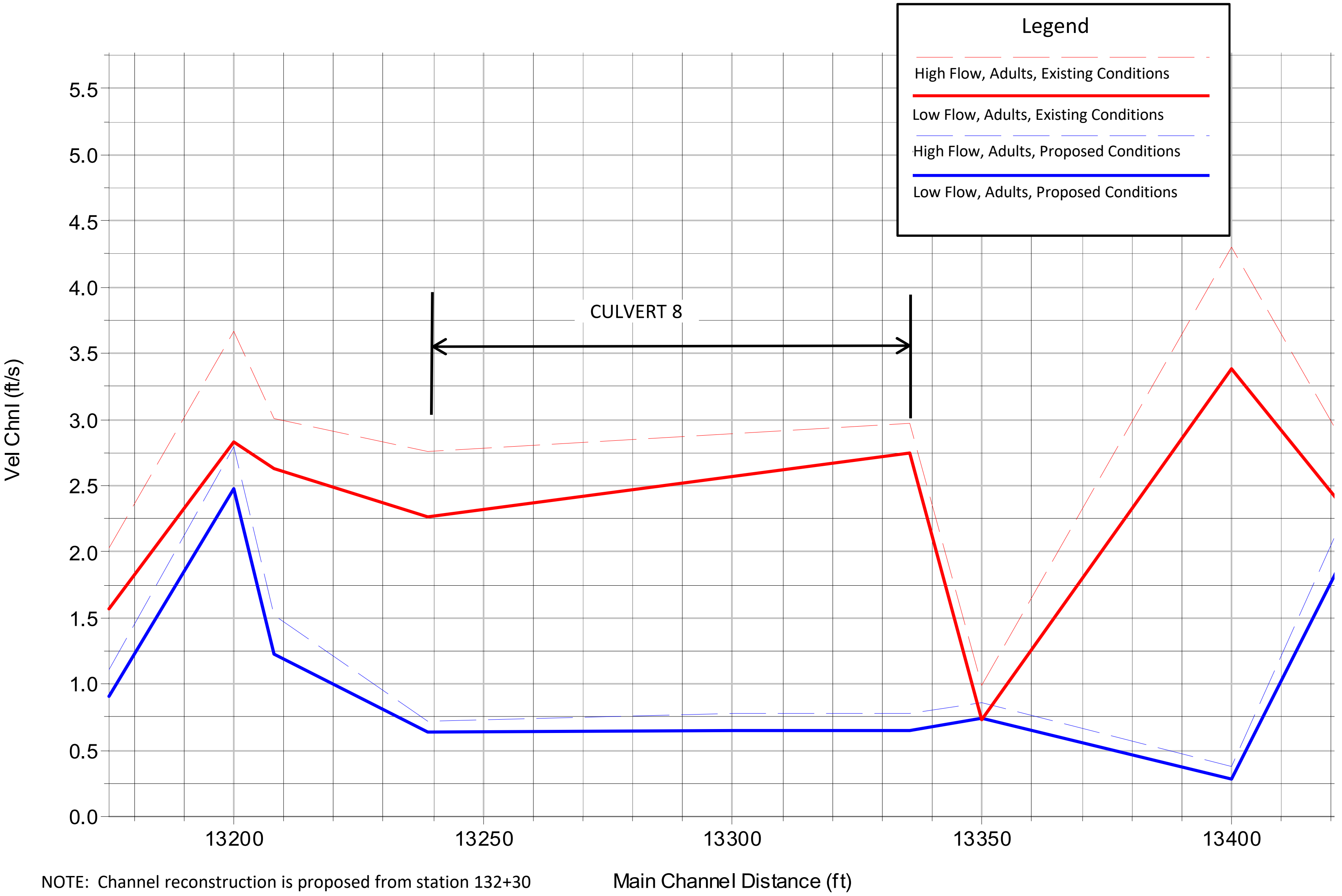

NOTE: Channel reconstruction is proposed from station 132+30 to 133+90 where Culvert #8 is removed.

**FIGURE**

**F17**

VELOCITY PROFILES FOR ADULT NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #8, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

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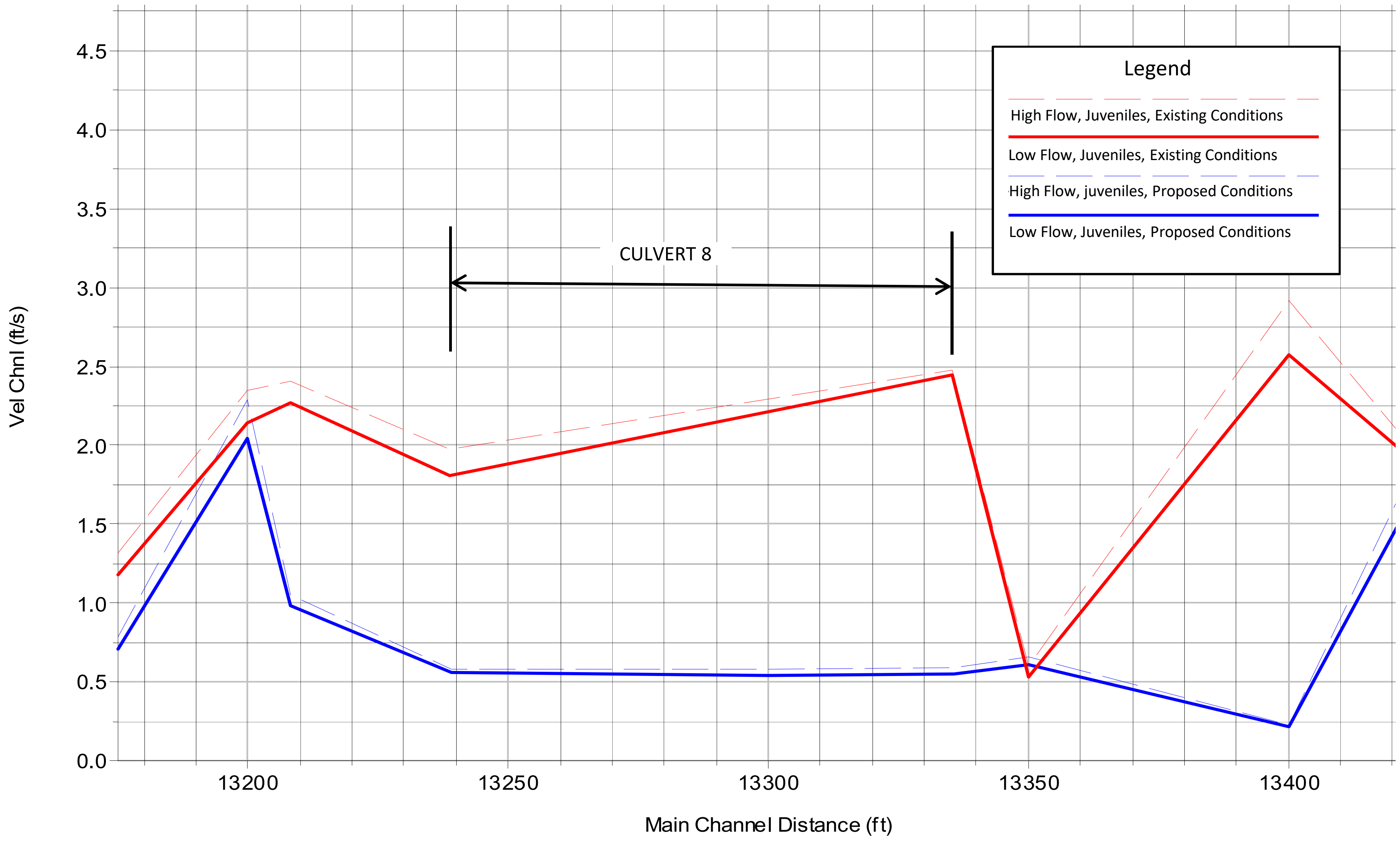

**FIGURE**

**F18**

VELOCITY PROFILES FOR JUVENILE NON-ANADROMOUS SALMONID FISH PASSAGE FLOWS AT CULVERT #8, CHANNEL WIDENING AREA

PERMANENTE CREEK

90% SUBMITTAL

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# HEC-RAS MODEL RESULTS

## Tabular Data

## Channel Widening and Rock Pile Areas Material Removal Area

## Evaluation of Overtopping Flow along Vehicle Barrier

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

UPSTREAM BOUNDARY CONDITION = NORMAL DEPTH, SLOPE 0.015
DOWNSTREAM BOUNDARY CONDITION = NORMAL DEPTH, SLOPE 0.023

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 16150 | Q100 | Existing | 1145 | 806.67 | 810.64 | 3.39 | 5.67 | 207 | 60.9 | | 0.05 | 0.10 | 0.05 |
| | 16150 | Q100 | Proposed | 1145 | 803.98 | 808.86 | 2.58 | 10.82 | 151 | 58.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 16150 | Q10 | Existing | 653 | 806.67 | 809.22 | 2.08 | 5.43 | 122 | 58.5 | | 0.05 | 0.10 | 0.05 |
| | 16150 | Q10 | Proposed | 653 | 803.98 | 807.96 | 1.85 | 8.84 | 100 | 54.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 16150 | Q1.5 | Existing | 219 | 806.67 | 808.05 | 0.97 | 4.02 | 55 | 56.4 | | 0.05 | 0.10 | 0.05 |
| | 16150 | Q1.5 | Proposed | 219 | 803.98 | 806.33 | 1.30 | 6.95 | 33 | 25.2 | 0.10 | 0.06 | | 0.05 |
| | 16100 | Q100 | Existing | 1145 | 805.24 | 810.65 | 4.53 | 3.85 | 305 | 67.4 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 16100 | Q100 | Proposed | 1145 | 800.19 | 804.08 | 1.72 | 16.32 | 99 | 57.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 16100 | Q10 | Existing | 653 | 805.24 | 809.20 | 3.22 | 3.17 | 209 | 64.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 16100 | Q10 | Proposed | 653 | 800.19 | 803.27 | 1.20 | 14.34 | 55 | 46.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 16100 | Q1.5 | Existing | 219 | 805.24 | 806.55 | 0.74 | 4.98 | 44 | 59.4 | | 0.05 | 0.10 | 0.05 |
| | 16100 | Q1.5 | Proposed | 219 | 800.19 | 802.14 | 1.29 | 9.84 | 22 | 17.3 | | 0.06 | | 0.06 |
| | 16050 | Q100 | Existing | 1145 | 804.14 | 810.62 | 5.31 | 3.27 | 374 | 70.5 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 16050 | Q100 | Proposed | 1145 | 796.29 | 800.40 | 2.15 | 14.6 | 106 | 49.4 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 16050 | Q10 | Existing | 653 | 804.14 | 809.17 | 4.11 | 2.49 | 275 | 66.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 16050 | Q10 | Proposed | 653 | 796.29 | 799.66 | 1.50 | 11.96 | 70 | 47.1 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 16050 | Q1.5 | Existing | 219 | 804.14 | 805.94 | 1.26 | 3.01 | 73 | 58.1 | | 0.05 | 0.10 | 0.05 |
| | 16050 | Q1.5 | Proposed | 219 | 796.29 | 798.58 | 1.28 | 7.69 | 29 | 22.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 16000 | Q100 | Existing | 1145 | 802.84 | 810.61 | 5.98 | 2.74 | 450 | 75.3 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 16000 | Q100 | Proposed | 1145 | 792.29 | 796.45 | 2.38 | 14.94 | 97 | 41.0 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 16000 | Q10 | Existing | 653 | 802.84 | 809.16 | 4.79 | 2.01 | 344 | 71.7 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 16000 | Q10 | Proposed | 653 | 792.29 | 795.55 | 1.65 | 12.77 | 62 | 37.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 16000 | Q1.5 | Existing | 219 | 802.84 | 805.85 | 1.91 | 1.84 | 121 | 63.0 | | 0.05 | 0.10 | 0.05 |
| | 16000 | Q1.5 | Proposed | 219 | 792.29 | 794.29 | 1.32 | 9.45 | 23 | 17.5 | | 0.06 | | 0.06 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15982.36 | Q100 | Existing | 1145 | 801.83 | 810.60 | 5.48 | 2.68 | 498 | 90.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 15982.36 | Q100 | Proposed | 1145 | 791.02 | 795.19 | 2.38 | 14.83 | 100 | 42.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15982.36 | Q10 | Existing | 653 | 801.83 | 809.15 | 4.93 | 1.94 | 378 | 76.7 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 15982.36 | Q10 | Proposed | 653 | 791.02 | 794.35 | 1.70 | 12.23 | 66 | 38.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15982.36 | Q1.5 | Existing | 219 | 801.83 | 805.83 | 2.06 | 1.69 | 139 | 67.3 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 15982.36 | Q1.5 | Proposed | 219 | 791.02 | 793.32 | 1.12 | 7.62 | 29 | 26.4 | | 0.06 | 0.10 | 0.05 |
| | 15950 | Q100 | Existing | 1145 | 793.81 | 810.62 | 7.88 | 2.88 | 855 | 108.6 | 0.10 | 0.05 | 0.10 | 0.08 |
| | 15950 | Q100 | Proposed | 1145 | 788.29 | 792.29 | 2.24 | 15.54 | 93 | 41.7 | 0.08 | 0.06 | 0.10 | 0.06 |
| | 15950 | Q10 | Existing | 653 | 793.81 | 809.16 | 6.87 | 1.97 | 699 | 101.8 | 0.10 | 0.05 | 0.10 | 0.08 |
| | 15950 | Q10 | Proposed | 653 | 788.29 | 791.50 | 1.59 | 12.89 | 61 | 38.6 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 15950 | Q1.5 | Existing | 219 | 793.81 | 805.85 | 4.67 | 1.1 | 398 | 85.3 | 0.10 | 0.05 | 0.10 | 0.08 |
| | 15950 | Q1.5 | Proposed | 219 | 788.29 | 790.24 | 1.30 | 9.63 | 23 | 17.6 | | 0.06 | | 0.06 |
| | 15917.67 | Q100 | Existing | 1145 | 791.85 | 810.64 | 9.23 | 1.04 | 1153 | 124.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 15917.67 | Q100 | Proposed | 1145 | 785.57 | 789.55 | 2.15 | 15.52 | 95 | 44.2 | 0.08 | 0.06 | 0.10 | 0.06 |
| | 15917.67 | Q10 | Existing | 653 | 791.85 | 809.17 | 7.96 | 0.69 | 972 | 122.1 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 15917.67 | Q10 | Proposed | 653 | 785.57 | 788.79 | 1.54 | 12.81 | 63 | 40.7 | 0.09 | 0.06 | 0.10 | 0.05 |
| | 15917.67 | Q1.5 | Existing | 219 | 791.85 | 805.85 | 5.66 | 0.37 | 600 | 106.1 | 0.10 | 0.05 | | 0.05 |
| | 15917.67 | Q1.5 | Proposed | 219 | 785.57 | 787.78 | 1.29 | 8.1 | 27 | 21.1 | 0.10 | 0.06 | | 0.06 |
| | 15900 | Q100 | Existing | 1145 | 791.72 | 810.64 | 9.20 | 1.01 | 1184 | 128.7 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 15900 | Q100 | Proposed | 1145 | 784.31 | 788.49 | 2.31 | 14.49 | 103 | 44.6 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 15900 | Q10 | Existing | 653 | 791.72 | 809.17 | 8.23 | 0.67 | 1000 | 121.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 15900 | Q10 | Proposed | 653 | 784.31 | 787.69 | 1.65 | 11.96 | 68 | 41.5 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 15900 | Q1.5 | Existing | 219 | 791.72 | 805.85 | 5.72 | 0.36 | 623 | 109.0 | 0.10 | 0.05 | | 0.05 |
| | 15900 | Q1.5 | Proposed | 219 | 784.31 | 786.49 | 1.38 | 8.31 | 26 | 19.0 | | 0.06 | 0.10 | 0.06 |
| Culvert #11 | 15878.42 | Q100 | Existing | 1145 | 798.16 | 810.56 | 5.09 | 2.74 | 659 | 129.6 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 15878.42 | Q100 | Proposed | 1145 | 782.58 | 786.73 | 2.29 | 14.91 | 102 | 44.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15878.42 | Q10 | Existing | 653 | 798.16 | 809.13 | 4.11 | 2.01 | 477 | 116.1 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 15878.42 | Q10 | Proposed | 653 | 782.58 | 785.88 | 1.58 | 12.54 | 65 | 41.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15878.42 | Q1.5 | Existing | 219 | 798.16 | 805.82 | 2.92 | 1.41 | 189 | 64.9 | 0.10 | 0.05 | | 0.05 |
| | 15878.42 | Q1.5 | Proposed | 219 | 782.58 | 784.70 | 1.39 | 8.69 | 25 | 18.1 | | 0.06 | | 0.06 |

## TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Culvert #11 (Half culvert in Existing Conditions modeled as open channel) | 15850 | Q100 | Existing | 1145 | 799.75 | 809.03 | 3.03 | 10.84 | 130 | 42.8 | 0.03 | 0.02 | 0.03 | 0.03 |
| | 15850 | Q100 | Proposed | 1145 | 780.31 | 784.40 | 2.25 | 15.19 | 99 | 44.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15850 | Q10 | Existing | 653 | 799.75 | 807.91 | 2.33 | 9.24 | 85 | 36.7 | 0.03 | 0.02 | 0.03 | 0.02 |
| | 15850 | Q10 | Proposed | 653 | 780.31 | 783.59 | 1.57 | 12.63 | 64 | 41.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15850 | Q1.5 | Existing | 219 | 799.75 | 804.06 | 3.22 | 10.15 | 22 | 6.7 | | 0.02 | | 0.02 |
| | 15850 | Q1.5 | Proposed | 219 | 780.31 | 782.46 | 1.42 | 8.47 | 26 | 18.3 | | 0.06 | | 0.06 |
| | 15800 | Q100 | Existing | 1145 | 800.05 | 808.60 | 3.25 | 11.13 | 131 | 40.3 | 0.03 | 0.02 | 0.03 | 0.02 |
| | 15800 | Q100 | Proposed | 1145 | 776.33 | 780.46 | 2.30 | 15.15 | 99 | 43.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15800 | Q10 | Existing | 653 | 800.05 | 806.81 | 1.97 | 10.91 | 65 | 32.9 | 0.03 | 0.02 | 0.03 | 0.02 |
| | 15800 | Q10 | Proposed | 653 | 776.33 | 779.62 | 1.59 | 12.6 | 64 | 40.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15800 | Q1.5 | Existing | 219 | 800.05 | 803.31 | 2.26 | 10.38 | 21 | 9.3 | | 0.02 | | 0.02 |
| | 15800 | Q1.5 | Proposed | 219 | 776.33 | 778.46 | 1.40 | 8.61 | 25 | 18.2 | | 0.06 | | 0.06 |
| | 15750 | Q100 | Existing | 1145 | 798.71 | 805.99 | 2.45 | 15.87 | 85 | 34.8 | 0.03 | 0.02 | 0.03 | 0.02 |
| | 15750 | Q100 | Proposed | 1145 | 772.22 | 776.27 | 2.24 | 15.47 | 95 | 42.4 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 15750 | Q10 | Existing | 653 | 798.71 | 803.77 | 3.69 | 16.2 | 40 | 10.9 | | 0.02 | | 0.02 |
| | 15750 | Q10 | Proposed | 653 | 772.22 | 775.47 | 1.58 | 12.83 | 62 | 39.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15750 | Q1.5 | Existing | 219 | 798.71 | 801.47 | 1.90 | 12.73 | 17 | 9.1 | | 0.02 | | 0.02 |
| | 15750 | Q1.5 | Proposed | 219 | 772.22 | 774.32 | 1.30 | 8.71 | 25 | 19.4 | 0.10 | 0.06 | | 0.06 |
| | 15700 | Q100 | Existing | 1145 | 797.35 | 803.97 | 2.21 | 17.92 | 73 | 32.9 | 0.03 | 0.02 | 0.03 | 0.02 |
| | 15700 | Q100 | Proposed | 1145 | 768.08 | 771.95 | 1.82 | 15.16 | 95 | 51.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15700 | Q10 | Existing | 653 | 797.35 | 801.84 | 3.53 | 17.53 | 37 | 10.6 | | 0.02 | | 0.02 |
| | 15700 | Q10 | Proposed | 653 | 768.08 | 771.12 | 1.52 | 12.57 | 57 | 37.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15700 | Q1.5 | Existing | 219 | 797.35 | 799.64 | 1.82 | 13.72 | 16 | 8.8 | | 0.02 | | 0.02 |
| | 15700 | Q1.5 | Proposed | 219 | 768.08 | 769.97 | 1.25 | 8.59 | 25 | 20.4 | | 0.06 | | 0.06 |
| | 15650 | Q100 | Existing | 1145 | 795.45 | 801.87 | 2.52 | 19.34 | 61 | 24.0 | 0.03 | 0.02 | 0.03 | 0.02 |
| | 15650 | Q100 | Proposed | 1145 | 764.00 | 767.80 | 1.51 | 15.2 | 110 | 72.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15650 | Q10 | Existing | 653 | 795.45 | 799.74 | 3.37 | 18.65 | 35 | 10.4 | | 0.02 | | 0.02 |
| | 15650 | Q10 | Proposed | 653 | 764.00 | 767.15 | 1.28 | 12.21 | 69 | 53.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15650 | Q1.5 | Existing | 219 | 795.45 | 797.67 | 1.74 | 14.39 | 15 | 8.8 | | 0.02 | | 0.02 |
| | 15650 | Q1.5 | Proposed | 219 | 764.00 | 766.11 | 0.96 | 8.1 | 28 | 29.2 | 0.10 | 0.06 | | 0.05 |

## TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Culvert #11 | 15600 | Q100 | Existing | 1145 | 793.89 | 800.00 | 4.80 | 20.24 | 57 | 11.8 | | 0.02 | | 0.02 |
| | 15600 | Q100 | Proposed | 1145 | 759.91 | 763.88 | 1.44 | 14.58 | 125 | 87.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15600 | Q10 | Existing | 653 | 793.89 | 797.99 | 3.39 | 18.89 | 35 | 10.2 | | 0.02 | | 0.02 |
| | 15600 | Q10 | Proposed | 653 | 759.91 | 763.17 | 1.14 | 12.33 | 72 | 63.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15600 | Q1.5 | Existing | 219 | 793.89 | 795.98 | 1.77 | 14.13 | 15 | 8.8 | | 0.02 | | 0.02 |
| | 15600 | Q1.5 | Proposed | 219 | 759.91 | 761.96 | 1.36 | 8.89 | 25 | 18.2 | | 0.06 | | 0.06 |
| | 15550 | Q100 | Existing | 1145 | 788.69 | 794.69 | 4.59 | 24.88 | 46 | 10.0 | | 0.02 | | 0.02 |
| | 15550 | Q100 | Proposed | 1145 | 756.06 | 759.77 | 1.42 | 14.84 | 127 | 89.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15550 | Q10 | Existing | 653 | 788.69 | 792.75 | 3.26 | 23.27 | 28 | 8.6 | | 0.02 | | 0.02 |
| | 15550 | Q10 | Proposed | 653 | 756.06 | 759.22 | 0.93 | 12.4 | 78 | 84.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15550 | Q1.5 | Existing | 219 | 788.69 | 790.72 | 1.48 | 19.03 | 12 | 7.8 | | 0.02 | | 0.02 |
| | 15550 | Q1.5 | Proposed | 219 | 756.06 | 758.23 | 1.15 | 8.11 | 27 | 23.8 | | 0.06 | 0.10 | 0.05 |
| CULVERT #10 | 15500 | Q100 | Existing | 1145 | 781.80 | 787.68 | 4.37 | 27.6 | 41 | 9.5 | | 0.05 | | 0.05 |
| | 15500 | Q100 | Proposed | 1145 | 752.25 | 755.99 | 1.62 | 13.69 | 128 | 79.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15500 | Q10 | Existing | 653 | 781.80 | 792.44 | 6.09 | 6.77 | 97 | 15.9 | 0.03 | 0.05 | | 0.05 |
| | 15500 | Q10 | Proposed | 653 | 752.25 | 755.28 | 1.14 | 11.98 | 76 | 66.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15500 | Q1.5 | Existing | 219 | 781.80 | 784.21 | 1.55 | 18.67 | 12 | 7.6 | | 0.05 | | 0.05 |
| | 15500 | Q1.5 | Proposed | 219 | 752.25 | 754.24 | 1.19 | 8.65 | 25 | 21.3 | | 0.06 | 0.10 | 0.06 |
| | 15450 | Q100 | Proposed | 1145 | 748.42 | 752.41 | 1.80 | 13.6 | 123 | 68.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15450 | Q10 | Proposed | 653 | 748.42 | 751.62 | 1.40 | 11.51 | 75 | 53.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15450 | Q1.5 | Proposed | 219 | 748.42 | 750.55 | 0.94 | 7.99 | 28 | 29.9 | | 0.06 | 0.10 | 0.05 |
| | 15400 | Q100 | Proposed | 1145 | 744.50 | 748.75 | 1.78 | 14.22 | 118 | 66.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15400 | Q10 | Proposed | 653 | 744.50 | 747.91 | 1.43 | 12 | 70 | 48.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15400 | Q1.5 | Proposed | 219 | 744.50 | 746.62 | 1.34 | 8.71 | 25 | 18.8 | | 0.06 | 0.10 | 0.06 |
| | 15350 | Q100 | Proposed | 1145 | 740.46 | 744.48 | 1.69 | 15.39 | 108 | 64.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15350 | Q10 | Proposed | 653 | 740.46 | 743.71 | 1.33 | 12.91 | 64 | 48.4 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15350 | Q1.5 | Proposed | 219 | 740.46 | 742.60 | 1.41 | 8.54 | 26 | 18.2 | | 0.06 | | 0.06 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT #10 | 15300 | Q100 | Proposed | 1145 | 736.48 | 740.50 | 1.96 | 15.08 | 108 | 54.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15300 | Q10 | Proposed | 653 | 736.48 | 739.77 | 1.31 | 12.53 | 68 | 52.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15300 | Q1.5 | Proposed | 219 | 736.48 | 738.62 | 1.41 | 8.57 | 26 | 18.2 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| | 15250 | Q100 | Proposed | 1145 | 732.49 | 736.55 | 2.14 | 14.97 | 104 | 48.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15250 | Q10 | Proposed | 653 | 732.49 | 735.74 | 1.45 | 12.66 | 66 | 45.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15250 | Q1.5 | Proposed | 219 | 732.49 | 734.62 | 1.41 | 8.57 | 26 | 18.2 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| | 15200 | | | Culvert | | | | | | | | | | |
| | 15200 | Q100 | Proposed | 1145 | 728.50 | 732.66 | 2.33 | 14.96 | 101 | 43.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15200 | Q10 | Proposed | 653 | 728.50 | 731.78 | 1.61 | 12.55 | 65 | 40.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15200 | Q1.5 | Proposed | 219 | 728.50 | 730.63 | 1.41 | 8.58 | 26 | 18.1 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| | 15150 | Q100 | Proposed | 1145 | 724.50 | 728.61 | 2.25 | 15.31 | 99 | 43.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15150 | Q10 | Proposed | 653 | 724.50 | 727.79 | 1.58 | 12.64 | 64 | 40.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15150 | Q1.5 | Proposed | 219 | 724.50 | 726.63 | 1.40 | 8.57 | 26 | 18.2 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| | 15100 | Q100 | Proposed | 1145 | 720.52 | 724.63 | 2.21 | 15.28 | 99 | 45.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15100 | Q10 | Proposed | 653 | 720.52 | 723.81 | 1.54 | 12.66 | 64 | 41.4 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15100 | Q1.5 | Proposed | 219 | 720.52 | 722.65 | 1.40 | 8.54 | 26 | 18.3 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| | 15050 | Q100 | Proposed | 1145 | 716.54 | 720.61 | 2.16 | 15.3 | 100 | 46.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15050 | Q10 | Proposed | 653 | 716.54 | 719.79 | 1.52 | 12.66 | 64 | 42.1 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15050 | Q1.5 | Proposed | 219 | 716.54 | 718.65 | 1.40 | 8.57 | 26 | 18.3 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| | 15000 | Q100 | Proposed | 1145 | 712.56 | 716.64 | 2.09 | 15.21 | 103 | 49.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 15000 | Q10 | Proposed | 653 | 712.56 | 715.86 | 1.45 | 12.56 | 66 | 45.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 15000 | Q1.5 | Proposed | 219 | 712.56 | 714.71 | 1.41 | 8.49 | 26 | 18.3 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| | 14950 | Q100 | Proposed | 1145 | 708.59 | 712.63 | 1.98 | 15.17 | 104 | 52.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14950 | Q10 | Proposed | 653 | 708.59 | 711.83 | 1.42 | 12.67 | 64 | 45.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 14950 | Q1.5 | Proposed | 219 | 708.59 | 710.69 | 1.38 | 8.6 | 25 | 18.4 | | 0.06 | | 0.06 |

## TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS

## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT #10 | 14923.42 | Q100 | Existing | 1145 | 705.88 | 713.26 | 4.60 | 13.7 | 101 | 22.0 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14923.42 | Q100 | Proposed | 1145 | 706.35 | 710.53 | 1.96 | 15.07 | 103 | 52.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14923.42 | Q10 | Existing | 653 | 705.88 | 711.27 | 3.52 | 11.64 | 62 | 17.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14923.42 | Q10 | Proposed | 653 | 706.35 | 709.66 | 1.52 | 12.65 | 62 | 40.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 14923.42 | Q1.5 | Existing | 219 | 705.88 | 708.25 | 1.72 | 11.59 | 19 | 11.0 | | 0.05 | 0.00 | 0.05 |
| | 14923.42 | Q1.5 | Proposed | 219 | 706.35 | 708.43 | 1.35 | 8.73 | 25 | 18.5 | | 0.06 | 0.00 | 0.06 |
| | 14900 | Q100 | Existing | 1145 | 704.46 | 710.45 | 3.64 | 16.92 | 77 | 21.1 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 14900 | Q100 | Proposed | 1145 | 704.78 | 708.26 | 2.01 | 15.55 | 95 | 47.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14900 | Q10 | Existing | 653 | 704.46 | 709.03 | 2.85 | 14.05 | 49 | 17.4 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 14900 | Q10 | Proposed | 653 | 704.78 | 707.44 | 1.51 | 13 | 59 | 39.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14900 | Q1.5 | Existing | 219 | 704.46 | 707.60 | 2.01 | 8.14 | 27 | 13.6 | | 0.07 | 0.10 | 0.06 |
| | 14900 | Q1.5 | Proposed | 219 | 704.78 | 706.43 | 1.22 | 8.37 | 27 | 21.8 | | 0.06 | 0.10 | 0.06 |
| | 14850 | Q100 | Existing | 1145 | 701.28 | 710.33 | 5.82 | 7.78 | 177 | 30.4 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14850 | Q100 | Proposed | 1145 | 701.28 | 706.42 | 2.30 | 13.35 | 137 | 59.4 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14850 | Q10 | Existing | 653 | 701.28 | 707.97 | 4.48 | 6.47 | 112 | 25.0 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14850 | Q10 | Proposed | 653 | 701.28 | 705.50 | 1.62 | 10.94 | 85 | 52.7 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14850 | Q1.5 | Existing | 219 | 701.28 | 704.90 | 2.59 | 4.76 | 46 | 17.9 | 0.10 | 0.05 | | 0.05 |
| | 14850 | Q1.5 | Proposed | 219 | 701.28 | 704.19 | 2.09 | 6.63 | 33 | 15.8 | 0.10 | 0.05 | | 0.05 |
| | 14802.52 | Q100 | Existing | 1145 | 700.05 | 708.01 | 4.54 | 14.32 | 121 | 26.7 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14802.52 | Q100 | Proposed | 1145 | 700.05 | 704.87 | 2.24 | 14.51 | 156 | 69.9 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 14802.52 | Q10 | Existing | 653 | 700.05 | 705.97 | 3.48 | 12.2 | 73 | 20.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14802.52 | Q10 | Proposed | 653 | 700.05 | 704.19 | 1.67 | 11.55 | 110 | 65.9 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14802.52 | Q1.5 | Existing | 219 | 700.05 | 703.35 | 2.07 | 8.91 | 28 | 13.4 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14802.52 | Q1.5 | Proposed | 219 | 700.05 | 703.33 | 0.92 | 6.9 | 55 | 60.0 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14794.09 | Q100 | Existing | 1145 | 697.70 | 704.67 | 4.03 | 20.6 | 85 | 21.1 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14794.09 | Q100 | Proposed | 1145 | 697.70 | 703.03 | 1.62 | 17.18 | 127 | 78.5 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14794.09 | Q10 | Existing | 653 | 697.70 | 702.64 | 2.94 | 18.66 | 47 | 16.1 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14794.09 | Q10 | Proposed | 653 | 697.70 | 702.39 | 1.10 | 14.36 | 80 | 72.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14794.09 | Q1.5 | Existing | 219 | 697.70 | 700.24 | 1.54 | 15.49 | 16 | 10.2 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14794.09 | Q1.5 | Proposed | 219 | 697.70 | 700.47 | 1.72 | 13.69 | 16 | 9.3 | | 0.05 | | 0.05 |

## TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | 14750 | Q100 | Existing | 1145 | 696.69 | 702.06 | 3.62 | 19.66 | 68 | 18.7 | 0.10 | 0.05 | 0.10 | 0.04 |
|  | 14750 | Q100 | Proposed | 1145 | 696.69 | 701.15 | 1.83 | 14.8 | 152 | 82.9 | 0.10 | 0.05 | 0.10 | 0.06 |
|  | 14750 | Q10 | Existing | 653 | 696.69 | 700.81 | 2.82 | 15.62 | 46 | 16.2 | 0.10 | 0.05 | 0.10 | 0.04 |
|  | 14750 | Q10 | Proposed | 653 | 696.69 | 700.44 | 1.22 | 12.87 | 95 | 78.1 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14750 | Q1.5 | Existing | 219 | 696.69 | 699.52 | 1.93 | 8.52 | 26 | 13.7 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14750 | Q1.5 | Proposed | 219 | 696.69 | 699.60 | 0.78 | 7.75 | 37 | 47.3 | 0.10 | 0.05 | 0.10 | 0.03 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 14700 | Q100 | Existing | 1145 | 692.71 | 698.67 | 3.44 | 20.19 | 68 | 19.7 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14700 | Q100 | Proposed | 1145 | 692.71 | 697.47 | 1.78 | 17.4 | 135 | 76.0 | 0.10 | 0.05 | 0.10 | 0.07 |
|  | 14700 | Q10 | Existing | 653 | 692.71 | 697.33 | 2.74 | 16.38 | 44 | 16.0 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14700 | Q10 | Proposed | 653 | 692.71 | 696.78 | 1.13 | 15.18 | 83 | 73.4 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14700 | Q1.5 | Existing | 219 | 692.71 | 695.33 | 1.63 | 12.78 | 17 | 10.6 |  | 0.05 | 0.10 | 0.05 |
|  | 14700 | Q1.5 | Proposed | 219 | 692.71 | 695.30 | 1.33 | 12.88 | 17 | 13.0 | 0.10 | 0.05 | 0.10 | 0.04 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 14667.14 | Q100 | Existing | 1145 | 687.94 | 692.19 | 2.72 | 24.05 | 49 | 18.1 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14667.14 | Q100 | Proposed | 1145 | 687.94 | 693.05 | 1.24 | 18 | 79 | 63.8 | 0.10 | 0.05 | 0.10 | 0.03 |
|  | 14667.14 | Q10 | Existing | 653 | 687.94 | 691.18 | 2.02 | 20.42 | 32 | 15.9 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14667.14 | Q10 | Proposed | 653 | 687.94 | 691.54 | 2.31 | 17.66 | 37 | 16.2 |  | 0.05 | 0.10 | 0.05 |
|  | 14667.14 | Q1.5 | Existing | 219 | 687.94 | 689.96 | 1.28 | 14.58 | 15 | 11.7 |  | 0.05 |  | 0.05 |
|  | 14667.14 | Q1.5 | Proposed | 219 | 687.94 | 689.97 | 1.30 | 14.46 | 15 | 11.7 |  | 0.05 |  | 0.05 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 14650 | Q100 | Existing | 1145 | 687.66 | 692.34 | 3.02 | 19.82 | 63 | 20.9 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14650 | Q100 | Proposed | 1145 | 687.66 | 692.48 | 1.48 | 16.95 | 97 | 65.8 | 0.10 | 0.05 | 0.10 | 0.04 |
|  | 14650 | Q10 | Existing | 653 | 687.66 | 691.44 | 2.46 | 15.02 | 45 | 18.4 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14650 | Q10 | Proposed | 653 | 687.66 | 691.62 | 1.52 | 13.51 | 54 | 35.9 | 0.10 | 0.05 | 0.10 | 0.04 |
|  | 14650 | Q1.5 | Existing | 219 | 687.66 | 690.38 | 1.76 | 8.03 | 27 | 15.6 | 0.00 | 0.05 | 0.10 | 0.05 |
|  | 14650 | Q1.5 | Proposed | 219 | 687.66 | 690.38 | 1.74 | 7.95 | 28 | 15.9 |  | 0.05 | 0.10 | 0.05 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 14600 | Q100 | Existing | 1145 | 685.80 | 691.86 | 3.48 | 11.94 | 159 | 45.7 | 0.10 | 0.05 | 0.10 | 0.06 |
|  | 14600 | Q100 | Proposed | 1145 | 685.80 | 689.95 | 1.65 | 16.82 | 125 | 75.6 | 0.10 | 0.05 | 0.10 | 0.06 |
|  | 14600 | Q10 | Existing | 653 | 685.80 | 690.29 | 2.72 | 10.21 | 97 | 35.6 | 0.10 | 0.05 | 0.10 | 0.06 |
|  | 14600 | Q10 | Proposed | 653 | 685.80 | 689.36 | 1.25 | 13.2 | 82 | 65.5 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 14600 | Q1.5 | Existing | 219 | 685.80 | 688.73 | 1.57 | 6.59 | 46 | 29.4 | 0.10 | 0.05 | 0.10 | 0.06 |
|  | 14600 | Q1.5 | Proposed | 219 | 685.80 | 688.68 | 1.18 | 6.59 | 46 | 38.8 | 0.10 | 0.05 | 0.10 | 0.05 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14550 | Q100 | Existing | 1145 | 684.39 | 691.39 | 4.25 | 10.22 | 172 | 40.4 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14550 | Q100 | Proposed | 1145 | 684.39 | 690.73 | 3.37 | 7.92 | 257 | 76.4 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 14550 | Q10 | Existing | 653 | 684.39 | 689.50 | 2.94 | 9.19 | 101 | 34.5 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14550 | Q10 | Proposed | 653 | 684.39 | 689.30 | 2.35 | 7.35 | 156 | 66.5 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 14550 | Q1.5 | Existing | 219 | 684.39 | 687.38 | 1.22 | 7.45 | 34 | 28.1 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 14550 | Q1.5 | Proposed | 219 | 684.39 | 687.51 | 0.88 | 6.73 | 44 | 50.1 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 14500 | Q100 | Existing | 1145 | 682.99 | 689.58 | 3.82 | 12.58 | 118 | 30.8 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14500 | Q100 | Proposed | 1145 | 682.99 | 689.05 | 3.04 | 11.41 | 158 | 52.0 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14500 | Q10 | Existing | 653 | 682.99 | 687.95 | 2.89 | 10.67 | 72 | 24.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14500 | Q10 | Proposed | 653 | 682.99 | 687.76 | 2.31 | 9.85 | 97 | 42.2 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14500 | Q1.5 | Existing | 219 | 682.99 | 686.52 | 2.04 | 5.83 | 40 | 19.7 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14500 | Q1.5 | Proposed | 219 | 682.99 | 686.16 | 1.22 | 6.84 | 38 | 31.3 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 14450 | Q100 | Existing | 1145 | 681.13 | 687.19 | 2.63 | 11 | 145 | 54.9 | 0.04 | 0.05 | 0.10 | 0.04 |
| | 14450 | Q100 | Proposed | 1145 | 681.13 | 686.91 | 2.36 | 14.53 | 121 | 51.3 | 0.09 | 0.07 | 0.10 | 0.07 |
| | 14450 | Q10 | Existing | 653 | 681.13 | 687.75 | 3.09 | 4.95 | 176 | 57.1 | 0.04 | 0.05 | 0.10 | 0.04 |
| | 14450 | Q10 | Proposed | 653 | 681.13 | 686.19 | 2.22 | 11.31 | 88 | 39.8 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 14450 | Q1.5 | Existing | 219 | 681.13 | 684.96 | 2.04 | 9.59 | 34 | 16.5 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14450 | Q1.5 | Proposed | 219 | 681.13 | 684.70 | 1.43 | 7.77 | 40 | 27.7 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 14412.75 | Q100 | Existing | 1145 | 679.63 | 686.06 | 2.97 | 10.82 | 158 | 53.0 | 0.04 | 0.05 | 0.10 | 0.04 |
| | 14412.75 | Q100 | Proposed | 1145 | 679.63 | 685.33 | 2.90 | 13.78 | 135 | 46.6 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 14412.75 | Q10 | Existing | 653 | 679.63 | 685.68 | 3.50 | 13.01 | 87 | 24.7 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14412.75 | Q10 | Proposed | 653 | 679.63 | 683.84 | 2.42 | 13.13 | 78 | 32.5 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 14412.75 | Q1.5 | Existing | 219 | 679.63 | 682.22 | 1.67 | 13.17 | 22 | 12.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14412.75 | Q1.5 | Proposed | 219 | 679.63 | 682.18 | 1.20 | 10.22 | 30 | 25.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14388.99 | Q100 | Existing | 1145 | 674.81 | 682.95 | 4.47 | 16.31 | 101 | 22.5 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14388.99 | Q100 | Proposed | 1145 | 674.81 | 681.09 | 2.80 | 18.24 | 84 | 29.9 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 14388.99 | Q10 | Existing | 653 | 674.81 | 679.24 | 2.60 | 21.62 | 35 | 13.4 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14388.99 | Q10 | Proposed | 653 | 674.81 | 679.76 | 1.97 | 16.2 | 48 | 24.2 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 14388.99 | Q1.5 | Existing | 219 | 674.81 | 677.31 | 1.44 | 17.25 | 13 | 9.1 | 0.10 | 0.05 | | 0.05 |
| | 14388.99 | Q1.5 | Proposed | 219 | 674.81 | 677.58 | 1.64 | 14.11 | 16 | 9.5 | | 0.06 | | 0.06 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14350 | Q100 | Existing | 1145 | 672.28 | 677.77 | 3.62 | 21.76 | 65 | 18.1 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14350 | Q100 | Proposed | 1145 | 672.28 | 677.86 | 2.85 | 17.75 | 89 | 31.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14350 | Q10 | Existing | 653 | 672.28 | 676.18 | 2.63 | 19.09 | 39 | 14.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14350 | Q10 | Proposed | 653 | 672.28 | 676.74 | 2.09 | 14.58 | 56 | 26.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 14350 | Q1.5 | Existing | 219 | 672.28 | 674.80 | 1.68 | 11.31 | 20 | 12.2 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14350 | Q1.5 | Proposed | 219 | 672.28 | 675.17 | 1.98 | 9.19 | 25 | 12.7 | | 0.06 | 0.10 | 0.06 |
| | 14300 | Q100 | Existing | 1145 | 667.57 | 673.70 | 3.91 | 23.95 | 71 | 18.2 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14300 | Q100 | Proposed | 1145 | 667.57 | 673.41 | 2.82 | 16.65 | 85 | 30.2 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 14300 | Q10 | Existing | 653 | 667.57 | 672.35 | 2.86 | 19.27 | 48 | 16.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14300 | Q10 | Proposed | 653 | 667.57 | 672.39 | 2.08 | 13.67 | 56 | 27.0 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 14300 | Q1.5 | Existing | 219 | 667.57 | 670.50 | 1.56 | 13.21 | 20 | 12.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14300 | Q1.5 | Proposed | 219 | 667.57 | 670.71 | 1.69 | 10.26 | 22 | 12.9 | | 0.07 | 0.10 | 0.07 |
| | 14250 | Q100 | Existing | 1145 | 664.33 | 667.97 | 2.42 | 23.4 | 64 | 26.4 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14250 | Q100 | Proposed | 1145 | 664.33 | 668.56 | 2.01 | 14.07 | 100 | 49.6 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 14250 | Q10 | Existing | 653 | 664.33 | 667.17 | 1.79 | 18.78 | 44 | 24.4 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14250 | Q10 | Proposed | 653 | 664.33 | 667.82 | 1.45 | 11.21 | 64 | 44.2 | 0.10 | 0.07 | 0.10 | 0.05 |
| | 14250 | Q1.5 | Existing | 219 | 664.33 | 666.21 | 0.98 | 11.74 | 21 | 22.0 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14250 | Q1.5 | Proposed | 219 | 664.33 | 667.24 | 1.84 | 4.98 | 45 | 24.7 | | 0.07 | 0.10 | 0.07 |
| | 14192.69 | Q100 | Existing | 1145 | 662.17 | 667.79 | 3.76 | 12.41 | 108 | 28.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14192.69 | Q100 | Proposed | 1145 | 662.17 | 667.52 | 2.84 | 10.76 | 145 | 50.9 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 14192.69 | Q10 | Existing | 653 | 662.17 | 666.50 | 2.78 | 10.08 | 72 | 26.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14192.69 | Q10 | Proposed | 653 | 662.17 | 666.51 | 1.98 | 8.9 | 95 | 48.0 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 14192.69 | Q1.5 | Existing | 219 | 662.17 | 664.78 | 1.42 | 7.24 | 31 | 21.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14192.69 | Q1.5 | Proposed | 219 | 662.17 | 664.80 | 1.42 | 7.14 | 31 | 21.9 | | 0.06 | 0.10 | 0.06 |
| | 14150 | Q100 | Existing | 1145 | 660.23 | 664.78 | 2.89 | 14.67 | 88 | 30.3 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14150 | Q100 | Proposed | 1145 | 660.23 | 664.76 | 2.18 | 13.09 | 115 | 52.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14150 | Q10 | Existing | 653 | 660.23 | 663.76 | 2.17 | 11.99 | 58 | 27.0 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14150 | Q10 | Proposed | 653 | 660.23 | 663.85 | 1.40 | 11.14 | 68 | 48.8 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 14150 | Q1.5 | Existing | 219 | 660.23 | 662.64 | 1.30 | 7.39 | 30 | 23.3 | 0.00 | 0.05 | 0.10 | 0.05 |
| | 14150 | Q1.5 | Proposed | 219 | 660.23 | 662.68 | 1.33 | 7.16 | 31 | 23.6 | | 0.06 | 0.10 | 0.05 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14096.7 | Q100 | Existing | 1145 | 658.49 | 664.23 | 4.07 | 11.08 | 178 | 43.8 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 14096.7 | Q100 | Proposed | 1145 | 658.49 | 663.75 | 3.04 | 7.9 | 195 | 64.1 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 14096.7 | Q10 | Existing | 653 | 658.49 | 662.61 | 2.64 | 10.04 | 109 | 41.4 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 14096.7 | Q10 | Proposed | 653 | 658.49 | 662.59 | 2.03 | 6.91 | 122 | 60.3 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 14096.7 | Q1.5 | Existing | 219 | 658.49 | 661.04 | 1.20 | 7.41 | 46 | 38.6 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14096.7 | Q1.5 | Proposed | 219 | 658.49 | 660.93 | 1.10 | 5.98 | 42 | 38.3 | | 0.06 | 0.10 | 0.06 |
| | | | | | | | | | | | | | | |
| | 14081.95 | Q100 | Existing | 1145 | 657.82 | 663.13 | 3.51 | 13.48 | 143 | 40.7 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 14081.95 | Q100 | Proposed | 1145 | 657.82 | 662.74 | 2.56 | 10.44 | 151 | 59.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14081.95 | Q10 | Existing | 653 | 657.82 | 661.97 | 2.61 | 10.8 | 98 | 37.5 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 14081.95 | Q10 | Proposed | 653 | 657.82 | 661.70 | 1.84 | 8.95 | 93 | 50.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14081.95 | Q1.5 | Existing | 219 | 657.82 | 660.29 | 1.07 | 8.46 | 37 | 34.8 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 14081.95 | Q1.5 | Proposed | 219 | 657.82 | 660.34 | 1.12 | 6.49 | 39 | 34.9 | | 0.06 | 0.10 | 0.05 |
| | | | | | | | | | | | | | | |
| | 14050 | Q100 | Existing | 1145 | 657.20 | 662.81 | 4.09 | 7.31 | 170 | 41.6 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 14050 | Q100 | Proposed | 1145 | 657.20 | 662.24 | 2.94 | 7.47 | 182 | 61.8 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 14050 | Q10 | Existing | 653 | 657.20 | 661.30 | 2.94 | 6.22 | 111 | 37.6 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 14050 | Q10 | Proposed | 653 | 657.20 | 661.20 | 2.06 | 6.14 | 119 | 57.9 | 0.10 | 0.08 | 0.10 | 0.06 |
| | 14050 | Q1.5 | Existing | 219 | 657.20 | 659.59 | 1.52 | 4.42 | 50 | 33.0 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 14050 | Q1.5 | Proposed | 219 | 657.20 | 659.54 | 1.48 | 4.56 | 48 | 32.7 | | 0.08 | 0.10 | 0.07 |
| | | | | | | | | | | | | | | |
| | 14000 | Q100 | Existing | 1145 | 655.73 | 661.50 | 3.88 | 9.27 | 149 | 38.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14000 | Q100 | Proposed | 1145 | 655.73 | 660.53 | 2.50 | 9.91 | 160 | 64.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14000 | Q10 | Existing | 653 | 655.73 | 659.93 | 2.88 | 7.91 | 93 | 32.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14000 | Q10 | Proposed | 653 | 655.73 | 659.49 | 1.61 | 8.46 | 96 | 59.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 14000 | Q1.5 | Existing | 219 | 655.73 | 658.15 | 1.63 | 5.5 | 42 | 25.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 14000 | Q1.5 | Proposed | 219 | 655.73 | 658.10 | 1.60 | 5.52 | 41 | 25.8 | | 0.06 | 0.10 | 0.06 |
| | | | | | | | | | | | | | | |
| | 13950 | Q100 | Existing | 1145 | 653.77 | 659.47 | 3.79 | 11.89 | 108 | 28.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13950 | Q100 | Proposed | 1145 | 653.77 | 659.13 | 2.83 | 10.79 | 152 | 53.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13950 | Q10 | Existing | 653 | 653.77 | 658.04 | 2.80 | 9.99 | 70 | 24.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13950 | Q10 | Proposed | 653 | 653.77 | 657.98 | 1.88 | 9.33 | 93 | 49.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 13950 | Q1.5 | Existing | 219 | 653.77 | 656.29 | 1.56 | 7.24 | 31 | 19.6 | | 0.06 | 0.10 | 0.05 |
| | 13950 | Q1.5 | Proposed | 219 | 653.77 | 656.28 | 1.56 | 7.3 | 30 | 19.4 | | 0.06 | 0.10 | 0.05 |

## TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS

## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13900 | Q100 | Existing | 1145 | 650.13 | 655.72 | 3.39 | 15.92 | 80 | 23.5 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13900 | Q100 | Proposed | 1145 | 650.13 | 655.95 | 2.27 | 14.24 | 110 | 48.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 13900 | Q10 | Existing | 653 | 650.13 | 654.30 | 2.60 | 13.75 | 49 | 19.0 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13900 | Q10 | Proposed | 653 | 650.13 | 654.77 | 1.80 | 12.41 | 58 | 32.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 13900 | Q1.5 | Existing | 219 | 650.13 | 652.64 | 1.44 | 10.31 | 21 | 14.9 | | 0.05 | 0.10 | 0.05 |
| | 13900 | Q1.5 | Proposed | 219 | 650.13 | 653.66 | 2.25 | 6.27 | 36 | 16.0 | | 0.06 | 0.10 | 0.06 |
| | 13850 | Q100 | Existing | 1145 | 649.64 | 654.70 | 3.27 | 13.44 | 101 | 30.8 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13850 | Q100 | Proposed | 1145 | 649.64 | 654.19 | 2.19 | 12.04 | 133 | 60.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13850 | Q10 | Existing | 653 | 649.64 | 653.75 | 2.68 | 10.06 | 73 | 27.1 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13850 | Q10 | Proposed | 653 | 649.64 | 653.59 | 1.70 | 8.87 | 98 | 57.4 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 13850 | Q1.5 | Existing | 219 | 649.64 | 651.99 | 1.51 | 7.2 | 31 | 20.5 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13850 | Q1.5 | Proposed | 219 | 649.64 | 652.00 | 1.46 | 7.03 | 32 | 21.7 | | 0.06 | 0.10 | 0.05 |
| | 13800 | Q100 | Existing | 1145 | 647.10 | 654.19 | 4.54 | 7.15 | 176 | 38.8 | | 0.08 | 0.10 | 0.07 |
| | 13800 | Q100 | Proposed | 1145 | 647.10 | 652.77 | 2.53 | 9.54 | 160 | 63.0 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 13800 | Q10 | Existing | 653 | 647.10 | 652.47 | 3.36 | 6.18 | 114 | 33.8 | | 0.07 | 0.10 | 0.07 |
| | 13800 | Q10 | Proposed | 653 | 647.10 | 651.82 | 1.82 | 7.77 | 103 | 56.5 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 13800 | Q1.5 | Existing | 219 | 647.10 | 650.47 | 1.86 | 4.33 | 52 | 27.9 | | 0.07 | 0.10 | 0.07 |
| | 13800 | Q1.5 | Proposed | 219 | 647.10 | 650.48 | 1.78 | 4.8 | 47 | 26.5 | | 0.07 | 0.10 | 0.06 |
| | 13750 | Q100 | Existing | 1145 | 646.00 | 651.86 | 3.74 | 12.4 | 127 | 34.0 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13750 | Q100 | Proposed | 1145 | 646.00 | 651.41 | 2.50 | 10.62 | 181 | 72.2 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 13750 | Q10 | Existing | 653 | 646.00 | 650.54 | 2.66 | 10.23 | 84 | 31.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13750 | Q10 | Proposed | 653 | 646.00 | 650.49 | 1.78 | 8.82 | 117 | 65.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13750 | Q1.5 | Existing | 219 | 646.00 | 648.91 | 1.23 | 7.14 | 35 | 28.3 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 13750 | Q1.5 | Proposed | 219 | 646.00 | 648.98 | 1.30 | 6.75 | 37 | 28.5 | | 0.05 | 0.10 | 0.05 |
| | 13700 | Q100 | Existing | 1145 | 644.74 | 649.39 | 2.81 | 13.89 | 102 | 36.4 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 13700 | Q100 | Proposed | 1145 | 644.74 | 650.41 | 2.64 | 7.53 | 222 | 83.9 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 13700 | Q10 | Existing | 653 | 644.74 | 649.00 | 2.50 | 9.08 | 88 | 35.1 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 13700 | Q10 | Proposed | 653 | 644.74 | 649.37 | 1.86 | 6.51 | 139 | 74.7 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 13700 | Q1.5 | Existing | 219 | 644.74 | 647.58 | 1.36 | 6.02 | 41 | 30.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13700 | Q1.5 | Proposed | 219 | 644.74 | 647.68 | 1.44 | 5.52 | 45 | 31.0 | | 0.07 | 0.10 | 0.07 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13657.14 | Q100 | Existing | 1145 | 644.12 | 648.73 | 3.13 | 10.53 | 117 | 37.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13657.14 | Q100 | Proposed | 1145 | 644.12 | 648.76 | 2.14 | 9.37 | 154 | 72.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13657.14 | Q10 | Existing | 653 | 644.12 | 648.14 | 2.69 | 7.22 | 96 | 35.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13657.14 | Q10 | Proposed | 653 | 644.12 | 647.71 | 1.45 | 8.28 | 85 | 58.9 | 0.10 | 0.06 | 0.10 | 0.04 |
| | 13657.14 | Q1.5 | Existing | 219 | 644.12 | 646.50 | 1.40 | 5.32 | 42 | 29.9 | | 0.06 | 0.10 | 0.05 |
| | 13657.14 | Q1.5 | Proposed | 219 | 644.12 | 646.46 | 1.37 | 5.5 | 40 | 29.5 | | 0.06 | 0.10 | 0.05 |
| | | | | | | | | | | | | | | |
| | 13594.58 | Q100 | Existing | 1145 | 642.80 | 648.34 | 4.31 | 6.38 | 228 | 53.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13594.58 | Q100 | Proposed | 1145 | 642.80 | 646.47 | 2.25 | 10.91 | 132 | 58.8 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13594.58 | Q10 | Existing | 653 | 642.80 | 648.23 | 4.20 | 3.73 | 223 | 52.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13594.58 | Q10 | Proposed | 653 | 642.80 | 645.64 | 1.88 | 8.92 | 90 | 47.9 | | 0.05 | 0.10 | 0.06 |
| | 13594.58 | Q1.5 | Existing | 219 | 642.80 | 644.60 | 1.00 | 5.99 | 43 | 42.4 | | 0.05 | 0.10 | 0.06 |
| | 13594.58 | Q1.5 | Proposed | 219 | 642.80 | 644.60 | 1.00 | 6.04 | 43 | 42.4 | | 0.05 | 0.10 | 0.05 |
| | | | | | | | | | | | | | | |
| | 13560.62 | Q100 | Existing | 1145 | 641.52 | 648.25 | 5.27 | 6.45 | 298 | 56.6 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 13560.62 | Q100 | Proposed | 1145 | 641.52 | 646.15 | 2.30 | 6.64 | 206 | 89.6 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 13560.62 | Q10 | Existing | 653 | 641.52 | 648.21 | 5.23 | 3.71 | 295 | 56.4 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 13560.62 | Q10 | Proposed | 653 | 641.52 | 645.35 | 2.00 | 5.06 | 142 | 70.8 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 13560.62 | Q1.5 | Existing | 219 | 641.52 | 644.01 | 1.58 | 4.53 | 76 | 48.4 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 13560.62 | Q1.5 | Proposed | 219 | 641.52 | 643.97 | 1.55 | 3.28 | 70 | 45.1 | | 0.07 | 0.10 | 0.07 |
| | | | | | | | | | | | | | | |
| | 13500 | Q100 | Existing | 1145 | 640.53 | 648.09 | 5.28 | 5.9 | 338 | 64.0 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 13500 | Q100 | Proposed | 1145 | 640.53 | 645.20 | 2.10 | 7.24 | 253 | 120.5 | 0.09 | 0.06 | 0.10 | 0.07 |
| | 13500 | Q10 | Existing | 653 | 640.53 | 648.15 | 5.33 | 3.33 | 342 | 64.2 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 13500 | Q10 | Proposed | 653 | 640.53 | 644.33 | 1.46 | 6.39 | 155 | 106.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13500 | Q1.5 | Existing | 219 | 640.53 | 642.73 | 1.13 | 6.75 | 49 | 43.1 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13500 | Q1.5 | Proposed | 219 | 640.53 | 643.07 | 1.41 | 4.51 | 66 | 46.7 | | 0.06 | 0.10 | 0.07 |
| | | | | | | | | | | | | | | |
| | 13450 | Q100 | Existing | 1145 | 638.15 | 648.18 | 3.79 | 3.27 | 566 | 149.5 | 0.03 | 0.05 | 0.10 | 0.05 |
| | 13450 | Q100 | Proposed | 1145 | 638.15 | 643.90 | 1.95 | 9.23 | 211 | 108.3 | 0.09 | 0.05 | 0.10 | 0.05 |
| | 13450 | Q10 | Existing | 653 | 638.15 | 648.18 | 3.79 | 1.86 | 567 | 149.5 | 0.03 | 0.05 | 0.10 | 0.05 |
| | 13450 | Q10 | Proposed | 653 | 638.15 | 643.01 | 1.50 | 8.08 | 127 | 84.5 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13450 | Q1.5 | Existing | 219 | 638.15 | 640.88 | 1.53 | 7.6 | 29 | 19.2 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13450 | Q1.5 | Proposed | 219 | 638.15 | 641.28 | 1.55 | 7.18 | 31 | 19.7 | | 0.05 | | 0.05 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13426.44 | Q100 | Existing | 1145 | 637.86 | 648.20 | 4.62 | 2.26 | 651 | 140.7 | 0.03 | 0.06 | 0.10 | 0.05 |
| | 13426.44 | Q100 | Proposed | 1145 | 637.86 | 641.93 | 1.82 | 13.21 | 132 | 72.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13426.44 | Q10 | Existing | 653 | 637.86 | 648.19 | 4.62 | 1.29 | 650 | 140.7 | 0.03 | 0.06 | 0.10 | 0.05 |
| | 13426.44 | Q10 | Proposed | 653 | 637.86 | 641.11 | 1.16 | 11.74 | 75 | 64.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 13426.44 | Q1.5 | Existing | 219 | 637.86 | 640.44 | 1.55 | 6.17 | 38 | 24.7 | | 0.06 | 0.10 | 0.06 |
| | 13426.44 | Q1.5 | Proposed | 219 | 637.86 | 639.97 | 1.24 | 8.13 | 27 | 22.1 | | 0.06 | 0.10 | 0.05 |
| | 13400 | Q100 | Existing | 1145 | 635.37 | 648.21 | 6.39 | 1.93 | 925 | 144.7 | 0.04 | 0.05 | 0.10 | 0.05 |
| | 13400 | Q100 | Proposed | 1145 | 635.37 | 641.71 | 2.77 | 6.44 | 279 | 100.6 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 13400 | Q10 | Existing | 653 | 635.37 | 648.19 | 6.38 | 1.1 | 922 | 144.7 | 0.04 | 0.05 | 0.10 | 0.05 |
| | 13400 | Q10 | Proposed | 653 | 635.37 | 640.49 | 1.74 | 6.07 | 160 | 92.3 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 13400 | Q1.5 | Existing | 219 | 635.37 | 640.73 | 2.37 | 2.22 | 152 | 63.9 | 0.05 | 0.05 | 0.10 | 0.05 |
| | 13400 | Q1.5 | Proposed | 219 | 635.37 | 639.16 | 1.31 | 3.93 | 64 | 48.6 | 0.10 | 0.07 | 0.10 | 0.05 |
| | 13350 | Q100 | Existing | 1145 | 634.00 | 648.19 | 5.92 | 2.45 | 841 | 142.1 | 0.04 | 0.05 | 0.10 | 0.06 |
| | 13350 | Q100 | Proposed | 1145 | 635.68 | 641.10 | 3.14 | 6.73 | 250 | 79.6 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 13350 | Q10 | Existing | 653 | 634.00 | 648.18 | 5.92 | 1.4 | 841 | 142.1 | 0.04 | 0.05 | 0.10 | 0.06 |
| | 13350 | Q10 | Proposed | 653 | 635.68 | 639.73 | 2.05 | 6.28 | 147 | 72.0 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 13350 | Q1.5 | Existing | 219 | 634.00 | 640.71 | 3.98 | 2.1 | 178 | 44.9 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 13350 | Q1.5 | Proposed | 219 | 635.68 | 638.31 | 1.04 | 4.89 | 53 | 50.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| CULVERT #8 | 13335.55 | Q100 | Existing | 1145 | 634.01 | 647.84 | 5.15 | 6.27 | 326 | 63.3 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 13335.55 | Q100 | Proposed | 1145 | 635.28 | 640.89 | 3.17 | 6.55 | 229 | 72.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13335.55 | Q10 | Existing | 653 | 634.01 | 648.09 | 5.31 | 3.42 | 342 | 64.3 | 0.10 | 0.05 | 0.10 | 0.08 |
| | 13335.55 | Q10 | Proposed | 653 | 635.28 | 639.49 | 2.09 | 6.05 | 134 | 64.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13335.55 | Q1.5 | Existing | 219 | 634.01 | 640.07 | 3.26 | 6.21 | 36 | 11.1 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 13335.55 | Q1.5 | Proposed | 219 | 635.28 | 637.93 | 1.07 | 4.98 | 45 | 41.8 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 13300 | | | Culvert | | | | | | | | | | |
| | 13300 | Q100 | Proposed | 1145 | 634.82 | 640.28 | 3.40 | 7.51 | 195 | 57.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13300 | Q100 | Proposed | 653 | 634.82 | 638.83 | 2.36 | 6.63 | 117 | 49.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13300 | Q1.5 | Proposed | 219 | 634.82 | 637.09 | 1.57 | 4.94 | 44 | 28.2 | 0.10 | 0.06 | 0.10 | 0.06 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT #8 | 13238.93 | Q100 | Existing | 1276 | 632.54 | 641.63 | 4.89 | 15 | 131 | 26.8 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13238.93 | Q100 | Proposed | 1276 | 633.00 | 638.79 | 3.27 | 9.55 | 164 | 50.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13238.93 | Q10 | Existing | 728 | 632.54 | 639.39 | 3.78 | 12.8 | 78 | 20.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13238.93 | Q10 | Proposed | 728 | 633.00 | 637.89 | 2.73 | 6.98 | 121 | 44.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 13238.93 | Q1.5 | Existing | 244 | 632.54 | 636.43 | 2.28 | 9.41 | 29 | 12.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13238.93 | Q1.5 | Proposed | 244 | 633.00 | 636.50 | 1.96 | 3.86 | 65 | 33.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| | | | | | | | | | | | | | | |
| | 13208.08 | Q100 | Existing | 1276 | 631.15 | 636.50 | 3.15 | 21.83 | 81 | 25.7 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13208.08 | Q100 | Proposed | 1276 | 631.43 | 637.81 | 2.87 | 12.07 | 161 | 56.2 | 0.10 | 0.06 | 0.10 | 0.08 |
| | 13208.08 | Q10 | Existing | 728 | 631.15 | 635.26 | 2.37 | 18.54 | 51 | 21.7 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13208.08 | Q10 | Proposed | 728 | 631.43 | 636.87 | 2.15 | 10.03 | 111 | 51.6 | 0.10 | 0.06 | 0.10 | 0.08 |
| | 13208.08 | Q1.5 | Existing | 244 | 631.15 | 633.86 | 1.36 | 12.55 | 24 | 17.6 | 0.10 | 0.05 | | 0.05 |
| | 13208.08 | Q1.5 | Proposed | 244 | 631.43 | 635.71 | 1.17 | 6.87 | 54 | 46.0 | 0.10 | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| | 13200 | Q100 | Existing | 1276 | 630.29 | 635.23 | 2.87 | 22.86 | 82 | 28.4 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13200 | Q100 | Proposed | 1276 | 630.29 | 636.21 | 2.56 | 14.41 | 136 | 53.2 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13200 | Q10 | Existing | 728 | 630.29 | 634.18 | 2.11 | 18.9 | 53 | 25.3 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13200 | Q10 | Proposed | 728 | 630.29 | 635.05 | 1.65 | 12.94 | 78 | 47.3 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13200 | Q1.5 | Existing | 244 | 630.29 | 632.85 | 1.07 | 12.78 | 22 | 20.9 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 13200 | Q1.5 | Proposed | 244 | 630.29 | 632.78 | 1.57 | 13.41 | 18 | 11.6 | | 0.05 | | 0.05 |
| | | | | | | | | | | | | | | |
| | 13171.14 | Q100 | Existing | 1276 | 627.89 | 635.77 | 4.93 | 8.9 | 229 | 46.4 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 13171.14 | Q100 | Proposed | 1276 | 627.89 | 635.57 | 3.95 | 7.89 | 244 | 61.8 | 0.08 | 0.05 | 0.10 | 0.06 |
| | 13171.14 | Q10 | Existing | 728 | 627.89 | 633.76 | 3.27 | 8.03 | 139 | 42.6 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13171.14 | Q10 | Proposed | 728 | 627.89 | 634.00 | 2.82 | 7.3 | 153 | 54.5 | 0.09 | 0.05 | 0.10 | 0.06 |
| | 13171.14 | Q1.5 | Existing | 244 | 627.89 | 630.68 | 1.72 | 10.89 | 22 | 13.0 | | 0.05 | | 0.05 |
| | 13171.14 | Q1.5 | Proposed | 244 | 627.89 | 630.76 | 1.40 | 10.45 | 23 | 16.7 | 0.10 | 0.05 | | 0.04 |
| | | | | | | | | | | | | | | |
| | 13150 | Q100 | Existing | 1276 | 627.52 | 635.51 | 5.24 | 9.24 | 217 | 41.5 | 0.10 | 0.05 | 0.06 | 0.06 |
| | 13150 | Q100 | Proposed | 1276 | 627.52 | 634.27 | 3.22 | 12 | 185 | 57.4 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 13150 | Q10 | Existing | 728 | 627.52 | 633.57 | 3.71 | 7.87 | 140 | 37.9 | 0.10 | 0.05 | 0.05 | 0.06 |
| | 13150 | Q10 | Proposed | 728 | 627.52 | 633.06 | 2.28 | 9.89 | 119 | 52.1 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 13150 | Q1.5 | Existing | 244 | 627.52 | 631.00 | 1.48 | 6.64 | 49 | 33.2 | 0.10 | 0.05 | 0.05 | 0.05 |
| | 13150 | Q1.5 | Proposed | 244 | 627.52 | 630.75 | 1.56 | 7.88 | 35 | 22.5 | 0.10 | 0.05 | 0.10 | 0.04 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | 13112.96 | Q100 | Existing | 1276 | 626.28 | 633.66 | 4.13 | 14.05 | 151 | 36.6 | 0.10 | 0.05 | 0.10 | 0.06 |
|  | 13112.96 | Q100 | Proposed | 1276 | 626.28 | 632.49 | 2.63 | 14.68 | 151 | 57.4 | 0.10 | 0.05 | 0.10 | 0.06 |
|  | 13112.96 | Q10 | Existing | 728 | 626.28 | 632.05 | 3.09 | 11.69 | 96 | 31.2 | 0.10 | 0.05 | 0.10 | 0.06 |
|  | 13112.96 | Q10 | Proposed | 728 | 626.28 | 631.27 | 1.98 | 12.74 | 88 | 44.4 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 13112.96 | Q1.5 | Existing | 244 | 626.28 | 629.79 | 1.69 | 8.58 | 35 | 20.9 | 0.09 | 0.05 | 0.10 | 0.05 |
|  | 13112.96 | Q1.5 | Proposed | 244 | 626.28 | 629.76 | 1.47 | 8.06 | 36 | 24.6 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 13087 | Q100 | Existing | 1276 | 624.08 | 630.09 | 3.06 | 17.96 | 88 | 28.6 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 13087 | Q100 | Proposed | 1276 | 624.08 | 630.31 | 2.77 | 16.32 | 112 | 40.5 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 13087 | Q10 | Existing | 728 | 624.08 | 628.62 | 2.10 | 15.98 | 49 | 23.4 | 0.10 | 0.05 | 0.10 | 0.04 |
|  | 13087 | Q10 | Proposed | 728 | 624.08 | 628.91 | 1.83 | 14.64 | 60 | 32.9 | 0.10 | 0.05 | 0.10 | 0.04 |
|  | 13087 | Q1.5 | Existing | 244 | 624.08 | 626.50 | 1.70 | 13.71 | 18 | 10.5 |  | 0.05 |  | 0.05 |
|  | 13087 | Q1.5 | Proposed | 244 | 624.08 | 626.58 | 1.76 | 13.13 | 19 | 10.6 |  | 0.05 |  | 0.05 |
|  | 13050 | Q100 | Existing | 1276 | 622.58 | 628.12 | 3.11 | 17.88 | 92 | 29.7 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 13050 | Q100 | Proposed | 1276 | 622.58 | 628.37 | 3.26 | 16.62 | 100 | 30.5 | 0.10 | 0.05 | 0.06 | 0.05 |
|  | 13050 | Q10 | Existing | 728 | 622.58 | 627.09 | 2.38 | 14.06 | 63 | 26.5 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 13050 | Q10 | Proposed | 728 | 622.58 | 627.03 | 2.34 | 14.31 | 62 | 26.4 | 0.10 | 0.05 | 0.05 | 0.05 |
|  | 13050 | Q1.5 | Existing | 244 | 622.58 | 625.81 | 1.69 | 8.08 | 33 | 19.5 | 0.10 | 0.05 |  | 0.05 |
|  | 13050 | Q1.5 | Proposed | 244 | 622.58 | 625.82 | 1.69 | 8.06 | 33 | 19.6 | 0.10 | 0.05 |  | 0.05 |
|  | 13000 | Q100 | Existing | 1276 | 619.73 | 627.46 | 4.16 | 14.19 | 118 | 28.3 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 13000 | Q100 | Proposed | 1276 | 619.73 | 627.61 | 4.23 | 13.62 | 122 | 28.9 | 0.10 | 0.06 | 0.10 | 0.06 |
|  | 13000 | Q10 | Existing | 728 | 619.73 | 625.53 | 3.05 | 12.48 | 69 | 22.5 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 13000 | Q10 | Proposed | 728 | 619.73 | 625.80 | 3.19 | 11.55 | 75 | 23.5 | 0.10 | 0.06 | 0.10 | 0.05 |
|  | 13000 | Q1.5 | Existing | 244 | 619.73 | 623.11 | 1.91 | 10.11 | 24 | 12.7 | 0.00 | 0.05 |  | 0.05 |
|  | 13000 | Q1.5 | Proposed | 244 | 619.73 | 623.18 | 1.93 | 9.73 | 25 | 13.0 | 0.10 | 0.06 |  | 0.05 |
|  | 12950 | Q100 | Existing | 1276 | 616.64 | 622.93 | 2.88 | 19.71 | 91 | 31.6 | 0.10 | 0.05 | 0.10 | 0.05 |
|  | 12950 | Q100 | Proposed | 1276 | 616.64 | 622.97 | 2.92 | 18.32 | 92 | 31.7 | 0.10 | 0.06 | 0.10 | 0.05 |
|  | 12950 | Q10 | Existing | 728 | 616.64 | 621.72 | 2.13 | 16.17 | 55 | 25.8 | 0.10 | 0.05 | 0.10 | 0.04 |
|  | 12950 | Q10 | Proposed | 728 | 616.64 | 621.80 | 2.15 | 15.08 | 57 | 26.6 | 0.10 | 0.06 | 0.10 | 0.05 |
|  | 12950 | Q1.5 | Existing | 244 | 616.64 | 619.83 | 2.11 | 10.8 | 23 | 10.7 | 0.00 | 0.05 |  | 0.05 |
|  | 12950 | Q1.5 | Proposed | 244 | 616.64 | 620.00 | 2.15 | 9.99 | 24 | 11.4 |  | 0.06 | 0.10 | 0.05 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12900 | Q100 | Existing | 1276 | 614.95 | 621.19 | 3.13 | 16.54 | 98 | 31.3 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12900 | Q100 | Proposed | 1276 | 614.95 | 622.29 | 3.94 | 12.67 | 134 | 33.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12900 | Q10 | Existing | 728 | 614.95 | 619.97 | 2.20 | 13.37 | 62 | 27.9 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 12900 | Q10 | Proposed | 728 | 614.95 | 620.61 | 2.70 | 10.96 | 80 | 29.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 12900 | Q1.5 | Existing | 244 | 614.95 | 618.18 | 2.25 | 8.47 | 29 | 12.8 | | 0.05 | | 0.05 |
| | 12900 | Q1.5 | Proposed | 244 | 614.95 | 618.17 | 2.24 | 8.54 | 29 | 12.8 | | 0.06 | | 0.06 |
| | 12850 | Q100 | Existing | 1276 | 613.16 | 621.61 | 4.69 | 10.06 | 162 | 34.6 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12850 | Q100 | Proposed | 1276 | 613.16 | 620.04 | 3.30 | 14.04 | 115 | 35.0 | 0.09 | 0.06 | 0.10 | 0.05 |
| | 12850 | Q10 | Existing | 728 | 613.16 | 619.73 | 3.50 | 8.5 | 102 | 29.2 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 12850 | Q10 | Proposed | 728 | 613.16 | 619.01 | 2.82 | 10.32 | 82 | 29.1 | 0.09 | 0.06 | 0.10 | 0.05 |
| | 12850 | Q1.5 | Existing | 244 | 613.16 | 617.37 | 2.61 | 5.52 | 45 | 17.2 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 12850 | Q1.5 | Proposed | 244 | 613.16 | 617.19 | 2.62 | 5.86 | 42 | 16.0 | 0.09 | 0.06 | 0.10 | 0.05 |
| | 12800 | Q100 | Existing | 1276 | 612.41 | 619.51 | 4.00 | 12.99 | 132 | 33.1 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12800 | Q100 | Proposed | 1276 | 612.41 | 619.16 | 3.40 | 12.42 | 144 | 42.2 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 12800 | Q10 | Existing | 728 | 612.41 | 617.79 | 3.01 | 11 | 81 | 26.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12800 | Q10 | Proposed | 728 | 612.41 | 617.72 | 2.59 | 10.51 | 89 | 34.3 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 12800 | Q1.5 | Existing | 244 | 612.41 | 615.39 | 2.23 | 8.43 | 29 | 13.0 | | 0.05 | | 0.05 |
| | 12800 | Q1.5 | Proposed | 244 | 612.41 | 615.36 | 2.21 | 8.49 | 29 | 13.0 | | 0.06 | | 0.06 |
| | 12750 | Q100 | Existing | 1276 | 610.30 | 615.61 | 2.85 | 17 | 88 | 30.8 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12750 | Q100 | Proposed | 1276 | 610.30 | 615.98 | 2.41 | 14.87 | 111 | 46.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 12750 | Q10 | Existing | 728 | 610.30 | 614.35 | 2.48 | 14.31 | 53 | 21.2 | | 0.05 | 0.10 | 0.05 |
| | 12750 | Q10 | Proposed | 728 | 610.30 | 614.73 | 2.29 | 12.64 | 62 | 26.9 | 0.08 | 0.06 | 0.10 | 0.05 |
| | 12750 | Q1.5 | Existing | 244 | 610.30 | 613.62 | 2.27 | 6.32 | 39 | 17.0 | | 0.05 | 0.10 | 0.05 |
| | 12750 | Q1.5 | Proposed | 244 | 610.30 | 613.84 | 2.33 | 5.79 | 42 | 18.3 | | 0.06 | 0.10 | 0.05 |
| | 12700 | Q100 | Existing | 1276 | 608.75 | 616.22 | 3.94 | 12.78 | 143 | 36.3 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12700 | Q100 | Proposed | 1276 | 608.75 | 615.29 | 3.07 | 11.91 | 163 | 53.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12700 | Q10 | Existing | 728 | 608.75 | 614.45 | 2.65 | 11.13 | 82 | 31.0 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 12700 | Q10 | Proposed | 728 | 608.75 | 614.17 | 2.26 | 9.72 | 107 | 47.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12700 | Q1.5 | Existing | 244 | 608.75 | 612.00 | 2.02 | 8.34 | 30 | 14.7 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12700 | Q1.5 | Proposed | 244 | 608.75 | 612.05 | 2.05 | 8.23 | 30 | 14.4 | | 0.06 | | 0.06 |

## TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS

## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12650 | Q100 | Existing | 1276 | 606.96 | 612.25 | 2.73 | 17.21 | 85 | 31.1 | 0.10 | 0.05 | 0.10 | 0.04 |
| | 12650 | Q100 | Proposed | 1276 | 606.96 | 612.60 | 2.60 | 14.11 | 124 | 47.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 12650 | Q10 | Existing | 728 | 606.96 | 610.97 | 2.40 | 14.76 | 50 | 20.7 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12650 | Q10 | Proposed | 728 | 606.96 | 611.40 | 1.71 | 12.32 | 70 | 41.1 | 0.10 | 0.06 | 0.10 | 0.04 |
| | 12650 | Q1.5 | Existing | 244 | 606.96 | 610.52 | 2.48 | 5.87 | 42 | 16.8 | | 0.05 | | 0.05 |
| | 12650 | Q1.5 | Proposed | 244 | 606.96 | 610.45 | 2.23 | 6.03 | 41 | 18.2 | 0.10 | 0.06 | | 0.05 |
| | 12600 | Q100 | Existing | 1276 | 605.60 | 612.46 | 3.75 | 9.61 | 170 | 45.4 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 12600 | Q100 | Proposed | 1276 | 605.60 | 611.63 | 2.88 | 11.66 | 162 | 56.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12600 | Q10 | Existing | 728 | 605.60 | 610.82 | 2.49 | 9.01 | 100 | 40.3 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 12600 | Q10 | Proposed | 728 | 605.60 | 610.68 | 2.11 | 9.26 | 111 | 52.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12600 | Q1.5 | Existing | 244 | 605.60 | 608.92 | 1.80 | 7.19 | 34 | 19.0 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 12600 | Q1.5 | Proposed | 244 | 605.60 | 608.83 | 1.87 | 7.63 | 32 | 17.1 | | 0.06 | | 0.06 |
| | 12590.0* | Q100 | Proposed | 1276 | 605.24 | 611.10 | 2.79 | 12.52 | 154 | 55.1 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 12590.0* | Q10 | Proposed | 728 | 605.24 | 610.01 | 1.94 | 10.62 | 97 | 49.9 | 0.09 | 0.06 | 0.10 | 0.05 |
| | 12590.0* | Q1.5 | Proposed | 244 | 605.24 | 608.44 | 1.37 | 7.67 | 33 | 24.0 | 0.09 | 0.06 | 0.10 | 0.05 |
| | 12580.0* | Q100 | Proposed | 1276 | 604.88 | 610.32 | 2.51 | 13.32 | 133 | 52.8 | 0.09 | 0.06 | 0.10 | 0.07 |
| | 12580.0* | Q10 | Proposed | 728 | 604.88 | 609.37 | 1.79 | 11.21 | 85 | 47.4 | 0.09 | 0.06 | 0.10 | 0.06 |
| | 12580.0* | Q1.5 | Proposed | 244 | 604.88 | 607.96 | 1.32 | 7.86 | 33 | 25.2 | | 0.06 | 0.10 | 0.05 |
| | 12570.0* | Q100 | Proposed | 1276 | 604.52 | 610.51 | 2.97 | 11.32 | 164 | 55.1 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12570.0* | Q10 | Proposed | 728 | 604.52 | 609.34 | 2.09 | 9.85 | 103 | 49.2 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12570.0* | Q1.5 | Proposed | 244 | 604.52 | 607.60 | 1.46 | 7.61 | 36 | 25.0 | | 0.06 | 0.10 | 0.06 |
| | 12560.0* | Q100 | Proposed | 1276 | 604.16 | 610.00 | 2.90 | 12.06 | 157 | 54.2 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12560.0* | Q10 | Proposed | 728 | 604.16 | 609.00 | 2.13 | 9.94 | 106 | 49.5 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12560.0* | Q1.5 | Proposed | 244 | 604.16 | 607.22 | 1.62 | 7.47 | 39 | 24.0 | | 0.07 | 0.10 | 0.07 |

## TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12550 | Q100 | Existing | 1276 | 603.80 | 610.45 | 3.77 | 13.87 | 180 | 47.6 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 12550 | Q100 | Proposed | 1276 | 603.80 | 609.79 | 3.06 | 11.56 | 168 | 54.8 | 0.10 | 0.07 | 0.10 | 0.08 |
| | 12550 | Q10 | Existing | 728 | 603.80 | 609.14 | 2.77 | 11.41 | 120 | 43.3 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 12550 | Q10 | Proposed | 728 | 603.80 | 607.73 | 1.57 | 14.16 | 65 | 41.6 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 12550 | Q1.5 | Existing | 244 | 603.80 | 606.86 | 1.81 | 8.67 | 41 | 22.9 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 12550 | Q1.5 | Proposed | 244 | 603.80 | 606.87 | 1.81 | 7.18 | 42 | 23.0 | | 0.07 | 0.10 | 0.07 |
| | 12540.4* | Q100 | Proposed | 1276 | 603.47 | 609.47 | 3.08 | 11.12 | 169 | 54.9 | 0.10 | 0.07 | 0.10 | 0.08 |
| | 12540.4* | Q10 | Proposed | 728 | 603.47 | 607.34 | 2.03 | 13.83 | 65 | 32.1 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12540.4* | Q1.5 | Proposed | 244 | 603.47 | 606.44 | 1.77 | 7.28 | 41 | 23.0 | | 0.07 | 0.10 | 0.07 |
| | 12530.8* | Q100 | Proposed | 1276 | 603.13 | 608.99 | 3.00 | 11.42 | 162 | 54.2 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12530.8* | Q10 | Proposed | 728 | 603.13 | 607.94 | 2.23 | 9.52 | 109 | 48.7 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12530.8* | Q1.5 | Proposed | 244 | 603.13 | 606.04 | 1.74 | 7.2 | 41 | 23.2 | | 0.07 | 0.10 | 0.07 |
| | 12521.2* | Q100 | Proposed | 1276 | 602.80 | 608.61 | 2.98 | 11.33 | 161 | 54.1 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12521.2* | Q10 | Proposed | 728 | 602.80 | 607.39 | 2.15 | 10.01 | 100 | 46.6 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12521.2* | Q1.5 | Proposed | 244 | 602.80 | 605.65 | 1.73 | 7.11 | 40 | 23.4 | | 0.07 | 0.10 | 0.07 |
| | 12511.6* | Q100 | Proposed | 1276 | 602.47 | 608.15 | 2.93 | 11.49 | 157 | 53.5 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12511.6* | Q10 | Proposed | 728 | 602.47 | 607.01 | 2.20 | 9.76 | 100 | 45.5 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12511.6* | Q1.5 | Proposed | 244 | 602.47 | 605.25 | 1.71 | 7.03 | 40 | 23.5 | | 0.07 | 0.10 | 0.07 |
| | 12502.0* | Q100 | Proposed | 1276 | 602.13 | 607.81 | 2.95 | 11.2 | 159 | 53.8 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12502.0* | Q10 | Proposed | 728 | 602.13 | 606.52 | 2.17 | 9.96 | 96 | 44.2 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12502.0* | Q1.5 | Proposed | 244 | 602.13 | 604.87 | 1.71 | 6.9 | 40 | 23.6 | | 0.07 | 0.10 | 0.07 |
| | 12492.4* | Q100 | Proposed | 1276 | 601.80 | 607.25 | 2.88 | 11.64 | 150 | 52.0 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12492.4* | Q10 | Proposed | 728 | 601.80 | 606.15 | 2.20 | 9.69 | 97 | 44.3 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12492.4* | Q1.5 | Proposed | 244 | 601.80 | 604.50 | 1.72 | 6.71 | 41 | 23.9 | | 0.07 | 0.10 | 0.07 |
| | 12482.8* | Q100 | Proposed | 1276 | 601.47 | 606.92 | 2.92 | 11.24 | 153 | 52.4 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12482.8* | Q10 | Proposed | 728 | 601.47 | 605.63 | 2.18 | 9.95 | 92 | 42.1 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12482.8* | Q1.5 | Proposed | 244 | 601.47 | 604.00 | 1.63 | 7.04 | 39 | 23.6 | | 0.07 | 0.10 | 0.07 |

## TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12473.2* | Q100 | Proposed | 1276 | 601.13 | 606.61 | 2.96 | 10.05 | 158 | 53.4 | 0.06 | 0.06 | 0.10 | 0.06 |
| | 12473.2* | Q10 | Proposed | 728 | 601.13 | 605.35 | 2.25 | 8.85 | 97 | 43.1 | 0.06 | 0.06 | 0.10 | 0.06 |
| | 12473.2* | Q1.5 | Proposed | 244 | 601.13 | 603.71 | 1.69 | 6.3 | 41 | 24.3 | | 0.06 | 0.10 | 0.06 |
| | 12463.7 | Q100 | Existing | 1276 | 600.80 | 605.38 | 2.81 | 17.51 | 104 | 36.9 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12463.7 | Q100 | Proposed | 1276 | 600.80 | 606.16 | 2.95 | 10.84 | 155 | 52.7 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12463.7 | Q10 | Existing | 728 | 600.80 | 603.97 | 2.10 | 15.88 | 59 | 27.8 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12463.7 | Q10 | Proposed | 728 | 600.80 | 604.85 | 2.21 | 9.56 | 93 | 42.3 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 12463.7 | Q1.5 | Existing | 244 | 600.80 | 602.66 | 1.17 | 10.74 | 26 | 22.2 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12463.7 | Q1.5 | Proposed | 244 | 600.80 | 603.41 | 1.74 | 6.12 | 43 | 25.0 | | 0.07 | 0.10 | 0.07 |
| | 12411.83 | Q100 | Existing | 1276 | 598.95 | 604.30 | 3.32 | 14.99 | 133 | 40.1 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 12411.83 | Q100 | Proposed | 1276 | 598.95 | 603.86 | 2.54 | 11.59 | 142 | 55.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12411.83 | Q10 | Existing | 728 | 598.95 | 603.29 | 2.64 | 11.37 | 95 | 35.9 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 12411.83 | Q10 | Proposed | 728 | 598.95 | 603.18 | 2.20 | 8.45 | 107 | 48.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12411.83 | Q1.5 | Existing | 244 | 598.95 | 601.47 | 1.54 | 7.91 | 40 | 25.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12411.83 | Q1.5 | Proposed | 244 | 598.95 | 601.39 | 1.49 | 6.74 | 37 | 25.1 | | 0.06 | 0.10 | 0.06 |
| | 12356.27 | Q100 | Existing | 1276 | 596.53 | 603.15 | 3.54 | 13.18 | 140 | 39.4 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12356.27 | Q100 | Proposed | 1276 | 596.53 | 602.84 | 2.67 | 9.83 | 172 | 64.4 | 0.08 | 0.07 | 0.10 | 0.06 |
| | 12356.27 | Q10 | Existing | 728 | 596.53 | 601.82 | 2.83 | 10.52 | 91 | 32.3 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12356.27 | Q10 | Proposed | 728 | 596.53 | 601.71 | 2.30 | 8.6 | 108 | 47.1 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 12356.27 | Q1.5 | Existing | 244 | 596.53 | 599.85 | 2.16 | 6.53 | 42 | 19.5 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12356.27 | Q1.5 | Proposed | 244 | 596.53 | 600.24 | 1.57 | 5.15 | 52 | 33.2 | 0.10 | 0.07 | 0.10 | 0.05 |
| | 12301.23 | Q100 | Existing | 1276 | 595.07 | 603.06 | 3.33 | 4.77 | 251 | 75.5 | 0.03 | 0.09 | 0.10 | 0.06 |
| | 12301.23 | Q100 | Proposed | 1276 | 595.07 | 600.66 | 2.47 | 11.31 | 156 | 62.9 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 12301.23 | Q10 | Existing | 728 | 595.07 | 600.00 | 2.84 | 9.92 | 79 | 27.9 | | 0.08 | 0.10 | 0.08 |
| | 12301.23 | Q10 | Proposed | 728 | 595.07 | 599.68 | 2.23 | 9.51 | 103 | 46.4 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 12301.23 | Q1.5 | Existing | 244 | 595.07 | 598.09 | 1.83 | 7.43 | 34 | 18.8 | | 0.08 | 0.10 | 0.08 |
| | 12301.23 | Q1.5 | Proposed | 244 | 595.07 | 597.99 | 1.36 | 7.72 | 33 | 24.6 | 0.10 | 0.08 | 0.10 | 0.06 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12250.48 | Q100 | Existing | 1276 | 592.67 | 603.15 | 5.33 | 2.53 | 458 | 86.1 | 0.04 | 0.08 | 0.10 | 0.06 |
| | 12250.48 | Q100 | Proposed | 1276 | 593.40 | 598.95 | 2.94 | 9.75 | 168 | 57.0 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 12250.48 | Q10 | Existing | 728 | 592.67 | 599.77 | 2.49 | 4.37 | 187 | 75.1 | 0.04 | 0.08 | 0.10 | 0.06 |
| | 12250.48 | Q10 | Proposed | 728 | 593.40 | 597.73 | 2.59 | 7.88 | 111 | 42.7 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 12250.48 | Q1.5 | Existing | 244 | 592.67 | 596.04 | 1.94 | 5.65 | 44 | 23.0 | | 0.08 | 0.10 | 0.07 |
| | 12250.48 | Q1.5 | Proposed | 244 | 593.40 | 595.99 | 1.85 | 5.41 | 45 | 24.4 | 0.10 | 0.06 | | 0.05 |
| CULVERT #7 | 12225.03 | Q100 | Existing | 1276 | 591.00 | 599.28 | 7.10 | 15.27 | 86 | 16.6 | 0.10 | 0.05 | | 0.05 |
| | 12225.03 | Q100 | Proposed | 1276 | 592.20 | 598.28 | 2.60 | 10.88 | 160 | 61.4 | 0.09 | 0.06 | 0.10 | 0.05 |
| | 12225.03 | Q10 | Existing | 728 | 591.00 | 596.98 | 4.80 | 12.68 | 58 | 14.4 | 0.10 | 0.05 | | 0.05 |
| | 12225.03 | Q10 | Proposed | 728 | 592.20 | 596.77 | 2.41 | 9.75 | 93 | 38.5 | 0.09 | 0.06 | 0.10 | 0.05 |
| | 12225.03 | Q1.5 | Existing | 244 | 591.00 | 594.27 | 2.47 | 8.97 | 27 | 11.5 | | 0.05 | | 0.05 |
| | 12225.03 | Q1.5 | Proposed | 244 | 592.20 | 594.82 | 1.75 | 7.72 | 32 | 18.1 | 0.06 | 0.06 | | 0.05 |
| | 12200 | | | Culvert | | | | | | | | | | |
| | 12191.69 | Q100 | Existing | 1276 | 590.60 | 600.48 | 2.18 | 8.27 | 174 | 80.1 | 0.03 | 0.05 | 0.10 | 0.04 |
| | 12191.69 | Q100 | Proposed | 1276 | 591.00 | 595.72 | 2.84 | 14.61 | 107 | 37.6 | 0.10 | 0.06 | 0.06 | 0.05 |
| | 12191.69 | Q10 | Existing | 728 | 590.60 | 596.02 | 5.03 | 12.72 | 57 | 13.9 | | 0.05 | | 0.05 |
| | 12191.69 | Q10 | Proposed | 728 | 591.00 | 594.68 | 2.01 | 12.24 | 69 | 34.5 | 0.10 | 0.06 | 0.06 | 0.05 |
| | 12191.69 | Q1.5 | Existing | 244 | 590.60 | 593.52 | 2.60 | 8.41 | 29 | 12.1 | | 0.05 | | 0.05 |
| | 12191.69 | Q1.5 | Proposed | 244 | 591.00 | 593.64 | 1.40 | 6.95 | 36 | 26.0 | 0.10 | 0.06 | 0.06 | 0.05 |
| | 12141.98 | Q100 | Existing | 1276 | 589.06 | 593.20 | 2.67 | 21.32 | 81 | 30.1 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 12141.98 | Q100 | Proposed | 1276 | 589.51 | 594.63 | 3.15 | 12.77 | 158 | 50.1 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 12141.98 | Q10 | Existing | 728 | 589.06 | 592.57 | 2.14 | 15.64 | 62 | 28.9 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 12141.98 | Q10 | Proposed | 728 | 589.51 | 593.54 | 2.28 | 10.45 | 105 | 46.1 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 12141.98 | Q1.5 | Existing | 244 | 589.06 | 591.86 | 1.52 | 7.67 | 42 | 27.5 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 12141.98 | Q1.5 | Proposed | 244 | 589.51 | 591.98 | 1.53 | 7.45 | 44 | 28.5 | | 0.06 | 0.10 | 0.07 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12092.64 | Q100 | Existing | 1276 | 587.42 | 592.96 | 3.42 | 13.43 | 161 | 47.0 | 0.10 | 0.05 | 0.10 | 0.07 |
| | 12092.64 | Q100 | Proposed | 1276 | 587.42 | 592.11 | 2.41 | 14.8 | 154 | 63.8 | 0.10 | 0.06 | 0.10 | 0.07 |
| | 12092.64 | Q10 | Existing | 728 | 587.42 | 591.80 | 2.56 | 10.88 | 109 | 42.7 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 12092.64 | Q10 | Proposed | 728 | 587.42 | 591.37 | 1.77 | 11.79 | 108 | 60.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12092.64 | Q1.5 | Existing | 244 | 587.42 | 590.28 | 1.33 | 7.39 | 49 | 36.6 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 12092.64 | Q1.5 | Proposed | 244 | 587.42 | 590.22 | 1.27 | 7.54 | 47 | 36.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 12033.91 | Q100 | Existing | 1276 | 584.73 | 589.70 | 2.99 | 15.51 | 118 | 39.4 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 12033.91 | Q100 | Proposed | 1276 | 584.73 | 589.73 | 2.56 | 10.74 | 142 | 55.7 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 12033.91 | Q10 | Existing | 728 | 584.73 | 589.56 | 2.88 | 9.23 | 112 | 39.0 | 0.10 | 0.05 | 0.10 | 0.06 |
| | 12033.91 | Q10 | Proposed | 728 | 584.73 | 589.33 | 2.23 | 7.14 | 120 | 53.9 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 12033.91 | Q1.5 | Existing | 244 | 584.73 | 587.10 | 1.08 | 10.31 | 27 | 25.5 | 0.10 | 0.05 | | 0.05 |
| | 12033.91 | Q1.5 | Proposed | 244 | 584.73 | 587.18 | 1.13 | 8.56 | 29 | 25.3 | | 0.06 | | 0.05 |
| | 11982.07 | Q100 | Existing | 1276 | 581.86 | 588.60 | 5.38 | 0.82 | 640 | 119.1 | 0.03 | 0.07 | 0.10 | 0.03 |
| | 11982.07 | Q100 | Proposed | 1276 | 581.86 | 588.50 | 5.55 | 1.01 | 660 | 118.8 | 0.03 | 0.06 | 0.10 | 0.03 |
| | 11982.07 | Q10 | Existing | 728 | 581.86 | 587.20 | 3.40 | 10.81 | 70 | 20.5 | | 0.07 | 0.10 | 0.07 |
| | 11982.07 | Q10 | Proposed | 728 | 581.86 | 587.16 | 2.68 | 10.29 | 86 | 32.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 11982.07 | Q1.5 | Existing | 244 | 581.86 | 585.05 | 1.97 | 7.91 | 31 | 15.7 | | 0.06 | | 0.06 |
| | 11982.07 | Q1.5 | Proposed | 244 | 581.86 | 585.05 | 1.92 | 7.92 | 31 | 16.0 | 0.00 | 0.06 | | 0.06 |
| | 11932.45 | Q100 | Existing | 1276 | 579.56 | 585.64 | 3.01 | 14.47 | 126 | 41.8 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 11932.45 | Q100 | Proposed | 1276 | 579.56 | 584.61 | 2.41 | 17.01 | 111 | 46.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 11932.45 | Q10 | Existing | 728 | 579.56 | 584.22 | 2.01 | 12.77 | 71 | 35.3 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 11932.45 | Q10 | Proposed | 728 | 579.56 | 583.70 | 1.68 | 14.08 | 71 | 42.0 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 11932.45 | Q1.5 | Existing | 244 | 579.56 | 582.42 | 1.84 | 8.81 | 28 | 15.1 | | 0.05 | 0.10 | 0.05 |
| | 11932.45 | Q1.5 | Proposed | 244 | 579.56 | 582.42 | 1.84 | 8.8 | 28 | 15.1 | | 0.06 | 0.10 | 0.05 |
| | 11881.79 | Q100 | Existing | 1276 | 576.99 | 582.87 | 3.08 | 15.22 | 104 | 33.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 11881.79 | Q100 | Proposed | 1276 | 576.99 | 582.87 | 3.05 | 13.11 | 134 | 43.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 11881.79 | Q10 | Existing | 728 | 576.99 | 581.67 | 2.29 | 12.96 | 67 | 29.1 | 0.10 | 0.05 | | 0.05 |
| | 11881.79 | Q10 | Proposed | 728 | 576.99 | 581.72 | 2.28 | 11.14 | 87 | 38.2 | 0.10 | 0.06 | | 0.06 |
| | 11881.79 | Q1.5 | Existing | 244 | 576.99 | 580.17 | 1.80 | 8.87 | 28 | 15.3 | | 0.05 | | 0.05 |
| | 11881.79 | Q1.5 | Proposed | 244 | 576.99 | 580.30 | 1.10 | 7.88 | 36 | 33.3 | 0.10 | 0.06 | | 0.05 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS

# PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11827.76 | Q100 | Existing | 1276 | 573.31 | 581.72 | 5.04 | 7.17 | 204.72 | 40.58 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 11827.76 | Q100 | Proposed | 1276 | 573.31 | 578.82 | 2.63 | 15.08 | 109.65 | 41.71 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 11827.76 | Q10 | Existing | 728 | 573.31 | 580.44 | 4.22 | 5.22 | 155.2 | 36.81 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 11827.76 | Q10 | Proposed | 728 | 573.31 | 577.8 | 1.94 | 12.68 | 69.6 | 35.88 | 0.10 | 0.07 | 0.10 | 0.06 |
| | 11827.76 | Q1.5 | Existing | 244 | 573.31 | 578.14 | 2.62 | 3.24 | 78.47 | 29.92 | 0.10 | 0.08 | 0.10 | 0.07 |
| | 11827.76 | Q1.5 | Proposed | 244 | 573.31 | 576.19 | 1.2 | 9.86 | 26.51 | 22.09 | 0.10 | 0.07 | | 0.06 |
| | 11774.33 | Q100 | Existing | 1276 | 571.58 | 581.25 | 5.65 | 6.59 | 210.95 | 37.32 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 11774.33 | Q100 | Proposed | 1276 | 571.58 | 580.09 | 4.88 | 5.86 | 285.11 | 58.37 | 0.10 | 0.07 | 0.10 | 0.08 |
| | 11774.33 | Q10 | Existing | 728 | 571.58 | 580.19 | 5.25 | 4.42 | 173.62 | 33.08 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 11774.33 | Q10 | Proposed | 728 | 571.58 | 578.85 | 4.13 | 4.31 | 216.49 | 52.4 | 0.10 | 0.07 | 0.10 | 0.08 |
| | 11774.33 | Q1.5 | Existing | 244 | 571.58 | 578.03 | 4.47 | 2.2 | 111.3 | 24.89 | 0.10 | 0.07 | | 0.07 |
| | 11774.33 | Q1.5 | Proposed | 244 | 571.58 | 575.01 | 2.62 | 5.18 | 47.11 | 17.99 | 0.00 | 0.06 | | 0.06 |
| | 11724.31 | Q100 | Existing | 1276 | 570.29 | 581.33 | 6.54 | 4.8 | 353.22 | 54 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 11724.31 | Q100 | Proposed | 1276 | 570.29 | 580.05 | 5.79 | 4.15 | 434.04 | 74.97 | 0.10 | 0.07 | 0.10 | 0.08 |
| | 11724.31 | Q10 | Existing | 728 | 570.29 | 580.21 | 5.9 | 3.17 | 295.42 | 50.06 | 0.10 | 0.06 | 0.10 | 0.06 |
| | 11724.31 | Q10 | Proposed | 728 | 570.29 | 578.82 | 4.95 | 2.93 | 345.14 | 69.73 | 0.10 | 0.07 | 0.10 | 0.08 |
| | 11724.31 | Q1.5 | Existing | 244 | 570.29 | 578.03 | 4.59 | 1.51 | 194.5 | 42.39 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 11724.31 | Q1.5 | Proposed | 244 | 570.29 | 574.77 | 1.93 | 3.12 | 98.79 | 51.17 | 0.10 | 0.07 | 0.10 | 0.07 |
| | 11678.1 | Q100 | Existing | 1276 | 568.65 | 581.39 | 7.64 | 3.09 | 509.41 | 66.64 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 11678.1 | Q100 | Proposed | 1276 | 568.65 | 580.01 | 5.53 | 3.14 | 534.83 | 96.69 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 11678.1 | Q10 | Existing | 728 | 568.65 | 580.24 | 6.81 | 2.06 | 434.29 | 63.79 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 11678.1 | Q10 | Proposed | 728 | 568.65 | 578.79 | 5.41 | 2.18 | 431.78 | 79.84 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 11678.1 | Q1.5 | Existing | 244 | 568.65 | 578.03 | 5.3 | 0.97 | 300.47 | 56.69 | 0.10 | 0.08 | 0.10 | 0.08 |
| | 11678.1 | Q1.5 | Proposed | 244 | 568.65 | 574.71 | 2.89 | 1.82 | 156.22 | 54.1 | 0.10 | 0.08 | 0.10 | 0.08 |

# TABLE T1. HEC-RAS OUTPUT FOR CHANNEL WIDENING AND ROCK PILE AREAS, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| Culvert | RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT #6 | 11620.76 | Q100 | Existing | 1276 | 567.07 | 580.48 | 4.63 | 7.86 | 222.97 | 48.14 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 11620.76 | Q100 | Proposed | 1276 | 567.07 | 579.73 | 4.34 | 4.53 | 377.54 | 87.02 | 0.07 | 0.06 | 0.10 | 0.05 |
| | 11620.76 | Q10 | Existing | 728 | 567.07 | 579.85 | 4.25 | 5.06 | 193.21 | 45.41 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 11620.76 | Q10 | Proposed | 728 | 567.07 | 578.63 | 4.15 | 3.18 | 287.12 | 69.27 | 0.10 | 0.06 | 0.10 | 0.04 |
| | 11620.76 | Q1.5 | Existing | 244 | 567.07 | 577.91 | 2.96 | 2.66 | 112.32 | 37.98 | 0.10 | 0.05 | 0.10 | 0.05 |
| | 11620.76 | Q1.5 | Proposed | 244 | 567.07 | 574.59 | 4.04 | 2.14 | 115.9 | 28.69 | 0.10 | 0.06 | 0.10 | 0.05 |
| | 11550 | | | Culvert | | | | | | | | | | |
| | 11527.04 | Q100 | Existing | 1276 | 565.75 | 575.25 | 3.17 | 9.37 | 130 | 41.0 | 0.10 | 0.07 | 0.03 | 0.06 |
| | 11527.04 | Q100 | Proposed | 1276 | 565.75 | 575.35 | 3.22 | 9.96 | 134 | 41.5 | 0.10 | 0.07 | 0.03 | 0.06 |
| | 11527.04 | Q10 | Existing | 728 | 565.75 | 573.94 | 2.40 | 9.02 | 81 | 33.6 | 0.10 | 0.07 | 0.03 | 0.06 |
| | 11527.04 | Q10 | Proposed | 728 | 565.75 | 574.08 | 2.49 | 9.33 | 86 | 34.4 | 0.10 | 0.07 | 0.03 | 0.06 |
| | 11527.04 | Q1.5 | Existing | 244 | 565.75 | 569.71 | 3.70 | 10.91 | 22 | 14.6 | | 0.07 | | 0.07 |
| | 11527.04 | Q1.5 | Proposed | 244 | 565.75 | 569.71 | 3.70 | 10.91 | 22 | 14.6 | | 0.07 | | 0.07 |
| | 11476.78 | Q100 | Existing | 1276 | 564.68 | 568.48 | 2.78 | 16.51 | 77 | 27.8 | | 0.07 | 0.03 | 0.07 |
| | 11476.78 | Q100 | Proposed | 1276 | 564.68 | 568.29 | 2.62 | 17.74 | 72 | 27.5 | | 0.07 | 0.03 | 0.07 |
| | 11476.78 | Q10 | Existing | 728 | 564.68 | 567.63 | 2.09 | 13.43 | 54 | 25.9 | | 0.07 | | 0.07 |
| | 11476.78 | Q10 | Proposed | 728 | 564.68 | 567.40 | 1.91 | 15.04 | 48 | 25.3 | | 0.07 | | 0.07 |
| | 11476.78 | Q1.5 | Existing | 244 | 564.68 | 566.64 | 1.29 | 8.14 | 30 | 23.3 | | 0.07 | | 0.07 |
| | 11476.78 | Q1.5 | Proposed | 244 | 564.68 | 566.60 | 1.25 | 8.42 | 29 | 23.2 | | 0.07 | | 0.07 |
| | 11412.87 | Q100 | Existing | 1276 | 561.20 | 569.31 | 4.98 | 6.79 | 190 | 38.2 | 0.10 | 0.07 | 0.03 | 0.06 |
| | 11412.87 | Q100 | Proposed | 1276 | 561.20 | 569.29 | 4.97 | 7.27 | 190 | 38.2 | 0.10 | 0.07 | 0.03 | 0.06 |
| | 11412.87 | Q10 | Existing | 728 | 561.20 | 568.31 | 4.13 | 4.82 | 153 | 36.9 | 0.10 | 0.07 | 0.03 | 0.06 |
| | 11412.87 | Q10 | Proposed | 728 | 561.20 | 568.25 | 4.08 | 5.19 | 151 | 36.9 | 0.10 | 0.07 | 0.03 | 0.06 |
| | 11412.87 | Q1.5 | Existing | 244 | 561.20 | 566.34 | 3.03 | 2.89 | 84 | 27.8 | 0.00 | 0.07 | | 0.07 |
| | 11412.87 | Q1.5 | Proposed | 244 | 561.20 | 566.34 | 3.03 | 2.98 | 84 | 27.8 | 0.10 | 0.07 | | 0.06 |

HEC-RAS RESULTS FOR STATIONS 9739 TO 11363 NOT SHOWN ~ PROPOSED CONDITIONS SIMILAR TO EXISTING CONDITIONS

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UPSTREAM BOUNDARY CONDITION = NORMAL DEPTH, SLOPE 0.01 | | | | | | | | | | | | | | |
| DOWNSTREAM BOUNDARY CONDITION = NORMAL DEPTH, SLOPE 0.025 | | | | | | | | | | | | | | |
| 3300 | Q100 | Existing | 858 | 1258.76 | 1262.41 | 2.64 | 1262.07 | 8.13 | 112.84 | 42.66 | 0.1 | 0.06 | 0.1 | 0.058 |
| 3300 | Q10 | Existing | 489 | 1258.76 | 1261.66 | 2.11 | 1261.21 | 6.22 | 82.25 | 39.01 | 0.1 | 0.06 | | 0.059 |
| 3300 | Q1.5 | Existing | 164 | 1258.76 | 1260.76 | 1.41 | 1260.18 | 3.42 | 48.85 | 34.64 | 0.1 | 0.06 | | 0.059 |
| 3250 | Q100 | Existing | 858 | 1258.88 | 1262.29 | 2.87 | | 4.42 | 198.84 | 69.36 | 0.1 | 0.06 | 0.1 | 0.058 |
| 3250 | Q10 | Existing | 489 | 1258.88 | 1261.18 | 1.91 | | 3.96 | 124.34 | 65.17 | 0.1 | 0.06 | | 0.059 |
| 3250 | Q1.5 | Existing | 164 | 1258.88 | 1260 | 0.85 | | 3.26 | 50.29 | 59.3 | | 0.06 | | 0.06 |
| 3200 | Q100 | Existing | 858 | 1257.70 | 1262.18 | 3.41 | | 3.19 | 281.91 | 82.77 | 0.1 | 0.06 | 0.1 | 0.059 |
| 3200 | Q10 | Existing | 489 | 1257.70 | 1261 | 2.4 | | 2.68 | 187.3 | 78.05 | 0.1 | 0.06 | 0.1 | 0.059 |
| 3200 | Q1.5 | Existing | 164 | 1257.70 | 1259.48 | 1.08 | | 2.23 | 74.22 | 68.58 | | 0.06 | 0.1 | 0.06 |
| 3150 | Q100 | Existing | 858 | 1257.43 | 1262.03 | 3.79 | | 3.18 | 270.13 | 71.33 | | 0.06 | | 0.06 |
| 3150 | Q10 | Existing | 489 | 1257.43 | 1260.85 | 2.86 | | 2.58 | 189.18 | 66.08 | | 0.06 | | 0.06 |
| 3150 | Q1.5 | Existing | 164 | 1257.43 | 1259.28 | 1.54 | | 1.81 | 90.83 | 59.09 | | 0.06 | | 0.06 |
| 3100 | Q100 | Existing | 858 | 1257.05 | 1261.75 | 3.81 | | 4 | 214.71 | 56.3 | | 0.06 | 0.1 | 0.059 |
| 3100 | Q10 | Existing | 489 | 1257.05 | 1260.63 | 3.01 | | 3.16 | 154.78 | 51.35 | | 0.06 | | 0.06 |
| 3100 | Q1.5 | Existing | 164 | 1257.05 | 1259.11 | 1.78 | | 2.02 | 81.1 | 45.49 | | 0.06 | | 0.06 |
| 3050 | Q100 | Existing | 858 | 1256.61 | 1261.64 | 3.8 | | 3.13 | 274.38 | 72.16 | 0.1 | 0.06 | 0.1 | 0.06 |
| 3050 | Q10 | Existing | 489 | 1256.61 | 1260.52 | 3.02 | | 2.48 | 197.27 | 65.41 | | 0.06 | | 0.06 |
| 3050 | Q1.5 | Existing | 164 | 1256.61 | 1259.01 | 1.87 | | 1.56 | 105.33 | 56.28 | | 0.06 | | 0.06 |
| 3000 | Q100 | Existing | 858 | 1256.56 | 1261.48 | 3.42 | | 3.27 | 262.25 | 76.65 | | 0.06 | | 0.06 |
| 3000 | Q10 | Existing | 489 | 1256.56 | 1260.37 | 2.68 | | 2.68 | 182.19 | 68 | | 0.06 | | 0.06 |
| 3000 | Q1.5 | Existing | 164 | 1256.56 | 1258.89 | 1.59 | | 1.82 | 89.96 | 56.4 | | 0.06 | | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2950 | Q100 | Existing | 858 | 1256.22 | 1261.29 | 3.18 | | 3.38 | 256.61 | 80.78 | 0.1 | 0.06 | 0.1 | 0.057 |
| 2950 | Q10 | Existing | 489 | 1256.22 | 1260.17 | 2.43 | | 2.85 | 171.72 | 70.61 | | 0.06 | 0.1 | 0.06 |
| 2950 | Q1.5 | Existing | 164 | 1256.22 | 1258.71 | 1.55 | | 2.01 | 81.49 | 52.68 | | 0.06 | | 0.06 |
| 2900 | Q100 | Existing | 858 | 1255.59 | 1260.89 | 2.7 | | 4.44 | 194.8 | 72.24 | 0.1 | 0.06 | | 0.057 |
| 2900 | Q10 | Existing | 489 | 1255.59 | 1259.71 | 2.08 | | 4.12 | 118.63 | 56.91 | | 0.06 | | 0.06 |
| 2900 | Q1.5 | Existing | 164 | 1255.59 | 1258.31 | 1.38 | | 3.13 | 52.39 | 37.96 | | 0.06 | | 0.06 |
| 2850 | Q100 | Existing | 858 | 1254.37 | 1260.09 | 2.56 | | 6.62 | 169.17 | 66.15 | 0.1 | 0.06 | 0.1 | 0.057 |
| 2850 | Q10 | Existing | 489 | 1254.37 | 1258.64 | 1.87 | | 6.39 | 87.14 | 46.66 | 0.1 | 0.06 | 0.1 | 0.054 |
| 2850 | Q1.5 | Existing | 164 | 1254.37 | 1257.1 | 1.2 | | 5.25 | 31.25 | 26.05 | | 0.06 | 0.001 | 0.06 |
| 2800 | Q100 | Existing | 858 | 1253.42 | 1259.88 | 3.22 | | 5.1 | 206.69 | 64.18 | 0.1 | 0.06 | 0.1 | 0.055 |
| 2800 | Q10 | Existing | 489 | 1253.42 | 1258.34 | 2.54 | | 4.46 | 120.56 | 47.42 | 0.1 | 0.06 | 0.1 | 0.053 |
| 2800 | Q1.5 | Existing | 164 | 1253.42 | 1256.39 | 1.67 | | 3.46 | 47.42 | 28.38 | | 0.06 | 0.1 | 0.06 |
| 2750 | Q100 | Existing | 858 | 1252.81 | 1259.67 | 3.5 | | 4.81 | 215.05 | 61.38 | 0.1 | 0.06 | 0.1 | 0.056 |
| 2750 | Q10 | Existing | 489 | 1252.81 | 1258.07 | 2.76 | | 4.18 | 128.51 | 46.59 | 0.1 | 0.06 | | 0.056 |
| 2750 | Q1.5 | Existing | 164 | 1252.81 | 1255.96 | 1.87 | | 3.23 | 50.83 | 27.19 | | 0.06 | | 0.06 |
| 2700 | Q100 | Existing | 858 | 1252.52 | 1259.25 | 4.06 | | 5.44 | 159.62 | 39.27 | 0.1 | 0.06 | 0.1 | 0.057 |
| 2700 | Q10 | Existing | 489 | 1252.52 | 1257.61 | 3.16 | | 4.84 | 101.07 | 31.98 | | 0.06 | | 0.06 |
| 2700 | Q1.5 | Existing | 164 | 1252.52 | 1255.4 | 1.91 | | 3.93 | 41.77 | 21.85 | | 0.06 | | 0.06 |
| 2650 | Q100 | Existing | 858 | 1251.56 | 1258.3 | 4.35 | | 7.49 | 115.02 | 26.47 | | 0.06 | 0.1 | 0.058 |
| 2650 | Q10 | Existing | 489 | 1251.56 | 1256.76 | 3.45 | | 6.31 | 77.51 | 22.49 | | 0.06 | | 0.06 |
| 2650 | Q1.5 | Existing | 164 | 1251.56 | 1254.62 | 2.01 | | 4.7 | 34.86 | 17.38 | | 0.06 | | 0.06 |
| 2600 | Q100 | Existing | 858 | 1250.65 | 1256.05 | 3.63 | 1256.05 | 10.88 | 78.85 | 21.74 | | 0.06 | | 0.06 |
| 2600 | Q10 | Existing | 489 | 1250.65 | 1254.68 | 2.8 | 1254.68 | 9.54 | 51.26 | 18.33 | | 0.06 | | 0.06 |
| 2600 | Q1.5 | Existing | 164 | 1250.65 | 1253.06 | 1.73 | 1252.9 | 6.6 | 24.85 | 14.33 | | 0.06 | | 0.06 |

## TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS

## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2550 | Q100 | Existing | 858 | 1248.71 | 1253.43 | 3.44 | 1253.7 | 11.66 | 73.58 | 21.4 |  | 0.06 |  | 0.06 |
| 2550 | Q10 | Existing | 489 | 1248.71 | 1252.29 | 2.64 | 1252.37 | 9.68 | 50.52 | 19.11 |  | 0.06 |  | 0.06 |
| 2550 | Q1.5 | Existing | 164 | 1248.71 | 1250.76 | 1.47 | 1250.76 | 6.95 | 23.61 | 16.04 |  | 0.06 |  | 0.06 |
| 2500 | Q100 | Existing | 858 | 1243.85 | 1248.15 | 2.89 | 1249.25 | 15.25 | 56.26 | 19.48 |  | 0.06 |  | 0.06 |
| 2500 | Q10 | Existing | 489 | 1243.85 | 1247.02 | 2.14 | 1247.91 | 13.61 | 35.94 | 16.78 |  | 0.06 |  | 0.06 |
| 2500 | Q1.5 | Existing | 164 | 1243.85 | 1245.71 | 1.17 | 1246.21 | 10.28 | 15.95 | 13.61 |  | 0.06 |  | 0.06 |
| 2450 | Q100 | Existing | 858 | 1238.99 | 1243.59 | 2.94 | 1244.61 | 15.23 | 59.66 | 20.3 | 0.1 | 0.06 | 0.1 | 0.055 |
| 2450 | Q10 | Existing | 489 | 1238.99 | 1242.61 | 2.31 | 1243.18 | 12.13 | 41.08 | 17.77 | 0.1 | 0.06 | 0.1 | 0.056 |
| 2450 | Q1.5 | Existing | 164 | 1238.99 | 1241.37 | 1.45 | 1241.51 | 7.79 | 21.07 | 14.58 |  | 0.06 |  | 0.06 |
| 2400 | Q100 | Existing | 858 | 1230.99 | 1235.58 | 2.93 | 1237.3 | 19.06 | 45.01 | 15.34 |  | 0.06 |  | 0.06 |
| 2400 | Q10 | Existing | 489 | 1230.99 | 1234.45 | 2.23 | 1235.8 | 16.9 | 28.94 | 12.96 |  | 0.06 |  | 0.06 |
| 2400 | Q1.5 | Existing | 164 | 1230.99 | 1232.93 | 1.19 | 1233.82 | 14.09 | 11.64 | 9.78 |  | 0.06 |  | 0.06 |
| 2372.58 | Q100 | Existing | 858 | 1225.04 | 1228.16 | 1.82 | 1229.94 | 20.43 | 42.04 | 23.04 | 0.1 | 0.06 |  | 0.059 |
| 2372.58 | Q10 | Existing | 489 | 1225.04 | 1227.56 | 1.39 | 1228.77 | 16.99 | 28.78 | 20.72 |  | 0.06 |  | 0.06 |
| 2372.58 | Q1.5 | Existing | 164 | 1225.04 | 1226.82 | 0.97 | 1227.39 | 11.06 | 14.83 | 15.3 |  | 0.06 |  | 0.06 |
| 2350 | Q100 | Existing | 858 | 1216.16 | 1219.13 | 1.71 | 1220.94 | 21.65 | 39.63 | 23.16 |  | 0.06 |  | 0.06 |
| 2350 | Q10 | Existing | 489 | 1216.16 | 1218.57 | 1.26 | 1219.85 | 18.12 | 26.99 | 21.47 |  | 0.06 |  | 0.06 |
| 2350 | Q1.5 | Existing | 164 | 1216.16 | 1217.77 | 0.73 | 1218.52 | 14.58 | 11.25 | 15.34 |  | 0.06 |  | 0.06 |
| 2300 | Q100 | Existing | 858 | 1208.34 | 1212.01 | 2.23 | 1212.99 | 14.16 | 60.59 | 27.16 |  | 0.06 |  | 0.06 |
| 2300 | Q10 | Existing | 489 | 1208.34 | 1211.34 | 1.74 | 1211.92 | 11.36 | 43.05 | 24.8 |  | 0.06 |  | 0.06 |
| 2300 | Q1.5 | Existing | 164 | 1208.34 | 1210.4 | 1.07 | 1210.62 | 7.58 | 21.63 | 20.22 |  | 0.06 |  | 0.06 |
| 2250 | Q100 | Existing | 858 | 1204.37 | 1207.1 | 1.85 | 1207.66 | 12.19 | 81.82 | 44.12 |  | 0.06 | 0.1 | 0.067 |
| 2250 | Q10 | Existing | 489 | 1204.37 | 1206.5 | 1.41 | 1206.83 | 9.88 | 56.61 | 40.23 |  | 0.06 | 0.1 | 0.067 |
| 2250 | Q1.5 | Existing | 164 | 1204.37 | 1205.74 | 0.79 | 1205.84 | 6.47 | 27.92 | 35.28 |  | 0.06 | 0.1 | 0.069 |

## TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2200 | Q100 | Existing | 858 | 1197.08 | 1198.55 | 1.34 | 1199.19 | 11.18 | 74.07 | 55.34 |  | 0.06 | 0.1 | 0.084 |
| 2200 | Q10 | Existing | 489 | 1197.08 | 1198.08 | 1.06 | 1198.55 | 8.17 | 50.54 | 47.69 |  | 0.06 | 0.1 | 0.086 |
| 2200 | Q1.5 | Existing | 164 | 1197.08 | 1197.4 | 0.77 | 1197.63 | 3.82 | 23.48 | 30.63 |  | 0.06 | 0.1 | 0.093 |
| 2150 | Q100 | Existing | 858 | 1187.44 | 1191.56 | 1.5 | 1192.35 | 12.38 | 79.95 | 53.27 | 0.1 | 0.06 | 0.1 | 0.048 |
| 2150 | Q10 | Existing | 489 | 1187.44 | 1190.67 | 1.69 | 1191.22 | 10.85 | 47.61 | 28.09 |  | 0.06 | 0.1 | 0.056 |
| 2150 | Q1.5 | Existing | 164 | 1187.44 | 1189.35 | 1.2 | 1189.64 | 8.52 | 19.25 | 16 |  | 0.06 |  | 0.06 |
| 2100 | Q100 | Existing | 858 | 1183.52 | 1186.38 | 1.28 | 1187.15 | 13.44 | 77.51 | 60.49 | 0.1 | 0.06 | 0.1 | 0.056 |
| 2100 | Q10 | Existing | 489 | 1183.52 | 1185.92 | 1.08 | 1186.45 | 10.68 | 51.88 | 48 | 0.1 | 0.06 |  | 0.056 |
| 2100 | Q1.5 | Existing | 164 | 1183.52 | 1185.32 | 0.84 | 1185.43 | 6.38 | 25.73 | 30.62 | 0.1 | 0.06 |  | 0.058 |
| 2050 | Q100 | Existing | 858 | 1178.31 | 1181.28 | 1.98 | 1181.88 | 11.76 | 73.06 | 36.99 |  | 0.06 | 0.1 | 0.059 |
| 2050 | Q10 | Existing | 489 | 1178.31 | 1180.6 | 1.43 | 1181.01 | 9.89 | 49.43 | 34.49 |  | 0.06 |  | 0.06 |
| 2050 | Q1.5 | Existing | 164 | 1178.31 | 1179.75 | 0.73 | 1180.01 | 7.62 | 21.52 | 29.48 |  | 0.06 |  | 0.06 |
| 2000 | Q100 | Existing | 858 | 1170.64 | 1174.61 | 2.6 | 1175.69 | 15.03 | 57.1 | 21.93 |  | 0.06 |  | 0.06 |
| 2000 | Q10 | Existing | 489 | 1170.64 | 1173.68 | 1.91 | 1174.47 | 12.98 | 37.67 | 19.72 |  | 0.06 |  | 0.06 |
| 2000 | Q1.5 | Existing | 164 | 1170.64 | 1172.64 | 1.07 | 1172.98 | 8.88 | 18.48 | 17.25 |  | 0.06 |  | 0.06 |
| 1950 | Q100 | Existing | 858 | 1159.83 | 1163.56 | 2.18 | 1165.32 | 19.7 | 43.55 | 19.94 |  | 0.06 |  | 0.06 |
| 1950 | Q10 | Existing | 489 | 1159.83 | 1162.73 | 1.74 | 1164.09 | 17.14 | 28.52 | 16.43 |  | 0.06 |  | 0.06 |
| 1950 | Q1.5 | Existing | 164 | 1159.83 | 1161.55 | 1.06 | 1162.39 | 13.58 | 12.08 | 11.41 |  | 0.06 |  | 0.06 |
| 1900 | Q100 | Existing | 858 | 1151.21 | 1154.62 | 2.34 | 1156.21 | 18.28 | 48.93 | 20.91 | 0.1 | 0.06 | 0.1 | 0.055 |
| 1900 | Q10 | Existing | 489 | 1151.21 | 1153.83 | 1.85 | 1154.86 | 14.74 | 33.43 | 18.11 | 0.1 | 0.06 | 0.1 | 0.057 |
| 1900 | Q1.5 | Existing | 164 | 1151.21 | 1152.81 | 1.16 | 1153.26 | 9.73 | 16.85 | 14.53 |  | 0.06 |  | 0.06 |
| 1850 | Q100 | Existing | 858 | 1145.20 | 1149.59 | 2.38 | 1150.58 | 15.73 | 68.11 | 28.63 | 0.1 | 0.06 | 0.1 | 0.064 |
| 1850 | Q10 | Existing | 489 | 1145.20 | 1148.87 | 1.8 | 1149.47 | 12.27 | 48.32 | 26.79 | 0.1 | 0.06 | 0.1 | 0.061 |
| 1850 | Q1.5 | Existing | 164 | 1145.20 | 1147.76 | 1.07 | 1148.05 | 8.35 | 20.69 | 19.37 | 0.1 | 0.06 |  | 0.054 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1800 | Q100 | Existing | 858 | 1141.77 | 1146.45 | 2.7 | 1146.96 | 13.16 | 81.87 | 30.37 | 0.1 | 0.06 | 0.1 | 0.062 |
| 1800 | Q10 | Existing | 489 | 1141.77 | 1145.47 | 1.97 | 1145.82 | 10.94 | 53.58 | 27.21 | 0.1 | 0.06 | 0.1 | 0.061 |
| 1800 | Q1.5 | Existing | 164 | 1141.77 | 1144.32 | 1.04 | 1144.45 | 7.37 | 24.41 | 23.51 | 0.1 | 0.06 | 0.1 | 0.055 |
| 1750 | Q100 | Existing | 858 | 1137.61 | 1141.97 | 2.51 | 1142.93 | 14.81 | 64.68 | 25.8 | 0.1 | 0.06 | 0.1 | 0.059 |
| 1750 | Q10 | Existing | 489 | 1137.61 | 1141.04 | 1.88 | 1141.73 | 12.44 | 42.44 | 22.64 | 0.1 | 0.06 |  | 0.057 |
| 1750 | Q1.5 | Existing | 164 | 1137.61 | 1139.72 | 1.3 | 1140.11 | 9.32 | 17.6 | 13.59 |  | 0.06 |  | 0.06 |
| 1685.16 | Q100 | Existing | 858 | 1129.12 | 1132.69 | 2.34 | 1134.12 | 17.53 | 49.57 | 21.21 | 0.1 | 0.06 | 0.1 | 0.057 |
| 1685.16 | Q10 | Existing | 489 | 1129.12 | 1131.91 | 1.76 | 1132.89 | 14.51 | 33.69 | 19.15 |  | 0.06 |  | 0.06 |
| 1685.16 | Q1.5 | Existing | 164 | 1129.12 | 1130.84 | 1.11 | 1131.36 | 10.33 | 15.87 | 14.27 |  | 0.06 |  | 0.06 |
| 1631.51 | Q100 | Existing | 858 | 1123.59 | 1127.42 | 1.53 | 1128.1 | 15.19 | 96.4 | 62.86 | 0.1 | 0.06 | 0.1 | 0.073 |
| 1631.51 | Q10 | Existing | 489 | 1123.59 | 1126.96 | 1.27 | 1127.36 | 11.67 | 69.52 | 54.9 | 0.1 | 0.06 | 0.1 | 0.069 |
| 1631.51 | Q1.5 | Existing | 164 | 1123.59 | 1126.15 | 0.77 | 1126.38 | 7.99 | 31.03 | 40.14 | 0.1 | 0.06 | 0.1 | 0.059 |
| 1558.62 | Q100 | Existing | 858 | 1114.84 | 1120.21 | 2.6 | 1120.62 | 14.6 | 68.44 | 26.34 | 0.1 | 0.06 | 0.1 | 0.05 |
| 1558.62 | Q10 | Existing | 489 | 1114.84 | 1118.46 | 2.92 | 1119.35 | 13.73 | 35.66 | 12.23 | 0.1 | 0.06 | 0.1 | 0.058 |
| 1558.62 | Q1.5 | Existing | 164 | 1114.84 | 1116.38 | 1.36 | 1117.12 | 12.5 | 13.12 | 9.67 |  | 0.06 |  | 0.06 |
| 1514 | Q100 | Existing | 858 | 1110.83 | 1115.72 | 1.78 | 1117.05 | 15.55 | 59.08 | 33.17 | 0.1 | 0.06 |  | 0.049 |
| 1514 | Q10 | Existing | 489 | 1110.83 | 1115.07 | 2.54 | 1115.72 | 11.38 | 42.99 | 16.94 |  | 0.06 |  | 0.06 |
| 1514 | Q1.5 | Existing | 164 | 1110.83 | 1113.67 | 1.69 | 1113.67 | 7.47 | 21.96 | 12.96 |  | 0.06 |  | 0.06 |
| 1485.63 | Q100 | Existing | 858 | 1106.93 | 1110.66 | 2.33 | 1112.03 | 16.99 | 50.5 | 21.64 |  | 0.06 |  | 0.06 |
| 1485.63 | Q10 | Existing | 489 | 1106.93 | 1109.79 | 1.59 | 1110.85 | 15.19 | 32.2 | 20.2 |  | 0.06 |  | 0.06 |
| 1485.63 | Q1.5 | Existing | 164 | 1106.93 | 1108.5 | 1.14 | 1109.44 | 13.39 | 12.25 | 10.73 |  | 0.06 |  | 0.06 |
| 1451.92 | Q100 | Existing | 858 | 1104.87 | 1109.36 | 2.38 | 1109.81 | 11.76 | 85.48 | 35.91 |  | 0.06 | 0.1 | 0.059 |
| 1451.92 | Q10 | Existing | 489 | 1104.87 | 1108.65 | 1.74 | 1108.8 | 9.07 | 60.36 | 34.71 |  | 0.06 | 0.1 | 0.052 |
| 1451.92 | Q1.5 | Existing | 164 | 1104.87 | 1107.17 | 1.41 | 1107.17 | 6.81 | 24.08 | 17.05 |  | 0.06 |  | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1418.62 | Q100 | Existing | 858 | 1102.17 | 1105.89 | 1.85 | 1106.79 | 13.78 | 65.04 | 35.23 |  | 0.06 | 0.1 | 0.053 |
| 1418.62 | Q10 | Existing | 489 | 1102.17 | 1104.96 | 1.7 | 1105.75 | 12.62 | 38.75 | 22.85 |  | 0.06 |  | 0.06 |
| 1418.62 | Q1.5 | Existing | 164 | 1102.17 | 1103.89 | 1.08 | 1104.3 | 9.27 | 17.7 | 16.39 |  | 0.06 |  | 0.06 |
| 1362.71 | Q100 | Existing | 858 | 1097.54 | 1101.8 | 2.45 | 1102.32 | 11.52 | 74.46 | 30.4 |  | 0.06 |  | 0.06 |
| 1362.71 | Q10 | Existing | 489 | 1097.54 | 1101.05 | 2 | 1101.27 | 9.2 | 53.15 | 26.51 |  | 0.06 |  | 0.06 |
| 1362.71 | Q1.5 | Existing | 164 | 1097.54 | 1099.83 | 1.26 | 1099.86 | 6.61 | 24.82 | 19.63 |  | 0.06 |  | 0.06 |
| 1308.81 | Q100 | Existing | 858 | 1094.21 | 1098.37 | 2.04 | 1099.03 | 12.35 | 86.75 | 42.61 | 0.1 | 0.06 | 0.1 | 0.056 |
| 1308.81 | Q10 | Existing | 489 | 1094.21 | 1097.47 | 1.6 | 1097.87 | 10.49 | 53.48 | 33.49 | 0.1 | 0.06 | 0.1 | 0.054 |
| 1308.81 | Q1.5 | Existing | 164 | 1094.21 | 1096.35 | 1.08 | 1096.49 | 7.19 | 22.96 | 21.35 | 0.1 | 0.06 | 0.1 | 0.057 |
| 1243.78 | Q100 | Existing | 858 | 1090.38 | 1094.43 | 2.43 | 1094.92 | 11.75 | 74.51 | 30.63 | 0.1 | 0.06 | 0.1 | 0.057 |
| 1243.78 | Q10 | Existing | 489 | 1090.38 | 1093.74 | 1.88 | 1093.93 | 9.12 | 53.92 | 28.72 | 0.001 | 0.06 | 0.1 | 0.059 |
| 1243.78 | Q1.5 | Existing | 164 | 1090.38 | 1092.66 | 1.18 | 1092.66 | 6.25 | 26.24 | 22.27 |  | 0.06 |  | 0.06 |
| 1172.3 | Q100 | Existing | 858 | 1082.54 | 1087.59 | 2.84 | 1088.92 | 14.59 | 58.92 | 20.72 | 0.1 | 0.06 |  | 0.057 |
| 1172.3 | Q10 | Existing | 489 | 1082.54 | 1086.22 | 2.4 | 1087.14 | 13.68 | 35.76 | 14.87 |  | 0.06 |  | 0.06 |
| 1172.3 | Q1.5 | Existing | 164 | 1082.54 | 1084.48 | 1.34 | 1085.17 | 11.83 | 13.86 | 10.32 |  | 0.06 |  | 0.06 |
| 1126.39 | Q100 | Existing | 858 | 1076.73 | 1080.07 | 2.3 | 1081.49 | 17.54 | 48.91 | 21.23 |  | 0.06 |  | 0.06 |
| 1126.39 | Q10 | Existing | 489 | 1076.73 | 1079.36 | 1.68 | 1080.32 | 14.33 | 34.13 | 20.29 |  | 0.06 |  | 0.06 |
| 1126.39 | Q1.5 | Existing | 164 | 1076.73 | 1078.53 | 1.1 | 1078.88 | 8.84 | 18.55 | 16.94 |  | 0.06 |  | 0.06 |
| 1063.6 | Q100 | Existing | 858 | 1073.21 | 1078.42 | 2.94 | 1078.42 | 10.92 | 92.8 | 31.59 | 0.1 | 0.06 | 0.1 | 0.055 |
| 1063.6 | Q10 | Existing | 489 | 1073.21 | 1077.11 | 2.3 | 1077.11 | 9.38 | 56.17 | 24.43 | 0.1 | 0.06 | 0.1 | 0.054 |
| 1063.6 | Q1.5 | Existing | 164 | 1073.21 | 1075.47 | 1.51 | 1075.47 | 7.04 | 23.3 | 15.4 |  | 0.06 |  | 0.06 |
| 992.88 | Q100 | Existing | 858 | 1069.14 | 1072.5 | 1.72 | 1073.46 | 14.5 | 59.57 | 34.73 | 0.1 | 0.06 | 0.1 | 0.058 |
| 992.88 | Q10 | Existing | 489 | 1069.14 | 1072.05 | 1.39 | 1072.59 | 10.99 | 44.49 | 32.03 |  | 0.06 |  | 0.06 |
| 992.88 | Q1.5 | Existing | 164 | 1069.14 | 1071.39 | 1.01 | 1071.47 | 6.44 | 25.48 | 25.16 |  | 0.06 |  | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 965.98 | Q100 | Existing | 858 | 1067.81 | 1072.71 | 2.48 | 1072.71 | 9.87 | 121.43 | 48.96 | 0.1 | 0.06 | 0.1 | 0.061 |
| 965.98 | Q10 | Existing | 489 | 1067.81 | 1071.68 | 1.74 | 1071.68 | 8.5 | 73.54 | 42.28 | 0.1 | 0.06 | 0.1 | 0.055 |
| 965.98 | Q1.5 | Existing | 164 | 1067.81 | 1070.18 | 1.61 | 1070.04 | 6.38 | 25.69 | 15.95 |  | 0.06 |  | 0.06 |
| 896.36 | Q100 | Existing | 858 | 1065.69 | 1070.42 | 3.27 | 1069.71 | 8.01 | 120.03 | 36.7 | 0.1 | 0.06 | 0.1 | 0.058 |
| 896.36 | Q10 | Existing | 489 | 1065.69 | 1068.53 | 1.79 | 1068.73 | 9.13 | 55.1 | 30.85 | 0.1 | 0.06 | 0.1 | 0.055 |
| 896.36 | Q1.5 | Existing | 164 | 1065.69 | 1067.52 | 1.3 | 1067.4 | 5.76 | 28.49 | 21.89 |  | 0.06 |  | 0.06 |
| 863.1 | Q100 | Existing | 858 | 1063.94 | 1070.05 | 4.28 |  | 8.47 | 149.47 | 34.93 | 0.1 | 0.06 | 0.1 | 0.07 |
| 863.1 | Q10 | Existing | 489 | 1063.94 | 1068.02 | 2.86 | 1067.36 | 8.07 | 84.22 | 29.42 | 0.1 | 0.06 | 0.1 | 0.069 |
| 863.1 | Q1.5 | Existing | 164 | 1063.94 | 1065.99 | 1.25 | 1065.99 | 7.03 | 30.01 | 24.07 | 0.1 | 0.06 | 0.1 | 0.064 |
| 828.53 | Q100 | Existing | 858 | 1061.14 | 1067.83 | 3.5 | 1067.83 | 13.64 | 96.69 | 27.66 | 0.1 | 0.06 | 0.1 | 0.061 |
| 828.53 | Q10 | Existing | 489 | 1061.14 | 1066.1 | 3 | 1066.1 | 11.53 | 57.82 | 19.26 | 0.1 | 0.06 | 0.1 | 0.061 |
| 828.53 | Q1.5 | Existing | 164 | 1061.14 | 1063.94 | 1.65 | 1064.04 | 8.67 | 22.8 | 13.85 | 0.1 | 0.06 | 0.1 | 0.058 |
| 826.84 | Q100 | Existing | 858 | 1060.76 | 1065.18 | 2.97 | 1066.62 | 17.16 | 51.18 | 17.23 | 0.1 | 0.06 | 0.1 | 0.055 |
| 826.84 | Q10 | Existing | 489 | 1060.76 | 1063.92 | 2.35 | 1065.01 | 15.17 | 32.23 | 13.7 |  | 0.06 |  | 0.06 |
| 826.84 | Q1.5 | Existing | 164 | 1060.76 | 1062.44 | 1.18 | 1063.12 | 12.12 | 13.54 | 11.44 |  | 0.06 |  | 0.06 |
| 803.52 | Q100 | Existing | 858 | 1055.18 | 1059.39 | 3 | 1061.57 | 21.35 | 43.46 | 14.47 | 0.1 | 0.06 | 0.1 | 0.053 |
| 803.52 | Q10 | Existing | 489 | 1055.18 | 1058.21 | 2.25 | 1059.74 | 18.16 | 27.63 | 12.26 | 0.1 | 0.06 | 0.1 | 0.055 |
| 803.52 | Q1.5 | Existing | 164 | 1055.18 | 1056.86 | 1.31 | 1057.62 | 12.8 | 12.81 | 9.77 |  | 0.06 |  | 0.06 |
| 788.49 | Q100 | Existing | 858 | 1052.86 | 1056.12 | 2.37 | 1058.14 | 21.75 | 41.1 | 17.33 | 0.1 | 0.06 | 0.1 | 0.056 |
| 788.49 | Q10 | Existing | 489 | 1052.86 | 1055.39 | 1.78 | 1056.71 | 17.31 | 28.76 | 16.2 | 0.1 | 0.06 | 0.1 | 0.057 |
| 788.49 | Q1.5 | Existing | 164 | 1052.86 | 1054.56 | 1.08 | 1055.04 | 10.3 | 15.93 | 14.75 |  | 0.06 | 0.1 | 0.06 |
| 752.92 | Q100 | Existing | 858 | 1042.81 | 1046.27 | 1.89 | 1048.21 | 23.5 | 43.7 | 23.15 | 0.1 | 0.06 |  | 0.06 |
| 752.92 | Q10 | Existing | 489 | 1042.81 | 1045.56 | 1.49 | 1047.09 | 19.36 | 28.64 | 19.25 | 0.1 | 0.06 |  | 0.057 |
| 752.92 | Q1.5 | Existing | 164 | 1042.81 | 1044.45 | 0.97 | 1045.36 | 14.49 | 11.41 | 11.71 | 0.1 | 0.06 |  | 0.057 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 740.16 | Q100 | Existing | 858 | 1041.85 | 1046.1 | 2.35 | 1047.54 | 17.98 | 55.96 | 23.82 | 0.1 | 0.06 | 0.1 | 0.057 |
| 740.16 | Q10 | Existing | 489 | 1041.85 | 1045.37 | 1.83 | 1046.25 | 13.86 | 39.41 | 21.49 | 0.1 | 0.06 | 0.1 | 0.055 |
| 740.16 | Q1.5 | Existing | 164 | 1041.85 | 1044.44 | 1.28 | 1044.6 | 7.87 | 21.25 | 16.6 | 0.1 | 0.06 | 0.1 | 0.055 |
| | | | | | | | | | | | | | | |
| 709.95 | Q100 | Existing | 858 | 1038.62 | 1044.11 | 2.77 | 1045.02 | 14.59 | 62.93 | 22.69 | 0.1 | 0.06 | 0.1 | 0.052 |
| 709.95 | Q10 | Existing | 489 | 1038.62 | 1042.93 | 2.83 | 1043.48 | 12.09 | 40.45 | 14.27 | | 0.06 | | 0.06 |
| 709.95 | Q1.5 | Existing | 164 | 1038.62 | 1040.92 | 1.5 | 1041.42 | 10.48 | 15.64 | 10.42 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| 659.75 | Q100 | Existing | 858 | 1036.65 | 1042.11 | 3.38 | 1042.22 | 11.68 | 76.31 | 22.58 | 0.1 | 0.06 | 0.1 | 0.054 |
| 659.75 | Q10 | Existing | 489 | 1036.65 | 1040.84 | 2.79 | 1040.84 | 9.64 | 50.84 | 18.25 | 0.1 | 0.06 | 0.1 | 0.058 |
| 659.75 | Q1.5 | Existing | 164 | 1036.65 | 1039.05 | 1.65 | 1039.05 | 7.35 | 22.31 | 13.53 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| 597.67 | Q100 | Existing | 858 | 1033.94 | 1038.55 | 3.36 | 1039.05 | 13.03 | 67.19 | 19.97 | 0.1 | 0.06 | 0.1 | 0.056 |
| 597.67 | Q10 | Existing | 489 | 1033.94 | 1037.53 | 2.58 | 1037.72 | 10.31 | 47.57 | 18.42 | 0.1 | 0.06 | 0 | 0.059 |
| 597.67 | Q1.5 | Existing | 164 | 1033.94 | 1036.13 | 1.64 | 1036.04 | 6.75 | 24.31 | 14.84 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| 552.31 | Q100 | Existing | 858 | 1032.03 | 1036.48 | 3.07 | 1036.85 | 12.21 | 74.45 | 24.26 | 0.1 | 0.06 | 0.1 | 0.055 |
| 552.31 | Q10 | Existing | 489 | 1032.03 | 1035.48 | 2.44 | 1035.56 | 9.64 | 51.77 | 21.24 | 0.1 | 0.06 | 0.1 | 0.056 |
| 552.31 | Q1.5 | Existing | 164 | 1032.03 | 1033.95 | 1.53 | 1033.95 | 7.03 | 23.33 | 15.28 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| 500 | Q100 | Existing | 858 | 1028.47 | 1033.33 | 3.07 | 1033.96 | 13.38 | 68.21 | 22.21 | 0.1 | 0.06 | 0.1 | 0.053 |
| 500 | Q10 | Existing | 489 | 1028.47 | 1032.06 | 2.53 | 1032.45 | 11.37 | 43.37 | 17.14 | 0.1 | 0.06 | 0 | 0.058 |
| 500 | Q1.5 | Existing | 164 | 1028.47 | 1030.49 | 1.51 | 1030.67 | 8.25 | 19.89 | 13.14 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| 450 | Q100 | Existing | 858 | 1026.39 | 1031.14 | 2.67 | 1031.65 | 11.75 | 77.1 | 28.86 | 0.1 | 0.06 | 0 | 0.054 |
| 450 | Q10 | Existing | 489 | 1026.39 | 1030.2 | 2.45 | 1030.2 | 9.22 | 53.28 | 21.73 | 0.1 | 0.06 | | 0.057 |
| 450 | Q1.5 | Existing | 164 | 1026.39 | 1028.49 | 1.56 | 1028.49 | 7.14 | 22.96 | 14.71 | | 0.06 | | 0.06 |
| | | | | | | | | | | | | | | |
| 400 | Q100 | Existing | 858 | 1024.77 | 1028.21 | 2.06 | 1028.76 | 12.22 | 83.15 | 40.38 | 0.1 | 0.06 | 0.1 | 0.06 |
| 400 | Q10 | Existing | 489 | 1024.77 | 1028.15 | 2.01 | 1027.89 | 7.15 | 80.82 | 40.25 | 0.1 | 0.06 | 0.1 | 0.06 |
| 400 | Q1.5 | Existing | 164 | 1024.77 | 1027 | 1.09 | 1026.74 | 4.79 | 36.71 | 33.79 | 0.1 | 0.06 | 0 | 0.055 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
# PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3300 | Q100 | Proposed | 858 | 1258.76 | 1262.38 | 2.62 | 1262.10 | 8.57 | 111 | 42.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3300 | Q10 | Proposed | 489 | 1258.76 | 1261.63 | 2.08 | 1261.22 | 6.52 | 81 | 38.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3300 | Q1.5 | Proposed | 164 | 1258.76 | 1260.75 | 1.40 | 1260.18 | 3.51 | 48 | 34.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3250 | Q100 | Proposed | 858 | 1258.88 | 1262.32 | 2.90 |  | 4.45 | 201 | 69.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3250 | Q10 | Proposed | 489 | 1258.88 | 1261.15 | 1.88 |  | 4.08 | 122 | 65.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3250 | Q1.5 | Proposed | 164 | 1258.88 | 1260.00 | 0.85 |  | 3.27 | 50 | 59.3 |  | 0.06 | 0.10 | 0.06 |
| 3200 | Q100 | Proposed | 858 | 1257.70 | 1262.22 | 3.44 |  | 3.15 | 286 | 83.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3200 | Q10 | Proposed | 489 | 1257.70 | 1260.96 | 2.37 |  | 2.72 | 184 | 77.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3200 | Q1.5 | Proposed | 164 | 1257.70 | 1259.43 | 1.05 |  | 2.35 | 71 | 67.5 |  | 0.06 | 0.10 | 0.06 |
| 3150 | Q100 | Proposed | 858 | 1257.43 | 1262.05 | 3.81 |  | 3.48 | 272 | 71.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3150 | Q10 | Proposed | 489 | 1257.43 | 1260.80 | 2.82 |  | 2.82 | 186 | 65.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3150 | Q1.5 | Proposed | 164 | 1257.43 | 1259.19 | 1.46 |  | 1.98 | 86 | 58.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3100 | Q100 | Proposed | 858 | 1257.05 | 1261.75 | 3.81 |  | 4.54 | 215 | 56.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3100 | Q10 | Proposed | 489 | 1257.05 | 1260.55 | 2.95 |  | 3.57 | 151 | 51.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3100 | Q1.5 | Proposed | 164 | 1257.05 | 1258.98 | 1.67 |  | 2.29 | 75 | 45.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3050 | Q100 | Proposed | 858 | 1256.61 | 1261.66 | 3.81 |  | 3.59 | 276 | 72.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3050 | Q10 | Proposed | 489 | 1256.61 | 1260.45 | 2.96 |  | 2.82 | 192 | 65.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3050 | Q1.5 | Proposed | 164 | 1256.61 | 1258.86 | 1.75 |  | 1.77 | 97 | 55.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3000 | Q100 | Proposed | 858 | 1256.56 | 1261.49 | 3.43 |  | 3.78 | 263 | 76.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3000 | Q10 | Proposed | 489 | 1256.56 | 1260.28 | 2.62 |  | 3.07 | 176 | 67.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 3000 | Q1.5 | Proposed | 164 | 1256.56 | 1258.70 | 1.45 |  | 2.14 | 79 | 54.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2950 | Q100 | Proposed | 858 | 1256.22 | 1261.35 | 3.22 |  | 3.32 | 262 | 81.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2950 | Q10 | Proposed | 489 | 1256.22 | 1260.10 | 2.39 |  | 2.94 | 166 | 69.6 |  | 0.06 | 0.10 | 0.06 |
| 2950 | Q1.5 | Proposed | 164 | 1256.22 | 1258.42 | 1.36 |  | 2.46 | 67 | 49.1 |  | 0.06 |  | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2900 | Q100 | Proposed | 858 | 1255.40 | 1260.41 | 2.52 |  | 7.89 | 168 | 66.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2900 | Q10 | Proposed | 489 | 1255.40 | 1259.06 | 1.90 | 1258.66 | 7.26 | 91 | 47.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2900 | Q1.5 | Proposed | 164 | 1255.40 | 1257.52 | 1.29 |  | 5.21 | 34 | 26.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2850 | Q100 | Proposed | 858 | 1253.92 | 1258.70 | 2.69 | 1258.70 | 10.49 | 110 | 40.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2850 | Q10 | Proposed | 489 | 1253.92 | 1257.84 | 2.16 | 1257.59 | 8.04 | 77 | 35.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2850 | Q1.5 | Proposed | 164 | 1253.92 | 1256.59 | 1.31 |  | 4.95 | 37 | 28.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2800 | Q100 | Proposed | 858 | 1253.07 | 1258.02 | 2.72 | 1257.50 | 8.36 | 156 | 57.3 | 0.10 | 0.06 | 0.10 | 0.07 |
| 2800 | Q10 | Proposed | 489 | 1253.07 | 1256.98 | 1.95 |  | 7.11 | 99 | 51.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2800 | Q1.5 | Proposed | 164 | 1253.07 | 1255.73 | 0.97 |  | 4.88 | 40 | 41.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2750 | Q100 | Proposed | 858 | 1252.22 | 1257.52 | 3.01 |  | 7.01 | 192 | 63.7 | 0.10 | 0.06 | 0.10 | 0.07 |
| 2750 | Q10 | Proposed | 489 | 1252.22 | 1256.37 | 2.09 |  | 6.1 | 122 | 58.1 | 0.10 | 0.06 | 0.10 | 0.07 |
| 2750 | Q1.5 | Proposed | 164 | 1252.22 | 1254.89 | 0.88 | 1254.41 | 4.86 | 41 | 46.8 | 0.10 | 0.06 | 0.10 | 0.04 |
| 2700 | Q100 | Proposed | 858 | 1251.38 | 1256.47 | 2.97 |  | 8.48 | 147 | 49.3 | 0.10 | 0.06 | 0.10 | 0.07 |
| 2700 | Q10 | Proposed | 489 | 1251.38 | 1255.42 | 2.12 |  | 7.03 | 97 | 45.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2700 | Q1.5 | Proposed | 164 | 1251.38 | 1254.06 | 1.11 |  | 4.82 | 40 | 36.0 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2650 | Q100 | Proposed | 858 | 1250.58 | 1255.80 | 3.11 |  | 7.82 | 163 | 52.3 | 0.10 | 0.06 | 0.10 | 0.07 |
| 2650 | Q10 | Proposed | 489 | 1250.58 | 1254.73 | 2.21 |  | 6.48 | 109 | 49.0 | 0.10 | 0.06 | 0.10 | 0.07 |
| 2650 | Q1.5 | Proposed | 164 | 1250.58 | 1253.40 | 1.11 |  | 4.38 | 47 | 42.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2600 | Q100 | Proposed | 858 | 1249.76 | 1254.13 | 2.53 | 1254.13 | 10.31 | 119 | 46.9 | 0.10 | 0.06 | 0.10 | 0.07 |
| 2600 | Q10 | Proposed | 489 | 1249.76 | 1253.27 | 1.80 | 1253.27 | 8.47 | 80 | 44.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2600 | Q1.5 | Proposed | 164 | 1249.76 | 1252.04 | 0.87 | 1252.04 | 6.32 | 28 | 32.8 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2550 | Q100 | Proposed | 858 | 1247.32 | 1251.43 | 2.28 | 1251.86 | 12.19 | 96 | 42.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2550 | Q10 | Proposed | 489 | 1247.32 | 1250.54 | 1.51 | 1250.95 | 10.49 | 60 | 39.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2550 | Q1.5 | Proposed | 164 | 1247.32 | 1249.40 | 1.35 | 1249.54 | 7.32 | 22 | 16.6 | 0.00 | 0.06 |  | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2500 | Q100 | Proposed | 858 | 1243.63 | 1247.22 | 1.92 | 1248.05 | 14.54 | 80 | 41.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2500 | Q10 | Proposed | 489 | 1243.63 | 1246.53 | 1.33 | 1247.15 | 12.03 | 52 | 39.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2500 | Q1.5 | Proposed | 164 | 1243.63 | 1245.55 | 1.13 | 1245.88 | 8.27 | 20 | 17.6 | 0.10 | 0.06 | | 0.06 |
| 2450 | Q100 | Proposed | 858 | 1234.43 | 1237.46 | 1.34 | 1238.89 | 19.89 | 56 | 41.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2450 | Q10 | Proposed | 489 | 1234.43 | 1236.83 | 1.01 | 1238.00 | 17.16 | 32 | 31.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2450 | Q1.5 | Proposed | 164 | 1234.43 | 1235.81 | 0.91 | 1236.67 | 13.62 | 12 | 13.2 | | 0.06 | | 0.06 |
| 2400 | Q100 | Proposed | 858 | 1223.18 | 1226.18 | 1.35 | 1227.59 | 19.94 | 56 | 41.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2400 | Q10 | Proposed | 489 | 1223.18 | 1225.66 | 0.93 | 1226.71 | 16.15 | 35 | 37.7 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2400 | Q1.5 | Proposed | 164 | 1223.18 | 1224.81 | 1.09 | 1225.42 | 10.5 | 16 | 14.4 | | 0.06 | | 0.06 |
| 2372.58 | Q100 | Proposed | 858 | 1217.59 | 1220.73 | 1.23 | 1222.11 | 19.4 | 59 | 48.0 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2372.58 | Q10 | Proposed | 489 | 1217.59 | 1220.08 | 1.12 | 1221.29 | 16.2 | 34 | 30.0 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2372.58 | Q1.5 | Proposed | 164 | 1217.59 | 1219.09 | 1.00 | 1219.73 | 11.57 | 14 | 14.1 | | 0.06 | | 0.06 |
| 2350 | Q100 | Proposed | 858 | 1213.54 | 1216.14 | 1.02 | 1217.32 | 19.4 | 64 | 62.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2350 | Q10 | Proposed | 489 | 1213.54 | 1215.74 | 0.82 | 1216.63 | 15.64 | 41 | 50.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2350 | Q1.5 | Proposed | 164 | 1213.54 | 1215.10 | 1.00 | 1215.64 | 9.95 | 16 | 16.5 | | 0.06 | | 0.06 |
| 2300 | Q100 | Proposed | 858 | 1203.29 | 1206.52 | 1.30 | 1207.73 | 17.55 | 67 | 51.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2300 | Q10 | Proposed | 489 | 1203.29 | 1205.87 | 1.13 | 1206.88 | 14.94 | 39 | 34.3 | | 0.06 | 0.10 | 0.05 |
| 2300 | Q1.5 | Proposed | 164 | 1203.29 | 1204.81 | 1.00 | 1205.49 | 11.56 | 14 | 14.2 | | 0.06 | | 0.06 |
| 2250 | Q100 | Proposed | 858 | 1193.29 | 1196.26 | 0.90 | 1197.40 | 19.43 | 67 | 74.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2250 | Q10 | Proposed | 489 | 1193.29 | 1195.78 | 0.73 | 1196.83 | 16.07 | 37 | 50.2 | 0.10 | 0.06 | 0.10 | 0.04 |
| 2250 | Q1.5 | Proposed | 164 | 1193.29 | 1194.90 | 1.07 | 1195.50 | 10.76 | 15 | 14.3 | | 0.06 | | 0.06 |
| 2200 | Q100 | Proposed | 858 | 1184.02 | 1187.10 | 1.04 | 1188.24 | 17.77 | 72 | 68.7 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2200 | Q10 | Proposed | 489 | 1184.02 | 1186.55 | 0.89 | 1187.53 | 15.01 | 40 | 44.7 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2200 | Q1.5 | Proposed | 164 | 1184.02 | 1185.59 | 1.04 | 1186.24 | 10.85 | 15 | 14.5 | | 0.06 | | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2150 | Q100 | Proposed | 858 | 1177.80 | 1181.22 | 1.16 | 1182.09 | 15.28 | 89 | 76.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2150 | Q10 | Proposed | 489 | 1177.80 | 1180.65 | 0.93 | 1181.47 | 12.71 | 51 | 55.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2150 | Q1.5 | Proposed | 164 | 1177.80 | 1179.68 | 1.25 | 1180.00 | 8.5 | 19 | 15.5 |  | 0.06 |  | 0.06 |
| 2100 | Q100 | Proposed | 858 | 1172.74 | 1175.88 | 1.17 | 1176.70 | 14.62 | 88 | 75.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2100 | Q10 | Proposed | 489 | 1172.74 | 1175.34 | 0.86 | 1176.05 | 12.39 | 51 | 58.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2100 | Q1.5 | Proposed | 164 | 1172.74 | 1174.39 | 1.08 | 1174.78 | 8.83 | 19 | 17.1 |  | 0.06 |  | 0.06 |
| 2050 | Q100 | Proposed | 858 | 1168.07 | 1171.44 | 1.51 | 1172.07 | 13.45 | 99 | 65.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2050 | Q10 | Proposed | 489 | 1168.07 | 1170.88 | 0.97 | 1171.41 | 11.37 | 62 | 64.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2050 | Q1.5 | Proposed | 164 | 1168.07 | 1170.01 | 1.01 | 1170.34 | 7.78 | 21 | 21.1 | 0.10 | 0.06 |  | 0.05 |
| 2000 | Q100 | Proposed | 858 | 1163.49 | 1167.21 | 1.79 | 1167.91 | 13.62 | 90 | 50.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| 2000 | Q10 | Proposed | 489 | 1163.49 | 1166.47 | 1.14 | 1167.09 | 11.79 | 54 | 47.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| 2000 | Q1.5 | Proposed | 164 | 1163.49 | 1165.32 | 1.20 | 1165.67 | 8.91 | 18 | 15.3 |  | 0.06 |  | 0.06 |
| 1950 | Q100 | Proposed | 858 | 1158.77 | 1162.03 | 1.38 | 1162.91 | 15.36 | 85 | 61.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1950 | Q10 | Proposed | 489 | 1158.77 | 1161.49 | 0.98 | 1162.15 | 12.76 | 53 | 54.2 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1950 | Q1.5 | Proposed | 164 | 1158.77 | 1160.69 | 1.26 | 1161.10 | 8.22 | 20 | 15.9 |  | 0.06 |  | 0.06 |
| 1900 | Q100 | Proposed | 858 | 1153.17 | 1156.53 | 1.52 | 1157.39 | 14.94 | 83 | 54.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1900 | Q10 | Proposed | 489 | 1153.17 | 1155.91 | 1.03 | 1156.62 | 12.72 | 50 | 48.8 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1900 | Q1.5 | Proposed | 164 | 1153.17 | 1154.87 | 1.12 | 1155.43 | 9.71 | 17 | 15.1 |  | 0.06 |  | 0.06 |
| 1850 | Q100 | Proposed | 858 | 1147.50 | 1150.88 | 1.42 | 1151.77 | 15.4 | 82 | 58.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1850 | Q10 | Proposed | 489 | 1147.50 | 1150.31 | 0.91 | 1151.04 | 12.93 | 50 | 54.8 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1850 | Q1.5 | Proposed | 164 | 1147.50 | 1149.37 | 1.23 | 1149.68 | 8.58 | 19 | 15.6 |  | 0.06 |  | 0.06 |
| 1800 | Q100 | Proposed | 858 | 1141.76 | 1145.13 | 1.51 | 1146.07 | 15.6 | 79 | 52.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1800 | Q10 | Proposed | 489 | 1141.76 | 1144.52 | 0.96 | 1145.29 | 13.28 | 48 | 49.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1800 | Q1.5 | Proposed | 164 | 1141.76 | 1143.50 | 1.15 | 1144.00 | 9.58 | 17 | 14.9 |  | 0.06 |  | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1750 | Q100 | Proposed | 858 | 1135.99 | 1139.36 | 1.52 | 1140.33 | 15.66 | 78 | 51.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1750 | Q10 | Proposed | 489 | 1135.99 | 1138.75 | 1.02 | 1139.49 | 13.16 | 48 | 47.0 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1750 | Q1.5 | Proposed | 164 | 1135.99 | 1137.81 | 1.21 | 1138.20 | 8.89 | 18 | 15.3 |  | 0.06 |  | 0.06 |
| 1685.16 | Q100 | Proposed | 858 | 1128.19 | 1131.58 | 1.58 | 1132.59 | 16.02 | 74 | 47.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1685.16 | Q10 | Proposed | 489 | 1128.19 | 1130.92 | 1.13 | 1131.76 | 13.5 | 45 | 39.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1685.16 | Q1.5 | Proposed | 164 | 1128.19 | 1129.89 | 1.14 | 1130.40 | 9.66 | 17 | 14.8 |  | 0.06 |  | 0.06 |
| 1631.51 | Q100 | Proposed | 858 | 1122.32 | 1125.56 | 1.33 | 1126.45 | 15.32 | 82 | 61.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1631.51 | Q10 | Proposed | 489 | 1122.32 | 1125.04 | 0.97 | 1125.72 | 12.59 | 51 | 52.7 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1631.51 | Q1.5 | Proposed | 164 | 1122.32 | 1124.13 | 1.03 | 1124.49 | 8.46 | 19 | 18.9 | 0.10 | 0.06 |  | 0.06 |
| 1558.62 | Q100 | Proposed | 858 | 1114.01 | 1117.50 | 1.70 | 1118.41 | 15.2 | 78 | 46.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1558.62 | Q10 | Proposed | 489 | 1114.01 | 1116.82 | 1.12 | 1117.55 | 13 | 48 | 42.8 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1558.62 | Q1.5 | Proposed | 164 | 1114.01 | 1115.76 | 1.15 | 1116.21 | 9.56 | 17 | 14.9 |  | 0.06 |  | 0.06 |
| 1514 | Q100 | Proposed | 858 | 1109.32 | 1112.91 | 1.71 | 1113.88 | 15.07 | 74 | 43.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1514 | Q10 | Proposed | 489 | 1109.32 | 1112.18 | 1.31 | 1112.94 | 12.59 | 45 | 34.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1514 | Q1.5 | Proposed | 164 | 1109.32 | 1111.18 | 1.23 | 1111.48 | 8.36 | 20 | 16.0 |  | 0.06 |  | 0.06 |
| 1485.63 | Q100 | Proposed | 858 | 1106.89 | 1110.30 | 1.70 | 1111.18 | 14.68 | 77 | 45.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1485.63 | Q10 | Proposed | 489 | 1106.89 | 1109.68 | 1.24 | 1110.32 | 11.84 | 50 | 40.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1485.63 | Q1.5 | Proposed | 164 | 1106.89 | 1108.70 | 1.20 | 1109.00 | 8.09 | 20 | 16.9 |  | 0.06 |  | 0.06 |
| 1451.92 | Q100 | Proposed | 858 | 1104.73 | 1108.63 | 1.80 | 1109.10 | 12.05 | 104 | 57.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1451.92 | Q10 | Proposed | 489 | 1104.73 | 1108.00 | 1.23 | 1108.36 | 9.76 | 68 | 55.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1451.92 | Q1.5 | Proposed | 164 | 1104.73 | 1106.88 | 1.31 | 1106.88 | 6.73 | 24 | 18.6 | 0.00 | 0.06 | 0.10 | 0.06 |
| 1418.62 | Q100 | Proposed | 858 | 1102.38 | 1106.14 | 1.53 | 1106.82 | 13.34 | 98 | 64.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1418.62 | Q10 | Proposed | 489 | 1102.38 | 1105.46 | 1.08 | 1106.07 | 11.42 | 57 | 53.0 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1418.62 | Q1.5 | Proposed | 164 | 1102.38 | 1104.32 | 1.26 | 1104.58 | 8.26 | 20 | 15.8 |  | 0.06 |  | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1362.71 | Q100 | Proposed | 858 | 1098.39 | 1101.88 | 1.61 | 1102.55 | 13.54 | 94 | 58.0 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1362.71 | Q10 | Proposed | 489 | 1098.39 | 1101.26 | 1.11 | 1101.80 | 11.37 | 59 | 53.3 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1362.71 | Q1.5 | Proposed | 164 | 1098.39 | 1100.43 | 1.08 | 1100.63 | 7.28 | 23 | 21.0 | 0.10 | 0.06 |  | 0.05 |
| 1308.81 | Q100 | Proposed | 858 | 1094.26 | 1097.98 | 1.59 | 1098.64 | 13.08 | 101 | 63.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1308.81 | Q10 | Proposed | 489 | 1094.26 | 1097.33 | 1.07 | 1097.86 | 11.07 | 61 | 57.7 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1308.81 | Q1.5 | Proposed | 164 | 1094.26 | 1096.17 | 1.25 | 1096.46 | 8.37 | 20 | 15.6 |  | 0.06 |  | 0.06 |
| 1243.78 | Q100 | Proposed | 858 | 1090.31 | 1094.19 | 1.90 | 1094.65 | 12.16 | 104 | 54.9 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1243.78 | Q10 | Proposed | 489 | 1090.31 | 1093.44 | 1.34 | 1093.88 | 10.36 | 65 | 48.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1243.78 | Q1.5 | Proposed | 164 | 1090.31 | 1092.53 | 0.82 | 1092.58 | 6.58 | 26 | 31.9 | 0.10 | 0.06 | 0.10 | 0.04 |
| 1172.3 | Q100 | Proposed | 858 | 1082.95 | 1086.32 | 1.69 | 1087.43 | 16.58 | 68 | 40.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1172.3 | Q10 | Proposed | 489 | 1082.95 | 1085.64 | 1.10 | 1086.52 | 14.18 | 41 | 37.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1172.3 | Q1.5 | Proposed | 164 | 1082.95 | 1084.44 | 0.98 | 1085.20 | 12.18 | 13 | 13.7 |  | 0.06 |  | 0.06 |
| 1126.39 | Q100 | Proposed | 858 | 1079.82 | 1082.07 | 1.84 | 1082.73 | 12.26 | 72 | 39.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1126.39 | Q10 | Proposed | 489 | 1079.82 | 1081.55 | 1.38 | 1081.91 | 9.54 | 52 | 37.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 1126.39 | Q1.5 | Proposed | 164 | 1079.82 | 1080.93 | 0.88 | 1080.95 | 5.55 | 30 | 33.7 |  | 0.06 |  | 0.06 |
| 1063.6 | Q100 | Proposed | 858 | 1073.21 | 1077.95 | 2.64 | 1078.43 | 12.45 | 80 | 30.1 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1063.6 | Q10 | Proposed | 489 | 1073.21 | 1076.78 | 2.11 | 1077.13 | 10.66 | 48 | 22.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| 1063.6 | Q1.5 | Proposed | 164 | 1073.21 | 1075.11 | 1.28 | 1075.47 | 9.11 | 18 | 14.1 |  | 0.06 |  | 0.06 |
| 992.88 | Q100 | Proposed | 858 | 1069.14 | 1072.71 | 1.89 | 1073.46 | 12.96 | 67 | 35.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| 992.88 | Q10 | Proposed | 489 | 1069.14 | 1072.99 | 2.12 | 1072.59 | 6.46 | 77 | 36.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 992.88 | Q1.5 | Proposed | 164 | 1069.14 | 1071.52 | 1.09 | 1071.48 | 5.68 | 29 | 26.5 |  | 0.06 |  | 0.06 |
| 965.98 | Q100 | Proposed | 858 | 1067.81 | 1072.86 | 2.51 | 1072.86 | 9.99 | 116 | 46.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 965.98 | Q10 | Proposed | 489 | 1067.81 | 1071.80 | 1.75 | 1071.80 | 8.58 | 69 | 39.6 | 0.10 | 0.06 | 0.10 | 0.05 |
| 965.98 | Q1.5 | Proposed | 164 | 1067.81 | 1070.17 | 1.60 | 1070.04 | 6.45 | 25 | 15.9 |  | 0.06 |  | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
## PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 896.36 | Q100 | Proposed | 858 | 1065.69 | 1070.43 | 3.31 | 1069.68 | 7.91 | 121 | 36.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 896.36 | Q10 | Proposed | 489 | 1065.69 | 1068.37 | 1.75 | 1068.67 | 9.68 | 52 | 29.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 896.36 | Q1.5 | Proposed | 164 | 1065.69 | 1067.52 | 1.28 | 1067.39 | 5.6 | 29 | 22.9 |  | 0.06 |  | 0.06 |
| 863.1 | Q100 | Proposed | 858 | 1063.94 | 1070.05 | 4.28 |  | 8.47 | 149 | 34.9 | 0.10 | 0.06 | 0.10 | 0.07 |
| 863.1 | Q10 | Proposed | 489 | 1063.94 | 1068.02 | 2.86 | 1067.36 | 8.07 | 84 | 29.4 | 0.10 | 0.06 | 0.10 | 0.07 |
| 863.1 | Q1.5 | Proposed | 164 | 1063.94 | 1065.99 | 1.25 | 1065.99 | 7.03 | 30 | 24.1 | 0.10 | 0.06 | 0.10 | 0.06 |
| 828.53 | Q100 | Proposed | 858 | 1061.14 | 1067.82 | 3.49 | 1067.82 | 13.64 | 97 | 27.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 828.53 | Q10 | Proposed | 489 | 1061.14 | 1066.10 | 3.00 | 1066.10 | 11.53 | 58 | 19.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 828.53 | Q1.5 | Proposed | 164 | 1061.14 | 1063.93 | 1.64 | 1064.04 | 8.69 | 23 | 13.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 826.84 | Q100 | Proposed | 858 | 1060.76 | 1065.18 | 2.97 | 1066.62 | 17.16 | 51 | 17.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| 826.84 | Q10 | Proposed | 489 | 1060.76 | 1063.93 | 2.35 | 1065.01 | 15.17 | 32 | 13.7 |  | 0.06 |  | 0.06 |
| 826.84 | Q1.5 | Proposed | 164 | 1060.76 | 1062.44 | 1.18 | 1063.12 | 12.12 | 14 | 11.4 |  | 0.06 |  | 0.06 |
| 803.52 | Q100 | Proposed | 858 | 1055.18 | 1059.39 | 3.00 | 1061.57 | 21.35 | 43 | 14.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 803.52 | Q10 | Proposed | 489 | 1055.18 | 1058.21 | 2.25 | 1059.74 | 18.16 | 28 | 12.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 803.52 | Q1.5 | Proposed | 164 | 1055.18 | 1056.86 | 1.31 | 1057.62 | 12.8 | 13 | 9.8 |  | 0.06 |  | 0.06 |
| 788.49 | Q100 | Proposed | 858 | 1052.86 | 1056.13 | 2.37 | 1058.17 | 21.73 | 41 | 17.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 788.49 | Q10 | Proposed | 489 | 1052.86 | 1055.40 | 1.78 | 1056.73 | 17.26 | 29 | 16.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| 788.49 | Q1.5 | Proposed | 164 | 1052.86 | 1054.57 | 1.09 | 1055.05 | 10.25 | 16 | 14.7 |  | 0.06 |  | 0.06 |
| 752.92 | Q100 | Proposed | 858 | 1042.81 | 1046.27 | 1.89 | 1048.21 | 23.47 | 44 | 23.2 | 0.10 | 0.06 |  | 0.06 |
| 752.92 | Q10 | Proposed | 489 | 1042.81 | 1045.56 | 1.49 | 1047.09 | 19.34 | 29 | 19.3 | 0.10 | 0.06 |  | 0.06 |
| 752.92 | Q1.5 | Proposed | 164 | 1042.81 | 1044.45 | 0.97 | 1045.36 | 14.49 | 11 | 11.7 | 0.10 | 0.06 |  | 0.06 |
| 740.16 | Q100 | Proposed | 858 | 1041.85 | 1046.09 | 2.35 | 1047.54 | 17.96 | 56 | 23.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 740.16 | Q10 | Proposed | 489 | 1041.85 | 1045.36 | 1.84 | 1046.24 | 13.86 | 39 | 21.4 | 0.10 | 0.06 | 0.10 | 0.06 |
| 740.16 | Q1.5 | Proposed | 164 | 1041.85 | 1044.43 | 1.28 | 1044.59 | 7.88 | 21 | 16.6 | 0.10 | 0.06 | 0.10 | 0.06 |

# TABLE T2. HEC-RAS OUTPUT FOR MATERIAL REMOVAL AREA, EXISTING AND PROPOSED CONDITIONS
# PERMANENTE CREEK RESTORATION PLAN

| RiverSta | Profile | Plan | QTotal (cfs) | MinChEl (ft) | W.S.Elev (ft) | HydrDepth (ft) | CritW.S. (ft) | VelChnl (ft/s) | FlowArea (sqft) | TopWidth (ft) | Manning LOB -- | Manning Chan -- | Manning ROB -- | Manning avg -- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 709.95 | Q100 | Proposed | 858 | 1038.62 | 1044.52 | 3.14 | 1045.49 | 16.2 | 73 | 23.1 | 0.10 | 0.06 | 0.10 | 0.05 |
| 709.95 | Q10 | Proposed | 489 | 1038.62 | 1043.03 | 2.89 | 1044.09 | 13.89 | 42 | 14.5 | 0.10 | 0.06 | 0.10 | 0.05 |
| 709.95 | Q1.5 | Proposed | 164 | 1038.62 | 1040.94 | 1.51 | 1041.46 | 10.98 | 16 | 10.5 | 0.10 | 0.06 | 0.00 | 0.06 |
| 659.75 | Q100 | Proposed | 858 | 1036.65 | 1041.33 | 3.07 | 1042.21 | 14.45 | 60 | 19.6 | 0.10 | 0.06 | 0.10 | 0.06 |
| 659.75 | Q10 | Proposed | 489 | 1036.65 | 1040.57 | 2.62 | 1040.84 | 10.62 | 46 | 17.6 | 0.00 | 0.06 | 0.00 | 0.06 |
| 659.75 | Q1.5 | Proposed | 164 | 1036.65 | 1039.05 | 1.65 | 1039.05 | 7.35 | 22 | 13.5 |  | 0.06 |  | 0.06 |
| 597.67 | Q100 | Proposed | 858 | 1033.94 | 1039.05 | 3.73 | 1039.05 | 11.44 | 77 | 20.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 597.67 | Q10 | Proposed | 489 | 1033.94 | 1037.72 | 2.73 | 1037.72 | 9.61 | 51 | 18.7 | 0.10 | 0.06 | 0.10 | 0.06 |
| 597.67 | Q1.5 | Proposed | 164 | 1033.94 | 1036.13 | 1.64 | 1036.04 | 6.75 | 24 | 14.8 |  | 0.06 |  | 0.06 |
| 552.31 | Q100 | Proposed | 858 | 1032.03 | 1036.19 | 2.90 | 1036.85 | 13.26 | 68 | 23.3 | 0.10 | 0.06 | 0.10 | 0.06 |
| 552.31 | Q10 | Proposed | 489 | 1032.03 | 1035.31 | 2.32 | 1035.56 | 10.29 | 48 | 20.8 | 0.10 | 0.06 | 0.10 | 0.06 |
| 552.31 | Q1.5 | Proposed | 164 | 1032.03 | 1033.95 | 1.53 | 1033.95 | 7.03 | 23 | 15.3 |  | 0.06 |  | 0.06 |
| 500 | Q100 | Proposed | 858 | 1028.47 | 1033.48 | 3.13 | 1033.96 | 12.86 | 72 | 22.9 | 0.10 | 0.06 | 0.10 | 0.05 |
| 500 | Q10 | Proposed | 489 | 1028.47 | 1032.18 | 2.60 | 1032.45 | 10.87 | 46 | 17.5 | 0.10 | 0.06 | 0.10 | 0.06 |
| 500 | Q1.5 | Proposed | 164 | 1028.47 | 1030.49 | 1.51 | 1030.67 | 8.25 | 20 | 13.1 |  | 0.06 |  | 0.06 |
| 450 | Q100 | Proposed | 858 | 1026.39 | 1031.01 | 2.63 | 1031.65 | 12.26 | 73 | 27.8 | 0.10 | 0.06 |  | 0.05 |
| 450 | Q10 | Proposed | 489 | 1026.39 | 1030.20 | 2.45 | 1030.20 | 9.22 | 53 | 21.7 | 0.10 | 0.06 |  | 0.06 |
| 450 | Q1.5 | Proposed | 164 | 1026.39 | 1028.49 | 1.56 | 1028.49 | 7.14 | 23 | 14.7 |  | 0.06 |  | 0.06 |
| 400 | Q100 | Proposed | 858 | 1024.77 | 1028.14 | 2.00 | 1028.58 | 10.89 | 81 | 40.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| 400 | Q10 | Proposed | 489 | 1024.77 | 1028.11 | 1.97 | 1027.79 | 6.31 | 79 | 40.2 | 0.10 | 0.06 | 0.10 | 0.06 |
| 400 | Q1.5 | Proposed | 164 | 1024.77 | 1027.07 | 1.12 | 1026.76 | 4.23 | 39 | 34.9 |  | 0.06 | 0.10 | 0.06 |

**Project:** Permanente Creek Restoration Project
**Project #:** 13-016
**Date:** 10/28/19
**By:** D.R.
**Checked by:** B.M.Z.
**Location:** Channel Widening Area

## Table T3
## Overtopping Flow Evaluation along Angular Rock Vehicle Barrier

**Purpose: Evaluate areas where the 100-year flood overtops the bank adjacent to the access road and determine if the proposed 4 to 8 inch angular rock vehicle barrier will remain stable.**

| HEC-RAS Station | Road Edge Elevation (ft) | 100-yr WSE (ft) | Depth at Road Edge (ft) | Velocity at Road Edge (ft/s) | Energy Slope (ft/ft) | Shear Stress (calculated) (lbs/sf) | Notes |
|---|---|---|---|---|---|---|---|
| 145+50 and upstream | 691.0 | 690.6 | -- | -- | -- | -- | road above 100-yr WSE |
| 145+00 | 688.0 | 689.1 | 1.1 | 2.2 | 0.019 | 1.3 | |
| 144+50 | 685.7 | 686.9 | 1.2 | 5.0 | 0.060 | 4.5 | Maximum shear |
| 144+12.75 | 684.4 | 685.3 | 0.9 | 4.3 | 0.039 | 2.2 | |
| 143+88.99 to 135+94 | -- | -- | -- | -- | | | road above 100-yr WSE |
| 135+60.62 | 645.7 | 646.2 | 0.5 | 1.1 | 0.017 | 0.5 | |
| 135+00 | 644.2 | 645.2 | 1.0 | 4.4 | 0.017 | 1.1 | |
| 134+50 | 642.5 | 643.9 | 1.4 | 4.9 | 0.016 | 1.4 | |
| 134+26 to 124+82.8 | -- | -- | -- | -- | -- | -- | road above 100-yr WSE |
| 124+63.7 | 605.9 | 606.2 | 0.3 | 2.4 | 0.037 | 0.7 | shallow |
| 124+11.83 | -- | -- | -- | -- | -- | -- | road above 100-yr WSE |
| 123+56.27 | 601.2 | 602.8 | 1.6 | 3.5 | 0.025 | 2.5 | |
| 123+01.23 | 600 | 600.3 | 0.3 | 3.4 | 0.047 | 0.9 | shallow |
| 122+50.48 to 117+24.31 | -- | -- | -- | -- | -- | -- | road above 100-yr WSE |
| 116+78.1 | 579.7 | 580.0 | 0.3 | 0.3 | 0.001 | 0.0 | shallow |
| 116+20.76 | 578.3 | 579.8 | 1.5 | 0.8 | 0.005 | 0.4 | Just upstream of culvert |

**Notes:**

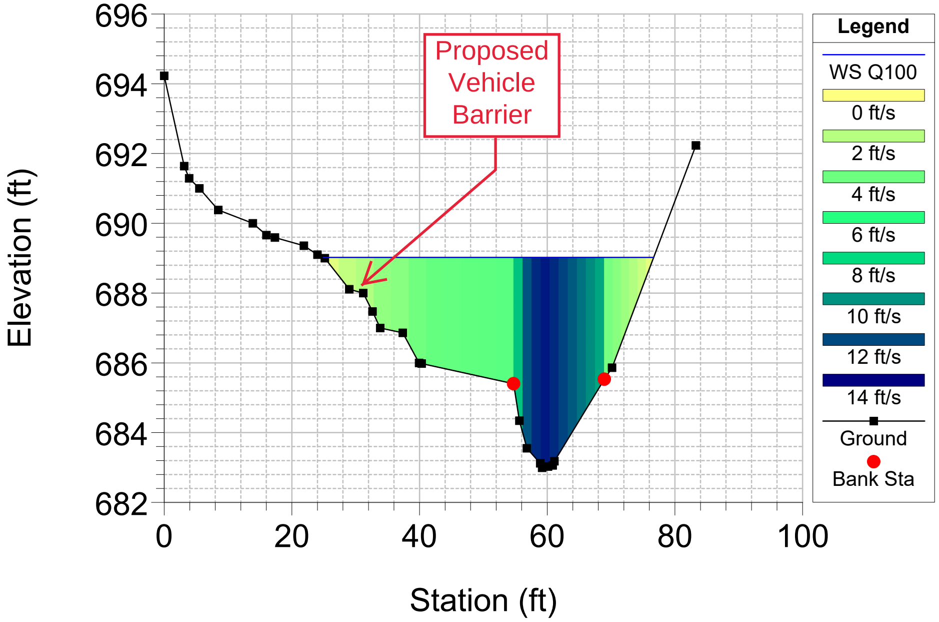
*The maximum permissible velocity of a 6-inch diameter rock is 10 ft/s and the maximum permissible shear stress is 2.5 $lb/ft^2$

*The maximum permissible velocity of a 12-inch diameter rock is 13 ft/s and the maximum permissible shear stress is 5.1 $lb/ft^2$

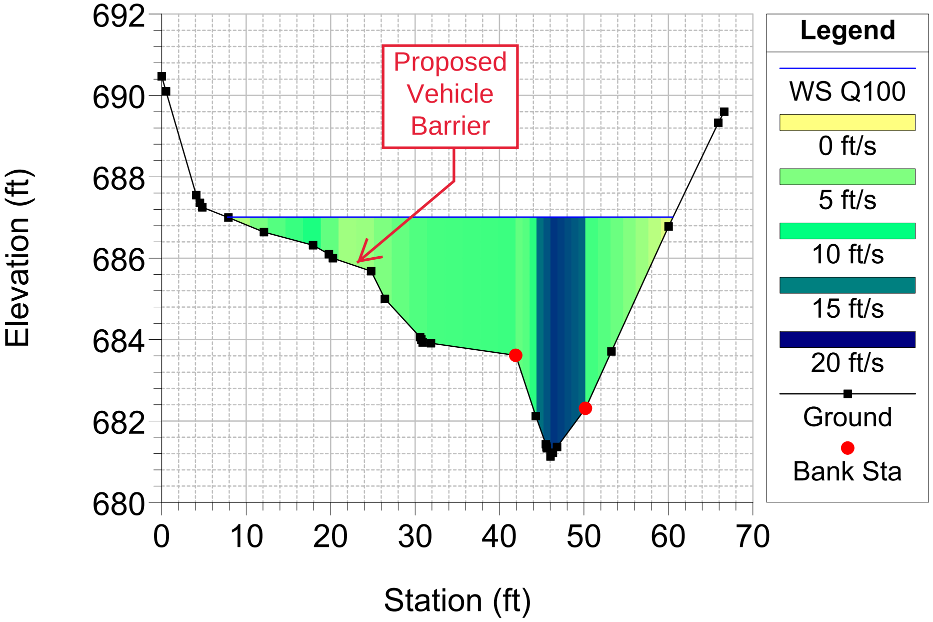
Use 10 to 16-inch diameter rock to constructe the vehicle barrier from Sta. 144+25 to 144+75.

*Source: Fischenich, Craig. May 2001. Stability Thresholds for Stream Restoration Materials. USAE Research and Development Center, Environmental Laboratory. Vicksburg Mississippi.

