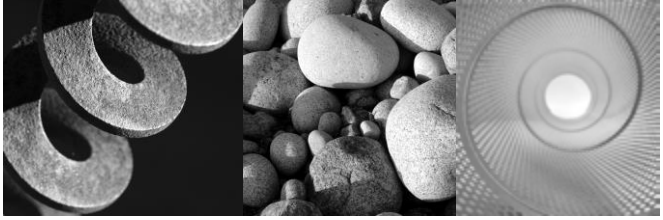


FINAL

GEI Consultants

Geotechnical
Water Resources
Environmental and
Ecological Services

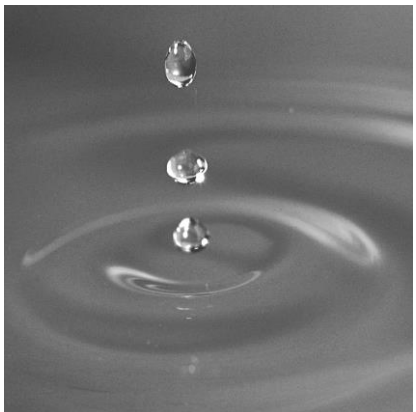
Calero Dam Seismic Retrofit Project

Planning Study Report

Submitted to:
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118-3686

Submitted by:
GEI Consultants, Inc.
180 Grand Ave, Suite 1410
Oakland, CA 94612

April 2015
Project 132838-0



CALERO DAM SEISMIC RETROFIT PROJECT

PROJECT NO. 91084020

PLANNING STUDY REPORT

I have reviewed and concur with the alternatives analysis and recommendation presented in this Planning Study Report for the Calero Dam Seismic Retrofit Project and recommend proceeding with design to implement the project as recommended.

Katherine Oven 5/19/2015

Katherine Oven, P.E. Date
Deputy Operating Officer
Water Utility Capital Division

I have reviewed and approve the alternatives analysis and recommendations presented in this Planning Study Report for the Calero Dam Seismic Retrofit Project and approve proceeding with design to implement the project as recommended.

F. Mo 6/9/2015

Frank Maitski, P.E. Date
Deputy Operating Officer
Water Utility Technical Support Division

CALERO DAM SEISMIC RETROFIT PROJECT
PROJECT NO. 91084020

PLANNING STUDY REPORT

Prepared By:
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Katherine Oven, P.E.
Deputy Operating Officer

Frank Maitski, P.E.
Deputy Operating Officer

Jim Fiedler
Chief Operating Officer

Beau Goldie
Chief Executive Officer

The Planning Study Report has been prepared by the undersigned, who hereby certifies that he is a Registered Civil Engineer in the State of California

April 2015

DISTRICT BOARD OF DIRECTORS

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Linda LeZotte	**District 4**		

Table of Contents

List of Tables (in text)

List of Figures (in text)

List of Appendices

Acronyms and Abbreviations

AACE	American Association of Cost Engineers
ADAS	automated data acquisition system
AF	acre-feet
AQ	Almaden Quicksilver
AVP	Almaden Valley Pipeline
cfs	cubic feet per second
CDFW	California Department of Fish and Wildlife
CEO	Chief Executive Officer
CEQA	California Environmental Quality Act
CLFE	Calero local fault event
CMP	corrugated metal pipe
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRHR	California Register of Historical Resources
CRPR	California Rare Plant Rank
CSC	County of Santa Clara
CSFE	Calero San Andreas fault event
CY	cubic yards
DSM	deep soil mixing
DSOD	California Division of Safety of Dams
DSP	Dam Safety Program
DTSC	Department of Toxic Substances Control
EIR	Environmental Impact Reports
ESA	Environmental Site Assessment
FE	Federally Endangered
FP	Fully Protected
FT	Federally Threatened
HCP	Habitat Conservation Plan
HMR	Hydrometeorological Report
LEDPA	Least Environmentally Damaging Project Alternative
MCE	Maximum Credible Earthquake
MMRP	Mitigation Monitoring and Reporting Plan
M_W	Moment Magnitude
NEPA	National Environmental Protection Act
NMFS	National Marine Fisheries Service
NAHC	Native American Heritage Commission
NAVD88	North American Vertical Datum of 1988
NGS	National Geodetic Survey
NGVD29	National Geodetic Vertical Datum of 1929
NRHR	National Register of Historic Places
NTP	Notice to Proceed
OPAU	Water Operations and Planning Unit

Acronyms and Abbreviations (continued)

PDR	Problem Definition Report
PFMA	Probable Failure Mode Analysis
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
Project	Calero and Guadalupe Dams Seismic Retrofits Project
PSR	Planning Study Report
QEMS	Quality and Environmental Management System
QMS	Quality Management System
RCP	Reinforced Concrete Pipe
ROV	Remotely Operated Vehicle
ROW	Right-of-way
RWQCB	Regional Water Quality Control Board
RWTP	Rinconada Water Treatment Plant
SCCPRD	Santa Clara County Parks and Recreation District
SCVWD (District)	Santa Clara Valley Water District
SFPUC	San Francisco Public Utilities Commission
SRA	Staff Recommended Alternative
SSC	Species of Special Concern
SSE	Seismic Stability Evaluation
SE	State Endangered
ST	State Threatened
STID	Supporting Technical Information Document
SVOC	semi volatile organic compound
TM	Technical Memorandum
TDR	Transition to Design Report
UT	Ultrasonic Thickness
USACE	United States Army Corp of Engineers
USFWS	United States Fish and Wildlife Service
VHP	Valley Habitat Plan
VWP	Vibrating Wire Piezometers

Executive Summary

The Calero Dam facilities are located in Santa Clara County about 12 miles southeast of downtown San Jose. The facilities include the Calero Main Dam with an ancillary spillway and outlet works, the Calero Auxiliary Dam, and the Fellows Dike. The embankments impound Calero Reservoir with a capacity of 9,934 acre-feet at full storage (Elevation 486.8 feet NAVD88). Construction of the facilities occurred in the mid 1930's with completion in 1935.

Calero Main Dam is located about 0.3 miles off McKean Road and across Calero Creek. Calero Auxiliary Dam is located on a topographic saddle approximately 0.7 miles to the northeast of the Main Dam and adjacent to McKean Road. Fellows Dike is located about 1.5 miles east of the Main Dam.

Calero Main Dam is a 90-foot-high, 840-foot-long rolled earth embankment and the Calero Auxiliary Dam is a 40-foot-high, 510-foot-long rolled earth embankment. Fellows Dike is an earth embankment at the upstream end of Calero Reservoir that was constructed concurrently with the main and auxiliary dams to protect the Bailey Fellows Ranch complex from inundation by reservoir water. The dike is approximately 2,000-feet-long, and wraps the Bailey Fellows Ranch complex in a general "U" shape and ranges from zero to 12 feet high. Additional pertinent data for Calero Main Dam and Auxiliary Dam are provided in **Appendix A.**

A seismic stability evaluation of the Calero dams completed in 2012 (URS, 2012a), indicated inadequate seismic stability of the Calero Main Dam from postulated design earthquake events. The Calero Auxiliary Dam seismic stability was determined not to be an issue. As a result, Calero Reservoir is currently subject to operational restrictions imposed by the California Division of Safety of Dams (DSOD) due to seismic stability concerns with the main dam, and the inadequacy of Fellows Dike at the upstream end of the reservoir. Calero Reservoir is restricted to elevation 467.4 feet, approximately 19 feet below spillway level which limits storage to approximately 4,585 acre-feet or 46 percent of the normal 9,934 acre-foot storage capacity. Retrofit of the 80-year-old Calero Dam and associated facilities is necessary to address seismic safety concerns and other identified dam issues; to meet current regulatory requirements; to satisfy District operational requirements; and to remove the reservoir operating restriction and restore normal water supply capacity.

The seismic safety concerns and potential embankment retrofit options were identified in prior Seismic Stability Evaluations (SSE1B) (URS, 2012a, 2012c). These reports provided the initial basis for the planning study documented herein.

The planning study included additional investigations and analyses to further define the dam safety and operational deficiencies at Calero Dam that were summarized in the Calero Dam Problem Definition Report (GEI, 2014b). The investigations and analyses included flood studies (probable maximum precipitation/probable maximum flood; PMP/PMF), underwater outlet works inspections and condition assessments, and geotechnical and geologic explorations to further define the dam safety issues. The Calero Dam Problem Definition Report provides documentation of the existing conditions; identifies the problems and issues affecting the dam and appurtenant facilities; identifies constraints and options for

remediation of the issues; and documents the District's Project Requirements. The Project Requirements are also included in this report in **Appendix B.**

Based on the evaluations documented in the SSE1B Report (URS, 2012a) and the Problem Definition Report (GEI, 2014b), the following deficiencies have been identified at Calero Dam:

1) Seismic stability: the main dam embankment will experience excessive and unacceptable deformations under the maximum credible earthquake. Consequently, the California Division of Safety of Dams (DSOD) accepted reservoir operating restrictions that limit the storage at Calero to approximately 46% of its design capacity.
2) PMF passage: an updated PMP/PMF study identified that the PMF (HMR 59) exceeds the existing spillway capacity and will potentially overtop the Main Dam and Auxiliary Dam during this maximum flood event.
3) Outlet works capacity and condition: the existing low-level outlet works provides only marginal capacity for emergency drawdown in accordance with DSOD guidelines and its current condition will not provide 50-years of service without modifications, nor provide hydraulic capacity for a potential 30-foot crest raise and reservoir capacity increase.
4) Seepage: although not considered a significant dam safety problem, seepage through the main dam embankment and right abutment occurs as the reservoir level increases above key elevations, and;
5) Fellow Dike inadequacies: the dike is in poor physical condition and not stable under seismic loading.

The Project also considered the potential enlargement of Calero Reservoir in the future. The main dam stabilization, PMF passage, and outlet retrofit options must accommodate, or avoid precluding to the extent practical, a raise of the main and auxiliary dams by up to 30 feet without major removal/reconstruction of the planned work.

The planning process, including alternatives formulation, evaluation and screening was documented in the Calero Dam Alternatives Report (GEI, 2015a). Fifteen (15) conceptual alternatives to remediate the dam and mitigate the identified dam safety deficiencies were developed, and evaluated leading to five feasible alternatives. The five feasible alternatives were further refined and evaluated to identify the Staff-Recommended Alternative.

The Staff-Recommended Alternative includes the following:

- Partially removing the downstream embankment of the main dam to remove liquefiable alluvium below the downstream shell;
- Stabilizing the downstream portion of the dam with a buttress and installing an internal filter and drain system;
- Raising the crests of the main dam and the auxiliary dam up to 7 feet to pass the updated probable maximum flood (PMF) with adequate freeboard;
- Adding a new multi-level sloping intake on the left abutment;
- Adding a new outlet tunnel with carrier pipe below the left abutment that connects to the existing Almaden Valley Pipeline;

- Abandoning the existing outlet works by removing and/or backfilling/sealing the existing conduit;
- Replacing the existing spillway weir with a new ogee crest;
- Removing/relocating the Bailey Ranch structures behind Fellows Dike; and
- Breaching of Fellows Dike.

The Staff-Recommended Alternative is presented in the drawings included in **Appendix C.**

In conjunction with the planning study, evaluations of borrow and spoil disposal requirements are being completed. The evaluation concluded that soil and rock for the buttress could be obtained from on-site sources through the development of a borrow site on the north rim of the reservoir. Filter and drain material would be imported from off-site commercial sources.

The implementation of the Staff-Recommended Alternative will not only remove the DSOD storage restrictions allowing full operational use of the reservoir, but also improve reliability and extend the service life of the Calero Dam facilities for another 50 to 100 years.

For planning purposes, it was concluded that Calero Reservoir would be fully lowered (drained) to facilitate retrofit construction, with the reservoir lowered for approximately two years. The total estimated construction duration is approximately 2-1/2 to 3 years.

The estimated project cost is approximately $70 million in 2015 dollars. This cost estimate is an Association for Advancement of Cost Engineering (AACE) Classification Class 3 cost estimate, which is assumed to represent the actual total installed cost within the range of -20 percent to +30 percent of the cost indicated. The cost estimate does not include District administrative and legal costs, right of way costs, replacement water supply, planning/environmental studies and permitting, habitat restoration and mitigation, and removal or demolition of historical structures.

The estimated schedule for the project is as follows:

- Completion of design – March 2017
- Completion of California Environmental Quality Act (CEQA) studies – Dec 2016
- Acquisition of Permits – February 2018
- Start of Construction – March 2018
- End of Construction – October 2020

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1.0 Introduction and Project Background

1.1 Project Overview

A seismic stability evaluation of Calero Dams completed in 2012 (URS, 2012a), determined that significant deformation of the Calero Main Dam could occur from postulated design earthquake events. Deformations of the crest were estimated to be up to 27 feet horizontal and 6 feet vertical under the anticipated Maximum Credible Earthquake (MCE) of M_W 6.7 on the local Shannon fault (1.7 km away). Deformations of the crest were estimated to be up to 18 feet horizontal and 5 feet vertical for a MCE of M_W 7.9 on the San Andreas fault (approximately 13 km away). The deformations estimated at Calero Auxiliary Dam were less than 1.5 feet and were not expected to compromise the integrity of the auxiliary dam.

Based on the findings, Calero Reservoir was and remains restricted to elevation 467.4 feet, approximately 19 feet below spillway level that limits storage to approximately 4,585 acre-feet or 46 percent of the normal 9,934 acre-foot storage volume. The restriction was approved by the California Division of Safety of Dams (DSOD) (DSOD, 2012; URS, 2012b). Lesser restrictions had been in place since 2006 due to concerns on the adequacy of Fellows Dike at the upstream end of the reservoir. These interim risk reduction measures will remain in place until the seismic deficiencies are remediated.

Retrofit of the 80-year-old Calero Dam and associated facilities is necessary to address seismic safety concerns and identified dam safety issues; to meet current DSOD regulatory requirements; to satisfy District operational requirements; and to remove the reservoir operating restriction. Implementation of the Staff-Recommended Alternative to address these problems will not only remove the DSOD storage restrictions allowing full operational use of the reservoir, but also improve reliability and extend the service life of the facilities for another 50 to 100 years.

1.2 Project Objectives

The District's objectives for the Project are to make improvements necessary to:

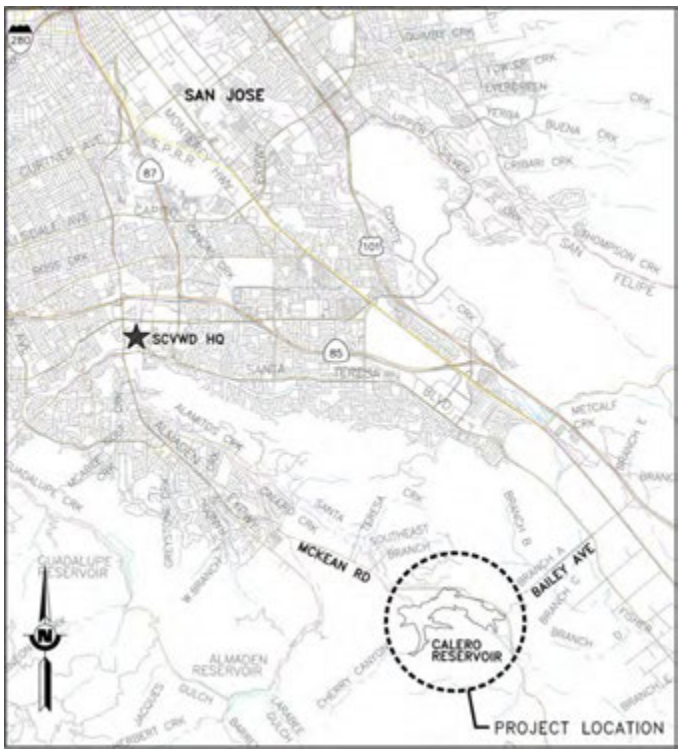
1) Stabilize the Calero Dam embankments for the Maximum Credible Earthquake;
2) Modify or replace the outlet works if determined to be inadequate;
3) Modify the spillway or increase the freeboard of the Calero dams for safe passage of the Probable Maximum Flood (PMF);
4) Provide modifications that do not preclude potential future expansion of Calero Dam and reservoir to provide additional reservoir storage;
5) Remove or relocate the Bailey Ranch structures and breach Fellow's Dike, and;
6) Incorporate other measures to address seismic and other deficiencies that are identified through the Project planning process.