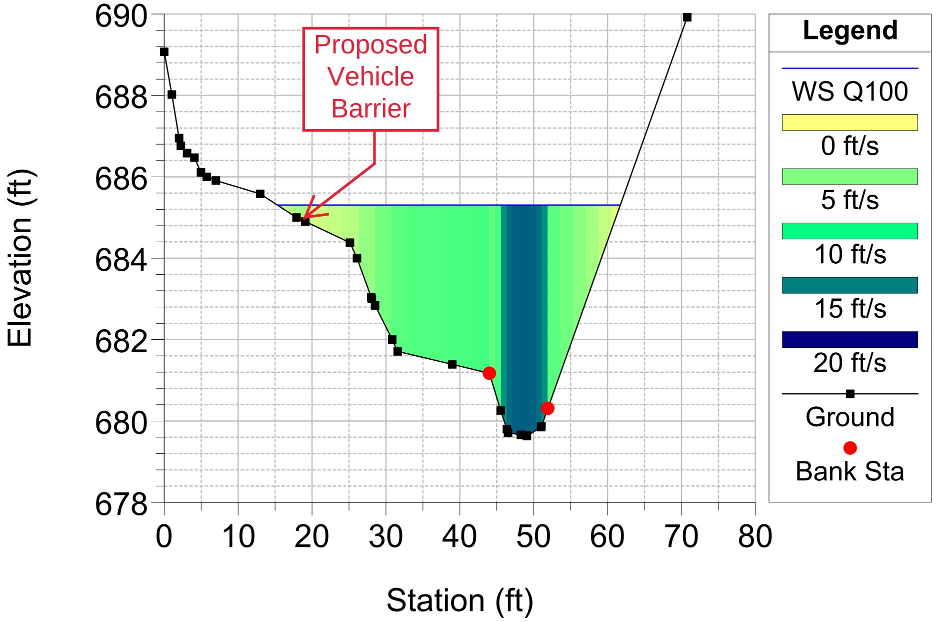
River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 14500



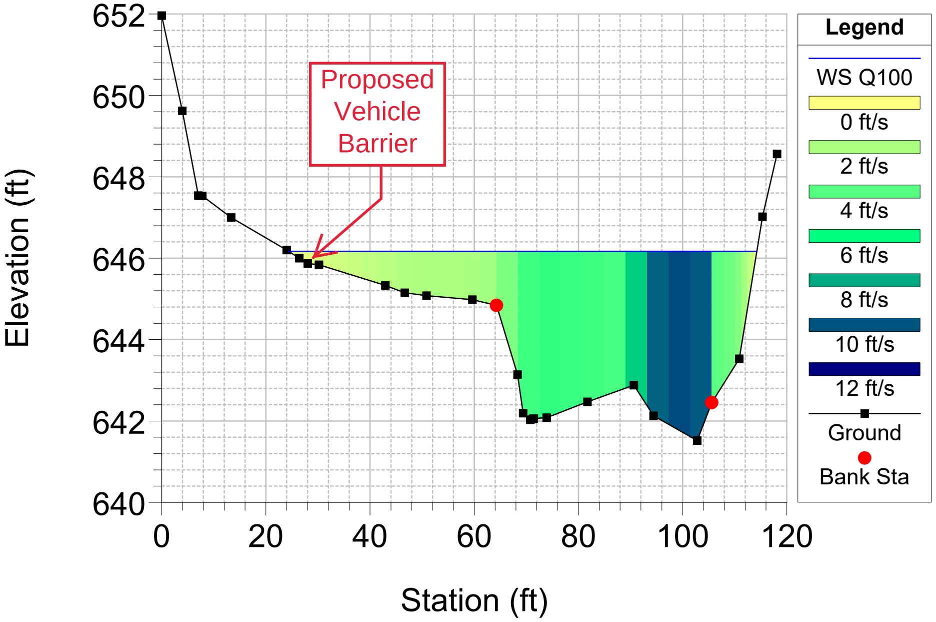
River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 14450



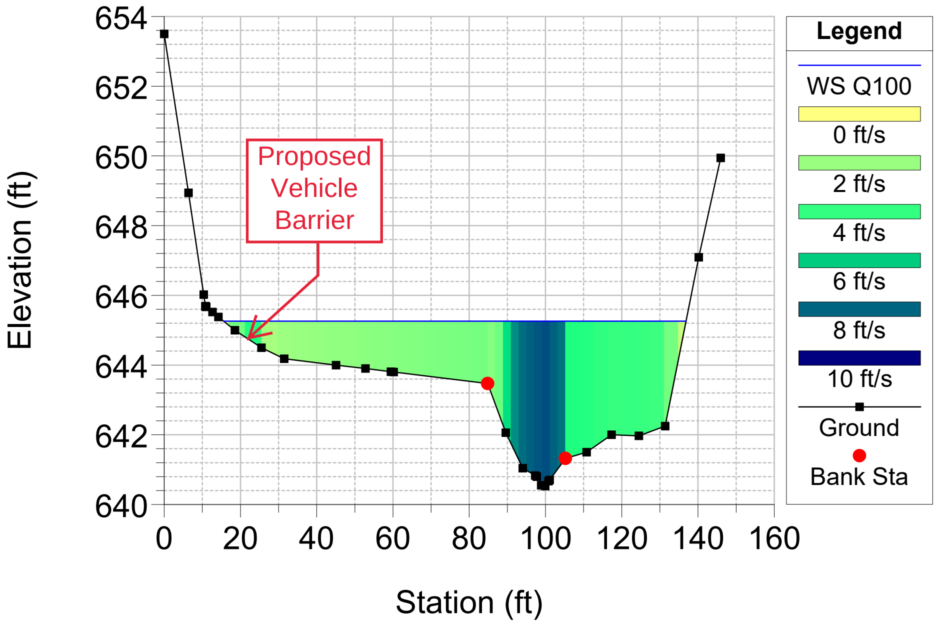
River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 14412.75



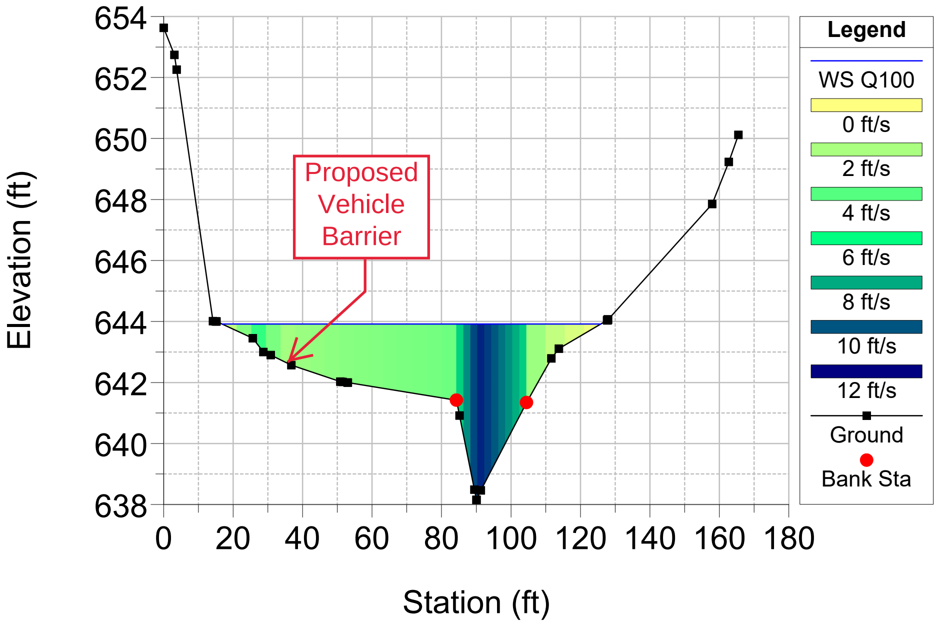
River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 13560.62



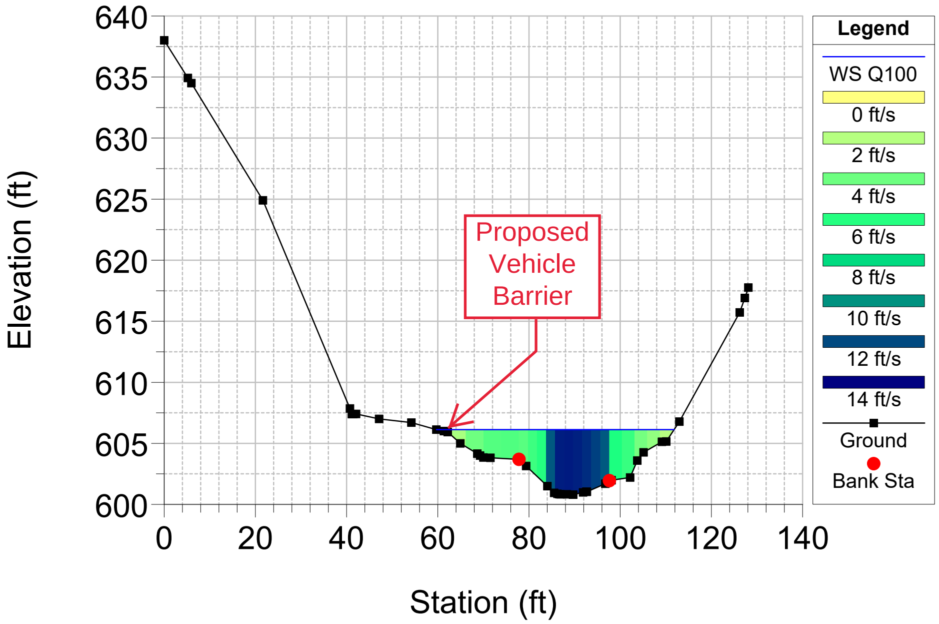
River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 13500



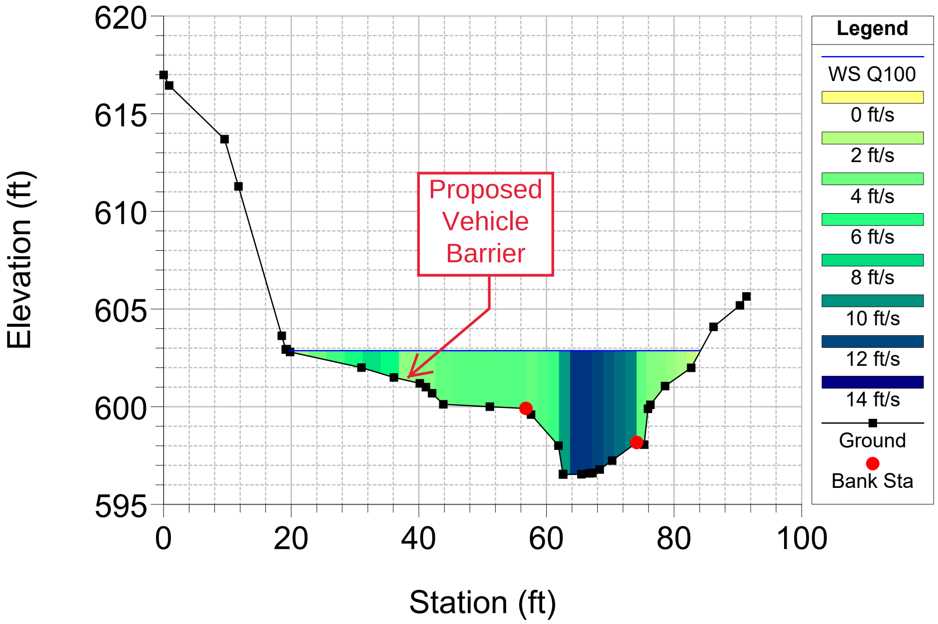
River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 13450



River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 12463.7



River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 12356.27



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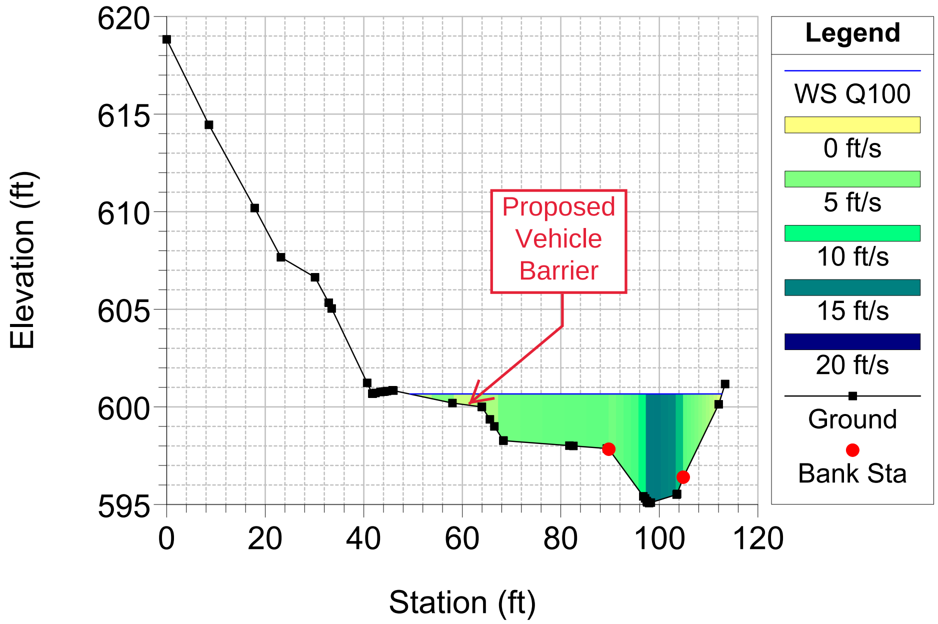
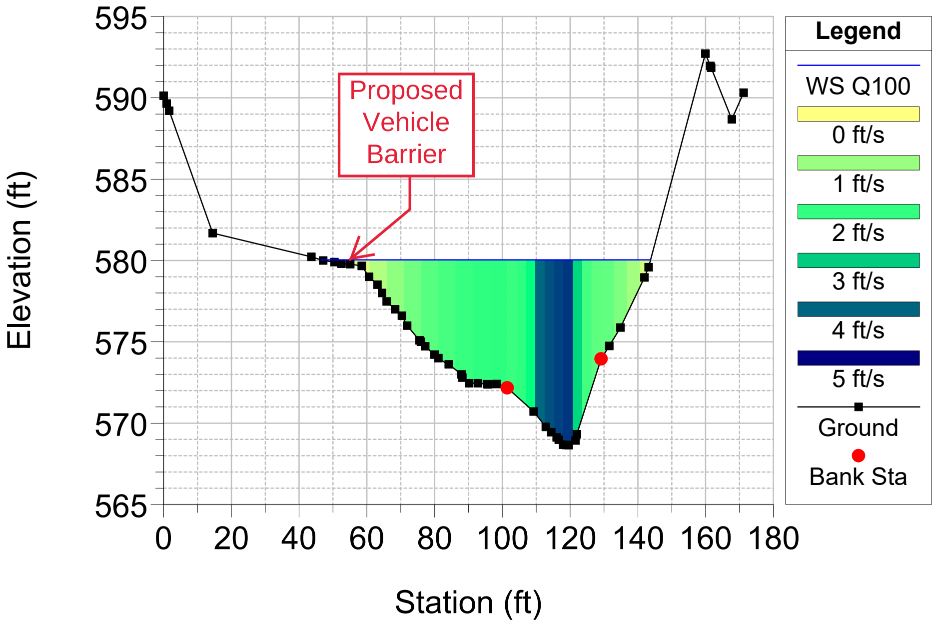


River = Permanente Creek Reach = HEC-RAS ALIGN_4- RS = 11678.1



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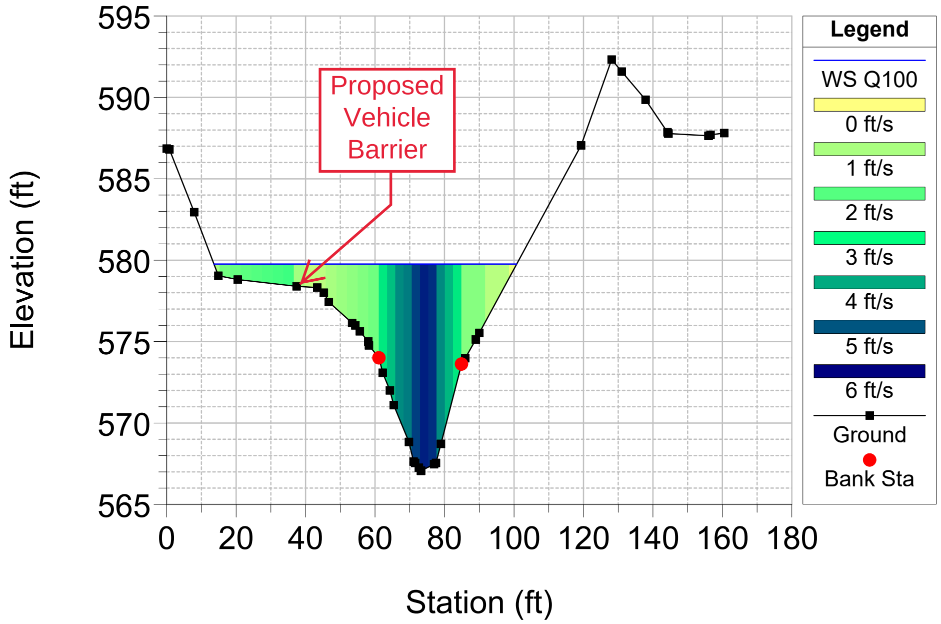

## TABLE T4. SENSITIVITY ANALYSIS: COMPARISONS OF WATER SURFACE ELEVATIONS FROM HEC-RAS BY RAISING AND LOWERING CHANNEL ROUGHNESS DESIGN VALUES BY 10%
## PERMANENTE CREEK RESTORATION PLAN

| | Water Surface Elevations | | | Water Surface Elevations | | | Water Surface Elevations | | | Differences between Sensitivity Trial and Design * | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEC-RAS | 1.5-YR Proposed Conditions | | | 10-YR Proposed Conditions | | | 100-YR Proposed Conditions | | | 1.5-YR Water Surface | | 10-YR Water Surface | | 100-YR Water Surface | |
| STATION | DESIGN | n + 10% | n - 10% | DESIGN | n + 10% | n - 10% | DESIGN | n + 10% | n - 10% | n + 10% | n - 10% | n + 10% | n - 10% | n + 10% | n - 10% |
| 16350.0 | 815.0 | 815.1 | 815.0 | 816.4 | 816.5 | 816.2 | 817.5 | 817.7 | 817.3 | 0.07 | -0.06 | 0.14 | -0.15 | 0.20 | -0.21 |
| 16307.7 | 813.5 | 813.6 | 813.4 | 814.9 | 815.1 | 814.8 | 816.1 | 816.3 | 815.9 | 0.11 | -0.12 | 0.17 | -0.16 | 0.21 | -0.21 |
| 16250.0 | 811.8 | 811.8 | 811.7 | 813.3 | 813.4 | 813.1 | 814.4 | 814.5 | 814.2 | 0.05 | -0.03 | 0.06 | -0.18 | 0.11 | -0.22 |
| 16200.0 | 809.7 | 809.8 | 809.5 | 810.5 | 810.8 | 810.5 | 811.4 | 811.6 | 811.4 | 0.14 | -0.15 | 0.23 | 0.01 | 0.21 | 0.00 |
| 16150.0 | 806.3 | 806.3 | 806.3 | 808.0 | 808.0 | 807.8 | 808.9 | 808.9 | 808.7 | 0.00 | 0.00 | 0.02 | -0.17 | 0.05 | -0.17 |
| 16100.0 | 802.1 | 802.3 | 802.0 | 803.3 | 803.4 | 803.2 | 804.1 | 804.1 | 804.1 | 0.16 | -0.15 | 0.09 | -0.03 | 0.06 | -0.02 |
| 16050.0 | 798.6 | 798.6 | 798.5 | 799.7 | 799.8 | 799.5 | 800.4 | 800.6 | 800.2 | 0.06 | -0.08 | 0.13 | -0.16 | 0.17 | -0.19 |
| 16000.0 | 794.3 | 794.4 | 794.2 | 795.6 | 795.6 | 795.4 | 796.5 | 796.6 | 796.3 | 0.11 | -0.09 | 0.09 | -0.11 | 0.12 | -0.15 |
| 15982.4 | 793.3 | 793.4 | 793.2 | 794.4 | 794.5 | 794.2 | 795.2 | 795.3 | 795.0 | 0.10 | -0.15 | 0.13 | -0.14 | 0.15 | -0.15 |
| 15950.0 | 790.2 | 790.3 | 790.2 | 791.5 | 791.6 | 791.4 | 792.3 | 792.4 | 792.2 | 0.05 | -0.04 | 0.09 | -0.11 | 0.11 | -0.12 |
| 15917.7 | 787.8 | 787.9 | 787.6 | 788.8 | 788.9 | 788.7 | 789.6 | 789.7 | 789.4 | 0.13 | -0.14 | 0.12 | -0.12 | 0.13 | -0.14 |
| 15900.0 | 786.5 | 786.6 | 786.4 | 787.7 | 787.8 | 787.6 | 788.5 | 788.7 | 788.3 | 0.06 | -0.09 | 0.13 | -0.14 | 0.17 | -0.17 |
| 15878.5 | 784.7 | 784.8 | 784.6 | 785.9 | 786.0 | 785.8 | 786.7 | 786.9 | 786.6 | 0.10 | -0.10 | 0.09 | -0.12 | 0.12 | -0.15 |
| 15850.0 | 782.5 | 782.6 | 782.4 | 783.6 | 783.7 | 783.5 | 784.4 | 784.5 | 784.3 | 0.09 | -0.10 | 0.10 | -0.12 | 0.12 | -0.14 |
| 15800.0 | 778.5 | 778.6 | 778.4 | 779.6 | 779.7 | 779.5 | 780.5 | 780.6 | 780.3 | 0.09 | -0.10 | 0.11 | -0.12 | 0.14 | -0.15 |
| 15750.0 | 774.3 | 774.4 | 774.2 | 775.5 | 775.6 | 775.4 | 776.3 | 776.4 | 776.1 | 0.09 | -0.10 | 0.10 | -0.12 | 0.13 | -0.13 |
| 15700.0 | 770.0 | 770.1 | 769.9 | 771.1 | 771.3 | 771.0 | 772.0 | 772.1 | 771.8 | 0.08 | -0.09 | 0.13 | -0.14 | 0.14 | -0.16 |
| 15650.0 | 766.1 | 766.2 | 766.0 | 767.2 | 767.2 | 767.1 | 767.8 | 767.9 | 767.7 | 0.09 | -0.10 | 0.08 | -0.10 | 0.10 | -0.11 |
| 15600.0 | 762.0 | 762.1 | 761.9 | 763.2 | 763.3 | 763.1 | 763.9 | 764.0 | 763.8 | 0.10 | -0.08 | 0.09 | -0.11 | 0.11 | -0.12 |
| 15550.0 | 758.2 | 758.3 | 758.1 | 759.2 | 759.3 | 759.1 | 759.8 | 759.8 | 759.7 | 0.10 | -0.11 | 0.08 | -0.09 | 0.07 | -0.08 |
| 15500.0 | 754.2 | 754.3 | 754.2 | 755.3 | 755.4 | 755.2 | 756.0 | 756.1 | 755.9 | 0.07 | -0.08 | 0.09 | -0.10 | 0.11 | -0.13 |
| 15450.0 | 750.6 | 750.7 | 750.4 | 751.6 | 751.7 | 751.5 | 752.4 | 752.5 | 752.3 | 0.10 | -0.11 | 0.10 | -0.11 | 0.11 | -0.13 |
| 15400.0 | 746.6 | 746.7 | 746.5 | 747.9 | 748.0 | 747.8 | 748.8 | 748.9 | 748.6 | 0.07 | -0.08 | 0.10 | -0.12 | 0.11 | -0.12 |
| 15350.0 | 742.6 | 742.7 | 742.5 | 743.7 | 743.8 | 743.6 | 744.5 | 744.6 | 744.4 | 0.11 | -0.12 | 0.09 | -0.11 | 0.10 | -0.10 |
| 15300.0 | 738.6 | 738.7 | 738.5 | 739.8 | 739.9 | 739.6 | 740.5 | 740.6 | 740.4 | 0.08 | -0.09 | 0.11 | -0.13 | 0.13 | -0.14 |
| 15250.0 | 734.6 | 734.7 | 734.5 | 735.7 | 735.8 | 735.6 | 736.6 | 736.7 | 736.4 | 0.10 | -0.11 | 0.10 | -0.11 | 0.12 | -0.14 |
| 15200.0 | 730.6 | 730.7 | 730.5 | 731.8 | 731.9 | 731.7 | 732.7 | 732.8 | 732.5 | 0.08 | -0.10 | 0.12 | -0.12 | 0.14 | -0.16 |
| 15150.0 | 726.6 | 726.7 | 726.5 | 727.8 | 727.9 | 727.7 | 728.6 | 728.7 | 728.5 | 0.10 | -0.10 | 0.11 | -0.12 | 0.13 | -0.14 |
| 15100.0 | 722.7 | 722.7 | 722.6 | 723.8 | 723.9 | 723.7 | 724.6 | 724.8 | 724.5 | 0.08 | -0.10 | 0.12 | -0.12 | 0.14 | -0.15 |
| 15050.0 | 718.7 | 718.8 | 718.6 | 719.8 | 719.9 | 719.7 | 720.6 | 720.7 | 720.5 | 0.10 | -0.10 | 0.11 | -0.12 | 0.12 | -0.15 |
| 15000.0 | 714.7 | 714.8 | 714.6 | 715.9 | 716.0 | 715.8 | 716.6 | 716.8 | 716.5 | 0.08 | -0.11 | 0.11 | -0.11 | 0.13 | -0.14 |
| 14950.0 | 710.7 | 710.8 | 710.6 | 711.8 | 711.9 | 711.7 | 712.6 | 712.8 | 712.5 | 0.10 | -0.10 | 0.11 | -0.12 | 0.13 | -0.14 |
| 14923.5 | 708.4 | 708.5 | 708.3 | 709.7 | 709.8 | 709.5 | 710.5 | 710.7 | 710.4 | 0.08 | -0.10 | 0.13 | -0.14 | 0.13 | -0.15 |
| 14900.0 | 706.4 | 706.5 | 706.4 | 707.4 | 707.5 | 707.3 | 708.3 | 708.4 | 708.1 | 0.07 | -0.08 | 0.10 | -0.11 | 0.12 | -0.14 |
| 14850.0 | 704.2 | 704.3 | 704.1 | 705.5 | 705.7 | 705.3 | 706.4 | 706.6 | 706.2 | 0.12 | -0.14 | 0.16 | -0.18 | 0.19 | -0.21 |
| 14802.6 | 703.3 | 703.3 | 703.4 | 704.2 | 704.2 | 704.1 | 704.9 | 704.9 | 704.8 | -0.01 | 0.02 | 0.01 | -0.05 | 0.00 | -0.05 |
| 14794.1 | 700.5 | 700.5 | 700.4 | 702.4 | 702.4 | 702.4 | 703.0 | 703.0 | 703.0 | 0.03 | -0.04 | 0.01 | -0.03 | -0.01 | -0.01 |
| 14750.0 | 699.6 | 699.7 | 699.4 | 700.4 | 700.6 | 700.3 | 701.2 | 701.3 | 701.0 | 0.13 | -0.16 | 0.11 | -0.10 | 0.14 | -0.12 |
| 14700.0 | 695.3 | 695.3 | 695.3 | 696.8 | 696.8 | 696.7 | 697.5 | 697.5 | 697.4 | 0.01 | -0.03 | 0.04 | -0.07 | 0.02 | -0.05 |
| 14667.2 | 690.0 | 690.1 | 689.9 | 691.5 | 691.7 | 691.4 | 693.1 | 693.2 | 692.9 | 0.11 | -0.09 | 0.15 | -0.15 | 0.14 | -0.17 |
| 14650.0 | 690.4 | 690.4 | 690.1 | 691.6 | 691.9 | 691.4 | 692.5 | 692.6 | 692.3 | 0.06 | -0.28 | 0.26 | -0.25 | 0.15 | -0.17 |
| 14600.0 | 688.7 | 688.8 | 688.3 | 689.4 | 689.4 | 689.3 | 690.0 | 691.2 | 689.9 | 0.13 | -0.37 | 0.02 | -0.05 | 1.25 | -0.10 |

## TABLE T4. SENSITIVITY ANALYSIS: COMPARISONS OF WATER SURFACE ELEVATIONS FROM HEC-RAS BY RAISING AND LOWERING CHANNEL ROUGHNESS DESIGN VALUES BY 10%
## PERMANENTE CREEK RESTORATION PLAN

|  | Water Surface Elevations |  |  | Water Surface Elevations |  |  | Water Surface Elevations |  |  | Differences between Sensitivity Trial and Design * |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEC-RAS | 1.5-YR Proposed Conditions |  |  | 10-YR Proposed Conditions |  |  | 100-YR Proposed Conditions |  |  | 1.5-YR Water Surface |  | 10-YR Water Surface |  | 100-YR Water Surface |  |
| STATION | DESIGN | n + 10% | n - 10% | DESIGN | n + 10% | n - 10% | DESIGN | n + 10% | n - 10% | n + 10% | n - 10% | n + 10% | n - 10% | n + 10% | n - 10% |
| 14550.0 | 687.5 | 687.5 | 687.5 | 689.3 | 689.4 | 689.2 | 690.7 | 690.8 | 690.7 | 0.01 | -0.01 | 0.07 | -0.11 | 0.03 | -0.02 |
| 14500.0 | 686.2 | 686.3 | 685.8 | 687.8 | 687.8 | 687.8 | 689.1 | 689.0 | 689.1 | 0.12 | -0.34 | 0.03 | 0.03 | -0.06 | 0.05 |
| 14450.0 | 684.7 | 684.7 | 684.7 | 686.2 | 686.4 | 686.0 | 686.9 | 687.1 | 686.8 | -0.01 | 0.01 | 0.19 | -0.16 | 0.14 | -0.12 |
| 14412.8 | 682.2 | 682.2 | 682.1 | 683.8 | 683.8 | 683.9 | 685.3 | 685.3 | 685.3 | 0.05 | -0.05 | -0.06 | 0.01 | -0.02 | -0.04 |
| 14389.0 | 677.6 | 677.6 | 677.5 | 679.8 | 679.8 | 679.7 | 681.1 | 681.1 | 681.1 | 0.04 | -0.05 | 0.08 | -0.06 | 0.04 | -0.03 |
| 14350.0 | 675.2 | 675.3 | 675.0 | 676.7 | 676.9 | 676.6 | 677.9 | 678.0 | 677.7 | 0.17 | -0.15 | 0.11 | -0.12 | 0.12 | -0.12 |
| 14300.0 | 670.7 | 670.7 | 670.7 | 672.4 | 672.5 | 672.3 | 673.4 | 673.5 | 673.3 | -0.01 | -0.01 | 0.06 | -0.06 | 0.09 | -0.11 |
| 14250.0 | 667.2 | 667.3 | 667.2 | 667.8 | 667.9 | 667.8 | 668.6 | 668.6 | 668.5 | 0.07 | -0.07 | 0.05 | -0.04 | 0.04 | -0.03 |
| 14192.7 | 664.8 | 664.8 | 664.8 | 666.5 | 666.5 | 666.5 | 667.5 | 667.5 | 667.5 | 0.00 | -0.01 | 0.00 | 0.00 | -0.02 | 0.01 |
| 14150.0 | 662.7 | 662.8 | 662.6 | 663.9 | 663.9 | 663.8 | 664.8 | 664.8 | 664.7 | 0.15 | -0.10 | 0.09 | -0.09 | 0.08 | -0.07 |
| 14096.7 | 660.9 | 661.0 | 660.9 | 662.6 | 662.6 | 662.5 | 663.8 | 663.8 | 663.7 | 0.06 | -0.04 | 0.01 | -0.07 | 0.00 | -0.02 |
| 14082.0 | 660.3 | 660.4 | 660.3 | 661.7 | 661.8 | 661.7 | 662.7 | 662.8 | 662.8 | 0.07 | -0.08 | 0.10 | 0.02 | 0.04 | 0.02 |
| 14050.0 | 659.5 | 659.6 | 659.5 | 661.2 | 661.2 | 661.1 | 662.2 | 662.2 | 662.2 | 0.03 | -0.01 | 0.03 | -0.08 | -0.05 | -0.05 |
| 14000.0 | 658.1 | 658.2 | 658.0 | 659.5 | 659.6 | 659.5 | 660.5 | 660.7 | 660.5 | 0.12 | -0.14 | 0.06 | 0.00 | 0.20 | -0.01 |
| 13950.0 | 656.3 | 656.3 | 656.3 | 658.0 | 658.1 | 657.9 | 659.1 | 659.1 | 659.0 | 0.00 | 0.00 | 0.11 | -0.13 | -0.02 | -0.16 |
| 13900.0 | 653.7 | 653.8 | 652.6 | 654.8 | 654.8 | 654.7 | 656.0 | 656.1 | 655.9 | 0.14 | -1.04 | 0.07 | -0.07 | 0.11 | -0.03 |
| 13850.0 | 652.0 | 652.0 | 652.0 | 653.6 | 653.6 | 653.5 | 654.2 | 654.3 | 654.1 | 0.00 | 0.00 | 0.01 | -0.12 | 0.12 | -0.13 |
| 13800.0 | 650.5 | 650.5 | 650.4 | 651.8 | 651.9 | 651.3 | 652.8 | 652.9 | 652.7 | 0.04 | -0.06 | 0.11 | -0.54 | 0.13 | -0.12 |
| 13750.0 | 649.0 | 649.1 | 648.9 | 650.5 | 650.5 | 650.5 | 651.4 | 651.4 | 651.5 | 0.10 | -0.06 | -0.02 | 0.02 | -0.05 | 0.05 |
| 13700.0 | 647.7 | 647.7 | 647.7 | 649.4 | 649.4 | 649.3 | 650.4 | 650.5 | 650.3 | 0.04 | 0.01 | 0.02 | -0.10 | 0.06 | -0.09 |
| 13657.2 | 646.5 | 646.6 | 646.3 | 647.7 | 647.9 | 647.7 | 648.8 | 648.8 | 648.8 | 0.13 | -0.16 | 0.14 | -0.01 | 0.03 | 0.00 |
| 13594.6 | 644.6 | 644.6 | 644.6 | 645.6 | 645.7 | 645.5 | 646.5 | 646.6 | 646.3 | -0.01 | 0.00 | 0.05 | -0.15 | 0.16 | -0.16 |
| 13560.7 | 644.0 | 644.0 | 643.9 | 645.4 | 645.4 | 645.3 | 646.2 | 646.2 | 646.1 | 0.04 | -0.04 | 0.04 | -0.03 | 0.05 | -0.06 |
| 13500.0 | 643.1 | 643.2 | 643.0 | 644.3 | 644.4 | 644.2 | 645.2 | 645.3 | 645.1 | 0.08 | -0.11 | 0.06 | -0.09 | 0.05 | -0.07 |
| 13450.0 | 641.3 | 641.3 | 641.3 | 643.0 | 643.0 | 643.0 | 643.9 | 643.9 | 644.0 | 0.00 | 0.00 | 0.00 | 0.02 | -0.05 | 0.07 |
| 13426.5 | 640.0 | 640.1 | 639.9 | 641.1 | 641.2 | 641.1 | 641.9 | 642.0 | 641.9 | 0.12 | -0.11 | 0.05 | -0.05 | 0.05 | -0.04 |
| 13400.0 | 639.2 | 639.2 | 639.1 | 640.5 | 640.6 | 640.4 | 641.7 | 641.8 | 641.6 | 0.06 | -0.07 | 0.10 | -0.08 | 0.13 | -0.14 |
| 13350.0 | 638.3 | 638.4 | 638.2 | 639.7 | 639.9 | 639.6 | 641.1 | 641.3 | 640.9 | 0.08 | -0.08 | 0.15 | -0.18 | 0.15 | -0.19 |
| 13335.6 | 637.9 | 638.0 | 637.8 | 639.5 | 639.6 | 639.3 | 640.9 | 641.0 | 640.7 | 0.09 | -0.09 | 0.15 | -0.16 | 0.14 | -0.16 |
| 13300.0 | 637.1 | 637.2 | 637.0 | 638.8 | 639.0 | 638.6 | 640.3 | 640.4 | 640.1 | 0.12 | -0.14 | 0.16 | -0.20 | 0.14 | -0.17 |
| 13239.0 | 636.5 | 636.5 | 636.5 | 637.9 | 638.0 | 637.8 | 638.8 | 638.9 | 638.7 | 0.04 | -0.04 | 0.06 | -0.06 | 0.12 | -0.08 |
| 13208.1 | 635.7 | 635.7 | 635.7 | 636.9 | 636.8 | 636.9 | 637.8 | 637.7 | 637.9 | -0.01 | 0.02 | -0.04 | 0.07 | -0.07 | 0.04 |
| 13200.0 | 632.8 | 632.8 | 632.7 | 635.1 | 635.1 | 635.0 | 636.2 | 636.2 | 636.2 | 0.04 | -0.04 | 0.03 | -0.03 | -0.01 | 0.01 |
| 13171.2 | 630.8 | 630.9 | 630.6 | 634.0 | 634.0 | 634.0 | 635.6 | 635.5 | 635.6 | 0.15 | -0.18 | 0.03 | -0.03 | -0.06 | 0.06 |
| 13150.0 | 630.8 | 631.0 | 630.7 | 633.1 | 633.0 | 633.1 | 634.3 | 634.2 | 634.3 | 0.20 | -0.05 | -0.02 | 0.03 | -0.09 | 0.07 |
| 13113.0 | 629.8 | 629.8 | 629.6 | 631.3 | 631.4 | 631.2 | 632.5 | 632.6 | 632.5 | 0.00 | -0.17 | 0.08 | -0.07 | 0.08 | -0.04 |
| 13087.0 | 626.6 | 626.7 | 626.6 | 628.9 | 629.0 | 628.8 | 630.3 | 630.4 | 630.2 | 0.09 | -0.03 | 0.12 | -0.13 | 0.12 | -0.11 |
| 13050.0 | 625.8 | 625.8 | 625.6 | 627.0 | 627.2 | 626.9 | 628.4 | 628.6 | 628.2 | 0.02 | -0.24 | 0.19 | -0.17 | 0.22 | -0.20 |
| 13000.0 | 623.2 | 623.4 | 623.1 | 625.8 | 625.9 | 625.4 | 627.6 | 627.7 | 627.1 | 0.21 | -0.05 | 0.06 | -0.44 | 0.05 | -0.54 |
| 12950.0 | 620.0 | 620.1 | 619.8 | 621.8 | 621.9 | 621.7 | 623.0 | 623.0 | 622.9 | 0.09 | -0.19 | 0.12 | -0.07 | 0.07 | -0.05 |
| 12900.0 | 618.2 | 618.3 | 618.2 | 620.6 | 620.7 | 620.3 | 622.3 | 622.3 | 621.7 | 0.08 | 0.00 | 0.11 | -0.30 | -0.02 | -0.60 |
| 12850.0 | 617.2 | 617.3 | 617.0 | 619.0 | 619.3 | 618.2 | 620.0 | 620.3 | 619.8 | 0.15 | -0.16 | 0.26 | -0.78 | 0.22 | -0.24 |

## TABLE T4. SENSITIVITY ANALYSIS: COMPARISONS OF WATER SURFACE ELEVATIONS FROM HEC-RAS BY RAISING AND LOWERING CHANNEL ROUGHNESS DESIGN VALUES BY 10%
## PERMANENTE CREEK RESTORATION PLAN

| | Water Surface Elevations | | | Water Surface Elevations | | | Water Surface Elevations | | | Differences between Sensitivity Trial and Design * | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEC-RAS | 1.5-YR Proposed Conditions | | | 10-YR Proposed Conditions | | | 100-YR Proposed Conditions | | | 1.5-YR Water Surface | | 10-YR Water Surface | | 100-YR Water Surface | |
| STATION | DESIGN | n + 10% | n - 10% | DESIGN | n + 10% | n - 10% | DESIGN | n + 10% | n - 10% | n + 10% | n - 10% | n + 10% | n - 10% | n + 10% | n - 10% |
| 12800.0 | 615.4 | 615.4 | 615.4 | 617.7 | 617.7 | 617.7 | 619.2 | 619.2 | 619.1 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | -0.11 |
| 12750.0 | 613.8 | 614.0 | 613.7 | 614.7 | 615.0 | 614.5 | 616.0 | 616.1 | 615.9 | 0.15 | -0.17 | 0.22 | -0.21 | 0.13 | -0.12 |
| 12700.0 | 612.1 | 612.1 | 612.1 | 614.2 | 614.2 | 614.1 | 615.3 | 615.3 | 615.0 | 0.02 | 0.00 | -0.01 | -0.06 | 0.03 | -0.34 |
| 12650.0 | 610.5 | 610.6 | 610.3 | 611.4 | 611.6 | 611.3 | 612.6 | 612.8 | 612.5 | 0.11 | -0.16 | 0.17 | -0.13 | 0.15 | -0.10 |
| 12600.0 | 608.8 | 609.0 | 608.8 | 610.7 | 610.7 | 610.6 | 611.6 | 611.7 | 611.3 | 0.12 | -0.06 | -0.02 | -0.13 | 0.08 | -0.32 |
| 12590.0 | 608.4 | 608.5 | 608.3 | 610.0 | 610.1 | 610.0 | 611.1 | 611.1 | 610.9 | 0.06 | -0.16 | 0.04 | -0.04 | 0.04 | -0.19 |
| 12580.0 | 608.0 | 608.2 | 608.0 | 609.4 | 609.5 | 609.3 | 610.3 | 610.9 | 610.2 | 0.20 | 0.03 | 0.08 | -0.08 | 0.56 | -0.15 |
| 12570.0 | 607.6 | 607.7 | 607.6 | 609.3 | 609.4 | 609.4 | 610.5 | 610.5 | 610.4 | 0.11 | 0.03 | 0.10 | 0.04 | 0.00 | -0.07 |
| 12560.0 | 607.2 | 607.3 | 607.1 | 609.0 | 609.1 | 609.0 | 610.0 | 610.2 | 610.0 | 0.07 | -0.11 | 0.07 | -0.05 | 0.15 | -0.02 |
| 12550.0 | 606.9 | 606.9 | 606.8 | 607.7 | 607.7 | 607.7 | 609.8 | 609.9 | 609.7 | 0.05 | -0.05 | -0.01 | 0.01 | 0.06 | -0.08 |
| 12540.4 | 606.4 | 606.5 | 606.4 | 607.3 | 608.4 | 607.4 | 609.5 | 609.5 | 609.4 | 0.06 | -0.07 | 1.02 | 0.02 | 0.04 | -0.10 |
| 12530.9 | 606.0 | 606.1 | 606.0 | 607.9 | 608.0 | 607.0 | 609.0 | 609.0 | 609.0 | 0.06 | -0.07 | 0.04 | -0.96 | 0.04 | 0.03 |
| 12521.3 | 605.7 | 605.7 | 605.6 | 607.4 | 607.5 | 607.5 | 608.6 | 608.6 | 608.5 | 0.06 | -0.07 | 0.06 | 0.10 | 0.02 | -0.09 |
| 12511.7 | 605.3 | 605.3 | 605.2 | 607.0 | 607.0 | 606.9 | 608.2 | 608.2 | 608.2 | 0.07 | -0.07 | 0.01 | -0.14 | 0.05 | 0.09 |
| 12502.1 | 604.9 | 604.9 | 604.8 | 606.5 | 606.6 | 606.5 | 607.8 | 607.8 | 607.7 | 0.06 | -0.06 | 0.10 | 0.01 | -0.02 | -0.15 |
| 12492.5 | 604.5 | 604.5 | 604.5 | 606.2 | 606.3 | 606.1 | 607.3 | 607.3 | 607.2 | 0.03 | -0.03 | 0.12 | -0.09 | 0.09 | -0.06 |
| 12482.9 | 604.0 | 604.1 | 603.9 | 605.6 | 605.7 | 605.6 | 606.9 | 606.9 | 606.7 | 0.08 | -0.07 | 0.04 | -0.07 | -0.03 | -0.18 |
| 12473.3 | 603.7 | 603.8 | 603.6 | 605.4 | 605.4 | 604.9 | 606.6 | 606.7 | 605.9 | 0.05 | -0.07 | 0.09 | -0.45 | 0.12 | -0.69 |
| 12463.7 | 603.4 | 603.5 | 603.3 | 604.9 | 604.9 | 604.9 | 606.2 | 606.1 | 606.2 | 0.05 | -0.09 | 0.01 | 0.01 | -0.02 | 0.02 |
| 12411.9 | 601.4 | 601.5 | 601.3 | 603.2 | 603.3 | 603.1 | 603.9 | 604.3 | 603.7 | 0.10 | -0.07 | 0.10 | -0.11 | 0.48 | -0.12 |
| 12356.3 | 600.2 | 600.3 | 600.2 | 601.7 | 601.8 | 601.6 | 602.8 | 602.8 | 602.9 | 0.07 | -0.07 | 0.11 | -0.12 | -0.02 | 0.03 |
| 12301.3 | 598.0 | 598.0 | 598.0 | 599.7 | 599.7 | 599.7 | 600.7 | 600.8 | 600.6 | 0.00 | -0.01 | -0.02 | 0.01 | 0.11 | -0.10 |
| 12250.5 | 596.0 | 596.1 | 595.9 | 597.7 | 597.9 | 597.6 | 599.0 | 599.1 | 598.7 | 0.09 | -0.13 | 0.12 | -0.16 | 0.19 | -0.22 |
| 12225.1 | 594.8 | 594.9 | 594.8 | 596.8 | 596.8 | 596.8 | 598.3 | 598.2 | 598.4 | 0.04 | 0.00 | -0.01 | 0.00 | -0.06 | 0.08 |
| 12191.7 | 593.6 | 593.7 | 593.3 | 594.7 | 594.8 | 594.6 | 595.7 | 595.9 | 595.6 | 0.04 | -0.34 | 0.13 | -0.12 | 0.13 | -0.13 |
| 12142.0 | 592.0 | 592.1 | 592.0 | 593.5 | 593.5 | 593.6 | 594.6 | 594.6 | 594.5 | 0.14 | -0.03 | -0.07 | 0.03 | -0.05 | -0.18 |
| 12092.7 | 590.2 | 590.2 | 590.1 | 591.4 | 591.5 | 591.3 | 592.1 | 592.2 | 592.1 | -0.01 | -0.11 | 0.13 | -0.09 | 0.11 | -0.02 |
| 12033.9 | 587.2 | 587.3 | 587.1 | 589.3 | 589.5 | 588.4 | 589.7 | 589.9 | 589.4 | 0.15 | -0.07 | 0.14 | -0.92 | 0.12 | -0.32 |
| 11982.1 | 585.1 | 585.1 | 585.0 | 587.2 | 587.2 | 587.2 | 588.5 | 588.5 | 588.5 | 0.02 | -0.01 | 0.00 | 0.02 | 0.00 | 0.00 |
| 11932.5 | 582.4 | 582.6 | 582.2 | 583.7 | 583.8 | 583.6 | 584.6 | 584.5 | 584.7 | 0.19 | -0.19 | 0.09 | -0.09 | -0.10 | 0.12 |
| 11881.8 | 580.3 | 580.3 | 580.2 | 581.7 | 582.0 | 581.5 | 582.9 | 583.1 | 582.5 | 0.02 | -0.06 | 0.23 | -0.23 | 0.27 | -0.36 |
| 11827.8 | 576.2 | 576.3 | 576.1 | 577.8 | 579.0 | 577.7 | 578.8 | 580.2 | 578.8 | 0.14 | -0.10 | 1.16 | -0.08 | 1.42 | -0.06 |
| 11774.4 | 575.0 | 575.1 | 575.0 | 578.9 | 578.9 | 578.8 | 580.1 | 580.1 | 580.1 | 0.05 | -0.05 | 0.02 | -0.02 | 0.03 | -0.03 |
| 11724.3 | 574.8 | 574.8 | 574.8 | 578.8 | 578.8 | 578.8 | 580.1 | 580.1 | 580.0 | 0.02 | -0.02 | 0.01 | -0.01 | 0.00 | -0.02 |
| 11678.1 | 574.7 | 574.7 | 574.7 | 578.8 | 578.8 | 578.8 | 580.0 | 580.0 | 580.0 | 0.01 | -0.01 | 0.01 | -0.01 | 0.00 | -0.01 |
| 11668.6 | 574.7 | 574.7 | 574.7 | 578.8 | 578.8 | 578.8 | 580.0 | 580.0 | 580.0 | 0.01 | -0.01 | 0.01 | -0.01 | 0.00 | -0.01 |
| 11659.0 | 574.7 | 574.7 | 574.7 | 578.8 | 578.8 | 578.7 | 579.9 | 579.9 | 579.9 | 0.01 | -0.01 | 0.01 | -0.01 | 0.00 | -0.01 |
| 11649.4 | 574.6 | 574.7 | 574.6 | 578.7 | 578.7 | 578.7 | 579.9 | 579.9 | 579.9 | 0.01 | 0.00 | 0.00 | -0.01 | 0.00 | -0.01 |
| 11639.9 | 574.6 | 574.6 | 574.6 | 578.7 | 578.7 | 578.7 | 579.8 | 579.8 | 579.8 | 0.01 | 0.00 | 0.00 | -0.01 | 0.00 | -0.01 |
| 11630.3 | 574.6 | 574.6 | 574.6 | 578.7 | 578.7 | 578.7 | 579.8 | 579.8 | 579.8 | 0.00 | -0.01 | 0.00 | 0.00 | 0.00 | -0.01 |
| 11620.76 ** | 574.6 | 574.6 | 574.6 | 578.6 | 578.6 | 578.6 | 579.7 | 579.7 | 579.7 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | -0.02 |
| 11527.0 | 569.7 | 569.7 | 569.7 | 574.1 | 574.1 | 574.1 | 575.4 | 575.4 | 575.4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## TABLE T4. SENSITIVITY ANALYSIS: COMPARISONS OF WATER SURFACE ELEVATIONS FROM HEC-RAS BY RAISING AND LOWERING CHANNEL ROUGHNESS DESIGN VALUES BY 10%
## PERMANENTE CREEK RESTORATION PLAN

| | Water Surface Elevations | | | Water Surface Elevations | | | Water Surface Elevations | | | Differences between Sensitivity Trial and Design * | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEC-RAS | 1.5-YR Proposed Conditions | | | 10-YR Proposed Conditions | | | 100-YR Proposed Conditions | | | 1.5-YR Water Surface | | 10-YR Water Surface | | 100-YR Water Surface | |
| STATION | DESIGN | n + 10% | n - 10% | DESIGN | n + 10% | n - 10% | DESIGN | n + 10% | n - 10% | n + 10% | n - 10% | n + 10% | n - 10% | n + 10% | n - 10% |
| 11476.8 | 566.6 | 566.6 | 566.6 | 567.4 | 567.4 | 567.4 | 568.3 | 568.3 | 568.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11412.9 | 566.3 | 566.3 | 566.3 | 568.3 | 568.3 | 568.3 | 569.3 | 569.3 | 569.3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11362.7 | 566.3 | 566.3 | 566.3 | 568.3 | 568.3 | 568.3 | 569.5 | 569.5 | 569.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11318.1 | 566.3 | 566.3 | 566.3 | 568.3 | 568.3 | 568.3 | 569.5 | 569.5 | 569.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11287.2 | 565.8 | 565.8 | 565.8 | 568.0 | 568.0 | 568.0 | 569.0 | 569.0 | 569.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11211.2 | 561.0 | 561.0 | 561.0 | 565.8 | 565.8 | 565.8 | 566.5 | 566.5 | 566.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11200.0 | 557.7 | 557.7 | 557.7 | 559.0 | 559.0 | 559.0 | 560.2 | 560.2 | 560.2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11186.2 | 559.5 | 559.5 | 559.5 | 560.9 | 560.9 | 560.9 | 561.9 | 561.9 | 561.9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11137.9 | 559.5 | 559.5 | 559.5 | 560.9 | 560.9 | 560.9 | 561.8 | 561.8 | 561.8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11102.5 | 559.5 | 559.5 | 559.5 | 560.8 | 560.8 | 560.8 | 561.8 | 561.8 | 561.8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11070.7 | 559.5 | 559.5 | 559.5 | 560.7 | 560.7 | 560.7 | 561.7 | 561.7 | 561.7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10790.0 | 546.7 | 546.7 | 546.7 | 549.3 | 549.3 | 549.3 | 551.8 | 551.8 | 551.8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10739.3 | 545.1 | 545.1 | 545.1 | 548.3 | 548.3 | 548.3 | 550.6 | 550.6 | 550.6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10690.7 | 544.6 | 544.6 | 544.6 | 548.1 | 548.1 | 548.1 | 550.6 | 550.6 | 550.6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10644.3 | 544.3 | 544.3 | 544.3 | 548.0 | 548.0 | 548.0 | 550.6 | 550.6 | 550.6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10601.6 | 543.4 | 543.4 | 543.4 | 546.7 | 546.7 | 546.7 | 548.2 | 548.2 | 548.2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10485.2 | 542.8 | 542.8 | 542.8 | 545.9 | 545.9 | 545.9 | 546.9 | 546.9 | 546.9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10432.9 | 541.7 | 541.7 | 541.7 | 543.4 | 543.4 | 543.4 | 544.1 | 544.1 | 544.1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10382.9 | 541.3 | 541.3 | 541.3 | 542.7 | 542.7 | 542.7 | 543.7 | 543.7 | 543.7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10332.7 | 541.2 | 541.2 | 541.2 | 542.6 | 542.6 | 542.6 | 543.7 | 543.7 | 543.7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10295.4 | 541.1 | 541.1 | 541.1 | 542.5 | 542.5 | 542.5 | 543.6 | 543.6 | 543.6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10166.1 | 536.7 | 536.7 | 536.7 | 538.0 | 538.0 | 538.0 | 538.5 | 538.5 | 538.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10115.9 | 532.9 | 532.9 | 532.9 | 535.1 | 535.1 | 535.1 | 536.4 | 536.4 | 536.4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10065.8 | 532.1 | 532.1 | 532.1 | 534.0 | 534.0 | 534.0 | 534.7 | 534.7 | 534.7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10016.3 | 530.5 | 530.5 | 530.5 | 532.5 | 532.5 | 532.5 | 533.2 | 533.2 | 533.2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9966.5 | 528.5 | 528.5 | 528.5 | 531.1 | 531.1 | 531.1 | 531.9 | 531.9 | 531.9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9920.0 | 527.1 | 527.1 | 527.1 | 529.6 | 529.6 | 529.6 | 530.8 | 530.8 | 530.8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9869.7 | 525.4 | 525.4 | 525.4 | 528.1 | 528.1 | 528.1 | 529.5 | 529.5 | 529.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9819.5 | 524.3 | 524.3 | 524.3 | 527.0 | 527.0 | 527.0 | 528.0 | 528.0 | 528.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9769.3 | 523.0 | 523.0 | 523.0 | 525.7 | 525.7 | 525.7 | 527.5 | 527.5 | 527.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9739.1 | 522.3 | 522.3 | 522.3 | 525.1 | 525.1 | 525.1 | 526.9 | 526.9 | 526.9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**NOTES:**

* Some differences between the water surface elevations for the design model and the sensitivity models exceeded a magnitude (absolute value) of 0.3 feet at discreet locations, as shown in green. These fluctations in water surface elevations occur at single cross sections and are bracketed by fluctations that are typically well below 0.3 feet. The sensitivity models were not iterated and stabilized to remove these fluctuations, as the goal of the sensitiy analysis was to assess general and potential changes in water surface elevations from specific changes in channel roughness values. The spot variations are attributed to anamolies in model stability that would typically be resolved for design purposes.

** Mannings n was not revised downstream of Culvert #6 at station 11620.76, as proposed conditions in the channel do not extend beyond that point.

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# APPENDIX F

## Engineered Streambed Material, Floodplain Armor and Vegetated Rock Slope Protection Sizing Calculations

# Engineered Streambed Material (ESM) Calculations

Project: Permanente Quarry
Project #: 13-016
Date: 9/28/2018
Calculated by: BMZ
Checked by: B.M.S.

**Calculations to determine the gradation and thickness of ESM for constructed floodplains throughout project area.**

## 1. Inputs

| | Proposed Conditions Site Data (Culvert #7) | Proposed Conditions Site Data (Culvert #8) | Sediment Fan Tributary | Material Removal Area Tributary | Rock Pile 7.7% | Material Removal Area 12% |
|---|---|---|---|---|---|---|
| Design Flow* | 1087 cfs | 1009 cfs | 12.1 cfs | 16.2 cfs | 949 cfs | 683 cfs |
| Channel Width = | 20 ft | 26 ft | 6 ft | 7 ft | 18.5 ft | 16.3 ft |
| q = | 54.4 cu.ft./sec ft | 38.8 cu.ft./sec ft | 2.0 cu.ft./sec ft | 2.3 cu.ft./sec ft | 51.3 cu.ft./sec ft | 41.9 cu.ft./sec ft |
| gravity, g | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 |
| Slope, S | 0.039 ft/ft | 0.027 ft/ft | 0.249 ft/ft | 0.141 ft/ft | 0.077 ft/ft | 0.120 ft/ft |

***Portion of 100-year design flow that is being conveyed over the ESM.**

***Portion of 100-year design flow that is being conveyed**

## 2. Equations to Calculate D50 particle size

**2. Equations to Calculate D50 particle size**

| | Bathhurst (1987) | Bathhurst (1987) | Bathhurst (1987) | Bathhurst (1987) | Bathhurst (1987) | Bathhurst (1987) |
|---|---|---|---|---|---|---|
| developed for: | slope (0.23 to 9%)<br>particle dia. (0.35 to 11 inches) | slope (0.23 to 9%)<br>particle dia. (0.35 to 11 inches) | slope (0.23 to 9%)<br>particle dia. (0.35 to 11 inches) | slope (0.23 to 9%)<br>particle dia. (0.35 to 11 inches) | slope (0.23 to 9%)<br>particle dia. (0.35 to 11 inches) | slope (0.23 to 9%)<br>particle dia. (0.35 to 11 inches) |
| $D_{50}$ = | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 |
| $D_{50}$ = | 1.4 ft | 0.9 ft | 0.6 ft | 0.5 ft | 2.3 ft | 2.8 ft |

| | Robinson et al. (1998) | Robinson et al. (1998) | Robinson et al. (1998) | Robinson et al. (1998) | Robinson et al. (1998) | Robinson et al. (1998) |
|---|---|---|---|---|---|---|
| developed for: | slope (2% to 40%)<br>particle dia. (0.6 to 11 inches) | slope (2% to 40%)<br>particle dia. (0.6 to 11 inches) | slope (2% to 40%)<br>particle dia. (0.6 to 11 inches) | slope (2% to 40%)<br>particle dia. (0.6 to 11 inches) | slope (2% to 40%)<br>particle dia. (0.6 to 11 inches) | slope (2% to 40%)<br>particle dia. (0.6 to 11 inches) |
| $D_{50}$ = | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ |
| $q_{design}$ ($m^3$/s/m) = | 5.05 | 3.61 | 0.19 | 0.21 | 4.77 | 3.89 |
| $D_{50}$ (mm) = | 431 | 322 | 133 | 120 | 514 | 354 |
| $D_{50}$ = | 1.4 ft | 1.1 ft | 0.4 ft | 0.4 ft | 1.7 ft | 1.2 ft |

| | Abt and Johnson (1991) | Abt and Johnson (1991) | Abt and Johnson (1991) | Abt and Johnson (1991) | Abt and Johnson (1991) | Abt and Johnson (1991) |
|---|---|---|---|---|---|---|
| developed for: | slope (1% to 20%)<br>particle dia. (1 to 6 inches) | slope (1% to 20%)<br>particle dia. (1 to 6 inches) | slope (1% to 20%)<br>particle dia. (1 to 6 inches) | slope (1% to 20%)<br>particle dia. (1 to 6 inches) | slope (1% to 20%)<br>particle dia. (1 to 6 inches) | slope (1% to 20%)<br>particle dia. (1 to 6 inches) |
| $D_{50}$ = | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 |
| $q_{sizing}$ = | q * sizing factor | q * sizing factor | q * sizing factor | q * sizing factor | q * sizing factor | q * sizing factor |
| | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 |
| $D_{50}$ = | 1.2 ft | 0.8 ft | 0.4 ft | 0.4 ft | 1.6 ft | 1.7 ft |
| **Choose $D_{50}$ =** | 1.4 ft | 1.1 ft | 0.6 ft | 0.5 ft | 2.0 ft | 2.0 ft |

## 3. Develop Grain Size Distribution Utilizing the Calculated D50

### Washinton Department of Fish and Wildlife Grain Size Distribution (WDFW, 2003)

| | | | | | | |
|---|---|---|---|---|---|---|
| $D_{84}/D_{100}$ = | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| $D_{84}/D_{50}$ = | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| $D_{84}/D_{16}$ = | 8 | 8 | 8 | 8 | 8 | 8 |

| | WDFW Substrate Gradation | WDFW Substrate Gradation | WDFW Substrate Gradation | WDFW Substrate Gradation | WDFW Substrate Gradation | WDFW Substrate Gradation |
|---|---|---|---|---|---|---|
| $D_{100}$ = | 8.8 ft | 6.9 ft | 3.8 ft | 3.1 ft | 12.5 ft | 12.5 ft |
| $D_{84}$ = | 3.5 ft | 2.8 ft | 1.5 ft | 1.3 ft | 5.0 ft | 5.0 ft |
| $D_{50}$ = | 1.4 ft | 1.1 ft | 0.6 ft | 0.5 ft | 2.0 ft | 2.0 ft |
| $D_{16}$ = | 5.25 in | 4.13 in | 2.25 in | 1.88 in | 7.50 in | 7.50 in |

__Note__: WDFW gradation above is based on wide variety of stream beds in different environments. The $D_{84}/D_{100}$ ratio of 0.4 may give too large of boulder size in some cases. Experience and engineering judgment should be used to adjust distribution to the site. ACOE EM 1110-2-1601 suggests using $D_{100}$=2x$D_{50}$. If using ACOE steep slope methods to size substrate, then $D_{84}$ =1.5$D_{30}$ (WDFW, 2003). Choose the largest size of Stream Simulation Material to be equal to the $D_{84}$ calculated using the WDFW gradation. Note: the largest rock should not be greater in individual size than 1/4 of the active channel width.

### Resulting Floodplain Armor Gradation for Various Work Areas

| Size Class | Particle Diamter | Particle Diamter | Particle Diamter | Particle Diamter | Particle Diamter | Particle Diamter |
|---|---|---|---|---|---|---|
| $D_{100}$ = | 3.5 ft | 2.8 ft | 1.5 ft | 1.3 ft | 5.0 ft | 5.0 ft |
| $D_{84}$ = | 2.5 ft | 2.0 ft | 1.0 ft | 0.9 ft | 4.0 ft | 4.0 ft |
| $D_{50}$ = | 1.4 ft | 1.1 ft | 0.6 ft | 0.5 ft | 2.0 ft | 2.2 ft |
| $D_{16}$ = | 2.0 in | 2.0 in | 2.0 in | 2.0 in | 6.0 in | 4.0 in |
| $D_8$ = | 0.08 in | 0.08 in | 0.08 in | 0.08 in | 0.08 in | 0.08 in |
| | Note: Refer to Specifications for final size gradation | Note: Refer to Specifications for final size gradation | Note: Refer to Specifications for final size gradation | Note: Refer to Specifications for final size gradation | Note: Refer to Specifications for final size gradation | Note: Refer to Specifications for final size gradation |

### Justification

Choose largest size of Floodplain Armor to be equal to the $D_{84}$ calculated using the WDFW gradation.

## 4. ESM Thickness

Thickness greater or equal to max(1.5X$D_{50}$ or $D_{100}$) (ACOE EM 1110-2-1601)

## 5. References

1.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.
2.) Washington Department of Fish and Wildlife. 2003 Design of Road Culverts for Fish Passage
3.) U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control Channels, EM-1110-2-1601
4.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

# Floodplain Armor Calculations (Page 1 of 2)

Project: Permanente Quarry
Project #: 13-016
Date: 9/28/2018
Calculated by: BMZ
Checked by: B.M.S.

**Calculations to determine the gradation and thickness of Floodplain Armor for constructed floodplains throughout project area.**

## 1. Inputs

| | Channel Widening (Sta. 16+70 to 21+25) | Channel Widening (Sta. 21+25 to 23+00) | Channel Widening (Sta. 23+00 to 28+00) | Channel Widening (Sta. 30+75 to 31+75) | Channel Widening (Sta.31+75 to 40+50) |
|---|---|---|---|---|---|
| Design Flow* | 577 cfs | 174 cfs | 326.9 cfs | 381.3 cfs | 115.9 cfs |
| Channel Width = | 50 ft | 14 ft | 31.3 ft | 35 ft | 18.5 ft |
| q = | 11.5 cu.ft./sec ft | 12.4 cu.ft./sec ft | 10.4 cu.ft./sec ft | 10.9 cu.ft./sec ft | 6.3 cu.ft./sec ft |
| gravity, g | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 |
| Slope, S | 0.049 ft/ft | 0.035 ft/ft | 0.040 ft/ft | 0.081 ft/ft | 0.032 ft/ft |

***Portion of 100-year design flow that is being conveyed over the floodplain armor.**

## 2. Equations to Calculate D50 particle size

| | Bathhurst (1987) | Bathhurst (1987) | Bathhurst (1987) | Bathhurst (1987) | Bathhurst (1987) |
|---|---|---|---|---|---|
| developed for: | slope (0.23 to 9%) | slope (0.23 to 9%) | slope (0.23 to 9%) | slope (0.23 to 9%) | slope (0.23 to 9%) |
| | particle dia. (0.35 to 11 inches) | particle dia. (0.35 to 11 inches) | particle dia. (0.35 to 11 inches) | particle dia. (0.35 to 11 inches) | particle dia. (0.35 to 11 inches) |
| $D_{50}$ = | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 |
| $D_{50}$ = | 0.6 ft | 0.5 ft | 0.5 ft | 0.8 ft | 0.3 ft |

| | Robinson et al. (1998) | Robinson et al. (1998) | Robinson et al. (1998) | Robinson et al. (1998) | Robinson et al. (1998) |
|---|---|---|---|---|---|
| developed for: | slope (2% to 40%) | slope (2% to 40%) | slope (2% to 40%) | slope (2% to 40%) | slope (2% to 40%) |
| | particle dia. (0.6 to 11 inches) | particle dia. (0.6 to 11 inches) | particle dia. (0.6 to 11 inches) | particle dia. (0.6 to 11 inches) | particle dia. (0.6 to 11 inches) |
| $D_{50}$ = | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ |
| $q_{design}$ ($m^3/s/m$) = | 1.07 | 1.15 | 0.97 | 1.01 | 0.58 |
| $D_{50}$ (mm) = | 204 | 191 | 182 | 230 | 129 |
| $D_{50}$ = | 0.7 ft | 0.6 ft | 0.6 ft | 0.8 ft | 0.4 ft |

| | Abt and Johnson (1991) | Abt and Johnson (1991) | Abt and Johnson (1991) | Abt and Johnson (1991) | Abt and Johnson (1991) |
|---|---|---|---|---|---|
| developed for: | slope (1% to 20%) | slope (1% to 20%) | slope (1% to 20%) | slope (1% to 20%) | slope (1% to 20%) |
| | particle dia. (1 to 6 inches) | particle dia. (1 to 6 inches) | particle dia. (1 to 6 inches) | particle dia. (1 to 6 inches) | particle dia. (1 to 6 inches) |
| $D_{50}$ = | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 |
| | $q_{sizing}$ = q * sizing factor | $q_{sizing}$ = q * sizing factor | $q_{sizing}$ = q * sizing factor | $q_{sizing}$ = q * sizing factor | $q_{sizing}$ = q * sizing factor |
| | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 |
| $D_{50}$ = | 0.6 ft | 0.5 ft | 0.5 ft | 0.7 ft | 0.3 ft |
| **Choose $D_{50}$ =** | 0.6 ft | 0.6 ft | 0.6 ft | 0.8 ft | 0.4 ft |

## 3. Develop Grain Size Distribution Utilizing the Calculated $D_{50}$

### Washinton Department of Fish and Wildlife Grain Size Distribution (WDFW, 2003)

| | | | | | |
|---|---|---|---|---|---|
| $D_{84}/D_{100}$ = | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| $D_{84}/D_{50}$ = | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| $D_{84}/D_{16}$ = | 8 | 8 | 8 | 8 | 8 |

| | WDFW Substrate Gradation | WDFW Substrate Gradation | WDFW Substrate Gradation | WDFW Substrate Gradation | WDFW Substrate Gradation |
|---|---|---|---|---|---|
| $D_{100}$ = | 3.8 ft | 3.8 ft | 3.8 ft | 5.0 ft | 2.5 ft |
| $D_{84}$ = | 1.5 ft | 1.5 ft | 1.5 ft | 2.0 ft | 1.0 ft |
| $D_{50}$ = | 0.6 ft | 0.6 ft | 0.6 ft | 0.8 ft | 0.4 ft |
| $D_{16}$ = | 2.25 in | 2.25 in | 2.25 in | 3.00 in | 1.50 in |

**Note**: WDFW gradation above is based on wide variety of stream beds in different environments. The $D_{84}/D_{100}$ ratio of 0.4 may give too large of boulder size in some cases. Experience and engineering judgment should be used to adjust distribution to the site. ACOE EM 1110-2-1601 suggests using $D_{100}=2xD_{50}$. If using ACOE steep slope methods to size substrate, then $D_{84} = 1.5D_{30}$ (WDFW, 2003). Choose the largest size of Stream Simulation Material to be equal to the $D_{84}$ calculated using the WDFW gradation. Note: the largest rock should not be greater in individual size than 1/4 of the active channel width.

### Resulting Floodplain Armor Gradation for Various Work Areas

| Size Class | Particle Diamter |
|---|---|
| $D_{100}$ = | 1.5 ft |
| $D_{84}$ = | 1.0 ft |
| $D_{50}$ = | 0.6 ft |
| $D_{16}$ = | 2.0 in |
| $D_{8}$ = | 0.08 in |

Note: Refer to Specifications for final size gradation

| Size Class | Particle Diamter |
|---|---|
| $D_{100}$ = | 1.5 ft |
| $D_{84}$ = | 1.0 ft |
| $D_{50}$ = | 0.6 ft |
| $D_{16}$ = | 2.0 in |
| $D_{8}$ = | 0.08 in |

Note: Refer to Specifications for final size gradation

| Size Class | Particle Diamter |
|---|---|
| $D_{100}$ = | 1.5 ft |
| $D_{84}$ = | 1.0 ft |
| $D_{50}$ = | 0.6 ft |
| $D_{16}$ = | 2.0 in |
| $D_{8}$ = | 0.08 in |

Note: Refer to Specifications for final size gradation

| Size Class | Particle Diamter |
|---|---|
| $D_{100}$ = | 2.0 ft |
| $D_{84}$ = | 1.3 ft |
| $D_{50}$ = | 0.8 ft |
| $D_{16}$ = | 2.0 in |
| $D_{8}$ = | 0.08 in |

Note: Refer to Specifications for final size gradation

| Size Class | Particle Diamter |
|---|---|
| $D_{100}$ = | 1.0 ft |
| $D_{84}$ = | 0.8 ft |
| $D_{50}$ = | 0.4 ft |
| $D_{16}$ = | 2.0 in |
| $D_{8}$ = | 0.08 in |

Note: Refer to Specifications for final size gradation

### Justification

Choose largest size of Floodplain Armor to be equal to the $D_{84}$ calculated using the WDFW gradation.

## 4. Floodplain Armor Thickness

Thickness greater or equal to max($1.5XD_{50}$ or $D_{100}$) (ACOE EM 1110-2-1601)

## 5. References

1.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.
2.) Washington Department of Fish and Wildlife. 2003 Design of Road Culverts for Fish Passage
3.) U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control Channels, EM-1110-2-1601
4.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

# Floodplain Armor Calculations (Page 2 of 2)

Project: Permanente Quarry
Project #: 13-016
Date: 9/28/2018
Calculated by: BMZ
Checked by: B.M.S.

**Calculations to determine the gradation and thickness of Floodplain Armor for constructed floodplains throughout project area.**

## 1. Inputs

| | Channel Widening (Sta. 40+50 to 45+00) | Channel Widening (Sta. 40+50 to 45+00) | Channel Widening (Sta. 45+00 to 48+75) | Rock Pile |
|---|---|---|---|---|
| Design Flow* | 159 cfs | 433 cfs | 449 cfs | 1145 cfs |
| Channel Width = | 8 ft | 14 ft | 60 ft | 22 ft |
| q = | 19.9 cu.ft./sec ft | 30.9 cu.ft./sec ft | 7.5 cu.ft./sec ft | 52.0 cu.ft./sec ft |
| gravity, g | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 | 32.2 ft/sec^2 |
| Slope, S | 0.057 ft/ft | 0.057 ft/ft | 0.054 ft/ft | 0.12 ft/ft |

***Portion of 100-year design flow that is being conveyed over the floodplain armor.**

## 2. Equations to Calculate D50 particle size

**Bathhurst (1987)**

| | | | | |
|---|---|---|---|---|
| developed for: | slope (0.23 to 9%) | slope (0.23 to 9%) | slope (0.23 to 9%) | slope (0.23 to 9%) |
| | particle dia. (0.35 to 11 inches) | particle dia. (0.35 to 11 inches) | particle dia. (0.35 to 11 inches) | particle dia. (0.35 to 11 inches) |
| $D_{50}$ = | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 | 3.56 q^2/3 S^.75 / g^1/3 |
| $D_{50}$ = | 1.0 ft | 1.3 ft | 0.5 ft | 3.2 ft |

**Robinson et al. (1998)**

| | | | | |
|---|---|---|---|---|
| developed for: | slope (2% to 40%) | slope (2% to 40%) | slope (2% to 40%) | slope (2% to 40%) |
| | particle dia. (0.6 to 11 inches) | particle dia. (0.6 to 11 inches) | particle dia. (0.6 to 11 inches) | particle dia. (0.6 to 11 inches) |
| $D_{50}$ = | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ | $[q_{design} / (8.07 \times 10^{-6} S^{-0.58})]^{0.529}$ |
| $q_{design}$ ($m^3$/s/m) = | 1.85 | 2.87 | 0.70 | 4.84 |
| $D_{50}$ (mm) = | 238 | 359 | 170 | 473 |
| $D_{50}$ = | 0.8 ft | 1.2 ft | 0.6 ft | 1.6 ft |

**Abt and Johnson (1991)**

| | | | | |
|---|---|---|---|---|
| developed for: | slope (1% to 20%) | slope (1% to 20%) | slope (1% to 20%) | slope (1% to 20%) |
| | particle dia. (1 to 6 inches) | particle dia. (1 to 6 inches) | particle dia. (1 to 6 inches) | particle dia. (1 to 6 inches) |
| $D_{50}$ = | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 | 0.436 $q_{sizing}$^0.56 S^0.43 |
| $q_{sizing}$ = | q * sizing factor | q * sizing factor | q * sizing factor | q * sizing factor |
| | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 | sizing factor = 1.35 |
| $D_{50}$ = | 0.8 ft | 1.0 ft | 0.5 ft | 1.9 ft |
| **Choose $D_{50}$ =** | 1.0 ft | 1.3 ft | 0.6 ft | 1.9 ft |

## 3. Develop Grain Size Distribution Utilizing the Calculated D50

**Washinton Department of Fish and Wildlife Grain Size Distribution** (WDFW, 2003)

| | | | | |
|---|---|---|---|---|
| $D_{84}/D_{100}$ = | 0.4 | 0.4 | 0.4 | 0.4 |
| $D_{84}/D_{50}$ = | 2.5 | 2.5 | 2.5 | 2.5 |
| $D_{84}/D_{16}$ = | 8 | 8 | 8 | 8 |

**WDFW Substrate Gradation**

| | | | | |
|---|---|---|---|---|
| $D_{100}$ = | 6.3 ft | 8.1 ft | 3.8 ft | 11.9 ft |
| $D_{84}$ = | 2.5 ft | 3.3 ft | 1.5 ft | 4.8 ft |
| $D_{50}$ = | 1.0 ft | 1.3 ft | 0.6 ft | 1.9 ft |
| $D_{16}$ = | 3.75 in | 4.88 in | 2.25 in | 7.13 in |

**Note**: WDFW gradation above is based on wide variety of stream beds in different environments. The $D_{84}/D_{100}$ ratio of 0.4 may give too large of boulder size in some cases. Experience and engineering judgment should be used to adjust distribution to the site. ACOE EM 1110-2-1601 suggests using $D_{100}=2xD_{50}$. If using ACOE steep slope methods to size substrate, then $D_{84}$ =1.5$D_{30}$ (WDFW, 2003). Choose the largest size of Stream Simulation Material to be equal to the $D_{84}$ calculated using the WDFW gradation. Note: the largest rock should not be greater in individual size than 1/4 of the active channel width.

**Resulting Floodplain Armor Gradation for Various Work Areas**

| Size Class | Particle Diamter | Particle Diamter | Particle Diamter | Particle Diamter |
|---|---|---|---|---|
| $D_{100}$ = | 2.5 ft | 3.3 ft | 1.5 ft | 5.0 ft |
| $D_{84}$ = | 2.0 ft | 2.5 ft | 1.0 ft | 4.0 ft |
| $D_{50}$ = | 1.0 ft | 1.3 ft | 0.6 ft | 2.0 ft |
| $D_{16}$ = | 4.0 in | 4.0 in | 2.0 in | 6.0 in |
| $D_8$ = | 0.08 in | 0.08 in | 0.08 in | 0.08 in |

Note: Refer to Specifications for final size gradation | Note: Refer to Specifications for final size gradation | Note: Refer to Specifications for final size gradation | Note: Refer to Specifications for final size gradation

### Justification

Choose largest size of Floodplain Armor to be equal to the $D_{84}$ calculated using the WDFW gradation.

## 4. Floodplain Armor Thickness

Thickness greater or equal to max(1.5X$D_{50}$ or $D_{100}$) (ACOE EM 1110-2-1601)

## 5. References

1.) U.S. Department of the Interior Bureau of Reclamation. 2007. Rock Ramp Design Guidelines.
2.) Washington Department of Fish and Wildlife. 2003 Design of Road Culverts for Fish Passage
3.) U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control Channels, EM-1110-2-1601
4.) California Department of Fish and Game (CDFG). 2009. Fish Passage Design and Implementation: Part XII of the California Salmonid Stream Habitat Restoration Manual. Sacramento, CA, CA Department of Fish and Game.

# Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/15/2019
Calculated by: DR
Checked by: BMZ

## Caltrans RSP Design at Culvert #6

FHWC-CA-TL-95-10

$$W_{min} = \frac{0.00002\ (V_{av}.V_f)^6\ SG}{(SG-1)^3\ SIN^3(r-a)}$$ (Eq. 1, 5-1-C)

| Parameter | Value | Units | Data type | Description |
|---|---|---|---|---|
| **Flow** | 1276 | cfs | | 100-year Design Flow |
| **RS u/s** | 116+20.76 | ft | (enter) | River Station |
| **$V_{av}$** | **4.53** | fps | (enter) | Average channel velocity at Section A |
| **SG** | 2.5 | - | (constant) | Min. Specific Gravity (Caltrans 72-2.02) |
| **r** | 70 | - | (constant) | Constant for randomly placed rubble. |
| **a** | 45.00 | degrees | (enter) | Outside slope face angle (26.6 for 2H:1V) |
| **sin(r-a)** | 0.42 | - | (result) | |
| **Vf** | 1.33 | - | (enter) | Velocity Factor (.67 for parallel and 1.33 for impinging) |
| **$V_{ss}$** | 6.02 | fps | (result) | Factored velocity ($V_{av}$ x $V_f$) |
| **$W_{min}$** | **9** | lbs | (result) | Theoretical Min. Rock Mass that remains stable |
| **RSP-Class** | 0.50 | ton | (enter) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **RSP-Class** | 1000 | lbs | (result) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **$D_{min}$** | 0.48 | ft | (result) | Min. Rock Dia. based on a sphere, 165 pcf. |
| **$D_{50}$** | 2.26 | ft | (result) | Diameter of STANDARD (50-100%) rock size, 165 pcf. |
| **$t_A$** | 3.39 | ft | (result) | Thickness for Type A placement, t = 1.5 $D_{50}$ |
| **$t_B$** | 4.24 | ft | (result) | Thickness for Type B placement, t = 1.875 $D_{50}$ |

**Notes:**

Results are for HEC Sta. 116+20.76
Design velocity is low, resulting in small rock size.

Use 1/2 ton RSP for construction efficiency (1/2 ton RSP is specified for the Culvert #7 removal area). The 1/2 ton RSP will also allow for stacking of rock to conform the proposed floodplain bench to the existing oversteepened bank at the Culvert #6 inlet. The larger rock size will also help ensure stability if debris collects near the culvert inlet and creates complex hydraulic conditions that result in eddy formation or other hydraulic forces that are not easy to predict and have the potential to be erosive.

Use Method A - individually place rocks.

# Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/15/2019
Calculated by: DR
Checked by: BMZ

## Caltrans RSP Design at Culvert #7

FHWC-CA-TL-95-10

$$W_{min} = \frac{0.00002\ (V_{av}.V_f)^6\ SG}{(SG-1)^3\ \ SIN^3(r-a)}$$ (Eq. 1, 5-1-C)

| Parameter | Value | Units | Data type | Description |
|---|---|---|---|---|
| **Flow** | 1276 | cfs | | 100-year Design Flow |
| **RS u/s** | 121+91 | ft | (enter) | River Station |
| **$V_{av}$** | **14.61** | fps | (enter) | Average channel velocity at Section A |
| **SG** | 2.5 | - | (constant) | Min. Specific Gravity (Caltrans 72-2.02) |
| **r** | 70 | - | (constant) | Constant for randomly placed rubble. |
| **a** | 45.00 | degrees | (enter) | Outside slope face angle (26.6 for 2H:1V) |
| **sin(r-a)** | 0.42 | - | (result) | |
| **Vf** | 0.9 | - | (enter) | Velocity Factor (.67 for parallel and 1.33 for impinging) |
| **$V_{ss}$** | 1.20 | fps | (result) | Factored velocity ($V_{av}$ x $V_f$) |
| **$W_{min}$** | **949** | lbs | (result) | Theoretical Min. Rock Mass that remains stable |
| **RSP-Class** | 0.50 | ton | (enter) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **RSP-Class** | 1000 | lbs | (result) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **$D_{min}$** | 2.22 | ft | (result) | Min. Rock Dia. based on a sphere, 165 pcf. |
| **$D_{50}$** | 2.26 | ft | (result) | Diameter of STANDARD (50-100%) rock size, 165 pcf. |
| **$t_A$** | 3.39 | ft | (result) | Thickness for Type A placement, t = 1.5 $D_{50}$ |
| **$t_B$** | 4.24 | ft | (result) | Thickness for Type B placement, t = 1.875 $D_{50}$ |

**Notes:**
Results are for HEC Sta. 122+25
Use Method A - individually place rocks
Use 1/2 Ton RSP

# Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/25/2019
Calculated by: BMZ
Checked by: BMS

## Caltrans RSP Design at Culvert #9

FHWC-CA-TL-95-10

$$W_{min} = \frac{0.00002\ (V_{av} \cdot V_f)^6\ SG}{(SG-1)^3\ SIN^3(r-a)}$$ (Eq. 1, 5-1-C)

| Parameter | Value | Units | Data type | Description |
|---|---|---|---|---|
| **Flow** | 1276 | cfs | | 100-year Design Flow |
| **RS u/s** | 143+50 | ft | (enter) | River Station |
| **$V_{av}$** | **18.24** | fps | (enter) | Average channel velocity at Section A |
| **SG** | 2.5 | - | (constant) | Min. Specific Gravity (Caltrans 72-2.02) |
| **r** | 70 | - | (constant) | Constant for randomly placed rubble. |
| **a** | 45.00 | degrees | (enter) | Outside slope face angle (26.6 for 2H:1V) |
| **sin(r-a)** | 0.42 | - | (result) | |
| **Vf** | 0.9 | - | (enter) | Velocity Factor (.67 for parallel and 1.33 for impinging) |
| **$V_{ss}$** | 16.42 | fps | (result) | Factored velocity ($V_{av}$ x $V_f$) |
| **$W_{min}$** | **3841** | lbs | (result) | Theoretical Min. Rock Mass that remains stable |
| **RSP-Class** | 2.00 | ton | (enter) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **RSP-Class** | 4000 | lbs | (result) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **$D_{min}$** | 3.54 | ft | (result) | Min. Rock Dia. based on a sphere, 165 pcf. |
| **$D_{50}$** | 3.59 | ft | (result) | Diameter of STANDARD (50-100%) rock size, 165 pcf. |
| **$t_A$** | 5.39 | ft | (result) | Thickness for Type A placement, t = 1.5 $D_{50}$ |
| **$t_B$** | 6.73 | ft | (result) | Thickness for Type B placement, t = 1.875 $D_{50}$ |

**Notes:**
Results are for HEC Sta. 122+25
Use Method A - individually place rocks
Use 2 Ton RSP

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# RSP Sizing Sensitivity Analysis

# Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/25/2019
Calculated by: BMZ
Checked by: BMS

## Caltrans RSP Design at Culvert #7

FHWC-CA-TL-95-10

(The velocity is from the hydraulic modeling sensitivity analysis where Manning's n was increased by 10%)

$$W_{min} = \frac{0.00002\ (V_{av}.V_f)^6\ SG}{(SG-1)^3\ \text{SIN}^3(r-a)}$$ (Eq. 1, 5-1-C)

| Parameter | Value | Units | Data type | Description |
|---|---|---|---|---|
| **Flow** | 1276 | cfs | | 100-year Design Flow |
| **RS u/s** | 121+91 | ft | (enter) | River Station |
| **$V_{av}$** | **13.90** | fps | (enter) | Average channel velocity at Section A |
| **SG** | 2.5 | - | (constant) | Min. Specific Gravity (Caltrans 72-2.02) |
| **r** | 70 | - | (constant) | Constant for randomly placed rubble. |
| **a** | 45.00 | degrees | (enter) | Outside slope face angle (26.6 for 2H:1V) |
| **sin(r-a)** | 0.42 | - | (result) | |
| **Vf** | 0.9 | - | (enter) | Velocity Factor (.67 for parallel and 1.33 for impinging) |
| **$V_{ss}$** | 1.20 | fps | (result) | Factored velocity ($V_{av}$ x $V_f$) |
| **$W_{min}$** | **704** | lbs | (result) | Theoretical Min. Rock Mass that remains stable |
| **RSP-Class** | 0.50 | ton | (enter) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **RSP-Class** | 1000 | lbs | (result) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **$D_{min}$** | 2.01 | ft | (result) | Min. Rock Dia. based on a sphere, 165 pcf. |
| **$D_{50}$** | 2.26 | ft | (result) | Diameter of STANDARD (50-100%) rock size, 165 pcf. |
| **$t_A$** | 3.39 | ft | (result) | Thickness for Type A placement, t = 1.5 $D_{50}$ |
| **$t_B$** | 4.24 | ft | (result) | Thickness for Type B placement, t = 1.875 $D_{50}$ |

**Notes:**
Results are for HEC Sta. 122+25
Use Method A - individually place rocks
Use 1/2 Ton RSP

# Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/25/2019
Calculated by: BMZ
Checked by: BMS

## Caltrans RSP Design at Culvert #7

FHWC-CA-TL-95-10

(The velocity is from the hydraulic modeling sensitivity analysis where Manning's n was decreased by 10%)

$$W_{min} = \frac{0.00002\ (V_{av}.V_f)^6\ SG}{(SG-1)^3\ \ SIN^3(r-a)} \quad \text{(Eq. 1, 5-1-C)}$$

| Parameter | Value | Units | Data type | Description |
|---|---|---|---|---|
| **Flow** | 1276 | cfs | | 100-year Design Flow |
| **RS u/s** | 121+91 | ft | (enter) | River Station |
| **$V_{av}$** | **15.34** | fps | (enter) | Average channel velocity at Section A |
| **SG** | 2.5 | - | (constant) | Min. Specific Gravity (Caltrans 72-2.02) |
| **r** | 70 | - | (constant) | Constant for randomly placed rubble. |
| **a** | 45.00 | degrees | (enter) | Outside slope face angle (26.6 for 2H:1V) |
| **sin(r-a)** | 0.42 | - | (result) | |
| **Vf** | 0.9 | - | (enter) | Velocity Factor (.67 for parallel and 1.33 for impinging) |
| **$V_{ss}$** | 1.20 | fps | (result) | Factored velocity ($V_{av}$ x $V_f$) |
| **$W_{min}$** | **1188** | lbs | (result) | Theoretical Min. Rock Mass that remains stable |
| **RSP-Class** | 0.50 | ton | (enter) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **RSP-Class** | 1000 | lbs | (result) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **$D_{min}$** | 2.40 | ft | (result) | Min. Rock Dia. based on a sphere, 165 pcf. |
| **$D_{50}$** | 2.26 | ft | (result) | Diameter of STANDARD (50-100%) rock size, 165 pcf. |
| **$t_A$** | 3.39 | ft | (result) | Thickness for Type A placement, t = 1.5 $D_{50}$ |
| **$t_B$** | 4.24 | ft | (result) | Thickness for Type B placement, t = 1.875 $D_{50}$ |

**Notes:**
Results are for HEC Sta. 122+25
Use Method A - individually place rocks
Use 1/2 Ton RSP

# Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/25/2019
Calculated by: BMZ
Checked by: BMS

## Caltrans RSP Design at Culvert #9

FHWC-CA-TL-95-10

(The velocity is from the hydraulic modeling sensitivity analysis where Manning's n was increased by 10%)

$$W_{min} = \frac{0.00002\ (V_{av}.V_f)^6\ SG}{(SG-1)^3\ \ SIN^3(r-a)} \quad \text{(Eq. 1, 5-1-C)}$$

| Parameter | Value | Units | Data type | Description |
|---|---|---|---|---|
| **Flow** | 1276 | cfs | | 100-year Design Flow |
| **RS u/s** | 143+50 | ft | (enter) | River Station |
| **$V_{av}$** | **17.88** | fps | (enter) | Average channel velocity at Section A |
| **SG** | 2.5 | - | (constant) | Min. Specific Gravity (Caltrans 72-2.02) |
| **r** | 70 | - | (constant) | Constant for randomly placed rubble. |
| **a** | 45.00 | degrees | (enter) | Outside slope face angle (26.6 for 2H:1V) |
| **sin(r-a)** | 0.42 | - | (result) | |
| **Vf** | 0.9 | - | (enter) | Velocity Factor (.67 for parallel and 1.33 for impinging) |
| **$V_{ss}$** | 16.09 | fps | (result) | Factored velocity ($V_{av}$ x $V_f$) |
| **$W_{min}$** | **3408** | lbs | (result) | Theoretical Min. Rock Mass that remains stable |
| **RSP-Class** | 2.00 | ton | (enter) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **RSP-Class** | 4000 | lbs | (result) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **$D_{min}$** | 3.40 | ft | (result) | Min. Rock Dia. based on a sphere, 165 pcf. |
| **$D_{50}$** | 3.59 | ft | (result) | Diameter of STANDARD (50-100%) rock size, 165 pcf. |
| **$t_A$** | 5.39 | ft | (result) | Thickness for Type A placement, t = 1.5 $D_{50}$ |
| **$t_B$** | 6.73 | ft | (result) | Thickness for Type B placement, t = 1.875 $D_{50}$ |

**Notes:**
Results are for HEC Sta. 122+25
Use Method A - individually place rocks
Use 2 Ton RSP

# Rock Slope Protection Calculations

Project: Permanente Creek
Project #: 13-016
Date: 10/25/2019
Calculated by: BMZ
Checked by: BMS

## Caltrans RSP Design at Culvert #9

FHWC-CA-TL-95-10

(The velocity is from the hydraulic modeling sensitivity analysis where Manning's n was decreased by 10%)

$$W_{min} = \frac{0.00002\ (V_{av} \cdot V_f)^6\ SG}{(SG-1)^3\ \ SIN^3(r-a)}$$ (Eq. 1, 5-1-C)

| Parameter | Value | Units | Data type | Description |
|---|---|---|---|---|
| **Flow** | 1276 | cfs | | 100-year Design Flow |
| **RS u/s** | 143+50 | ft | (enter) | River Station |
| **$V_{av}$** | **18.57** | fps | (enter) | Average channel velocity at Section A |
| **SG** | 2.5 | - | (constant) | Min. Specific Gravity (Caltrans 72-2.02) |
| **r** | 70 | - | (constant) | Constant for randomly placed rubble. |
| **a** | 45.00 | degrees | (enter) | Outside slope face angle (26.6 for 2H:1V) |
| **sin(r-a)** | 0.42 | - | (result) | |
| **Vf** | 0.9 | - | (enter) | Velocity Factor (.67 for parallel and 1.33 for impinging) |
| **$V_{ss}$** | 16.53 | fps | (result) | Factored velocity ($V_{av}$ x $V_f$) |
| **$W_{min}$** | **4000** | lbs | (result) | Theoretical Min. Rock Mass that remains stable |
| **RSP-Class** | 2.00 | ton | (enter) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **RSP-Class** | 4000 | lbs | (result) | STANDARD Rock Size greater than $W_{min}$ (T 5-1) |
| **$D_{min}$** | 3.59 | ft | (result) | Min. Rock Dia. based on a sphere, 165 pcf. |
| **$D_{50}$** | 3.59 | ft | (result) | Diameter of STANDARD (50-100%) rock size, 165 pcf. |
| **$t_A$** | 5.39 | ft | (result) | Thickness for Type A placement, t = 1.5 $D_{50}$ |
| **$t_B$** | 6.73 | ft | (result) | Thickness for Type B placement, t = 1.875 $D_{50}$ |

**Notes:**
Results are for HEC Sta. 122+25
Use Method A - individually place rocks
Use 2 Ton RSP

# APPENDIX G

## Floodplain Log Ballast Calculations

**Wood and Ballast Calculations for Floodplain logs at Permanente Creek**

**Project:** Permanente Creek Restoration Project
**Project #:** 13-016
**Date:** 10/25/18
**Calculated by:** B.M.S.
**Checked by:** B.M.Z.

**Note: adjust values in red cells.**

Alder/willow average dry density = 28 lbs/cuft

**Ballast Estimate**
Density of water = 62.4 lbs/cuft

**Ballast in one cubic foot Small Cobble:**

Average Dry Unit Weigh Cobble = 142.6 lbs/cuft
Ballast provided by one cubic foot of Cobble = 80.20 lbs/cuft

**Log Dimensions**
Diameter 1.5 ft average diameter along length of log

Bouyant Force on Log = 60.8 lbs/ft

**Ballast of Cobble Over Log per Linear Foot**
Width of trench = 1.5 Width of trench equal to diameter of log
Burial Depth (i.e. trench depth) = 1.5 Adjust burial depth as needed to calculate acceptible factor of safety

Ballast of rock in trench = 180.45 lbs/ft ballast force per linear foot of trench

**Assume:**
50% of log is burried by rock ballast to a minimum depth of 1.5 ft

Then

Weight of rock ballast per linear foot of trench = 180.45 lbs/ft

Unit weight of ballast per linear foot over entire log assuming 50% of log buried below ballast = 90.225 lbs/ft ballast force per foot of burried log

Factor of Safety = 1.5 for a 1.5 ft. diameter log

Note: Smaller diameter logs would have a greater factor of safety, larger diameter logs would have a smaller Fs for the specified burial depth.
Adjust calculations as required during construction to conform to available log sizes and species.

**Calculations are conservative because they do not account for:**
Friction forces of soil/ballast material on log that result pullout
Additional ballast weight from cone of influence of material outside of trench width

**Log Structure Ballast Calculations**
**Project: Permanente Creek Restoration Project**
**Project #: 13-016**
**Date: 10/15/19**
**Calculated by: BMZ**

## Anchor Mass Solver: Log Revetment Structure

**Reference: D'Aoust and Millar, 2000. Stability of ballasted woody debris habitat structures.**

### Input Variables

| | | |
|---|---|---|
| Design Velocity (V) | **4.5** | m/s |
| Target $FS_B$ | **1.50** | |
| Number of anchor boulders | **4** | X |

**Solution**

**1.22** m boulder(s)
for a total mass of
**9,980** kg

| **Summary of LWD & $F_{BL}$** | LWD | | | Ballast Factor | Buoyancy Force ($F_{BL}$) Equation (3-1) (N) |
|---|---|---|---|---|---|
| | Length (m) | Diam.(m) | Number | | |
| LWD No. 1 (25 foot cross logs) | **7.6** | **0.6** | **2** | **2** | 27,511 |
| LWD No. 2 (25 foot cross logs) | | | | | 0 |
| LWD No. 3 (20 foot cell logs) | | | | | 0 |
| LWD No. 4 (10 foot back piles) | | | | | 0 |
| LWD No. 5 (15 foot back piles) | | | | | 0 |
| LWD No. 6 | | | | | |
| | Length | RW Diam. | Butt Diam. | Number | |
| Root Wad No.1 | **1.2** | **1.8** | **0.9** | **1** | 5,282 |
| Root Wad No.2 | | | | | |
| **Total Buoyant Force** | | | | | **32,793** |

| | | | |
|---|---|---|---|
| Vertical Lift Force on Boulders ($F_{LB}$) | 7,832 | N | Equation (3-4) |
| Immersed Weight of Boulders (W') | 60,955 | N | Equation (3-5) |
| **Computed Mass of Boulders** | **9,979** | kg | |
| **Computed Factors of Safety (FS)** | **1.50** | | Equation (3-9) |

### Summary (English untis)

| | | |
|---|---|---|
| Total Buoyant Force | 7,378 | lbf |
| Vertical Lift Force on Boulders ($F_{LB}$) | 1,762 | lbf |
| Immersed Weight of Boulders (W') | 13,715 | lbf |
| **Computed Mass of Boulders** | **21,954** | lbs |
| **Number of 4' dia. Boulders** | **4.0** | |

### Adjusted for Backfill Ballast

| | | |
|---|---|---|
| Volume of Backfill Ballast* | 45 | cu.ft. |
| Immersed Weight of 1 cu. Ft. gravel | 61.56 | lbs |
| Immersed Weight of Backfill Ballast | 2,770 | lbs |
| Actual Weight of Ballast | 4,454 | lbs |
| | | |
| **Adjusted Mass of Boulders Required*** | **17,501** | lbs |
| **Number of 4' dia. Boulders** | **3.2** | |

### Design Assumptions:

Log structures to be installed at the Culvert #7 and #8 removal areas.

The design velocity is the maximum Q100 velocity from the proposed conditions HEC-RAS model occuring at the Culvert #7 removal area.

Log structures to be ballasted with four 2.5 ton (5,000 lb) boulders and backfill to resist buoyont forces.

# APPENDIX H

## Golder Associates 2019

## Geologic and Geomorphic Assessment of Permanente Creek

# TECHNICAL MEMORANDUM

**DATE** October 31, 2019 **Project No.** 179018601

**TO** Erika Guerra, Talia Flagan
Lehigh Permanente

**CC** Brent Zacharia, Waterways Consulting, Inc.

**FROM** Robert Humphries; William Fowler, PG 4401, CEG 1401 **EMAIL bfowler@golder.com**

**GEOLOGIC AND GEOMORPHIC ASSESSMENT OF PERMANENTE CREEK, LEHIGH HANSON PERMANENTE QUARRY, SANTA CLARA COUNTY, CA**

## 1.0 INTRODUCTION

This technical memorandum provides the results of our geologic and geomorphic assessment of the Permanente Creek Restoration Plan – 90% Level Submittal, Waterways Consulting, Inc., dated 11/15/18 and updated 10/31/19 (the Project). The focus of the study was to determine if there were any specific areas of the proposed project which require further subsurface geotechnical exploration and testing to refine the project restoration design, so as to respond to comments dated February 14, 2019 from the County of Santa Clara Planning Office ("County"). Specifically, this work focused on a field assessment of the proposed alignment and longitudinal gradient of the proposed stream channel and how it compares to existing conditions. Particular attention was placed on the Rock Pile and Material Removal Area and the proposed depth of excavations required and stability of the adjacent creek sideslopes.

The scope of work for our study included a desktop data review, and site reconnaissance and mapping of the project area to evaluate the geologic conditions in conjunction with the proposed restoration design. The work product from our investigation includes a geologic map and cross sections of the project area, along with this technical memorandum. This memorandum includes:

- A brief presentation of the methods applied in this assessment
- A summary of pertinent supporting data from our previous investigations throughout the facility
- A geologic map and a description of the earth materials encountered along Permanente Creek
- A geologic and geomorphic assessment of the Permanente Creek channel profile
- A discussion of these results and their significance to the proposed Permanente Creek Restoration Plan
- Golder Associates Inc.'s (Golder) conclusions and recommendations regarding this assessment

# 2.0 METHODS

## 2.1 Data Compilation and Review

Golder reviewed available existing data pertaining to the project including aerial photographs, historical USGS topographic and geologic maps, site boring logs, seismic data from previously completed work within the project area, the Waterways 90% plan set, and pertinent site and regional geologic data.

## 2.2 Site Reconnaissance

Golder conducted a site visit over three days from July 25 to 27, 2019. The field team consisted of three primary members, including a fluvial geomorphologist, a geohazards geologist, and a staff geologist. The field team was given a site orientation and tailgate safety briefing by a locally based senior technician with long term familiarity with the site and specific knowledge of creek access points and safety. Creek access is difficult, and locally hazardous, because of very steep terrain, heavy vegetation, and other obstacles such as loose rock, fallen trees, etc. This rugged terrain also severely limits access for drill rigs to many of the reaches of the creek.

Golder communicated with Waterways to discuss our initial opinions and received feedback as to what specific reaches or features needed further study, or have the most uncertainty, with respect to the 90% design effort to focus our field mapping efforts. The field mapping efforts focused on the reaches that include the following two areas: 1) Rockpile and 2) Material Removal Area. Note, however, that the entire project area was traversed on foot by the field reconnaissance team.

## 2.3 Field Mapping

The mapping focused on defining areas of mining disturbance, (e.g., overburden, roads, structures, etc.) versus native slopes and development of geologic cross sections in key locations (e.g., Rockpile and Materials Removal Area). The mapping also identified other pertinent geomorphic features such as native slope angles, natural shallow slides, areas of erosion, sediment accumulation, bedrock exposures, etc.

# 3.0 REGIONAL GEOLOGIC AND GEOMORPHIC SETTING

## 3.1 Bedrock Geologic Units

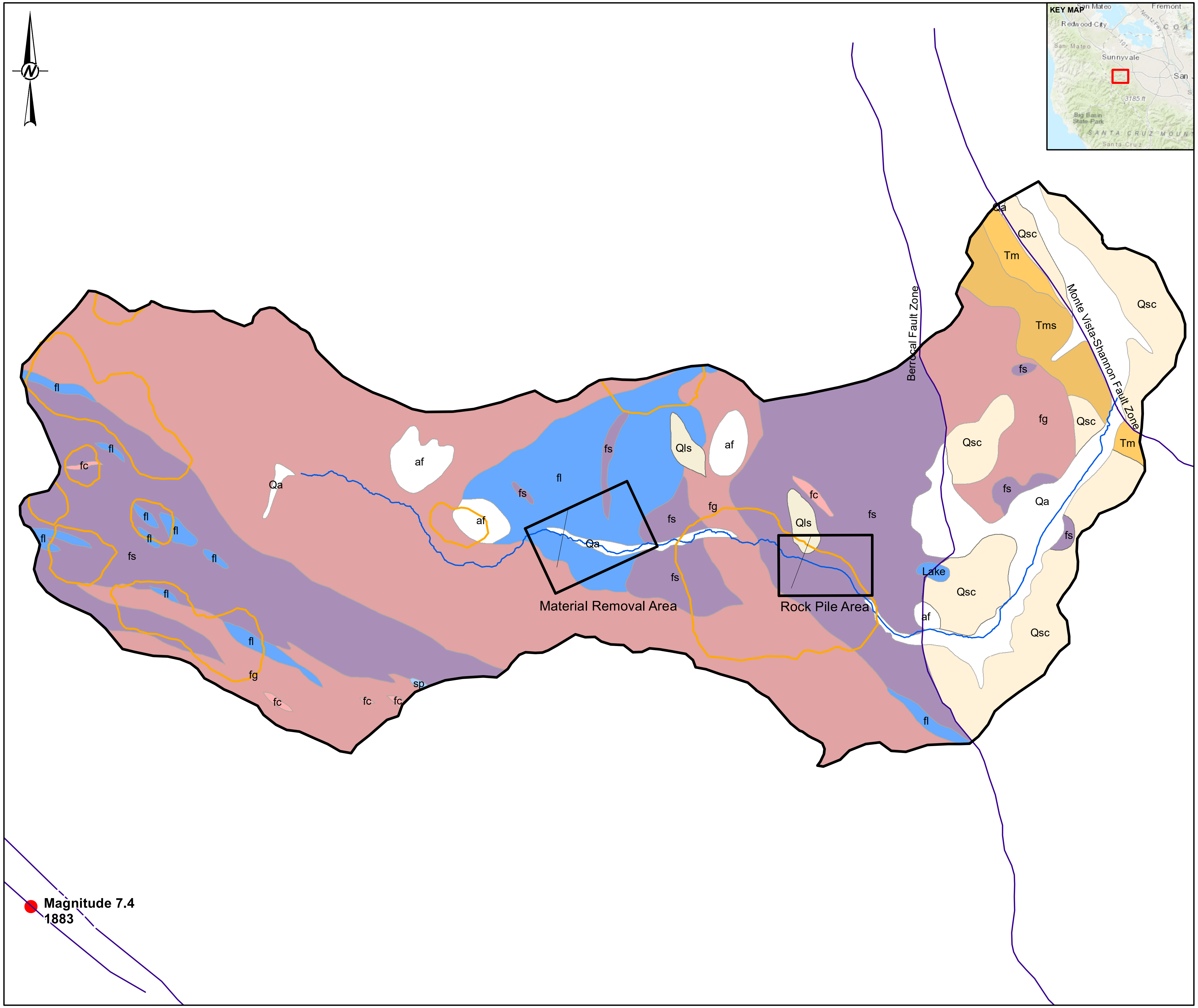
The bedrock materials exposed in the Quarry are part of the Permanente Terrane of the Franciscan Assemblage. The Franciscan Assemblage is comprised of highly deformed and variably metamorphosed, marine sedimentary rocks with submarine basalt (greenstone), chert, and limestone. The Franciscan is considered a tectonic mélange that was formed in the subduction zone between the Pacific tectonic plate and the North American plate. This plate boundary is now a transform, strike-slip plate boundary defined by the San Andreas Fault zone located about two miles southwest of the Quarry.

Golder has referenced two geologic map sources in our presentation of the geology of the Permanente Creek Basin (Figure 1). One set of maps comes from the Cupertino and Mindego Hills quadrangles (Dibblee and Minch 2007a and b), and the other comes from the San Francisco Bay Landslide Mapping Team (USGS 1997). Previous researchers have mapped the basin (Brabb 1970, Pulver 1979a and b).

## 3.2 Surficial Geologic Units

### 3.2.1 Overburden and Fill

Many of the south-facing slopes that flank Permanente Creek are mantled with varying thicknesses of overburden. These are generally described as side-cast fills that mantle existing canyon slopes and fill small



**LEGEND**

- ▭ Areas of Interest
- — Cross Sections
- — Permanente Creek
- ▭ PermCrkBasin_V2
- ▭ Mostly Landslides
- — Faults
- ● Earthquake Epicenter Location

**Geologic Units**

**UnitNam**

- 🟦 Lake
- ☐ af
- ☐ Qa
- ▨ Qls
- ▨ Qsc
- 🟨 Tm
- 🟧 Tms
- 🟦 sp
- 🟥 fg
- 🟪 fs
- 🟥 fc
- 🟦 fl

0 2,000 4,000

1 IN = 1,667 FT FEET

**NOTE(S)**

1. LINE NOTES
2. LINE NOTES
3. LINE NOTES

**REFERENCE(S)**

1. USGS (LANDSLIDES, 1997; FAULTS, 2000, 2002)
2. CALIFORNIA DIVISION OF MINES AND GEOLOGY (EARTHQUAKES, 1982)
3. WATERWAYS CONSULTING, INC. (PERMANENTE CREEK, 2018)
4. CALIFORNIA DEPARTMENT OF FORESTRY (GEOLOGY AND LANDSLIDES, 1979)
5. COORDINATE SYSTEM: NAD 1983 STATE PLANE CALIFORNIA III (FT)
6. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT

LEHIGH SOUTHWEST CEMENT COMPANY AND HANSON PERMANENTE CEMENT, INC.

PROJECT

GEOLOGIC AND GEOMORPHIC ASSESSMENT OF PERMANENTE CREEK

TITLE

## GEOLOGIC MAP OF PERMANENTE CREEK BASIN

CONSULTANT

GOLDER

YYYY-MM-DD 2019-10-02
DESIGNED RPH/BVJ
PREPARED RPH/BVJ
REVIEWED BF/CJ/RPH
APPROVED BF

| PROJECT NO. | PHASE | REV. | FIGURE |
|---|---|---|---|
| 179018601 | 100 | 0 | 1 |

PATH: G:\LehighHanson\PermanenteCreek\99_PROJECTS\179018601_GeomorphMap\100\02_PRODUCTION\MXD\FIGURES\Rev0\179018601_100_001_Fx_Rev0_GeologyMap.mxd PRINTED ON: 2019-10-02 AT: 10:44:12 AM

1 in

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B drainages and swales that formerly reported to Permanente Creek. The overburden deposits are of highly variable thickness, starting at the Rock Pile Area and continuing up through the Material Removal Area. A large percentage of this material within the Project area will be removed as part of the restoration effort.

The Rock Pile area is comprised of stockpiled material for production. The character of the overburden is variable but generally consists of fine to coarse gravel to angular cobble sized rock fragments. Elsewhere, overburden is a heterogeneous mixture of fines, sand, gravel and cobble sized fragments (i.e., greenstone, graywacke, cherts, and soil materials) but with small percentages of limestone.

### 3.2.2 Alluvium

This includes modern unconsolidated alluvial deposits along the active stream channel of Permanente Creek. These deposits are comprised of a poorly sorted mixture of cobbles, gravels, sand, silt and clay. Deposits range from a few inches thick in the upper reaches of the watershed where erosion has cut the channel down into bedrock, to tens of feet thick where the channel widens and deepens as it approaches the flatter terrain of the Santa Clara Valley.

### 3.2.3 Colluvium

Colluvial and slope wash deposits are common throughout the steep terrain of the Santa Cruz Mountains. In general, the natural slopes in the region are overlain with approximately one to two feet of soil and colluvial materials, which thicken to several feet or more in the larger natural swales in the region. Colluvium is generally described as predominantly clayey sand with gravel to clayey gravel, with some gravelly clay.

### 3.2.4 Ancient Natural Landslide Deposits

Several large, ancient landslides have been mapped by various investigators in various areas of the 3,510-acre Lehigh property, and throughout the broader foothill's region (Figure 1). These landslides are generally described as possible old landslides and considered to be early Holocene or possibly late- Pleistocene features. These are naturally occurring landslides that are not related to any modern day mining activities. Along the south flank of Permanente Creek, two large landslides are identified by Sorg and McLaughlin (1975) while Rogers and Armstrong (1973) map only one of the landslide features.

The presence of these ancient landslides, as well as much smaller surficial slides that occur along the canyon walls, and in steep zero-order drainages that report to Permanent Creek, reflects the young, steep geologic terrain that comprises the Santa Cruz Mountains. The relatively thin surficial failures that are common in this terrain are to be expected going forward with this Project both from natural sources—like the zero-order drainages along the south canyon wall—and potentially from restored natural grades once overburden is removed as part of the Project. Note that one of the primary goals of the creek restoration program is to remove specified overburden and fill materials and restore, to the extent practicable, natural slope angles both along the longitudinal profile of the creek and transverse to the creek (i.e., the creek banks).

## 3.3 Faulting and Seismicity

The San Andreas Fault zone is located approximately two miles southwest of the Quarry (Figure 1). The Sargent-Berrocal Fault Zone (SBFZ), part of the Santa Cruz Mountains front-range thrust fault system, parallels the San Andreas to the east and forms the eastern-most structural boundary to the Permanente Terrain.

Near the Quarry, the SBFZ consists of two northwest-trending, sub-parallel faults, namely the northeastern-most Monta Vista Fault Zone and the southwestern-most Berrocal Fault Zone (Sorg and McLaughlin, 1975) (Figure 1).

The Monta Vista Fault Zone is located approximately 1 mile to the northeast of the Quarry. A strand of the Berrocal Fault Zone lies beneath the Permanente Cement Plant area to the south of the EMSA, and extends west to other portions of the Quarry (Mathieson, 1982; Sorg and McLaughlin, 1975).

Using the 2008 Update of the United States National Seismic Hazard Maps (Peterson, et.al., 2008), which incorporates the findings of the Next Generation Attenuation Relation Project, Golder estimates that design peak ground accelerations should be approximately 0.57g for the site.

## 4.0 BASIN GEOMORPHOLOGY

The geomorphology of the Permanente Creek basin is influenced by multiple active geologic processes. The highly active tectonics of the San Andreas Fault and other nearby faults and fault zones result in a high rate of uplift and relatively frequent, high magnitude earthquakes. The tectonic activity has modified both the headwater basins and offsets lower elevations of landscape in juxtaposition to each other. The relatively frequent occurrence of high magnitude earthquakes is likely to have increased magnitude and occurrence of ancient, naturally-occurring landslides within the basin. Additionally, the highly variable rock types, tectonic histories, and geomechanical properties of the accretionary island arc geology of the Franciscan mélange have resulted in highly differential rates of erosion. These differential erosion rates are expressed in the varying morphologic characteristics of the basin.