The District also developed project requirements for addressing issues associated with the planning and design of the Calero Dam Retrofit. The project requirements are provided in **Appendix B** for reference.

1.3 Calero Facilities Location and Overview

The Calero Dam and Reservoir are located in south Santa Clara County, approximately 6.3 miles southeast of the District headquarters on Almaden Expressway, and approximately 5 miles west of US 101 as shown in **Figure 1-1.** The District uses Calero Reservoir to store natural watershed runoff, replenish downstream wells by ground water recharge, provide flood control, and provide recreation and environmental flows. Controlled releases from Calero Reservoir provide water to recharge the groundwater basin and raw water for treatment at the District's Rinconada or Santa Teresa water treatment plants. Storage in Calero Reservoir also serves as the emergency backup to the District's imported water supplies.

Figure 1-1: Project Vicinity Map



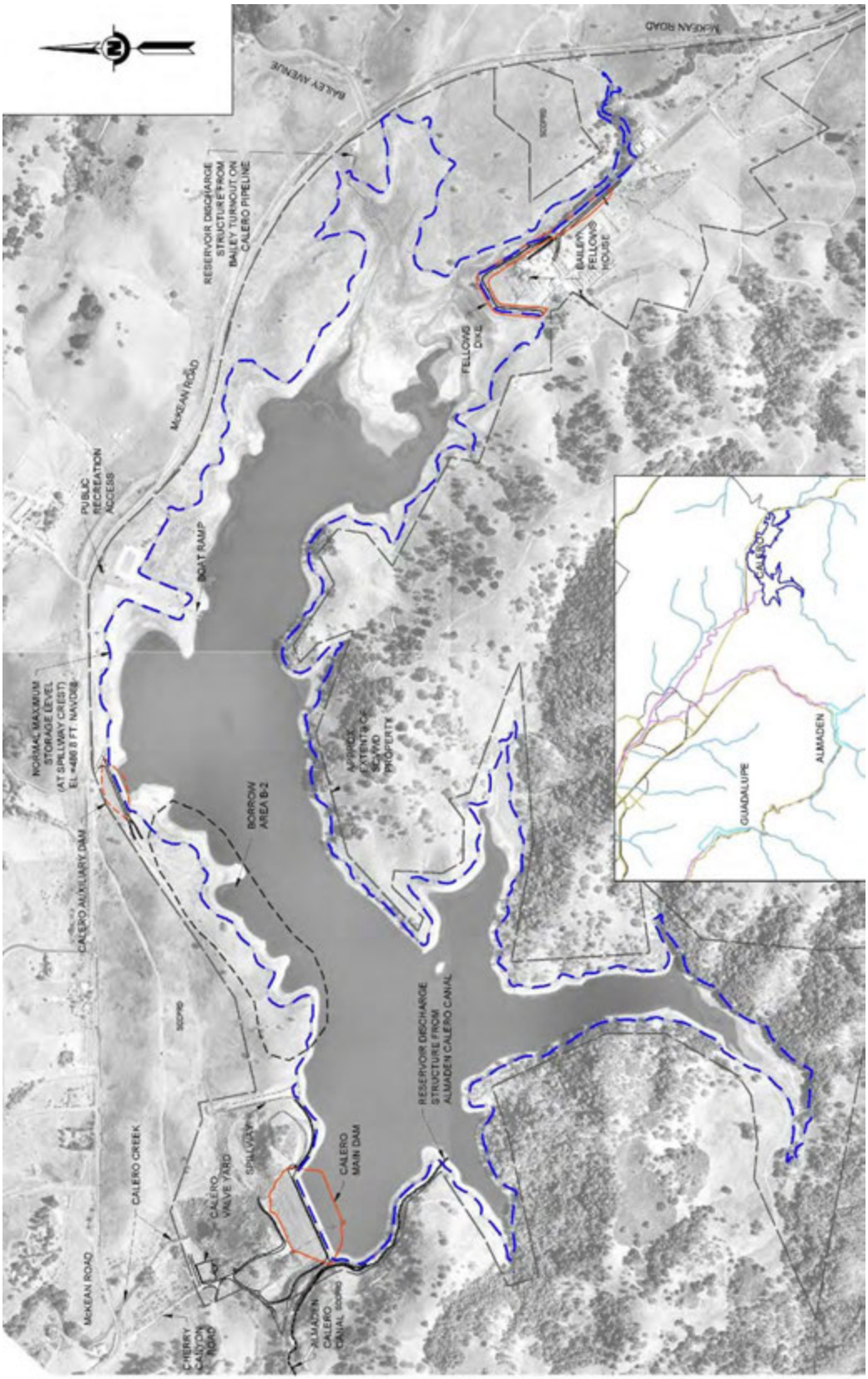
Typically, the reservoir is filled during the winter and early spring and drawn down from late spring to early fall. The reservoir is filled with local watershed runoff, transfers from Almaden Reservoir via the Almaden-Calero Canal, and imported water from the federal Central Valley Project via the Calero Pipeline at the Bailey Turnout or through bidirectional pumping through the outlet conduit.

Calero Reservoir is impounded by three embankments: the Calero Main Dam across Calero Creek; the Calero Auxiliary Dam; and Fellows Dike as shown in **Figure 1-2**. Access to Calero Dam is from McKean Road, a county road that skirts the northern and eastern perimeter of Calero Reservoir. A gravel single-lane road referred to as Cherry Canyon Road extends south from McKean Road near the overcrossing of Calero Creek, south approximately 0.3 miles to the toe of Calero Dam. The access road is gated at McKean Road.

Calero Auxiliary Dam is approximately 0.7 miles east of the Calero Main dam adjacent to McKean Road. Record drawings indicate that McKean Road was relocated to higher ground during construction of the Calero Auxiliary Dam. The auxiliary dam can be accessed via a locked gate at McKean Road or from a gravel roadway extending west from the Santa Clara County Parks boat launch area near McKean Road and Fortini Road.

Fellows Dike is approximately 1.4 miles southeast of the Calero Main dam. Access to the Fellows Dike area is via an unnamed, paved roadway extending from McKean Road (across from the Cinnabar Hills Golf Club) northwest approximately 0.6 miles.

Figure 1-2: Calero Site Plan



1.4 Calero Facilities Description

1.4.1 Embankments

Calero Main Dam is a 90-foot-high, 840-foot-long rolled earth embankment and the Calero Auxiliary Dam is a 40-foot-high, 510-foot-long rolled earth embankment. Fellows Dike is an earth embankment at the upstream end of Calero Reservoir that was constructed at the time of the Calero Dam construction to protect the Bailey Fellows Ranch complex from inundation by reservoir water. The dike is approximately 2,000 feet long, and wraps the Bailey Fellows Ranch complex in a general "U" shape. The dike heights range from zero feet at its south end where it transitions into the natural topography to a maximum height of about 12 feet at its north end. The embankments impound Calero Reservoir with a capacity of approximately 10,000 acre-feet at full storage (Elevation 486.7 feet NAVD88).

Construction of the Calero facilities occurred in the mid 1930's with completion in 1935. Calero Dam has a Total Class Weight of 30 and falls in the "High Consequence" category according to the DSOD Consequence-Hazard Matrix for seismic hazard analysis (DSOD, 2002). Additional pertinent data for Calero Main Dam and Auxiliary Dam are provided in **Appendix A.**

1.4.2 Spillway

The Calero Reservoir spillway is located in a natural saddle 880 feet east of the Main Dam, and consists of a concrete overflow weir and concrete-lined chute with downstream unlined plunge pool. The weir crest is 84.4 feet long and was originally constructed in 1935 as a concrete ogee at elevation 485.4 feet NAVD88 (484.0 NGVD29); however it was raised in 1962 to elevation 486.8 feet NAVD88 (482.6 NGVD29).

The concrete-lined spillway chute is 640 feet long, 20 feet wide, and has side slopes of 1H:1V. The concrete-lined spillway chute directs spills north into an excavated, unlined open area, approximately 100 feet long, where the flow is redirected about 90 degrees west into a gully then back toward Calero Creek.

The reservoir level had significant fluctuations in years prior to 1988 (URS 2012b) with numerous spills. The last reported spill was in 1989. Since 2006 when the operating restriction was implemented due to the Fellows Dike inadequacies, (restriction to elevation 480.4 feet NAVD88), the spillway has not spilled.

1.4.3 Outlet Works

The original Calero Dam outlet works, constructed in 1935, consisted of a concrete intake structure and a straight, 481-foot-long, 36-inch-diameter, concrete-encased steel pipe under the Main dam which discharged to a stilling basin at Calero Creek, located at the downstream left toe of the dam. Flow control was provided at both the inlet structure (hydraulically actuated, 42-inch slide guard gate) with the hydraulic controls on the dam crest, and at the discharge structure (electrically actuated 30-inch butterfly valve).

In 1982 the outlet works were modified as part of the Almaden Valley Pipeline Project, and the existing outlet was connected directly to the Almaden Valley Pipeline with a turnout extending to Calero Creek. At that time, a modified trash rack was constructed for the inlet structure. The modifications included extending the outlet pipe from the original 30-inch

butterfly valve with a 48-inch-diameter pipe that connects to the District's raw water transmission system at the Calero valve yard, situated approximately 700 feet downstream from the toe of the dam, and filling a limited length of Calero Creek. A new stream release facility was also constructed approximately 650 feet downstream of the original outlet adjacent to the valve yard, consisting of an impact-type stilling basin. In total, the outlet works from the inlet structure to the creek outlet currently consists of approximately 481 feet of 36-inch-diameter steel pipe (circa 1935) and approximately 787 feet of 48-inch-diameter steel pipe (circa 1982).

In 1989, the Calero Pipeline was constructed and tied into the Almaden Valley Pipeline at the Calero valve yard. The Calero Pipeline project included construction of the Bailey Turnout structure (near Bailey Road and McKean Road) allowing water from Calero Pipeline to discharge into Calero Reservoir. With the Calero Pipeline, Calero Reservoir is able to receive imported water from the federal Central Valley Project via the Bailey Turnout or by pumping water back into the Calero Reservoir through the outlet conduit.

1.5 Project Studies

This Calero Dam Planning Study Report builds upon numerous previous studies performed for the Calero facilities including problem definition studies, alternatives evaluations, stability analyses, and borrow studies. Key studies are listed in Section 6, References.

1.6 Datum and Topographic Information

The District and future designers will prepare the design documents for the Project using elevations based on NAVD88. Unless noted, elevations listed in this report are shown as NAVD88 and as appropriate, the NGVD29 elevation in parenthesis. Many existing reports refer to elevations in NGVD29. DSOD correspondence and the District's ALERT system use NGVD29 elevations. The National Geodetic Survey (NGS) datum conversion indicates NAVD88 is 2.8 feet higher in elevation than NGVD29 at the location of Calero Dam.

1.7 Report Organization

The Planning Study Report is organized into the following sections:

- **Section 1** provides an introduction to the purpose, scope, and organization of this Planning Study Report. It also provides an overview and location of the Calero Facilities.
- **Section 2** provides a summary of the project's problem definition as the basis for the development and evaluation of project alternatives.
- **Section 3** describes the alternatives analysis planning process, including the Conceptual-level Alternatives Evaluation for 15 conceptual alternatives, Feasibility-level Alternatives Evaluation for 5 feasible alternatives, and identifies the Staff-Recommended Alternative.
- **Section 4** introduces and describes the recommended project, including the preliminary design of embankment, outlet works, and spillway components. It also discusses the breach of Fellows Dike, real estate needs for the Project, environmental considerations, and issues to be considered for final design.

- **Section 5** presents preliminary construction cost estimates and schedule based on the preliminary design of the Staff-Recommended Alternative.
- **Section 6** lists references utilized in preparing this Planning Study Report.
- **Appendix A** is a table of pertinent data for Calero Main Dam and Calero Auxiliary Dam.
- **Appendix B** is a table of the District's project requirements for the Calero Dam retrofit.
- **Appendix C** includes the set of drawings describing the Calero Dam Staff-Recommended Alternative.

2.0 Problem Definition

2.1 Overview

For the current planning study, existing data review, field investigations and analyses were performed to define the problems, identify dam safety issues, and develop feasible alternatives to remediate the seismic and other identified dam safety deficiencies. The results of the investigations and analyses were summarized in the Calero Dam Problem Definition Report (GEI, 2014b). The following problems have been identified at Calero Dam:

1. Seismic Stability: The main dam embankment will experience excessive and unacceptable deformations under the MCE. Consequently, DSOD accepted reservoir operating restrictions that limit the storage at Calero to less than 50% of its design capacity.
2. Spillway Capacity: An updated PMF study identified that the PMF (HMR 59) exceeds the existing spillway capacity and will potentially overtop the Main Dam and Auxiliary Dam during this maximum flood event.
3. Outlet Works Capacity and Condition: The existing low-level outlet works provides only marginal capacity for emergency drawdown in accordance with DSOD guidelines, and its current condition will not provide 50 years of additional service without modifications, nor provide the hydraulic capacity for a potential 30-foot crest raise and reservoir capacity increase.
4. Seepage: Although not considered a significant dam safety problem, seepage through the main dam embankment and right abutment occurs as the reservoir level increases above key levels, and;
5. Fellow Dike Inadequacies: The dike is in poor physical condition, susceptible to erosion, and not stable under seismic loading,

A synopsis of the investigations and analyses leading to the identification of these deficiencies is provided below.

2.2 Embankments

The District completed a Seismic Stability Evaluation of the Calero Main Dam and Auxiliary Dam in 2012 (SSE1B) (URS, 2012a) following earlier DSOD studies that indicated seismic concerns for Calero Dam. The analyses included seismic source evaluation, liquefaction evaluation of the embankment and underlying foundation materials (alluvium) and post-earthquake stability and deformation estimates of the embankment under potential seismic ground motions. Two events were identified as the controlling Maximum Credible Earthquakes (MCE); a local M_W 6.7 event on the Shannon fault (designated as the Calero Local Fault Event, (CLFE)) with a closest distance of 1.7 km, and a M_W 7.9 event on the San Andreas fault (designated as the Calero San Andreas Fault Event, (CSFE)) with a closest distance of approximately 13 km. Potential ground motions from these MCE events were used for the seismic stability analyses.

The Calero Main Dam seismic stability analyses indicated that during the controlling MCE events, the downstream slope would become unstable as a result of liquefaction of the underlying alluvial soils in the foundation of the dam causing downstream movement.

Deformations of the crest were estimated to be up to 27 feet horizontal and 6 feet vertical under the CLFE. Deformations of the crest were estimated to be up to 18 feet horizontal and 5 feet vertical for the CSFE. The downstream toe displacements were estimated to be over 30 feet horizontal and 10 feet upward for the CLFE, and over 18 feet horizontal and 8 feet upward for the CSFE. Such large deformations and the expected embankment cracking would compromise the integrity of the dam and are considered unacceptable for dam safety.