As an added complexity, the carbonate units of the Franciscan complex have resulted in carbonate-rich water precipitating travertine deposits on the bed and banks of Permanente Creek. These travertine deposits interact with the self-forming step-pools of the steeper portions of the channel and contribute to a repeating cycle of travertine dam formation and breaching (Fuller et al. 2010). Additionally, the subsurface precipitation of travertine in the interstitial voids between sediment grains in sediment deposits increases the intergranular bond strength, making the sediment more resistant to erosion and potentially decreasing the rippability of the material.

In addition to the natural processes interacting with the basin morphology, the long history of mining in the basin has also substantially interacted with the surface processes defining the basin morphology. The very high rate of sediment supplied to the channel, in the form of overburden and fill placed along the margin of the stream channel during the early history of mining (1940s and 1950s), has resulted in aggradation of the channel in lower gradient portions of the channel.

### 4.1 Fault Influence

The drainage basins of the northeast side of the Santa Cruz mountains are characterized by geomorphic features that are controlled by faulting. The features include right-lateral deflected and offset drainages, drainages that follow lineaments, sidehill benches, closed depressions, aligned benches, linear scarps, linear troughs, saddles, and linear vegetation contrasts (Smith 1981).

In the downstream portion of the basin, the Monte Vista-Shannon fault zone defines geomorphic features. These features are believed to have been formed during the Pleistocene and possible Holocene. They include the reverse displacement of lower elevation sediment to higher elevations than those of their original deposition, forming benches, saddles, linear valleys, faceted spurs, scarps, linear range fronts, linear depressions, and associated vegetation contrasts (Bedrossian 1980, Hitchcock et al. 1994).

Similarly, the Jurassic and Cretaceous aged rocks of the Franciscan Complex are thrust over Pliocene and Pleistocene alluvial sediment of the Santa Clara Formation and younger Quaternary deposits (Sorg and

McLaughlin 1975, Wesling and Helley 1989, McLaughlin et al. 1991, Hitchcock et al. 1994). On the site, colluvial deposits are thrust over fluvial gravel of Permanente Creek, indicating late Pleistocene and possible Holocene displacement (Hitchcock et al. 1994).

Hitchcock and Kelson (1999) noted that coseismic deformation associated with the 1989 Loma Prieta earthquake, was coincident with geomorphic features suggestive of faulting along the Monte Vista-Shannon fault zone (Haugerud and Ellen 1990, Hitchcock et al. 1994, Langenheim et al. 1997). This could indicate that repeated localized contraction is in part coincident with the occurrence of Loma Prieta-type earthquakes. This would suggest a recurrence interval of about 400 years (Working Group on California Earthquake Probabilities 1996). Hitchcock et al. (1994) reported a late Pleistocene displacement rate across the Monte Vista fault zone of 0.3 ±0.2 mm/yr.

## 4.2 Hillslopes and Landslide Processes

The Santa Cruz Mountains are a steep and rugged terrain with a long history of landslide activity. The geomorphology of the Permanente Creek basin exhibits a high rate of dynamic change. This high rate of change, termed morphodynamics, is driven by the complex interaction between the dual processes of rapid uplift associated with the compressional tectonics along the San Andreas Fault system (as discussed above) and the relatively weak, easily erodible, and highly variable rocks of the Franciscan Complex.

The resulting topography forms narrow, steep sided, and actively eroding canyons. The Santa Cruz Mountains, and Permanente Creek canyon, are subject to both shallow (e.g., debris flows or “mudslides”) and deep landslides (e.g., large rotational slumps or translational block glides). Average slope angles in the canyon are approximately 25 degrees (or 2H:1V) which is reflective of the natural stability of the highly broken and sheared greenstone and mélange terrane. Steeper slopes, greater than 35 to 40 degrees, are locally observed in areas underlain by more competent limestone and graywacke bedrock but these are the exception.

## 4.3 Geotechnical Background and Considerations

Golder has a long history of geologic and geotechnical investigations at the Permanente Site starting in 2006 and continuing to present. The investigations include (but are not limited to) sector specific investigations of the quarry pitshell including existing landslides, both the EMSA and WMSA overburden stockpiles and foundation conditions, several investigations for updated storm water basins, a new crusher location and foundation, and a proposed water treatment plant location. In summary, we have an extensive library of material properties and corresponding stability analyses and therefore a good understanding of slope behavior for different types of materials and slope angles. Our geotechnical recommendations for slope design, discussed below, are based on this extensive background. A summary of material types and properties based on a number of our previous investigations is included in Appendix A.

From a geotechnical perspective, the proposed project primarily involves excavation and removal of man-made surficial deposits (i.e., overburden and artificial fills) to restore the creek channel and creek banks back to a more natural state. The intent is to remove the man-made surficial materials down to bedrock (or native soils) while minimizing excavations/cuts into bedrock or soil slopes. In general, excavations onto canyon slopes will only be done where the surfaces have been altered or affected by mining activities. Existing natural slopes will not be modified or excavated.

Our geotechnical recommendations for the Project include:

- Rock Slopes: Slopes greater than 20 feet in height in greenstone materials should not exceed slope angles of 2H:1V if possible. Slopes less than 20 feet should perform adequately at 1.5H:1V; however, localized areas of instability may be encountered. Cutslopes in limestone and graywacke greater than 20 feet in height should not exceed 1H:1V and slopes less than 20 feet should be limited to no steeper than 3/4H:1V.
- Fill or Soil Slopes: For planning purposes, permanent slopes comprised of overburden, alluvium, colluvium or other site-derived fill should not exceed 2H:1V.

Earlier versions of the Project included construction of retaining structures, or engineered structural elements, that warranted more detailed geotechnical investigations for design purposes. Retaining structures have been eliminated from the Project (with the exception of the Material Removal Area), and with other modifications, the main geotechnical considerations are limited to recommended slope angles for final slopes of previously filled or otherwise disturbed surfaces.

The Material Removal Area, and the Rock Pile Area, present the largest challenges due to depths of the cuts that are required, and the steep natural terrain underlying and comprising the hillslopes that are overlain by overburden. In some locations along creek banks, it is anticipated that cuts will expose natural surficial materials (i.e., colluvium and slope wash) as opposed to bedrock and may require localized cuts steeper than 2H:1V in order to daylight the cuts into natural slopes.

The Material Removal Area may require a retaining structure, depending on timing of the creek restoration project with respect to site operations, to preserve infrastructure and access associated with the Upper Water Treatment System (UTS). This is discussed in further detail in Section 6.2.

## 5.0 SITE RECONNAISSANCE AND GEOMORPHIC CHARACTERIZATION

The following section provides a summary of our geomorphic observations of the Project. All station references in this report are coincident with that used by Waterways on Sheets C2-C4 in their 90% restoration plan report (2019).

### 5.1 Overview of Permanente Creek Profile

The profile of Permanente Creek can broadly be classified into depositional reaches and bedrock reaches (delineated on Figure 2 as Reach A, Reach B, etc.). The processes that define these reaches are the rate that sediment is supplied to the channel and the rate at which the channel can convey the supplied sediment. The rate of sediment supply is controlled by hillslope processes and the rate that sediment is delivered to the channel. The rate of sediment transport is controlled by the channel geometry and the hydraulic characteristics of the reach. The channel hydraulics are directly coupled to the rate at which water is delivered to the channel.

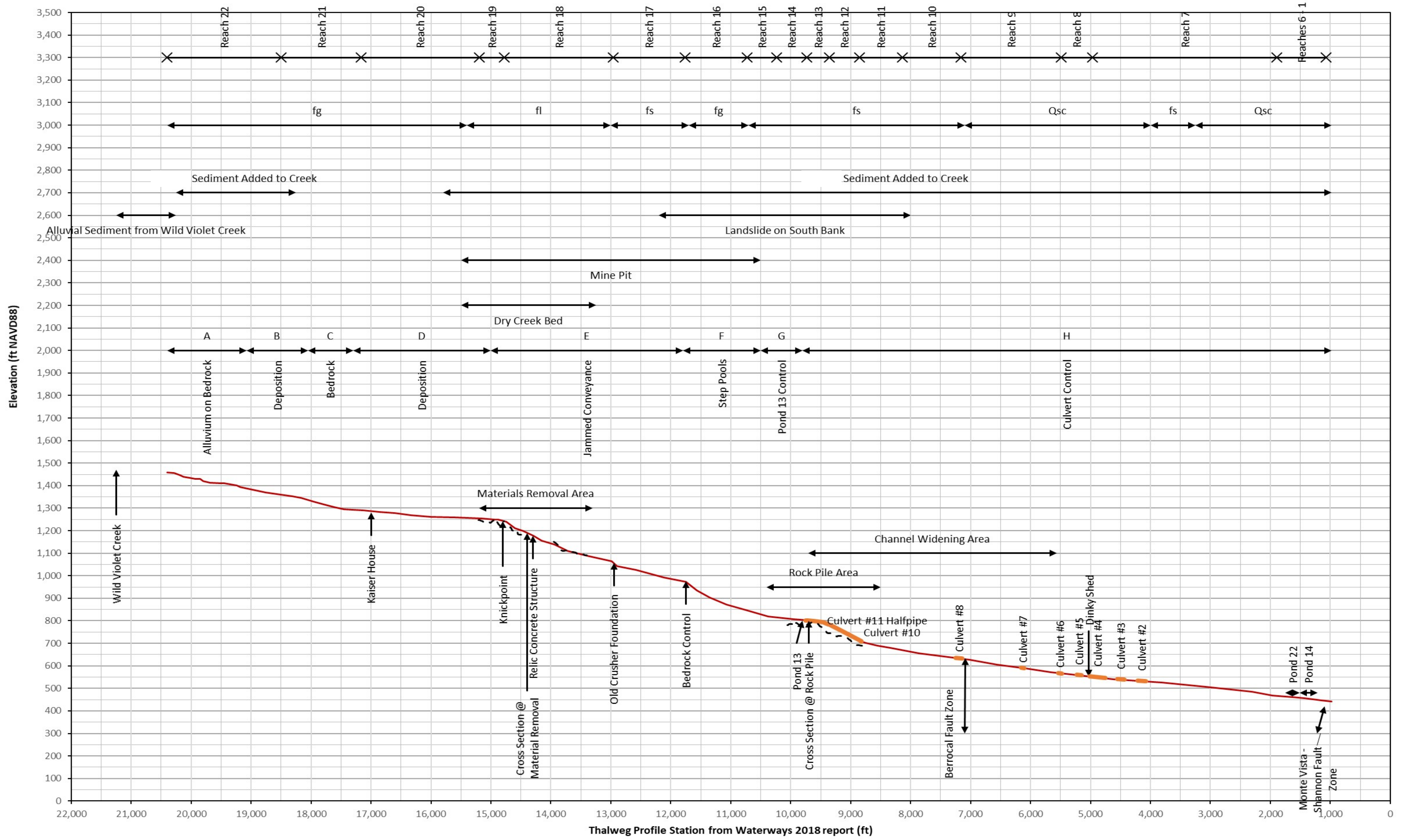


**Figure 2: Permanente Creek Profile with geomorphic and geologic delineations. Stationing from Waterways (2019).**

### 5.1.1 Reach A: Alluvium on Bedrock

The upstream most portion of the survey channel is characterized by alluvium in the form of travertine reinforced step pool morphology that partially covers a bedrock channel. The sediment supplied here is likely to come from natural processes and is likely partially supplied from an alluvial fan originating from Wild Violet Creek. Carbonate-rich water percolates from the south bank of the channel in this reach, indicating that the source of the carbonate-rich spring is likely within the Wild Violet drainage. Geologic maps (Dibblee and Minch 2007a and b) indicate that the limestone unit of the Franciscan complex outcrops within the Wild Violet drainage. The debris from this alluvial fan is being transported downstream and has deposited small terraces along both valley walls. These terraces are possibly abandoned by the modern hydraulic regime of the river and may be coupled to the debris flows originating from Wild Violet Creek.

### 5.1.2 Reach B: Deposition

This depositional reach is characterized by a relatively wide, low gradient, flat valley floor that extends for approximately 1,000 feet along the valley axis. In combination with downstream gradient controlled from the Bedrock reach, the sediment load is too great and too coarse for the local hydraulics to transport, resulting in deposition on the valley floor.

### 5.1.3 Reach C: Bedrock Control

The Bedrock controlled reach is relatively short (750 feet) and has a relatively low gradient (<2%), but the narrow bedrock channel maintains hydraulic and sediment continuity through this reach, resulting in a thin alluvial cover on a bedrock channel bed. It appears that this reach only receives sediment from the channel upstream and conveys almost all of this load through to the downstream reach.

### 5.1.4 Reach D: Deposition

This Deposition reach is characterized by the aggradation of sediment on the valley floor and relatively wide flat valley bottom that receives sediment from the upstream reach and the tributaries that confluence with Permanente Creek from the south. The downstream end of this reach is marked by the occurrence of a sharp change in channel gradient associated with a bedrock knickpoint. This portion of the landscape is within the Materials Removal Area. Further discussion of the implications of these features to the restoration plan are discussed in Section 6.

### 5.1.5 Reach E: Jammed Conveyance

The Jammed Conveyance is very steep (>9%), but due to the large quantity of material it receives, and the armoring effect of both the coarse sediment and the relict mining infrastructure within the channel, a large portion of this material remains within the reach. The geomorphic term ‘jammed’ describes steep channels that are clogged with debris (Zimmerman et al. 2010). Natural channels of this gradient are typically not depositional but rather erosional. The debris residing on the bed in this reach is immobile, and the modern channel alignment is constricted between the debris from the north and the south valley wall for much of this reach. The Material Removal Area is contained within the upstream portion of this reach.

### 5.1.6 Reach F: Step Pools

Downstream of the Jammed Conveyance, a large, mapped natural landslide borders the south bank of the river for the entirety of this reach. The large boulders from both mining and natural sources, as well as woody debris, form large, steep step-pools within this reach. Some of these step-pools appear to have been reinforced with travertine deposits, as evidenced by the relict abutment deposits on the channel margins.

### 5.1.7 Reach G: Pond 13 Control

The reach downstream of the Step Pools reach, appears to act as a gradient control. Although this gradient control may be driven by the back-water effect of the small reservoir at Pond 13, data from the Seismic survey indicates that this feature may be reinforced by naturally occurring bedrock ridges within the channel. A local bedrock ridge is present just downstream of Pond 13 (Figure 2).

### 5.1.8 Reach H: Culvert Control

Downstream from Pond 13 the channel is confined within culverts and canals that do not exhibit a morphologic connection to the adjacent landscape.

## 5.2 Geomorphic Observations

### 5.2.1 Knickpoints

In response to the dynamic changes driven by tectonic base level change, upstream propagating waves of erosion have migrated up Permanente Creek. The upstream most location of a given wave is marked by a distinct change in channel gradient, termed a knickpoint. Knickpoints characteristically migrate more rapidly through more easily erodible material, and more slowly through more erosion-resistant material (Whipple 2004). The upstream most knickpoint with the assessed channel is located at Station 148+00 within the Material Removal Area (Figure 2). This reach is characterized by a relatively low gradient reach upstream of this point and a steep reach downstream. The steep reach downstream is simultaneously receiving and conveying a large quantity of material, typically composed of the finer fraction of the total sediment load, and aggrading the coarser fraction, composed of large boulders.

### 5.2.2 Travertine

Travertine is a form of limestone precipitate that forms when calcium carbonate-rich water undergoes changes that cause the mineral to transition from solution to a solid state. This transition is largely controlled by physical processes, such as changes in pressure, temperature, or pH, but it can be influenced by biological processes and hydraulic variability as well (Fuller et al. 2010). Golder observed two types of travertine formation in Permanente Creek. One in which stalactites grew out of the southern stream bank downstream of the confluence with Wild Violet Creek, and the other along large portions of the channel where naturally forming step-pools were reinforced by travertine deposition to form travertine dams (Figure 3). These dams display a history of repeated formation and breaching, as evidenced by the clasts of travertine conglomerate from older dams being incorporated into modern dams, as well as the relict abutments of older travertine dams remaining on the channel margins. This natural process has been taking place throughout geologic time along Permanente Creek.

**Figure 3 - Travertine Deposits**

### 5.2.3 Basin Capture

A process termed basin capture can occur whereby drainage networks and flow paths are rearranged through landscape modifying influences of tectonics and surface processes. This process can result in characteristic landscape features like wind gaps, where valley geometry and upstream drainage are mismatched, and fishhooks, where headwater streams exhibit a significant curved alignment where the drainage meets the basin edge. The fishhook morphology is observable in the Permanente Creek basin, and adjacent basins (Figure 4). Evidence of basin capture is significant to the current investigation as the changes in basin area related to basin capture can be associated with a dis-equilibrium between the channel morphology and the sediment regime of the river. More straightforwardly, this implies that the basin used to be bigger, and the current hydrologic regime may not be sufficient to transport the former natural sediment load.

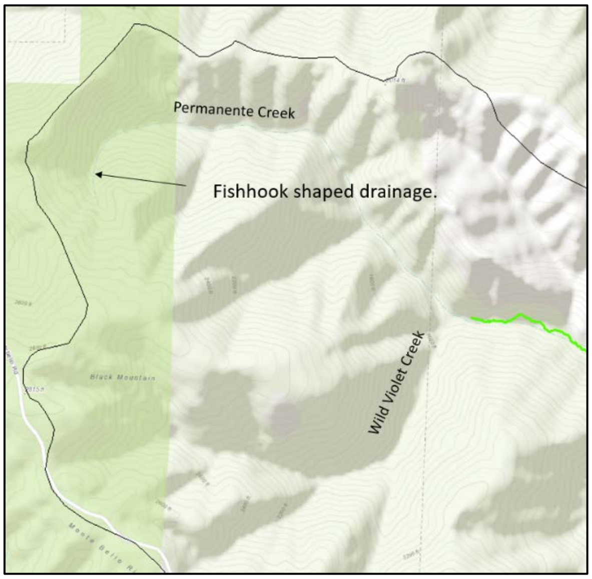


**Figure 4 – Fishhook shaped headwaters**

## 6.0 REVIEW OF RESTORATION DESIGN

This section provides an overview of the Waterways 90% design report (2019) with respect to the design basis and an evaluation of potential geotechnical issues for the Rock Pile and Material Removal Areas.

### 6.1 Geomorphic Design Basis

Waterways has based their geomorphic design on maintaining sediment transport continuity through the constructed reaches and proportionately distributing shear stresses across the channel bed and floodplain areas during floods to maintain a dynamic morphology without destabilizing the landscape. They optimized the design geometry by matching the hydraulics during flooding to the sediment size and transport rate of the channel. Additionally, design geometry incorporated the bankfull width and depth, and pool dimension and spacing relationships, of nearby reference watersheds and analog reaches (URS 2009). Waterways (2019) conducted hydrologic and hydraulic simulations of the restoration design and compared those results to fish passage capability, channel stability, flood conveyance, and sediment transport.

Waterways (2019) design specifications include the following primary elements:

- Engineered Streambed Material (ESM)
- Floodplain Armoring
- Vegetated Rock Slope Protection
- Vegetation Design
- Best Management Practices
- Engineered Woody Debris

- Slope Angle Guidance (Golder 2014)

## 6.2 Material Removal Area Design

**Location:** From Station 150+25 to 130+25

**General Description (Waterways):**

“This area has been modified by the placement of material within and adjacent to the channel… A seismic refraction analysis has been performed to estimate the depth to bedrock, in an effort to gain a clearer understanding of the pre-disturbance site geometry and allow a more informed evaluation of opportunities and constraints to enhancement.

Proposed cuts extend to depths of over thirty feet below existing ground, resulting in profile grades of 7.1% to 22.7%. These grades follow the peaks of the estimated subsurface bedrock profile. Final grades would be determined in the field to best fit bedrock exposures encountered during excavation.”

**Design Elements and Objectives:**

- Removal of overburden/fill and a relic concrete structure, and moving the north toe of slope northward 25 feet along the majority of the project area, except near Pond 4A where it will move northward 16 feet;
- Construction of a new channel with floodplain bench areas with habitat elements that will help improve ecological complexity; and
- Installation of native vegetation.

### 6.2.1 Evaluation and Discussion of Materials Removal Area

A geologic and a geomorphic map of the Material Removal Area is presented in Figure 5. Longitudinal and thalweg profiles of this area are presented in Figures 6, 7 and 8. In general, both the cross section and long profile indicate that bedrock is close to the surface throughout the Material Removal Area with the exception of a few local areas where depths may be in the range of 15 to 20 ft bgs. The design approach used by Waterways notes that the estimated bedrock contacts as shown are approximate, and that the design will allow for the work to conform to and follow the bedrock surface as it uncovered during excavation.[1] Golder concurs with this general approach and doesn’t believe any additional exploration would provide value to the design above and beyond the data provided by the seismic refraction surveys.

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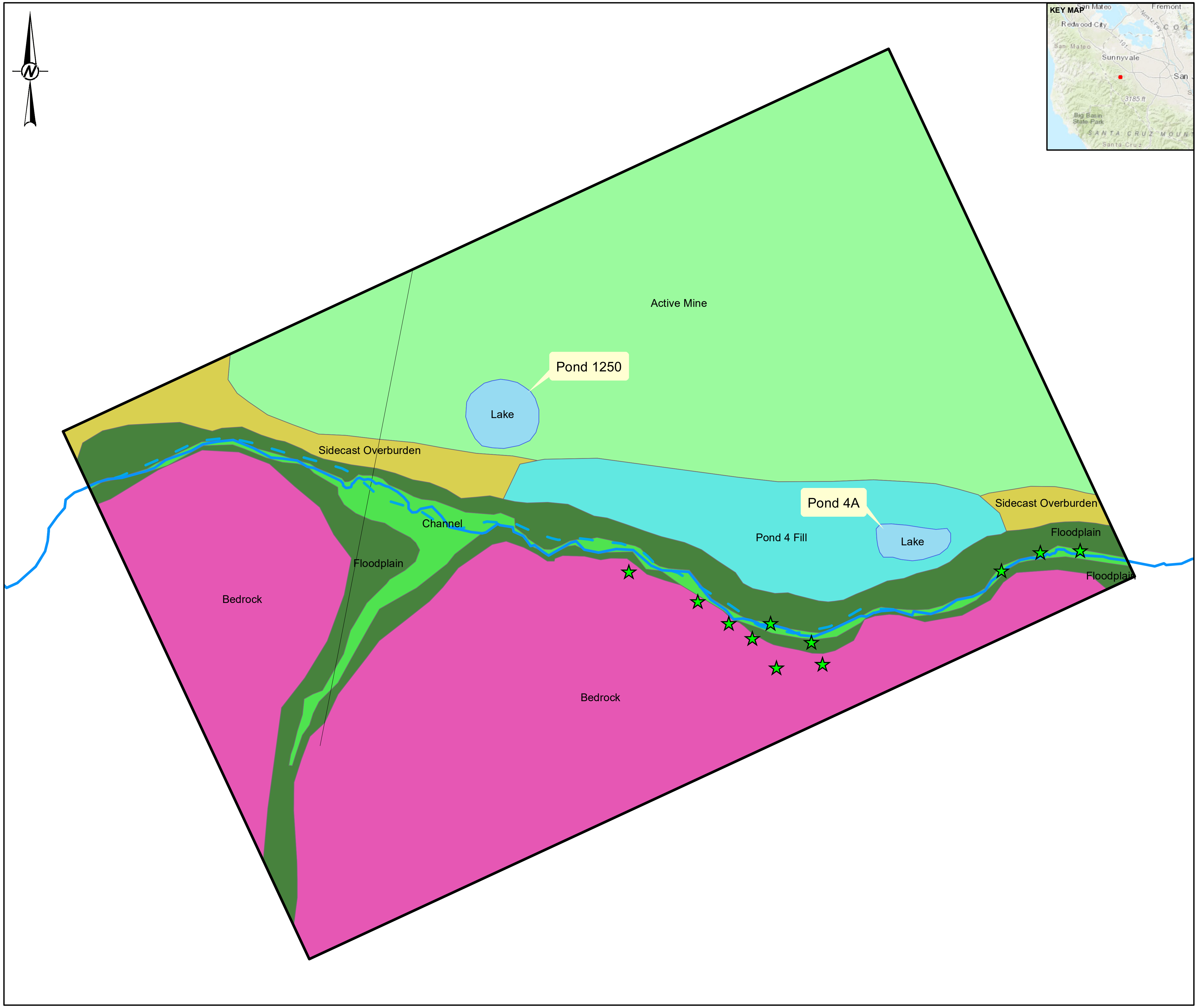
[1] It should be noted that where shown on included figures that the bedrock surface as interpreted from seismic refraction data is approximately located and will be field verified during construction.



**LEGEND**

- ▭ Areas of Interest
- — Permanente Creek
- – Design Thalweg
- — Cross Section @ Material Removal Area
- ★ BedrockPoints

## Geomorphic Units

- 🟩 Active Mine
- 🟪 Bedrock
- 🟩 Channel
- 🟩 Floodplain
- 🟦 Lake
- ☒ Mostly Landslides
- 🟦 Open Culvert
- 🟦 Pond 4 Fill
- 🟪 Rock Pile
- 🟨 Sidecast Overburden
- 🟫 Terrace

0 200 400

FEET

1 IN = 206 FT

**NOTE(S)**

1. LINE NOTES
2. LINE NOTES
3. LINE NOTES

**REFERENCE(S)**

1. WATERWAYS CONSULTING, INC. 2018. PERMANENTE CREEK RESTORATION PLAN INTERNAL DRAFT 90% LEVEL SUBMITTAL DESIGN BASIS TECHNICAL MEMORANDUM. PREPARED FOR LEHIGH SOUTHWEST CEMENT COMPANY AND HANSON PERMANENTE CEMENT, INC. NOVEMBER 5, 2018.
2. COORDINATE SYSTEM: NAD 1983 STATE PLANE CALIFORNIA III (FT)

CLIENT
LEHIGH SOUTHWEST CEMENT COMPANY AND HANSON PERMANENTE CEMENT, INC.

PROJECT
GEOLOGIC AND GEOMORPHIC ASSESSMENT OF PERMANENTE CREEK: MATERIAL REMOVAL AREA

TITLE
**GEOMORPHIC MAP OF THE MATERIAL REMOVAL AREA**

CONSULTANT
GOLDER

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| YYYY-MM-DD | 2019-10-02 |
| DESIGNED | RPH/BVJ |
| PREPARED | RPH/BVJ |
| REVIEWED | BF/CJ/RPH |
| APPROVED | BF |

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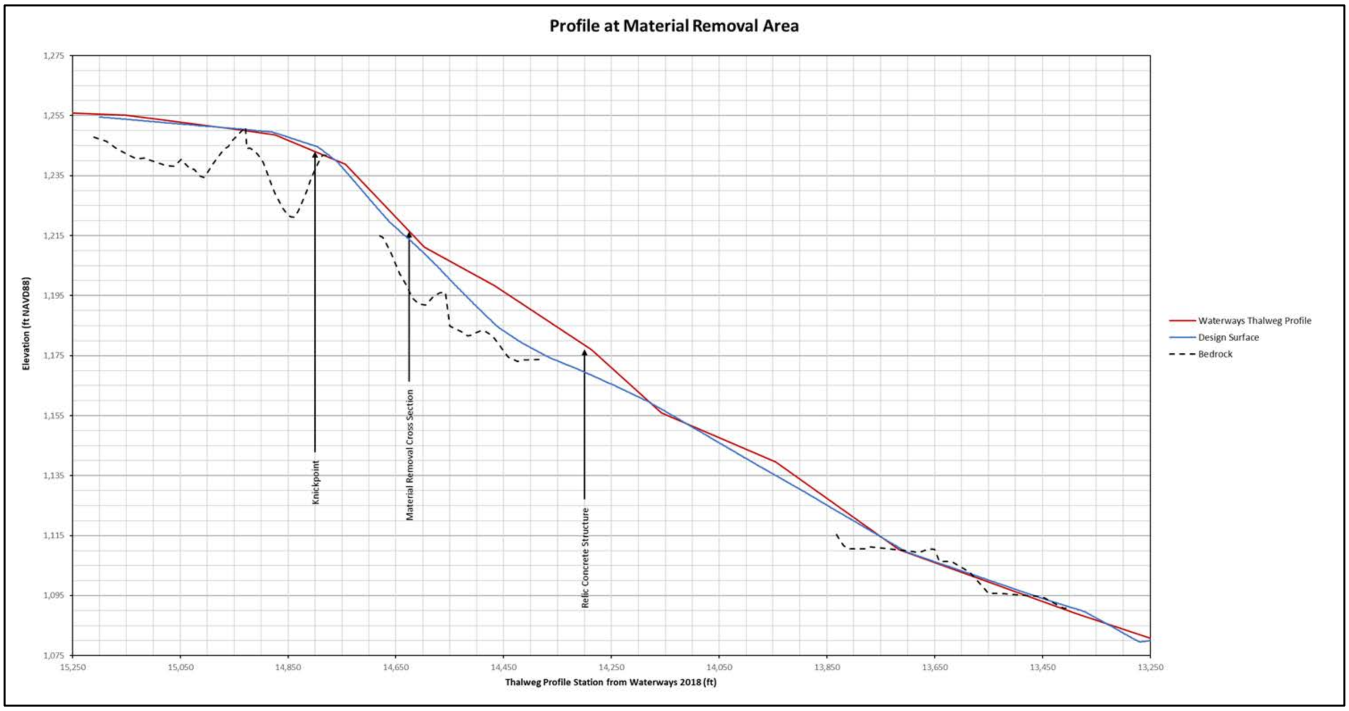


**Figure 6: Profile of Material Removal Area from Station 152+50 to 132+50.**

The following bullet points provide Golder’s observations of the design as compared to conditions observed in the site reconnaissance and as informed by the seismic refraction survey data.

- At Station 148+00, bedrock close to the surface is likely the controlling feature of an upstream migrating knickpoint. The design shows the channel invert conforming to knickpoint and then potentially being established on exposed bedrock downstream of the knickpoint. We concur with this design approach. Additional design elements proposed including ESM and other profile control elements such as boulder weirs and sills should help to ensure stability of the knickpoint.
- Between Stations 146+50 and 142+50, the restoration design identifies a large quantity of material for removal from the channel. The relic mining infrastructure may play a role in defining the channel alignment and facilitating an armored surface on some of the debris. The result of the restoration efforts will increase the local gradient within this reach and extend the length of the high-gradient portion of the channel. Sheet C34 of the 2019 plan set provides additional details for Step-pool and cascade channel design segments in this reach to mitigate the local gradient. We concur with this approach and note that field engineering design modifications and follow on monitoring may be necessary to ensure that the post material removal channel geometry is stable.
- Between Stations 138+50 and 134+50, the seismic profiles indicate that bedrock may be encountered below design grade, but as the seismic profile lines were collected adjacent to the channel and not in the thalweg, Golder believes that bedrock may be exposed at relatively shallow depths along the thalweg. We understand that the intent of the design is to construct the channel on exposed bedrock

occurring within the proposed grading envelope and based on our reconnaissance we think this is generally achievable.

- There is a large relic concrete structure located in the left bank of the stream channel five to ten feet above the channel invert (143+00). There is a smaller relic concrete structure located in the channel further downstream. Golder understands that the removal of old mining infrastructure from the channel will increase the connectivity of the channel to the adjacent landscape and also that the relict structures may currently be contributing to the stability of this reach. We understand that weirs and steps will be constructed using material with a minimum size meeting the D50 of the specified material and a boulder sill w/ a minimum size meeting the D84. This design approach is intended to replace any potential stability relic structures are providing.

- The most challenging geologic and geotechnical issue in the Material Removal Area is the presence of the Upper Water Treatment System infrastructure, including the 1250 Pond and associated facilities located along the top of the creek bank and the access road to Permanente Creek. The lifetime of these facilities is uncertain at this time as they are required for on-going operations of the Facility. However, once reclamation is completed, they may no longer be necessary. If the facilities need to be protected during the creek restoration project, a retaining structure (e.g., Mechanically Stabilized Earth wall) will be necessary to maintain the road and the 1250 pond (as shown in Figure 4.0 of Waterways Updated Response Letter to the County dated 3-5-18 shown below). The retaining structure would be required as the design calls for pushing the north bank of the creek approximately 25 further north than current conditions.

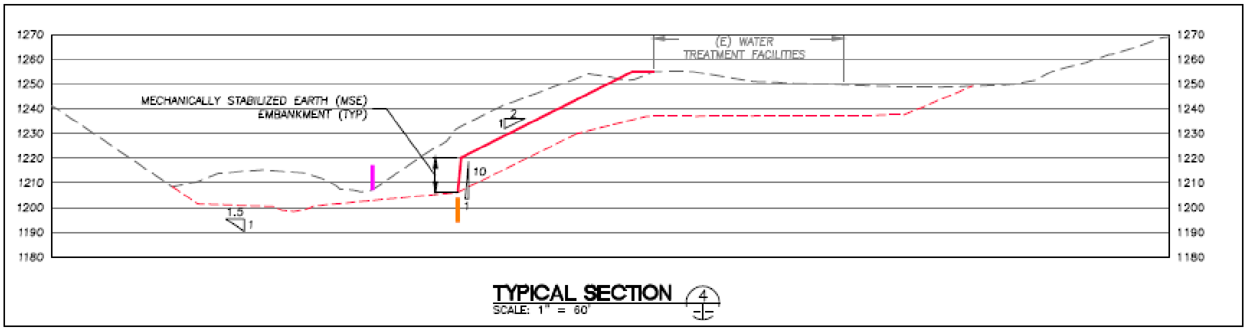


**Figure 7: Typical Section of Potential MSE Wall to protect Water Treatment Facilities**

- If a retaining structure is required, Golder recommends that a geotechnical investigation be performed along the alignment of the wall to verify depth to bedrock and to obtain appropriate design parameters for the design of the wall. However, depending on the timing of the restoration project, a retaining structure may not be necessary and therefore we recommend delaying any further investigation until such time it is needed. Figure 8 illustrates the design surface and bedrock conditions if the slope can be graded back at 2H:1V. This slope configuration meets Golder's general recommendations for cutslopes developed in surficial materials and is considered acceptable.

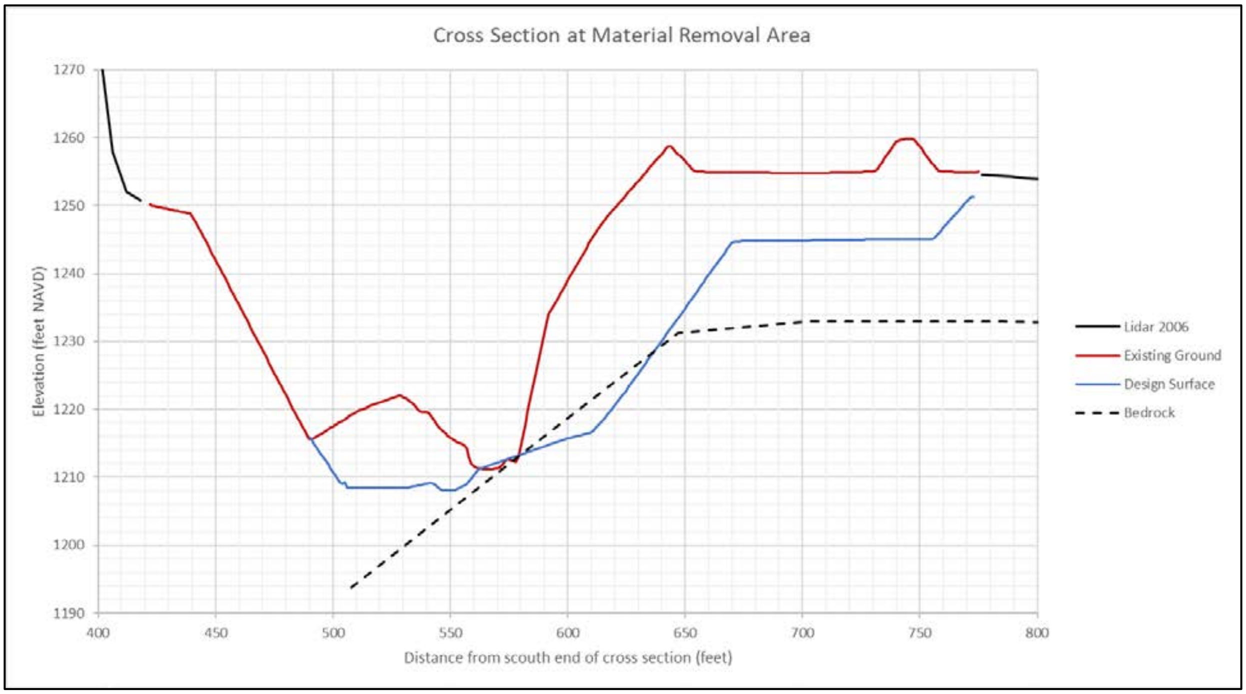


**Figure 8: Cross section at Material Removal Area. Located at Thalweg Profile Station 146+00. Note depth to bedrock is approximate and estimated based on seismic refraction data.**

## 6.3 Rock Pile Area Design

**Location:** From Station 104+50 to 85+50 within the Channel Widening Reach.

**General Description (Waterways 2019):**

“Extensive channel realignment and reconstruction is proposed throughout this area, including removal of Culverts #10 & #11 and the dam at Pond 13…. Cuts approximating thirty to forty feet of depth are required to accomplish this. The grading plan reflects the Lower Limit of Potential Design Channel Invert. The Upper Limit of Potential Design Channel Invert shown in profile has been established as a best fit to bedrock elevations that were estimated using a seismic refraction analysis and geotechnical borings. Final geometry will likely vary somewhat from that shown on the drawings, as necessary to conform to existing bedrock.

The rock pile and associated infrastructure will be removed to accommodate the lowered and widened channel…The slope exposed below the Rock Pile will be inspected by the Geotechnical Engineer or Project Engineering Geologist to evaluate the nature and stability of the exposed material and provide recommendations, as necessary, to ensure geotechnical stability of the slope and access road.”

**Design Elements and Objectives:**

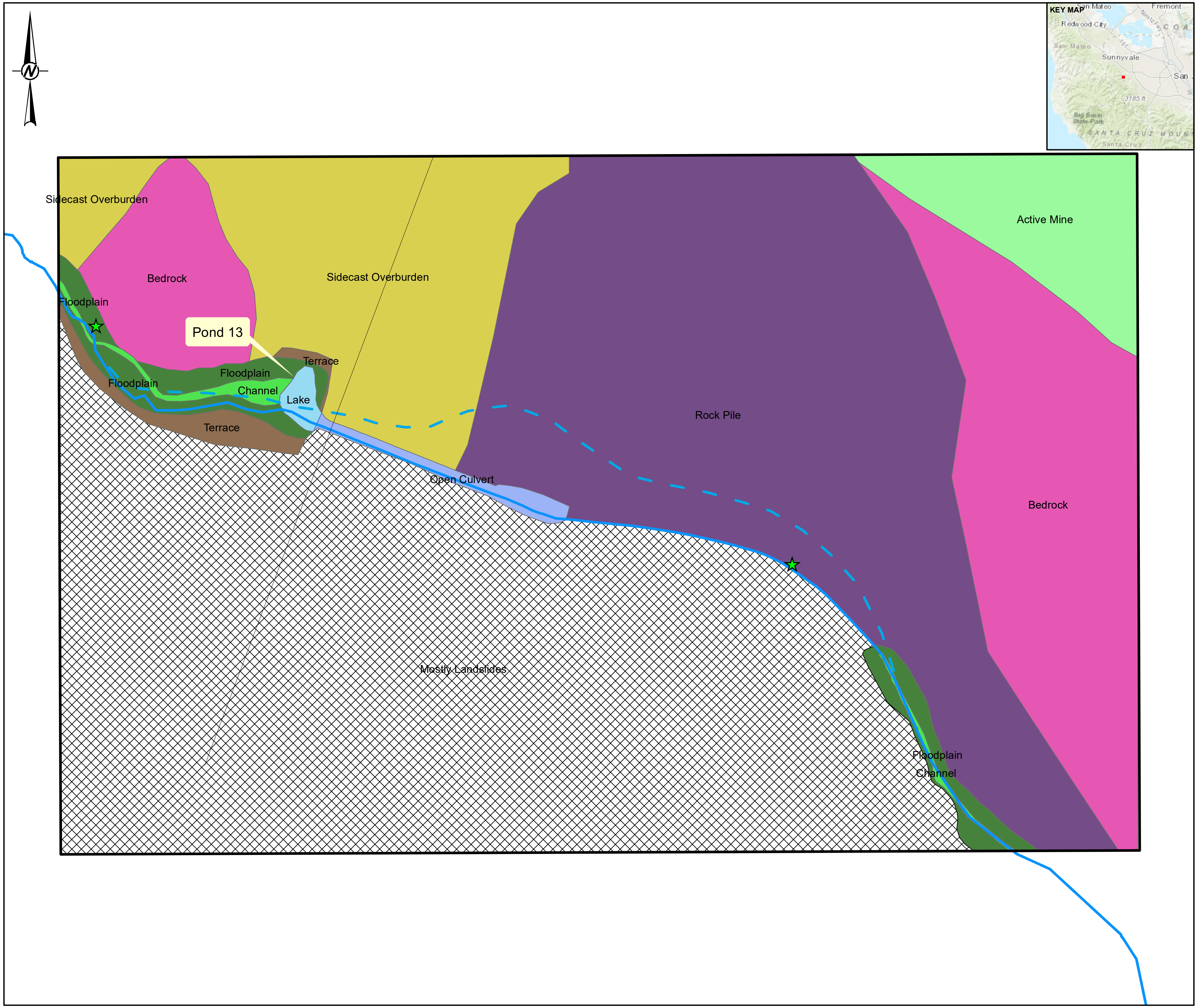
- Removal of concrete road segments and road-related fill material;
- Removal of 930 linear feet of culverts and daylighting of the creek that will help improve ecological complexity;
- Construction of a new channel with floodplain bench areas with habitat elements that will help improve ecological complexity;

- Removal of Rock Pile, retired Rock Plant conveyor system and associated infrastructure;
- Removal of Pond 13 dam/metal infrastructure; and
- Installation of native vegetation.

### 6.3.1 Evaluation and Discussion of Rock Pile Area

A geologic and a geomorphic map of the Rock Pile Area is presented in Figure 9. Cross sections and thalweg profiles of this area are presented in Figures 10 and 11. Appendix B includes Figure 1 from Waterways Updated Response Letter to the County dated March 5, 2018 showing the locations of exploratory borings drilled previously by Golder in the area of the Rockpile restoration work and boring logs. The following discussion provides additional observations of specific design elements as compared to conditions observed in the site reconnaissance and as informed by the seismic refraction survey data.

- In the Rock Pile Area, Golder's comparison of the restoration design with seismic survey results indicates that bedrock ranges from about 5 feet to approximately 25 feet below ground surface with significant relief along the longitudinal profile (Figure 10). As with the Material Removal Area, the design intent will allow for the work to conform to and follow the bedrock surface as it is uncovered during excavation.
- The interpreted depth to top of native alluvium or bedrock for borings along the proposed thalweg (Borings 1101 and 1103) is approximately 25 feet although native surficial materials were likely encountered approximately 5 to 10 feet shallower. Boring 1107, also along the thalweg but near the downstream limit of the area, encountered a concrete structure at approximately 7 feet bgs interpreted as being near original ground surface along the channel thalweg. The remaining borings were drilled upslope of the thalweg to evaluate depths of fill along the toe of the proposed slope. In general, these borings indicate depths of overburden along the toe of the slope in the range of 60 to 70 ft bgs.
- The bedrock surface depicted on Figure 10 is close to the "Upper Limit of Potential Design Channel Invert" as defined by Waterways (based on seismic lines and verification borings), whereas the grading plan included on the design drawings represents the "Lower Limit of Potential Design Channel Invert" to show the maximum extent of potential grading. It is our opinion based on the review of available data that the constructed profile will be close to the "Upper Limit" upstream of Rock Pile Design. In summary, it is our opinion that the design is reasonable, and additional exploration will not provide value to the design above and beyond the data provided by the seismic refraction surveys and previous completed borings.
- The seismic data also identifies a potential former bedrock channel, which extends through the Rock Pile Area that in some locations is north of the proposed thalweg (Figure 11). Golder understands that Waterways has, to the extent possible, re-occupied the historic thalweg; however, extensive grading would be required in some areas to realign the channel and move it further to the north to occupy the historic channel thalweg. We understand that pushing the toe of the slope further north is not considered feasible given that this would require significant flattening of the slope which would impact the extensive infrastructure located at the top of slope including the main access road and the crusher facility. Golder recommends that field engineering design modifications be applied to utilize existing



**LEGEND**

- ▭ Areas of Interest
- — Permanente Creek
- – – Design Thalweg
- — Cross Section @ Rock Pile Area
- ★ BedrockPoints

## Geomorphic Units

- 🟩 Active Mine
- 🟪 Bedrock
- 🟩 Channel
- 🟩 Floodplain
- 🟦 Lake
- ▨ Mostly Landslides
- 🟦 Open Culvert
- 🟦 Pond 4 Fill
- 🟪 Rock Pile
- 🟨 Sidecast Overburden
- 🟫 Terrace

0 200 400
FEET
1 IN = 145 FT

**NOTE(S)**
1. LINE NOTES
2. LINE NOTES
3. LINE NOTES

**REFERENCE(S)**
1. WATERWAYS CONSULTING, INC. 2018. PERMANENTE CREEK RESTORATION PLAN INTERNAL DRAFT 90% LEVEL SUBMITTAL DESIGN BASIS TECHNICAL MEMORANDUM. PREPARED FOR LEHIGH SOUTHWEST CEMENT COMPANY AND HANSON PERMANENTE CEMENT, INC. NOVEMBER 5, 2018.
2. COORDINATE SYSTEM: NAD 1983 STATE PLANE CALIFORNIA III (FT)

CLIENT
LEHIGH SOUTHWEST CEMENT COMPANY AND HANSON PERMANENTE CEMENT, INC.

PROJECT
GEOLOGIC AND GEOMORPHIC ASSESSMENT OF PERMANENTE CREEK: ROCK PILE AREA

TITLE
**GEOMORPHIC MAP OF THE ROCK PILE AREA**

CONSULTANT
GOLDER

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| APPROVED | BF |

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bedrock topography and historic thalweg to the extent possible to meet the desired restoration outcomes.

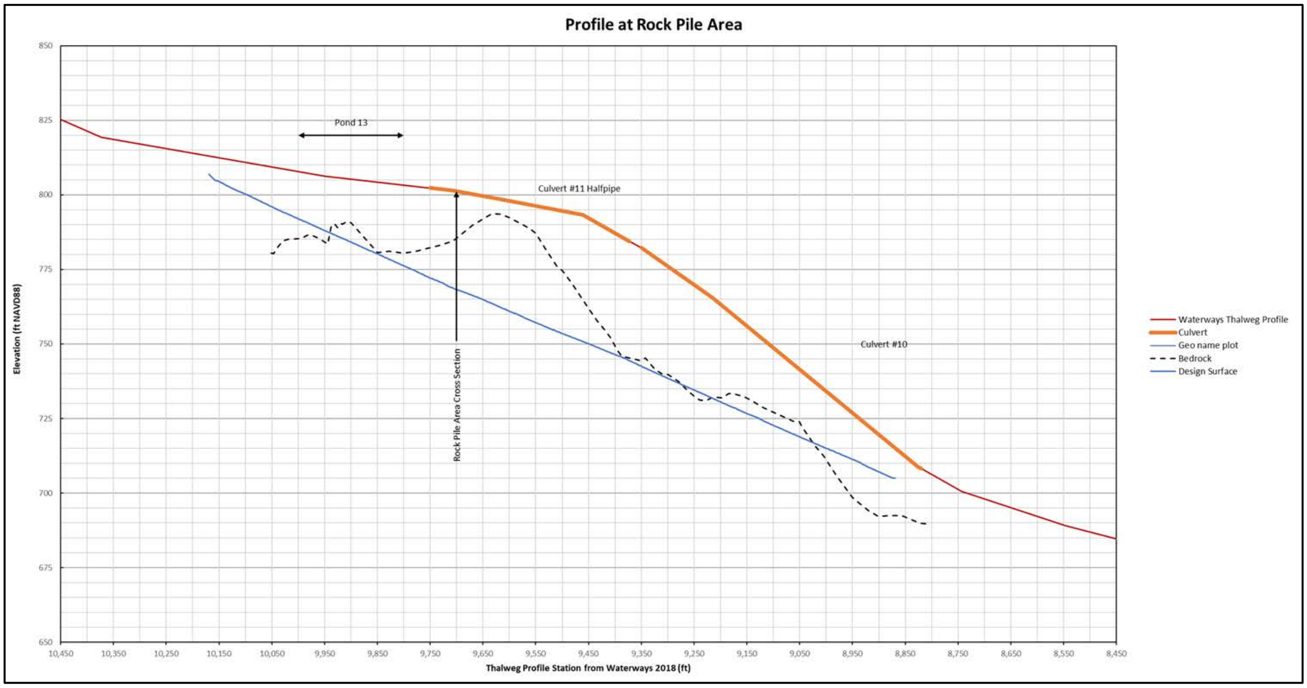

**Figure 10: Profile of Rock Pile Area from Station 104+50 to 84+50.**

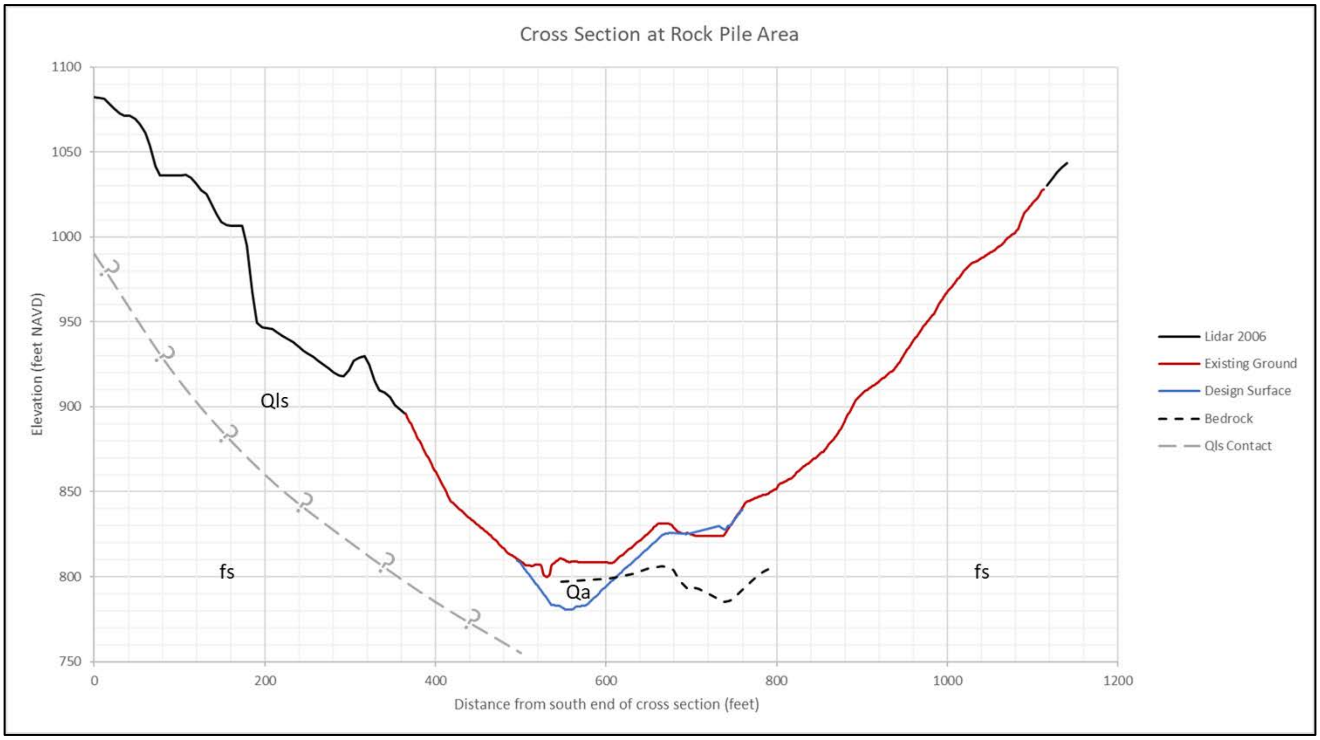

**Figure 11: Cross section at the Rock Pile Area. Located at Thalweg Profile Station 97+00.**

- The removal of the two culverts and creation of a floodplain with an inset channel in this reach will re-establish the lateral connectivity of the channel to the adjacent hillslopes. Reconnecting the channel to the adjacent landscape will have positive benefits as designed by Waterways, but it will also increase the potential for a laterally migrating channel to affect adjacent hillslopes. The north valley wall will consist of the excavated Rock Pile and the south valley wall is defined as a large, ancient landslide based on regional geologic mapping.
- The seismic data indicate that there is a bedrock ridge, oriented perpendicular to the valley axis, located just downstream of Pond 13. It appears that Pond 13, and/or the underlying more resistant bedrock, may be acting as a grade control structure on the reach upstream of Pond 13 (Figure 10).The channel morphology upstream of Pond 13 appears to have adjusted to this local gradient control and has resulted in the aggradation of sediment upstream of Pond 13. We understand that, the channel upstream of Pond 13 will be excavated into the stored sediment and depending on the depth to bedrock, a large proportion of these sediments will be removed as part of the restoration effort. In addition, we understand that grade control will be installed at the upstream limits of work under either Profile scenario.

# 7.0 CONCLUSIONS AND RECOMMENDATIONS

In this section, Golder summarizes the finding of our investigations and provides recommendations to facilitate the implementation of the Restoration Plan (Waterways 2018).

## 7.1 Adaptive Management and Monitoring

In our opinion, the most effective way to ensure a successful project is thorough engineering observation and field fitting of final profiles during excavation activities. This is the best way to achieve the goal of restoring natural profiles while minimizing excavation of native soils or bedrock materials. Note that this is a well-established concept first described and promoted by Karl Terzaghi as the “Observational Method” and was later described in detail by Ralph Peck (1969). The intent of the method is to balance the cost of investigation and design while still achieving a successful project through adaptive management in the field. The method entails designing to the most probable conditions rather than the most unfavorable conditions. Data gaps are filled by detailed observations during construction and designs are modified as needed.

It is important that stakeholders recognize that this is a restoration project, not an engineered stream channel, and this will by necessity entail restoration of new slopes to match previously existing slopes. This will require slope angles which, in some cases, may evidence stability just like the existing natural slopes. In our opinion, additional subsurface exploration will not alter this fundamental concept or improve the project outcome. Rather, it is understood by the Project team that shallow slides and/or erosion may occur on restored natural slopes.

## 7.2 Evolution of Design

The plan set is in general conformance with the applicable geotechnical recommendations as outlined in our “Preliminary Geotechnical Recommendations for Conceptual Level Permanente Creek Restoration Plans” dated April 28, 2014 (Golder 2014). We note that several structural construction elements that were part of the original project design in 2014 have been eliminated from the 2019 plan set. With the exception of a possible MSE wall in the Material Removal Area, structural elements such as gabions or retaining walls, which would warrant more detailed subsurface investigation and testing, are no longer part of the project.

## 7.3 Field Observations and Adaptive Management

As stated in the Field Engineering Notes section of the project plan notes (Sheet C28) stability of hillsides may necessitate:

- Field engineering and a field directed construction approach, i.e., field observations and adaptive design as discussed above
- Final geometries to be directed in the field by the Project Engineer to account for unanticipated subsurface conditions
- Flexibility with respect to final gradients and defined “grading envelopes” for channel gradients
- A narrowing of floodplain widths in areas where the final design profile approaches the lower limit of the grading envelope
- Slope benching to reduce slope angles and lengths in areas of disturbed terrain, and to control surface runoff and erosion while vegetation is established

We concur with the above recommendations, and the Field Engineering Notes in general, with respect to addressing and minimizing potential slope instabilities. We further recommend that the Project Geotechnical Engineer or Project Engineering Geologist inspect all interim and final cutslopes as the project progresses such that any potential areas of concern can be identified early in the process and remedial measures developed, if required.

## 7.4 Material Removal Area

The Material Removal Area may require a retaining structure, depending on timing of the creek restoration project with respect to site operations, to preserve infrastructure and access associated with the Upper Water Treatment System (UTS). Our understanding is that Waterways is recommending that work at the Material Removal Area is sequenced to occur after other portions of the project are constructed if the treatment facilities and Pond 1250 need to remain in place at the start of project implementation. Work would start with the Channel Widening Area and generally proceed upstream. The second phase of work would include the Rock Pile Area. The final stage of work would include the Material Removal Area.

If the MSE wall is required, then Golder recommends a geotechnical investigation be completed to prepare final design and construction plans. Based on the above construction sequence, there will adequate time to plan, permit and implement this investigation even after the project has started.

## 7.5 Rock Pile Area

The main geotechnical challenge for the proposed project is likely related to the Rock Pile Area which entails a reach of the creek where culverts will be removed, and a large stockpile of aggregate materials placed along the margin of the creek and up onto the hillside to a height in excess of 200 vertical feet. The estimated thickness of the rock pile ranges up to 100 feet. Estimated natural slopes angles underneath and above the rock pile are shown as steep as 1H:1V. We recommend inspection of these slopes by the Project Engineering Geologist or Geotechnical Engineer following the removals to evaluate the geologic conditions and stability of the exposed materials. If the removals expose bedrock, stability of the slopes should be adequate. However, if the cut leaves significant thicknesses of overburden in place, potential localized slope instability may be encountered. Golder recommends that Lehigh and Waterways have contingency plans in place to design and implement remedial measures such as:

- Additional localized removals of loose or unstable materials
- Slope laybacks and benching
- Engineered drainage controls
- Buttresses or slope sections comprised of compacted rockfill

## 7.6 Travertine Deposits

The deposition of travertine between clasts in step-pools and dam-like structures, as well as deposited sediment that is accessed by the channel flow is likely to have increased the apparent strength of localized areas of alluvial materials along the channel.  This cementation may make the removal of this material more difficult than anticipated and may play a role in long term channel stability.  Golder recommends that this cemented material be left in place wherever possible to augment the restoration design.

**Golder Associates Inc.**

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*Senior Program Leader/Principal*

*Dated: 10/31/19*

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# Appendix A

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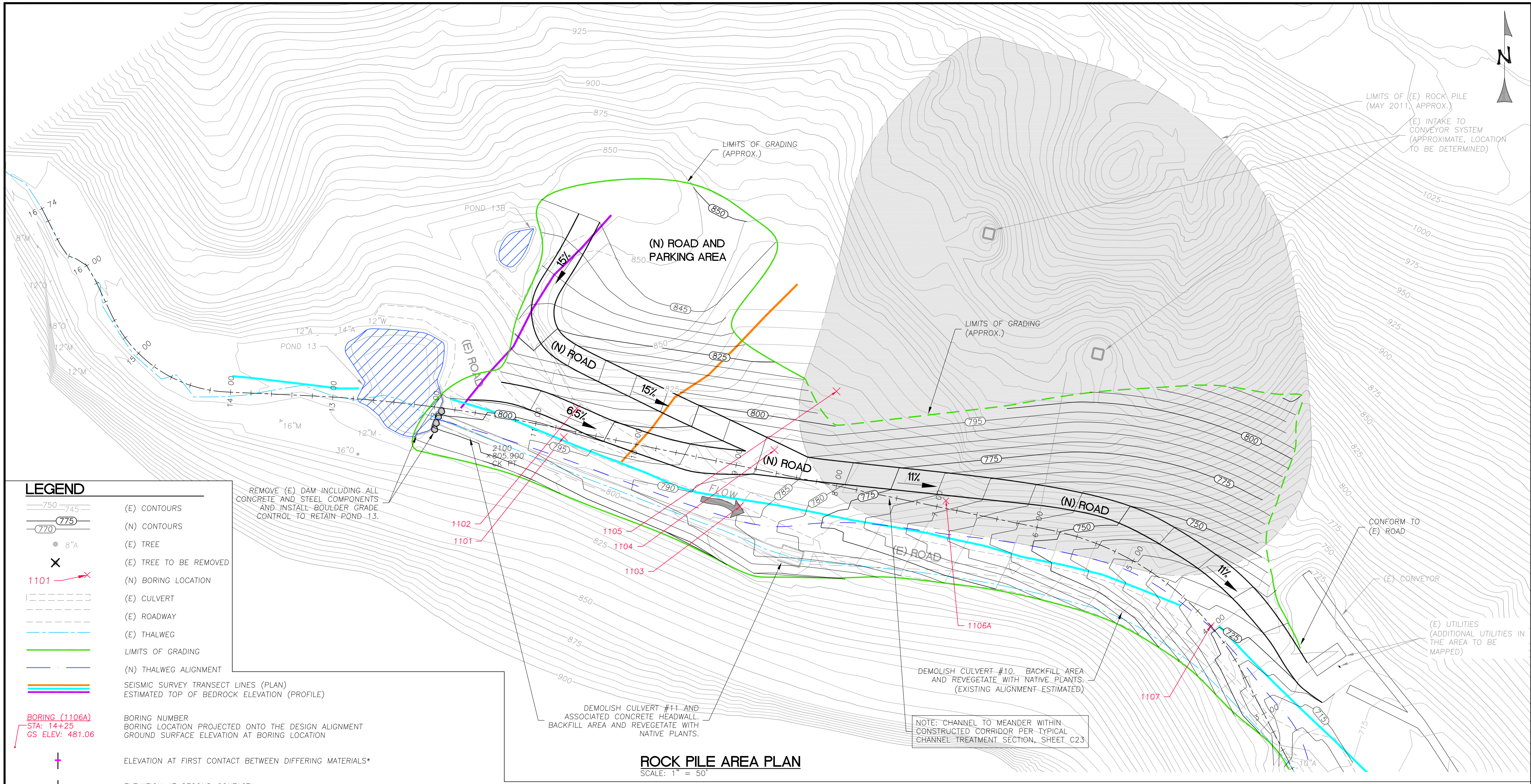
# Appendix B



## LEGEND

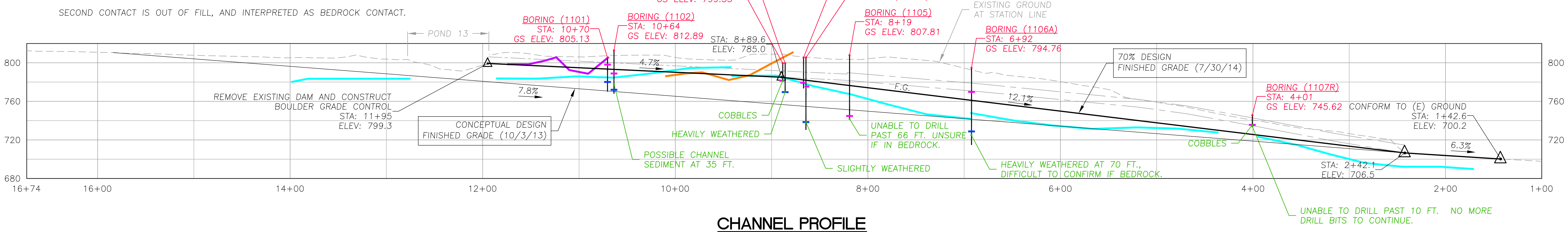
| | |
|---|---|
| 750 745 | (E) CONTOURS |
| 775 770 | (N) CONTOURS |
| ● 8"A | (E) TREE |
| ✕ | (E) TREE TO BE REMOVED |
| 1101 → ✕ | (N) BORING LOCATION |
| | (E) CULVERT |
| | (E) ROADWAY |
| | (E) THALWEG |
| | LIMITS OF GRADING |
| | (N) THALWEG ALIGNMENT |
| | SEISMIC SURVEY TRANSECT LINES (PLAN)<br>ESTIMATED TOP OF BEDROCK ELEVATION (PROFILE) |
| BORING (1106A)<br>STA: 14+25<br>GS ELEV: 481.06 | BORING NUMBER<br>BORING LOCATION PROJECTED ONTO THE DESIGN ALIGNMENT<br>GROUND SURFACE ELEVATION AT BORING LOCATION |
| ┼ | ELEVATION AT FIRST CONTACT BETWEEN DIFFERING MATERIALS* |
| ┼ | ELEVATION AT SECOND CONTACT* |

*PER PROJECT GEOTECHNICAL ENGINEER – THE FIRST CONTACT IS WHEN BORING HIT FINER MATERIAL (GRAVELY CLAY TO GRAVEL SILT). THIS COULD POSSIBLY BE EITHER FINER ZONES WITHIN THE FILL OR THE CHANNEL.

SECOND CONTACT IS OUT OF FILL, AND INTERPRETED AS BEDROCK CONTACT.

## ROCK PILE AREA PLAN

SCALE: 1" = 50'



## CHANNEL PROFILE

SCALE: 1" = 60'

WATERWAYS
CONSULTING INC.
509A SWIFT ST.
SANTA CRUZ, CA 95060
PH:(831)421-9291 // FAX:(888)819-6847
WWW.WATWAYS.COM

# PRELIMINARY

NOT FOR CONSTRUCTION

PREPARED AT THE REQUEST OF:

LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

ROCK PILE
AREA SEISMIC
STUDY AND
BORING
RESULTS

PERMANENTE CREEK
RESTORATION PLAN

SUBSURFACE BORING
LOCATIONS

| | |
|---|---|
| DESIGNED BY: | B.Z. |
| DRAWN BY: | B.M.S |
| CHECKED BY: | M.W.W. |
| DATE: | 03/10/15 |
| JOB NO.: | 13-016 |

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

FIG. 1

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# BORING NUMBER 1101

PAGE 1 OF 1

**PROJECT NUMBER** 1302968-01
**PROJECT NAME** Lehigh Rockpile Drill
**LOCATION** Cupertino, CA
**DRILLING METHOD** HSA
**GROUND ELEVATION**
**TOP OF CASING** ----
**LOGGED BY** LF
**DATE STARTED** 2/12/15
**DATE COMPLETED** 2/12/15
**CASING TYPE/DIAMETER** ----
**SCREEN TYPE/SLOT** ----
**GRAVEL PACK TYPE** ----
**GROUT TYPE/QUANTITY** ----
**DRILLING COMPANY** Gregg Drilling
**REMARKS** Borehole 1101 is located on road (furthest east location). Estimated depth of bedrock with seismic line is about 25 feet.
**REMARKS CONTINUED** Possible pond sediment at ~7 feet and weathered bedrock at ~25 feet.

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|
| | | ML | 5 | ▥ | (FILL; ML) gravelly SANDY SILT, subangular to subrounded sand and gravel, low plastic fines; brown; moist. |
| | | CH | 10<br>15<br>20 | ▨ | (NATIVE possible pond sediment; CH) gravelly CLAY, medium to high plastic fines, fine subangular gravel, some coarse sand; dark brownish-gray; mosit.<br>gravel decreases with depth<br>at 25 feet: driller notice material is a little harder |
| SS | 18/18 | CL | 25<br>30 | ▨ | (NATIVE; CL) gravelly CLAY, angular to subangular gravel, some FeOx staining, weathered Franciscan clasts; dark gray; moist. |
| | 12/18 | GM | 35 | ▨ | (NATIVE; GM) SILTY GRAVEL, angular to subangular, low to medium plastic fines, weathered Franciscan bedrock; dark gray; moist to wet. |
| | | | | | Bottom of borehole at 35.0 feet. |

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# BORING NUMBER 1102

PAGE 1 OF 1

**PROJECT NUMBER** 1302968-01

**PROJECT NAME** Lehigh Rockpile Drill

**LOCATION** Cupertino, CA

**DRILLING METHOD** HSA

**GROUND ELEVATION**

**TOP OF CASING** ----

**LOGGED BY** LF

**DATE STARTED** 2/12/15

**DATE COMPLETED** 2/12/15

**CASING TYPE/DIAMETER** ----

**SCREEN TYPE/SLOT** ----

**GRAVEL PACK TYPE** ----

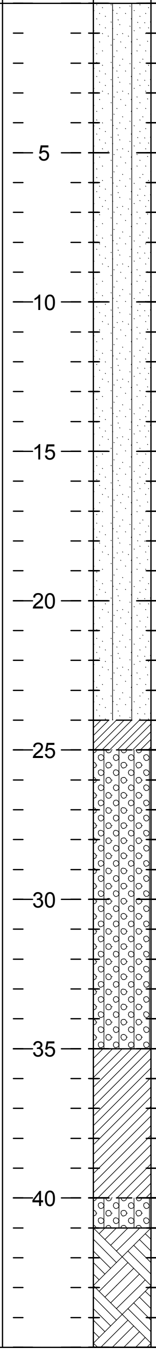
**GROUT TYPE/QUANTITY** ----

**DRILLING COMPANY** Gregg Drilling

**REMARKS** Borehole 1102 is located on road above 1101. Drilled through fill and hit clay at ~19 feet and possibly weathered Franciscan at ~41 feet.

**REMARKS CONTINUED**

DEPTH (ft. BGL) | GRAPHIC LOG



| SAMPLING METHOD | Recovery (ft) | USCS | LITHOLOGIC DESCRIPTION |
|---|---|---|---|
| | | SM | (FILL; SM) gravelly SILTY SAND, fine sand, subangular to subrounded gravel; brown; dry to moist. |
| | | | at 10-15 feet: increase in gravel, fine to coarse angular to subangular gravel; whitish-brown. |
| | 0/18 | | at 19 feet: driller noticed softer material; attempted a drive sample (no recovery) |
| | | CL | (FILL; CL) gravelly SILTY CLAY, fine subangular to subrounded gravel, some coarse sand; grayish-brown; moist. |
| | | GM | (FILL; GM) SILTY GRAVEL, angular to subangular gravel, some sand; wet. |
| | | CH | (NATIVE; CH) CLAY, possible channel sediment, medium to high plastic fines. |
| | 18/18 | GM | (NATIVE; GM) sandy SILTY GRAVEL, possible channel sediment. |
| | | ML | (NATIVE; ML) sandy gravelly SILT, low to medium plastic fines, weathered Franciscan bedrock; brownish-gray. |

Bottom of borehole at 45.0 feet.

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# BORING NUMBER 1103

PAGE 1 OF 1

**PROJECT NUMBER** 1302968-01

**DATE STARTED** 2/12/15

**PROJECT NAME** Lehigh Rockpile Drill

**DATE COMPLETED** 2/12/15

**LOCATION** Cupertino, CA

**CASING TYPE/DIAMETER** ----

**DRILLING METHOD** HSA

**SCREEN TYPE/SLOT** ----

**GROUND ELEVATION**

**GRAVEL PACK TYPE** ----

**TOP OF CASING** ----

**GROUT TYPE/QUANTITY** ----

**LOGGED BY** LF

**DRILLING COMPANY** Gregg Drilling

**REMARKS** Borehole 1103 is located on road. Hit cobbles at 18 feet and unable to drill past.

**REMARKS CONTINUED**

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|
| | | ML | | | (FILL; ML) gravelly SILT, low plastic fines, subangular to subrounded gravel, some fine sand; dark grayish-brown; moist. |
| | | SM | 5 | | (FILL; SM) gravelly SILTY SAND, fine sand, low plastic fines, subangular to subrounded gravel; brown; moist. |
| | | ML | 10 | | (FILL; ML) gravelly sandy SILT, low to medium plastic fines; dark brown; moist. |
| | | GM | 15 | | (FILL; GM) SILTY GRAVEL and COBBLES, angular to subangular; whitish-brown.<br>unable to drill past 18 feet; possibly stuck on a boulder |

Bottom of borehole at 18.0 feet.

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# BORING NUMBER 1103R

PAGE 1 OF 1

**PROJECT NUMBER** 1302968-01

**PROJECT NAME** Lehigh Rockpile Drill

**LOCATION** Cupertino, CA

**DRILLING METHOD** HSA

**GROUND ELEVATION**

**TOP OF CASING** ----

**LOGGED BY** LF

**DATE STARTED** 2/12/15

**DATE COMPLETED** 2/12/15

**CASING TYPE/DIAMETER** ----

**SCREEN TYPE/SLOT** ----

**GRAVEL PACK TYPE** ----

**GROUT TYPE/QUANTITY** ----

**DRILLING COMPANY** Gregg Drilling

**REMARKS** Borehole 1103R is 3 feet east of 1103. Hit weathered Franciscan bedrock at ~25-30 feet.

**REMARKS CONTINUED**

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION | |
|---|---|---|---|---|---|---|
| | | ML | 5 | ▥ | (FILL; ML) gravelly SILT, low plastic fines, subangular to subrounded gravel, some fine sand; light brown to brown; moist. | |
| | | SM | 10<br>15 | ░ | (FILL; SM) gravelly SILTY SAND, fine sand, low to medium plastic fines, subangular to subrounded gravel; brown to dark brown; moist. | |
| | | ML | 20 | ▥ | (FILL, ML) gravelly sandy SILT, angular to subangular gravel, weathered Franciscan clasts; brown. | |
| | | CL-ML | 25 | ▨ | (NATIVE; CL-ML) gravelly SILT to gravelly CLAY, angular to subangular gravel, weathered Franciscan bedrock; reddish-orangish-brownish-gray; moist to wet. | |
| | | | 30 | | Bottom of borehole at 30.0 feet. | |

# BORING NUMBER 1104

PAGE 1 OF 1

| | | | |
|---|---|---|---|
| **PROJECT NUMBER** | 1302968-01 | **DATE STARTED** | 2/12/15 |
| **PROJECT NAME** | Lehigh Rockpile Drill | **DATE COMPLETED** | 2/12/15 |
| **LOCATION** | Cupertino, CA | **CASING TYPE/DIAMETER** | ---- |
| **DRILLING METHOD** | HSA | **SCREEN TYPE/SLOT** | ---- |
| **GROUND ELEVATION** | | **GRAVEL PACK TYPE** | ---- |
| **TOP OF CASING** | ---- | **GROUT TYPE/QUANTITY** | ---- |
| **LOGGED BY** | LF | **DRILLING COMPANY** | Gregg Drilling |

**REMARKS** Borehole 1104 is located on rockpile. Hit cobbles at 32 feet and unable to drill past.

**REMARKS CONTINUED**

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|
| | | ML | 0–14<br>5<br>10 | ▥ | (FILL; ML) gravelly sandy SILT, low to medium plastic fines, subangular to subrounded gravel; gray; moist.<br>color change to light grayish-brown<br>color change to light brown |
| | | CL-ML | 14–20<br>15 | ▨ | (FILL; ML-CL) gravelly SILT to gravelly CLAY, medium plastic fines, subangular to subrounded gravel, trace coarse sand; brown; moist. |
| | | GM | 20–26<br>20<br>25 | ⁘ | (FILL; GM-ML) SILTY GRAVEL to gravelly SILT, low plastic fines, angular gravel, some coarse angular sand; tannish-whitish-brown; moist.<br>at 26 feet: driller noticed material became more stiff |
| | 18/18<br>3/12 | CL-ML | 26–33<br>30 | ▨ | (FILL; ML-CL) gravelly CLAY to gravelly SILT, medium plastic fines, fine subangular to subrounded gravel, some fine sand, weathered; dark brownish-gray; moist.<br>at 32 feet: hard material; unable to drill any further. |

Bottom of borehole at 33.0 feet.

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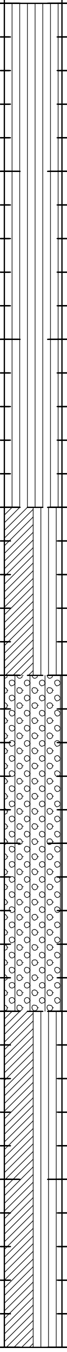
# BORING NUMBER 1104R

PAGE 1 OF 2

**PROJECT NUMBER** 1302968-01
**PROJECT NAME** Lehigh Rockpile Drill
**LOCATION** Cupertino, CA
**DRILLING METHOD** HSA
**GROUND ELEVATION**
**TOP OF CASING** ----
**LOGGED BY** LF
**REMARKS** Borehole 1104R is 3 feet east of 1104. Possibly hit weathered Franciscan bedrock at about 67 feet.
**REMARKS CONTINUED**

**DATE STARTED** 2/12/15
**DATE COMPLETED** 2/12/15
**CASING TYPE/DIAMETER** ----
**SCREEN TYPE/SLOT** ----
**GRAVEL PACK TYPE** ----
**GROUT TYPE/QUANTITY** ----
**DRILLING COMPANY** Gregg Drilling



| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|
| | | ML | 0–15 | | (FILL; ML) gravelly sandy SILT, low plastic fines, angular to subangular gravel; grayish-brown; moist.<br>at 9 ' color changes to light brown |
| | | CL-ML | 15–20 | | (FILL; ML-CL) gravelly SILT to gravelly CLAY, low to medium plastic fines; brown; moist. |
| | | GM | 20–30 | | (FILL; GM-ML) SILTY GRAVEL to gravelly SILT, low plastic fines, angular gravel; tanish-brown; moist. |
| | | CL-ML | 30– | | (FILL: ML-CL) gravelly SILT to gravelly CLAY, subangular to subrounded gravel; brown to reddish-brown; moist.<br>at 35' color changes to reddish-brown |

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# BORING NUMBER 1104R

**PROJECT NUMBER** 1302968-01

**DATE STARTED** 2/12/15

**PROJECT NAME** Lehigh Rockpile Drill

**DATE COMPLETED** 2/12/15

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|
| | | CL-ML | | | (FILL: ML-CL) gravelly SILT to gravelly CLAY, subangular to subrounded gravel; brown to reddish-brown; moist. *(continued)* |
| | | ML | 45 | | (FILL; ML) gravelly SILT, low plastic fines, coarse subangular to angular gravel; brown; moist. |
| | | CL-ML | 50 | | (FILL; ML-CL) gravelly SILT to gravelly CLAY, low to medium plastic fines, angular to subangular gravel; brown; moist. |
| | | GM | 55<br>60<br>65 | | (FILL; GM) SILTY GRAVEL, low plastic fines, fine subangular gravel; light tanish-brown; moist.<br>at 67 feet: driller notices a change in drilling |
| | | GM | 70 | | (NATIVE; GM-SM) sandy GRAVEL to gravely SAND, low plastic fines, weathered Franciscan clasts; brownish-gray to greenish-gray; moist to wet. |
| | | CL | 75 | | (NATIVE; CL) CLAY, slightly weathered Franciscan; dark gray; moist to wet. |

Bottom of borehole at 75.0 feet.

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# BORING NUMBER 1105

PAGE 1 OF 2

| | | | |
|---|---|---|---|
| **PROJECT NUMBER** | 1302968-01 | **DATE STARTED** | 2/13/15 |
| **PROJECT NAME** | Lehigh Rockpile Drill | **DATE COMPLETED** | 2/13/15 |
| **LOCATION** | Cupertino, CA | **CASING TYPE/DIAMETER** | ---- |
| **DRILLING METHOD** | HSA | **SCREEN TYPE/SLOT** | ---- |
| **GROUND ELEVATION** | | **GRAVEL PACK TYPE** | ---- |
| **TOP OF CASING** | ---- | **GROUT TYPE/QUANTITY** | ---- |
| **LOGGED BY** | LF | **DRILLING COMPANY** | Gregg Drilling |

**REMARKS** Borehole 1105 is located on rockpile (most North on Figure). Hit clay at ~63 feet, unable to drill past 66 feet.

**REMARKS CONTINUED**

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|
| | | GM | | | (FILL, GM) SILTY GRAVEL, angular to subangular; light to dark gray. |
| | | CL-ML | 5 | | (FILL; CL-ML) gravelly sandy CLAY to sandy SILT, medium plastic fines, medium to coarse sand, subangular gravel; dark gray; moist. |
| | | ML | 10<br>15 | | (FILL; ML) gravelly SILT, low plastic fines, fine to coarse subangular gravel, some coarse sand; brown; moist. |
| | | GM | 20<br>25<br>30 | | (FILL, GM) SILTY GRAVEL, fine to coarse angular to subangular gravel, low plastic fines; whitish-brown; moist. |
| | | ML | | | (FILL; ML) gravelly SILT, low to medium plastic fines, subangular gravel; brown; moist. |
| | | ML | 35 | | (FILL; ML) gravelly SILT, low plastic fines, angular to subangular gravel, some coarse angular to subangular sand, slightly weathered Franciscan clasts; reddish-orangish-brown; moist.<br>at 35 feet: driller noticed material became more stiff; drill bit became hot and started smoking. |

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# BORING NUMBER 1105

PAGE 2 OF 2

**PROJECT NUMBER** 1302968-01

**DATE STARTED** 2/13/15

**PROJECT NAME** Lehigh Rockpile Drill

**DATE COMPLETED** 2/13/15

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION | |
|---|---|---|---|---|---|---|
| | | ML | | | (FILL; ML) gravelly SILT, low plastic fines, angular to subangular gravel, some coarse angular to subangular sand, slightly weathered Franciscan clasts; reddish-orangish-brown; moist. *(continued)* | |
| | | ML | 45<br>50<br>55 | | (FILL; ML) gravelly SILT, low plastic fines, anuglar to subangular gravel; brown; moist. | |
| | | SM-ML | 60 | | (FILL; ML-SM) gravelly sandy SILT, low plastic fines, fine to coarse sand, subangular to subrounded gravel; brown; moist. | |
| SS | 3/6<br>5/6 | CH | 65 | | (NATIVE; CH) gravelly CLAY, possible pond sediment, medium to high plastic fines, subangular to subrounded gravel, some coarse subangular sand; brown to dark brownish-gray to black; moist. | |
| | | CL-ML | | | (NATIVE; ML-CL) CLAYEY SILT to SILTY CLAY, possible pond sediment, low plastic fines, some fine sand, trace coarse subangular sand; light brownish-gray mottled dark gray. | |

Bottom of borehole at 66.0 feet.

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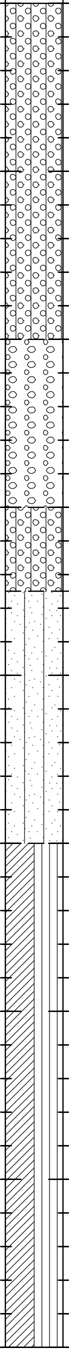
# BORING NUMBER 1106A

PAGE 1 OF 2

|  |  |  |  |
|---|---|---|---|
| **PROJECT NUMBER** | 1302968-01 | **DATE STARTED** | 2/13/15 |
| **PROJECT NAME** | Lehigh Rockpile Drill | **DATE COMPLETED** | 2/13/15 |
| **LOCATION** | Cupertino, CA | **CASING TYPE/DIAMETER** | ---- |
| **DRILLING METHOD** | HSA | **SCREEN TYPE/SLOT** | ---- |
| **GROUND ELEVATION** |  | **GRAVEL PACK TYPE** | ---- |
| **TOP OF CASING** | ---- | **GROUT TYPE/QUANTITY** | ---- |
| **LOGGED BY** | LF | **DRILLING COMPANY** | Gregg Drilling |

**REMARKS** Borehole 1106A location is downslope on rockpile (east of previous boreholes). Driller notes gravel at ~18 feet.

**REMARKS CONTINUED** Possible pond sediment at ~25 feet. Possibly hit weathered Franciscan bedrock at ~66 feet.



| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|
|  |  | GM | 0–10 |  | (FILL; GM) sandy SILTY GRAVEL, angular to subangular gravel, low plastic fines, fine to coarse sand; brown; moist. |
|  |  | GP | 10–15 |  | (FILL; GP) poorly graded GRAVEL, coarse subangular gravel, some silt; brown; moist. |
|  |  | GM | 15–17.5 |  | (FILL; GM-GC) SILTY GRAVEL to CLAYEY GRAVEL, low plastic fines, subangular gravel; brown; moist. |
|  |  | SM | 17.5–25 |  | (FILL; SM) SILTY SAND, fine sand, low plastic fines, some medium to coarse subangular sand, some fine to coarse subangular gravel; brown; moist. |
|  |  | CL-ML | 25– |  | (FILL/COLLUVIUM (?); ML-CL) gravelly SILT to gravelly CLAY, low to medium plastic fines, fine to coarse subangular gravel; brown; moist. |

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# BORING NUMBER 1106A

**PROJECT NUMBER** 1302968-01

**PROJECT NAME** Lehigh Rockpile Drill

**DATE STARTED** 2/13/15

**DATE COMPLETED** 2/13/15

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION | |
|---|---|---|---|---|---|---|
| | | ML | | ▥ | (FILL/COLLUVIUM (?); ML) gravelly SILT, low plastic fines, fine subangular gravel; brown; moist. | |
| | | ML | 45 | ▥ | (FILL/COLLUVIUM (?); ML) gravelly SILT, low palstic fines, fine subangular gravel, some fine to coarse subangular sand; brown; moist. | |
| | | GM | 50<br>55 | ○ | (FILL/COLLUVIUM (?); GM) SILTY GRAVEL, fine angular to subangular gravel, low plastic fines, some coarse subangular gravel; brown; moist. | |
| | | ML | 60 | ▥ | (FILL/COLLUVIUM (?); ML) gravelly SILT, low plastic fines, fine to coarse subangular gravel, some coarse subangular sand; brown; moist | |
| SS | 12/18 | | 65 | ▥ | | |
| | | SM | | ▨ | (NATIVE; SM/GP) SILTY SAND and GRAVEL, heavily weathered; wet. | |
| SS | 6/18 | CL-ML | 70 | ▨ | (NATIVE; ML-CL) gravelly SILT to gravelly CLAY, heavily weathered, possibly Franciscan bedrock; wet. | |
| | | GM | | ▨ | (NATIVE; GM) sandy SILTY GRAVEL, fine to coarse angular to subangular gravel, possibly Franciscan bedrock; brown and dark green; wet. | |
| SS | 12/18 | SM | 75 | ▨ | (NATIVE; SM) gravelly SILTY SAND, fine to coarse sand, low plastic fines, angular to subangular gravel, weathered, possibly Franciscan bedrock; reddish-brown mottled brown; wet. | |
| SS | 3/80 | | 80 | | Bottom of borehole at 80.0 feet. | |

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# BORING NUMBER 1107

PAGE 1 OF 1

| | | | |
|---|---|---|---|
| **PROJECT NUMBER** | 1302968-01 | **DATE STARTED** | 2/13/15 |
| **PROJECT NAME** | Lehigh Rockpile Drill | **DATE COMPLETED** | 2/13/15 |
| **LOCATION** | Cupertino, CA | **CASING TYPE/DIAMETER** | ---- |
| **DRILLING METHOD** | HSA | **SCREEN TYPE/SLOT** | ---- |
| **GROUND ELEVATION** | | **GRAVEL PACK TYPE** | ---- |
| **TOP OF CASING** | ---- | **GROUT TYPE/QUANTITY** | ---- |
| **LOGGED BY** | LF | **DRILLING COMPANY** | Gregg Drilling |

**REMARKS** Borehole 1107 is located on rockpile (most East on Figure). Hit a burried retaining wall at 7 feet and can't drill further.

**REMARKS CONTINUED**

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION | |
|---|---|---|---|---|---|---|
| | | GM | 5 | | (FILL; ML-GM) gravelly SILT to SILTY GRAVEL, low plastic fines, fine to coarse angular to subangular gravel, some coarse angular to subangular sand; dark gray; moist.<br>at 7 feet: hit retaining well; can't drill futher. | |
| | | | | | Bottom of borehole at 7.0 feet. | |

Golder Associates, Inc.

Telephone:

# BORING NUMBER 1107R

PAGE 1 OF 1

**PROJECT NUMBER** 1302968-01

**PROJECT NAME** Lehigh Rockpile Drill

**LOCATION** Cupertino, CA

**DRILLING METHOD** HSA

**GROUND ELEVATION**

**TOP OF CASING** ----

**LOGGED BY** LF

**DATE STARTED** 2/13/15

**DATE COMPLETED** 2/13/15

**CASING TYPE/DIAMETER** ----

**SCREEN TYPE/SLOT** ----

**GRAVEL PACK TYPE** ----

**GROUT TYPE/QUANTITY** ----

**DRILLING COMPANY** Gregg Drilling

**REMARKS** Borehole 1107R is 3 feet east of 1107. Hit cobbles 10 feet and unable to drill past.

**REMARKS CONTINUED**

| SAMPLING METHOD | Recovery (ft) | USCS | DEPTH (ft. BGL) | GRAPHIC LOG | LITHOLOGIC DESCRIPTION |  |
|---|---|---|---|---|---|---|
|  |  | GM | 0–10 (5, 10) | ▨ | (FILL; GM) SILTY GRAVEL, coarse subangular gravel; dark gray; moist.<br>at 10 feet: stuck on cobble; can't drill further. |  |
|  |  |  | 10 |  | Bottom of borehole at 10.0 feet. |  |

WATERWAYS
CONSULTING, INC.

# APPENDIX I

## Golder Associates 2021

## Slope Stability Analyses, Permanente Creek Restoration Plan

GOLDER
MEMBER OF WSP

# TECHNICAL MEMORANDUM

**DATE** July 22, 2021 **Project No.** 179018610

**TO** Erika Guerra
Lehigh Hanson

**FROM** Robert Paul C. Erickson, PE; William L. Fowler, PG, CEG **EMAIL robertpaul_erickson@golder.com, bill_fowler@golder.com**

**RE: SLOPE STABILITY ANALYSES, PERMANENTE CREEK RESTORATION PLAN, LEHIGH SOUTHWEST CEMENT COMPANY AND HANSON PERMANENTE CEMENT, INC. PERMANENTE QUARRY, CUPERTINO, CALIFORNIA**

Ms. Guerra,

Golder Associates Inc. (Golder) is submitting this technical memorandum to Lehigh Southwest Cement Company and Hanson Permanente Cement, Inc. (Lehigh) to present the results of our slope stability analyses of the proposed Rock Pile and mining overburden removal to the design finished grade related to Permanente Creek Restoration Plan, herein referred to as the Restoration Plan (Waterways, 2018)[1], at the Permanente Quarry in Cupertino, California. This work was performed in support of our response to comments dated June 25, 2021 compiled by ESA and submitted to the County of Santa Clara regarding the Permanente Creek Restoration Plan (PCRP).

The following sections provide a brief description of the analyses that were performed, the results and conclusions, and relevant slope stability analyses model outputs are provided as Attachment 1.

## 1.0 MODEL DEVELOPMENT

Golder analyzed cross-section C-C’, shown on Sheets 19 and 21 of the Restoration Plan, 90% design submittal (Waterways, 2019). This cross-section location is considered critical for slope stability because it consists of, nominally, the greatest height of the rockpile overburden material (250 feet measured from toe to crest) and captures the steepest inclinations of both the existing rockpile (approximately 1.1H to 1.2H:1V) and underlying native metabasalt (aka greenstone) (approximately 1H: 1V). The geometry of the existing site conditions is based on topographic data per a survey collected by Lehigh in May 2011. The Restoration Plan provides additional information regarding the interpretation of the depth to the underlying native bedrock. The topographic data provided to Golder was truncated at the existing haul road on the north side of the creek at approximately elevation 1070 feet (El. 1070), therefore, model geometry north of the haul road was estimated based on measurements from Google Earth.

In lieu of piezometer data along cross-section C-C’, Golder assumed a phreatic surface based on our understanding of the general subsurface water conditions along the south rim of the quarry as informed by long

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[1] Waterways Consulting, Inc. 2019. Permanente Creek Restoration Plan Grading Plan 90% Design. Santa Clara County Grading Permit Submittal, October 31, 2019.

term installation and data collection from vibrating wire piezometers installed between the quarry and Permanente Creek. The analyses performed here assumed the depth to water is approximately 75 feet below the existing haul road and declines through the native bedrock to a depth of approximately 20 feet below the existing culvert in the creek (near original creek thalweg elevation).

## 2.0 ANALYSES

Golder performed 2-dimensional, limit equilibrium slope stability analysis along cross-section C-C’ using Slide2 Modeler, Version 9.012[2]. The analyses presented here used Spencer’s method of analysis because it satisfies static horizontal and vertical equilibrium as well as moment equilibrium. These analyses evaluated circular failures only because the interpretation of the subsurface conditions indicate a block type failure is unlikely (i.e., no weak horizontal stratum). Critical slip surfaces and corresponding FOS were evaluated for local failures through upper and lower portions of the respective slopes as well as global failures that span from the ultimate crest to ultimate toe of the final slope configuration.

Golder analyzed the following four cases for slope stability:

1. The existing rockpile overburden given existing conditions.
2. The interpreted native bedrock following excavation and removal of the rockpile overburden and underlying thin surficial deposits.
3. The interpreted native bedrock surface in the creek bottom following excavation to the expected upper limit of the design finished subgrade of the creek per the Restoration Plan.
4. The interpreted native bedrock surface in the creek bottom following excavation to the expected lower limit of the design finished subgrade of the creek per the Restoration Plan.

As a limited sensitivity analysis, Golder evaluated each of the above four cases considering the assume phreatic surface described in Section 1 as well as under dry conditions to bracket the range of factors of safety (FOS).

## 3.0 GEOTECHNICAL PARAMETERS

The geotechnical parameters used in slope stability analyses are summarized in Table 1 and described below.

**Table 1: Summary of Geotechnical Parameters**

| Material | Unit Weight (pcf) | Cohesion (psf) | Effective Friction Angle (degrees) |
|---|---|---|---|
| Rockpile Overburden | 125 | 0 | 40 |
| Metabasalt/Greenstone | 165 | 6,480 | 30 |

Notes: pcf = pounds per cubic foot
psf = pounds per square foot

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[2] Rocscience Inc. 2020. Slide 2 Modeler, 2D Limit Equilibrium Analysis for Slopes. Build Version 9.012. Build date December 11, 2020.

Golder assumed the rockpile overburden has a unit weight of 125 pounds per cubic foot (pcf) with 0 cohesion and an effective friction angle (Φ') of 40 degrees. Its assumed friction angle corresponds to the rockpile's angle of repose and these assumed shear strength parameters yield a minimum static FOS of 1.0 which is reasonable considering the rockpile has performed well and appears stable since its placement.

Numerous previous analyses were performed by Golder[3] to back calculate, test, and develop shear strength parameters for the native greenstone at the site. These investigations and analyses determined the characteristics of the greenstone vary across the site with poorer quality greenstone generally observed in the northern portion of the quarry and better-quality rock located along the southern and southeastern portions of the site. The best geologic analog for the Rock Pile area is the nearby southern quarry rim which is located about 1500 feet west-northwest of the Rock Pile. The two areas are on trend with respect to the structural fabric of the quarry, and it is our opinion that they likely are underlain by the same general package of Franciscan bedrock comprised of a mixture of metabasalt and graywacke with associated interlayered limestone blocks.

Golder performed a detailed investigation and analyses of the south quarry area for the purpose of final pitslope design in 2008. The results of this work are included as Chapter 9 of our geotechnical report published in support of the updated 2011 Reclamation Plan. Four coreholes were installed in the south quarry rim and approximately 1500 feet of core were recovered and analyzed. Rock mass properties used for the pitslope design were developed from geotechnical core logging, point load testing, and laboratory testing of the core. Mohr-Coulomb strengths for the rock units were estimated from Hoek-Brown strengths using the computer program RocData, by Rocscience. Based on this previous work, Golder assumed the metabasalt/greenstone unit has a unit weight of 165 pounds per cubic foot (pcf) with 45 psi cohesion and an effective friction angle (Φ') of 30 degrees.

## 4.0 RESULTS

The results of slope stability analyses are summarized in Table 2 and relevant model outputs are provided as Attachment 1.

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[3] Golder Associates Inc. 2011. Geotechnical Evaluations and Design Recommendations (Revised), Permanente Quarry Reclamation Plan Update, Santa Clara County, California. December 2011.

**Table 2: Summary of Slope Stability Analyses**

| Case | Failure Mode | FOS | |
|---|---|---|---|
| | | Hypothetical Dry Conditions | Assumed Phreatic Surface |
| 1 – Existing Conditions | Upper Slope | 1.13 | 1.13 |
| | Lower Slope | 1.15 | 1.15 |
| | Global | 1.37 | 1.37 |
| 2 – Excavate Rockpile | Local (Upper Slope) | 2.09 | 1.98 |
| | Global | 2.32 | 2.05 |
| 3 – Excavate to Upper Limit of Finished Grade | Local (Upper Slope) | 2.09 | 1.97 |
| | Lower Slope | 5.58 | 5.13 |
| | Global | 2.14 | 1.87 |
| 4 – Excavation to Lower Limit of Finished Grade | Local (Upper Slope) | 2.09 | 1.98 |
| | Lower Slope | 4.92 | 4.37 |
| | Global | 2.13 | 1.83 |

## 5.0 CONCLUSIONS AND CONSIDERATIONS

The results of the analyses presented here indicate the proposed excavation of the existing rockpile as well as excavation to both the upper and lower limits of the finished subgrade of the creek per the Restoration Plan will exceed a static FOS of 1.8. These conclusions are based on the interpreted extent of the native metabasalt/greenstone beneath the rockpile as described in the Restoration Plan, the condition (and corresponding geotechnical parameters) of the native metabasalt/greenstone Golder assumed for the analyses, and the phreatic surface Golder assumed for the analyses.

As outlined in our response to comments, and our previous documents published in support of the Permanente Creek Restoration Plan, a qualified professional engineer or geologist is required to inspect and map the native bedrock that is exposed beneath the rockpile overburden to confirm, or modify, the assumptions made to perform these analyses. If the observed conditions are different than those assumed here, additional analyses may be required.

## 6.0 CLOSING

Please contact the undersigned if you have questions or require clarifications regarding the information provided in this memorandum.

**Golder Associates Inc.**

REGISTERED PROFESSIONAL ENGINEER
ROBERT-PAUL C. ERICKSON
EXP. 3/31/22
C84750
CIVIL
STATE OF CALIFORNIA

Robert Paul C. Erickson, PE
*Senior Consultant*

William L. Fowler, PG, CEG
*Principal Engineering Geologist*

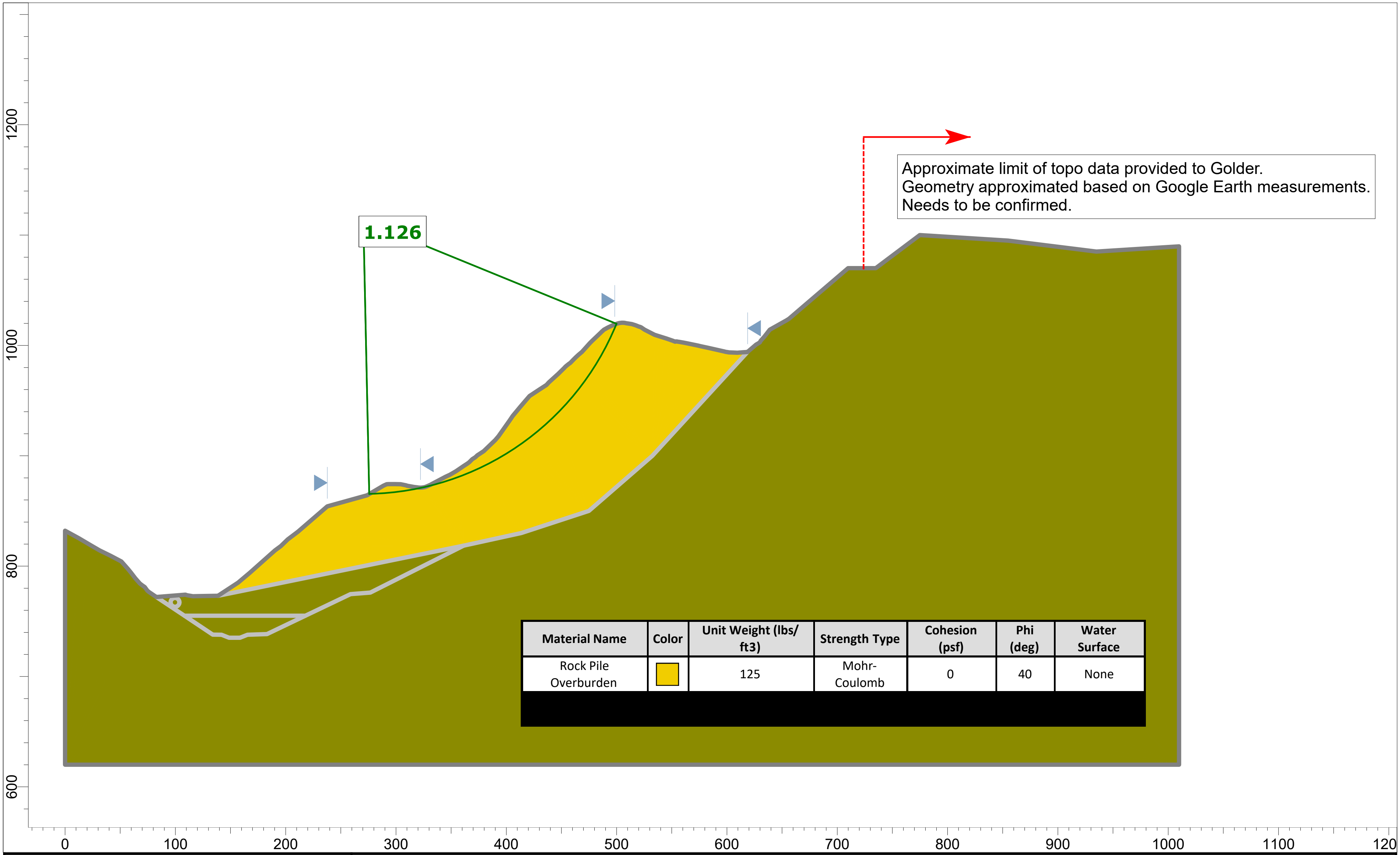
RPCE/WLF/rpce

Attachments: Attachment 1 – Slope Stability Analyses Model Outputs

https://golderassociates.sharepoint.com/sites/0637109940-lehighpermgwmonitoring-ca/shared documents/creek restoration/lehigh permanente creek restoration slope stability memo - 20210722.docx

## ATTACHMENT 1

# Slope Stability Analyses Model Outputs



Approximate limit of topo data provided to Golder.
Geometry approximated based on Google Earth measurements.
Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |

| | |
|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program |
| *Analysis Description* | |
| *Drawn By* | |
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| *Company* | |
| *Date* | 7/9/2021, 4:25:49 PM |
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GOLDER

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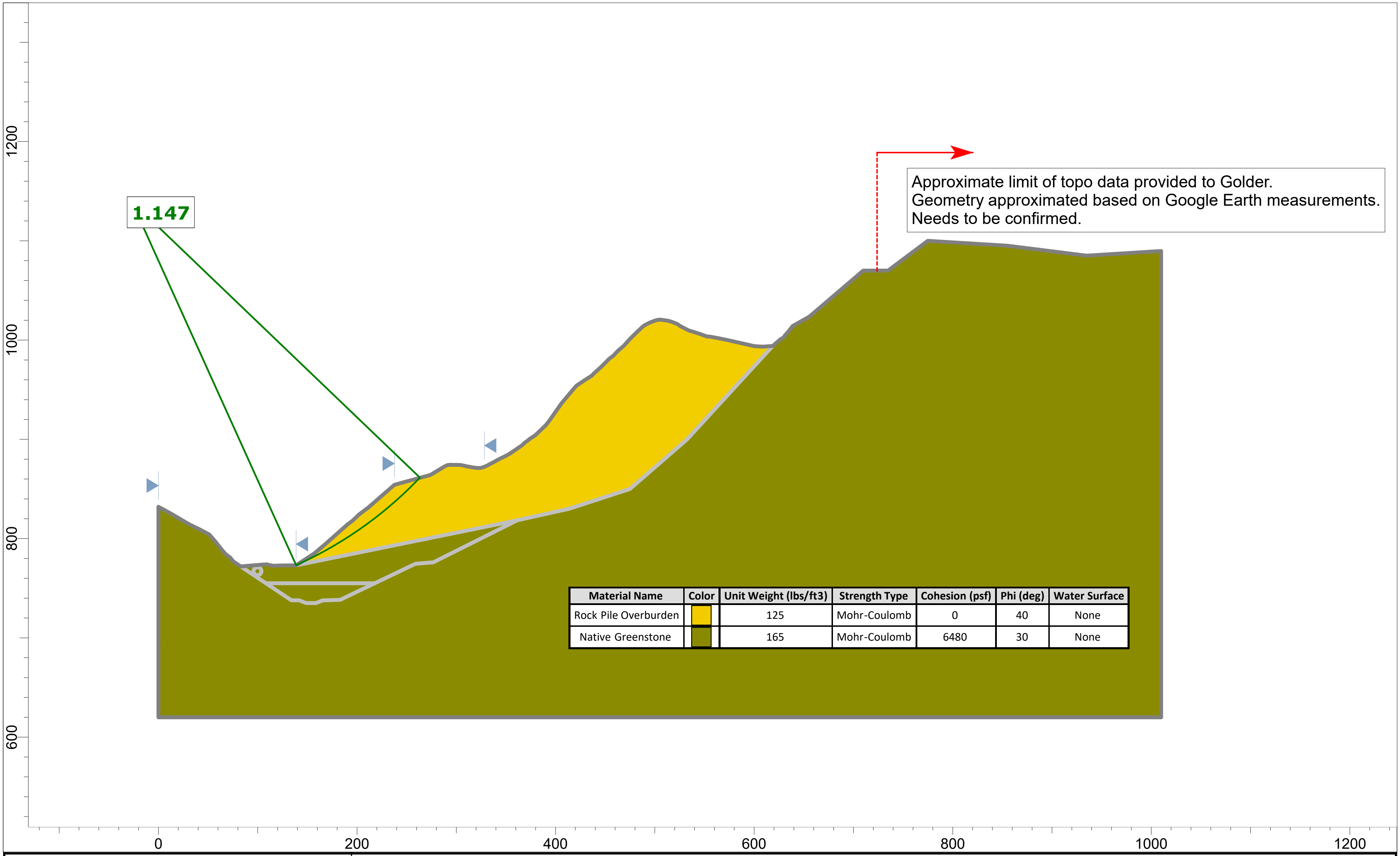

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Geometry approximated based on Google Earth measurements.
Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | None |

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*Project* SLIDE - An Interactive Slope Stability Program

*Analysis Description*

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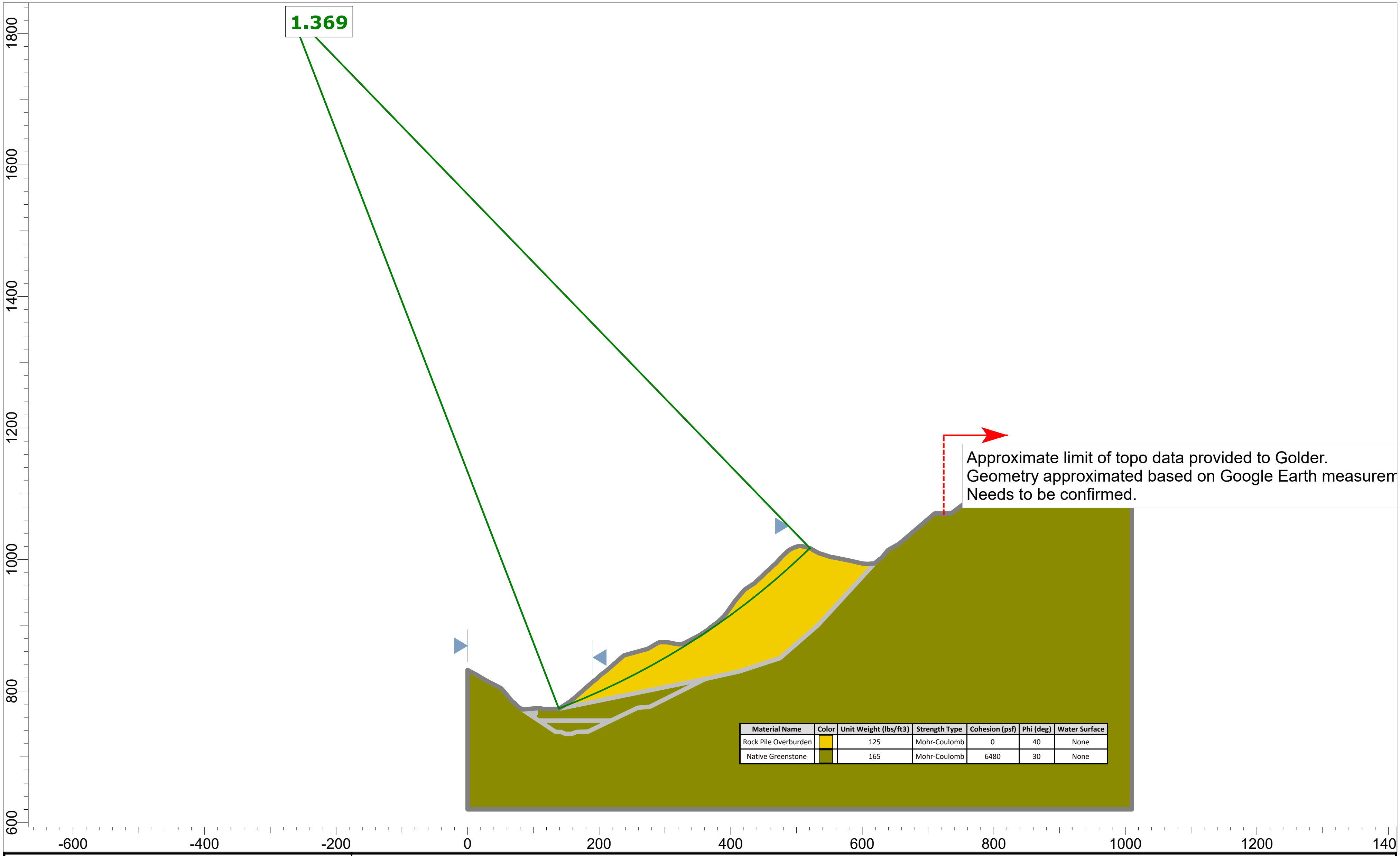
*Company*

*Date* 7/9/2021, 4:25:49 PM

*File Name* Section C-C'_20210715.slmd



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Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |
| Native Greenstone | 🟫 | 165 | Mohr-Coulomb | 6480 | 30 | None |

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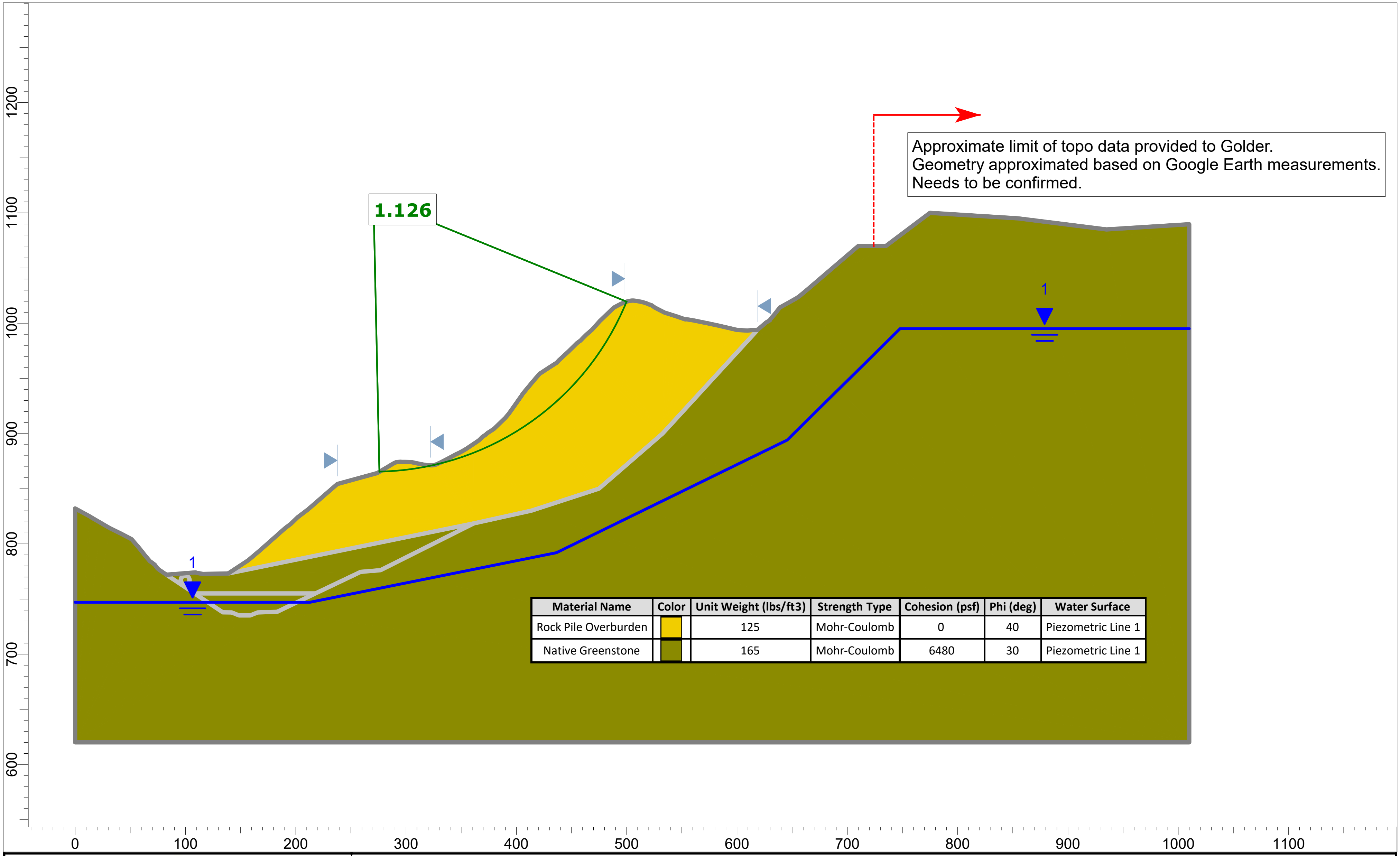

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Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | Piezometric Line 1 |

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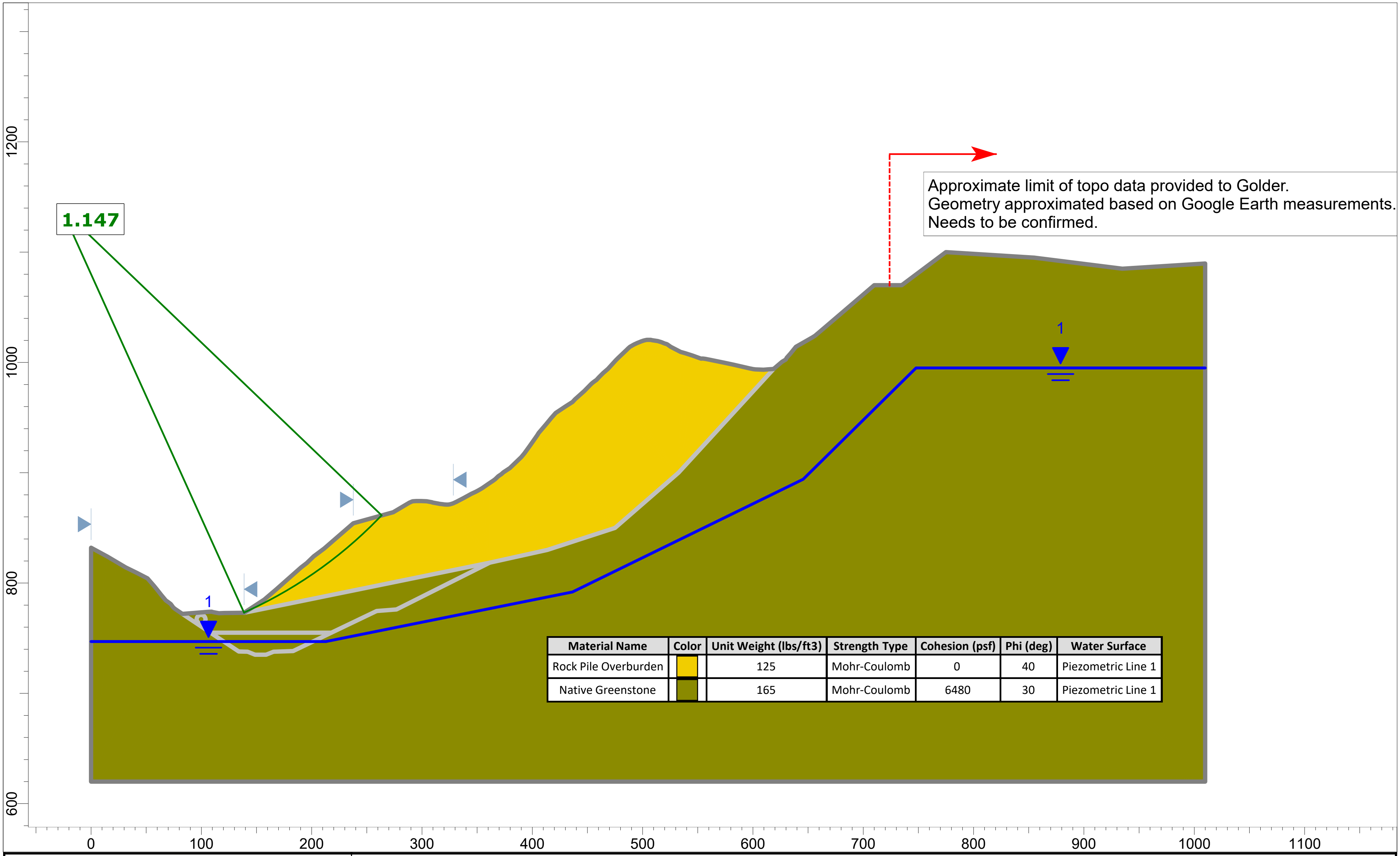

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Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | Piezometric Line 1 |

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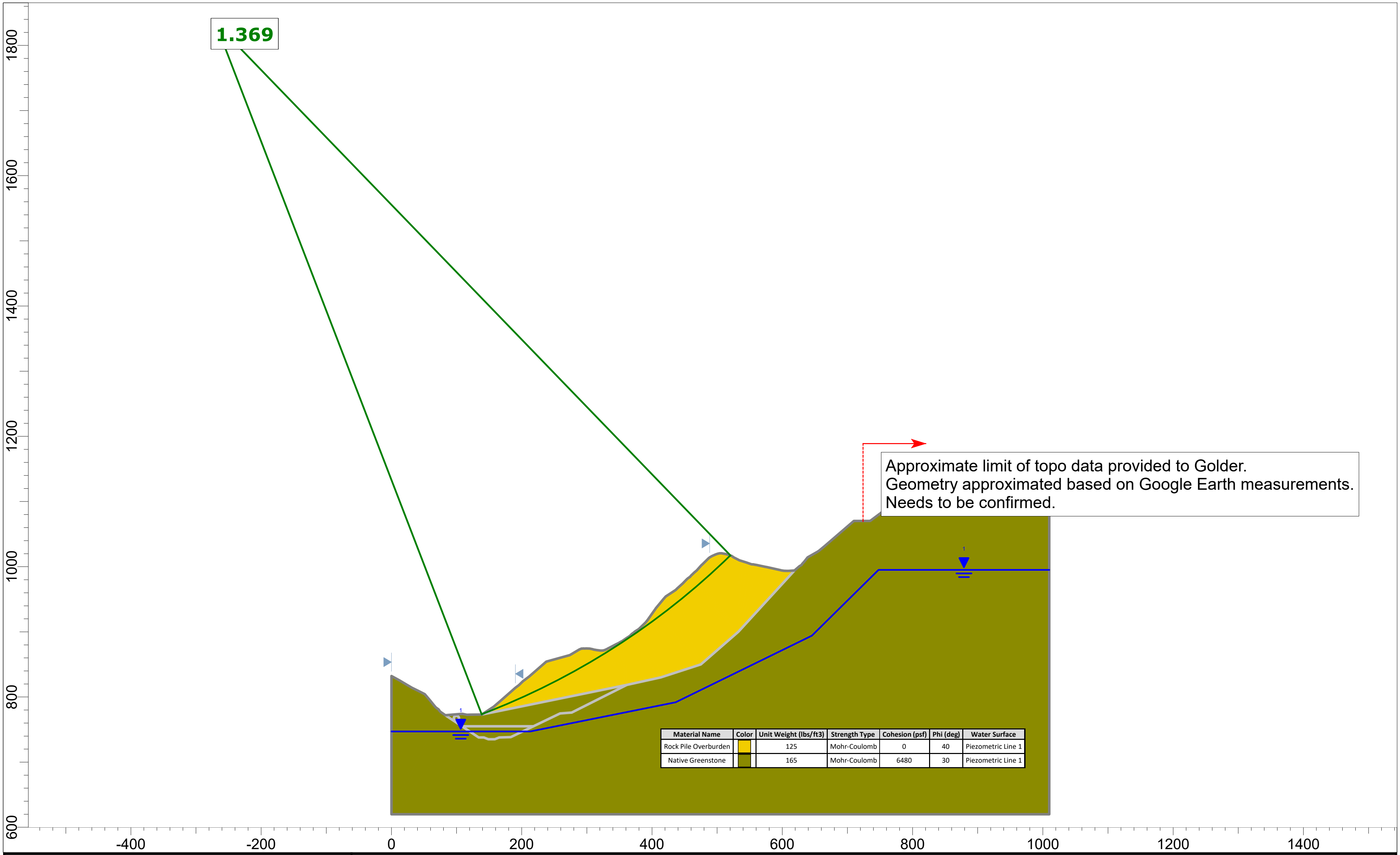

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Needs to be confirmed.

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|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | Piezometric Line 1 |

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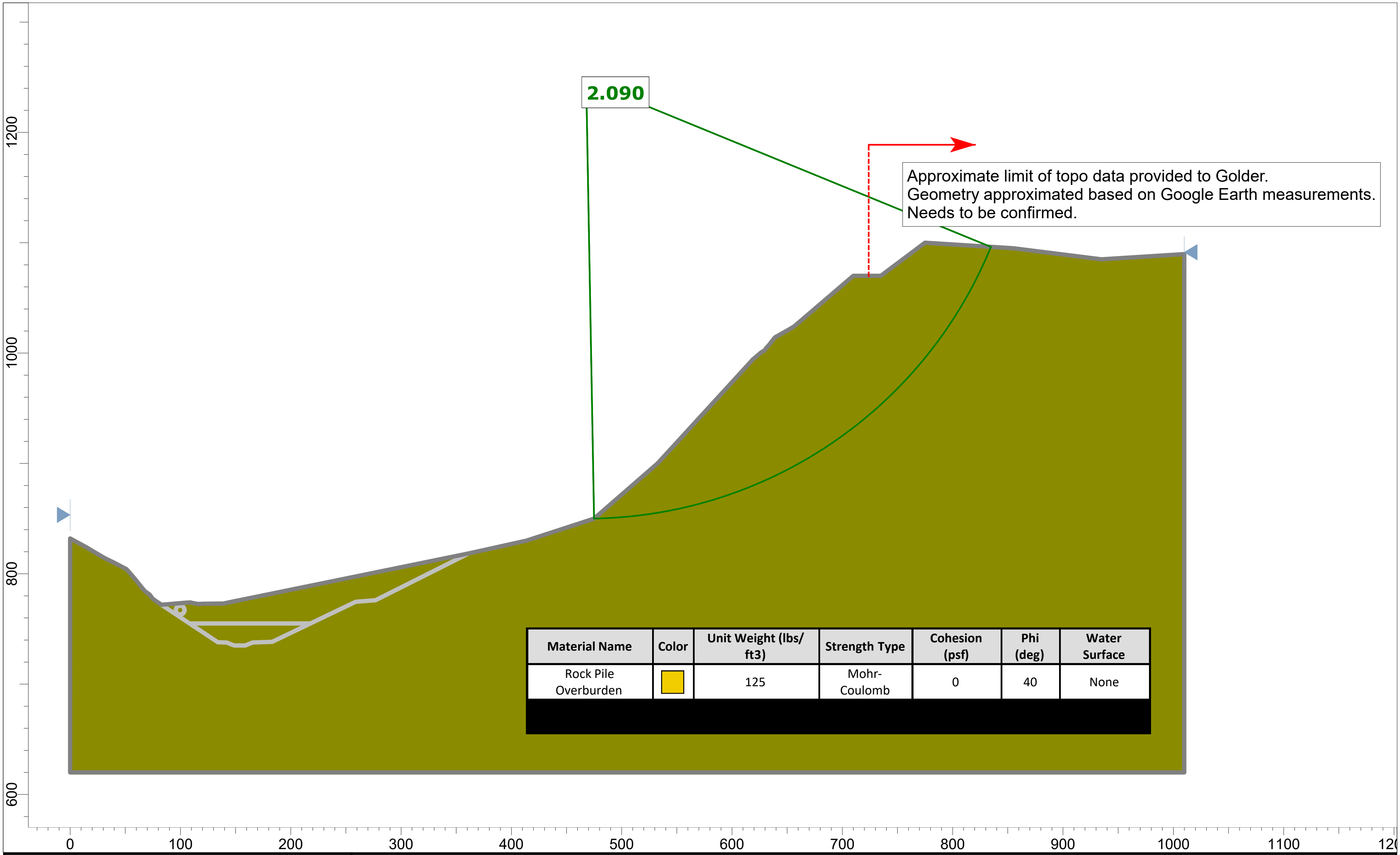

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Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |

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*Project* SLIDE - An Interactive Slope Stability Program

*Analysis Description*

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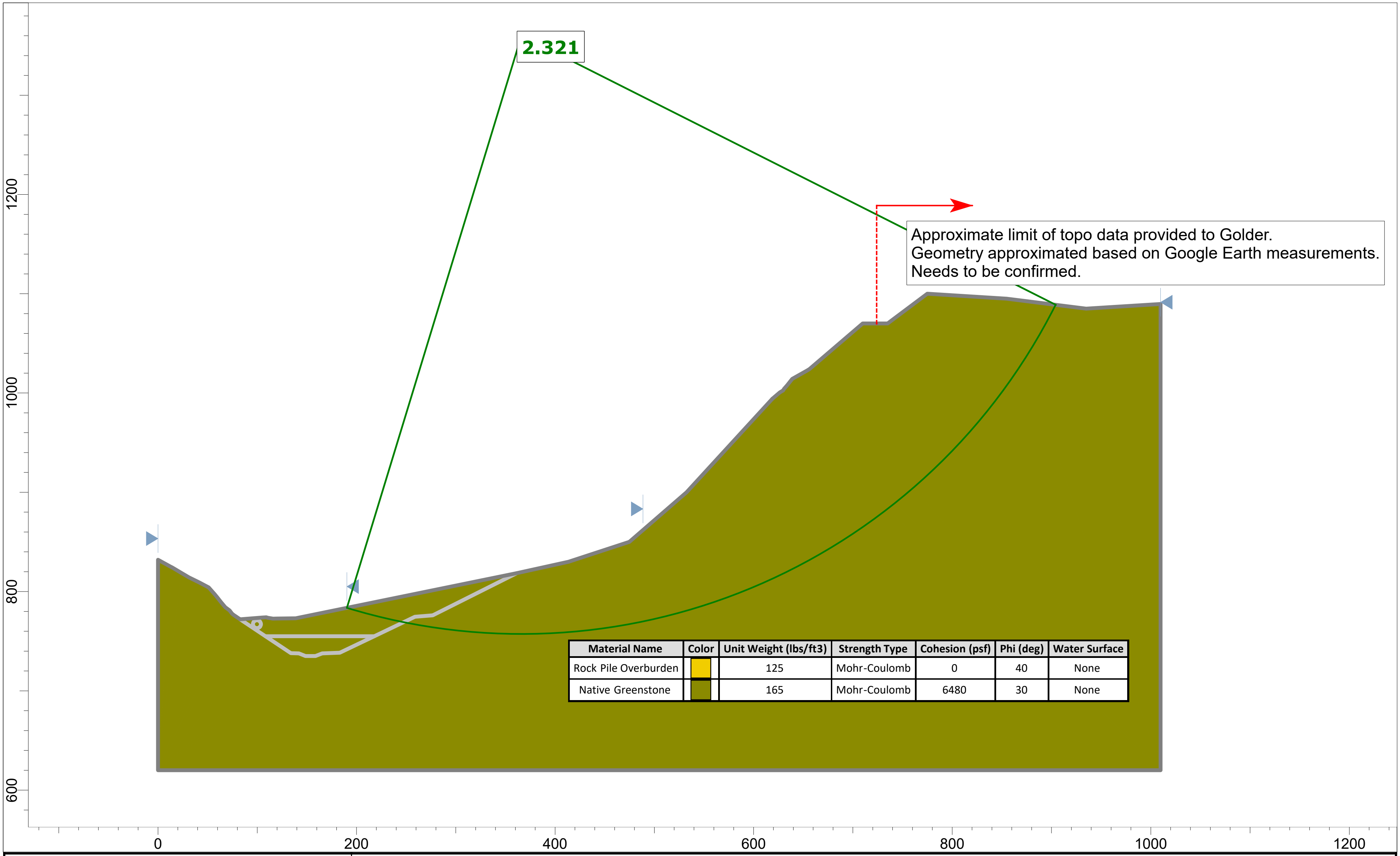

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Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | None |

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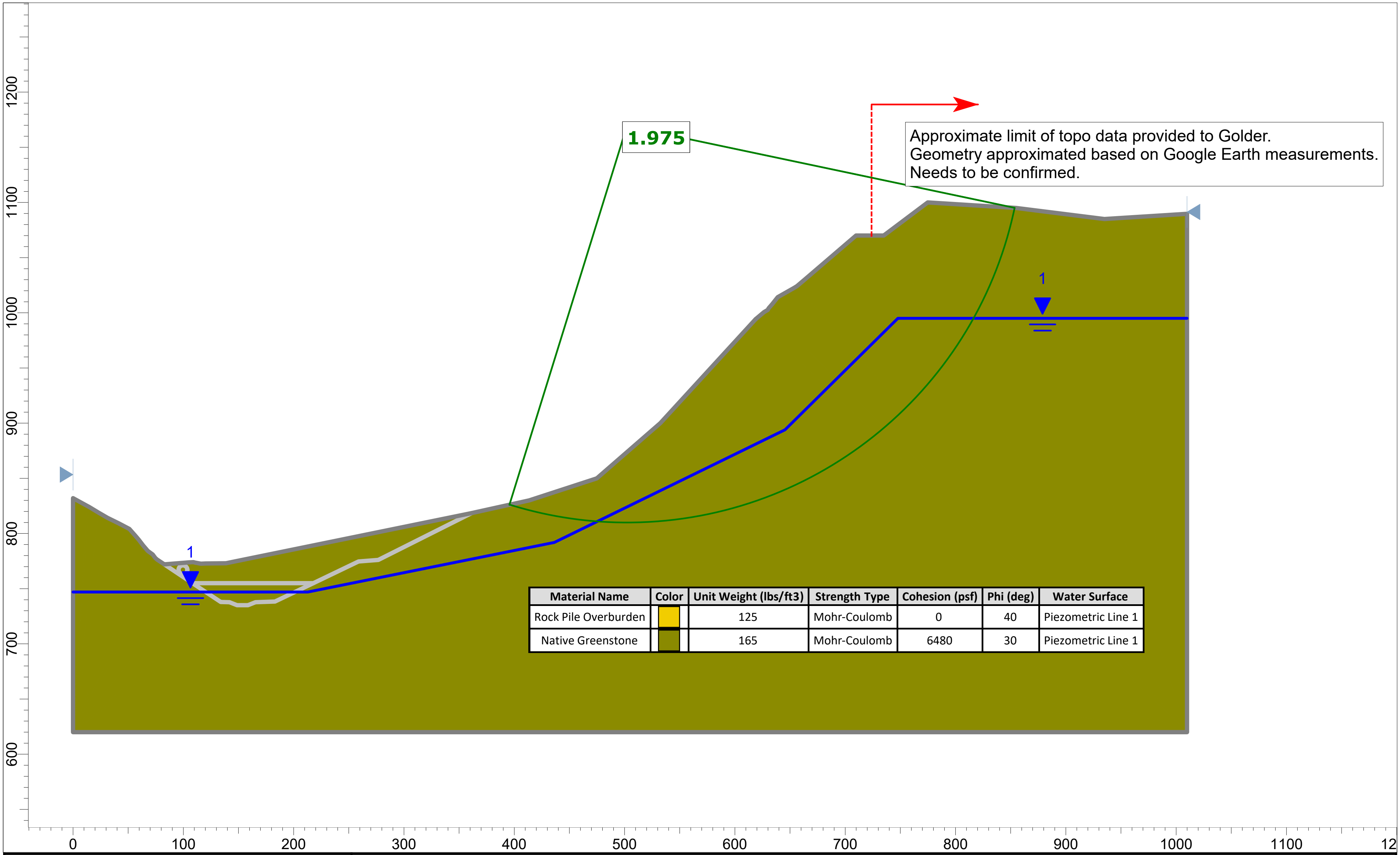

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Needs to be confirmed.

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|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | Piezometric Line 1 |

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*Project*
SLIDE - An Interactive Slope Stability Program

*Analysis Description*

*Drawn By*

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*Company*

*Date* 7/9/2021, 4:25:49 PM

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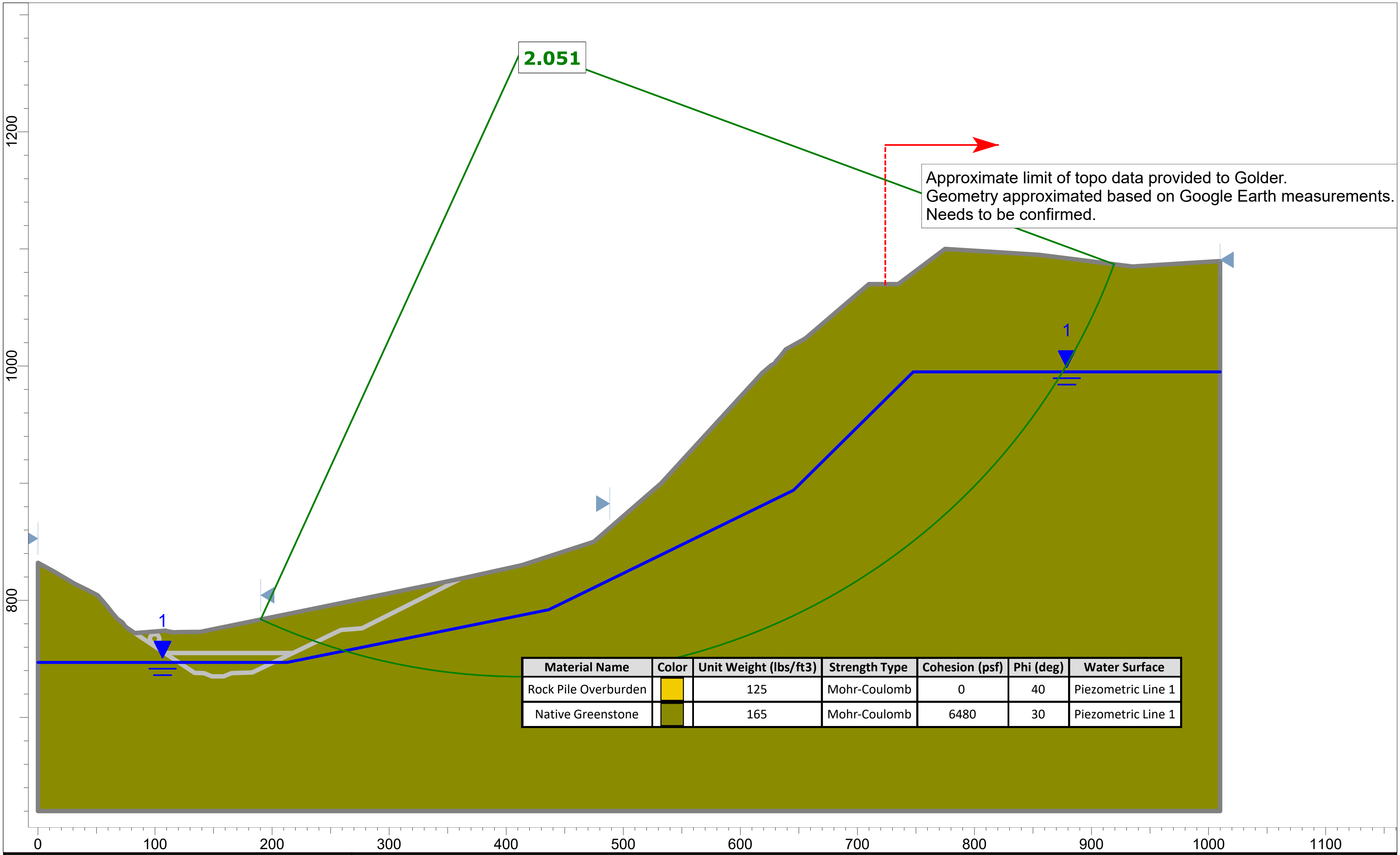

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Needs to be confirmed.

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|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | Piezometric Line 1 |

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*Project*
SLIDE - An Interactive Slope Stability Program

*Analysis Description*

*Drawn By*

*Scale* 1:1361

*Company*

*Date* 7/9/2021, 4:25:49 PM

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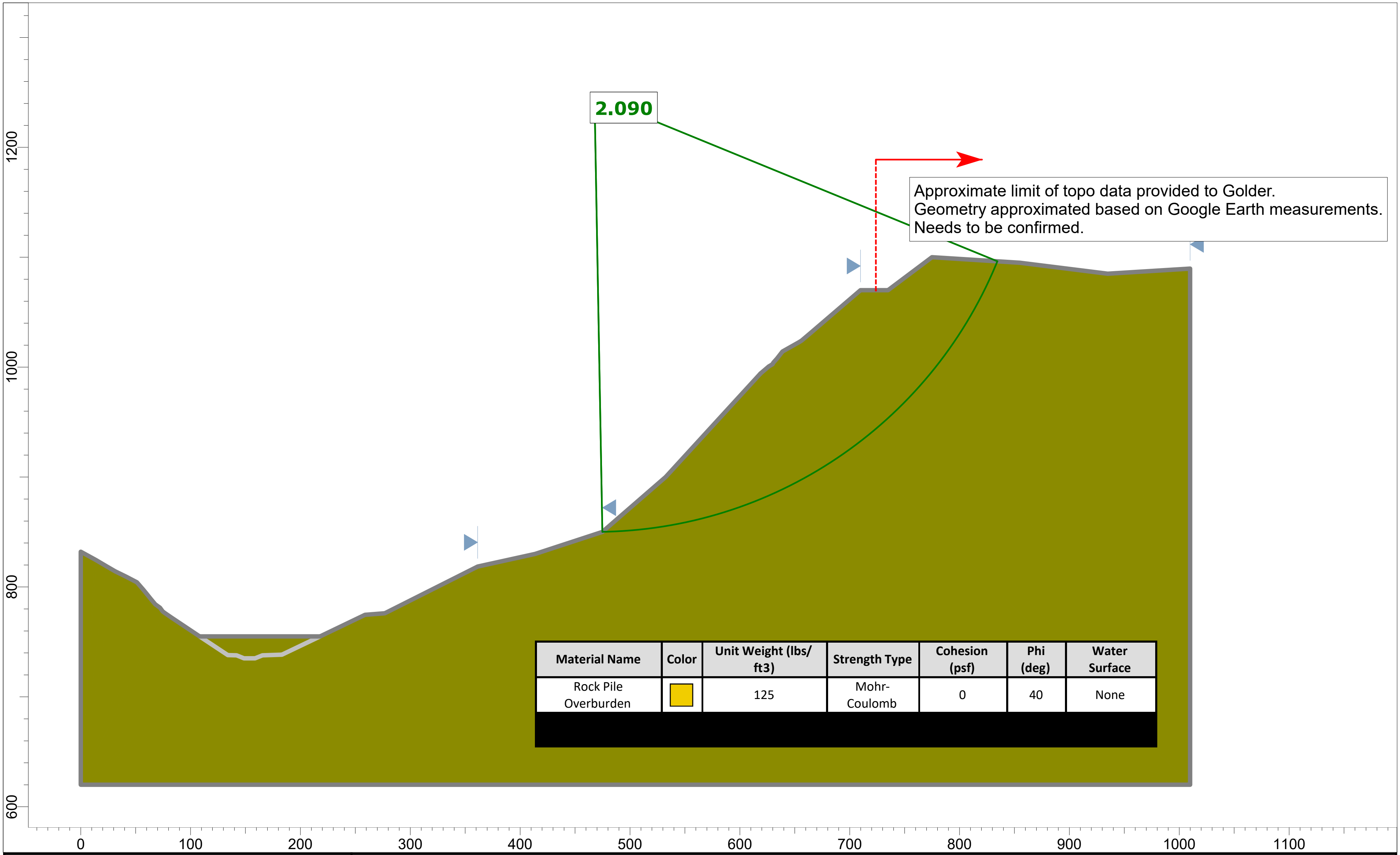

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Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |

| | | | |
|---|---|---|---|
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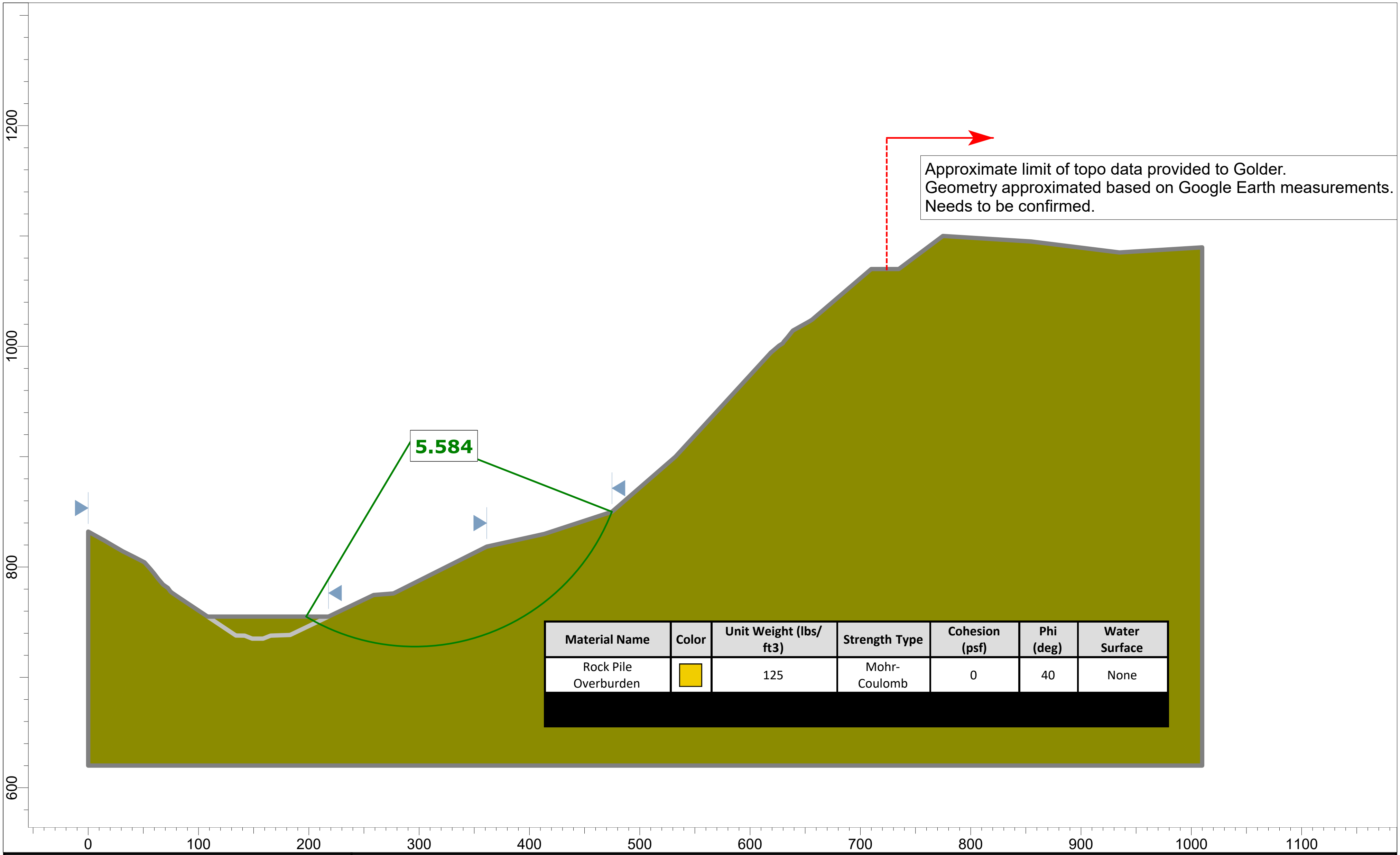

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Geometry approximated based on Google Earth measurements.
Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |

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| *Project* | SLIDE - An Interactive Slope Stability Program |
| *Analysis Description* | |
| *Drawn By* | |
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| *Company* | |
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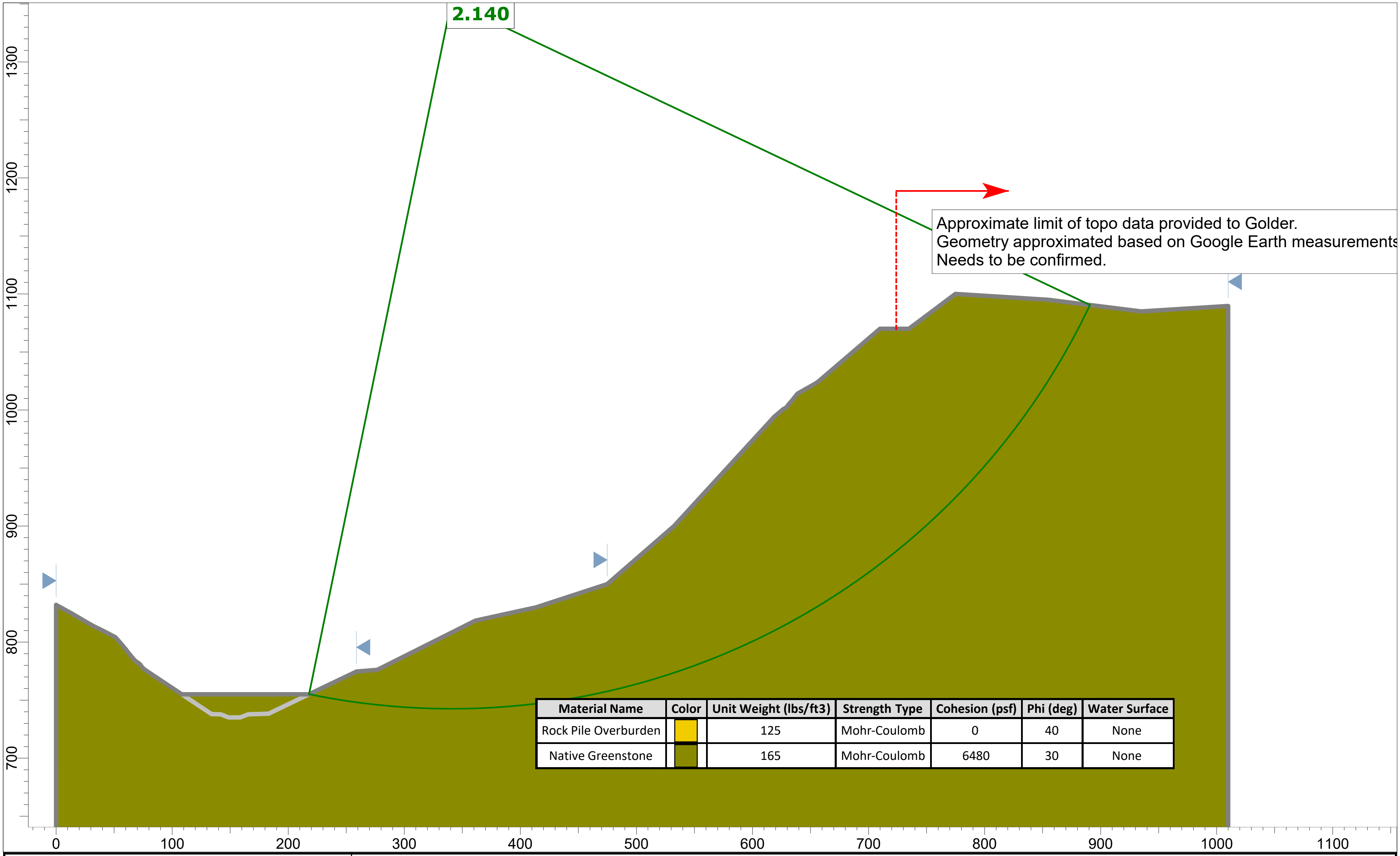

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Geometry approximated based on Google Earth measurements
Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | None |

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|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program |
| *Analysis Description* | |
| *Drawn By* | |
| *Scale* | 1:1373 |
| *Company* | |
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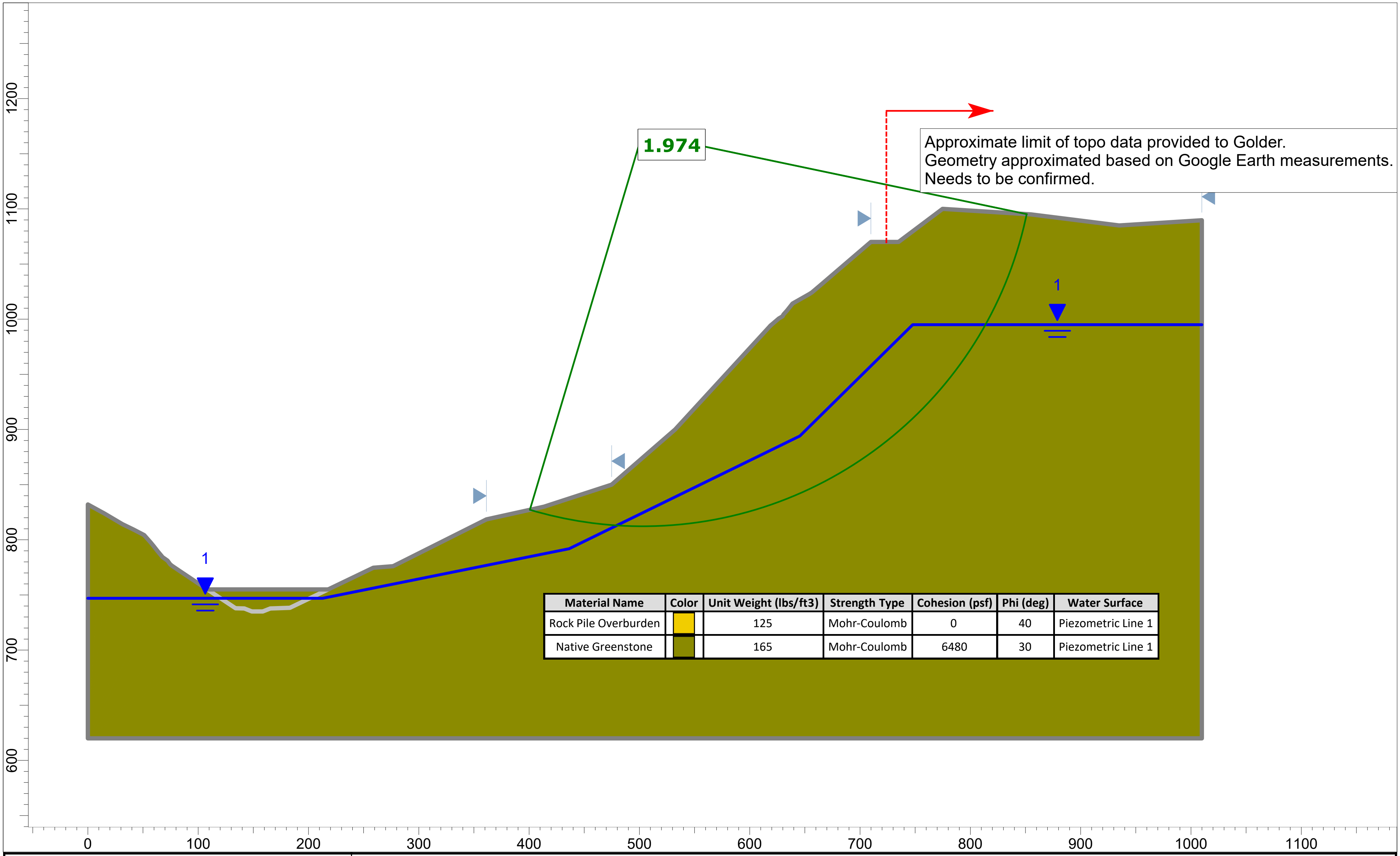

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | Piezometric Line 1 |

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|  |  |  |  |
|---|---|---|---|
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
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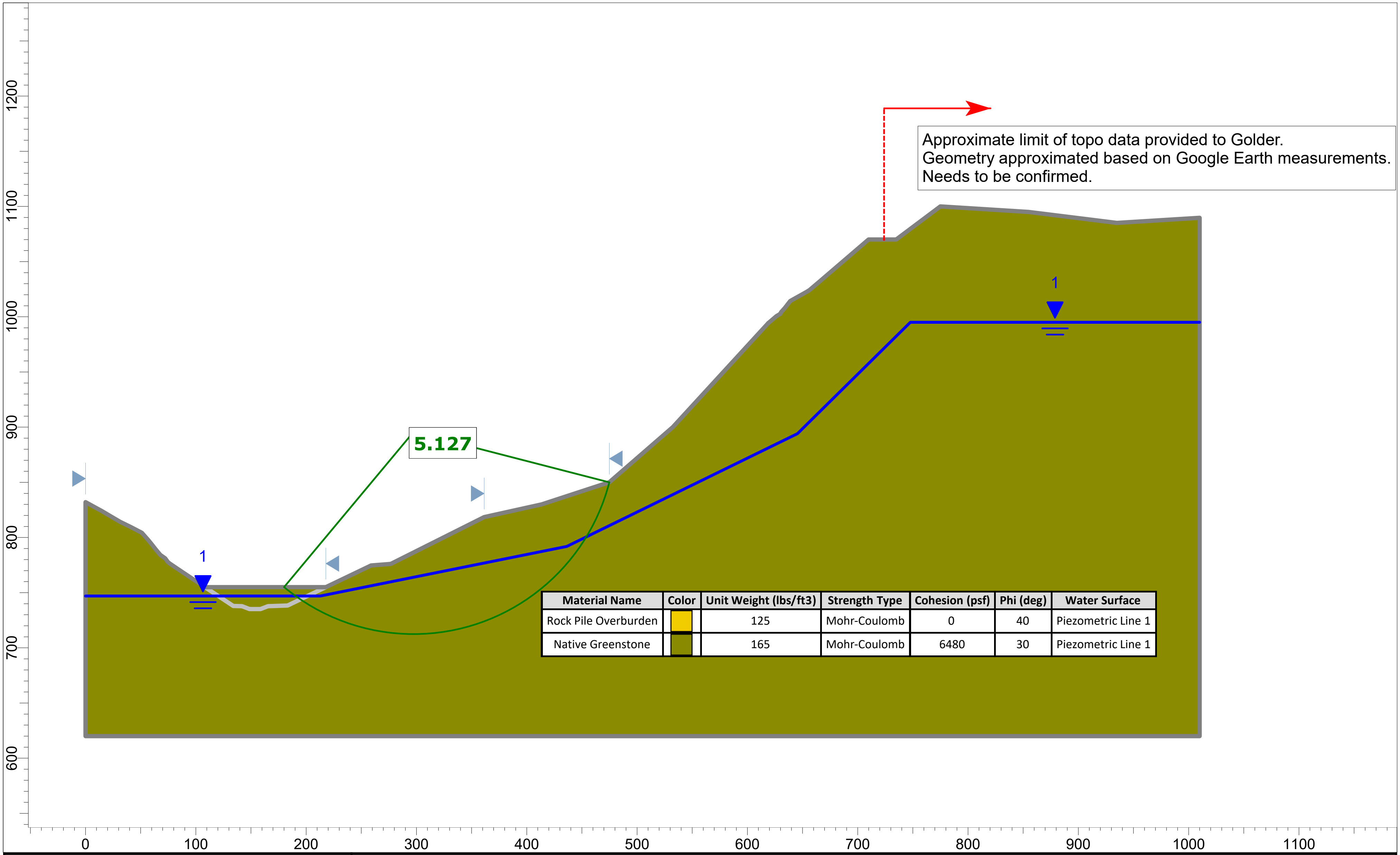

Approximate limit of topo data provided to Golder.
Geometry approximated based on Google Earth measurements.
Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | Piezometric Line 1 |

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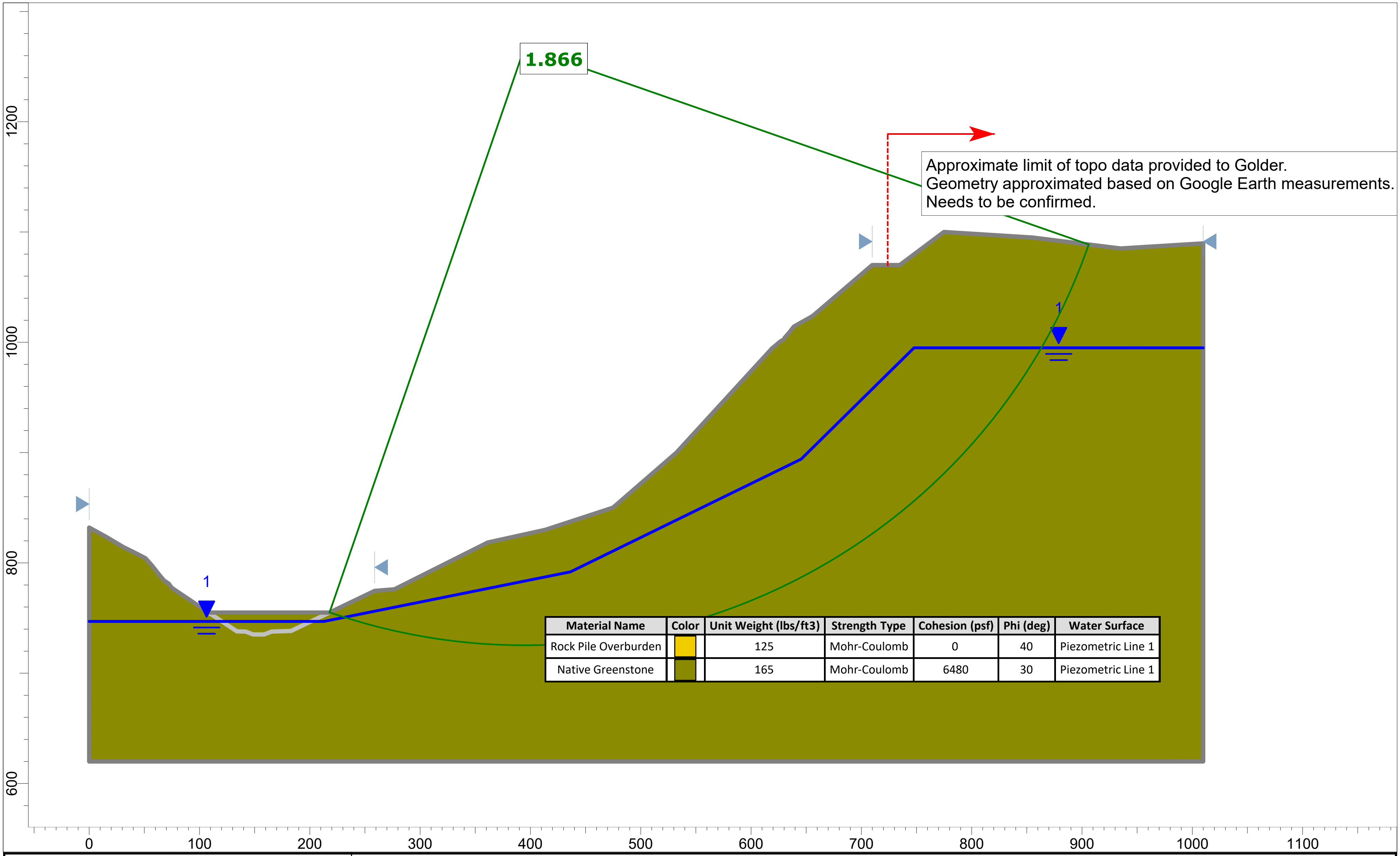
| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
| *Drawn By* | | *Scale* 1:1444 | *Company* |
| *Date* 7/9/2021, 4:25:49 PM | | *File Name* | Section C-C'_20210715.slmd |



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| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
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| *Project* | SLIDE - An Interactive Slope Stability Program | | |
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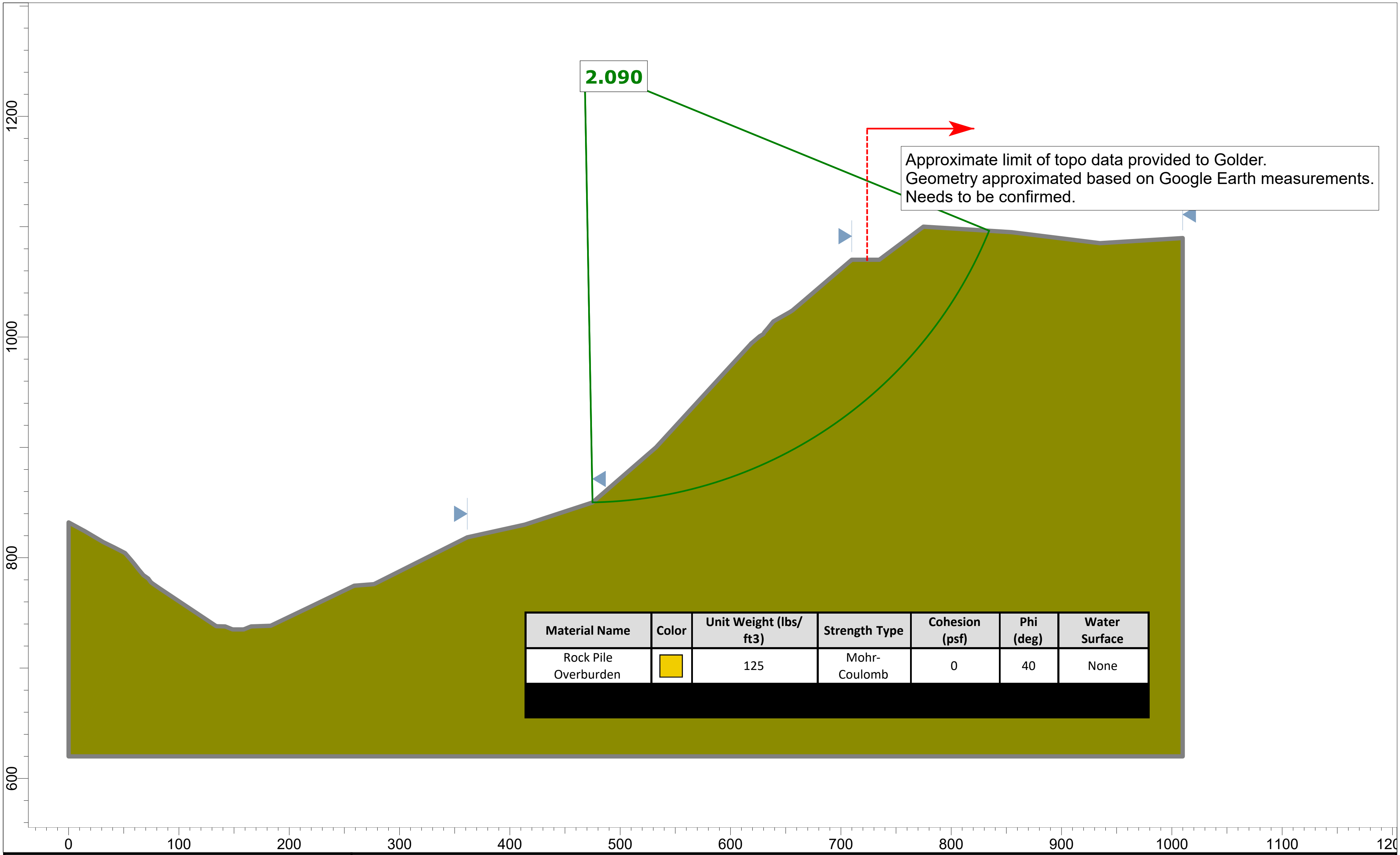

Approximate limit of topo data provided to Golder.
Geometry approximated based on Google Earth measurements.
Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |

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| GOLDER<br>SLIDEINTERPRET 9.012 | *Project* SLIDE - An Interactive Slope Stability Program | | |
| | *Analysis Description* | | |
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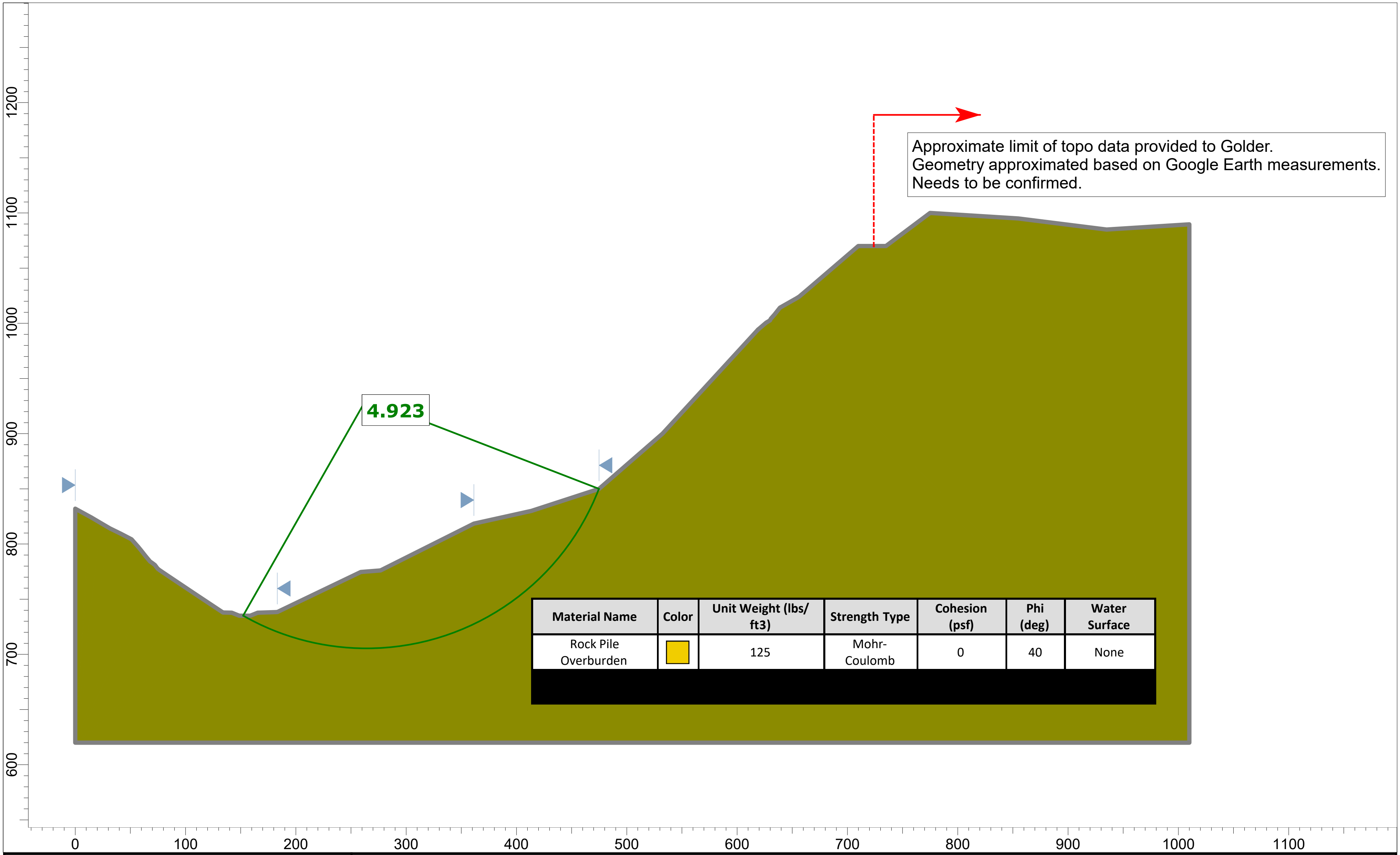
| | *Date* 7/9/2021, 4:25:49 PM | | *File Name* Section C-C'_20210715.slmd |



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| Material Name | Color | Unit Weight (lbs/ ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
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| *Project* | SLIDE - An Interactive Slope Stability Program | | |
| *Analysis Description* | | | |
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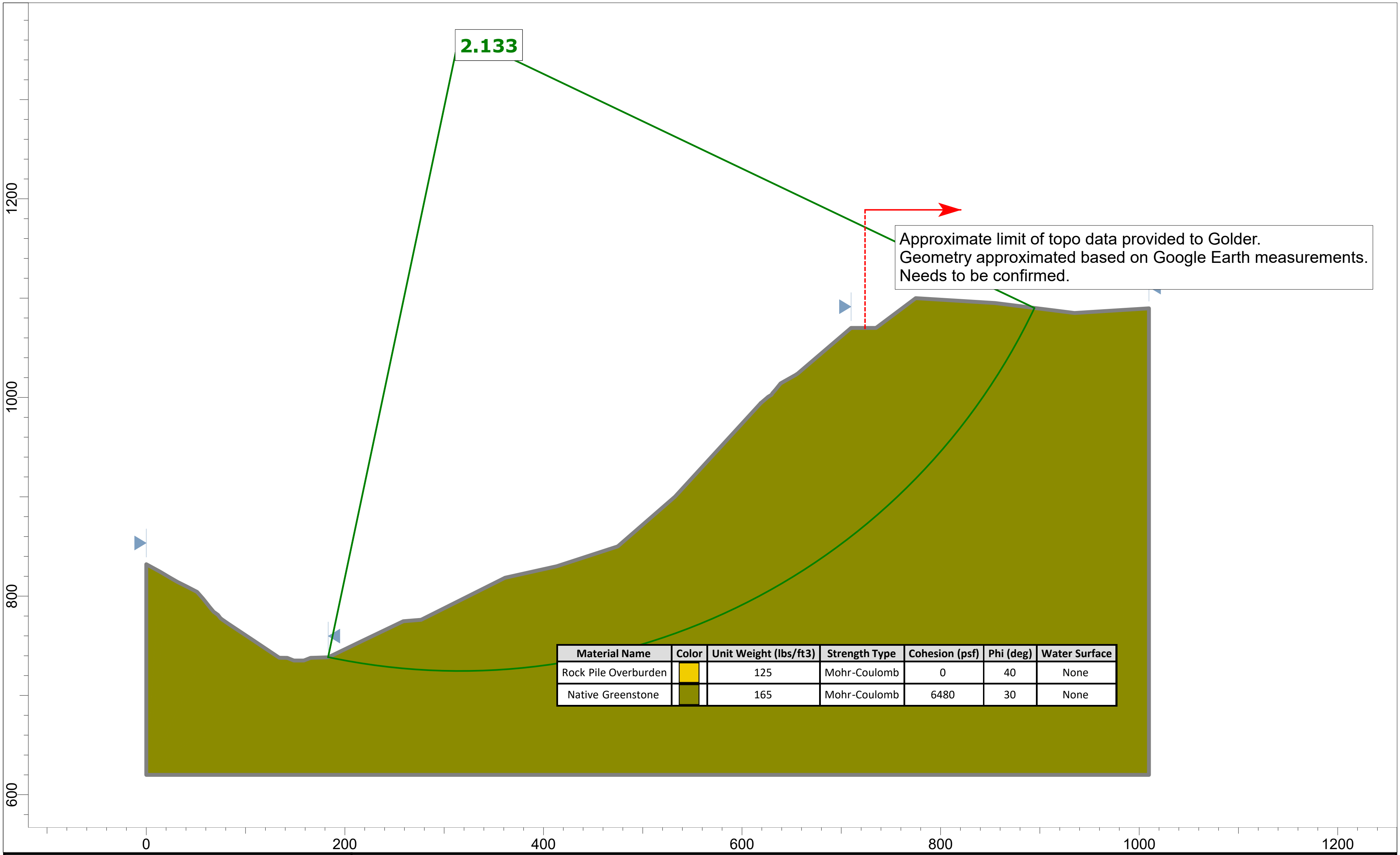

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Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | None |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | None |

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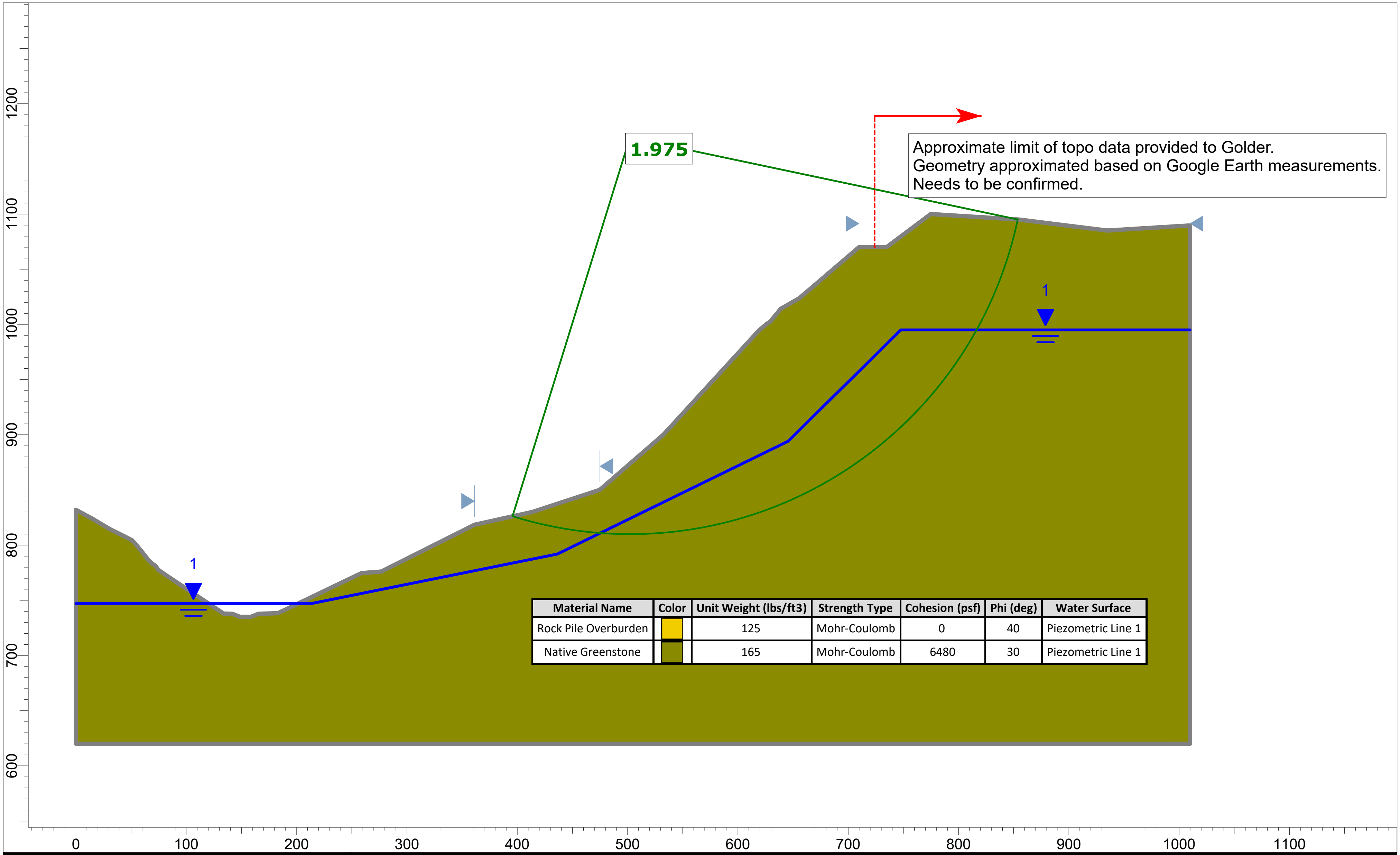

Approximate limit of topo data provided to Golder.
Geometry approximated based on Google Earth measurements.
Needs to be confirmed.

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Rock Pile Overburden | 🟨 | 125 | Mohr-Coulomb | 0 | 40 | Piezometric Line 1 |
| Native Greenstone | 🟩 | 165 | Mohr-Coulomb | 6480 | 30 | Piezometric Line 1 |

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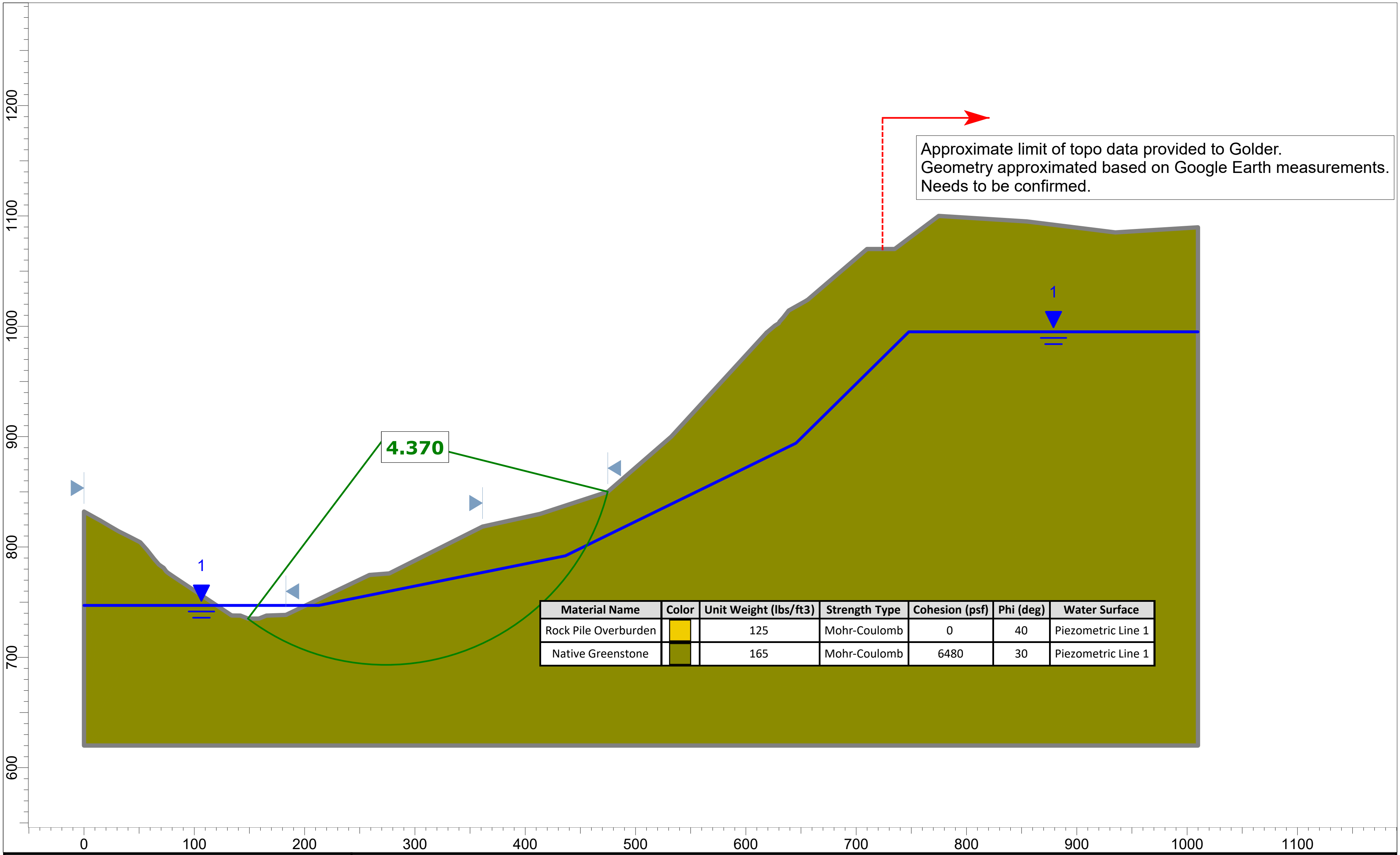

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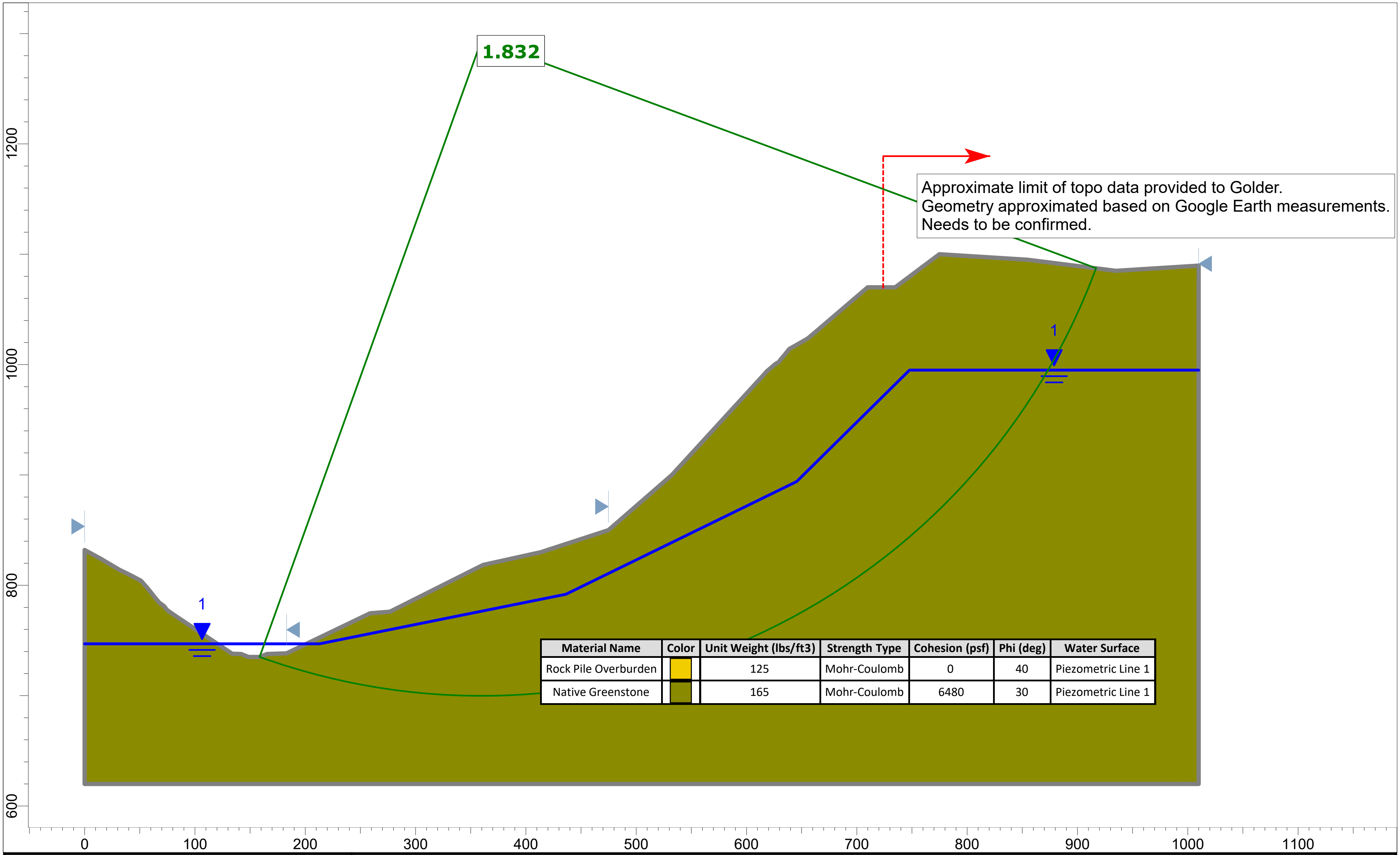

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*Analysis Description*

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Document Number
SOP-ENV-007

Permanente
Environmental
Department

**SOP**

# Sampling, Analysis, and Management Plan for Soil and Sediment Material from Maintenance Projects

**Description:**
Soil and sediment material that is generated from maintenance projects conducted at the Lehigh Permanente Facility (Site) will be sampled, analyzed, and managed according to this standard operating procedure (SOP). This document is intended to provide instructions to adequately manage soil and sediment from maintenance operations by specifying screening guidelines, testing requirements, and placement to conform to applicable Federal, State and Local regulations.

**Regulatory Framework:**
The San Francisco Bay Regional Water Quality Control Board (Water Board) issued Waste Discharge Requirements, Order No. R2-2018-0028, (WDRs) to Lehigh for the Permanente Facility. The WDR regulates discharges to land and governs wastes and activities that generate waste at the site that have the potential to impact groundwater and hydrogeologically connected surface waters. Operations and maintenance of Waste Management Units (WMUs) at the Facility, including the Eastern Material Storage Area (EMSA) and Western Material Storage Area (WMSA), must be conducted in accordance to California Code of Regulations (CCR) 27 (Title 27), section 13263 of the California Water Code (CWC) and the approved plans required by Waste Discharge Requirement Order No. R2-2018-0028. The purpose of the procedures set forth herein is to ensure that material placement resulting from soil and sediment removal from maintenance operations is consistent with the requirements established by the WDRs.

- **Responsibility**— Environmental Department
- **Applicability**— Sampling and sediment of creek sediment originated from culvert cleanout activities
- **Affected Area**— Culverts in Permanente Creek
- **Frequency**— As needed
- **Attachments**— Attachment A – Environmental Screening Levels
- **Safety**—Basic Plant mandated PPE is required

**Procedure:**
Soil or sediment samples will be collected by Lehigh personnel and sent to laboratory for analysis. Samples will be analyzed for parameters listed on Table 1 and results compared against the most recent, applicable Water Board's Tier 1 Environmental Screening Levels (ESLs) for soils and groundwater as modified (Attachment A contains the 2019 ESLs for metals, the primary constituents of concern), as described below.

The documentation required includes:
1. Reports of removed material volume, date of removal, and location
2. Field data sheets and testing results
3. Temporary storage location, including survey coordinates, if needed
4. Final placement location, including survey coordinates

5. Report with December Self-Monitoring Report.

**Sampling Guidelines:**

Samples will be collected and analyzed in a manner sufficient to characterize the material. Sampling and laboratory analysis will be conducted in compliance with the following requirements:

1. All analysis will be performed in accordance with EPA and California approved methods
2. Analysis of samples will be completed and reported by an analytical laboratory accredited by the California State Environmental Laboratory Accreditation Program and the National Environmental Laboratory Accreditation Program;
3. The laboratory detection limits for Modified Waste Extraction Test (WET) results must be below the applicable Tier 1 ESLs for groundwater;
4. The laboratory reporting limits will be reported on a dry-weight basis; and
5. The results of the laboratory analysis will be reported in a standard laboratory data package, including a summary of the quality control and quality assurance sample results and chain of custody documentation.

Discrete soil samples will be collected unless regulatory approval is obtained for collection of composite samples for a specific project or if the project is greater than acres (Table 2). Samples will be collected with dedicated sampling equipment (e.g., plastic scoops) when possible. Any non-dedicated sampling equipment will be decontaminated between sampling locations. Field data sheets documenting sampling collection date, time, location, personnel, weather conditions, and sample identification will be completed. Each sample will be logged on a chain-of-custody record, which will accompany the samples through collection and delivery to the analytical laboratory. Table 1 includes the analytical parameters and sampling schedule.

**Table 1: Laboratory Analytical Parameters**

| Analysis | EPA Analytical Method | Frequency |
|---|---|---|
| California Title 22 Metals (TTLC) | USEPA 6010B, 6020B, and/or 7471A | All |
| Modified WET California Title 22 Metals with DI Water | USEPA 6010B, 6020B, 1631E and/or 7471A | As necessary per TTLC results; minimum 1 out of 4 samples |
| VOCs | USEPA 82600/624 | 1 of 10 samples; minimum 1 sample per project |

| Analysis | EPA Analytical Method | Frequency |
|---|---|---|
| SVOCs | USEPA 8270/625/SIM | 1 of 10 samples; minimum 1 sample per project |
| PCBs and Pesticides (surface water only) | USEPA 8080/8081/608 | 1 of 10 samples; minimum 1 sample per project |
| TPH as diesel, motor oil, and gasoline | EPA 8015 | 1 of 10 samples; minimum 1 sample per project |
| Cyanide | EPA 335.4/10-204-00 | 1 of 10 samples; minimum 1 sample per project |

All samples will be analyzed for total metals via TTLC and a subset for leachability per the modified WET procedure. The WET results will be used to determine if metal concentrations in the soil or sediment have the potential to leach to groundwater. The WET results will be compared to the modified Tier 1 ESLs for groundwater.  An additional subset of samples will be analyzed for other potential constituents of concern. These parameters, as well as the TTLC metal results, will be compared to the Tier 1 ESLs for soil.

The sampling schedule varies depending on the volume of soil or sediment to be displaced as part of the maintenance project. The frequency is listed on Table 2 and is based on the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) Information Advisory Clean Imported Fill Material Fact Sheet (https://dtsc.ca.gov/information-advisory-clean-imported-fill-material-fact-sheet).

**Table 2: Sampling Frequency for Evaluation of Material**

| **Area of Individual Area** | **Sampling Requirements per Area** |
|---|---|
| 2 acres or less | Minimum of 4 samples |
| 2 to 4 acres | Minimum of 1 sample every ½ acre |
| Greater than 10 acres | Minimum of 8 samples with 4 subsamples per location |
| **Volume of Stockpiled Material** | **Samples per Volume** |
| Up to 1,000 cubic yards | 1 sample per 250 cubic yards |
| 1,000 to 5,000 cubic yards | 4 samples for first 1000 cubic yards +1 sample per each additional 500 cubic yards |

| | |
|---|---|
| Greater than 5,000 cubic yards | 12 samples for first 5,000 cubic yards + 1 sample per each additional 1,000 cubic yards |

**Results Evaluation and Material Placement:**

The sampling results will be tabulated and reviewed. Based on the findings, the following scenarios will be followed.

1. If the results are below applicable Tier 1 ESLs, the removed soil and sediment material may be considered for backfill or cover material on site with regulatory notification and approval.
2. If the metal concentrations do not meet the applicable Tier 1 ESLs, but are below TTLC and/or STLC thresholds, additional characterization may be completed to determine the appropriate placement based on the following:
    a. If the material is determined to be a Group B mining waste similar to the material already present in the WMUs, the material will be placed and managed within a WMU (e.g., WMSA) in accordance with the Operations, Maintenance, and Contingency (OM&C) Plan.
    b. If the material is characteristically distinct from the Group B waste present in the WMUs, contains concentrations above applicable Tier 1 ESLs, and concentrations below TTLC and/or STLC thresholds, Lehigh will consult with the Water Board regarding the management and potential on and offsite disposal of these materials.
3. While not anticipated, if the results are above TTLC and/or STLC thresholds, the WATER BOARD will be notified and additional characterization will be completed to confirm the results and aid in determining appropriate management and disposal options. Upon completion of the additional characterization, Lehigh will seek the Water Board's concurrence on the management and disposal of these materials.

***Dewatering Analysis and Placement Requirements:***

1. Dewatering – If dewatering is conducted, additional characterization of the material may be conducted after dewatering has been implemented and soil is no longer saturated.
2. The water from the dewatering operations will be collected and sent to the on-site water treatment system(s) via the reclaim water system.
3. The soil or sediment will be moved to a selected dewatering location if necessary. Once the material is dewatered and characterized, the material will be managed and disposed of as appropriate based on this SOP.

Attachment A: Screening Values

| Metal | CAS No. | Tier 1 ESL Soil (mg/kg) | TTLC (mg/kg) | Tier 1 ESL Groundwater (µg/L)* | STLC (µg/L) |
|---|---|---|---|---|---|
| | | **Total Metal** | | **WET Results** | |
| Antimony | 7440-36-0 | 11 | 500 | 6.0 | 1500 |
| Arsenic | 7440-38-2 | 0.067**** | 50 | 10**** | 500 |
| Barium | 7440-39-3 | 390 | 10000 | 1000 | 100000 |
| Beryllium | 7440-41-7 | 5.0 | 75 | 2.7 | 75 |
| Cadmium | 7440-43-9 | 1.9 | 100 | 0.25 | 1000 |
| Chromium | 7440-47-3 | 160 | 2500 | 50.0 | 5000*** |
| Cobalt | 7440-48-4 | 23 | 8000 | 3.0 | 80000 |
| Copper | 7440-50-8 | 180 | 2500 | 3.1 | 25000 |
| Lead | 7439-92-1 | 32 | 1000 | 2.5 | 5000 |
| Mercury | 7439-97-6 | 13 | 20 | 0.025 | 200 |
| Molybdenum | 7439-98-7 | 6.9 | 3500 | 100 | 350000 |
| Nickel | 7440-02-0 | 86 | 2000 | 8.2 | 20000 |
| Selenium | 7782-49-2 | 2.4 | 100 | 5.0** | 1000 |
| Silver | 7440-22-4 | 25 | 500 | 0.19 | 5000 |
| Thallium | 7440-28-0 | 0.78 | 700 | 2.0 | 7000 |
| Vanadium | 7440-62-2 | 18 | 2400 | 19 | 24000 |
| Zinc | 7440-66-6 | 340 | 5000 | 81 | 250000 |

Notes:

ESLs based on January 2019 (Rev. 1) Water Board ESL Workbook Tier 1 values for soil and groundwater unless otherwise noted.

* DI WET results to be compared to Tier 1 GW ESL.

** Freshwater Ecotox used instead of Saltwater Ecotox for the Aquatic Habitat Goal that comprises the GW Tier 1 ESL for selenium.

*** If the soluble chromium as determined by the TCLP is less than 5mg/L, and the soluble chromium as determined by the STLC test equals or exceeds 560mg/L, and the waste is not otherwise identified as a RCRA hazardous waste, then the waste is a non-RCRA hazardous waste.

**** Arsenic background levels are known to be above these screening levels.

# APPENDIX J

## Golder Associates 2022

## Water Quality Evaluation, Permanente Creek Restoration Project

# TECHNICAL MEMORANDUM

**DATE** August 26, 2022 **Project No.** 31405507

**TO** Carolina Addison
Lehigh Hanson, Inc.

**FROM** George Wegmann, PG, CHg;
Bill Fowler, PG, CEG

**EMAIL gwegmann@wsp.com**

**WATER QUALITY EVALUATION, PERMANENTE CREEK RESTORATION PROJECT, LEHIGH SOUTHWEST CEMENT COMPANY AND HANSON PERMANENTE CEMENT, INC., PERMANENTE QUARRY, CUPERTINO, CALIFORNIA**

## 1.0 INTRODUCTION

Golder Associates USA Inc. (Golder), a member of WSP, prepared this memorandum for Lehigh Southwest Cement Company and Hanson Permanente Cement, Inc. (Lehigh) to present the results of our assessment regarding the significance of potential water related impacts associated with specific elements of the proposed Permanente Creek Restoration Project (PCRP) adjacent to the Permanente Cement Plant and North Quarry (Permanente Site). The specific elements include:

- The type of onsite material(s) used for backfill or other restoration-related activities where those materials that may come in contact with the Permanente Creek watercourse, and recommendations related thereto;
- Expected geology of the restored creek channel that will come in contact with the Permanente Creek watercourse.

This evaluation is based on available geochemical characterization data and the conceptual site geochemical model prepared in accordance with applicable permits for the Permanente Site (*e.g.,* San Francisco Regional Water Quality Control Board (Water Board) Order No. R2-2018-002 (WDRs), and additional information or studies prepared in response to Water Code section 13267 Orders or as part of, site operations and reclamation-related activities. The scope of work for this evaluation included (1) a desktop data review of previous studies, (2) summarizing more recent rock unit characterization and creek sediment sampling, and (3) completing a site reconnaissance of the project area to evaluate the geologic conditions in conjunction with the proposed restoration design.

## 1.1 Background

The Permanente Site is located in Santa Clara County, California, west of the City of Cupertino. In response to a Cleanup and Abatement Order issued by the Water Board (Order No. 99-018) and as a result of a 2016 Amended Consent Decree entered into by Lehigh and the Sierra Club, Lehigh has committed to undertake the PCRP. Details regarding the scope of the PCRP are set forth in 2016 Amended Consent Decree and the 90% design documents prepared by Lehigh's consultant, Waterways, which were recently updated to incorporate regulatory agency and Santa Clara County comments to date, and submitted to the County on August 26, 2022 (90% Design drawings). The portion of Permanente Creek involved in the PCRP is located south/southeast of the Permanente Site, and the project involves, among other activities, removing material/sediment from Permanente Creek, laying back slopes, widening reaches, and ensuring stream bank stability and ecological/geomorphic function.

The headwaters of Permanente Creek are located approximately 2 miles west/southwest of the Permanente Site. Approximately 4.2 miles of Permanente Creek are adjacent or traverse through Lehigh's Permanente Site in a south/south-eastern/eastern "L" shaped direction, portions of which are included in the PCRP, including stretches of the Creek upstream of the Cement Plant that have been re-aligned into an open culverted channel or placed in underground culverts, or are subject to dam infrastructure (Pond 13). Flow in Permanente Creek continues in an eastern direction as it leaves the Permanente Site, flowing through the highly urbanized area Cities of Los Altos and Mountain View and into Mountain View Slough or Stevens Creek through the Stevens Creek Diversion Channel operated by the Santa Clara Valley Water District, which ultimately can reach the San Francisco Bay. The downstream hydrology of the Permanente Creek watershed has been substantially altered for flood protection purposes.

The Cement Plant and North Quarry at the Permanente Site have been operational since 1939 and has been a major source of cement for Santa Clara County. The facility contains two mining waste rock (also called "overburden") storage areas, the East Material Storage Area (EMSA) and West Material Storage Area (WMSA), largely comprised of soil and rocks excavated from the North Quarry, some of which may be accessed for onsite use as part of the PCRP as backfill. The North Quarry sits between the two storage areas, while the Cement Plant is located southwest of the EMSA (Attachment A, Figure 1).

## 1.2 Regional Geologic Setting

Most of the Site is underlain by complexly deformed and faulted rocks of the Franciscan Assemblage. The eastern portion of the Site, including portions of the Cement Plant and the EMSA, are underlain by Plio-Pleistocene rocks of the Santa Clara Formation, which in turn overlie the Franciscan bedrock. Overlying the bedrock are modern alluvial deposits associated with Permanente Creek, and relatively shallow surficial deposits comprised of soil and colluvium. The Miocene-age Monterey Formation lies just east of the Site in fault contact with the Franciscan basement rocks along the Monte Vista Fault System.

### 1.2.1 Bedrock Geologic Units

The bedrock materials exposed in the North Quarry are part of the Permanente Terrane of the Franciscan Assemblage. The Franciscan Assemblage is comprised of highly deformed and variably metamorphosed, marine sedimentary rocks with submarine basalt (greenstone) and limestone and, to a lesser extent, graywacke. The Franciscan is considered a tectonic mélange that was formed in the subduction zone between the Pacific tectonic plate and the North American plate. This plate boundary is now a transform, strike-slip plate boundary defined by the San Andreas Fault zone located about two miles southwest of the North Quarry. The Franciscan Complex contains complexly deformed marine sedimentary rocks and basalt, which were metamorphosed and altered during subduction and subsequent thrust faulting. The Santa Clara Formation, a late Tertiary-Pleistocene assemblage of conglomerate, sandstone, siltstone, and claystone sits unconformably on the Franciscan Complex in the eastern portion of the site. Surficial deposits of unconsolidated alluvial deposits, fill material, colluvium, landslide deposits, and surface soils overlie the bedrock units.

The geology of the Permanente Creek Basin is shown on Figure 2 (Attachment A) based on our site reconnaissance and two main geologic map sources: Cupertino and Mindego Hills quadrangles (Dibblee and Minch 2007a and b); and the San Francisco Bay Landslide Mapping Team (USGS 1997). Previous researchers have also mapped the basin (Brabb 1970, Pulver 1979a and b).