The SSE1B work determined that the post-earthquake stability of the upstream slope is acceptable. No remedial measures are necessary for the upstream slope because it is judged that if the downstream slope is stabilized, estimated deformations of the upstream slope under the controlling MCE event are tolerable from a dam safety perspective.

The Calero Auxiliary Dam was also analyzed as part of the SSE1B study (URS, 2012a). The deformations estimated at Calero Auxiliary Dam were less than 1.5 feet and were not expected to compromise the integrity of the auxiliary dam.

2.3 Spillway / PMF Passage

The standard hydraulic requirement for public safety on high-hazard potential dams is to provide spillway capacity capable of passing the probable maximum flood (PMF). When significant changes to the dam are proposed or made (such as a seismic retrofit project), DSOD requires confirmation of the PMF spillway capacity using updated methods. The previous PMF study for Calero Dam was completed in 1981 using Hydrometeorological Report (HMR) 36 whereas current studies use HMR 59. The updated PMF inflow to Calero Reservoir following the HMR 59 protocols produces a maximum still water surface elevation of 493.6 feet NAVD88 (490.8 feet NGVD29), which results in approximately 0.8 feet of potential overtopping over the entire length of both the main and auxiliary dams. DSOD requires passage of the PMF with no less than 1.5 feet of residual freeboard (DSOD, 2012). Under existing conditions, this requirement is not met.

2.4 Outlet Works

The original Calero Dam outlet works, constructed in 1935, consisted of a concrete intake structure and a straight, 481-foot-long, 36-inch-diameter, concrete-encased steel pipe under the Main dam which discharged to a stilling basin at Calero Creek, located at the downstream left toe of the dam. In 1982 the outlet works were modified and connected directly to the Almaden Valley Pipeline with a new turnout extending to Calero Creek, approximately 650 feet downstream of the dam. Key findings from the recent assessment of the Calero outlet works are summarized below:

1. No conditions were observed during the inspections that would require immediate repair for continued operational service over the next few years while the seismic retrofit project is being planned and implemented.
2. The hydraulic capacity of the existing outlet is judged satisfactory to meet DSOD emergency release criteria. Additional capacity would be required under a future 30-foot embankment raise.
3. Visual dive and ROV inspection and limited non-destructive (UT) testing of the conduit interior show the existing outlet conduit is unlined and has experienced

moderate to severe corrosion over the last 79 years that has reduced the computed hydraulic capacity and is causing significant wall thinning of the steel outlet pipe and appurtenances. No out-of-round deformation or other visual structural distress was observed during the inspections. Two small pinhole leaks near the upstream intake may be indicative of exterior corrosion that could have resulted from cracking of the exterior concrete encasement.

4. Inlet and outlet control facilities, while currently serviceable, will require full replacement if the existing outlet conduit is rehabilitated or replaced.

2.5 Calero Main Dam Seepage

Seepage has occurred at Calero Main Dam since shortly after construction and first reservoir filling in 1937 (Nelson, 2007). Seepage has been observed on the downstream right abutment, the downstream right groin, and the downstream face of the dam when the reservoir level is high. Remedial measures to reduce the seepage, including multiple grouting programs have been attempted with little success.

2.6 Fellows Dike

A geotechnical investigation conducted on Fellows Dike in 2001 (GEI, 2001) found that the dike would require extensive improvement to bring the facility up to DSOD minimum standards before it could be certified to impound water. Specifically, dike rehabilitation was required for the following reasons:

1. Potentially Liquefiable Soils: The dike foundation adjacent to Calero Creek contains several pockets of potentially liquefiable soils that may liquefy under heavy earthquake shaking.
2. Slope Erosion and Stability: The dike's water-side slope facing the reservoir and the creek has severely eroded in many areas presumably due to wave action and creek flows. Several areas of dike's side slopes are steeper than 2 horizontal to 1 vertical (2.0H:1.0V) and do not meet current safety standard.
3. Vegetation: The dike is covered with dense vegetation consisting of brush, shrubs, and mature trees preventing proper inspection and maintenance.

2.7 Potential Changes to Project Objectives

New investigations as documented in the Problem Definition Report (GEI, 2014a) confirmed the adequacy of project objectives. No changes to the project objectives were recommended in the report.

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3.0 Alternatives Analysis

3.1 Overview

Based on the issues identified and documented in the Problem Definition Report, and District and DSOD requirements, the seismic retrofit of Calero Dam included development and evaluation of alternatives for the following three primary project components:

1) Embankment seismic stabilization;
2) Safe passage of the PMF, and;
3) Outlet works replacement.

Each of these three primary components could be achieved with multiple options which in turn are strongly influenced by the water level in the reservoir during construction. In addition to these primary components, the project also includes consideration of improvements for handling the seepage at the main dam, and mitigation of the Fellows Dike safety issues.

The District requirements include the potential for a future Calero Reservoir enlargement with a raise of the main dam by up to 30 feet. For such an enlargement, it is noted that the auxiliary dam will require modification and new saddle dams constructed. The main dam stabilization, PMF passage and outlet works replacement options should accommodate, or avoid precluding, a potential future enlargement without major removal/reconstruction of the planned work.

Additional discussion of the technical considerations for formulation of the components and alternatives is presented in the Alternatives Report (GEI, 2015a).

3.2 Conceptual Alternatives Formulation

3.2.1 Primary Project Component Options

The options for the embankment seismic stabilization component were combined with required PMF passage and outlet works replacement components into overall project conceptual alternatives for conceptual-level screening. The following options (for each component) were considered in the initial formulation of alternatives.

Embankment stabilization - As identified in the SSE1B report (URS 2012b) the options for seismic stabilization of the main dam included the following:

1) Remove and replace downstream foundation and embankment.
2) Partial downstream foundation and embankment removal and full height buttress.
3) Partial height downstream rockfill buttress.
4) Insitu embankment and foundation treatment with Deep Soil Mixing (DSM).
5) Insitu foundation treatment with jet grout and downstream berm.

Safe PMF passage of the PMF with adequate freeboard – The options included the following:

1) Raising main and auxiliary dam by 7 feet to provide adequate containment and sufficient freeboard without modifying the spillway crest.

2) Raising main and auxiliary dam by 5 feet and widening the spillway crest to approximately 127 feet (150% of current width).
3) Lower the spillway crest by approximately 7 feet to provide adequate flood containment, and install an operable spillway crest gate that would be seasonally operated to maintain existing storage.

Outlet works modifications - Based on the outlet works condition assessment and the need to modify Calero Main Dam for seismic stability, the outlet works improvement alternatives judged most practical included a new replacement outlet works and abandonment of the existing outlet works. The replacement outlet works were configured to accommodate the planned seismic retrofit and current District operational and maintenance requirements, and the potential for a future enlargement of Calero Reservoir. The new replacement outlet works facilities should be located outside the footprint of the modified dam embankment, and incorporate appropriate air venting, man-ways and other operational improvements (e.g. multi-level intake, alternate actuators) deemed necessary by the District for improved reliability, operations and maintenance.

The options included three outlet works locations and alignments including:

1) A new tunneled outlet through the right abutment.
2) A new tunneled outlet through the left abutment.
3) A new tunneled outlet through the right ridge near spillway.

The two intake structure types including:

1) A sloping intake situated on the reservoir slope.
2) A vertical shaft situated on the rim of the reservoir with horizontal micro-tunneled intakes allowing construction into an active reservoir (i.e. wet-tap).