### 1.2.2 Surficial Geologic Units

Some of the south-facing slopes that flank Permanente Creek are mantled with varying thicknesses of overburden, which is a heterogeneous mixture of fines, sand, gravel and cobble-sized fragments (*i.e.,* greenstone, graywacke, and soil materials) but with small percentages of limestone. This same overburden comprises most of the WMSA and EMSA. Regarding the south-facing slopes, they are generally described as side-cast fills that mantle existing canyon slopes and fill small drainages and swales that formerly reported to Permanente Creek. The overburden deposits are of highly variable thickness and exist adjacent to the Rock Pile Area[1] (see 90% Design drawings at Sheet C19) and Material Removal Area (see 90% Design drawings at Sheets C23 & C24); this material will be removed and relocated as part of the PCRP.

Modern unconsolidated alluvial deposits are present along the active stream channel of Permanente Creek. These deposits are comprised of a poorly sorted mixture of cobbles, gravels, sand, silt and clay. Deposits range from a few inches thick in the upper reaches of the watershed where erosion has cut the channel down into bedrock over thousands of years, to tens of feet thick where the channel widens and deepens as it approaches the flatter terrain of the Santa Clara Valley.

Colluvial and slope wash deposits are common throughout the steep terrain of the Santa Cruz Mountains. In general, the natural slopes in the region are overlain with approximately one to two feet of soil and colluvial materials, which thicken to several feet or more in the larger natural swales in the region. Colluvium is generally described as predominantly clayey sand with gravel to clayey gravel, with some gravelly clay. The alluvial and colluvial deposits contain a mixture of fines, sand, gravel and cobble-sized fragments (*i.e.*, greenstone, graywacke, and soil materials) but with small percentages of limestone.

### 1.2.3 Creek Bed Geology Summary

Most of the PCRP area is underlain by complexly deformed and faulted rocks of the Franciscan Assemblage as depicted on Figure 2 (Attachment A). The eastern portion of the project area, including portions by the Cement Plant and the EMSA, are underlain by Plio-Pleistocene rocks of the Santa Clara Formation. Overlying the bedrock are modern alluvial deposits associated with Permanente Creek (restricted to the eastern portion of the property), and relatively shallow surficial deposits comprised of soil and colluvium.

Figure 3 (Attachment A) depicts the profile of Permanente Creek, which can broadly be classified into depositional reaches and bedrock reaches (delineated as Reach A, Reach B, etc.). The processes that define these reaches are the rate that sediment is supplied to the channel and the rate at which the channel can convey the supplied sediment. The rate of sediment supply is controlled by hillslope processes and the rate that sediment is delivered to the channel. The rate of sediment transport is controlled by the channel geometry and the hydraulic characteristics of the reach.

The furthest upstream portion of Permanente Creek, upstream of the PCRP area, is characterized by alluvium in the form of travertine reinforced step pool morphology that partially covers a bedrock channel that is comprised of greenstone and limestone. The sediment supplied here is likely to come from natural processes and is partially supplied from an alluvial fan originating from Wild Violet Creek. Carbonate-rich water percolates from the south bank of the channel in this reach, indicating that the source of the carbonate-rich spring is likely within the Wild Violet drainage. Geologic maps (Dibblee and Minch) indicate that the limestone unit of the Franciscan complex outcrops within the Wild Violet drainage. The debris from this alluvial fan is being transported downstream and has deposited small terraces along both valley walls. These terraces are possibly abandoned by the modern hydraulic regime of the Creek and may be coupled to the debris flows originating from Wild Violet Creek.

Travertine is a form of limestone precipitate that forms when calcium carbonate-rich water undergoes changes that cause the mineral to transition from solution to a solid state. This transition is largely controlled by physical

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[1] The Rock Pile area is comprised of stockpiled material for aggregate production, which is ongoing. The character of the Rock Pile is variable but generally consists of fine to coarse-grained gravel to angular cobble-sized rock fragments of limestone.

processes, such as changes in pressure, temperature, or pH, but it can be influenced by biological processes and hydraulic variability as well (Fuller, et al. 2010). Golder observed two types of travertine formation in Permanente Creek. One in which stalactites grew out of the southern stream bank downstream of the confluence with Wild Violet Creek, and the other along large portions of the channel where naturally formed step-pools were reinforced by travertine deposition to form travertine dams (Attachment A, Figure 3). These dams display a history of repeated formation and breaching, as evidenced by the clasts of travertine conglomerate from older dams being incorporated into modern dams, as well as the relict abutments of older travertine dams remaining on the channel margins. This natural process has been taking place throughout geologic time along Permanente Creek.

The primary geologic units within the PCRP area are mainly greenstone (including shear zones) and the Santa Clara Formation. Greenstone bedrock is present at Reaches 10-17 and 20-22 and Santa Clara Formation bedrock along reaches 1-9 (Attachment A, Figure 3). Limestone bedrock is present along Reaches 18 and 19, including south of the creek, and comprises less than 15% of the bedrock present along the PCRP area. Importantly, with regard to the material removal activities planned to occur in Reach 18, the bedrock surface within the creek channel has been unaltered by historical site activities (*i.e.,* no mining activities have occurred in the creek), and the PCRP activities will follow the contours of natural bedrock, and will not alter or change the bedrock surface or its profile as part of restoration construction activities (see 90% Design drawings at Sheet C23). The focus of the Project along the limestone bedrock reaches will be to remove loose material mantled on top of the bedrock.

# 2.0 DATA SUMMARY

## 2.1 Material Characterization

Historical mining activities have contributed surficial materials to Permanente Creek in addition to deposition from naturally occurring geologic and geomorphic processes. As part of site operations, regulatory efforts, and reclamation-related activities, a geochemical dataset has been compiled since 2008 to characterize the predominate Permanente Quarry rock types. The data includes work completed as part of the development of National Pollutant Discharge Elimination System (NPDES) permitting[2] and WDRs[3,4] as follows: (1) analysis on acid rock drainage (ARD) potential by acid base accounting (ABA) testing methods, (2) chemical and mineralogical composition by quantitative X-Ray Diffraction (XRD) and, (3) Total Threshold Limit Concentration (TTLC) and leaching potential via the California modified waste extraction test (WET) with deionized water and wall washing samples. The results have been previously summarized in several reports, including the Permanente Site's Conceptual Site Model (CSM) Update prepared in accordance with the WDRs,[5] and are discussed below along with supplemental information.

Golder previously completed sampling and testing of the following major units: limestone, greenstone, graywacke, Santa Clara Formation, and undisturbed soil/colluvium as summarized in the CSM Update.[6] In summary:

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[2] NPDES No. CA0030210, Regional Water Board Order No. R2-2019-0024, previously Order No. R2-2014-0010, as amended by Order No. R2-2017-0030.

[3] SLR, 2014, EMSA and WMSA Material Characterization, Permanente Quarry, Santa Clara, California.

[4] Golder Associates, August 2014, WMSA and EMSA Runoff and Seep Investigation Report, Lehigh Southwest Cement Company and Quarry, 24001 Stevens Creek Boulevard, Cupertino, CA

[5] Golder Associates, 2020, CSM Update and Proposed SMP, Lehigh Southwest Cement Company and Quarry, 24001 Stevens Creek Boulevard, Cupertino, CA. June 2020.

[6] Golder Associates, 2020 CSM Update and SMP, Lehigh Permanente. December 2020.

- No acid rock drainage potential was identified in the tested samples as would be expected based on the carbonate nature of the rock.
- The leachate testing indicates that greenstone and graywacke are not a significant source of metals.
- Greenstone samples reported higher leachate nickel concentrations as compared to limestone; however, the concentrations are below the San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs) based on the California primary maximum contaminant for Freshwater Aquatic levels.
- Molybdenum and selenium leachate concentrations were generally greater in limestone samples compared to the other samples from greenstone and graywacke. Selenium leachate from the limestone has been detected above the Freshwater Aquatic ESL of 5 µg/L consistent with limestone wall washing results.[7]
- The selenium data supports the premise that the oxidation of sulfides in the limestone is the primary mechanism of generating leachable selenium.[8,9]

### 2.1.1 Sequential Leach Testing via Modified WET Method

In 2020, rock samples were analyzed using the modified WET method and were then subjected to four additional cycles of sequential leaching repeating the same method for a total of five leaching cycles to aid in evaluating long-term leachability. Limestone and greenstone, the predominate rock units, were selected for this analysis. The test results were compared to STLC thresholds and ESLs. Full tabulated leaching results are included as Table 1, Attachment B and time-series plots of the sequential leachate concentrations of the different materials is included as Attachment C. The results of the sequential leach testing are summarized as follows:

#### Limestone Samples

- STLC limits were not exceeded for any of the samples.
- Limestone leachate concentrations decreased over the leaching sequence for the following constituents: sulfate, chloride, total alkalinity, bicarbonate, antimony, calcium, magnesium, molybdenum, selenium, and vanadium.
- Limestone leachate concentrations were stable or at detection limits over the leaching sequence for the following constituents: carbonate, hydroxide, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, potassium, silver, sodium, thallium, and zinc.
- Sulfate, calcium, and magnesium concentrations were elevated in leachates from the medium-grade non-weathered limestone sample during leaches 1-3 compared to the other limestone samples.
- Barium leachate concentrations gradually increased for all limestone samples over the leaching period.

#### Greenstone Samples

- STLC limits were not exceeded for any of the samples.
- Greenstone leachate concentrations decreased over the leaching sequence for the following constituents: total alkalinity, bicarbonate, antimony, magnesium, potassium, selenium, and sodium.

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[7] Golder Associates, 2011 Hydrogeologic Investigation, Lehigh Permanente. 2011.

[8] Diener, A., Neuman, T., Kramar, U., Schild, D. 2012. Structure of Selenium Incorporated in Pyrite and Machinawite as Determined by XAFS Analysis. Journal of Contaminant Hydrology: 133 (30-39).

[9] Presser, T. S. 1994. Geologic Origin and Pathways of Selenium from the California Coast Ranges to the West-Central San Joaquin Valley. Selenium in the Environment.

- Greenstone leachate concentrations were stable or at detection limits over the leaching sequence for the following constituents: chloride, sulfate, carbonate, hydroxide, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, silver, thallium, vanadium, and zinc.
- Total alkalinity, bicarbonate, arsenic, barium, magnesium, potassium, and sodium concentrations were higher in the non-weathered greenstone sample leachate compared to the weathered greenstone sample.
- The vanadium concentration was higher in the weathered greenstone leachate compared to the non-weathered greenstone sample across all leaching cycles.
- Aluminum concentrations in the weathered greenstone sample leachate increased between leaches 1-4 and plateaued after leach 4.

Overall, concentrations generally decrease with each leaching cycle, indicating that readily leachable parameters are depleted within a few flushing cycles and that the short-term metal leaching potential for the materials is low, and below regulatory thresholds. Furthermore, the greenstone samples exhibited less leachable concentrations than the limestone samples.

### 2.1.2 Material Characterization Summary

The leachate results indicate that greenstone and graywacke are not a significant source of metals to water. Limestone material is a potential source of selenium, though the potential is lesser in combined quantities and in a dynamic environment of a moving stream/creek. Specific observations include:

- Greenstone samples reported higher leachate nickel concentrations compared to limestone; however, the concentrations are below ESLs.
- Molybdenum and selenium leachate concentrations were predominantly greater in limestone samples as compared to the samples from greenstone and graywacke.
- Selenium leachate from the limestone was detected several times slightly above the Freshwater Aquatic ESL of 5 µg/L. The generation of leachable selenium decreases with subsequent leach tests.

The data supports the premise that the oxidation of sulfides in the limestone is the primary mechanism of generating leachable selenium—the primary constituent of concern. Following sulfide oxidation, water flow and/or infiltration is the primary transport mechanism for selenium transport. Greenstone and graywacke do not generate leachable materials at levels that would negatively affect groundwater or surface waters. Sampling and geochemical analysis of the greenstone and graywacke indicates a low potential to leach selenium and other metals at levels above surface or ground water quality standards, and that it is suitable to be used as fill material consistent with Water Board/WDR standards.

## 2.2 Background Water Samples and Bedrock Influence on Creek Water Quality

Water quality from the upstream headwaters has been monitored as part of the National Pollutant Discharge Elimination System (NPDES) permit sampling program. The upstream surface water results for selenium are consistently less than 1 ug/L. As noted in Section 1.2, bedrock limestone and associated travertine deposits are present in these areas. The results further support the premise that selenium production from oxidized limestone already present in the creek channel is finite. For this reason, we expect that the PCRP as designed, which proposes to remove material and follow the existing bedrock contours for the restored creek channel grade and elevation, will not contribute to increased in-stream concentrations of constituents of concern.

## 3.0 DISCUSSION AND RECOMMENDATIONS

For areas of the project where fill material is needed, it is recommended that onsite material comprised predominantly of greenstone or graywacke be used where needed for backfill, as both exhibit a low metals leaching potential under natural site conditions. Furthermore, greenstone is the prevalent native material at the Site and already encompasses the majority of the Permanente Creek basin. Based on the available data, we do not expect detrimental water quality impacts from the creek restoration activities (causing exceedance of applicable water quality standards) provided on-site materials adhere to the recommendations herein.

Further, the predominant areas where limestone is to naturally remain, e.g., Reach 18, will consist of non-disturbed bedrock, which, as demonstrated by upstream conditions, is not expected to contribute metals to the water column. Therefore, significant changes in the natural system will not occur and new source material will not be exposed to potentially undergo oxidation and mobilization of selenium based on the limestone bedrock present. As noted in Section 2.3, the water quality upstream of the PCRP is not impaired even though limestone bedrock and travertine deposits are present. As the bedrock surface in Reach 18 is inferred to have been exposed and undisturbed for a similar timeframe as the reaches upstream of the PCRP, impairment to water quality is not expected from the limestone bedrock section. Furthermore, as noted above, the production rate of leachable selenium from limestone decreases as the mobile fraction of selenium is depleted from the system. This process will be further expedited by removing potential sources (e.g., limestone material) via the PCRP, and the PCRP is not expected to interfere with those gains.

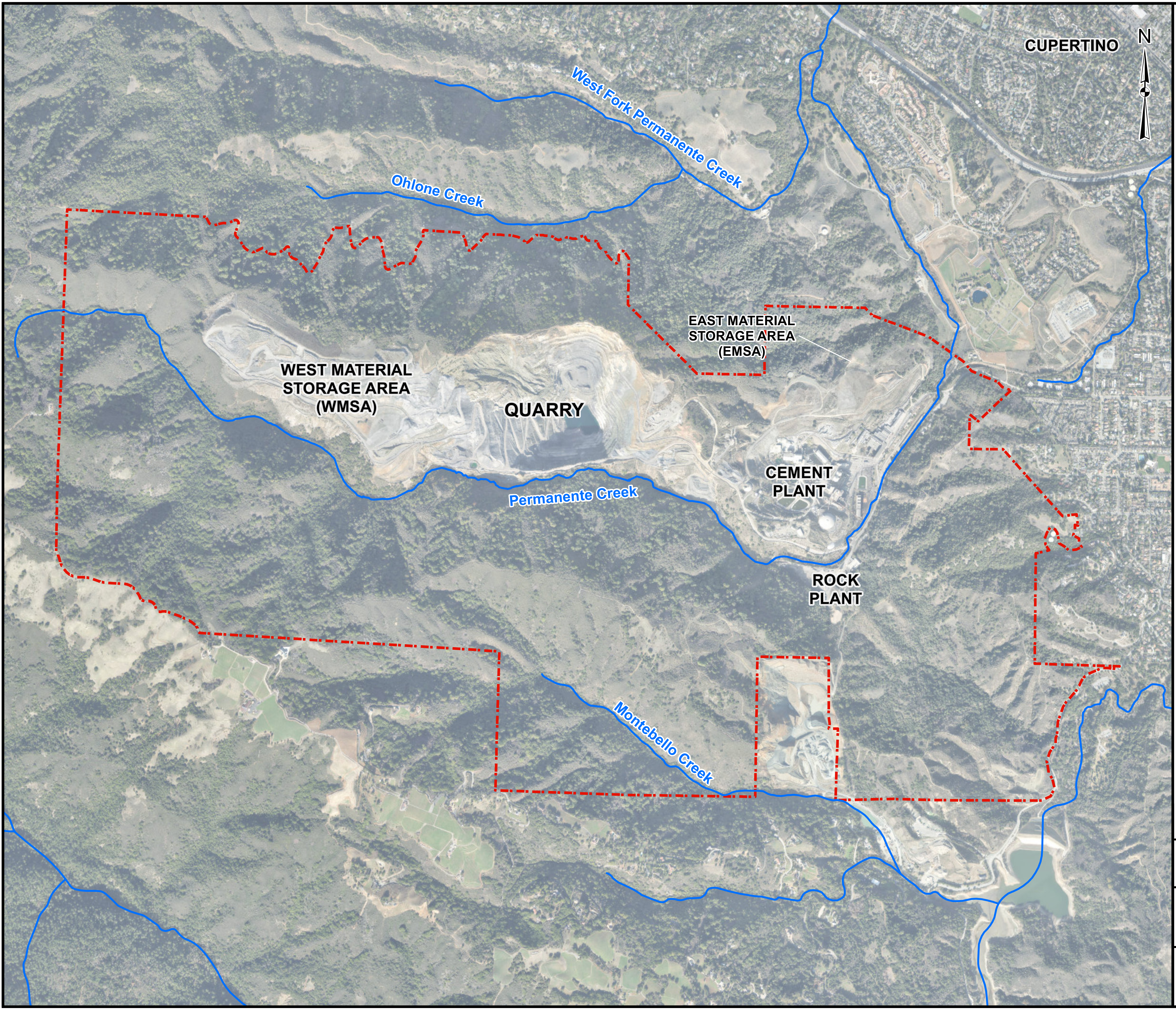
Attachments A: Figures 1-3
B: Data Summary Table 1
C: Time-Series Graphs

PCRP_Golder_creek_memo_fnl

## ATTACHMENT A

# Figures 1-3

Map Document: G:\GIS\Sites\Lehigh_Permanente_Quarry\Maps\General\SitePlan_March2019.mxd / Modified 3/27/2019 10:45:14 AM by SLeidinger / Exported 8/23/2022 1:50:33 PM by SLeidinger



## LEGEND

- ▬ Stream
- ⬚ Property Boundary

## NOTES

1) Locations based on conversion from local coordinates or Google Earth placement.

## REFERENCES

1)Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
2)Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
3)

1,200 0 1,200
Feet

PROJECT

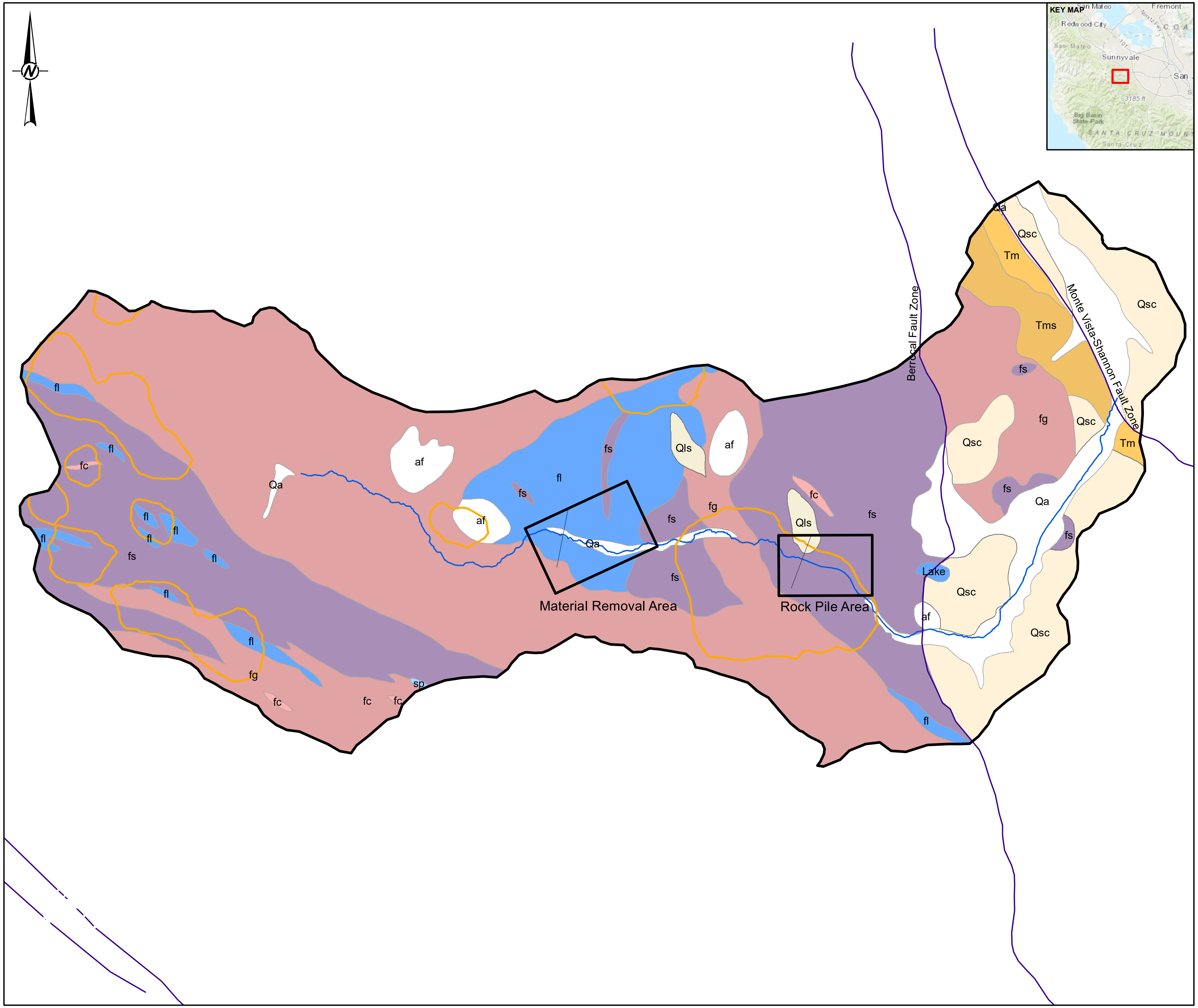
PERMANENTE QUARRY
SANTA CLARA COUNTY, CALIFORNIA

TITLE

## SITE OVERVIEW

WSP GOLDER

| | | | | |
|---|---|---|---|---|
| PROJECT No. | | 063-7109 | FILE No. | SitePlan_March2019.mxd |
| DESIGN | SHL | 10/31/2013 | SCALE: AS SHOWN | REV. 0 |
| GIS | SHL | 3/27/2019 | FIGURE 1 | |
| CHECK | GW | 3/27/2019 | | |
| REVIEW | GW | 3/27/2019 | | |



**LEGEND**

- ▭ Areas of Interest
- — Cross Sections
- — Permanente Creek
- ▭ PermCrkBasin_V2
- — Faults

**Geologic Units**

**UnitNam**

- ■ Lake
- □ af
- □ Qa
- ■ Qls
- ■ Qsc
- ■ Tm
- ■ Tms
- ■ sp
- ■ fg
- ■ fs
- ■ fc
- ■ fl

0 2,000 4,000

1 IN = 1,667 FT FEET

**NOTE(S)**

**REFERENCE(S)**

1. USGS (LANDSLIDES, 1997; FAULTS, 2000, 2002)
2. CALIFORNIA DIVISION OF MINES AND GEOLOGY (EARTHQUAKES, 1982)
3. WATERWAYS CONSULTING, INC. (PERMANENTE CREEK, 2018)
4. CALIFORNIA DEPARTMENT OF FORESTRY (GEOLOGY AND LANDSLIDES, 1979)
5. COORDINATE SYSTEM: NAD 1983 STATE PLANE CALIFORNIA III (FT)
6. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
PERMANENTE QUARRY
SANTA CLARA COUNTY, CALIFORNIA

PROJECT

TITLE
**GEOLOGIC MAP OF PERMANENTE CREEK BASIN**

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2019-10-02 |
| DESIGNED | RPH/BVJ |
| PREPARED | RPH/BVJ |
| REVIEWED | BF/CJ/RPH |
| APPROVED | BF |

| PROJECT NO. | PHASE | REV. | FIGURE |
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PATH: G:\LehighHanson\PermanenteCreek\99_PROJECTS\179018601_GeomorphMap\100\02_PRODUCTION\MXD\FIGURES\Rev0\179018601_100_001_Fx_Rev0_GeologyMap.mxd PRINTED ON: 2019-10-02 AT: 10:44:12 AM

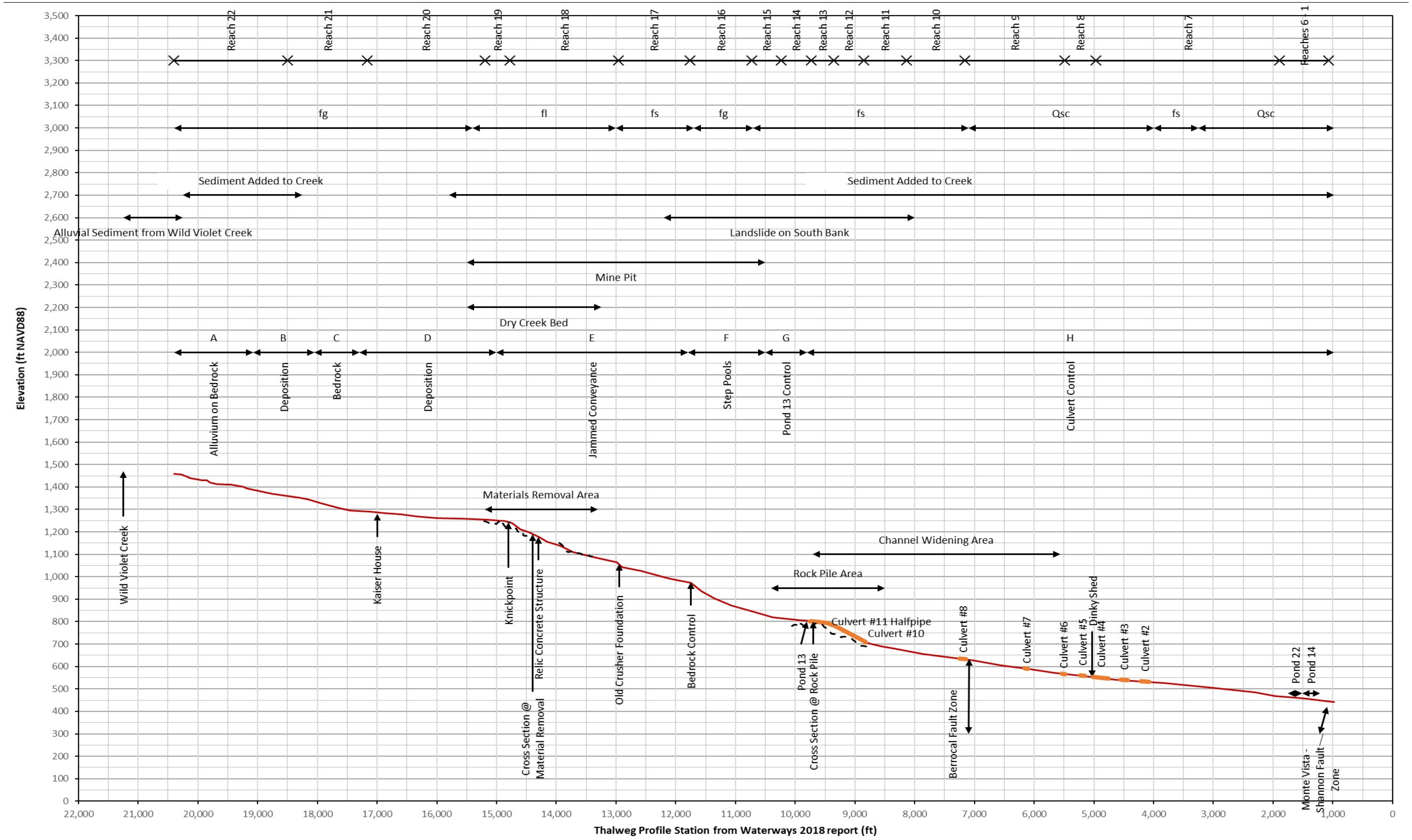


**Figure 3: Permanente Creek Profile with geomorphic and geologic delineations. Stationing from Waterways (2019).**

**ATTACHMENT B**

# Data Summary Table 1

**Table 1: Sequential WET Extraction Chemistry**

| Analyte | Units | STLC Regulatory Limit | ESL | B-1: High-Grade Limestone, Non-Weathered | | | | | B-2: Medium-Grade Limestone, Non-Weathered | | | | | B-3: Low-Grade, Limestone Non-Weathered | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Leach Initial | Leach 1 | Leach 2 | Leach 3 | Leach 4 | Leach Initial | Leach 1 | Leach 2 | Leach 3 | Leach 4 | Leach Initial | Leach 1 | Leach 2 | Leach 3 | Leach 4 |
| ***Dissolved Metals*** | | | | | | | | | | | | | | | | | | |
| Antimony | mg/l | 15 | 0.006 | 0.0042 | 0.0025 | 0.0018 B | 0.00123 B | 0.0012 B | 0.0057 | 0.0040 | 0.0032 | 0.0026 | 0.0027 | 0.013 | 0.0078 | 0.0052 | 0.0052 | 0.0040 |
| Arsenic | mg/l | 5 | 0.01 | 0.00022 B | 0.00047 B | 0.0003 B | 0.00029 B | <0.001 | 0.00066 B | 0.00088 B | 0.00073 B | 0.00091 B | 0.00080 B | 0.0013 | 0.0011 | 0.00065 B | 0.00073 B | 0.00062 B |
| Barium | mg/l | 100 | 1 | 0.41 | 0.70 | 0.42 | 0.70 | 0.96 | 0.0288 B | 0.11 | 0.13 | 0.27 | 0.45 | 0.15 | 0.29 | 0.17 | 0.32 | 0.45 |
| Beryllium | mg/l | 0.75 | 0.0027 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 |
| Cadmium | mg/l | 1 | 0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | 0.00011 B | <0.00025 | <0.00025 | <0.00025 | <0.00025 |
| Chromium | mg/l | 5 | 0.05 | <0.002 | 0.00157 B | 0.0007 B | 0.00079 B | 0.00079 B | <0.002 | 0.0031 | 0.00062 B | 0.00077 B | 0.0017 B | <0.002 | 0.0028 | 0.00059 B | 0.00138 B | 0.00121 B |
| Cobalt | mg/l | 80 | 0.003 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | 0.000209 B | 0.000062 B | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 |
| Copper | mg/l | 25 | 0.009 | 0.0012 B | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.0011 B | <0.002 | <0.002 | <0.002 | <0.002 |
| Lead | mg/l | 5 | 0.0025 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.00028 B | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0001 B | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Mercury | mg/l | 0.2 | 0.000025 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Molybdenum | mg/l | 350 | 0.1 | 0.14 | 0.024 B | 0.020 B | <0.1 | <0.1 | 0.27 | 0.070 B | 0.048 B | 0.026 B | 0.021 B | 1.1 | 0.21 | 0.10 | 0.038 B | <0.1 |
| Nickel | mg/l | 20 | 0.052* | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.0017 | 0.00042 B | <0.001 | <0.001 | <0.001 | 0.00099 B | 0.00069 B | <0.001 | <0.001 | <0.001 |
| Selenium | mg/l | 1 | 0.005* | 0.0017 | 0.0019 | 0.0011 | 0.00086 | 0.00080 | 0.0062 | 0.0051 | 0.0044 | 0.0049 | 0.0044 | 0.0085 | 0.0051 | 0.0043 | 0.0039 | 0.0033 |
| Silver | mg/l | 5 | 0.00019 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Thallium | mg/l | 7 | 0.002 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.00011 B | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Vanadium | mg/l | 24 | 0.019 | 0.041 | 0.016 | 0.0098 | 0.0097 | 0.0098 | 0.0092 | 0.012 | 0.014 | 0.019 | 0.019 | 0.37 | 0.13 | 0.083 | 0.083 | 0.076 |
| Zinc | mg/l | 250 | 0.081 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 |
| ***Wet Chemistry*** | | | | | | | | | | | | | | | | | | |
| Chloride | mg/l | | | 1.4 B | 2.5 | 0.77 B | 0.58 B | 0.85 B | <2 | 0.53 | 0.56 B | <2 | <2 | 2.3 | 3.6 | <2 | <2 | 0.78 B |
| Sulfate | mg/l | | | 9.0 | 5.9 | 7.9 | 4.4 B | 3.3 B | 212 | 31 | 26 | 9.2 | 7.9 | 22 | 12 | 16 | 9.1 | 4.8 B |
| Total Alkalinity | mg/l | | | 14 B | 17 B | 15 B | 14 B | 14 B | 16 B | 24 | 20 | 16 B | 17 B | 18 B | 23 | 18 B | 18 B | 17 B |
| Bicarbonate ($CaCO_3$) | mg/l | | | 14 B | 17 B | 15 B | 14 B | 14 B | 16 B | 24 | 20 | 16 B | 17 B | 18 B | 23 | 18 B | 18 B | 17 B |
| Carbonate as $CaCO_3$ | mg/l | | | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| Hydroxide as $CaCO_3$ | mg/l | | | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |

Notes:

Soluble Threshold Limit Concentrations (STLC) as per California Code of Regulations Title 22, Section 66261.24(2)(A) ESL listed is lower of freshwater aquatic or primary MCL;
As is based on background level.

* = the ESL and surface water quality objective (California Toxics Rule, 40 CFR section 131.38) are the same.

B = estimated value, below laboratory reporting limit; mg/l = milligrams per Liter

**Table 1: Sequential WET Extraction Chemistry**

| Analyte | Units | STLC Regulatory Limit | ESL | B-4: Non-Cement Grade Limestone, Non-Weathered | | | | | B-5-9: High-Grade Limestone, Weathered | | | | | B-6: Greenstone, Non-Weathered | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Leach Initial | Leach 1 | Leach 2 | Leach 3 | Leach 4 | Leach Initial | Leach 1 | Leach 2 | Leach 3 | Leach 4 | Leach Initial | Leach 1 | Leach 2 | Leach 3 | Leach 4 |
| ***Dissolved Metals*** | | | | | | | | | | | | | | | | | | |
| Antimony | mg/l | 15 | 0.006 | 0.0030 | 0.0018 B | 0.0014 B | 0.0012 B | 0.0011 B | 0.0065 | 0.0038 | 0.0025 | 0.0026 | 0.0021 | 0.0030 | 0.00128 B | 0.00085 B | 0.00054 B | 0.00043 B |
| Arsenic | mg/l | 5 | 0.01 | 0.0002 B | 0.00031 B | <0.001 | 0.00023 B | <0.001 | 0.00047 B | 0.00069 B | 0.00039 B | 0.00054 B | 0.00046 B | 0.0026 | 0.0029 | 0.0021 | 0.0021 | 0.0017 |
| Barium | mg/l | 100 | 1 | 0.13 | 0.40 | 0.26 | 0.44 | 0.60 | 0.20 | 0.38 | 0.21 | 0.39 | 0.63 | 0.11 | 0.11 | 0.099 | 0.11 | 0.10 |
| Beryllium | mg/l | 0.75 | 0.0027 | 0.000082 B | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 |
| Cadmium | mg/l | 1 | 0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 |
| Chromium | mg/l | 5 | 0.05 | <0.002 | 0.0007 B | <0.002 | <0.002 | <0.002 | <0.002 | 0.0026 | <0.002 | 0.00111 B | 0.00108 B | <0.002 | <0.002 | <0.002 | 0.00114 B | <0.002 |
| Cobalt | mg/l | 80 | 0.003 | <0.00025 | 0.00005 B | 0.000092 B | <0.00025 | <0.00025 | 0.000057 B | <0.00025 | <0.00025 | <0.00025 | 0.000059 B | <0.00025 | 0.000051 B | 0.000063 B | 0.00027 | 0.000066 B |
| Copper | mg/l | 25 | 0.009 | <0.002 | 0.0017 B | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Lead | mg/l | 5 | 0.0025 | <0.0005 | <0.0005 | 0.00086 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.00015 B | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Mercury | mg/l | 0.2 | 0.000025 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Molybdenum | mg/l | 350 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.23 | 0.067 B | 0.044 B | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Nickel | mg/l | 20 | 0.052* | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.00071 B | <0.001 | <0.001 | 0.0012 | <0.001 |
| Selenium | mg/l | 1 | 0.005* | 0.0013 | 0.0011 | 0.00092 | 0.00082 | 0.00077 | 0.0040 | 0.0035 | 0.0029 | 0.0028 | 0.0027 | 0.00054 | 0.00017 B | 0.00018 B | <0.00025 | <0.00025 |
| Silver | mg/l | 5 | 0.00019 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Thallium | mg/l | 7 | 0.002 | 0.00011 B | <0.0005 | 0.0005 B | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Vanadium | mg/l | 24 | 0.019 | 0.0046 | 0.00161 B | 0.0022 | 0.0022 | 0.0023 | 0.036 | 0.016 | 0.012 | 0.014 | 0.015 | 0.013 | 0.012 | 0.0095 | 0.0095 | 0.0090 |
| Zinc | mg/l | 250 | 0.081 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 |
| ***Wet Chemistry*** | | | | | | | | | | | | | | | | | | |
| Chloride | mg/l | | | 2.1 | 3.5 | 0.88 B | 1.1 B | 1.1 B | 1.35 B | 2.8 | <2 | <2 | 0.84 B | <2 | <2 | <2 | <2 | <2 |
| Sulfate | mg/l | | | 25 | 9.3 | 12 | 7.4 | 5.2 | 16 | 9.0 | 13 | 7.8 | 4.4 B | 12 | 6.6 | 4.9 B | 2.7 B | 1.7 B |
| Total Alkalinity | mg/l | | | 15 B | 22 | 16 B | 16 B | 16 B | 17 B | 22 | 17 B | 16 B | 17 B | 27 | 22 | 21 | 18 B | 17 B |
| Bicarbonate ($CaCO_3$) | mg/l | | | 15 B | 22 | 16 B | 16 B | 16 B | 17 B | 22 | 17 B | 16 B | 17 B | 27 | 22 | 21 | 18 B | 17 B |
| Carbonate as $CaCO_3$ | mg/l | | | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| Hydroxide as $CaCO_3$ | mg/l | | | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |

Notes:

Soluble Threshold Limit Concentrations (STLC) as per California Code of Regulations Title 22, Section 66261.24(2)(A) ESL listed is lower of freshwater aquatic or primary MCL; As is based on background level.

* = the ESL and surface water quality objective (California Toxics Rule, 40 CFR section 131.38) are the same.

B = estimated value, below laboratory reporting limit; mg/l = milligrams per Liter

**Table 1: Sequential WET Extraction Chemistry**

| Analyte | Units | STLC Regulatory Limit | ESL | B-7-10: Greenstone, Weathered | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Leach Initial | Leach 1 | Leach 2 | Leach 3 | Leach 4 |
| ***Dissolved Metals*** | | | | | | | | |
| Antimony | mg/l | 15 | 0.006 | 0.00065 B | <0.002 | <0.002 | <0.002 | <0.002 |
| Arsenic | mg/l | 5 | 0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Barium | mg/l | 100 | 1 | 0.029 B | 0.0247 B | 0.028 B | 0.026 B | 0.0226 B |
| Beryllium | mg/l | 0.75 | 0.0027 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 |
| Cadmium | mg/l | 1 | 0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 | <0.00025 |
| Chromium | mg/l | 5 | 0.05 | <0.002 | <0.002 | <0.002 | 0.00058 B | <0.002 |
| Cobalt | mg/l | 80 | 0.003 | <0.00025 | 0.000067 B | 0.000051 B | 0.00011 B | 0.000087 B |
| Copper | mg/l | 25 | 0.009 | 0.00133 B | <0.002 | <0.002 | 0.0013 B | <0.002 |
| Lead | mg/l | 5 | 0.0025 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.00018 B |
| Mercury | mg/l | 0.2 | 0.000025 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Molybdenum | mg/l | 350 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Nickel | mg/l | 20 | 0.052* | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium | mg/l | 1 | 0.005* | 0.00021 B | 0.00013 B | <0.00025 | <0.00025 | 0.00014 B |
| Silver | mg/l | 5 | 0.00019 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Thallium | mg/l | 7 | 0.002 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Vanadium | mg/l | 24 | 0.019 | 0.016 | 0.019 | 0.013 | 0.014 | 0.013 |
| Zinc | mg/l | 250 | 0.081 | <0.015 | <0.015 | <0.015 | <0.015 | <0.015 |
| ***Wet Chemistry*** | | | | | | | | |
| Chloride | mg/l | | | <2 | <2 | <2 | <2 | <2 |
| Sulfate | mg/l | | | 4.8 B | 1.4 B | 1.3 B | <5 | <5 |
| Total Alkalinity | mg/l | | | 24 | 22 | 22 | 21 | 20 |
| Bicarbonate ($CaCO_3$) | mg/l | | | 22 | 20 B | 21 | 18 B | 18 B |
| Carbonate as $CaCO_3$ | mg/l | | | 2.3 B | 2.5 B | <20 | 2.4 B | 2.2 B |
| Hydroxide as $CaCO_3$ | mg/l | | | <20 | <20 | <20 | <20 | <20 |

Notes:

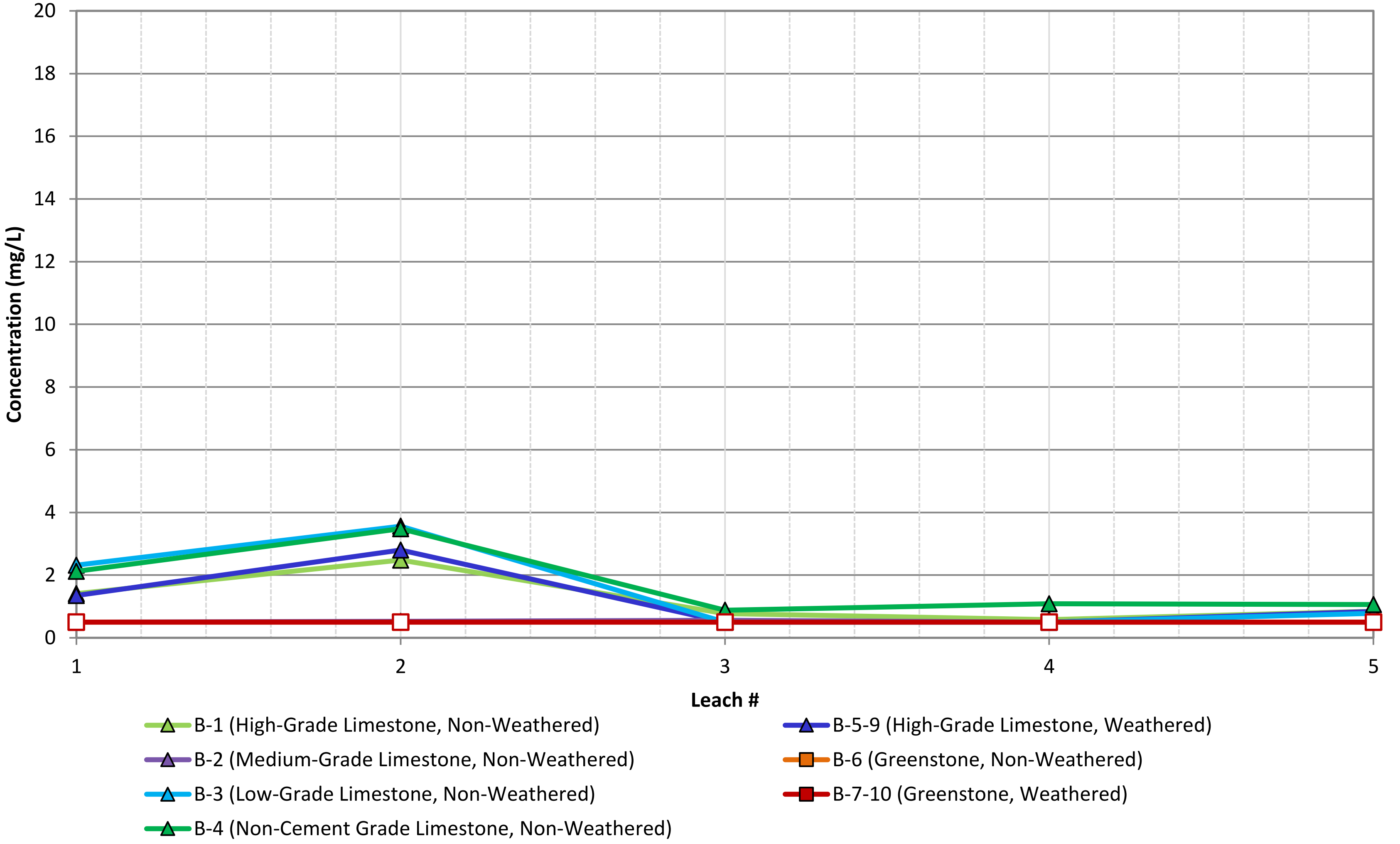
Soluble Threshold Limit Concentrations (STLC) as per California Code of Regulations Title 22, Section 66261.24(2)(A) ESL listed is lower of freshwater aquatic or primary MCL; As is based on background level.

* = the ESL and surface water quality objective (California Toxics Rule, 40 CFR section 131.38) are the same.

B = estimated value, below laboratory reporting limit; mg/l = milligrams per Liter

## ATTACHMENT C

# Time-Series Graphs

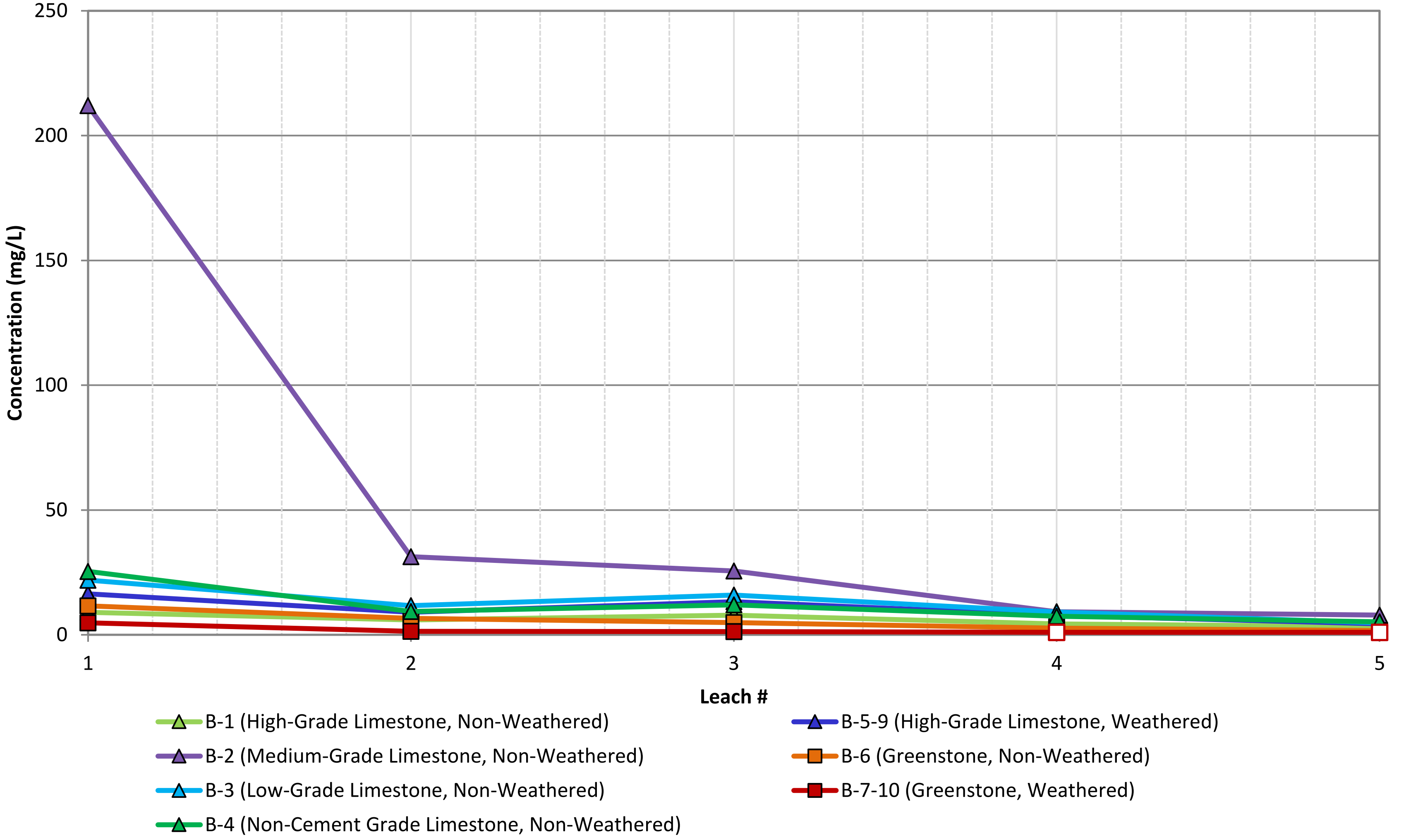


*Open symbols denote values at or below the method detection limit

Title

# Sequential Modified WET- Chloride

| | | |
|---|---|---|
| Project Name | Project No.<br>31405507 | FIGURE<br>C-1 |
| Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

Title
**Sequential Modified WET- Sulfate**

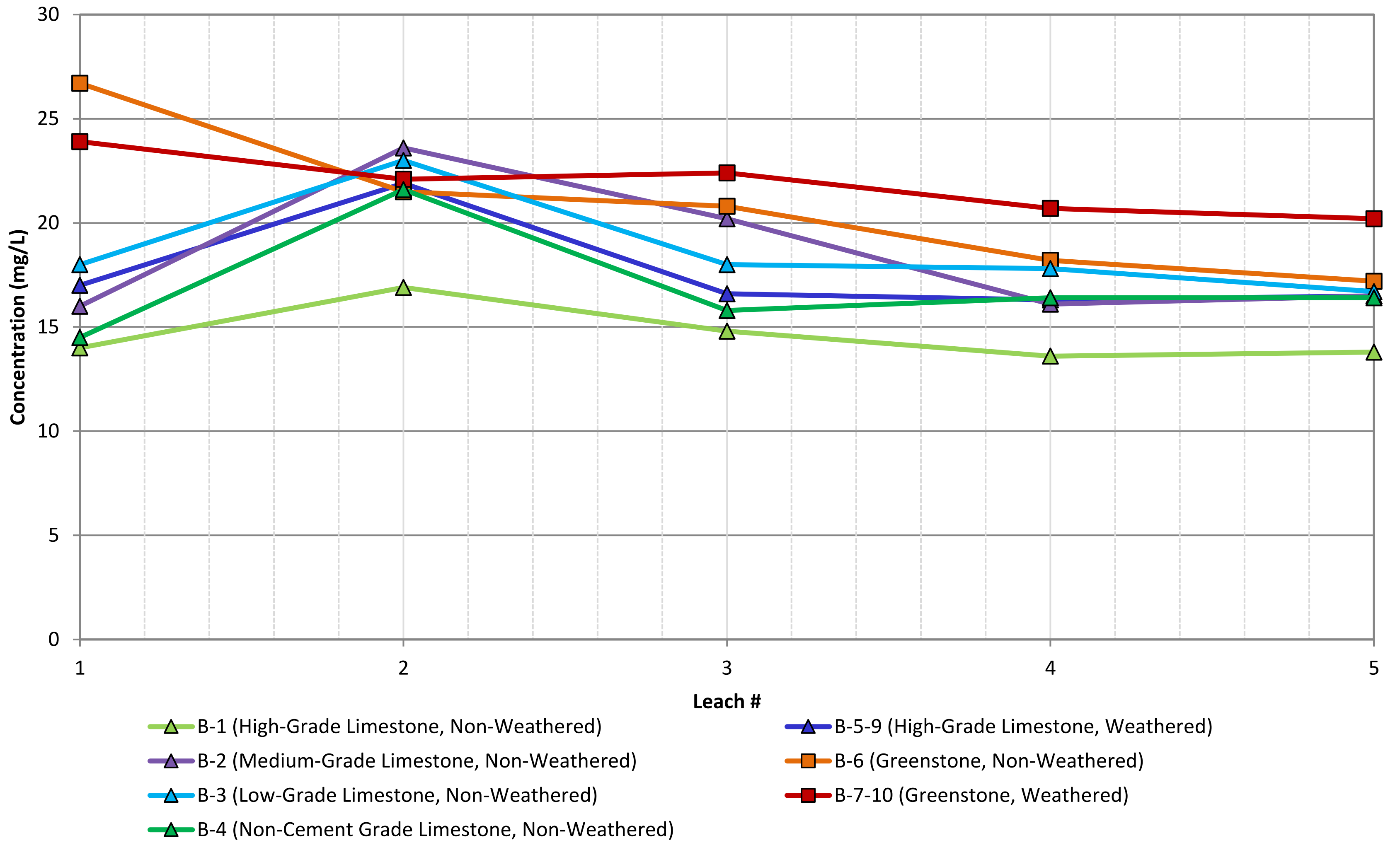
Project Name

Project No. 31405507

Client Name Lehigh Permanente

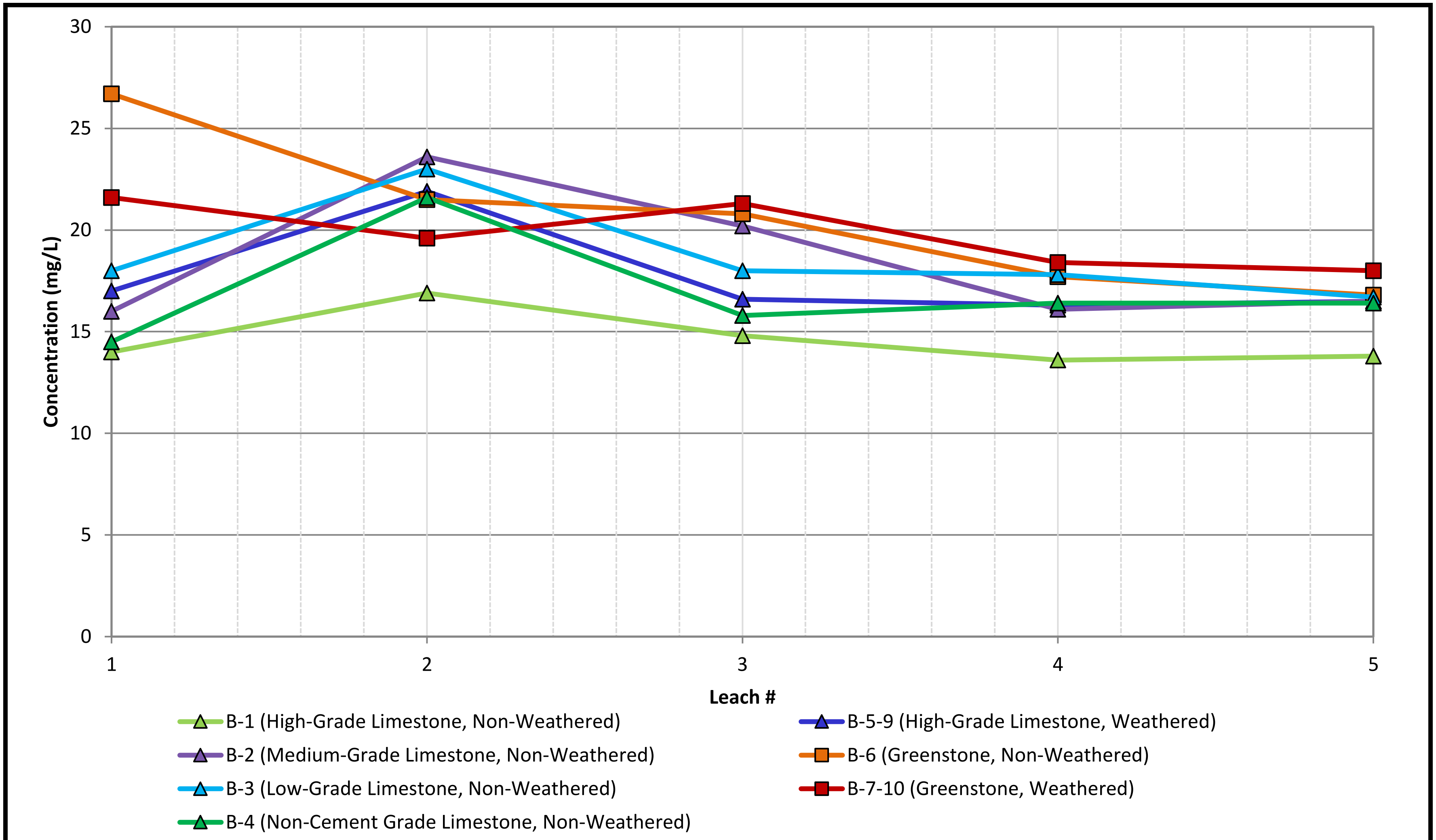
Date 8/4/2022

FIGURE
C-2



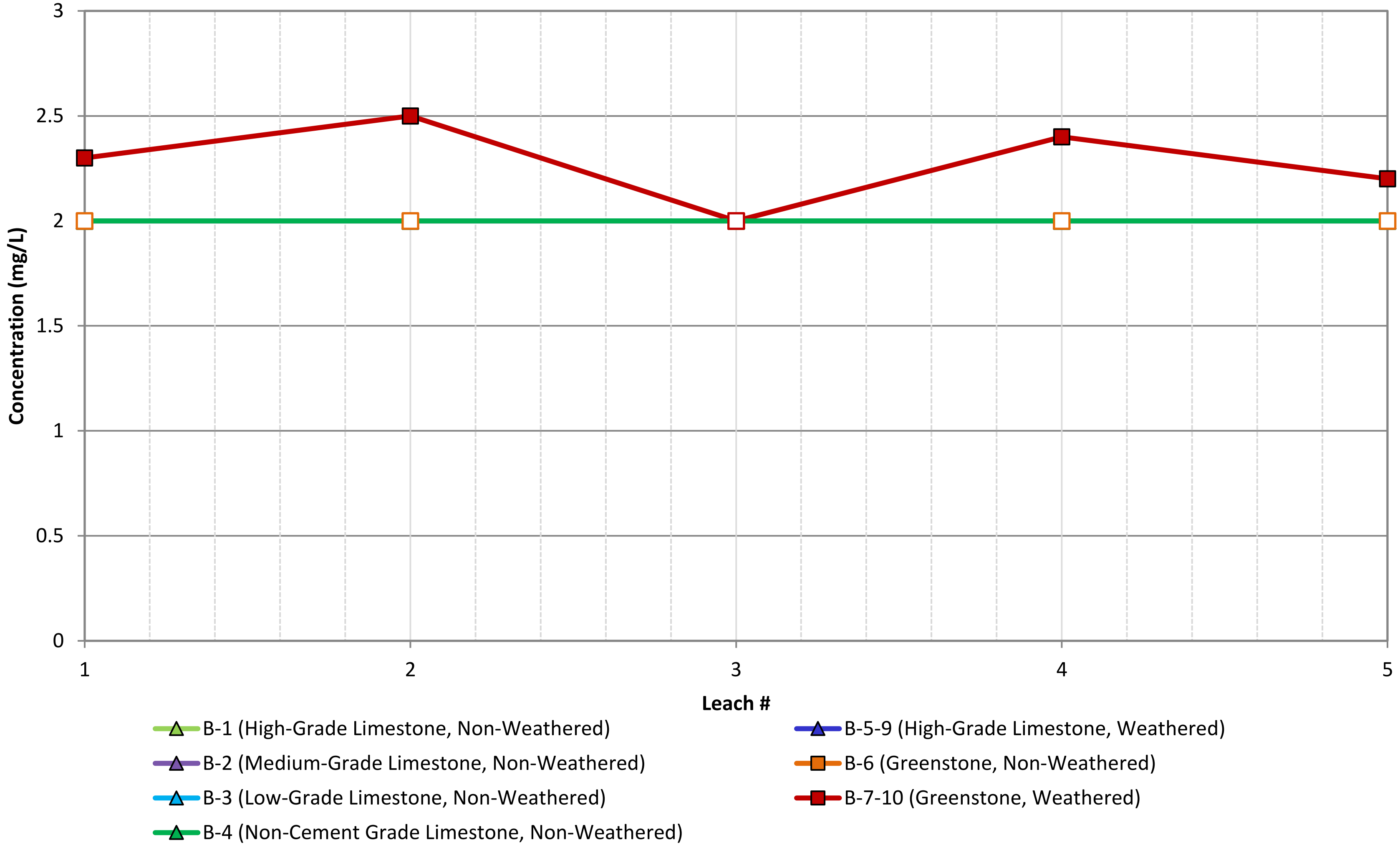
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Total Alkalinity** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-3 |
| | Client Name<br>Lehigh Permanente | Date<br>3/4/2022 | |



*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Bicarbonate as CaCO3** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-4 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

wsp GOLDER

Title
**Sequential Modified WET- Carbonate as CaCO3**

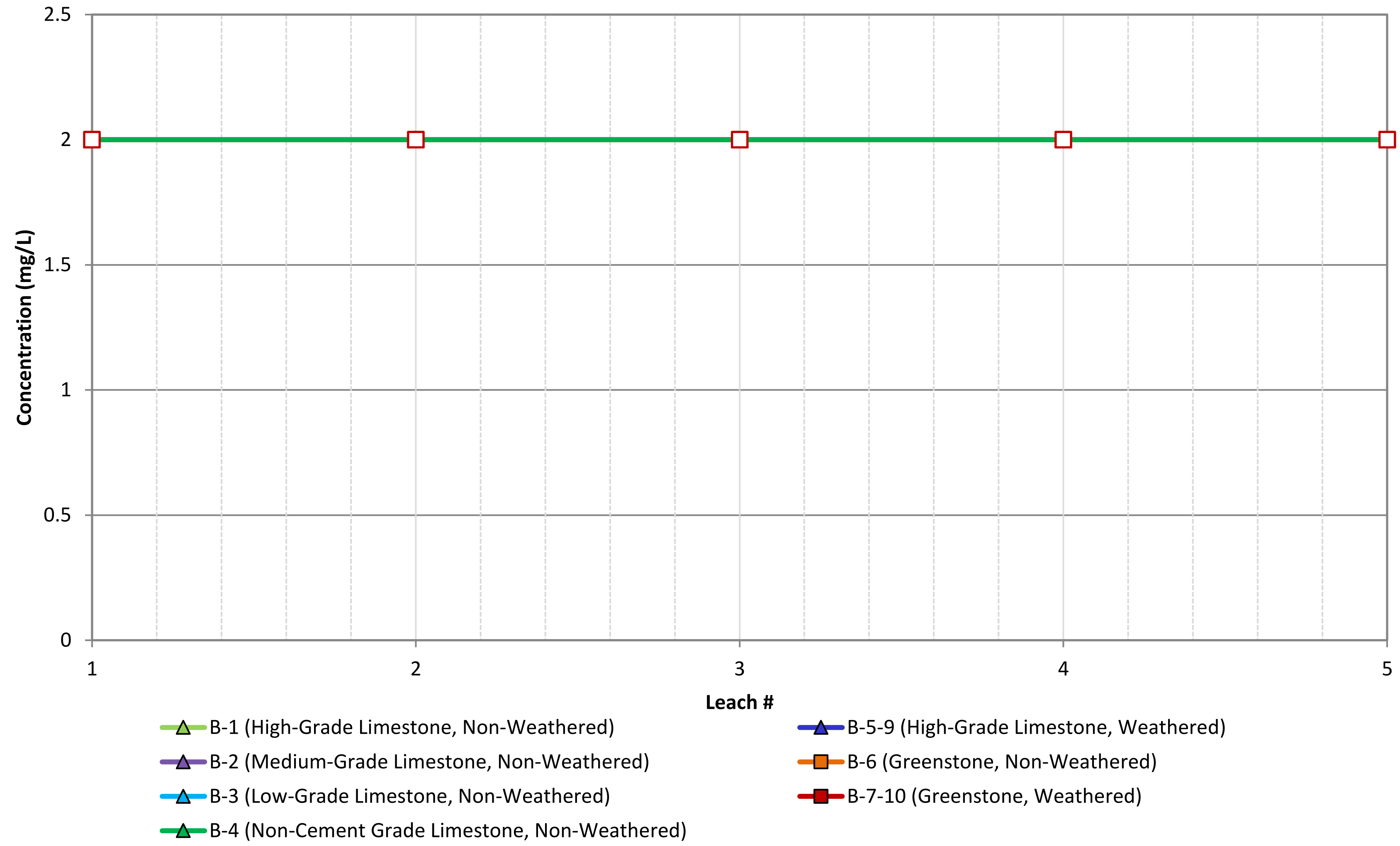
Project Name

Project No.
31405507

Client Name
Lehigh Permanente

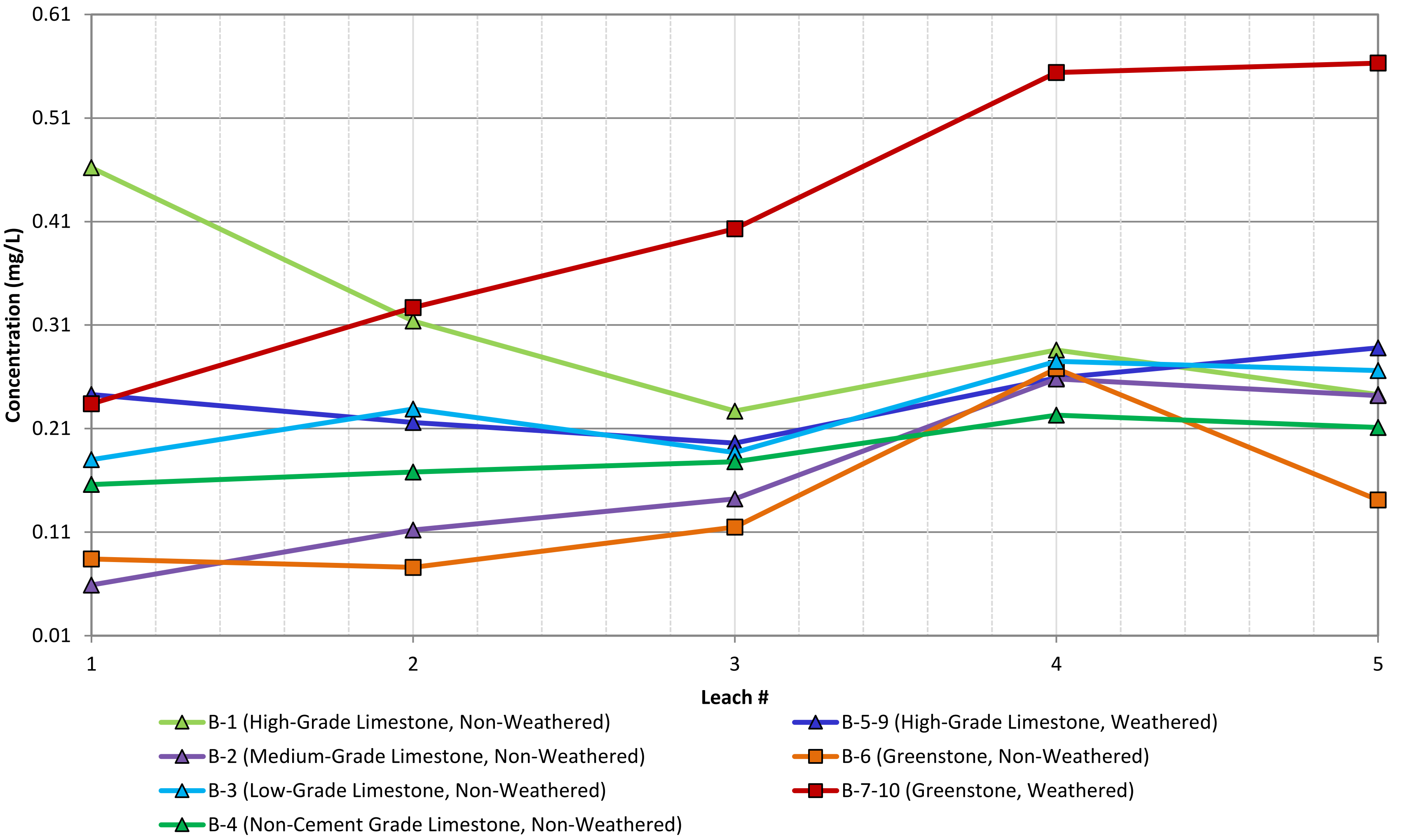
Date
8/4/2022

FIGURE
C-5



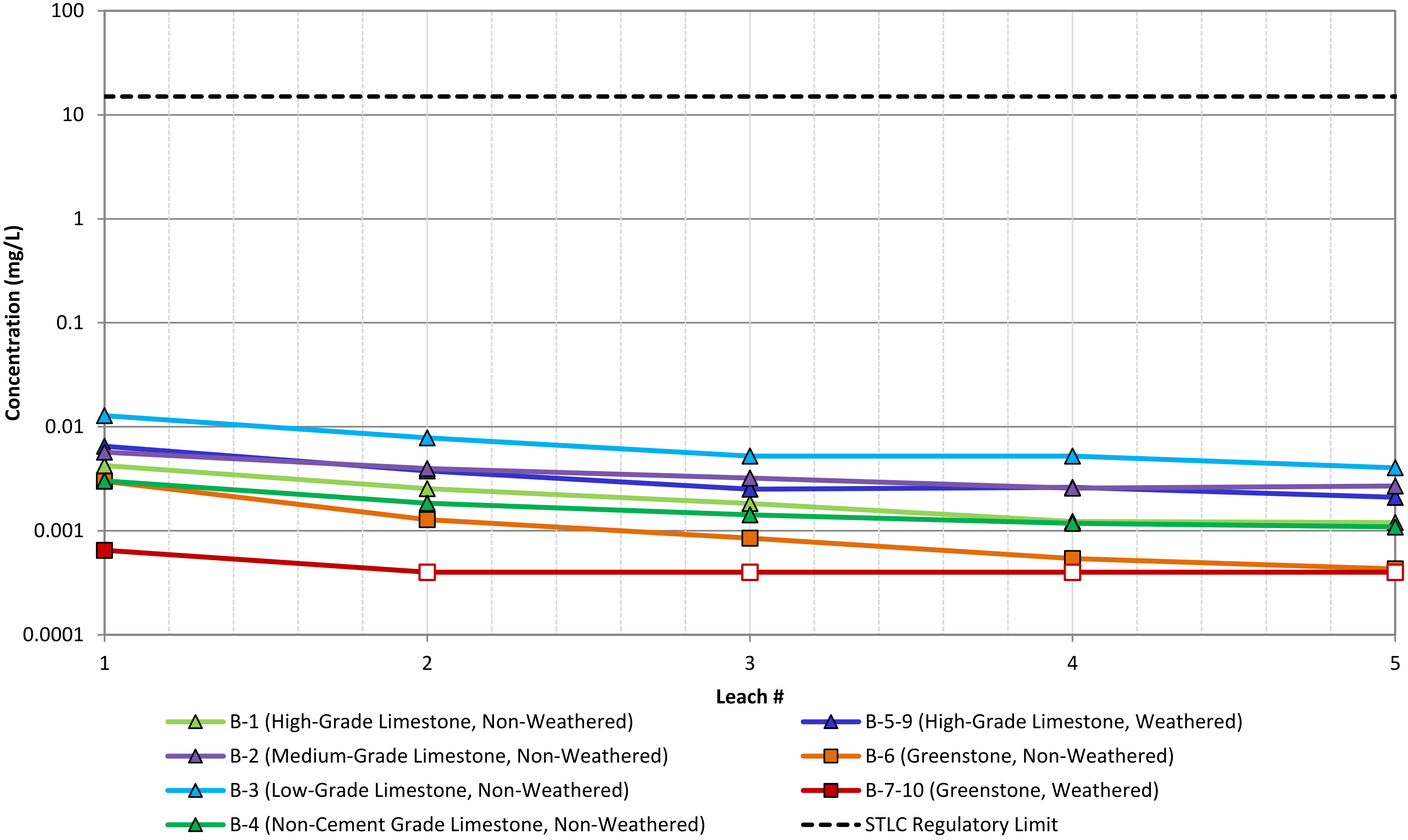
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Hydroxide as CaCO3** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-6 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Aluminum** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-7 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

wsp GOLDER

Title

# Sequential Modified WET- Antimony

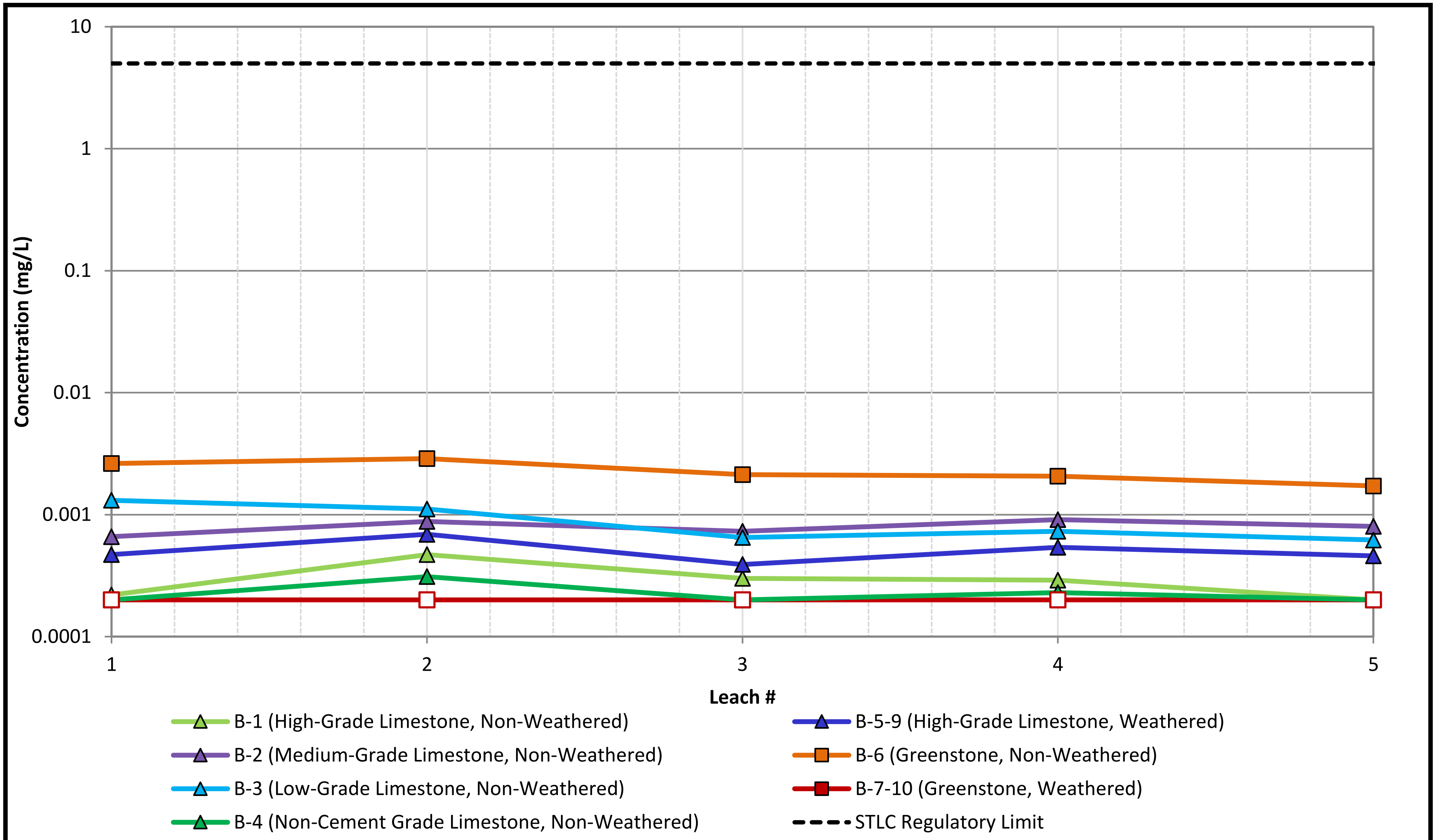
Project Name

Project No. 31405507

Client Name Lehigh Permanente

Date 8/4/2022

FIGURE C-8



*Open symbols denote values at or below the method detection limit

wsp GOLDER

Title
**Sequential Modified WET- Arsenic**

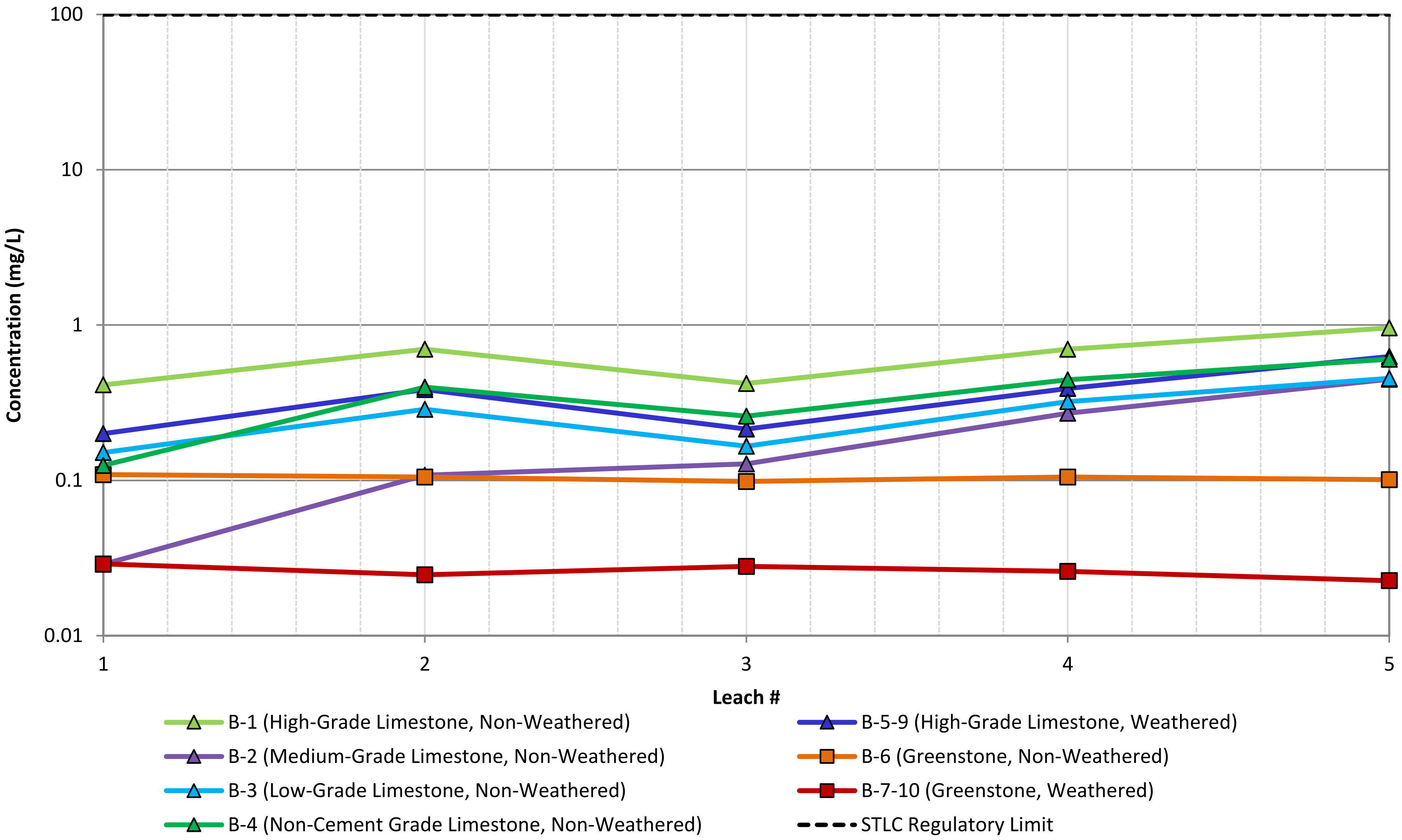
Project Name

Project No.
31405507

Client Name
Lehigh Permanente

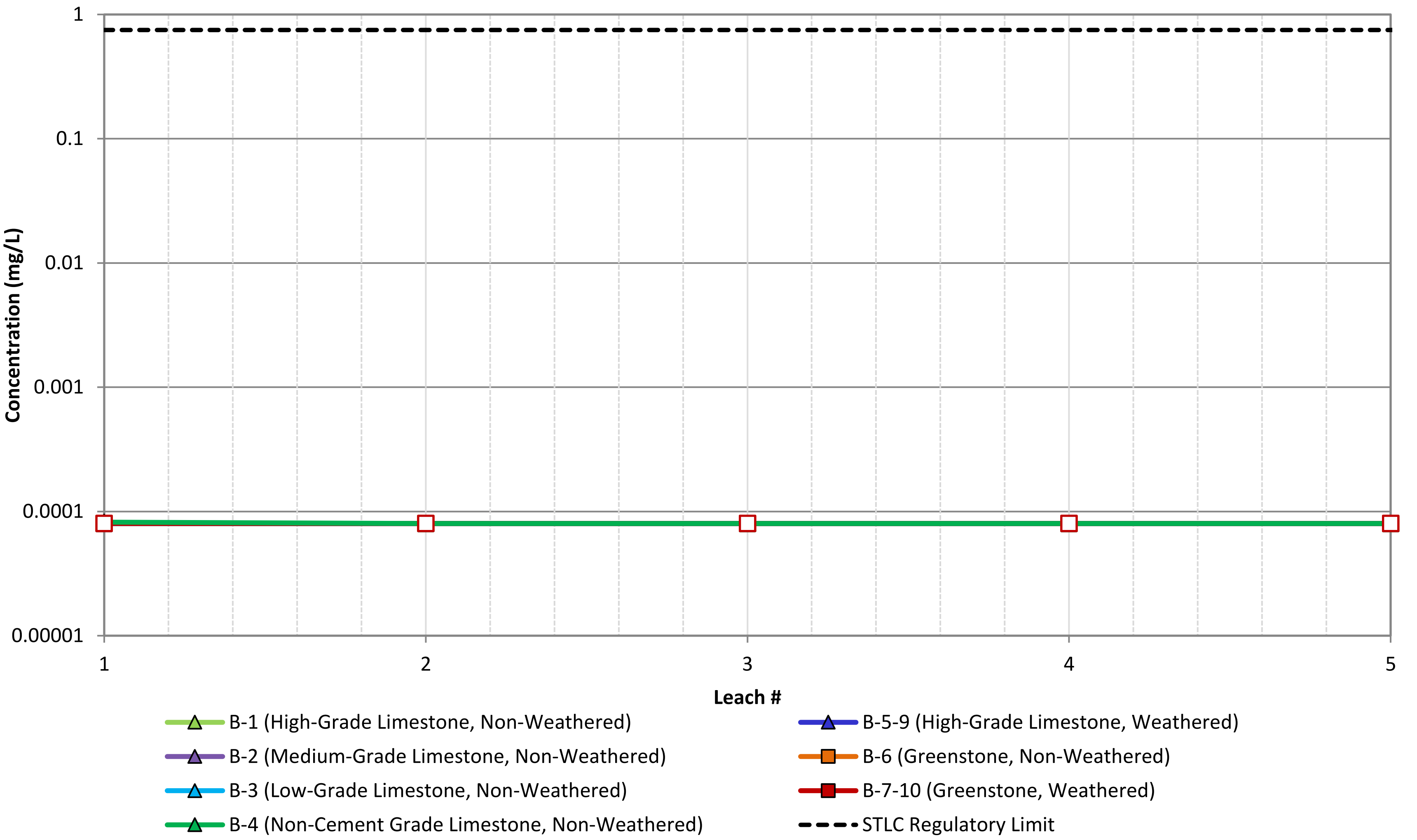
Date
8/4/2022

FIGURE
C-9



*Open symbols denote values at or below the method detection limit

|  |  |  |  |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Barium** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-10 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

wsp GOLDER

Title

# Sequential Modified WET- Beryllium

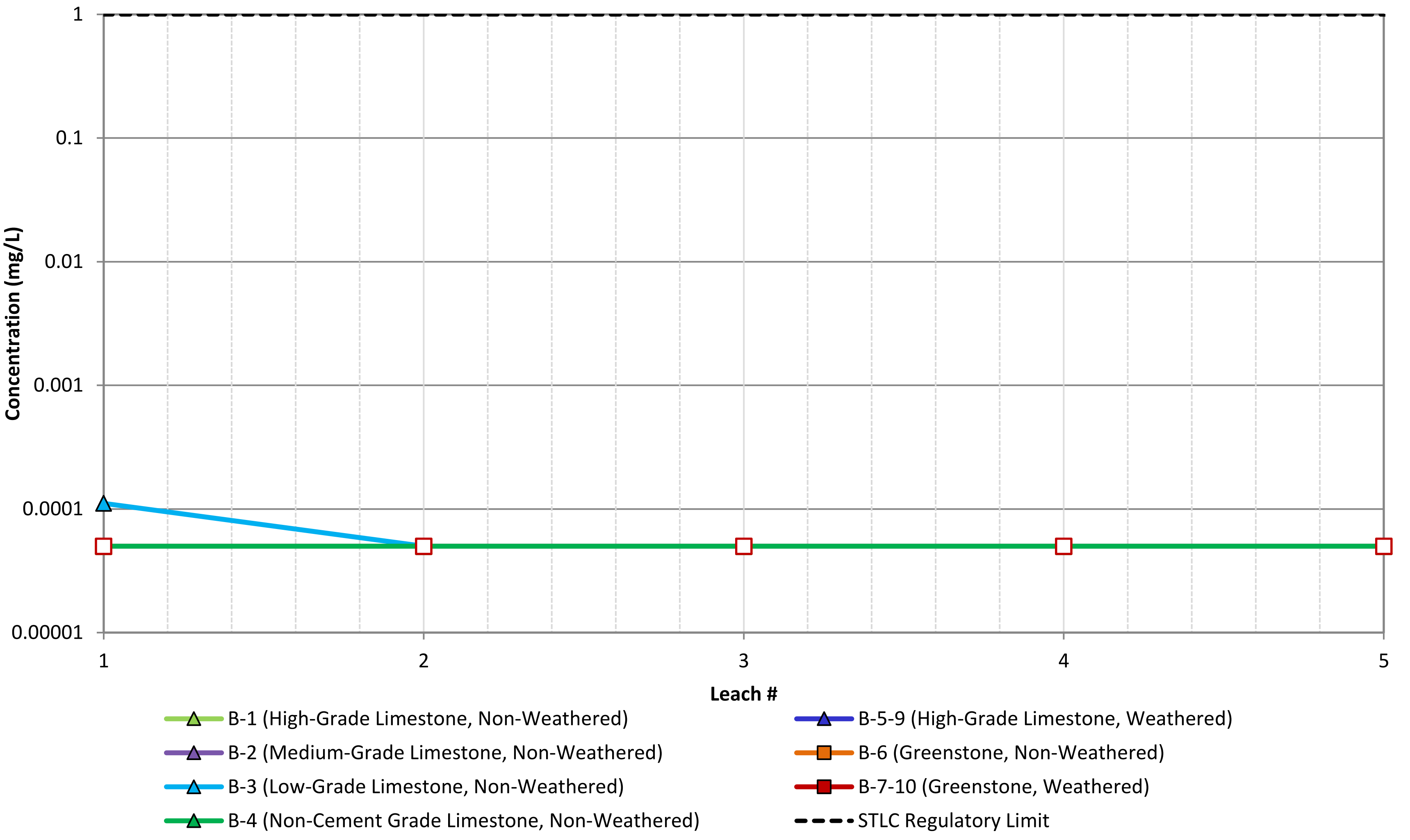
Project Name

Project No. 31405507

Client Name Lehigh Permanente

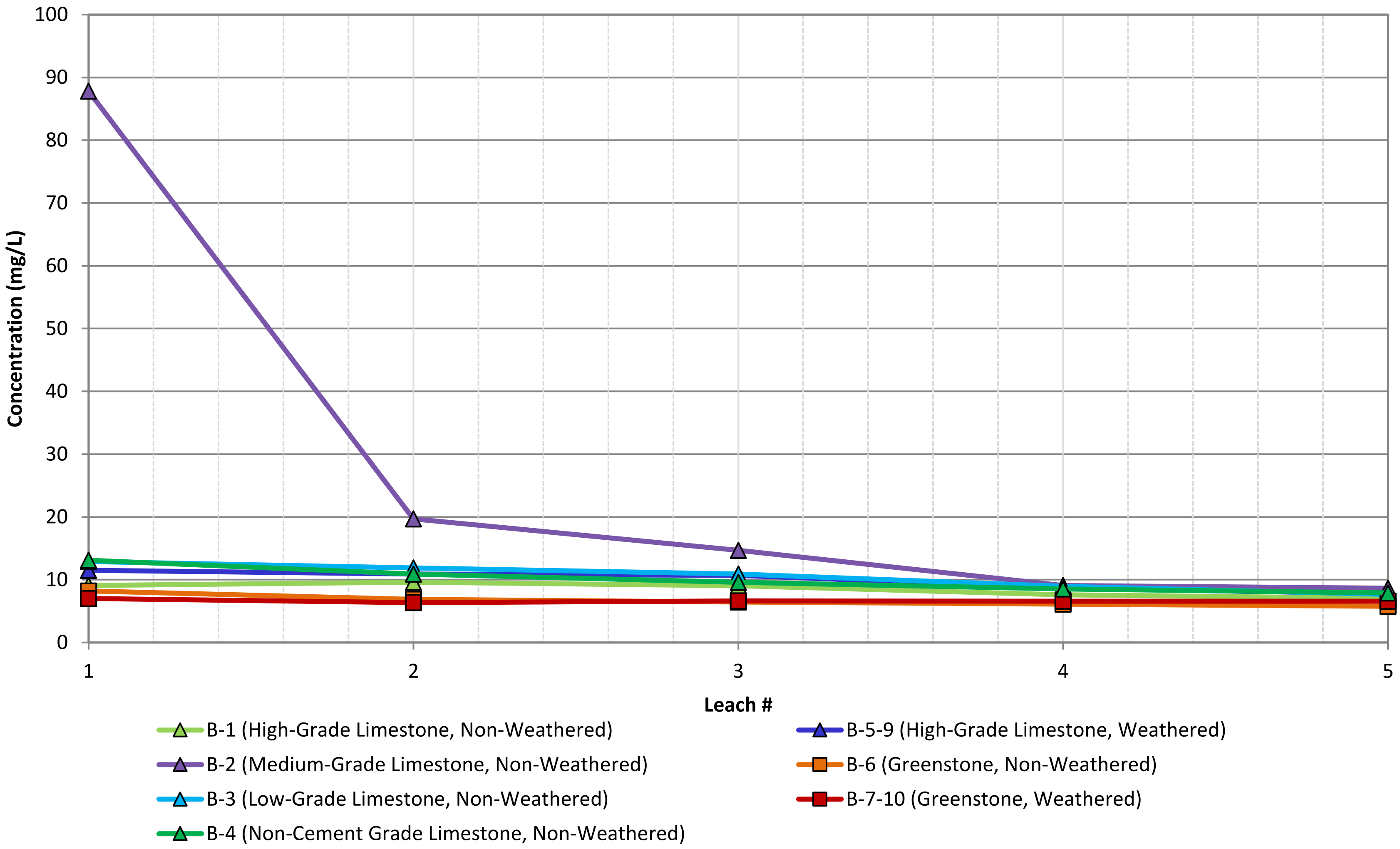
Date 8/4/2022

FIGURE C-11



*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Cadmium** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-12 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

Title

## Sequential Modified WET- Calcium

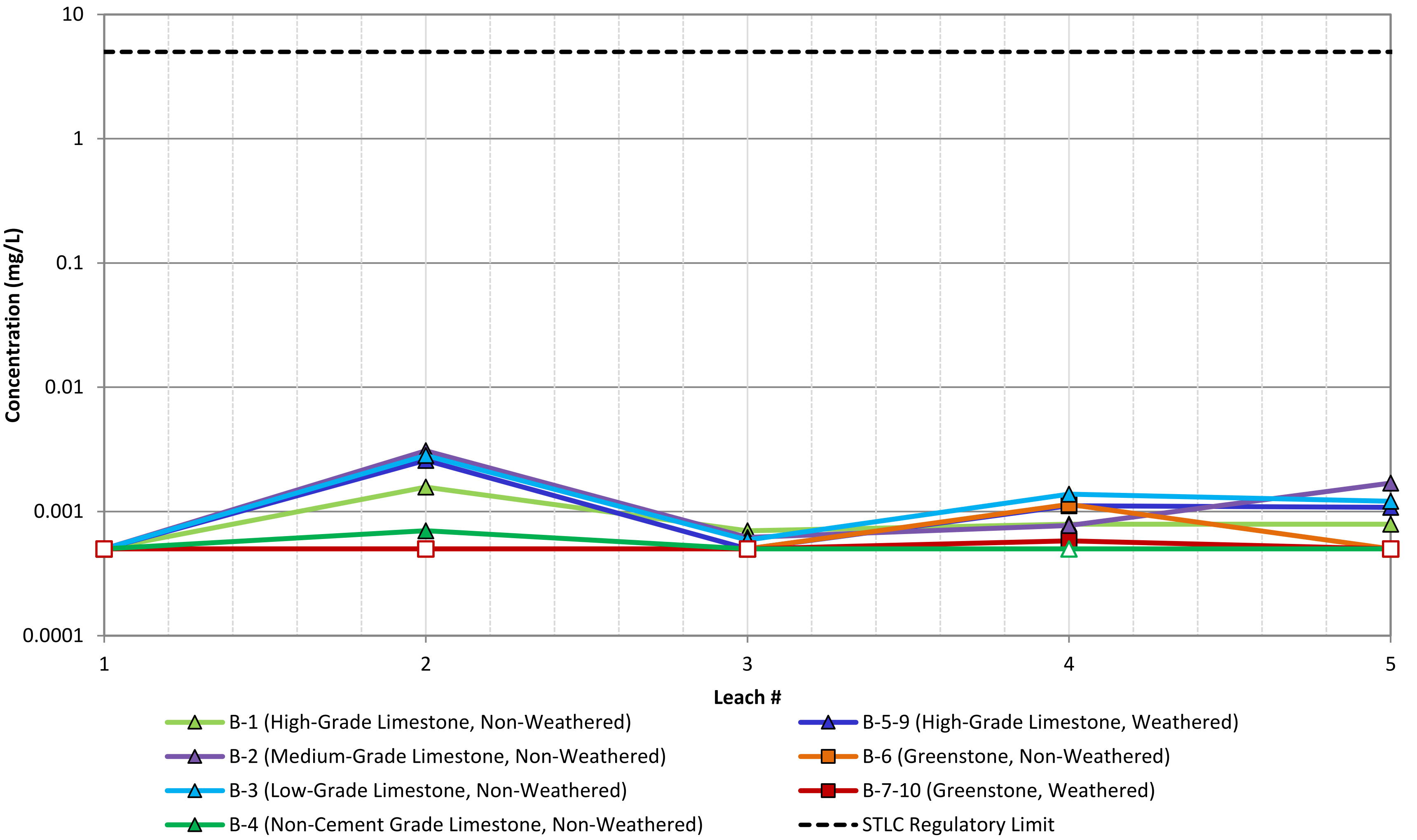
Project Name

Project No.
31405507

Client Name
Lehigh Permanente

Date
8/4/2022

FIGURE
C-13

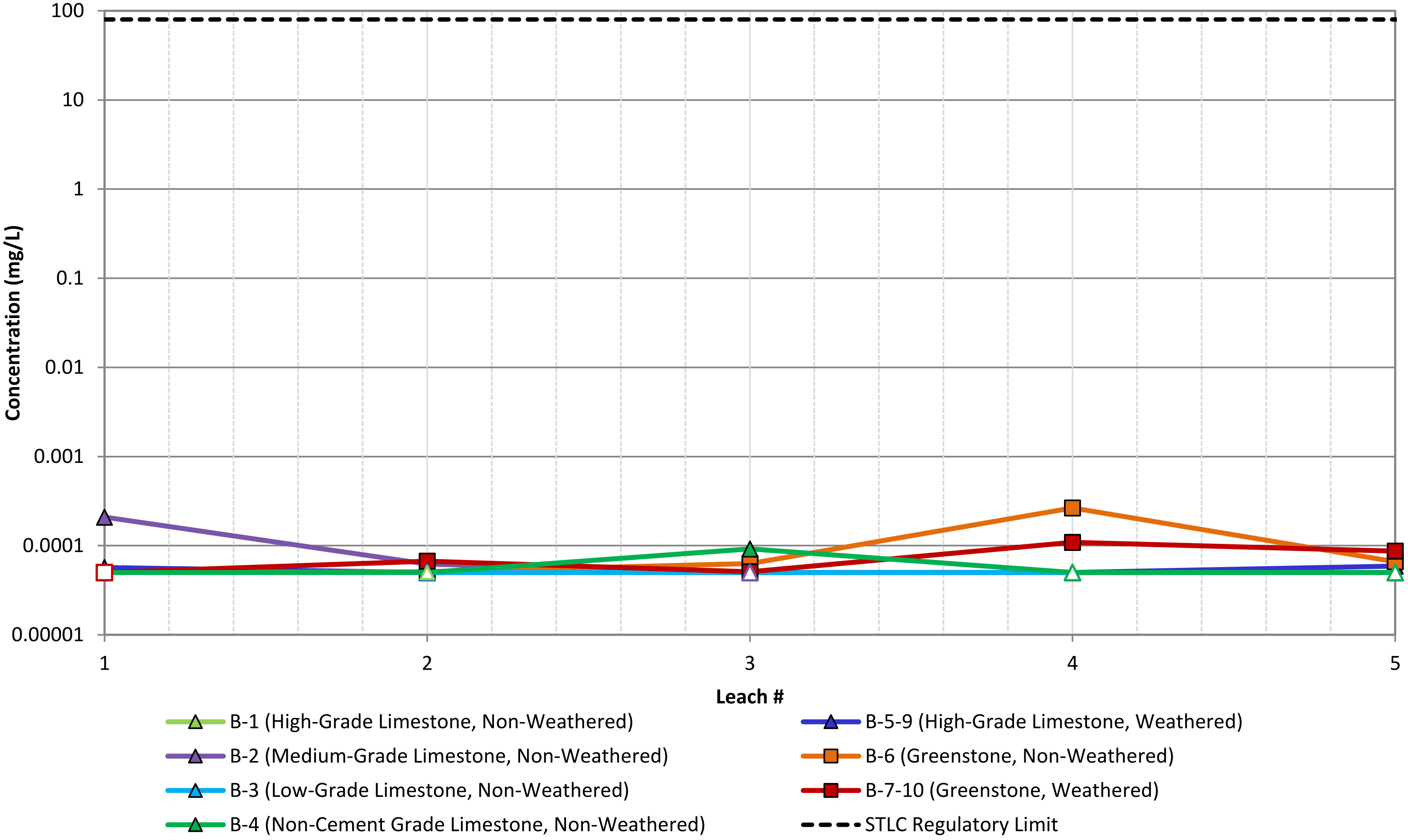


*Open symbols denote values at or below the method detection limit

WSP GOLDER

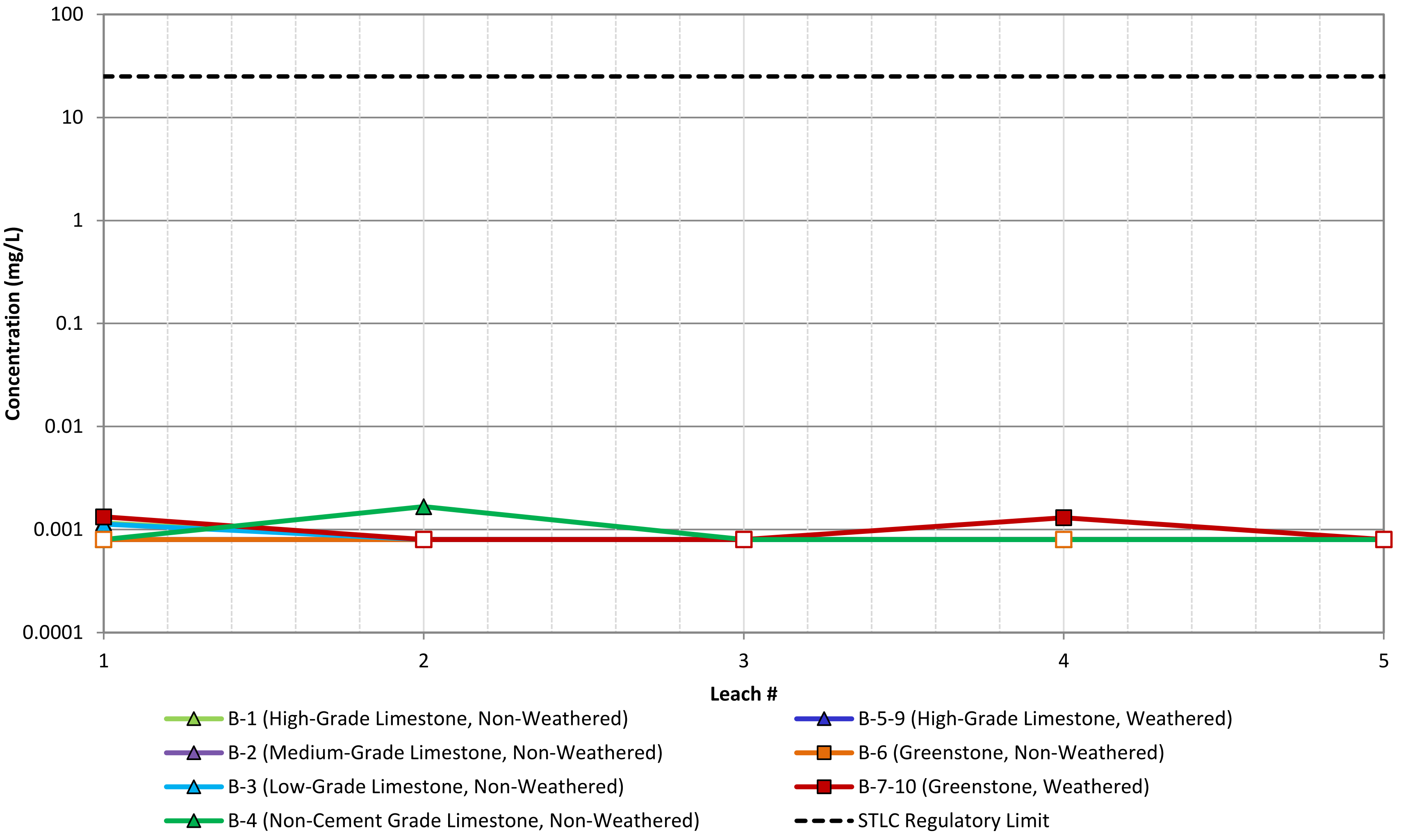
Title
**Sequential Modified WET- Chromium**

| | | |
|---|---|---|
| Project Name | Project No. 31405507 | FIGURE C-14 |
| Client Name Lehigh Permanente | Date 8/4/2022 | |