3.2.2 Reservoir Drawdown Considerations

Three reservoir drawdown levels during construction are summarized as follows:

1) Limited Drawdown – Temporary construction water level maintained no higher than the current DSOD restricted elevation (467.4 feet NAVD88), for a construction water depth of approximately 71 feet above the intake (invert elevation 395.7 feet NAVD88).
2) Major Drawdown – Temporary construction water level maintained no higher than elevation 440 feet NAVD88, for a construction water depth of approximately 44 feet above the intake invert. This provides up to approximately 1,000 acre-feet of water storage. (~10% of capacity and the minimum fish pool specified in the District's Board Policy. A tall cofferdam (e.g. cellular sheet pile) is likely feasible for marine construction which would allow a sloping intake and outlet tunnel to be constructed "in the dry". A micro-tunneled wet tap into an active reservoir may also be feasible without a cofferdam.
3) Full Drawdown – Temporary construction water level maintained no higher than elevation 410 feet NAVD88, for a construction water depth of approximately 14 feet above the intake invert. This provides no water storage in the reservoir during construction. A short cofferdam (e.g. earth or braced sheet pile) would be required for temporary diversion to provide limited protection of the sloping intake and outlet tunnel construction. The sloping intake and outlet tunnel would be constructed in the dry, using conventional methods.

3.2.3 Other Required Components

Calero Dam seepage improvements - The 2011 Potential Failure Mode Analysis (PFMA) Workshop, did not identify seepage as a postulated potential failure mode (Geosyntec, 2012a) for Calero Main Dam. It was recommended that an improved seepage collection and monitoring system be installed. Preliminary design considerations for an improved seepage collection and monitoring system are included in the Staff-Recommended Alternatives.

Fellows Dike rehabilitation The District's staff-recommended project (SCVWD, 2010) is to breach the dike, and remove the dike from DSOD jurisdiction. Prior to breaching the dike, the Bailey Ranch historic structures would be removed.

3.2.4 Conceptual Alternatives Considered

The initial formulation of alternatives resulted in over 100 possible pre-conceptual component combinations that could be considered. To focus on a realistic subset of conceptual alternatives (approximately 15), pre-conceptual screening was completed through consideration of the component feasibility given expected project needs and constraints, and also the compatibility/feasibility of one component with another component, or with the assumed amount of temporary reservoir drawdown during construction.

Key conclusions from the pre-conceptual screening included:

1) Limited temporary reservoir drawdown during construction (maintaining the reservoir at the DSOD restricted level of elevation 467.4 feet) is infeasible as a significant cofferdam (over 80 feet high) would be required if the preferred sloping intake is to be considered, and any excavation of the dam foundation and toe necessary for a number of the embankment stabilization options would not be possible due to assurance of dam safety risks during construction.
2) Major temporary reservoir drawdown during construction is possible (elevation 440 feet or lower), but with tradeoffs on the type of intake constructed.
3) Full temporary reservoir drawdown during construction provides the most flexibility for retrofit options.
4) High quality rockfill for use in a downstream rockfill buttress is likely not readily available on site, based on the preliminary Borrow Screening Study (GEI, 2014a), and would require import from offsite commercial sources.

Based on the prescreening, 15 conceptual alternatives were identified for evaluation and are listed in **Table 3-1** below.

Table 3-1: Calero Dam Conceptual Alternatives

No.	Embankment Retrofit	PMF Passage[1]	Outlet Location and Type	Construction Drawdown[2]
1-1	Downstream Removal/Replacement	Dam Crest Raise	Left Abutment Sloping Intake	Full
1-2	Downstream Removal/Replacement	Dam Crest Raise	Right Abutment Sloping Intake	Full
1-3	Downstream Removal/Replacement	Dam Crest Raise	Right Ridge Sloping Intake	Full
1-4	Downstream Removal/Replacement,	Dam Crest Raise Spillway Widening	Right Ridge Sloping Intake	Full
2-1	Partial Downstream Removal/Replacement with Buttress	Crest Gate Spillway	Left Abutment Sloping Intake	Major
2-2	Partial Downstream Removal/Replacement with Buttress	Crest Gate Spillway	Right Abutment Sloping Intake	Major
2-3	Partial Downstream Removal/Replacement with Buttress	Crest Gate Spillway	Right Ridge Microtunneled	Major
2-4	Partial Downstream Removal/Replacement with Buttress	Dam Crest Raise	Right Ridge Sloping Intake	Major
2a-1	Partial Downstream Removal/Replacement with Buttress	Dam Crest Raise	Left Abutment Sloping Intake	Full
2a-2	Partial Downstream Removal/Replacement with Buttress	Dam Crest Raise Spillway Widening	Left Abutment Sloping Intake	Full
2a-3	Partial Downstream Removal/Replacement with Buttress	Crest Gate Spillway	Left Abutment Sloping Intake	Full
3a-1	Partial Height Buttress with Rockfill	Crest Gate Spillway	Left Abutment Microtunneled	Major
4a-1	Insitu Treatment with DSM	Crest Gate Spillway	Left Abutment Microtunneled	Major
4a-2	Insitu Treatment with DSM	Dam Crest Raise	Left Abutment Sloping Intake	Major
5a-1	Insitu Treatment with Jet Grout and Buttress	Crest Gate Spillway	Left Abutment Sloping Intake	Major

1) PMF Passage: Dam crest raise - 7 foot raise of main and auxiliary dams
Dam crest raise with spillway widening – 5 foot raise of main and auxiliary dams

2) Construction Drawdown: Full - elev. 410, 0 acre-feet storage;
Major, elev. 440, 1,000 acre-feet storage

All 15 conceptual alternatives included common components: seepage collection and monitoring improvements at the main dam; provisions to accommodate the potential Calero Dam enlargement; and breaching of Fellows Dike. All alternatives also assume the existing outlet works is abandoned by grouting.

3.2.5 Evaluation and Scoring Criteria

The screening framework for evaluation of conceptual alternatives was formulated as a simple decision tree matrix with four major goals and with each goal having two to four key objectives. Relative weights were assigned to each goal and to each objective. The individual goal weights sum to 100%. The four major goals (with relative weights) for the Calero Dam alternatives included:

- Minimize Adverse Environmental Impacts (20%)

- Maximize Operational Effectiveness (20%)
- Minimize Overall Project Costs (30%)
- Maximize Project Implementability (30%)

Within each goal are a number of identified objectives that would be attained to varying degrees, depending on the configuration and performance of each alternative. Within each goal, the assigned objective weights must also sum to 100%. District staff were consulted and provided input to the relative weights for both the goals and objectives. The decision matrix with goals and objectives, and relative weighting percentages is shown in **Table 3-2**. The goals and objectives were measured based on the specific considerations noted.

Table 3-2: Calero Dam Screening Framework

GOALS	Goal WT %	OBJECTIVES	Objective WT%	CONSIDERATIONS
Minimize Adverse Environmental Impacts	**20%**	Minimize Adverse Impacts to Sensitive Biological Resources	35%	Habitat Sensitivity (HCP)
				Work Windows - Migratory Species
				Other T&E Species
		Minimize Adverse Water Resource Impacts	30%	Instream Flows
				Water Quality
		Minimize Community Impacts	35%	Construction Traffic
				Fugitive Dust
				Noise Impacts
				Visual Impacts
				Recreation
				Cultural and Archaeological Resources
Maximize Operational Effectiveness	**20%**	Safety & Security	40%	Operational Reliability/Dam Safety
				Security
		Water System Operations	35%	Water Supply Reliability
				Ease of Operations
				Flexibility for Enlargement
		Sustainability	25%	Long Service Life
				Ease of Maintenance
				Other Beneficial Uses
Minimize Overall Project Costs	**30%**	Implementation Costs	70%	Construction Cost
				Indirect Costs
		Life Cycle (O&M) Costs	30%	O&M & Replacement Costs
				Lost Benefits
Maximize Project Implementability	**30%**	Regulatory Approvals	30%	DSOD Approvals
				Environmental Permits
				Land Acquisition
		Risk Management/Claims Potential	20%	Environmental Risks
				Delay Potential
				Supply Interruption Risks
				Construction Claims Potential
		Completion Schedule	20%	Construction Duration
				Completion Date
		Constructability	30%	Borrow, Staging and Spoil Areas
				Construction QA Verification
				Temporary Facility Requirements
				Difficulty of Construction

3.2.6 Conceptual Alternatives Evaluation and Scoring Results

Each of the 15 conceptual alternatives were evaluated by assessing the key components and features, key assumptions needed for project implementation, design and construction feasibility considerations, and the advantages and disadvantages of the alternative. Drawings were developed at a conceptual level to identify key work items and quantities and identify approximate project footprint. Expected construction duration was estimated to the nearest 6-months based on a conceptual-level understanding of the work required, key construction constraints, and using professional judgment from similar projects. Construction costs (AACE Class 5) were estimated based on the conceptual-level layouts of key features and estimated quantities for major work items where there were differences among alternatives (earthwork, tunnel/pipe lengths, etc.), with unit prices and lump sum allowances based on similar projects and judgment.