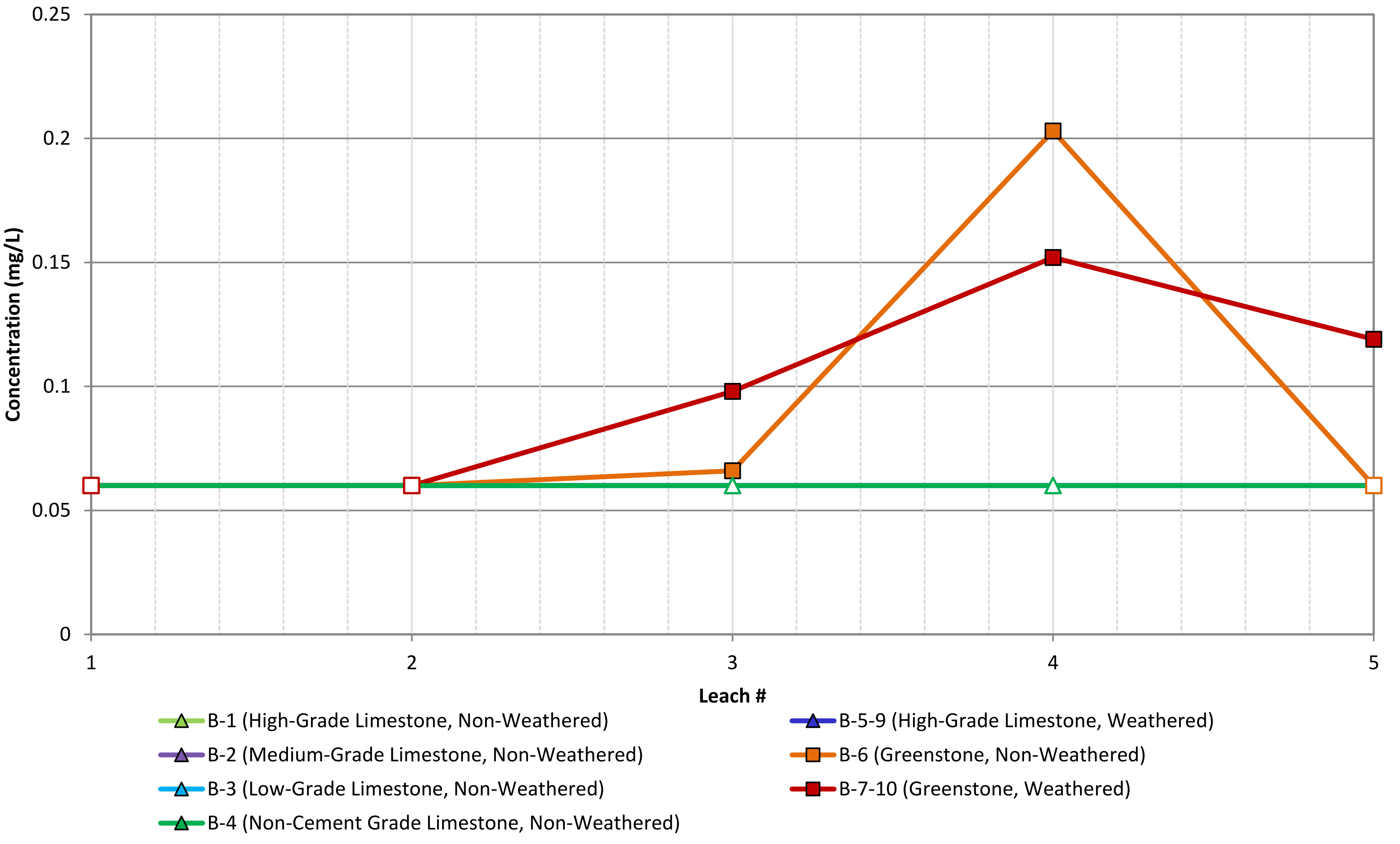
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Cobalt** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-15 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



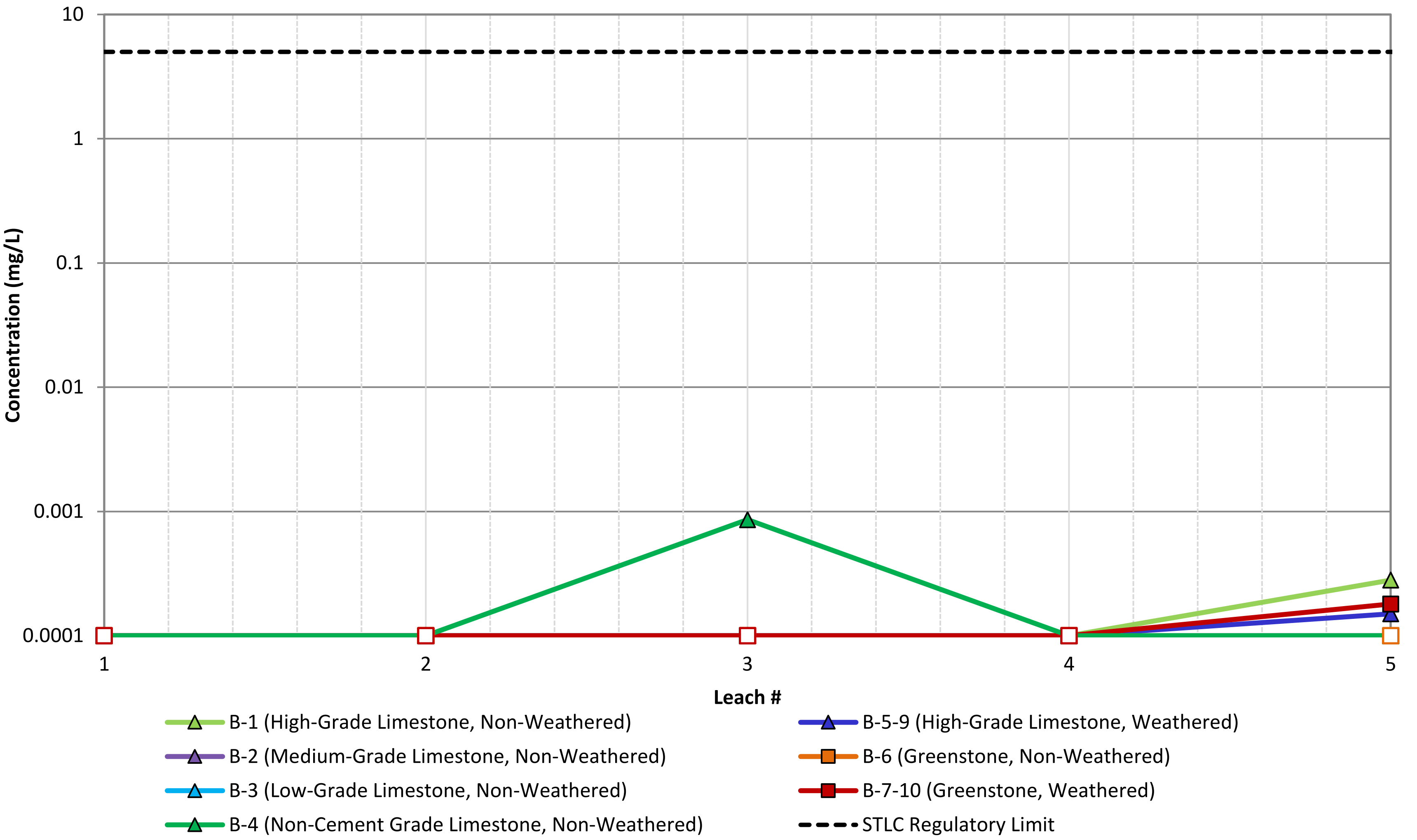
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Copper** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-16 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



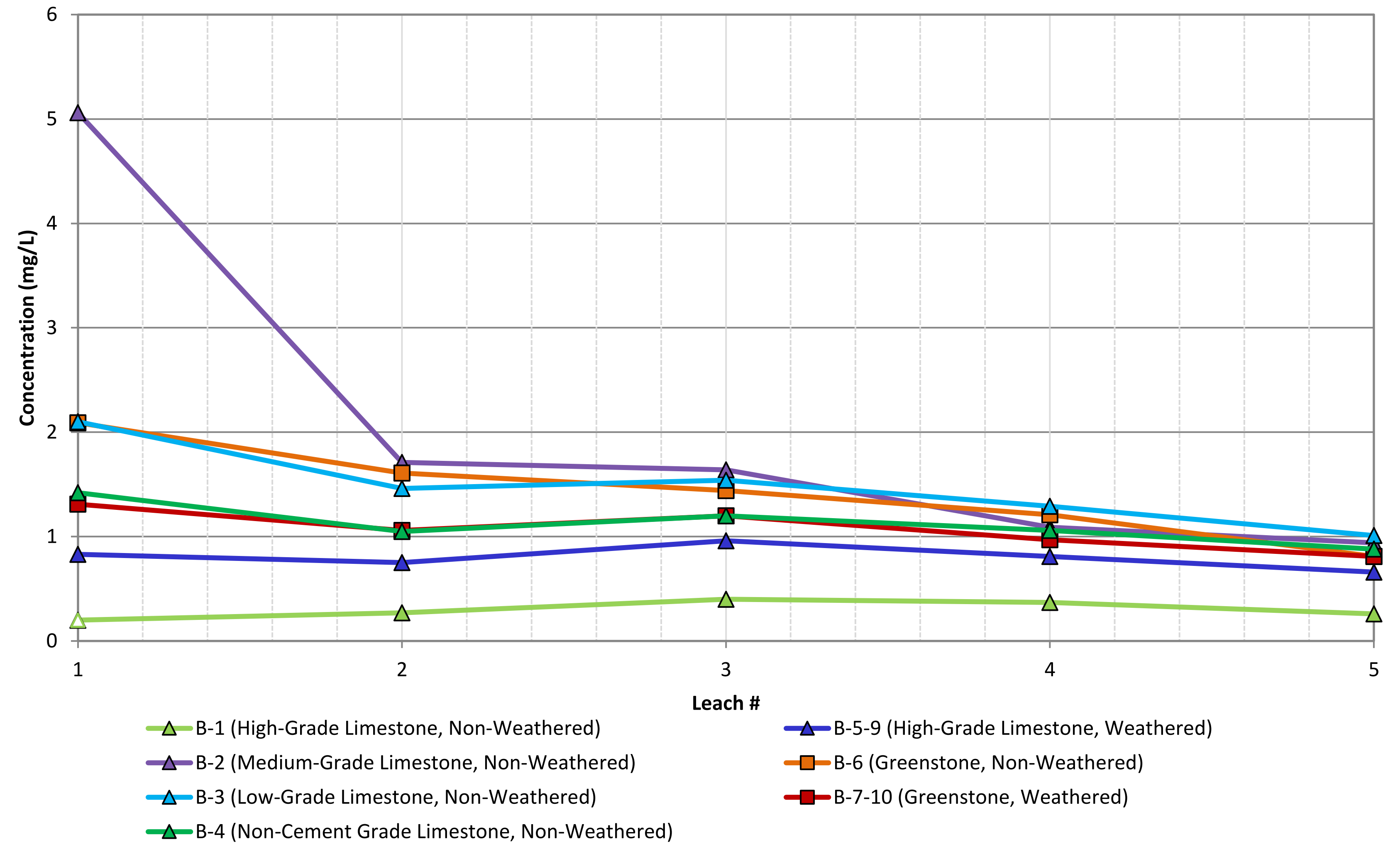
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Iron** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-17 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| | Title<br>**Sequential Modified WET- Lead** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-18 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |

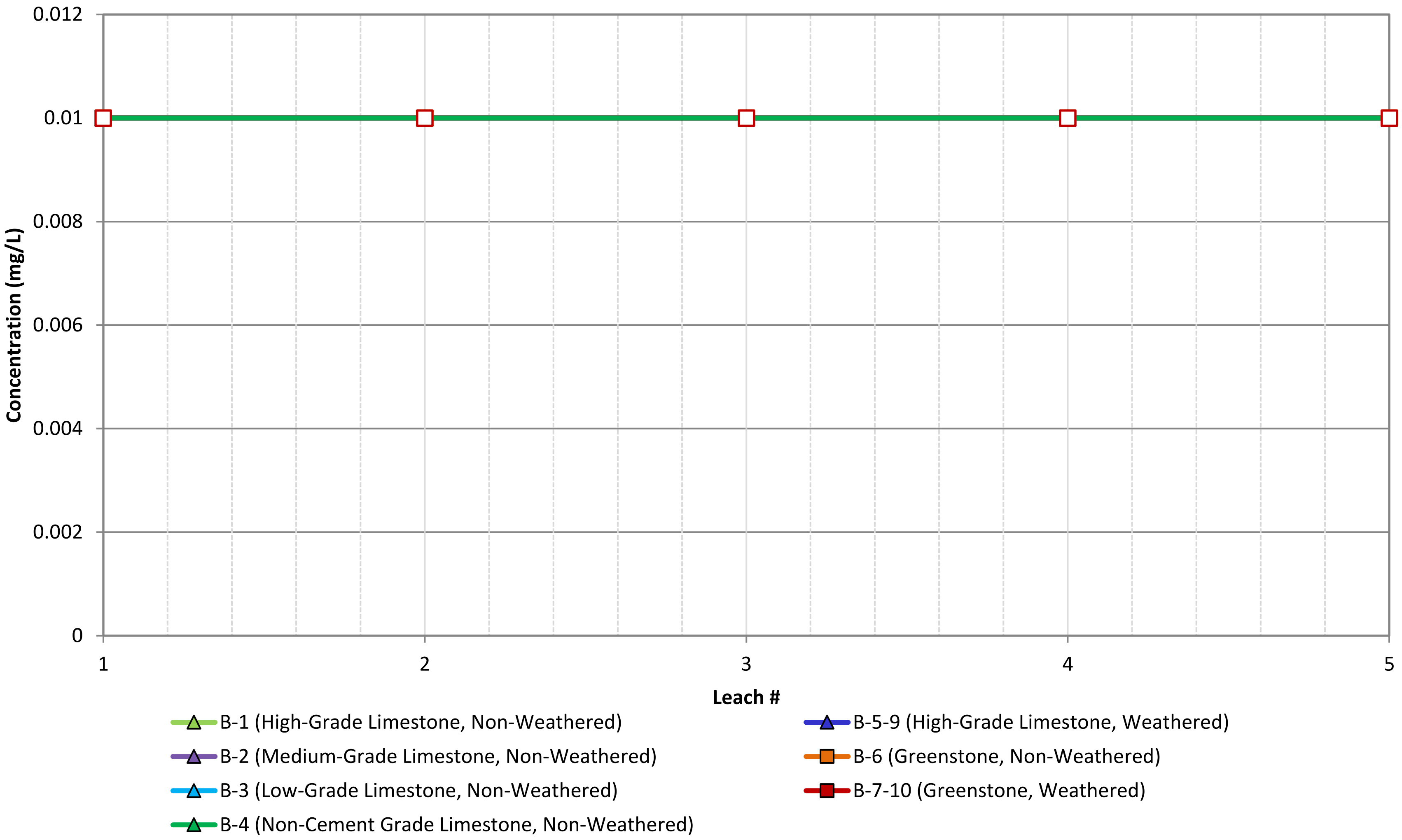


*Open symbols denote values at or below the method detection limit

WSP GOLDER

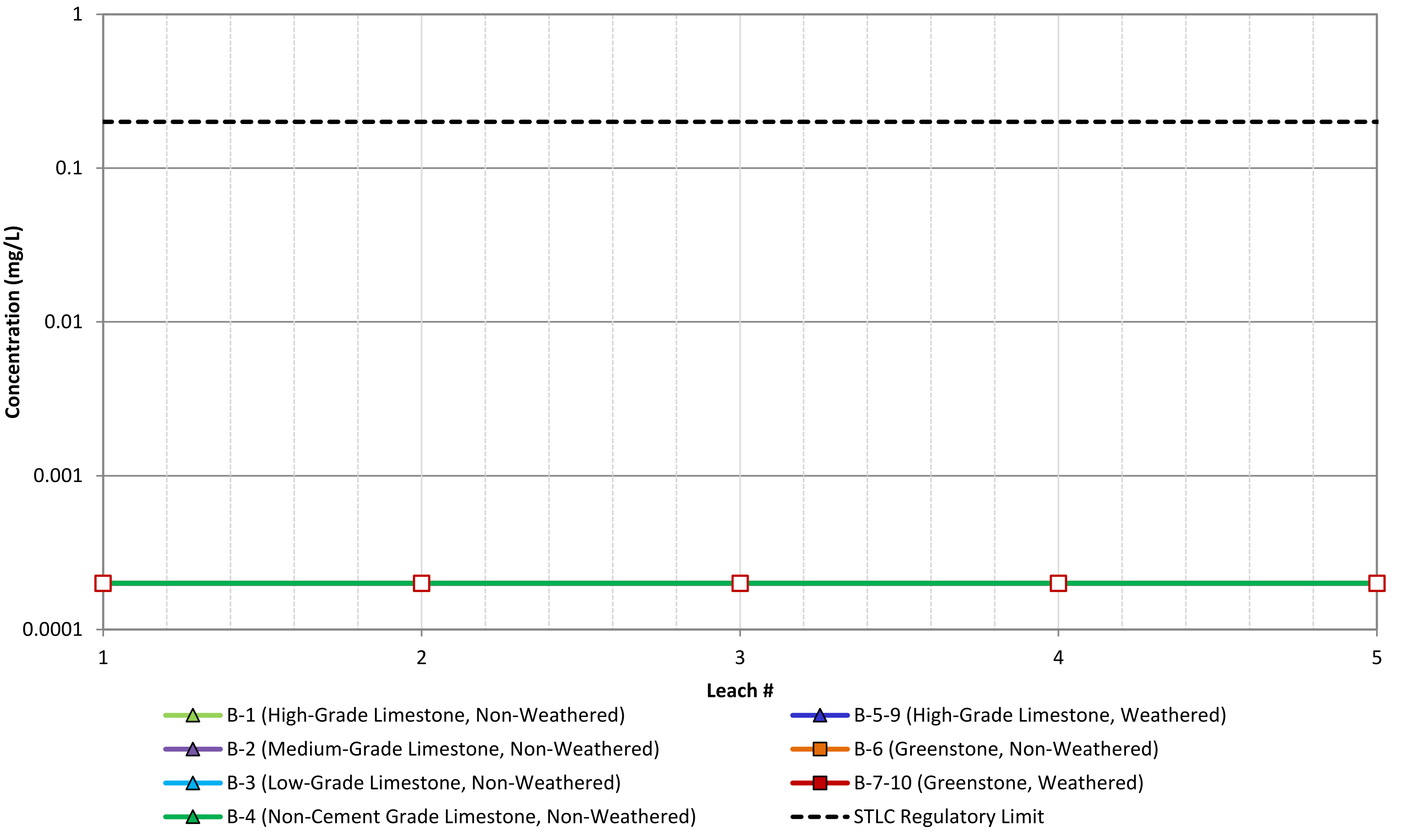
Title
# Sequential Modified WET- Magnesium

| | | |
|---|---|---|
| Project Name | Project No.<br>31405507 | FIGURE<br>C-19 |
| Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



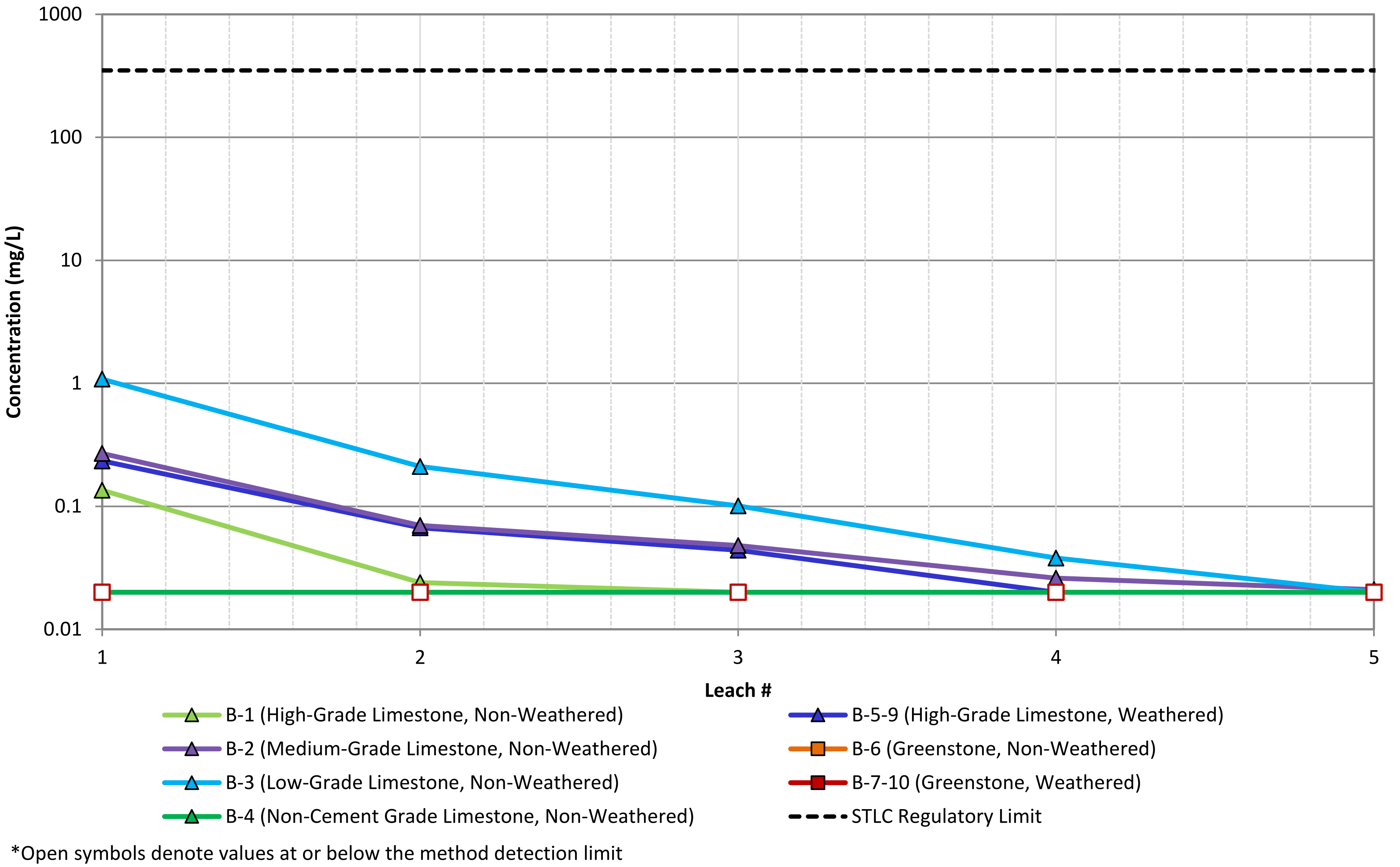
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| wsp GOLDER | Title<br>**Sequential Modified WET- Manganese** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-20 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



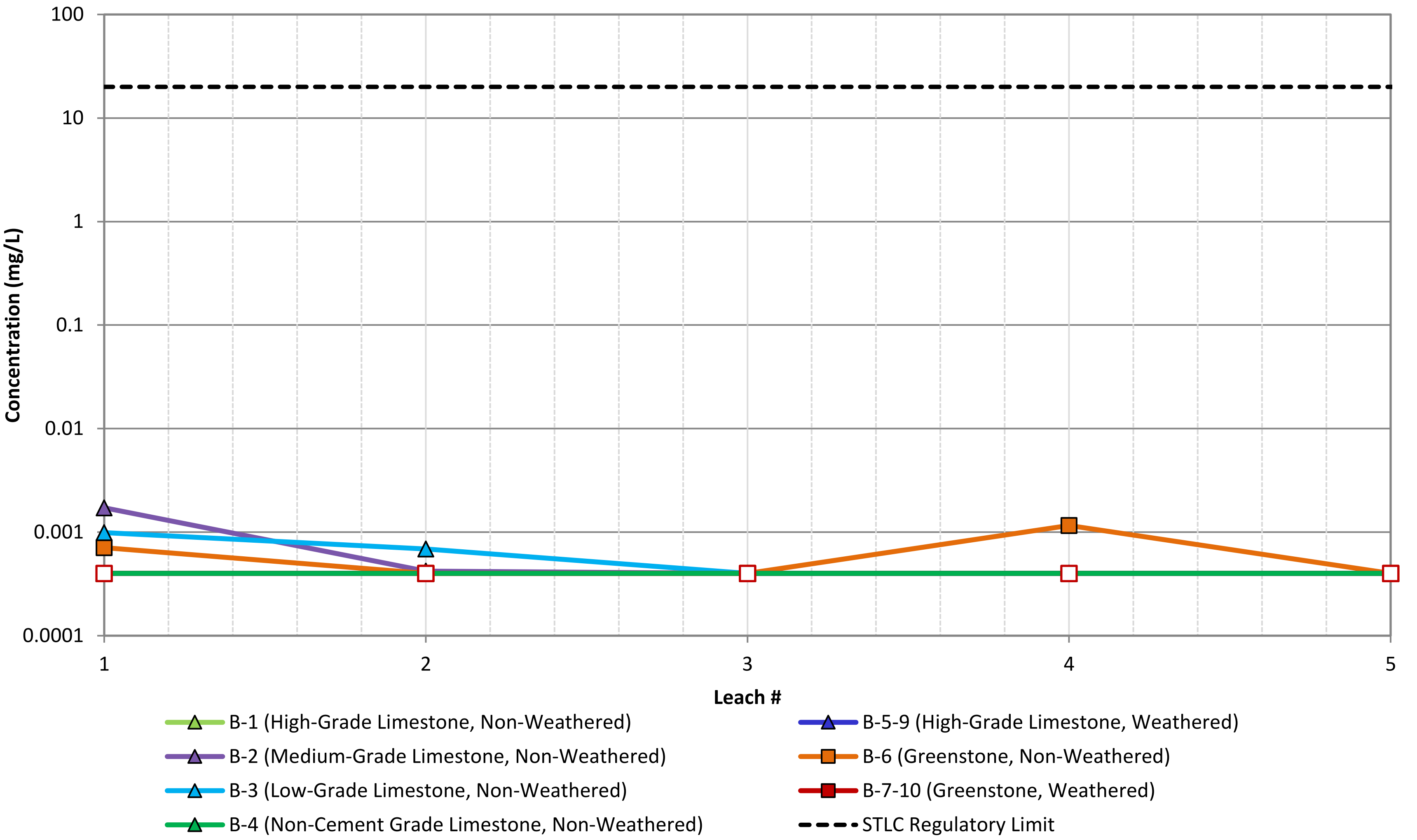
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Mercury** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-21 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



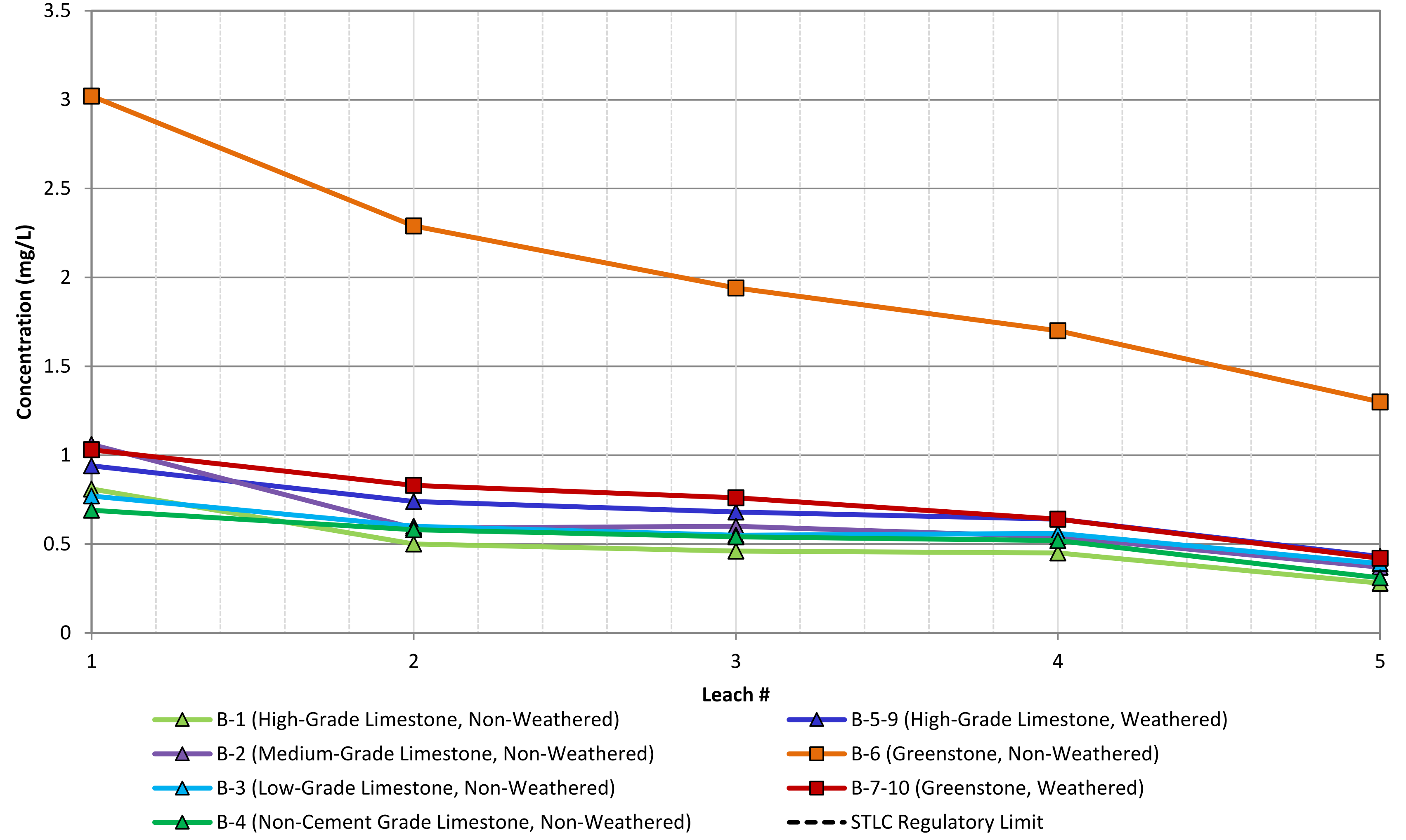
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Molybdenum** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-22 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Nickel** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-23 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |

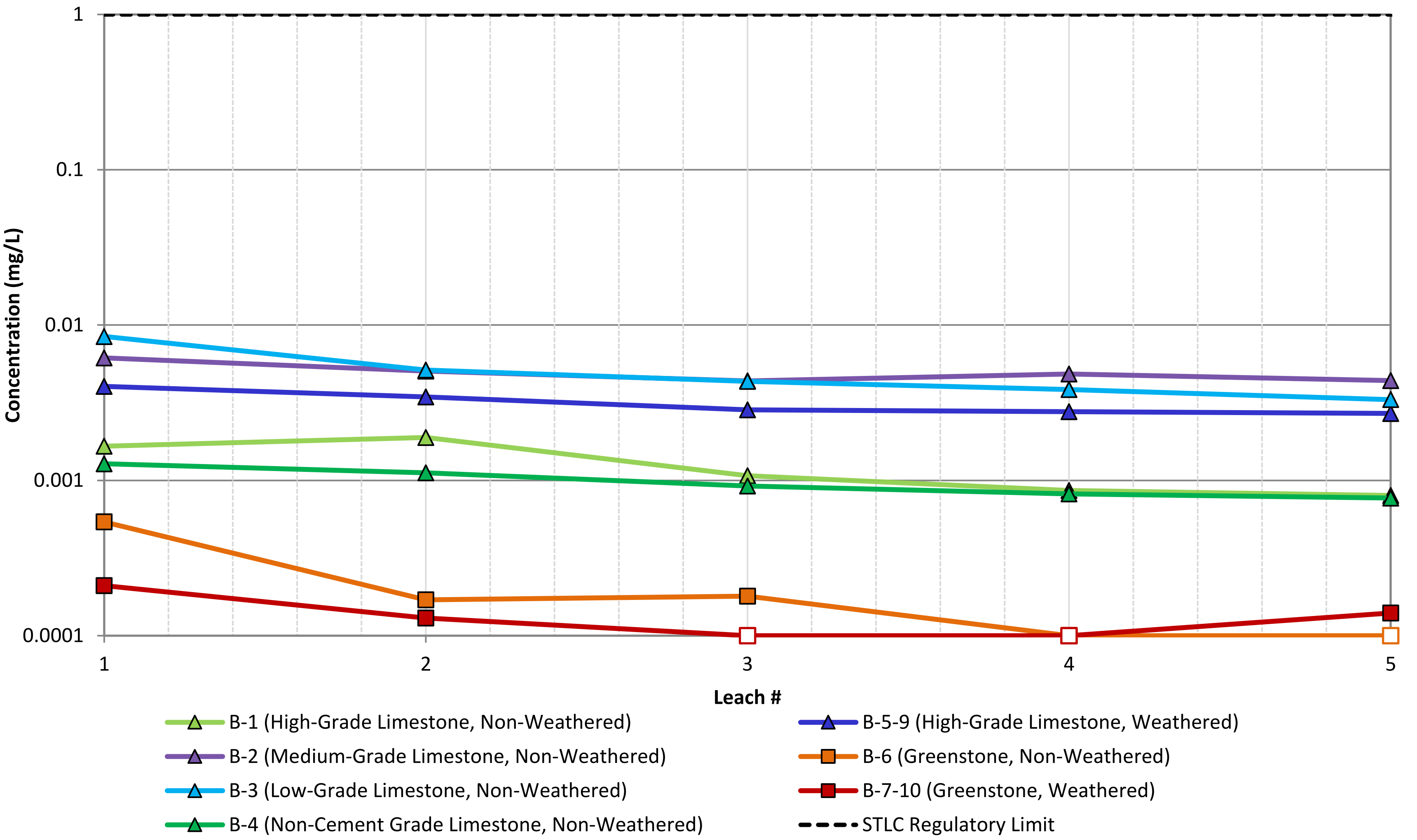


*Open symbols denote values at or below the method detection limit

| | | |
|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Potassium** | |
| | Project Name | Project No.<br>31405507 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 |

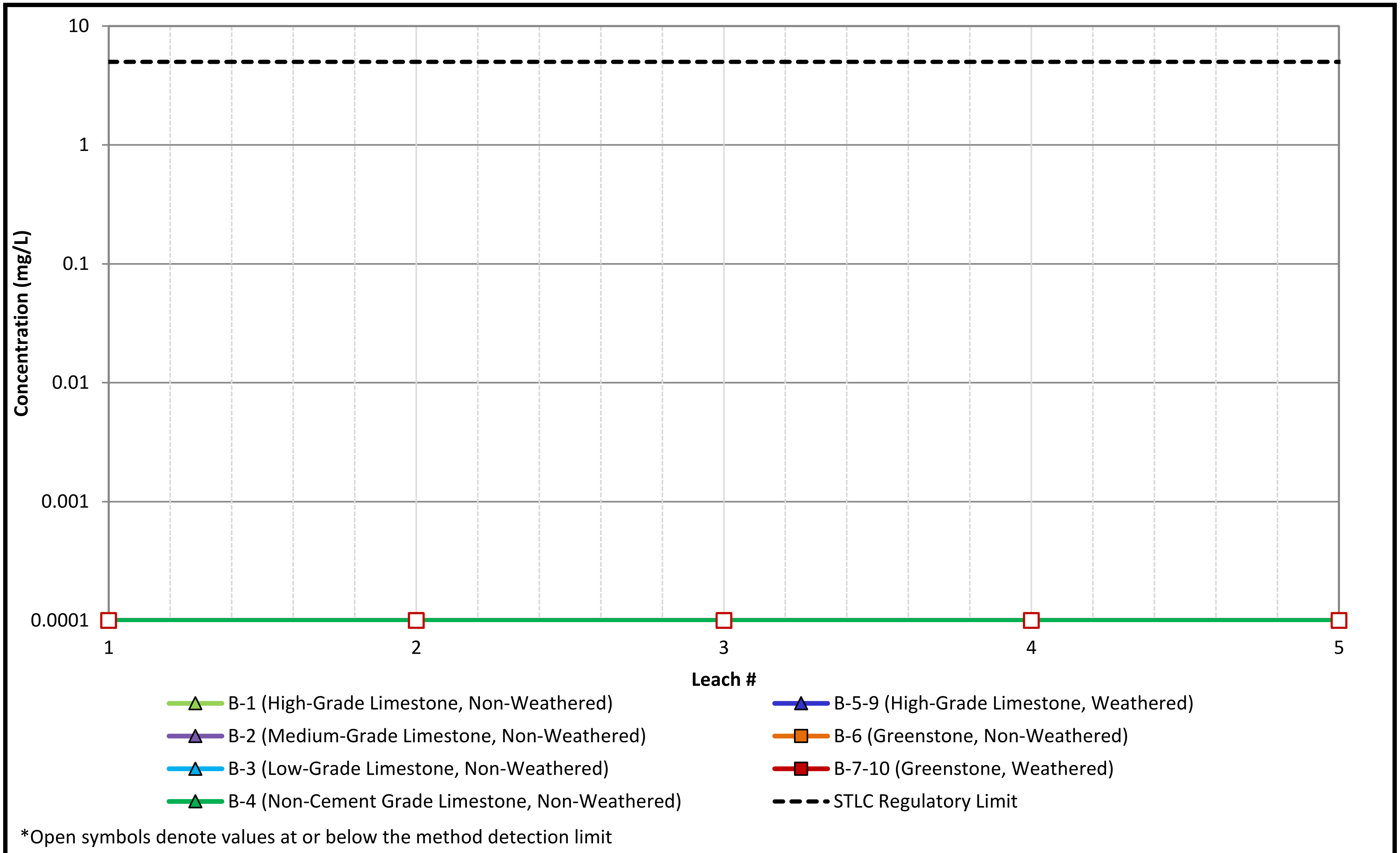
FIGURE

C-24



*Open symbols denote values at or below the method detection limit

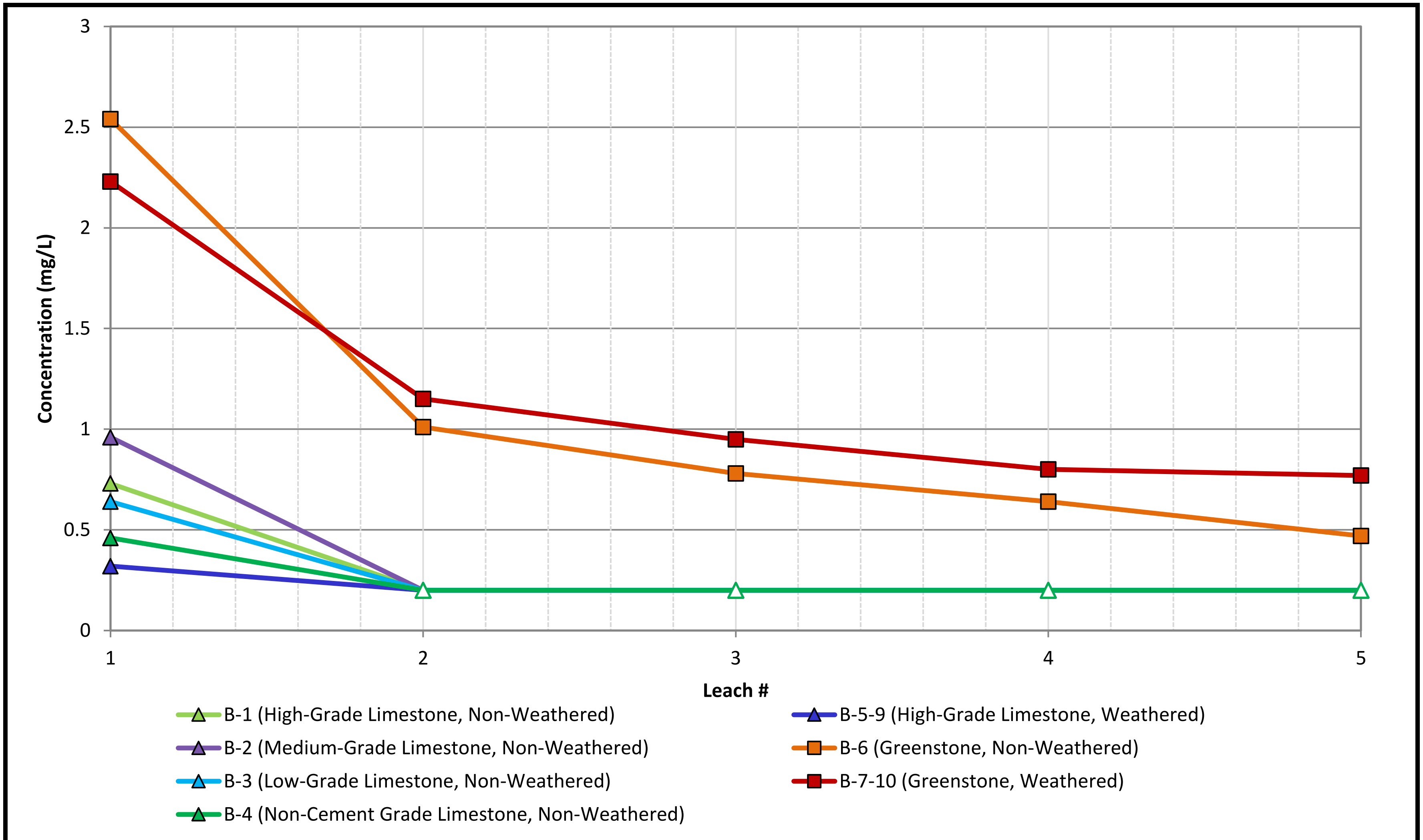
| | |
|---|---|
| Title | **Sequential Modified WET- Selenium** |
| Project Name | |
| Project No. | 31405507 |
| Client Name | Lehigh Permanente |
| Date | 8/4/2022 |
| FIGURE | C-25 |



WSP GOLDER

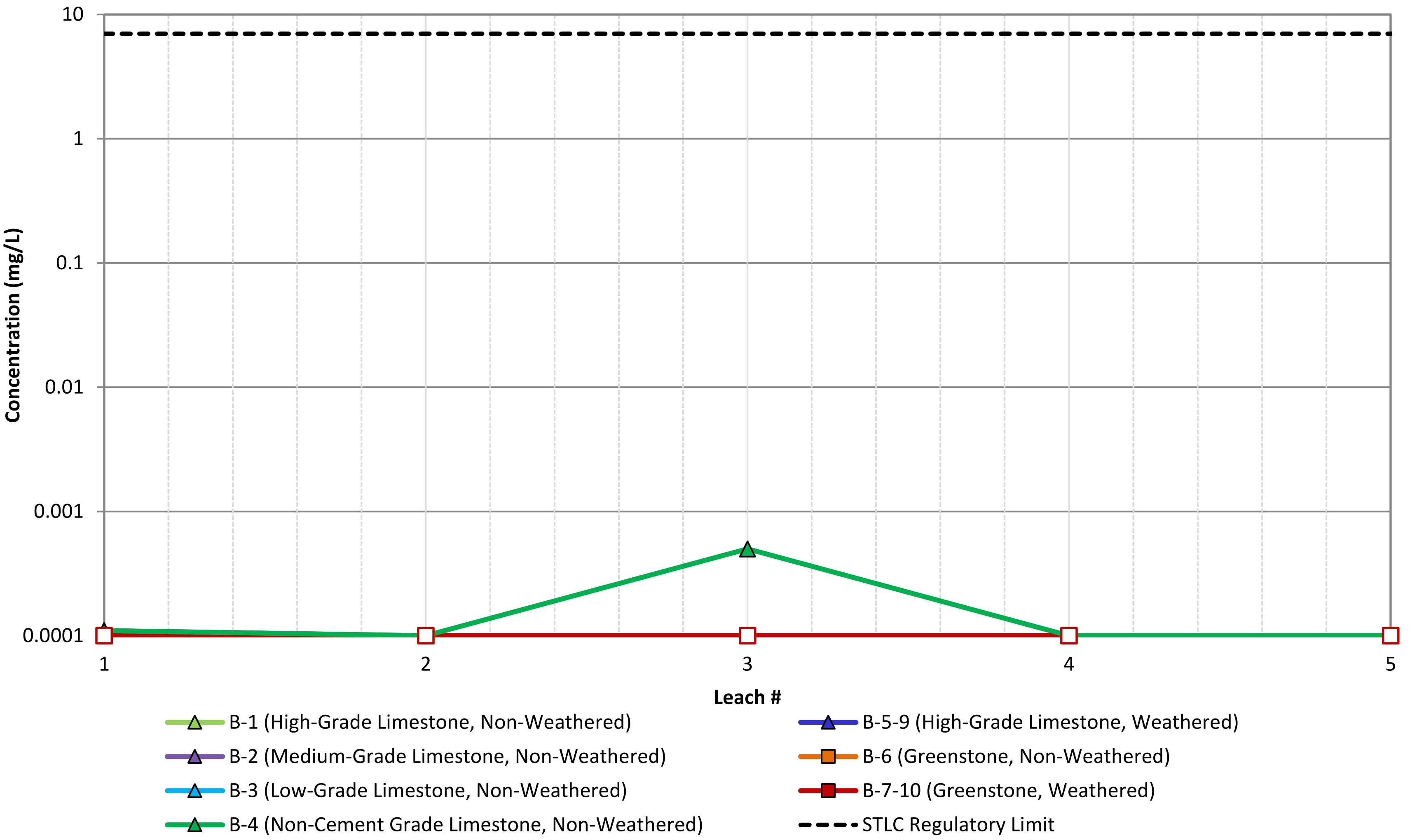
Title
## Sequential Modified WET- Silver

| | | |
|---|---|---|
| Project Name | Project No.<br>31405507 | FIGURE<br>C-26 |
| Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



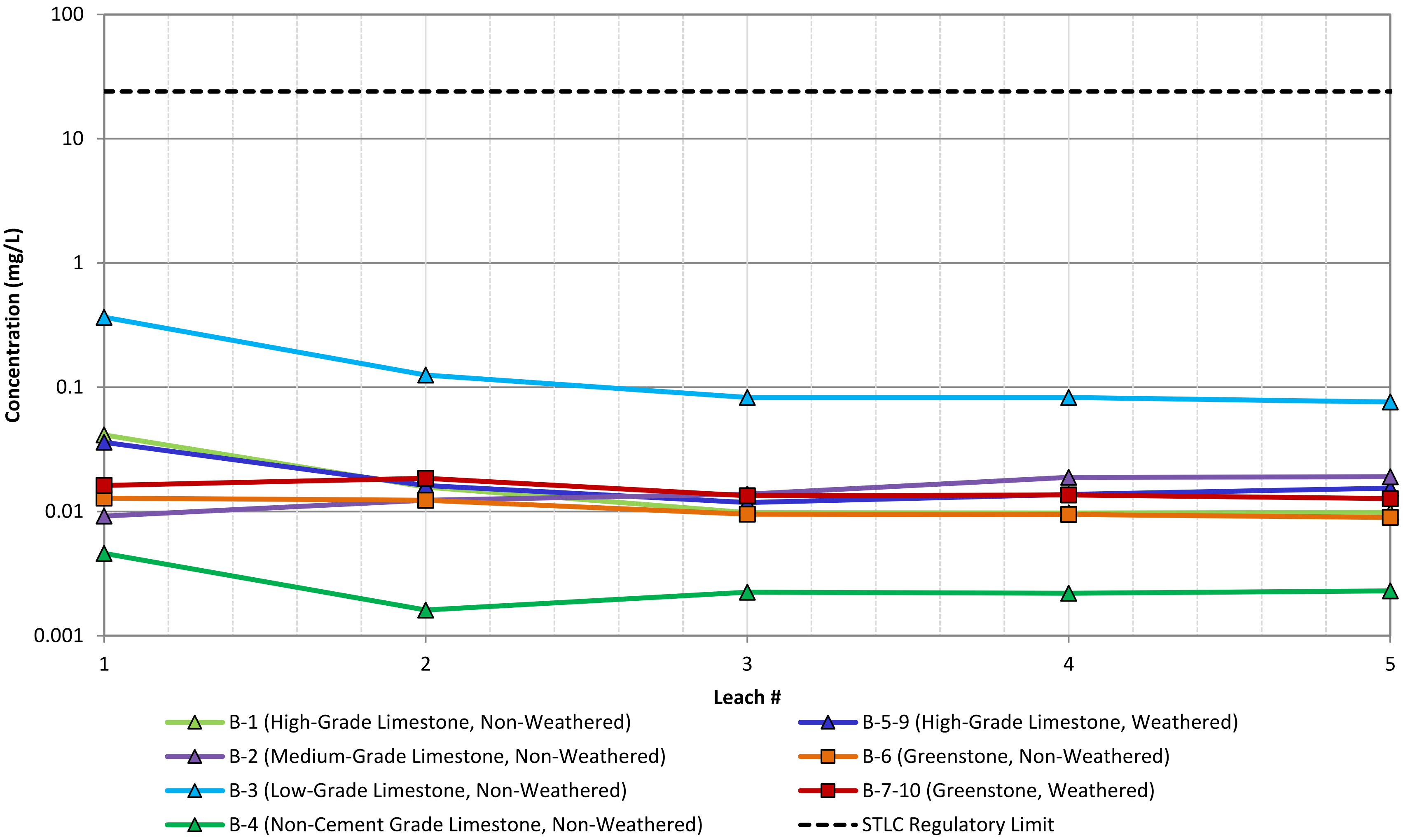
*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Sodium** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-27 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

| | | | |
|---|---|---|---|
| WSP GOLDER | Title<br>**Sequential Modified WET- Thallium** | | |
| | Project Name | Project No.<br>31405507 | FIGURE<br>C-28 |
| | Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |



*Open symbols denote values at or below the method detection limit

wsp GOLDER

Title
**Sequential Modified WET- Vanadium**

| | | |
|---|---|---|
| Project Name | Project No.<br>31405507 | FIGURE<br>C-29 |
| Client Name<br>Lehigh Permanente | Date<br>8/4/2022 | |

WATERWAYS
CONSULTING, INC.

# APPENDIX K

## Stantec 2022

## Permanente Creek Restoration Plan Stability Analysis

Stantec

Memo

| | | | |
|---|---|---|---|
| To: | Carolina Addison<br>Lehigh Permanente | From: | Paul Kos<br>Denver |
| Project/File: | 233001622 | Date: | August 26, 2022 |

**Reference: PCRP Stability Analysis- DRAFT**

## INTRODUCTION

Lehigh Southwest Cement Company (Lehigh), a subsidiary of Lehigh Hanson, Inc., engaged Stantec Consulting Services Inc. (Stantec) to provide professional engineering services for geotechnical analysis related to proposed grading associated with the Permanente Creek Restoration Project (PCRP) at the Permanente Facility in Cupertino, California. An element of the PCRP involves removing material from the creek corridor and adjacent slopes. The PCRP design and grading plans are presented in the associated report prepared by Waterways (90% Designs, dated August 26, 2022). The grading plans were provided to Stantec by Waterways, and Stantec performed geotechnical analyses of the proposed slopes in support of the environmental review and subsequent permit applications.

This PCRP Stability Analysis has been prepared to assist Lehigh with upcoming environmental review and subsequent permit applications to relevant regulatory agencies. This report documents the results of static and pseudo-static slope stability analyses of the reclamation surface. The report does not contain the creek restoration design details and shall be reviewed in conjunction with Waterways' 90% Designs.

## BACKGROUND

The Permanente Facility is a limestone and aggregate mining operation, active since the late 1930's, in the unincorporated foothills of western Santa Clara County, approximately two miles west of the City of Cupertino, California. The Quarry occupies a portion of a 3,510-acre property (Permanente Property) owned by Hanson Permanente Cement, Inc. and operated by Lehigh.

The Permanente Property is situated in the rugged foothills along the eastern side of the Santa Cruz Mountains segment of the California Coast Ranges. This area of the Coast Ranges is characterized by moderately to steeply sloping hillsides ranging from approximately 500 to 2,000 feet (ft) above mean sea level (AMSL). The eastern side of the range is incised with eastern flowing drainages, including the Permanente Creek Drainage Basin, which flows through the central part of the Permanente Property, and flows through the Cities of Los Altos and Mountain View and into Mountain View Slough or Stevens Creek through the Stevens Creek Diversion Channel operated by the Santa Clara Valley Water District, which ultimately can reach the San Francisco Bay.

## GEOLOGIC SETTING

The geology in the project area is complex due to the faulting and deformation associated with the Franciscan Complex. This geologic unit consists of faulted limestone and metabasalts (greenstone) and also contains basalt, diorite, shale, sandstone, chert, greywacke, and schist. Structure in the area includes numerous low- and high-angle faults. Low-angle faults separate limestone units from greenstone units and tend to follow the limestone bedding planes and typically dip to the southeast at 10° to 40°. High-angle faults, including the regional Berrocal Fault, are typically oriented in the northwest-southeast direction and dip at greater than 60°. The geology has been mapped several times by different geologists, and numerous drilling programs have been conducted. The results of these previous studies on the geologic units, structure, and interpretation were included in previous submittals (Golder 2011 and Foruria 2004).

## PREVIOUS GEOTECHNICAL EVALUATIONS

The geologic and geotechnical properties of the rocks present at the Permanente Quarry have been evaluated several times by several companies. Each investigation included drilling, laboratory testing, assessment of strength parameters for the various rock types encountered, and slope stability calculations. The rock strength parameters were based on laboratory data, rock mass rating (RMR) calculations, and back-analysis of landslide areas. The strength parameters for soil, greenstone overburden, and limestone have been consistent through multiple geotechnical analyses performed by multiple consultants, and these values are listed in Table 1. The strength parameters for greenstone vary significantly depending on the condition of the bedrock and particularly, the amount of weathering and shearing, and lower-bound values have historically been used for design purposes to be conservative. These lower-bound values are based on back-analysis of the Main Slide in the North Quarry. Laboratory data suggest the in-place greenstone may have significantly higher strength, particularly at depths greater than approximately 50 feet, where the bedrock has not been weathered. Site observations also suggest that greenstone strengths are often under-reported as several areas of the highwall are constructed in weathered greenstone, and these areas have maintained their integrity with 50-foot high benches with face angles of 60° to 70° (Golder 2011).

**Table 1: Historic Rock Strength Summary**

| Material | Unit Weight (pcf) | Cohesion (psf) | Φ' (°) |
|---|---|---|---|
| Limestone | 165 | 12,500 | 30 |
| Greenstone | 155-165 | 1,400-1,880 | 19-23 |
| Fault | 155 | 0 | 20 |
| Slide Debris | 135 | 0-700 | 20-23 |
| Greenstone Overburden | 125 | 0 | 35 |
| Soil | 120 | 200 | 30 |

## GEOTECHNICAL STABILITY EVALUATION

The slope stability analyses were modeled using the software Slide2 Modeler version 9 by rocscience, released in 2020. The software used limit equilibrium on slices of potential failure surface to calculate factor of safety (FoS). The models were evaluated under static and pseudo-static conditions, with horizontal ground acceleration, for the designed ramp configuration provided by the site using the Spencer method. The minimum FoS for each model evaluation is included in this report. The two types of analysis have been summarized in Table 2. The minimum acceptable factors of safety for the analyses are 1.3 for static conditions and 1.0 for pseudo-static conditions based on mining industry standards. For the pseudo-static model conditions, a horizontal seismic coefficient of 0.15 times the force of gravity (g) was applied to the static condition models to be consistent with previous studies and to follow recommendations for earthquakes with magnitudes up to 8.25 (Golder 2011). To evaluate the slope stabilities, cross-sections were analyzed for the reclamation surface.

**Table 2: Stability Analyses**

| Analysis Type | Description | Minimum Acceptable Factor of Safety |
|---|---|---|
| Static Analysis | A limit equilibrium method of analysis which satisfies moment and force equilibrium to solve a slope stability problem. The output is a single FoS for the potential failure surface with the lowest FoS. | 1.3 |
| Pseudo-static Analysis | A limit equilibrium method of analysis which represents the effects of earthquake shaking by accelerations that create inertial forces. This is the simplest way to analyze the dynamic effects of earthquake loading of a soil or slope. The output is a single FoS for the potential failure surface with the lowest FoS. | 1.0 |

Site specific geotechnical information is available for each rock type on the property, and strength parameters for the material have been established in previous geotechnical analyses (Golder 2011). These strength parameters are based on laboratory testing, back-calculation, and published values for soil properties. These strength parameters are listed in Table 3.

**Table 3: Geotechnical Strength Parameters**

| Material | Unit Weight (pcf) | Cohesion (psf) | Phi' (Degrees) |
|---|---|---|---|
| Greenstone (Weathered) | 165 | 1,800 | 27 |
| Greenstone (Unweathered) | 165 | 12,500 | 30 |
| Limestone | 165 | 12,500 | 30 |

As previously discussed, the greenstone strengths can vary significantly depending on the degree of weathering, and Stantec focused on evaluating the greenstone strengths as part of this geotechnical investigation. The greenstone strengths were re-evaluated based on RMR classifications. The historic greenstone strength (ɸ'=27° and cohesion=1,800 pounds per square foot [psf]) is suitable for areas that have been weathered and are near the surface. A stronger strength for greenstone is expected for bedrock at depths greater than 50 feet from the surface, which is “beyond” the surficial weathered zone. While this transition to competent bedrock has been demonstrated by drilling, Stantec has used the weathered greenstone strength values for all depths to be conservative. Similarly, there are likely areas with limestone that would exhibit greater strengths, and these have also not been included in the geotechnical analyses to be conservative.

Stability analyses are focused on areas with greater excavation volumes, particularly the rock pile removal area (Section A) and the 1250 Pond area (Sections C and E); the cross-sections modeled align with Waterway's sections and Waterway's naming conventions have been retained for clarity between the reports. Stantec modelled multiple cross-sections in the Pond 1250 area to evaluate the stability under different slope configurations and excavation depths. The cross-sections extend to the top of the surrounding slopes to evaluate any impacts that the grading may have on the global stability. Stantec adjusted the limits of the analyses to evaluate both the global slope stability and the stability in the area immediately adjacent to the PCRP grading.

The configurations modeled as part of this analysis exceed the minimum acceptable factor of safety, as defined in Table 3. Generally, the elevated geotechnical stability results are from the shallow cut slopes associated with the PCRP grading plan. Results from the stability analyses are shown in Table 4. Printouts of the slope stability sections are attached.

**Table 4: Geotechnical Stability Analyses Results**

| Analysis Area | Analysis method | Section A | Section C | Section E |
|---|---|---|---|---|
| Cut Slope | Static | 1.8 | 3.0 | 2.3 |
| | Pseudo-Static | 1.7 | 2.8 | 2.2 |
| Global Slope | Static | 1.5 | 2.8 | 1.5 |
| | Pseudo-Static | 1.5 | 2.7 | 1.4 |

## CLOSURE

This report provides the analysis and supporting information needed to demonstrate that Lehigh Southwest Cement Company's plan for the PCRP meets design and performance requirements under static and seismic conditions. The PCRP will be excavated so that stable slopes remain. As mutual protection to Lehigh, the public, and Stantec, this report was submitted for exclusive use by Lehigh Southwest Cement Company. Our report and recommendations should not be reproduced in whole or in part without the supporting Waterways 90% Design report and our express written permission, other than as required in relation to agency review and submittals. A draft of this report was reviewed by personnel from Lehigh Southwest Cement Company.

Regards,

**STANTEC CONSULTING SERVICES INC.**

**Reference: PCRP Stability Analysis**

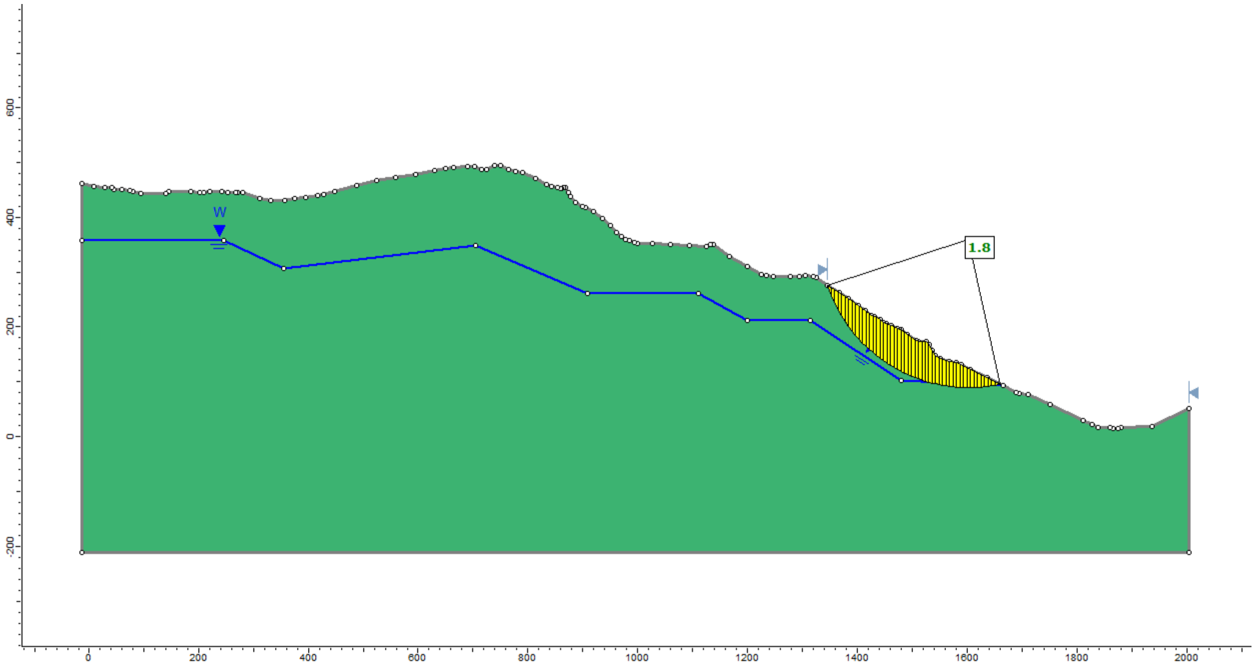
**Paul Kos** P.E.
Senior Geological Engineer
Mobile: 303-570-9163
paul.kos@stantec.com

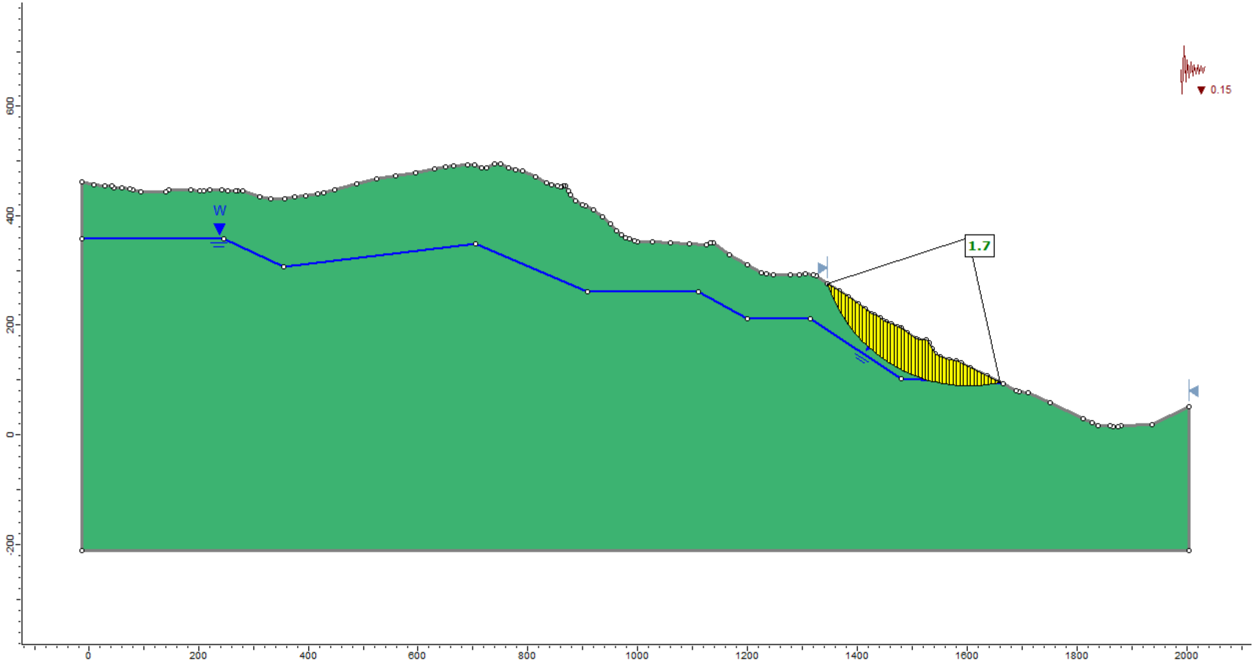
Attachment: Stability Model Reports

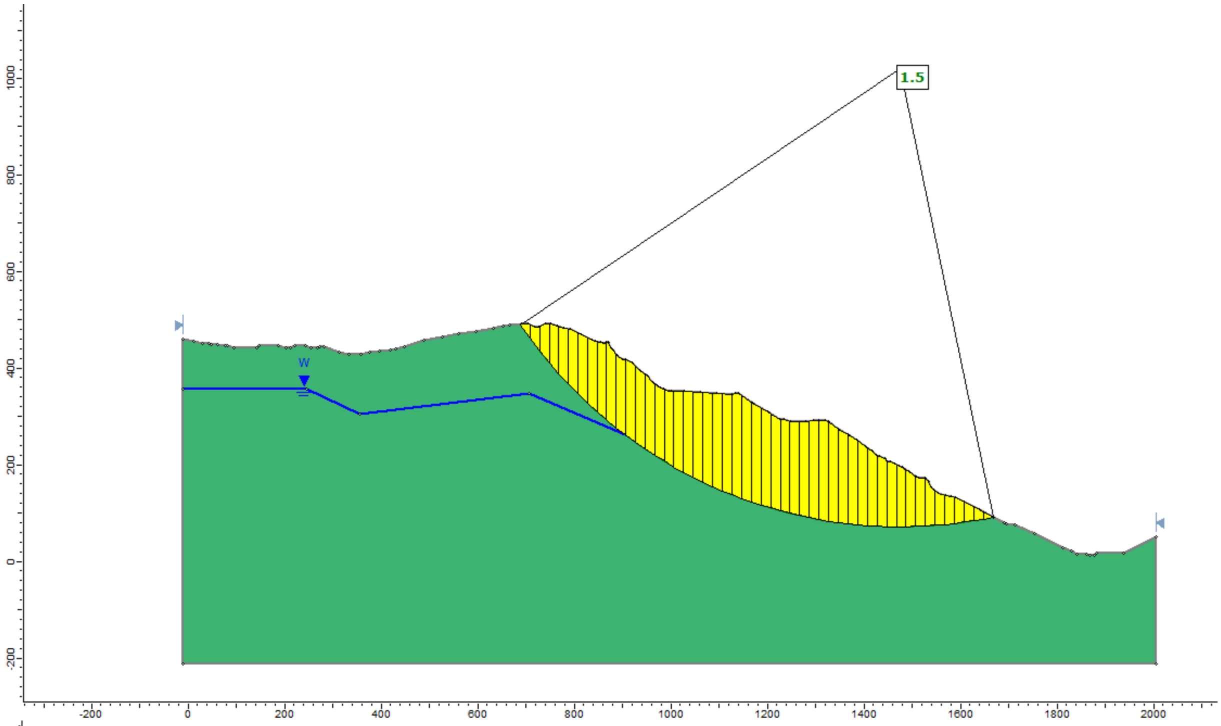
# Attachment A

## Stability Model Reports

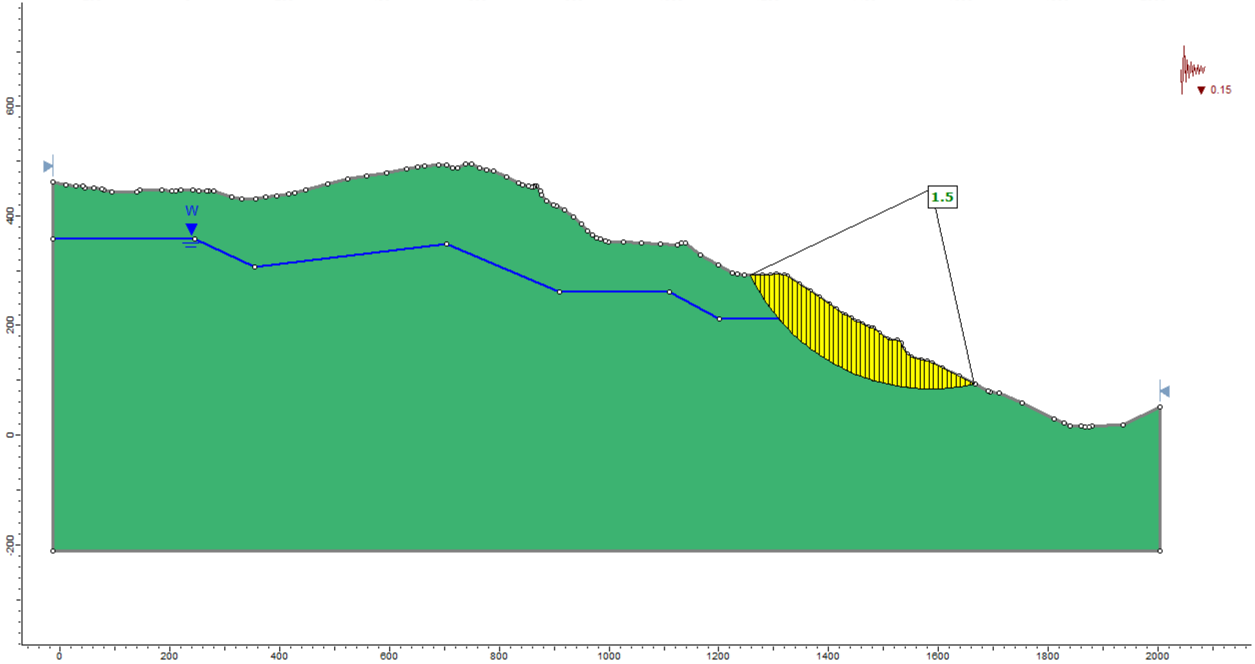
## SECTION A (Rock Pile Removal Area)





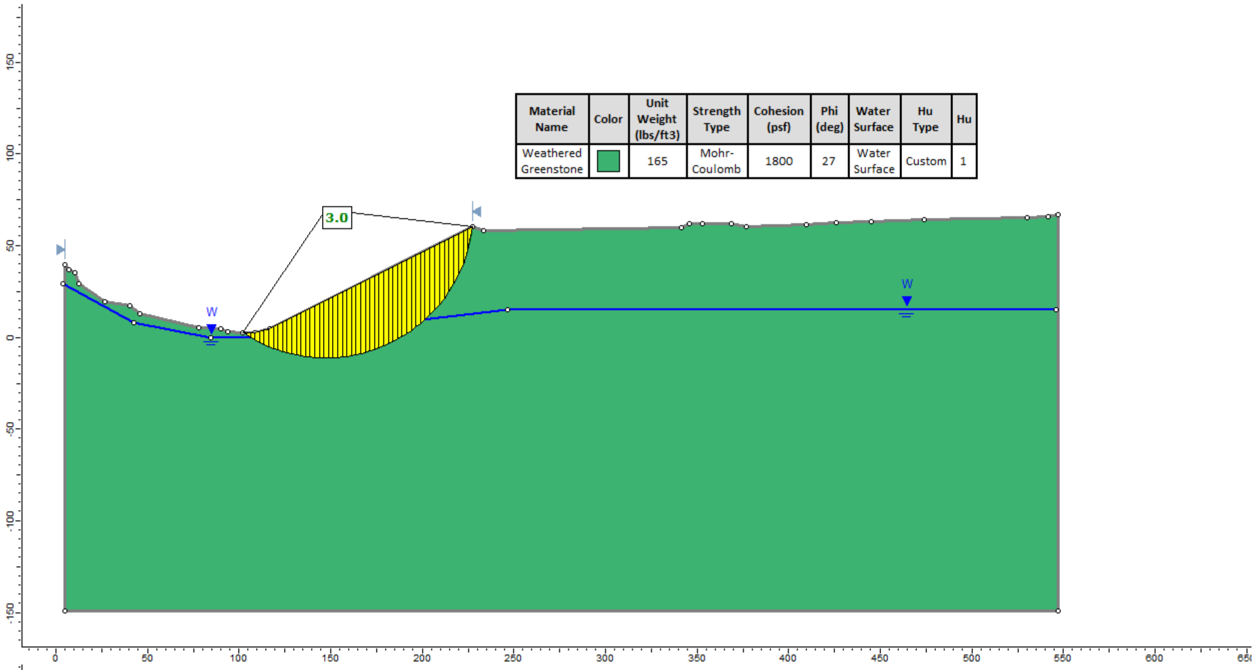


1.5
W
1000
800
600
400
200
0
-200
-200
0
200
400
600
800
1000
1200
1400
1600
1800
2000

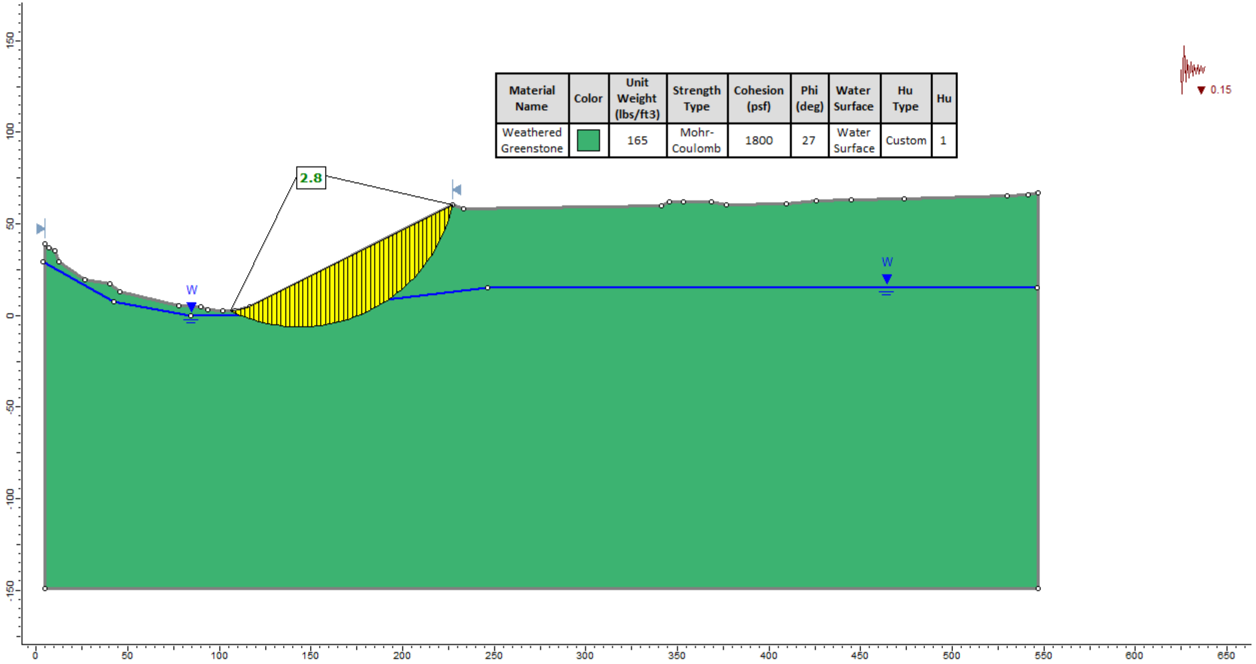


0.15
1.5
W
600
400
200
0
-200
0
200
400
600
800
1000
1200
1400
1600
1800
2000

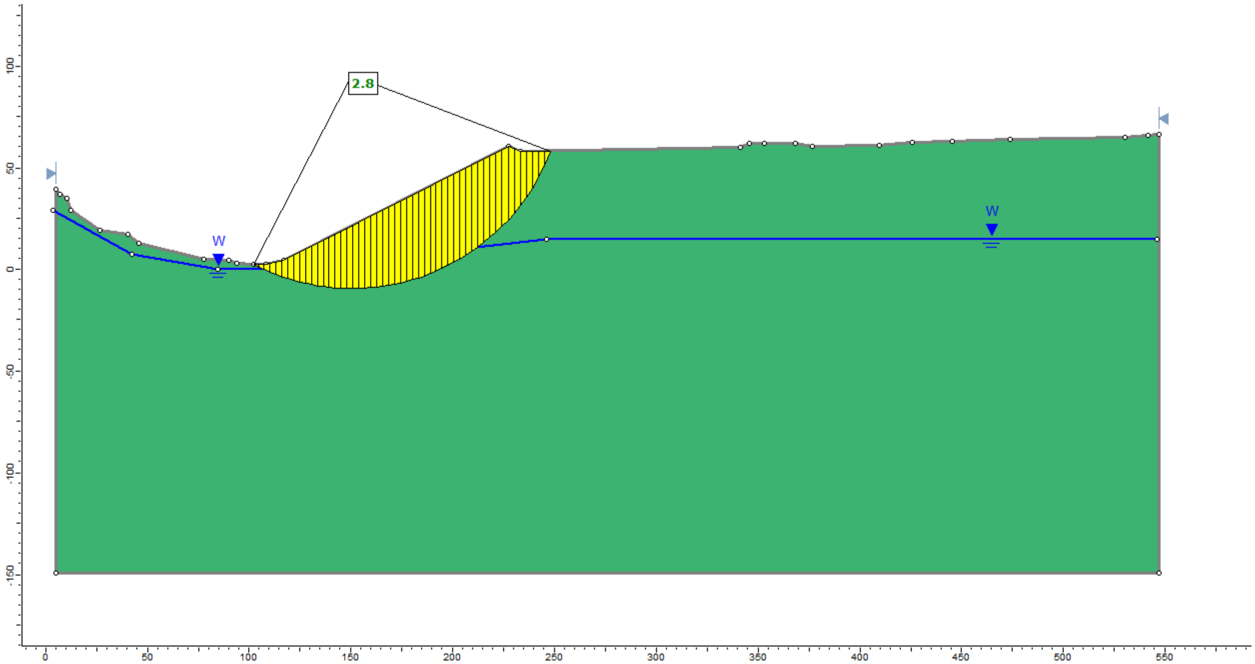
## SECTION C (Pond 1250 Area)

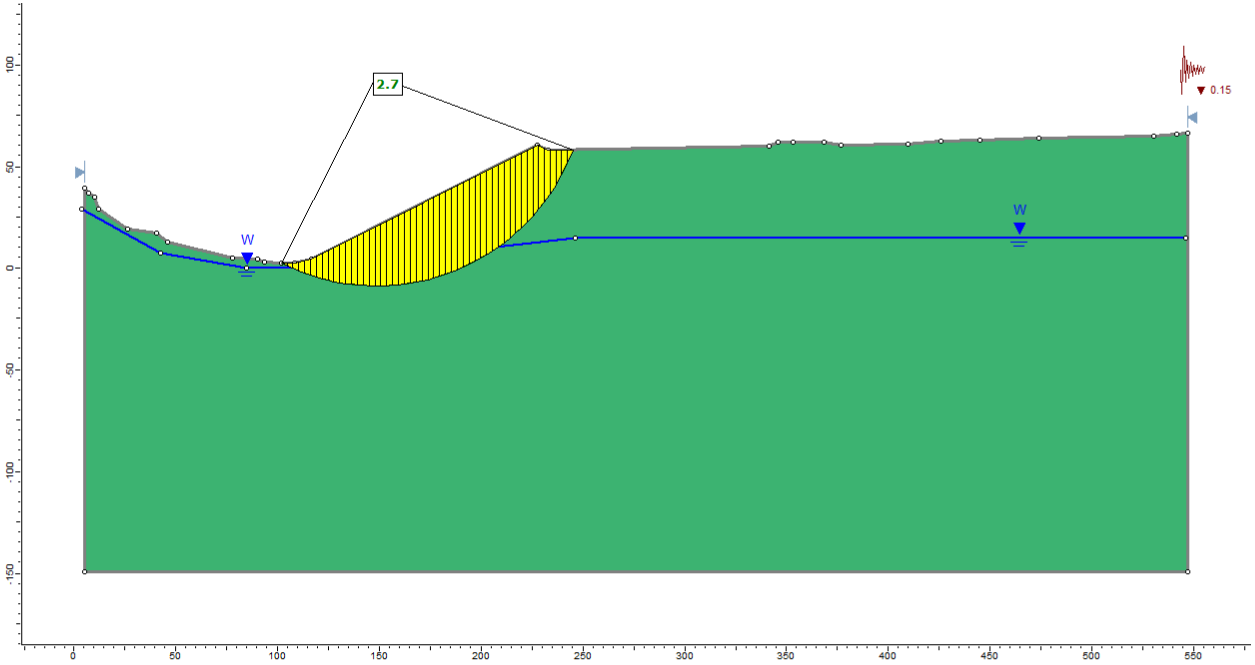


| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Weathered Greenstone | 🟩 | 165 | Mohr-Coulomb | 1800 | 27 | Water Surface | Custom | 1 |

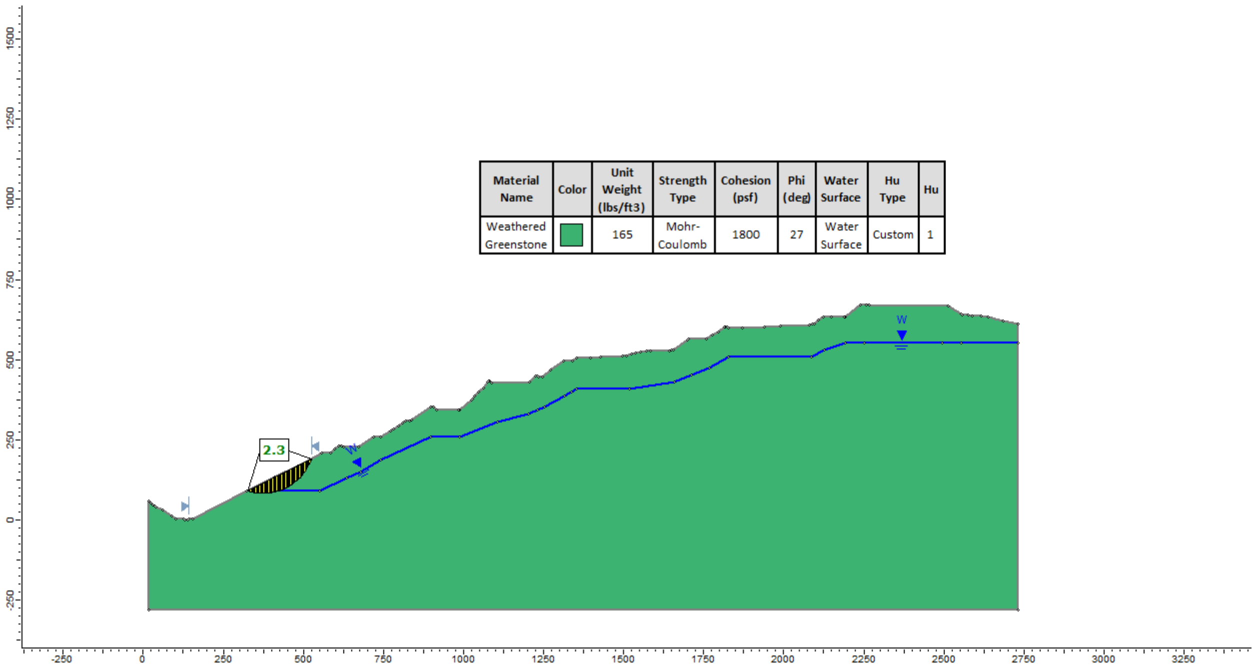


| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Weathered Greenstone | 🟩 | 165 | Mohr-Coulomb | 1800 | 27 | Water Surface | Custom | 1 |

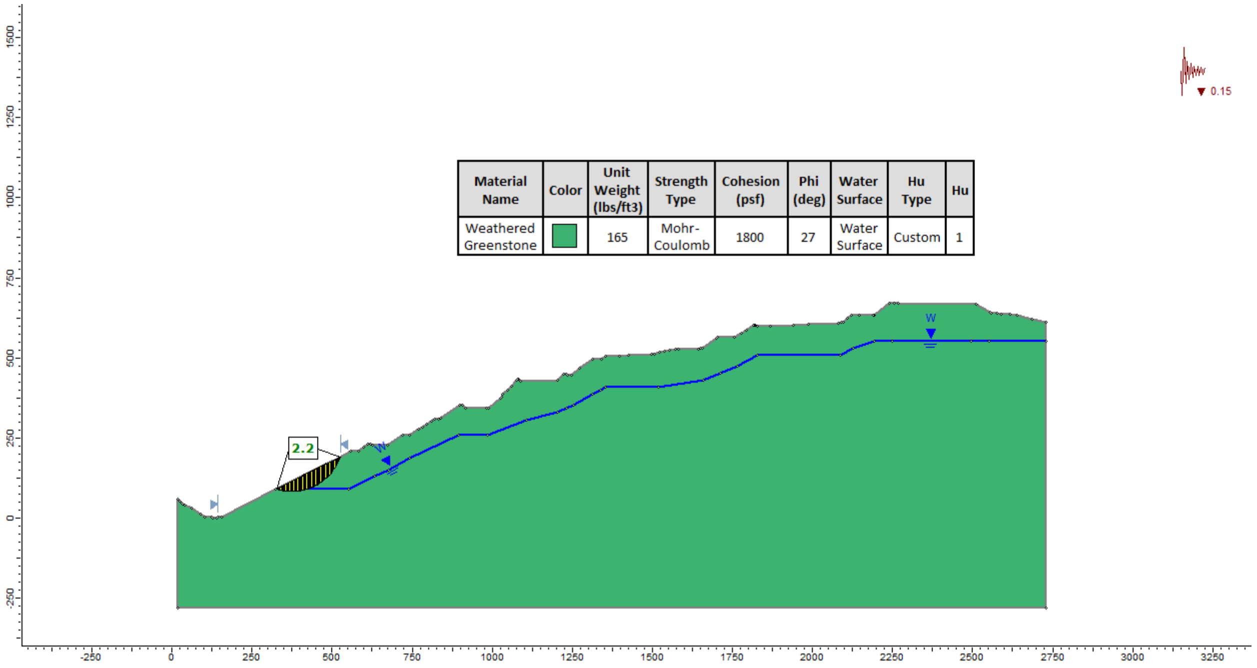

2.8
W
W
100
50
0
-50
-100
-150
0
50
100
150
200
250
300
350
400
450
500
550


2.7
0.15
W
W
100
50
0
-50
-100
-150
0
50
100
150
200
250
300
350
400
450
500
550

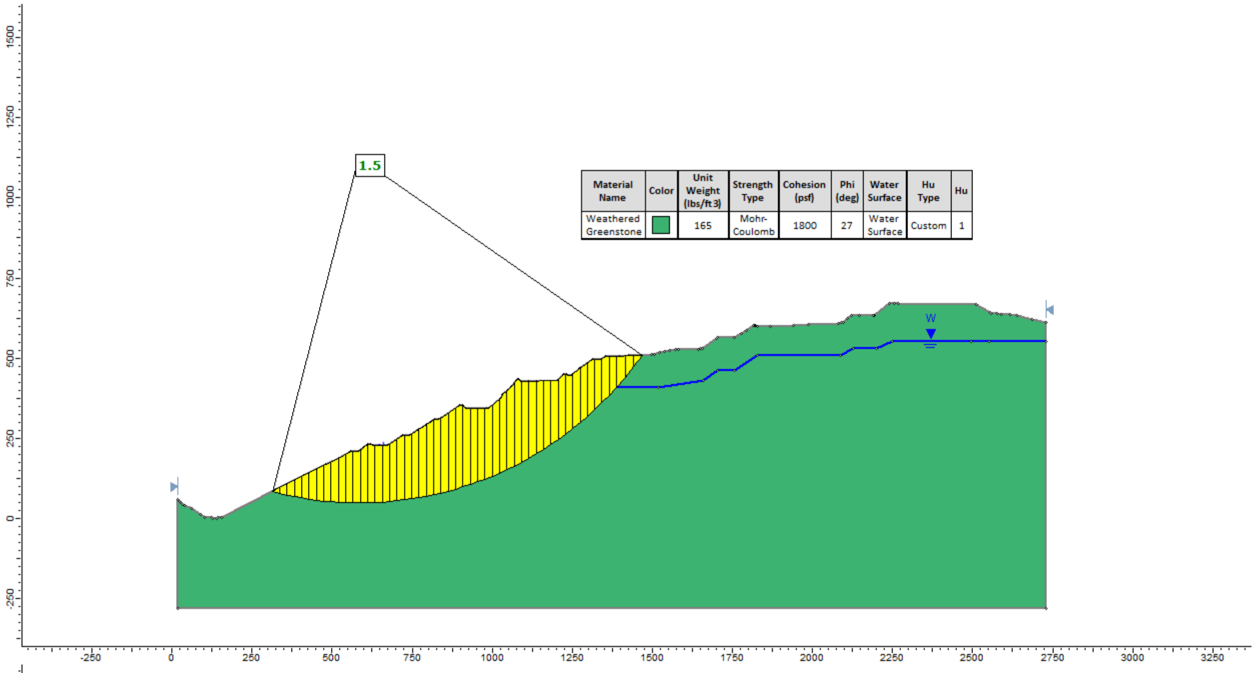
## SECTION E (Pond 1250 Area)



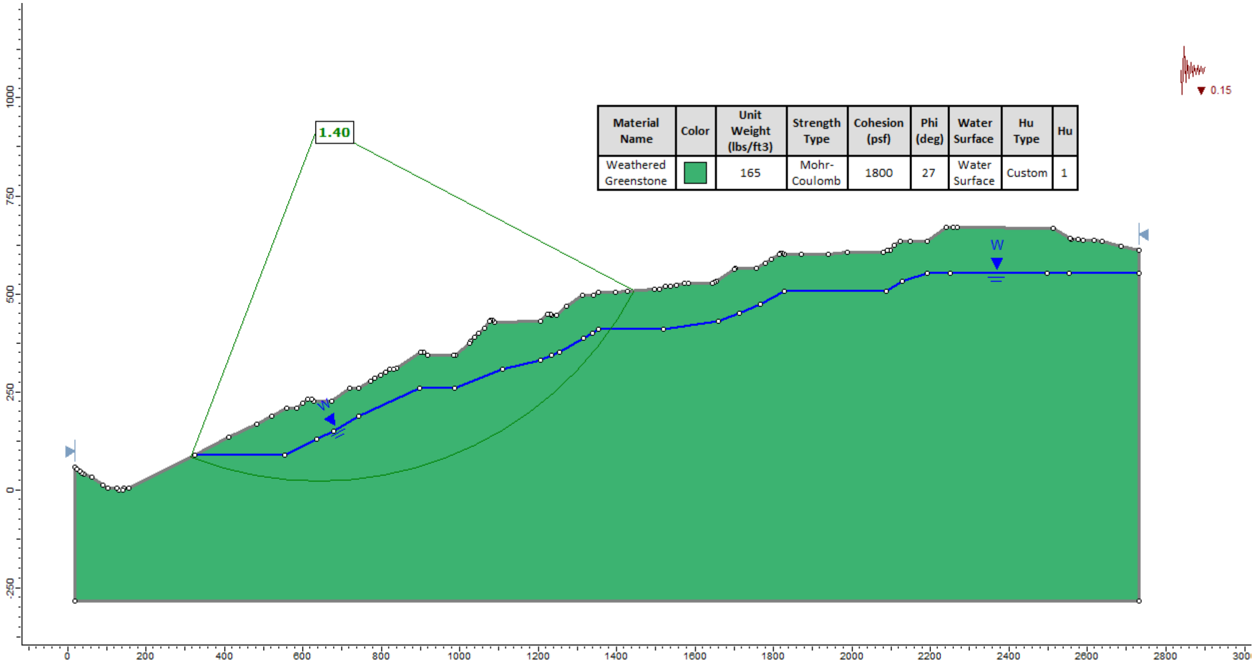
| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Weathered Greenstone | 🟩 | 165 | Mohr-Coulomb | 1800 | 27 | Water Surface | Custom | 1 |



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Weathered Greenstone | 🟩 | 165 | Mohr-Coulomb | 1800 | 27 | Water Surface | Custom | 1 |



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Weathered Greenstone | 🟩 | 165 | Mohr-Coulomb | 1800 | 27 | Water Surface | Custom | 1 |



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Weathered Greenstone | 🟩 | 165 | Mohr-Coulomb | 1800 | 27 | Water Surface | Custom | 1 |

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# APPENDIX L

## Material Removal Area

## Lower Limit of Potential Finished Grade Figures

## TREE REMOVAL SUMMARY

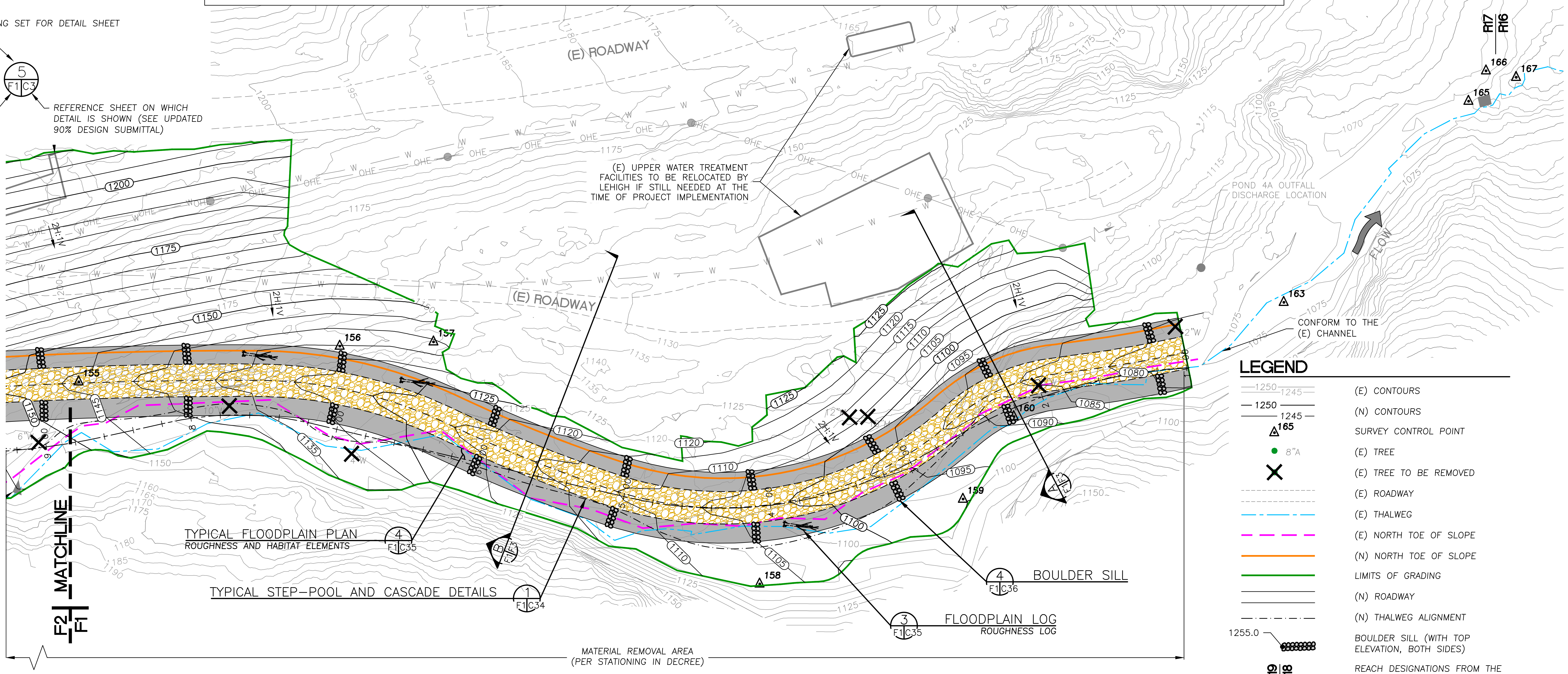
| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| MADRONE | 12" | 1 |
| MADRONE | 18" | 1 |
| WILLOW | 4" | 1 |
| WILLOW | 6" | 2 |
| WILLOW | 10" | 1 |
| WILLOW | 12" | 1 |

## DETAIL CALLOUT NOTES:

1. REFER TO THE COMPLETE DRAWING SET FOR DETAIL SHEET REFERENCES AS SHOWN BELOW.

## NOTES:

1. SEE THE UPDATED 90% DESIGN DRAWINGS, DATED AUGUST 26, 2022 FOR SHEETS REFERENCED IN THESE NOTES AND DETAIL CALLOUTS SHOWN ON FIGURES 1–4.
2. THE GRADING PLAN REFLECTS THE LOWER LIMIT OF POTENTIAL FINISHED GRADE CHANNEL PROFILES. REFER TO THE NOTES ON SHEET C40 OF THE DESIGN DRAWINGS FOR A DESCRIPTION OF PROPOSED METHODOLOGY FOR "FIELD–FITTING" THE DESIGN PROFILE TO ACCOMMODATE UNKNOWN SUBSURFACE CONDITIONS.
3. POOL AND STEP GEOMETRY AND LOCATIONS ARE NOT SHOWN ON THE GRADING PLAN OR DESIGN PROFILE DUE TO UNKNOWN SUBSURFACE CONDITIONS. POOL AND STEP GEOMETRY AND LOCATIONS WILL BE DETERMINED AT THE TIME OF CONSTRUCTION BY THE ENGINEER TO CONFORM TO SUBSURFACE CONDITIONS, PER THE TYPICAL CASCADE AND STEP–POOL DETAILS ON SHEET C34 OF THE DESIGN DRAWINGS.
4. INSTALL ENGINEERED STREAMBED MATERIAL AND FLOODPLAIN ARMOR PER THE TYPICAL CHANNEL TREATMENT SECTION, SHEET C26 OF THE DESIGN DRAWINGS, EXCEPT AT LOCATIONS WHERE BEDROCK IS EXPOSED DURING CONSTRUCTION.
5. SALVAGE TREES WITHIN AREAS TO BE GRADED PER THE TREE REMOVAL NOTES, SHEETS C1.
6. POND 1250 AND THE UPPER WATER TREATMENT FACILITIES WILL BE RELOCATED, AS NEEDED, TO ACCOUNT FOR SPATIAL CHANGES DUE TO CONSTRUCTION.

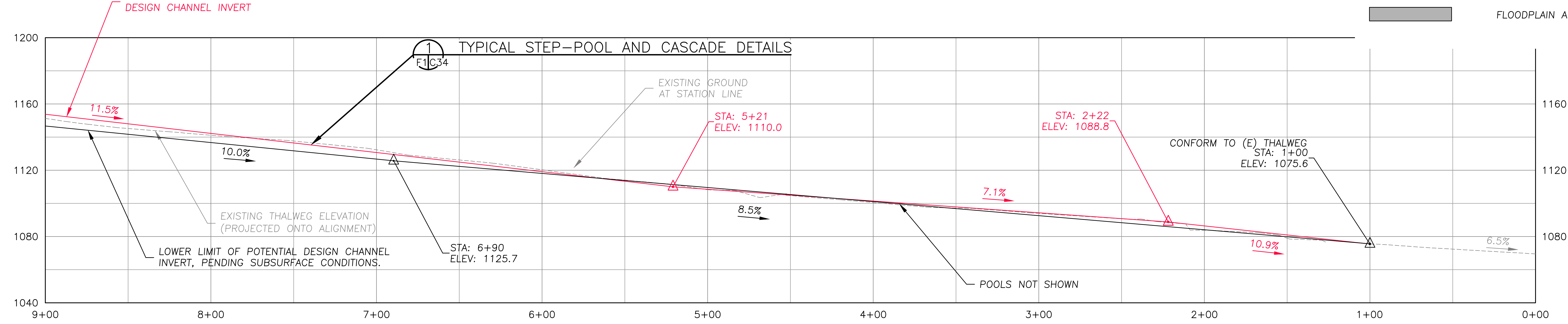


## LEGEND

| | |
|---|---|
| 1250 1245 | (E) CONTOURS |
| 1250 1245 | (N) CONTOURS |
| 165 | SURVEY CONTROL POINT |
| ● 8"A | (E) TREE |
| ✕ | (E) TREE TO BE REMOVED |
| - - - - | (E) ROADWAY |
| — · — | (E) THALWEG |
| — — — | (E) NORTH TOE OF SLOPE |
| —— | (N) NORTH TOE OF SLOPE |
| —— | LIMITS OF GRADING |
| —— | (N) ROADWAY |
| — · — · — | (N) THALWEG ALIGNMENT |
| 1255.0 | BOULDER SILL (WITH TOP ELEVATION, BOTH SIDES) |
| R19 \| R18 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" (URS, 2011) |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| ▨ | FLOODPLAIN ARMOR |

## MATERIAL REMOVAL AREA PLAN

SCALE: 1" = 40'



## MATERIAL REMOVAL AREA CHANNEL PROFILE

SCALE: 1" = 40'

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HEIDELBERG CEMENT
GROUP

PERMANENTE CREEK RESTORATION PLAN

MATERIAL REMOVAL AREA SITE PLANS, PROFILES AND SECTIONS THAT REFLECT THE LOWER LIMIT OF POTENTIAL FINISHED GRADE CHANNEL PROFILE

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

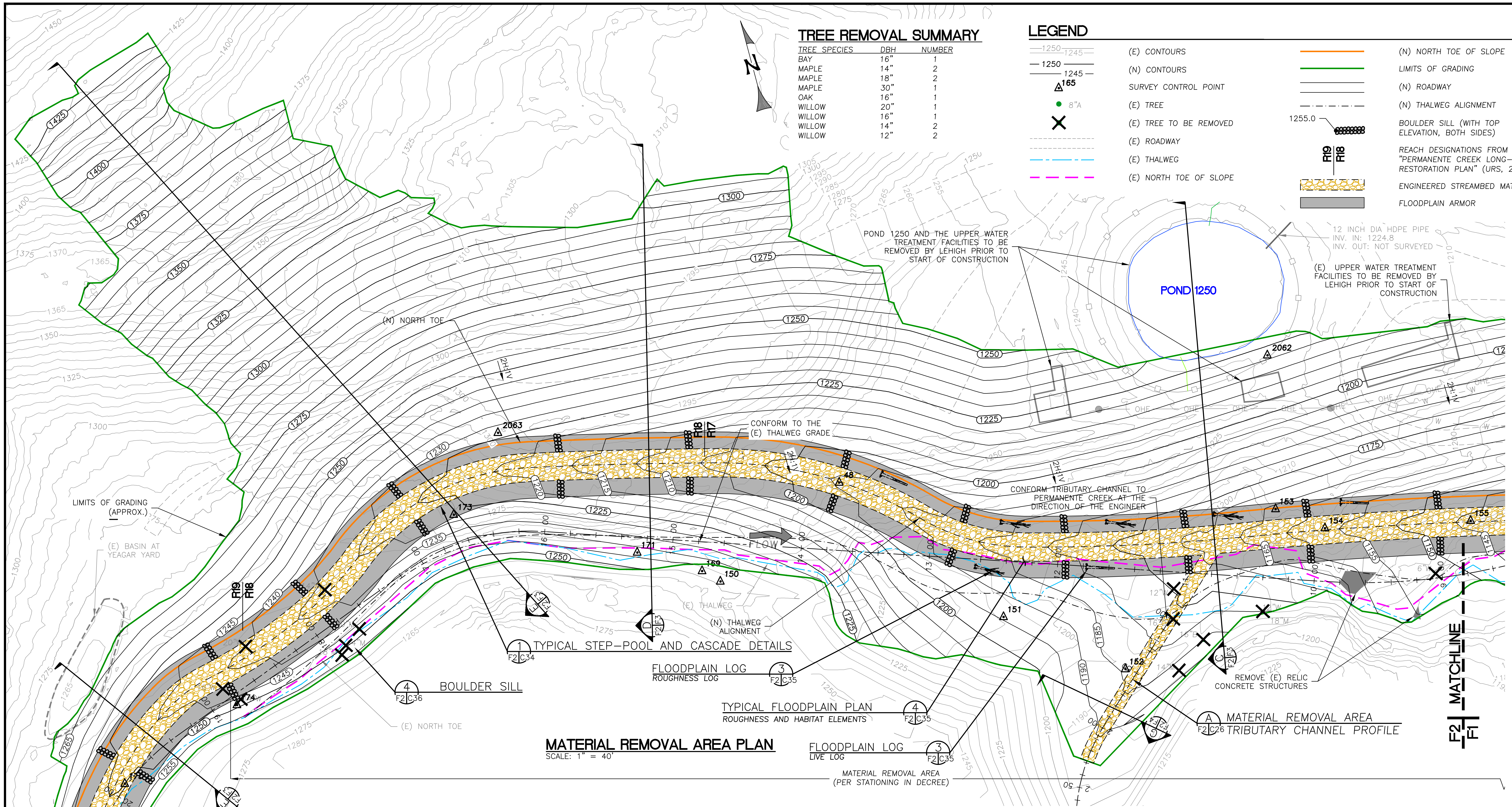
FIGURE
F1

## TREE REMOVAL SUMMARY

| TREE SPECIES | DBH | NUMBER |
|---|---|---|
| BAY | 16" | 1 |
| MAPLE | 14" | 2 |
| MAPLE | 18" | 2 |
| MAPLE | 30" | 1 |
| OAK | 16" | 1 |
| WILLOW | 20" | 1 |
| WILLOW | 16" | 1 |
| WILLOW | 14" | 2 |
| WILLOW | 12" | 2 |

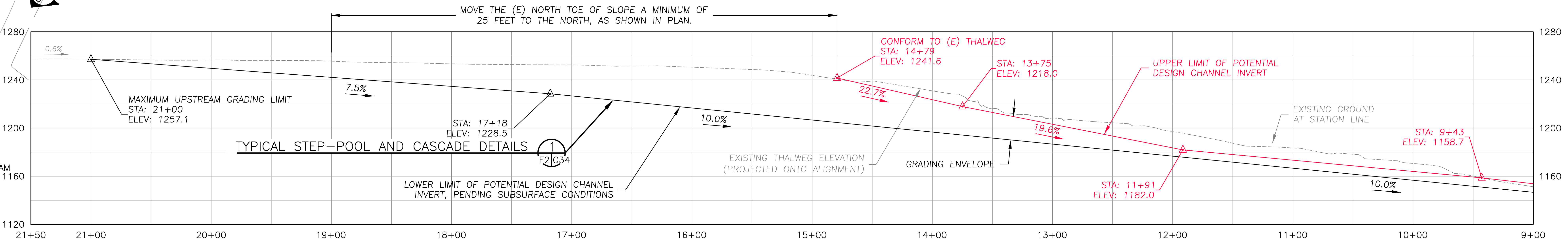
## LEGEND

| | | | |
|---|---|---|---|
| 1250 1245 | (E) CONTOURS | 🟧 | (N) NORTH TOE OF SLOPE |
| 1250 1245 | (N) CONTOURS | 🟩 | LIMITS OF GRADING |
| △165 | SURVEY CONTROL POINT | ═ | (N) ROADWAY |
| ● 8"A | (E) TREE | — · — · — | (N) THALWEG ALIGNMENT |
| ✕ | (E) TREE TO BE REMOVED | 1255.0 | BOULDER SILL (WITH TOP ELEVATION, BOTH SIDES) |
| - - - - | (E) ROADWAY | R19 \| R18 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| — · — · | (E) THALWEG | ▨ | ENGINEERED STREAMBED MATERIAL |
| - - - - | (E) NORTH TOE OF SLOPE | ▩ | FLOODPLAIN ARMOR |



## MATERIAL REMOVAL AREA PLAN

SCALE: 1" = 40'



## MATERIAL REMOVAL AREA CHANNEL PROFILE

SCALE: 1" = 50'

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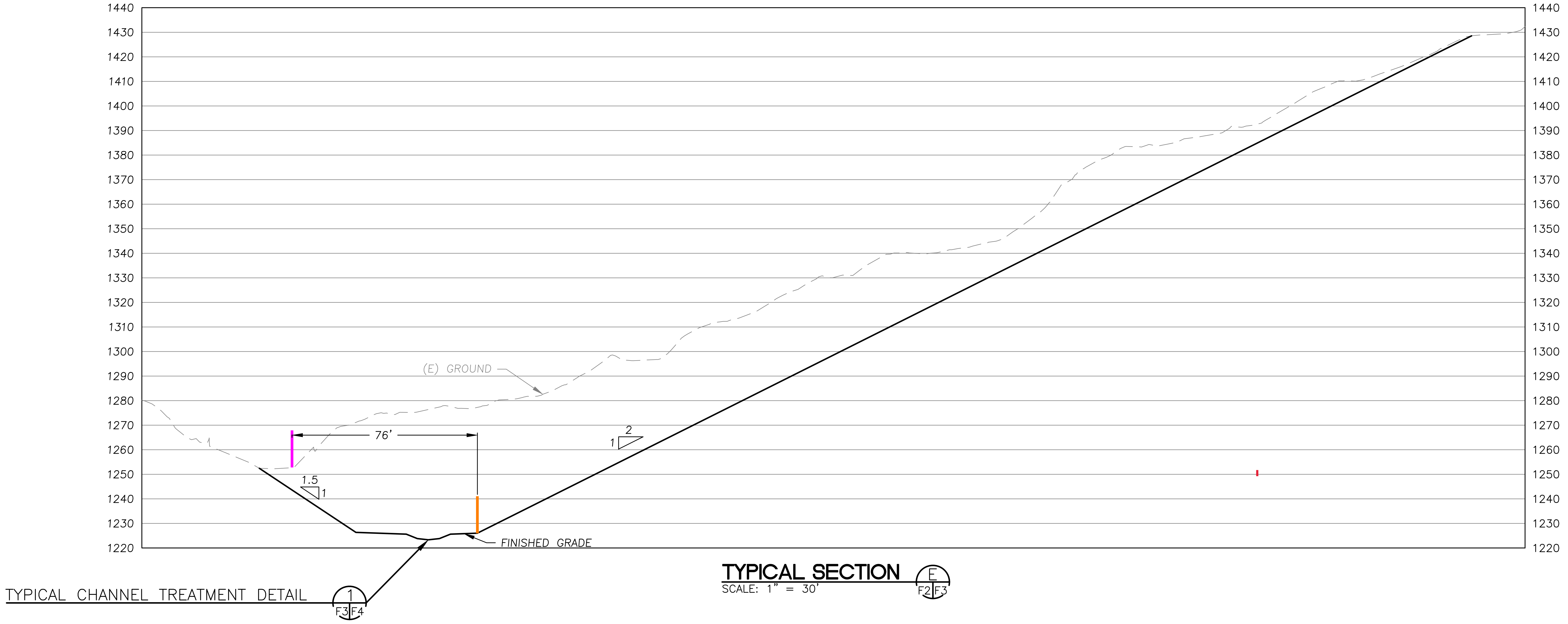
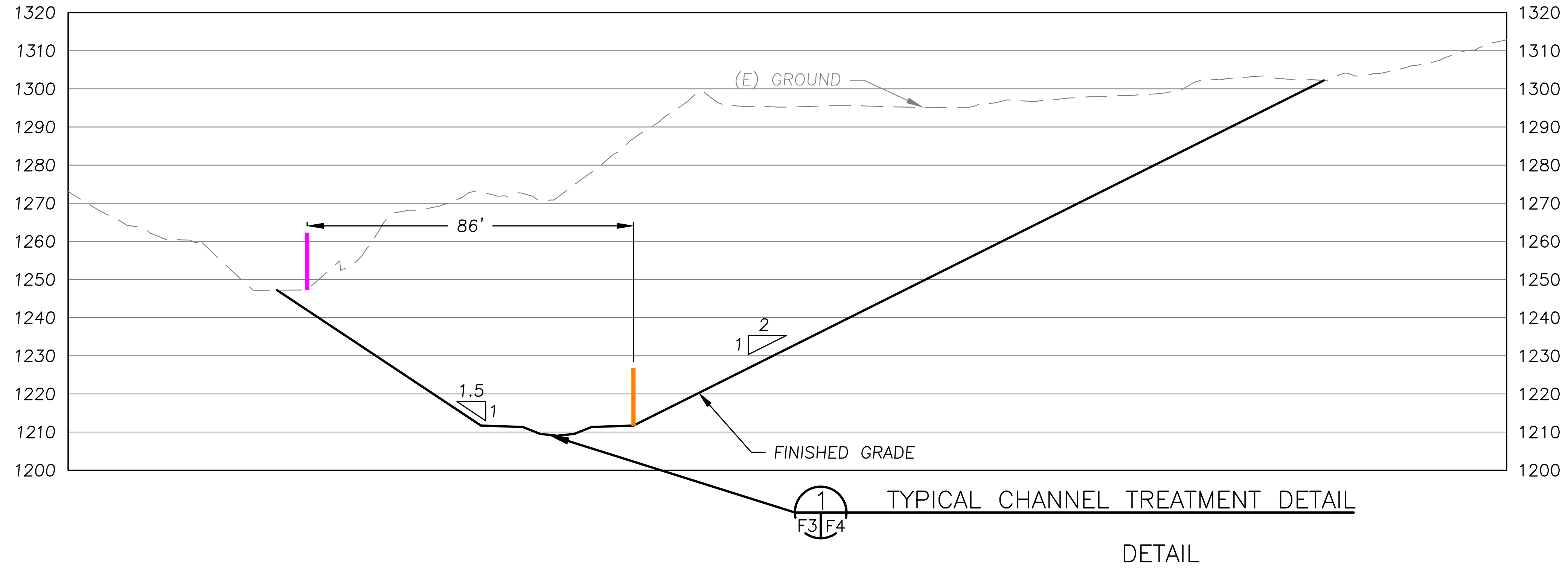
BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

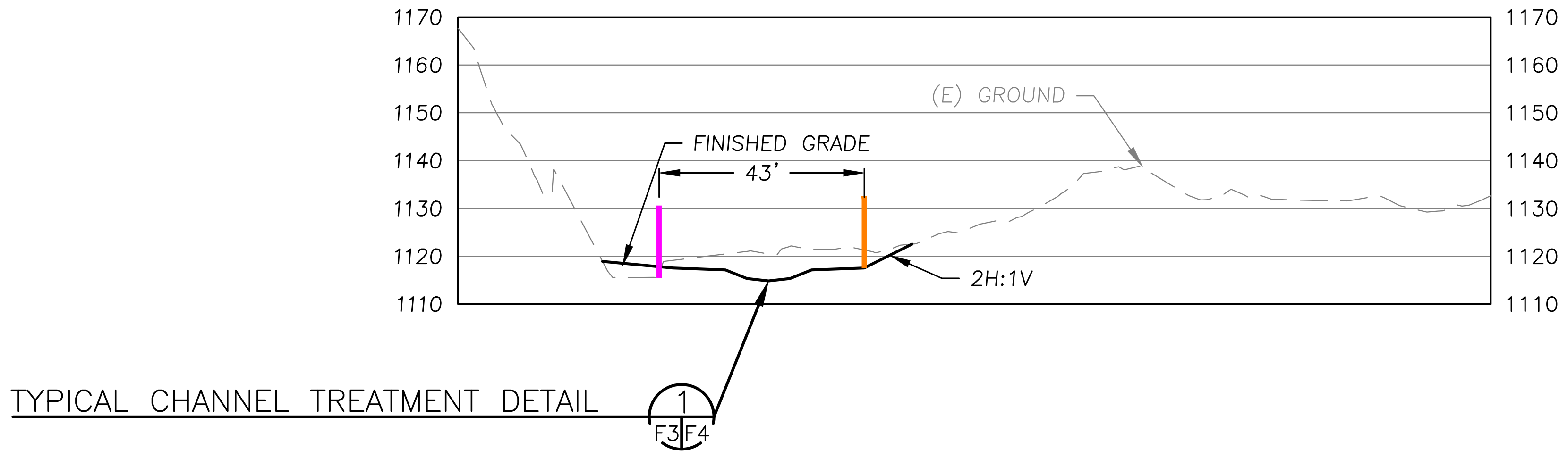
FIGURE
F2



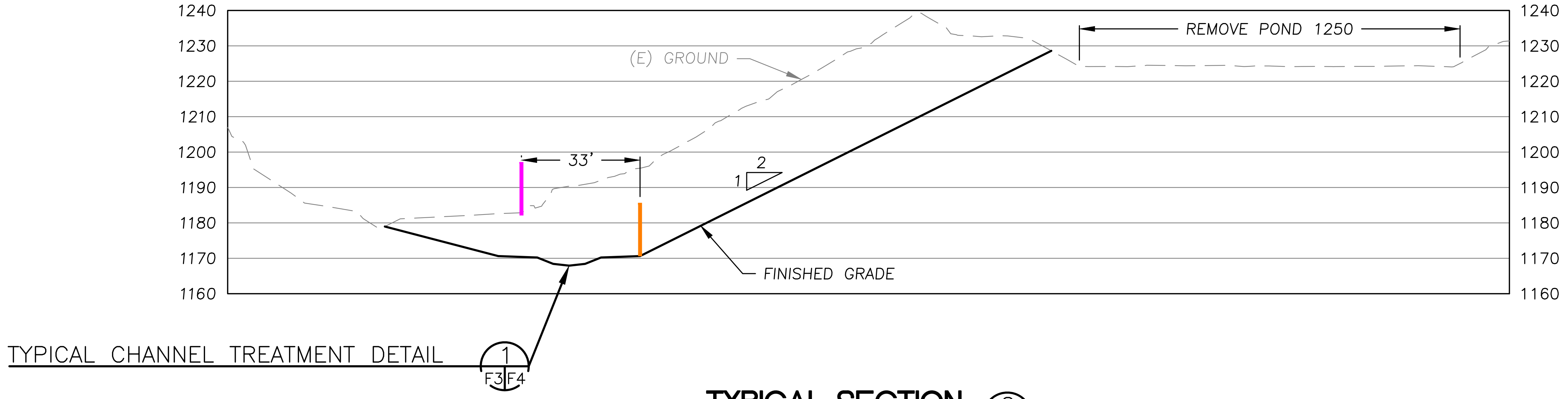
**TYPICAL SECTION** E F2 F3
SCALE: 1" = 30'

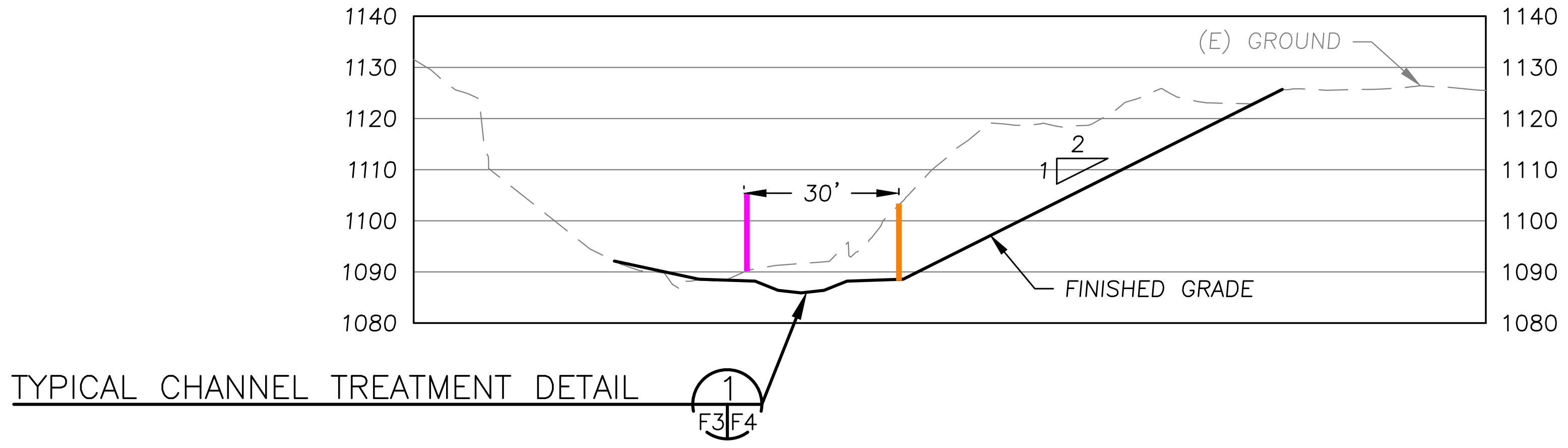


**TYPICAL SECTION** D F2 F3
SCALE: 1" = 30'



**TYPICAL SECTION** B F1 F3
SCALE: 1" = 30'





**TYPICAL SECTION** A F1 F3
SCALE: 1" = 30'

**TYPICAL SECTION** C F2 F3
SCALE: 1" = 30'

## LEGEND

| (E) NORTH SLOPE TOE

| PROPOSED NORTH SLOPE TOE

*NOTE:*
1. FINISHED GRADE SHOWN REPRESENTS THE LOWER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT.

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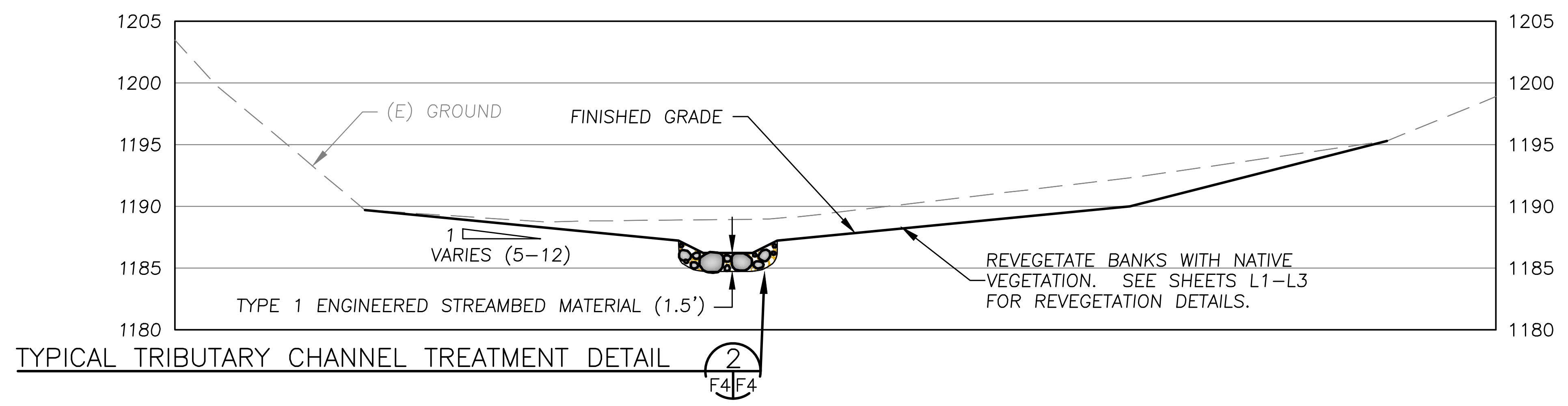
HEIDELBERG CEMENT
GROUP

PERMANENTE CREEK RESTORATION PLAN

MATERIAL REMOVAL AREA SITE PLANS, PROFILES AND SECTIONS THAT REFLECT THE LOWER LIMIT OF POTENTIAL FINISHED GRADE CHANNEL PROFILE

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

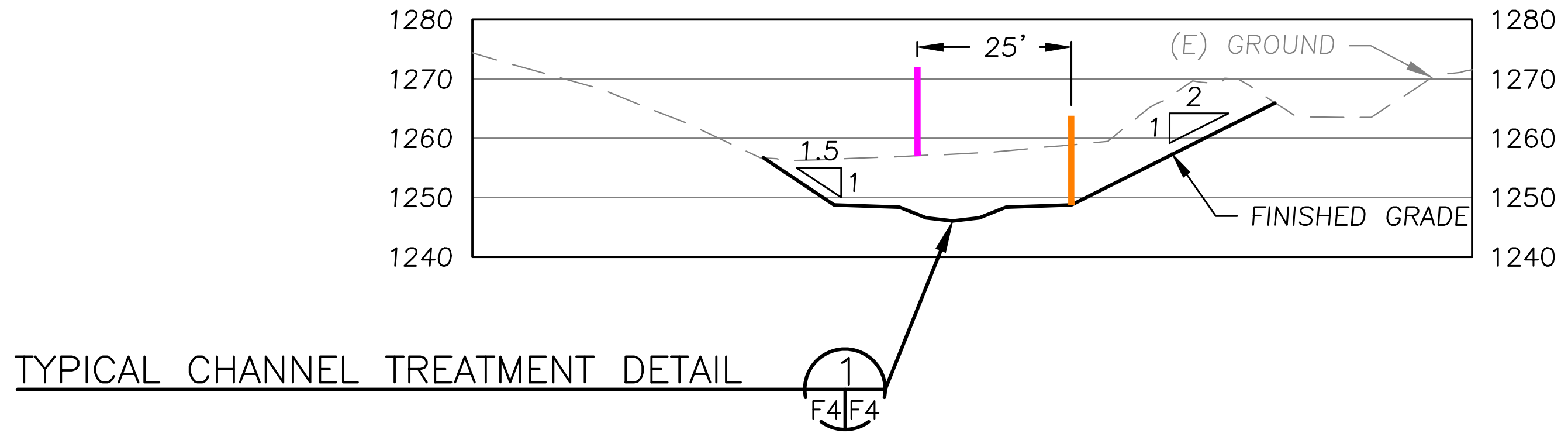
FIGURE
F3



## TYPICAL SECTION

SCALE: 1" = 10'

F
F2 F4



## TYPICAL SECTION

SCALE: 1" = 30'

F
F2 F4

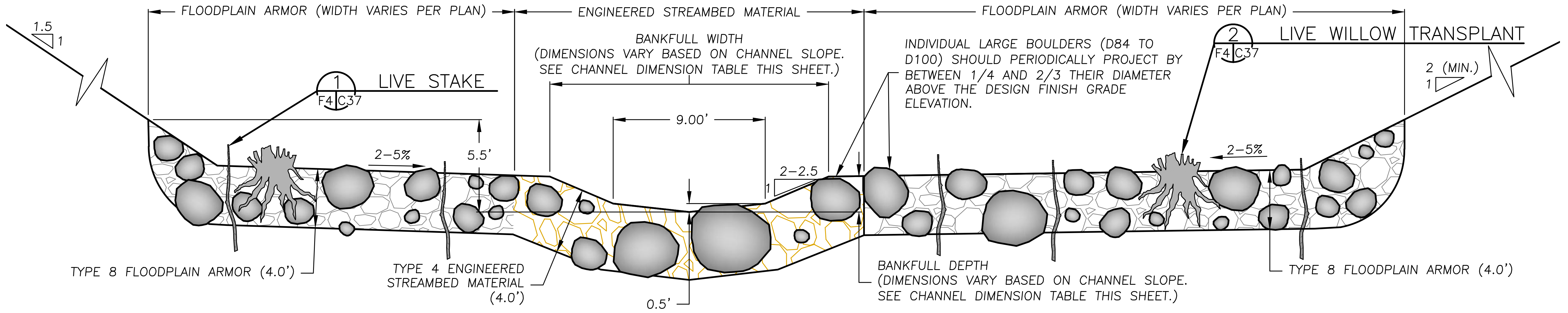
## LEGEND

| ▌ (E) NORTH SLOPE TOE | ▌ PROPOSED NORTH SLOPE TOE |
|---|---|

| CHANNEL DIMENSIONS FOR OVERBURDEN REMOVAL AREA | | |
|---|---|---|
| DESIGN SLOPE (%) | DESIGN DIMENSIONS | |
| | BANKFULL WIDTH | BANKFULL DEPTH |
| <4% | 16'–20' | 1.7'–2.1' |
| 4%–8% | 14.5'–18.5' | 1.9'–2.3' |
| >8% | 14'–18' | 2.3'–2.7' |

NOTES:

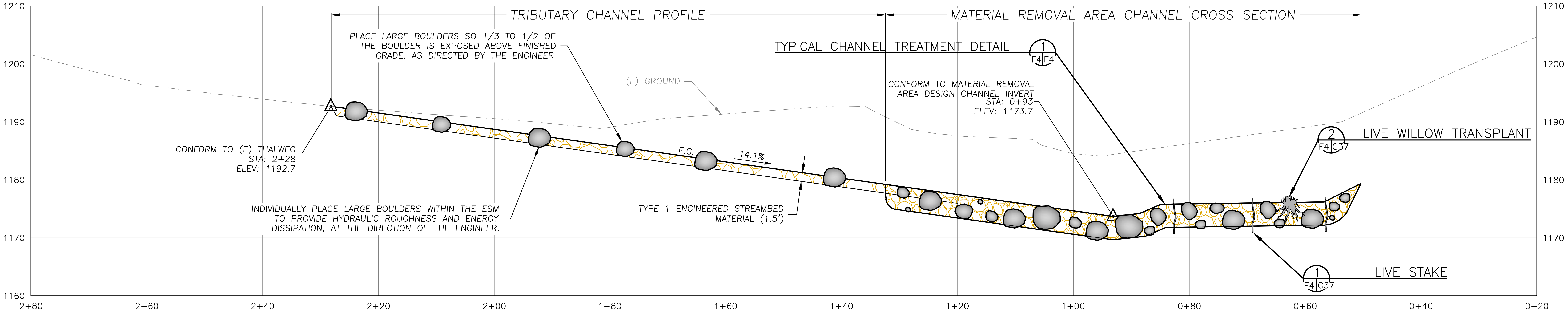
1. INSTALL TYPE 8 FLOODPLAIN ARMOR ALONG THE ENTIRE MATERIAL REMOVAL AREA PROJECT REACH WHERE FLOODPLAIN ARMOR IS SHOWN IN PLAN.
2. INSTALL TYPE 4 ENGINEERED STREAMBED MATERIAL ALONG THE ENTIRE MATERIAL REMOVAL AREA PROJECT REACH WHERE ESM IS SHOWN IN PLAN.
3. SEE THE TYPICAL FLOODPLAIN ROUGHNESS AND HABITAT PLAN, SHEET C35 FOR INFORMATION REGARDING FEATURES NOT SHOWN ON THE TYPICAL TREATMENT DETAIL.
4. FINISHED GRADE SHOWN REPRESENTS THE LOWER LIMIT OF POTENTIAL DESIGN CHANNEL INVERT.



## TYPIAL CHANNEL TREATMENT DETAIL

SCALE: 1" = 5'

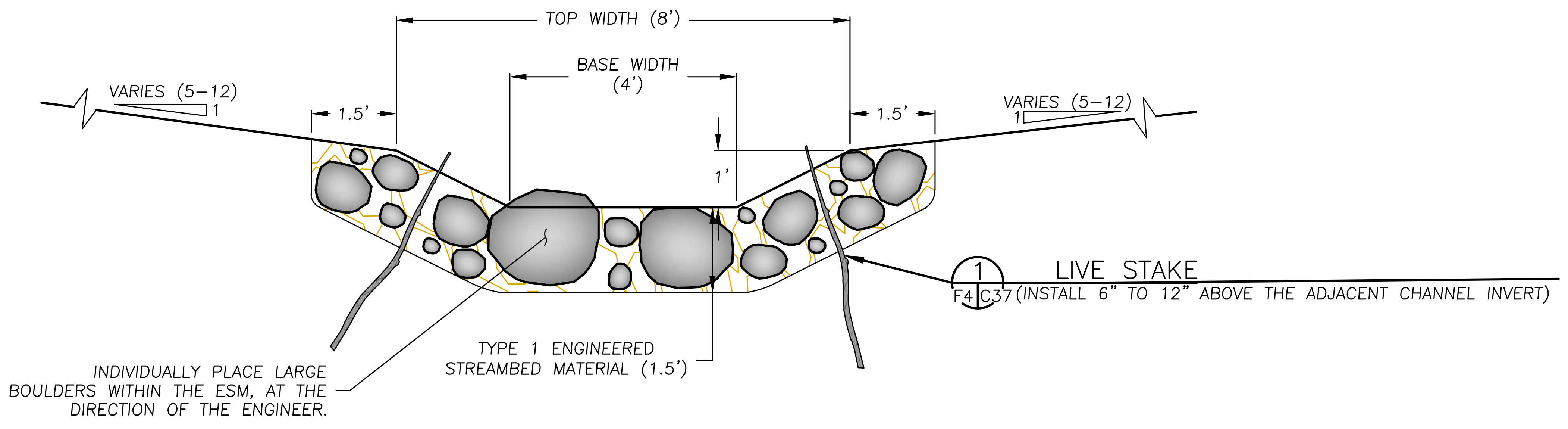
1
F3,F4 F4



## MATERIAL REMOVAL AREA TRIBUTARY CHANNEL PROFILE

SCALE: 1" = 10'

A
F2 F4



## TYPICAL TRIBUTARY CHANNEL TREATMENT DETAIL

SCALE: 1" = 2'

2
F4 F4

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PERMANENTE CREEK RESTORATION PLAN

MATERIAL REMOVAL AREA SITE PLANS, PROFILES AND SECTIONS
THAT REFLECT THE LOWER LIMIT OF POTENTIAL FINISHED GRADE
CHANNEL PROFILE

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS

0 1"

FIGURE

F4

# BEGIN SEPARATE DOCUMENT

WATERWAYS
CONSULTING, INC.

Ecological Restoration Design ~ Civil Engineering ~ Natural Resource Management

# TECHNICAL MEMORANDUM

*To:* Carolina Addison, Lehigh Hanson Inc.

*From:* Waterways Consulting, Inc.

*Date:* August 26, 2022

*Re:* Permanente Creek Restoration Project, Temporary Riparian Vegetation Impact Assessment

## Introduction

This memorandum has been prepared in response to comments provided to the County of Santa Clara on May 13, 2021 by the California Department of Fish and Wildlife (CDFW) in response to the County's Notice of Preparation of the Supplemental Draft Environmental Impact Report for the Permanente Creek Restoration Project (PRCP).[1] The comments are regarding impacts to riparian vegetation associated with implementation of the PRCP included under the "Biological Resources, Long-term Impacts to Riparian Sensitive Community" section of the letter. The relevant paragraph under the "Riparian Vegetation Impacts" subsection has been reproduced below for reference.

> The revised 90% engineering designs appear to indicate that approximately 30 trees will be removed during Project construction. However, only larger trees to be removed were included in the designs (e.g., non-oak trees equal to or greater than 12-inch diameter). Sapling (1-inch to 4-inch diameter) and pole sized (5-inch to 11-inch diameter) trees are important to riparian vegetation structural complexity and habitat succession. Based on the current designs, impacts of the Project to riparian habitat may be underestimated. CDFW recommends that analysis of riparian vegetation impacts include trees less than 12 inches in diameter or based on area calculations for seedlings and saplings and understory vegetation. As discussed in the previous section of this letter, the long-term (e.g., 10-year) post-construction monitoring and adaptive management plan should include monitoring of revegetated areas and include performance standards to ensure establishment or maintenance of riparian habitat.

## Background

Waterways Consulting, Inc. (Waterways) staff completed an evaluation of riparian vegetation within the limits of areas to be impacted during implementation of the PCRP. This included field work to determine the species, size and number of trees and shrubs that will be removed during project construction as outlined below.

## Methods

Waterways walked the extents of each component project area to evaluate riparian impacts during July and August 2022. This included the Channel Widening Area, Rock Pile Area and Material Removal Area. Each project area was broken into multiple smaller areas for determining riparian vegetation impacts as

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[1] The subject of the May 13, 2021 letter from CDFW to Mr. Robert Salisbury at the County of Santa Clara is "Permanente Creek Restoration Project, Notice of Preparation of a Supplemental Draft Environmental Impact Report, SCH No. 2021040331, Santa Clara County".

shown on Figures 1-10. Representative sample areas were evaluated where vegetation was very dense, and the findings were proportioned for estimating the impacts for the applicable reach of channel. Where the riparian corridor was reasonably open and Waterways staff were able to traverse a reach of channel, sample areas were not used and the riparian corridor within the limits of proposed grading was evaluated to determine vegetation impacts.

Species and diameter of trees and shrubs observed were recorded on field sheets for each riparian area assessed. Figure 1 provides an overview of the assessment area and Figures 2 - 10 show the limits of each riparian vegetation impact area. The upstream and downstream limits of each area were surveyed using a total station. Individual trees and shrubs were not surveyed as part of this assessment. Trees from the original mapping effort are shown on the drawings.[2] Solid lines shown on the Figures represent the limits of an assessment area. Dashed lines represent the boundary of sample areas within a larger assessment area with the color matching that of the assessment area. The boundary lines fall within the grading limits where an area is devoid of vegetation.

## Results

A table listing the area, species, diameter, and number of trees and shrubs documented in each assessment area is included on the attached Figures. A summary table is included below with the total estimated number of trees and shrubs that will be removed at each component project area and the estimated total for the project. Detailed summary tables that include species and diameter of trees and shrubs that would be removed at each component project area are attached.

**Table 1. Total Number of Trees and Shrubs Removed During Project Implementation**

| Project Location | Number of Trees/Shrubs Removed |
|---|---|
| Channel Widening Area | 271 |
| Rock Pile Area | 49 |
| Material Removal Area | 550 |
| Estimated Project Total = | 870 |

## Conclusion

The PCRP includes a robust revegetation effort to reestablish riparian vegetation along the restored channel reaches to help stabilize graded areas, provide cover and establish habitat complexity. While approximately 870 tree and shrubs will be removed during project implementation throughout an area of approximately 5.5 acres, over 7,000 tree and shrubs will be planted to reestablish and expand the riparian corridor along approximately 7.6 acres of restored riparian area.

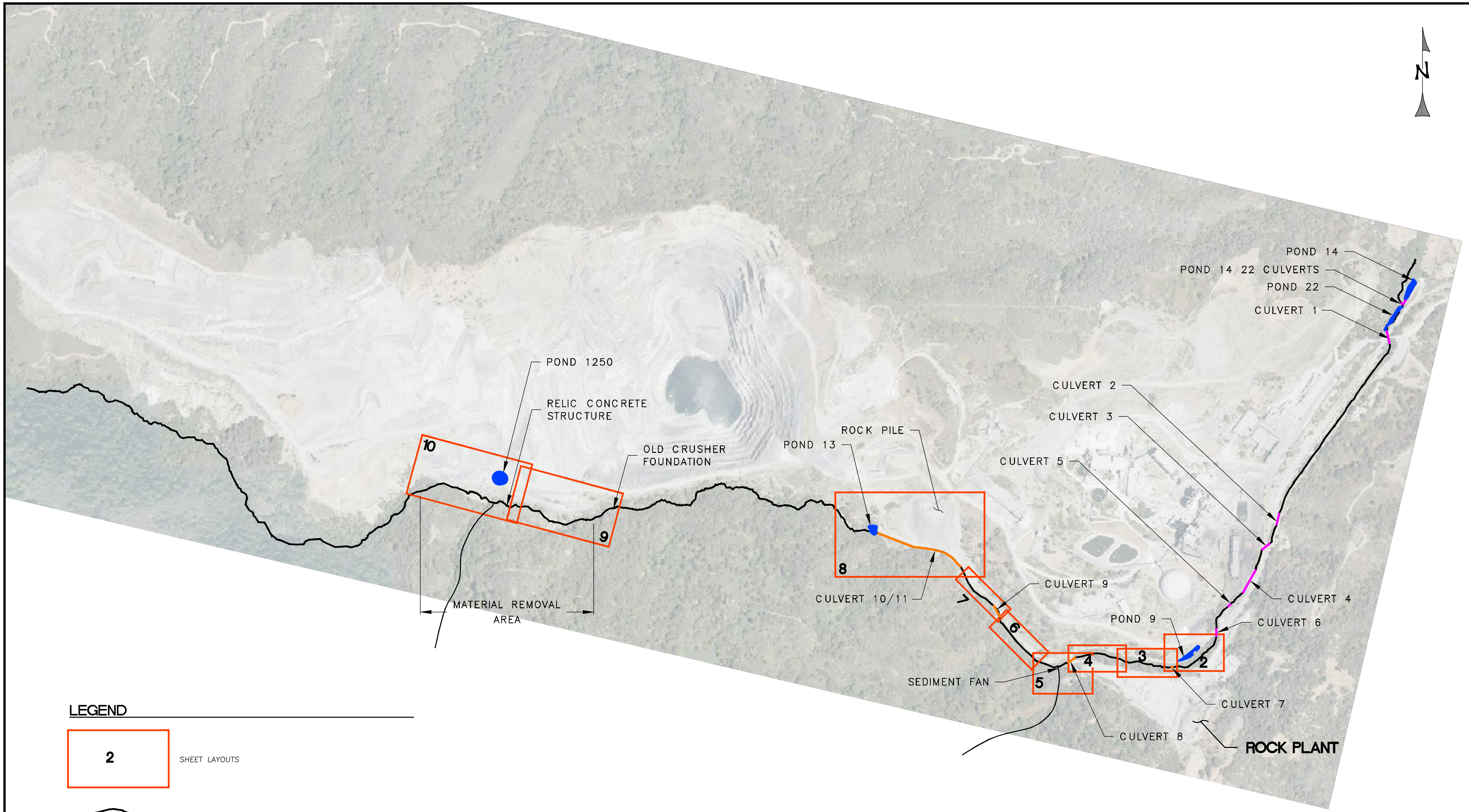
---

[2] The trees shown on the Riparian Vegetation Impact Assessment Figures include trees surveyed during mapping efforts completed during 2013-2015. Some trees may have died since the initial mapping effort. Additional trees meeting the survey threshold used during the original mapping efforts may now exist within the mapped areas and are not shown on the figures.

| CHANNEL WIDENING AREA | | |
|---|---|---|
| RIPARIAN VEGETATION IMPACT SUMMARY | | |
| AREA = | 1.55 | ACRE |
| SPECIES | (DIA. IN.) | COUNT |
| ALDER | 0-2 | 5 |
| ALDER | 2-4 | 1 |
| ALDER | 4-8 | 10 |
| ALDER | 8-12 | 5 |
| BAY | 2-4 | 1 |
| BAY | 4-8 | 14 |
| BIG LEAF MAPLE | 2-4 | 6 |
| BIG LEAF MAPLE | 4-8 | 1 |
| BUCKEYE SAPLING | <1 | 5 |
| COFFEEBERRY | 0-2 | 1 |
| ELDERBERRY | 0-2 | 18 |
| ELDERBERRY | 4-6 | 1 |
| MADRONE | 2-4 | 2 |
| OAK | 0-2 | 11 |
| OAK | 2-4 | 5 |
| OAK SAPPLING | <1 | 12 |
| SYCAMORE | 32 | 1 |
| TOYON | 0-2 | 9 |
| WALNUT | 0-2 | 11 |
| WILLOW | 0-4 | 43 |
| WILLOW | 4-8 | 56 |
| WILLOW | 8-12 | 52 |
| WILLOW | 24+ | 1 |
| | TOTAL COUNT = | 271 |

| ROCK PILE AREA<br>RIPARIAN VEGETATION IMPACT SUMMARY | | |
|---|---|---|
| AREA = | 1.11 | ACRE |
| SPECIES | (DIA. IN.) | COUNT |
| BIG LEAF MAPLE | 0-2 | 2 |
| ELDERBERRY | 0-2 | 5 |
| WILLOW | 0-4 | 27 |
| WILLOW | 4-8 | 6 |
| WILLOW | 8-12 | 9 |
| | TOTAL COUNT = | 49 |

| MATERIAL REMOVAL AREA<br>RIPARIAN VEGETATION IMPACT SUMMARY | | |
|---|---|---|
| AREA = | 2.80 | ACRE |
| SPECIES | (DIA. IN.) | COUNT |
| BAY | 0-2 | 25 |
| BAY SAPLING | <1 | 9 |
| BIG LEAF MAPLE SAPLING | <1 | 28 |
| BIG LEAF MAPLE | 1-2 | 29 |
| BIG LEAF MAPLE | 4-6 | 9 |
| BIG LEAF MAPLE | 6-8 | 23 |
| CEANOTHUS | 0-2 | 10 |
| MADRONE | 0-2 | 21 |
| MADRONE | 2-4 | 34 |
| MADRONE | 4-6 | 2 |
| TOYON | 0-2 | 32 |
| WILLOW | 0-4 | 266 |
| WILLOW | 4-8 | 53 |
| WILLOW | 8-12 | 8 |
| | TOTAL COUNT = | 550 |



## LEGEND

| | |
|---|---|
| 2 | SHEET LAYOUTS |
| ~~~ | PERMANENTE CREEK THALWEG ALIGNMENT 2013 |
| — | TRIBUTARY (RELEVANT TO PROJECT) |
| 🟧 | EXISTING CULVERT TO BE REMOVED |
| 🟪 | EXISTING CULVERT TO REMAIN |

## SHEET LAYOUT OVERVIEW

SCALE:1" = 500'

*RIPARIAN IMPACT ASSESSMENT ANALYSIS:*

*THESE DRAWINGS HAVE BEEN PREPARED TO ACCOMPANY THE TECHNICAL MEMORANDUM TITLED "PERMANENTE CREEK RESTORATION PROJECT, TEMPORARY RIPARIAN VEGETATION IMPACT ASSESSMENT", DATED 8/26/22, AND ASSIST WITH ESTIMATING TEMPORARY RIPARIAN VEGETATION IMPACTS THAT WOULD OCCUR DURING IMPLEMENTATION OF THE PERMANENTE CREEK RESTORATION PLAN. THE QUANTITY, SIZE AND SPECIES OF EXISTING TREES AND SHRUBS THAT WILL BE REMOVED DURING PROJECT IMPLEMENTATION WERE DOCUMENTED WITHIN THE AREAS SHOWN ON THE FOLLOWING FIGURES. SEE THE REFERENCED TECHNICAL MEMORANDUM FOR A DESCRIPTION OF ASSESSMENT METHODS AND RESULTS.*

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HEIDELBERG CEMENT
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PERMANENTE CREEK RESTORATION PLAN

RIPARIAN VEGETATION IMPACT ASSESSMENT

BAR IS ONE INCH
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

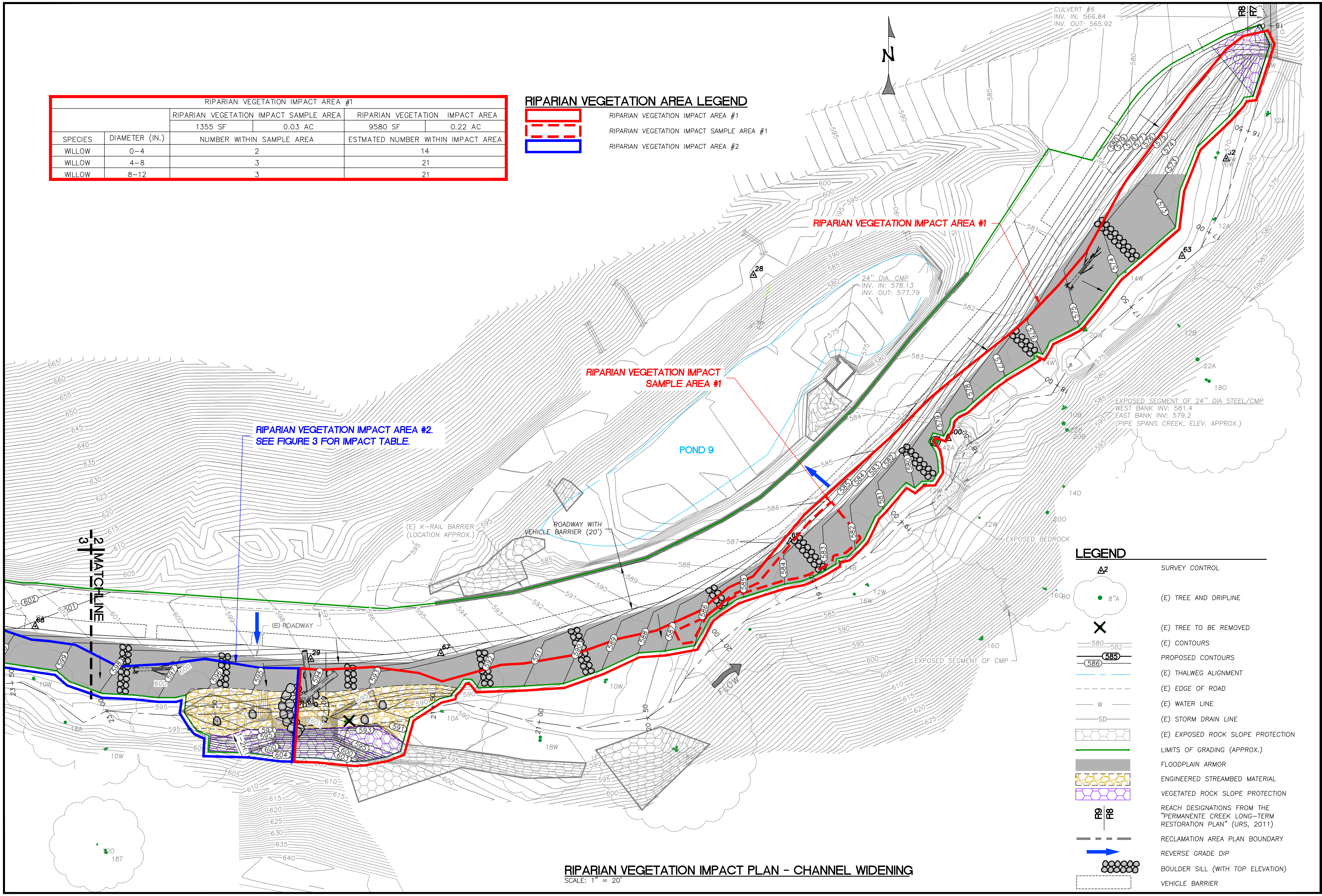
FIGURE
1

## RIPARIAN VEGETATION IMPACT AREA #1

| | | RIPARIAN VEGETATION IMPACT SAMPLE AREA | | RIPARIAN VEGETATION IMPACT AREA | |
|---|---|---|---|---|---|
| | | 1355 SF | 0.03 AC | 9580 SF | 0.22 AC |
| SPECIES | DIAMETER (IN.) | NUMBER WITHIN SAMPLE AREA | | ESTMATED NUMBER WITHIN IMPACT AREA | |
| WILLOW | 0–4 | 2 | | 14 | |
| WILLOW | 4–8 | 3 | | 21 | |
| WILLOW | 8–12 | 3 | | 21 | |

## RIPARIAN VEGETATION AREA LEGEND

| | |
|---|---|
| 🟥 | RIPARIAN VEGETATION IMPACT AREA #1 |
| ▭ | RIPARIAN VEGETATION IMPACT SAMPLE AREA #1 |
| 🟦 | RIPARIAN VEGETATION IMPACT AREA #2 |



## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE AND DRIPLINE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| | (E) THALWEG ALIGNMENT |
| | (E) EDGE OF ROAD |
| W | (E) WATER LINE |
| SD | (E) STORM DRAIN LINE |
| ▨ | (E) EXPOSED ROCK SLOPE PROTECTION |
| | LIMITS OF GRADING (APPROX.) |
| ▨ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| ▨ | VEGETATED ROCK SLOPE PROTECTION |
| R9 R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" (URS, 2011) |
| | RECLAMATION AREA PLAN BOUNDARY |
| → | REVERSE GRADE DIP |
| ●●●●● | BOULDER SILL (WITH TOP ELEVATION) |
| ▭ | VEHICLE BARRIER |

## RIPARIAN VEGETATION IMPACT PLAN – CHANNEL WIDENING

SCALE: 1" = 20'

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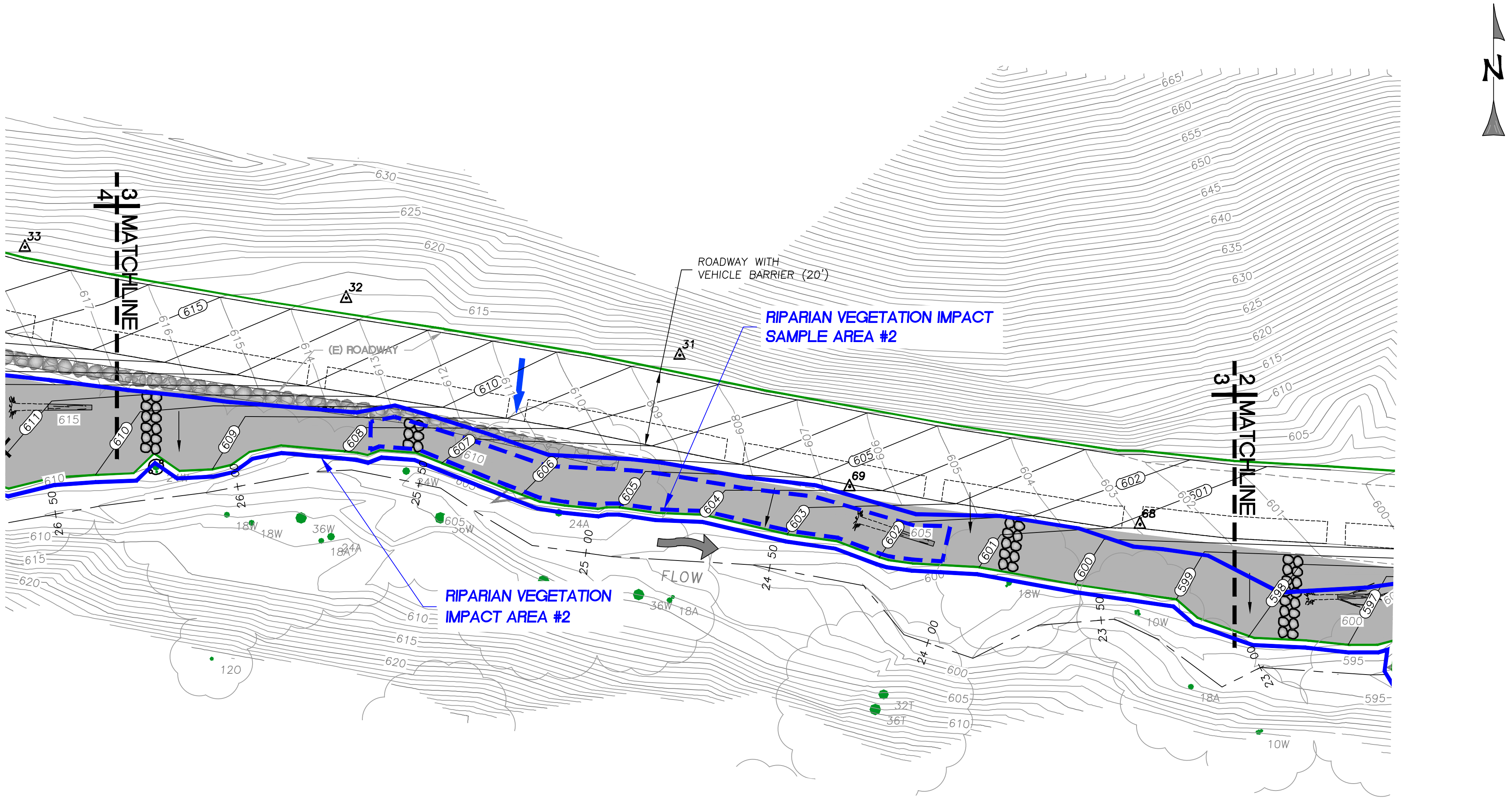
PERMANENTE CREEK RESTORATION PLAN
RIPARIAN VEGETATION IMPACT ASSESSMENT

BAR IS ONE INCH
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

FIGURE
2



## RIPARIAN VEGETATION IMPACT PLAN - CHANNEL WIDENING

SCALE: 1" = 20'

## LEGEND

△2 SURVEY CONTROL

● 8"A (E) TREE AND DRIPLINE

✕ (E) TREE TO BE REMOVED

580 582 (E) CONTOURS

585 586 PROPOSED CONTOURS

(E) THALWEG ALIGNMENT

(E) EDGE OF ROAD

W (E) WATER LINE

SD (E) STORM DRAIN LINE

(E) EXPOSED ROCK SLOPE PROTECTION

LIMITS OF GRADING (APPROX.)

FLOODPLAIN ARMOR

ENGINEERED STREAMBED MATERIAL

VEGETATED ROCK SLOPE PROTECTION

REVERSE GRADE DIP

BOULDER SILL (WITH TOP ELEVATION)

## RIPARIAN VEGETATION AREA LEGEND

RIPARIAN VEGETATION IMPACT AREA #2

RIPARIAN VEGETATION IMPACT SAMPLE AREA #2

| RIPARIAN VEGETATION IMPACT AREA #2 | | | | | |
|---|---|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT SAMPLE AREA | | RIPARIAN VEGETATION IMPACT AREA | |
| | | 1785 SF | 0.04 AC | 9010 SF | 0.21 AC |
| SPECIES | DIAMETER (IN.) | NUMBER WITHIN SAMPLE AREA | | ESTMATED NUMBER WITHIN IMPACT AREA | |
| ALDER | 0–2 | 1 | | 5 | |
| ALDER | 4–8 | 2 | | 10 | |
| ALDER | 8–12 | 1 | | 5 | |
| WALNUT | 0–2 | 2 | | 10 | |
| WILLOW | 0–4 | 3 | | 15 | |
| WILLOW | 4–8 | 2 | | 10 | |

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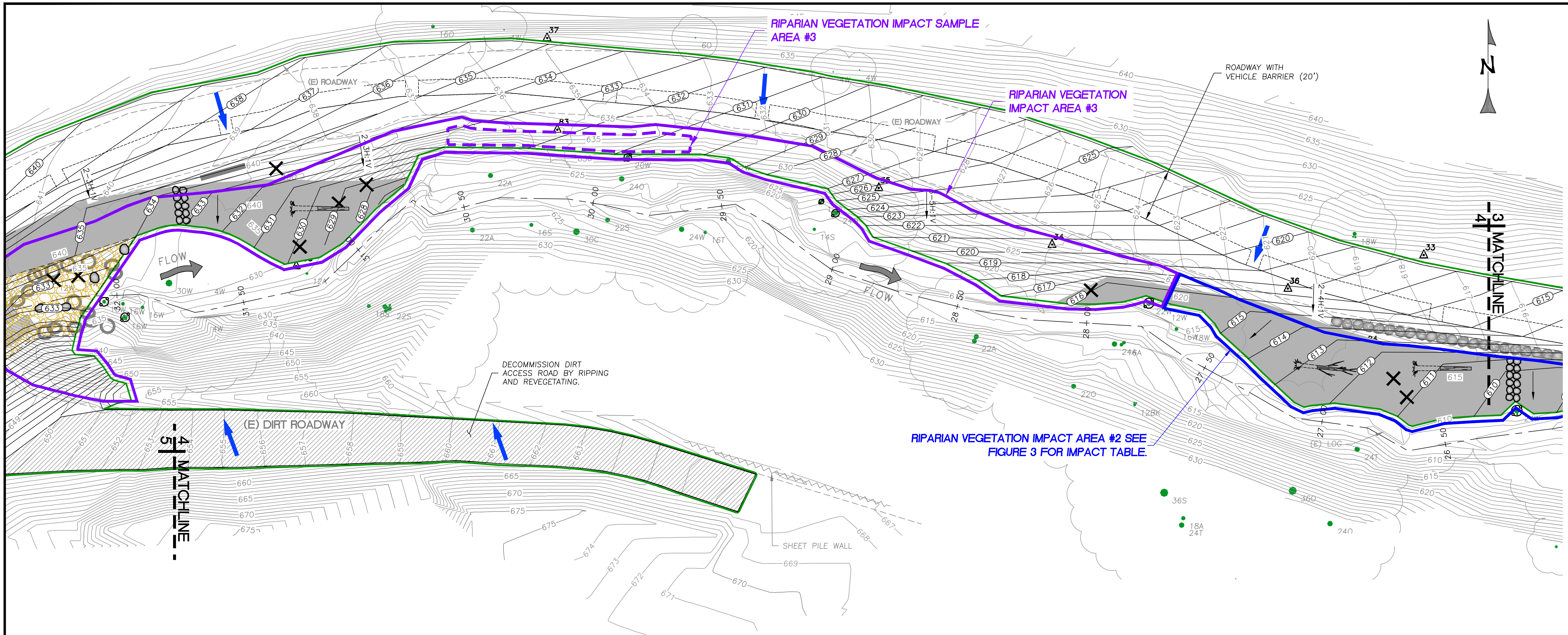
PERMANENTE CREEK RESTORATION PLAN

RIPARIAN VEGETATION IMPACT ASSESSMENT

BAR IS ONE INCH
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

FIGURE
3



## RIPARIAN VEGETATION IMPACT PLAN - CHANNEL WIDENING

SCALE: 1" = 20'

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE AND DRIPLINE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| | (E) THALWEG ALIGNMENT |
| | (E) EDGE OF ROAD |
| W | (E) WATER LINE |
| SD | (E) STORM DRAIN LINE |
| | (E) EXPOSED ROCK SLOPE PROTECTION |
| | LIMITS OF GRADING (APPROX.) |
| | FLOODPLAIN ARMOR |
| | ENGINEERED STREAMBED MATERIAL |
| | VEGETATED ROCK SLOPE PROTECTION |
| ▨ | ROAD DECOMMISSIONING AREA |
| R9 R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| | RECLAMATION AREA PLAN BOUNDARY |
| → | REVERSE GRADE DIP |
| | BOULDER SILL (WITH TOP ELEVATION) |
| | VEHICLE BARRIER |

## RIPARIAN VEGETATION AREA LEGEND

| | |
|---|---|
| | RIPARIAN VEGETATION IMPACT AREA #2 |
| | RIPARIAN VEGETATION IMPACT AREA #3 |
| | RIPARIAN VEGETATION IMPACT SAMPLE AREA #3 |

| RIPARIAN VEGETATION IMPACT AREA #3 | | | | | |
|---|---|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT SAMPLE AREA | | RIPARIAN VEGETATION IMPACT AREA | |
| | | 800 SF | 0.02 AC | 8670 SF | 0.20 AC |
| SPECIES | DIAMETER (IN.) | NUMBER WITHIN SAMPLE AREA | | ESTMATED NUMBER WITHIN IMPACT AREA | |
| BAY | 4–8 | 1 | | 11 | |
| ELDERBERRY | 0–2 | 1 | | 11 | |
| WILLOW | 0–4 | 1 | | 11 | |
| WILLOW | 4–8 | 1 | | 11 | |
| WILLOW | 8–12 | 2 | | 22 | |

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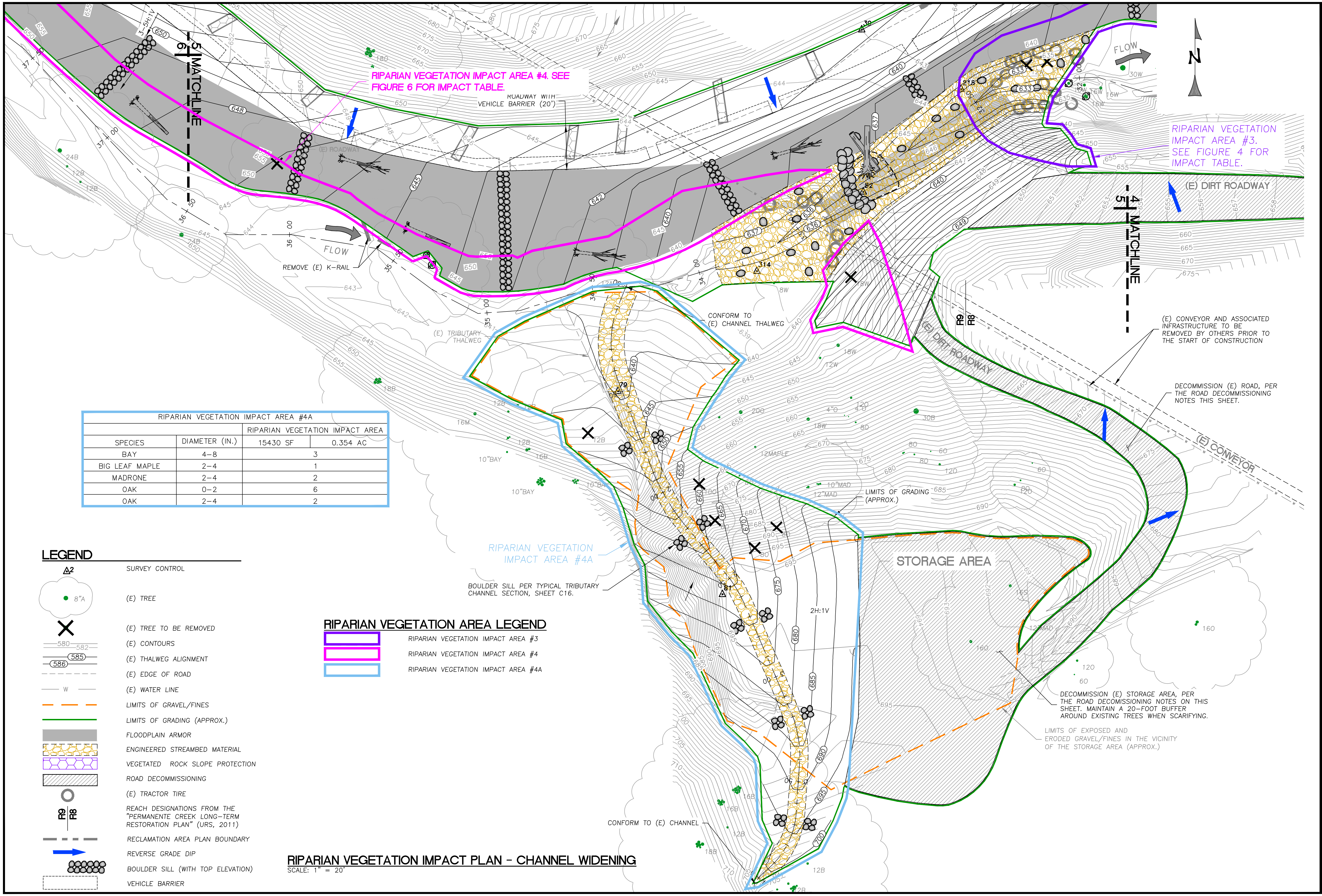
RIPARIAN VEGETATION IMPACT ASSESSMENT

BAR IS ONE INCH
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

FIGURE
4



| RIPARIAN VEGETATION IMPACT AREA #4A | | | |
|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT AREA | |
| SPECIES | DIAMETER (IN.) | 15430 SF | 0.354 AC |
| BAY | 4–8 | 3 | |
| BIG LEAF MAPLE | 2–4 | 1 | |
| MADRONE | 2–4 | 2 | |
| OAK | 0–2 | 6 | |
| OAK | 2–4 | 2 | |

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | (E) THALWEG ALIGNMENT |
| – – – – | (E) EDGE OF ROAD |
| — W — | (E) WATER LINE |
| – – – | LIMITS OF GRAVEL/FINES |
| — | LIMITS OF GRADING (APPROX.) |
| ▬ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| ▨ | VEGETATED ROCK SLOPE PROTECTION |
| ▨ | ROAD DECOMMISSIONING |
| ○ | (E) TRACTOR TIRE |
| R9 \| R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" (URS, 2011) |
| ▬ ▬ ▬ | RECLAMATION AREA PLAN BOUNDARY |
| → | REVERSE GRADE DIP |
| ●●●●● | BOULDER SILL (WITH TOP ELEVATION) |
| ☐ | VEHICLE BARRIER |

## RIPARIAN VEGETATION AREA LEGEND

| | |
|---|---|
| ☐ | RIPARIAN VEGETATION IMPACT AREA #3 |
| ☐ | RIPARIAN VEGETATION IMPACT AREA #4 |
| ☐ | RIPARIAN VEGETATION IMPACT AREA #4A |

## RIPARIAN VEGETATION IMPACT PLAN – CHANNEL WIDENING

SCALE: 1" = 20'

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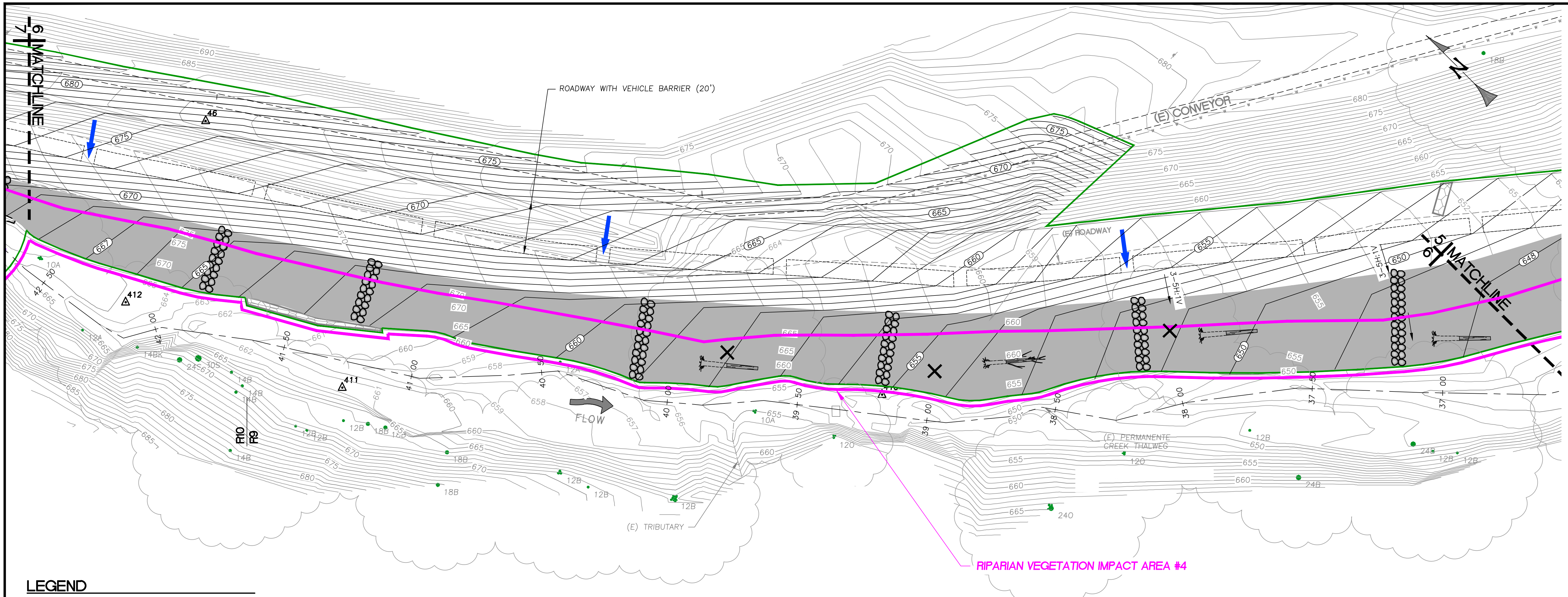
PERMANENTE CREEK RESTORATION PLAN

RIPARIAN VEGETATION IMPACT ASSESSMENT

BAR IS ONE INCH
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

FIGURE
5



## RIPARIAN VEGETATION IMPACT PLAN – CHANNEL WIDENING

SCALE: 1" = 20'

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE AND DRIPLINE |
| × | (E) TREE TO BE REMOVED |
| —580—582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| — · — | (E) THALWEG ALIGNMENT |
| - - - - | (E) EDGE OF ROAD |
| — W — | (E) WATER LINE |
| — SD — | (E) STORM DRAIN LINE |
| ▨ | (E) EXPOSED ROCK SLOPE PROTECTION |
| — | LIMITS OF GRADING (APPROX.) |
| ■ | FLOODPLAIN ARMOR |
| ▨ | ENGINEERED STREAMBED MATERIAL |
| R9 \| R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| — — — | RECLAMATION AREA PLAN BOUNDARY |
| → | REVERSE GRADE DIP |
| ○○○○ | BOULDER SILL (WITH TOP ELEVATION) |
| ☐ | VEHICLE BARRIER |

## RIPARIAN VEGETATION AREA LEGEND

| | |
|---|---|
| ☐ | RIPARIAN VEGETATION IMPACT AREA #4 |

| RIPARIAN VEGETATION IMPACT AREA #4 | | | |
|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT AREA | |
| SPECIES | DIAMETER (IN.) | 24,715 SF | 0.57 AC |
| ALDER | 2–4 | 1 | |
| BAY | 2–4 | 1 | |
| BIG LEAF MAPLE | 2–4 | 5 | |
| BIG LEAF MAPLE | 4–8 | 1 | |
| BUCKEYE SAPPLING | 0–2 | 5 | |
| COFFEEBERRY | 0–2 | 1 | |
| ELDERBERRY | 0–2 | 7 | |
| ELDERBERRY | 4–6 | 1 | |
| OAK SAPPLING | <1 | 12 | |
| OAK | 0–2 | 5 | |
| OAK | 2–4 | 3 | |
| SYCAMORE | 32 | 1 | |
| TOYON | 0–2 | 9 | |
| WALNUT | 0–2 | 1 | |
| WILLOW | 0–4 | 3 | |
| WILLOW | 4–8 | 14 | |
| WILLOW | 8–12 | 9 | |
| WILLOW | 24+ | 1 | |

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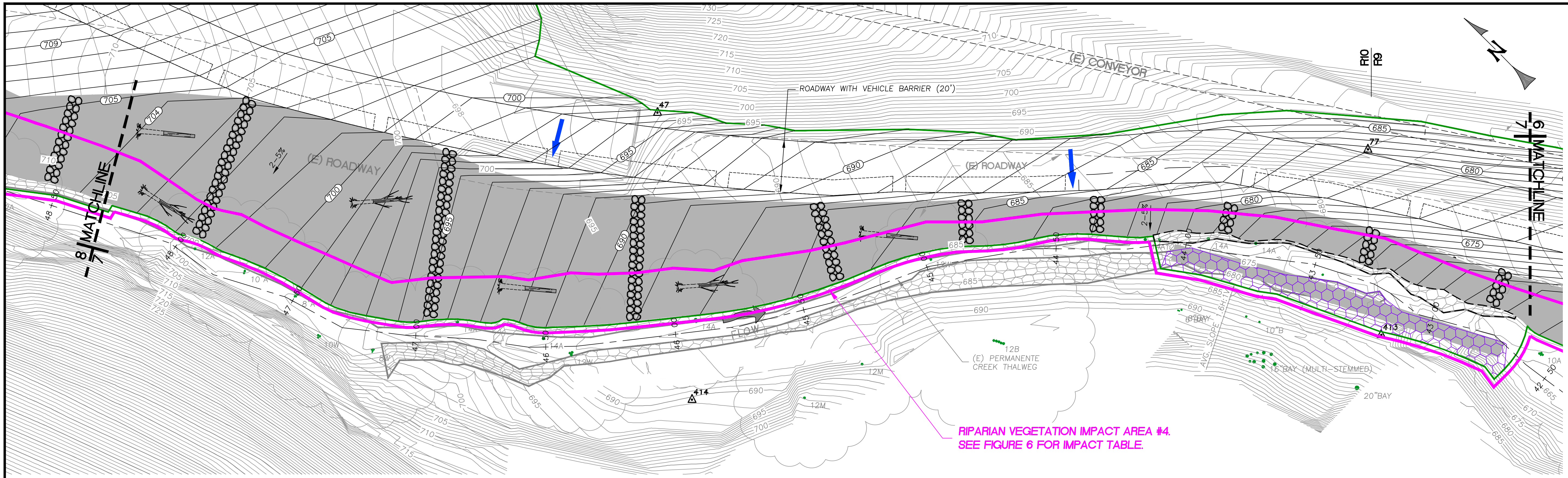
PERMANENTE CREEK RESTORATION PLAN

RIPARIAN VEGETATION IMPACT ASSESSMENT

BAR IS ONE INCH
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

FIGURE
6



RIPARIAN VEGETATION IMPACT AREA #4.
SEE FIGURE 6 FOR IMPACT TABLE.

## RIPARIAN VEGETATION IMPACT PLAN - CHANNEL WIDENING

SCALE: 1" = 20'

## LEGEND

| | |
|---|---|
| △2 | SURVEY CONTROL |
| ● 8"A | (E) TREE AND DRIPLINE |
| ✕ | (E) TREE TO BE REMOVED |
| 580 582 | (E) CONTOURS |
| 585 586 | PROPOSED CONTOURS |
| — - — | (E) THALWEG ALIGNMENT |
| - - - - | (E) EDGE OF ROAD |
| — W — | (E) WATER LINE |
| — SD — | (E) STORM DRAIN LINE |
| ⬡ | (E) EXPOSED ROCK SLOPE PROTECTION |
| — | LIMITS OF GRADING (APPROX.) |
| ▨ | FLOODPLAIN ARMOR |
| ⬡ | ENGINEERED STREAMBED MATERIAL |
| ⬡ | VEGETATED ROCK SLOPE PROTECTION |
| ▨ | ROAD DECOMMISSIONING AREA |
| R9 \| R8 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG-TERM RESTORATION PLAN" (URS, 2011) |
| → | REVERSE GRADE DIP |
| ●●●● | BOULDER SILL (WITH TOP ELEVATION) |
| ☐ | VEHICLE BARRIER |

## RIPARIAN VEGETATION AREA LEGEND

| | |
|---|---|
| ☐ | RIPARIAN VEGETATION IMPACT AREA #4 |

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RIPARIAN VEGETATION IMPACT ASSESSMENT

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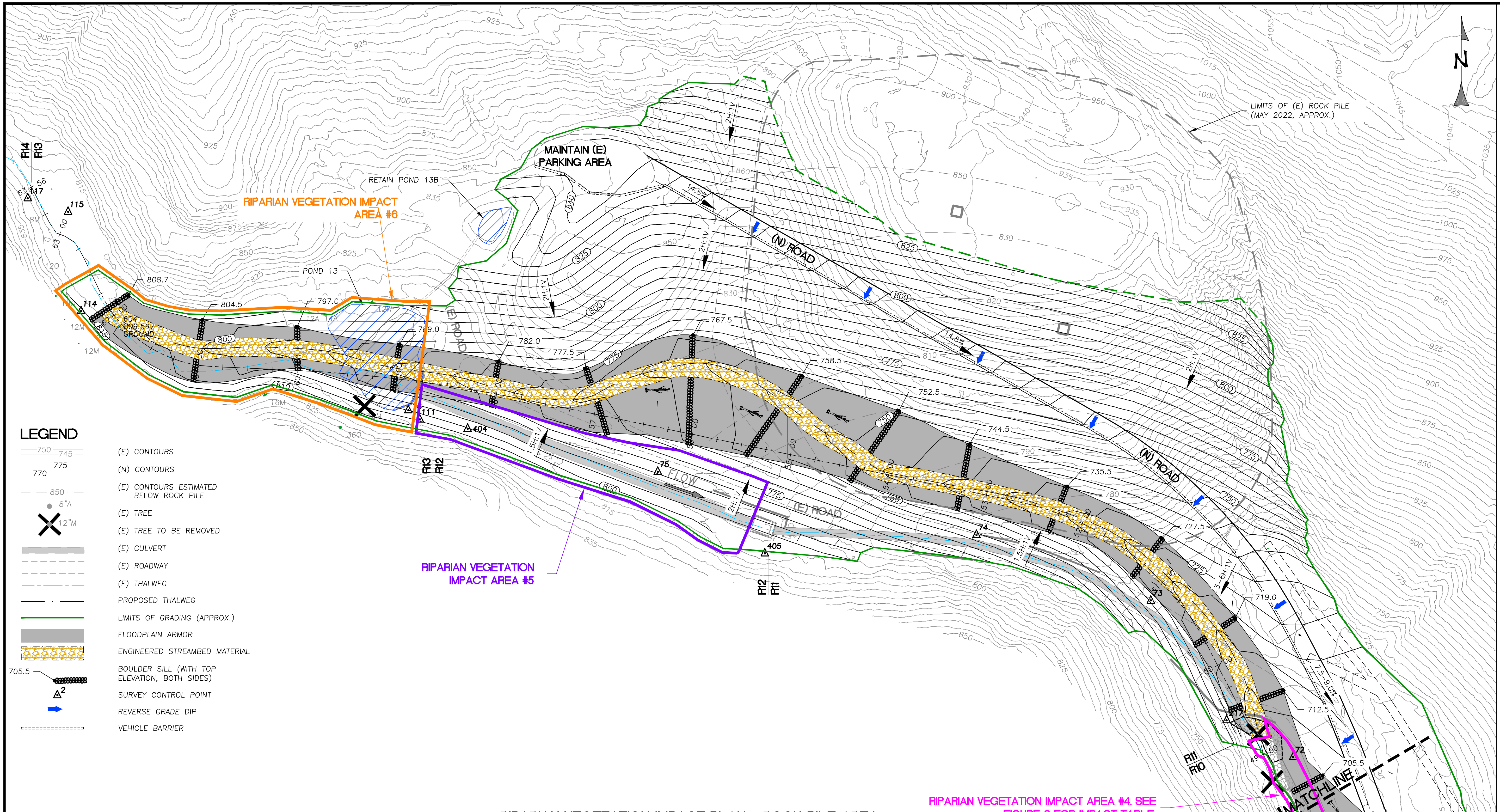
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

FIGURE
7



## RIPARIAN VEGETATION IMPACT PLAN - ROCK PILE AREA

SCALE: 1" = 50'

| RIPARIAN VEGETATION IMPACT AREA #5 | | | |
|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT AREA | |
| SPECIES | DIAMETER (IN.) | 19050 SF | 0.437 AC |
| BIG LEAF MAPLE | 0–2 | 1 | |
| WILLOW | 0–4 | 1 | |

### RIPARIAN VEGETATION AREA LEGEND

| | |
|---|---|
| 🟪 | RIPARIAN VEGETATION IMPACT AREA #4 |
| 🟪 | RIPARIAN VEGETATION IMPACT AREA #5 |
| 🟧 | RIPARIAN VEGETATION IMPACT AREA #6 |

| RIPARIAN VEGETATION IMPACT AREA #6 | | | |
|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT AREA | |
| SPECIES | DIAMETER (IN.) | 29200 SF | 0.670 AC |
| BIG LEAF MAPLE | 0–2 | 1 | |
| ELDERBERRY | 0–2 | 5 | |
| WILLOW | 0–4 | 26 | |
| WILLOW | 4–8 | 6 | |
| WILLOW | 8–12 | 9 | |

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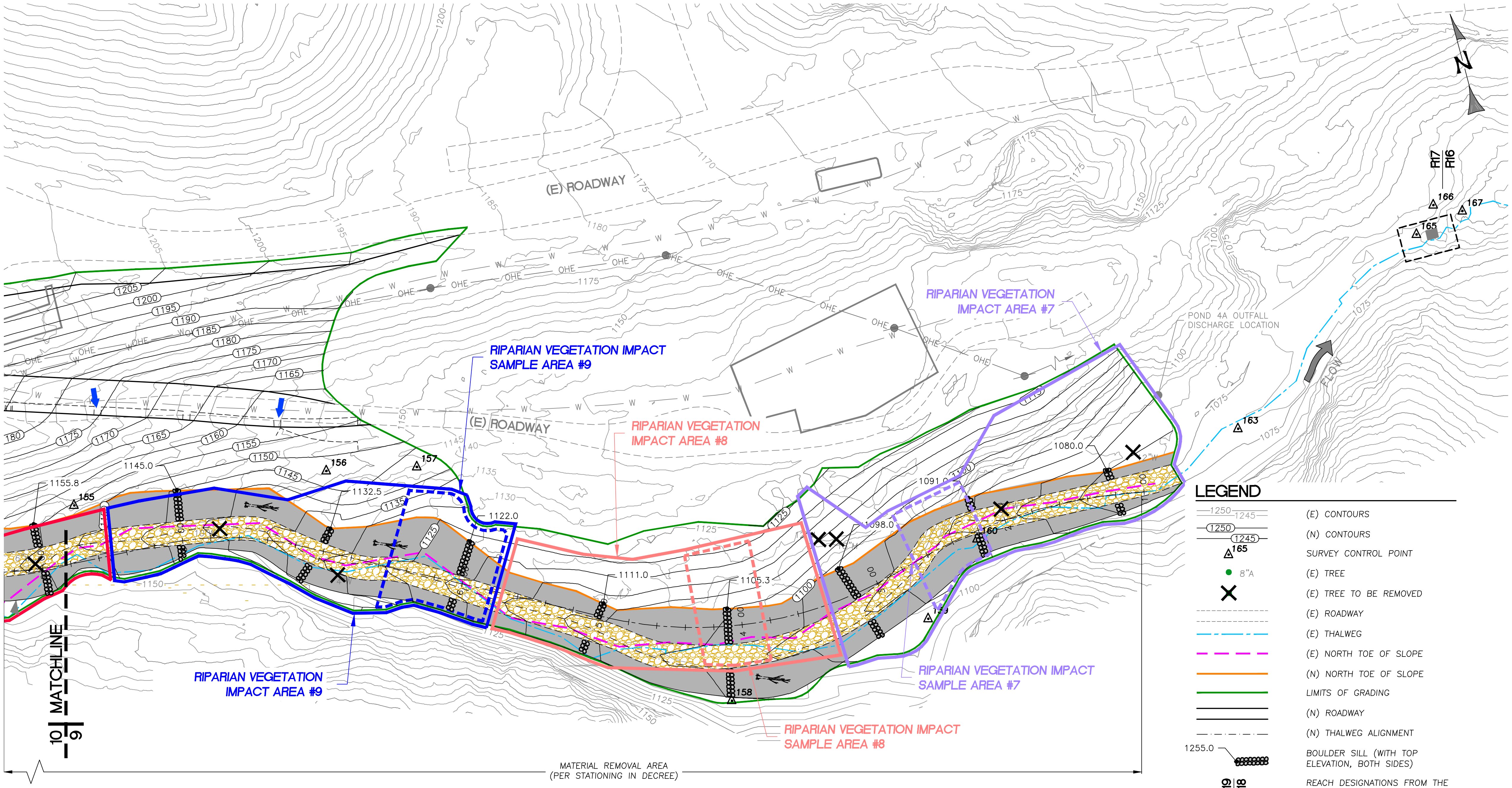
LEHIGH HANSON
HEIDELBERG CEMENT
GROUP

PERMANENTE CREEK RESTORATION PLAN

RIPARIAN VEGETATION IMPACT ASSESSMENT

BAR IS ONE INCH
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

FIGURE
8



## RIPARIAN VEGETATION IMPACT PLAN (1 OF 2) - MATERIAL REMOVAL AREA

SCALE: 1" = 40'

## LEGEND

- (E) CONTOURS
- (N) CONTOURS
- SURVEY CONTROL POINT
- ● 8"A (E) TREE
- ✕ (E) TREE TO BE REMOVED
- (E) ROADWAY
- (E) THALWEG
- (E) NORTH TOE OF SLOPE
- (N) NORTH TOE OF SLOPE
- LIMITS OF GRADING
- (N) ROADWAY
- (N) THALWEG ALIGNMENT
- 1255.0 BOULDER SILL (WITH TOP ELEVATION, BOTH SIDES)
- R19 | R18 REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" (URS, 2011)
- ENGINEERED STREAMBED MATERIAL
- FLOODPLAIN ARMOR

| RIPARIAN VEGETATION IMPACT AREA #7 | | | | | |
|---|---|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT SAMPLE AREA | | RIPARIAN VEGETATION IMPACT AREA | |
| | | 3495 SF | 0.080 AC | 24540 SF | 0.563 AC |
| SPECIES | DIAMETER (IN.) | NUMBER WITHIN SAMPLE AREA | | ESTMATED NUMBER WITHIN IMPACT AREA | |
| BIG LEAF MAPLE | 4–6 | 1 | | 8 | |
| BIG LEAF MAPLE | 6–8 | 3 | | 23 | |
| CEANOTHUS | 0–2 | 1 | | 8 | |
| MADRONE | 2–4 | 1 | | 8 | |
| TOYONE | 0–2 | 3 | | 23 | |
| WILLOW | 0–4 | 6 | | 47 | |

| RIPARIAN VEGETATION IMPACT AREA #8 | | | | | |
|---|---|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT SAMPLE AREA | | RIPARIAN VEGETATION IMPACT AREA | |
| | | 3,995 SF | 0.091 AC | 18,310 SF | 0.420 AC |
| SPECIES | DIAMETER (IN.) | NUMBER WITHIN SAMPLE AREA | | ESTMATED NUMBER WITHIN IMPACT AREA | |
| BAY | 0–2 | 3 | | 14 | |
| BIG LEAF MAPLE | 0–2 | 2 | | 9 | |
| MADRONE | 0–2 | 3 | | 14 | |
| MADRONE | 2–4 | 2 | | 9 | |
| TOYONE | 0–2 | 1 | | 5 | |
| WILLOW | 0–4 | 9 | | 41 | |

| RIPARIAN VEGETATION IMPACT AREA #9 | | | | | |
|---|---|---|---|---|---|
| | | RIPARIAN VEGETATION IMPACT SAMPLE AREA | | RIPARIAN VEGETATION IMPACT AREA | |
| | | 5,945 SF | 0.136 AC | 18,775 SF | 0.431 AC |
| SPECIES | DIAMETER (IN.) | NUMBER WITHIN SAMPLE AREA | | ESTMATED NUMBER WITHIN IMPACT AREA | |
| WILLOW | 0–4 | 24 | | 76 | |
| WILLOW | 4–8 | 9 | | 28 | |

## RIPARIAN VEGETATION AREA LEGEND

- RIPARIAN VEGETATION IMPACT AREA #7
- RIPARIAN VEGETATION IMPACT SAMPLE AREA #7
- RIPARIAN VEGETATION IMPACT AREA #8
- RIPARIAN VEGETATION IMPACT SAMPLE AREA #8
- RIPARIAN VEGETATION IMPACT AREA #9
- RIPARIAN VEGETATION IMPACT SAMPLE AREA #9

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BAR IS ONE INCH
ON ORIGINAL DRAWING
ADJUST SCALES FOR REDUCED PLOTS
0 1"

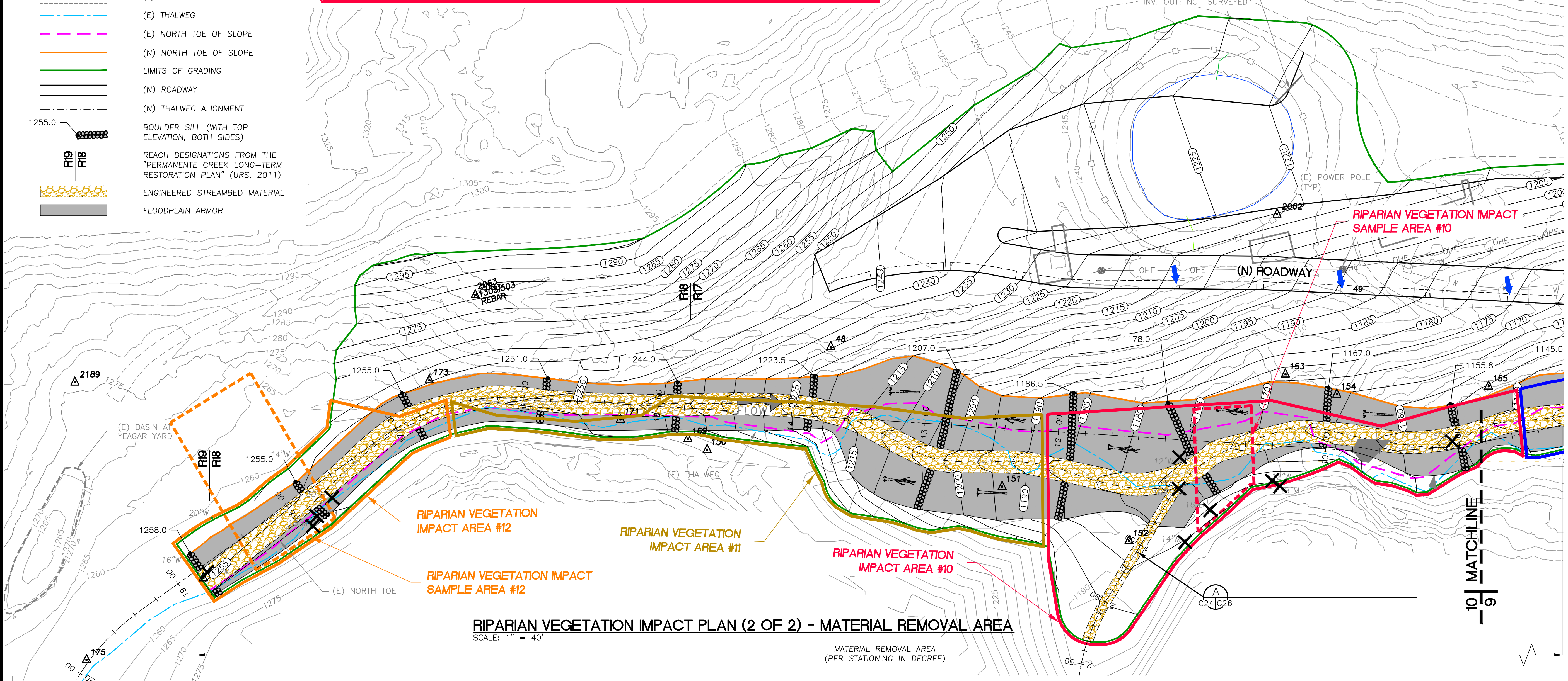
FIGURE
9

## LEGEND

| | |
|---|---|
| 1250 1245 | (E) CONTOURS |
| 1250 1245 | (N) CONTOURS |
| △165 | SURVEY CONTROL POINT |
| ● 8"A | (E) TREE |
| ✕ | (E) TREE TO BE REMOVED |
| | (E) ROADWAY |
| | (E) THALWEG |
| | (E) NORTH TOE OF SLOPE |
| | (N) NORTH TOE OF SLOPE |
| | LIMITS OF GRADING |
| | (N) ROADWAY |
| | (N) THALWEG ALIGNMENT |
| 1255.0 | BOULDER SILL (WITH TOP ELEVATION, BOTH SIDES) |
| R19 \| R18 | REACH DESIGNATIONS FROM THE "PERMANENTE CREEK LONG–TERM RESTORATION PLAN" (URS, 2011) |
| | ENGINEERED STREAMBED MATERIAL |
| ▨ | FLOODPLAIN ARMOR |

RIPARIAN VEGETATION IMPACT AREA #10

| | | RIPARIAN VEGETATION IMPACT SAMPLE AREA | | RIPARIAN VEGETATION IMPACT AREA | |
|---|---|---|---|---|---|
| | | 3,260 SF | 0.075 AC | 30,110 SF | 0.691 AC |
| SPECIES | DIAMETER (IN.) | NUMBER WITHIN SAMPLE AREA | | ESTMATED NUMBER WITHIN IMPACT AREA | |
| BAY | 0–2 | 1 | | 9 | |
| BAY SAPLING | <1 | 1 | | 9 | |
| BIG LEAF MAPLE | 0–2 | 1 | | 9 | |
| WILLOW | 0–4 | 8 | | 74 | |
| WILLOW | 4–8 | 2 | | 18 | |



### RIPARIAN VEGETATION IMPACT PLAN (2 OF 2) – MATERIAL REMOVAL AREA

SCALE: 1" = 40'

### RIPARIAN VEGETATION AREA LEGEND

| | |
|---|---|
| 🟥 | RIPARIAN VEGETATION IMPACT AREA #10 |
| ⬚ | RIPARIAN VEGETATION IMPACT SAMPLE AREA #10 |
| 🟨 | RIPARIAN VEGETATION IMPACT AREA #11 |
| ⬚ | RIPARIAN VEGETATION IMPACT SAMPLE AREA #11 |
| 🟧 | RIPARIAN VEGETATION IMPACT AREA #12 |
| ⬚ | RIPARIAN VEGETATION IMPACT SAMPLE AREA #12 |

RIPARIAN VEGETATION IMPACT AREA #11

| | | RIPARIAN VEGETATION IMPACT AREA | |
|---|---|---|---|
| SPECIES | DIAMETER (IN.) | 19425 SF | 0.446 AC |
| BAY | 0–2 | 2 | |
| CEANOTHUS | 0–2 | 2 | |
| MADRONE | 0–2 | 2 | |
| TOYON | 0–2 | 2 | |
| WILLOW | 0–4 | 25 | |

RIPARIAN VEGETATION IMPACT AREA #12

| | | RIPARIAN VEGETATION IMPACT SAMPLE AREA | | RIPARIAN VEGETATION IMPACT AREA | |
|---|---|---|---|---|---|
| | | 8,955 SF | 0.205 AC | 10,735 SF | 0.246 AC |
| SPECIES | DIAMETER (IN.) | NUMBER WITHIN SAMPLE AREA | | ESTMATED NUMBER WITHIN IMPACT AREA | |
| BIG LEAF MAPLE | <1 | 23 | | 28 | |
| BIG LEAF MAPLE | 0–2 | 9 | | 11 | |
| BIG LEAF MAPLE | 4–6 | 1 | | 1 | |
| MADRONE | 0–2 | 4 | | 5 | |
| MADRONE | 2–4 | 14 | | 17 | |
| MADRONE | 4–6 | 2 | | 2 | |
| TOYONE | 0–2 | 2 | | 2 | |
| WILLOW | 0–4 | 3 | | 4 | |
| WILLOW | 4–8 | 5 | | 6 | |
| WILLOW | 8–12 | 7 | | 8 | |

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FIGURE
10