The conceptual alternative were then screened and comparatively evaluated in a workshop using a discussion/consensus process, with the workshop participants comprised of District subject-matter experts with appropriate perspectives to cover the relevant goals and objectives. Key conclusions from conceptual-level screening are summarized in the following points:

1) Embankment Retrofit should focus on Alternative 1 (remove/replace), Alternative 2 (partial remove/replace plus buttress), and Alternative 4 (deep soil mixing). Alternative 3 (rockfill buttress) and Alternative 5 (jet grout soil improvement with buttress) should be eliminated because rockfill (Alternative 3) is not available on site and jet grout (Alternative 5) is not considered practical due to low performance reliability (implementation and verification challenges) and difficulty in dam safety permitting (approval) by DSOD.
2) Outlet Works Replacement should focus on locating the features in the left abutment and providing a sloping intake type structure. The left abutment proves a simpler tie-in with the existing Almaden Valley Pipeline and the Calero valve yard and avoids construction in an identified wetlands area downstream of the dam.
3) An accessible sloping intake structure based on District requirements is preferred. A microtunneled wet-tap should be eliminated unless the District requires maintaining over 1,000 acre-feet of storage during construction.
4) PMF Passage should further consider both a dam crest raise (Main and Auxiliary Dams) and an operable spillway crest gate. For the dam crest raise alternatives, a slightly longer spillway crest may be feasible and could reduce the height of the crest raise; this could be evaluated as a refinement during final design and after DSOD has approved the PMF study and final freeboard requirement, but does not need to be further evaluated at the feasibility stage.
5) Reservoir Lowering for Construction should be further evaluated (full lowering versus major lowering) due to the higher costs and complexities of construction in an active reservoir. Full lowering provides the most options and lowest risk for construction.

Based on the results of the conceptual alternatives screening, five conceptual alternatives were recommended for further consideration as feasible alternatives.

3.3 Feasible Alternatives Evaluation

3.3.1 Alternatives Carried Forward

The Calero Dam recommended feasible alternatives are summarized in **Table 3-3**. These five alternatives provide flexibility for different embankment retrofit approaches (three options), focus on the preferred left abutment location for the replacement intake, allow for two options for increased spillway capacity, and provide an accessible sloping intake structure that fully meets District operational requirements. As noted in the **Table 3-3**, two of the alternatives would require a large cellular cofferdam to preserve 1,000 acre-feet of reservoir storage during construction, while three of the alternatives require full draining of the reservoir with a small earthen cofferdam to protect the in-reservoir work areas during the construction season.

Table 3-3: Calero Dam Recommended Feasible Alternatives

No.	Embankment Retrofit	PMF Passage	Outlet Location and Type	Construction Drawdown
1-1	Downstream Removal/Replacement	Dam Crest Raise	Left Abutment Sloping Intake	Full
2-1	Partial Downstream Removal/Replacement with Buttress	Crest Gate Spillway	Left Abutment Sloping Intake	Major
2a-1	Partial Downstream Removal/Replacement with Buttress	Dam Crest Raise	Left Abutment Sloping Intake	Full
2a-3	Partial Downstream Removal/Replacement with Buttress	Crest Gate Spillway	Left Abutment Sloping Intake	Full
4a-2	Insitu Treatment with DSM	Dam Crest Raise	Left Abutment Sloping Intake	Major

3.3.2 Design Refinements, Baseline Cost and Schedule Estimates

The five feasible alternatives were further developed from the conceptual level to an approximate 10-percent level of project definition to better define project configuration and footprint, construction considerations including sequence and schedule, and further refine costs. The key feasibility level design refinements are summarized below:

1) Embankment Modification Configurations: More refined cross sections and layout of embankment modifications were developed to understand required limits, quantities, and construction sequence for foundation excavation/partial dam degrade, construction of filter drains, embankment placement, Deep Soil Mixing (DSM), and extension/restoration of concrete panels at the upstream face of the Main and Auxiliary Dams.
2) Sloping Intake: The design of the intake was revised from the sloping intake type used at the District's Lenihan Reservoir (hydraulically actuated sluice gates with non-submerged access) to the concept used at the San Francisco Public Utilities Commission's (SFPUC) San Antonio Reservoir (electrically actuated valves inside a sloping intake structure that provides dry access for maintenance). Also, the required excavation for placement of the intake structure and connection with the new tunneled outlet conduit was better defined.
3) Tunnel Alignment and Profile: The preliminary tunnel alignment through the left abutment was refined to include straight tangents rather than long bends, and tunnel portal location and excavation requirements were also identified.

4) Downstream Pipe Connections: The location of the downstream access structure and the general layout of downstream piping connections to the existing AVP were better refined.
5) Dam Crest Raise: The footprint and section for raising the crest of the Main and Auxiliary Dams for alternatives that include a dam crest raise to contain the PMF were better refined. The likely need for a backwater control gate to be installed on the Almaden-Calero Canal near the crest of the Main Dam was identified; the gate would be required to prevent unintended spills through the canal during extreme flood events.
6) Spillway Modifications: The configuration and estimated quantities for either replacement of the existing ogee crest, or installation of an operable crest gate were more accurately defined. Crest gates were recognized to be unfavorable to DSOD. Options were researched for use of a hydraulically actuated crest gate rather than a pneumatically actuated as the hydraulically actuated gate would more likely be accepted by DSOD,
7) Borrow, Stockpile, and Disposal: Initial findings of Borrow Screening study were incorporated in layout of potential borrow and disposal sites, and nature and volume of borrow materials available for embankment construction.
8) Haul Routes and Staging: Potential haul routes and staging areas were preliminarily identified for construction considering location and layout of key facility construction areas, reservoir drawdown, and borrow/stockpile/disposal locations.
9) Quantities: The expected quantities for construction were refined based on the refined facility layouts, including conservative estimates of the "use percentage" of identified borrow/stockpile/disposal areas to estimate the likely environmental impact footprint for construction. These use percentages conservatively assume removing all the dam and foundation soils in the Alternative 1 and 2 options, stockpiling of material, and then reusing the material once the entire footprint is excavated to a suitable foundation. This amounts to "double handling" of all excavated material to be removed and replaced in the dam embankment; whereas a contractor's construction sequence might "roll-over" this material to reduce the amount and footprint of required stockpiles for excavated or imported material.
10) Construction Sequence, Schedule, and Other Considerations: A potential sequence and preliminary schedule for construction were developed and special considerations were identified that could increase construction risk, constrain acceptance, or extend the project schedule.
11) Construction Cost Estimate: The cost estimates were refined to AACE Cost Class 4 to reflect an approximate 10% level of project definition based on the updated configuration and quantities of each alternative. It is noted that these cost opinions are for alternative comparison and not for project budgeting or approval as they do not include all project implementation costs.

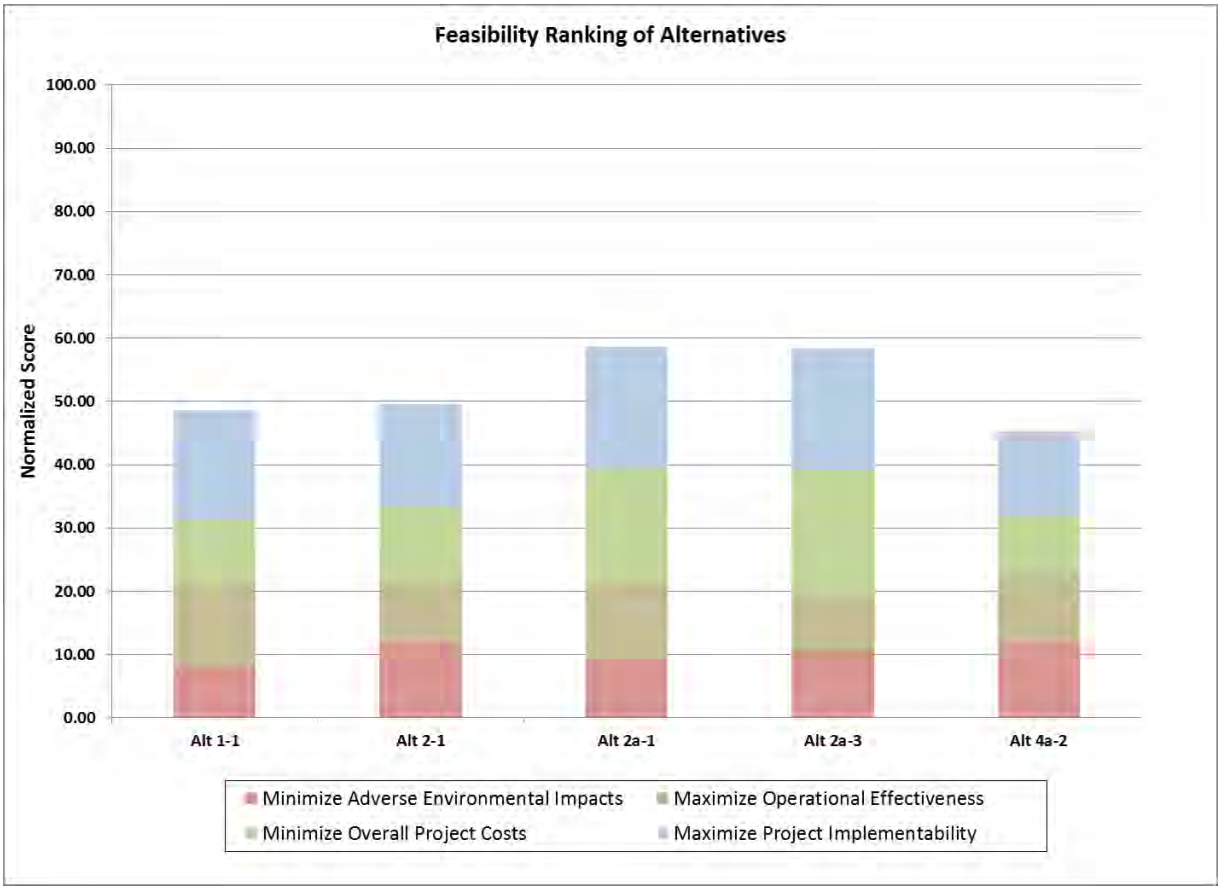
3.3.3 Feasible Alternatives Evaluation

The five feasible alternatives were screened using the same screening framework and workshop scoring process used in prior conceptual-level screening (see Section 3.2). **Table 3-4** presents a summary of the scores for each alternative, with results shown graphically in **Figure 3-1**. It is noted that these scores are relative, and for comparison purposes only.

Table 3-4: Summary Scores for Calero Dam Feasible Alternatives

NORMALIZED SCORES	Alt 1-1	Alt 2-1	Alt 2a-1	Alt 2a-3	Alt 4a-2
Minimize Adverse Environmental Impacts	8.00	12.00	9.40	10.80	12.00
Maximize Operational Effectiveness	13.60	9.40	12.00	8.00	10.40
Minimize Overall Project Costs	9.60	12.00	18.00	20.40	9.60
Maximize Project Implementability	17.40	16.20	19.20	19.20	13.20
Total	**48.60**	**49.60**	**58.60**	**58.40**	**45.20**

Figure 3-1: Graphical Relative Scoring of Calero Dam Feasible Alternatives



Key conclusions from feasibility-level screening are summarized as follows:

1) Alternatives 2a-1 and 2a-3 are the top-ranked alternatives and score similarly. Both involve Partial Removal of the Downstream Embankment and Foundation Alluvium with a Full Height Buttress and a Sloping Intake on the Left Abutment constructed with Full Drawdown of the Reservoir. The difference between these alternatives is how the PMF Passage is implemented. Alternative 2a-1 utilizes a Dam Crest Raise while Alternative 2a-3 utilizes an operable Spillway Crest Gate.
2) Alternative 2a-3 provides a slightly better cost and environmental profile, but the negative operational tradeoffs associated with an operable Spillway Crest Gate offset the slightly larger embankment (i.e., more Main Dam and Auxiliary Dam

embankment fill) and the need to modify the Auxiliary Dam in Alternative 2a-1 to incorporate the Dam Crest Raise.

3) Alternative 2a-1 is preferred assuming the District can obtain right of way at the toe of the Auxiliary Dam as needed for a Dam Crest Raise.
4) The reservoir should be completely dewatered to reduce the risk and complexities of the intake/outlet and seismic retrofit construction.

Based on the feasibility-level screening, Alternative 2a-1 is the Staff-Recommended Alternative for further design refinement and future consideration by the District Board. This alternative is discussed in further detail in Section 4.

4.0 Recommended Project

4.1 Staff-Recommended Alternative Description Overview

The Staff-Recommended Alternative 2a-1 includes the following elements:

- Partial removal of the downstream embankment of the main dam to remove liquefiable alluvium below the downstream shell;
- Rebuilding of the downstream portion of the dam with an internal filter and drain system and a downstream buttress;
- Raising the crests of the Main Dam and the Auxiliary Dam up to 7 feet to contain and pass the updated probable maximum flood (PMF) through the spillway;
- A new ogee crest at the existing spillway;
- A new sloping, multi-level intake on the left abutment;
- A new tunneled outlet works with fully accessible conduits that connect to the existing Almaden Valley Pipeline;
- Abandonment of the existing outlet works by backfilling/sealing with grout, and;
- Relocation and/or demolition of existing historical structures and subsequent breaching of Fellows Dike.

Figure 4-1 presents an overview of the Calero facilities that will be modified by construction of Alternative 2a-1, including callouts of key project features. Preliminary design drawings for the Staff-Recommended Alternative are included for reference in **Appendix C**. A more detailed description of the preliminary design considerations for Alternative 2a-1 is provided in the following sections.

4.2 Staff-Recommended Alternative Refinements

Further development of the Staff-Recommended Alternative includes:

1) Borrow Material: The results from recent subsurface explorations and lab testing were considered in refinement of borrow quality and processing requirements, and associated quantity and cost estimates. A summary of the borrow studies is included in Section 4.7.
2) Construction Flood Hydrology: The 2-yr, 10-yr and 100-yr floods were evaluated to support evaluation of diversion, cofferdam, and temporary embankment stability risks during construction, and to support refinement of the construction schedule and costs.
3) Embankment Stability: The temporary construction stability was analyzed for the partially excavated embankment, and preliminary analyses were also completed for the long term static (at normal pool) and seismic stability of the dam with the full-height buttress and crest raise.
4) Embankment Details: Additional cross sections and details of the embankment retrofit were developed, including filter, drain, and seepage collection and monitoring improvements.
5) Almaden-Calero Canal: Requirements for the re-route/bypass of the new proposed Calero intake structure were identified. Consideration was also given to the

configuration of a control gate at the Almaden-Calero Canal at the approximate dam centerline that may be needed to prevent uncontrolled reservoir outflow along the canal during an extreme flood event due to the dam crest raise.

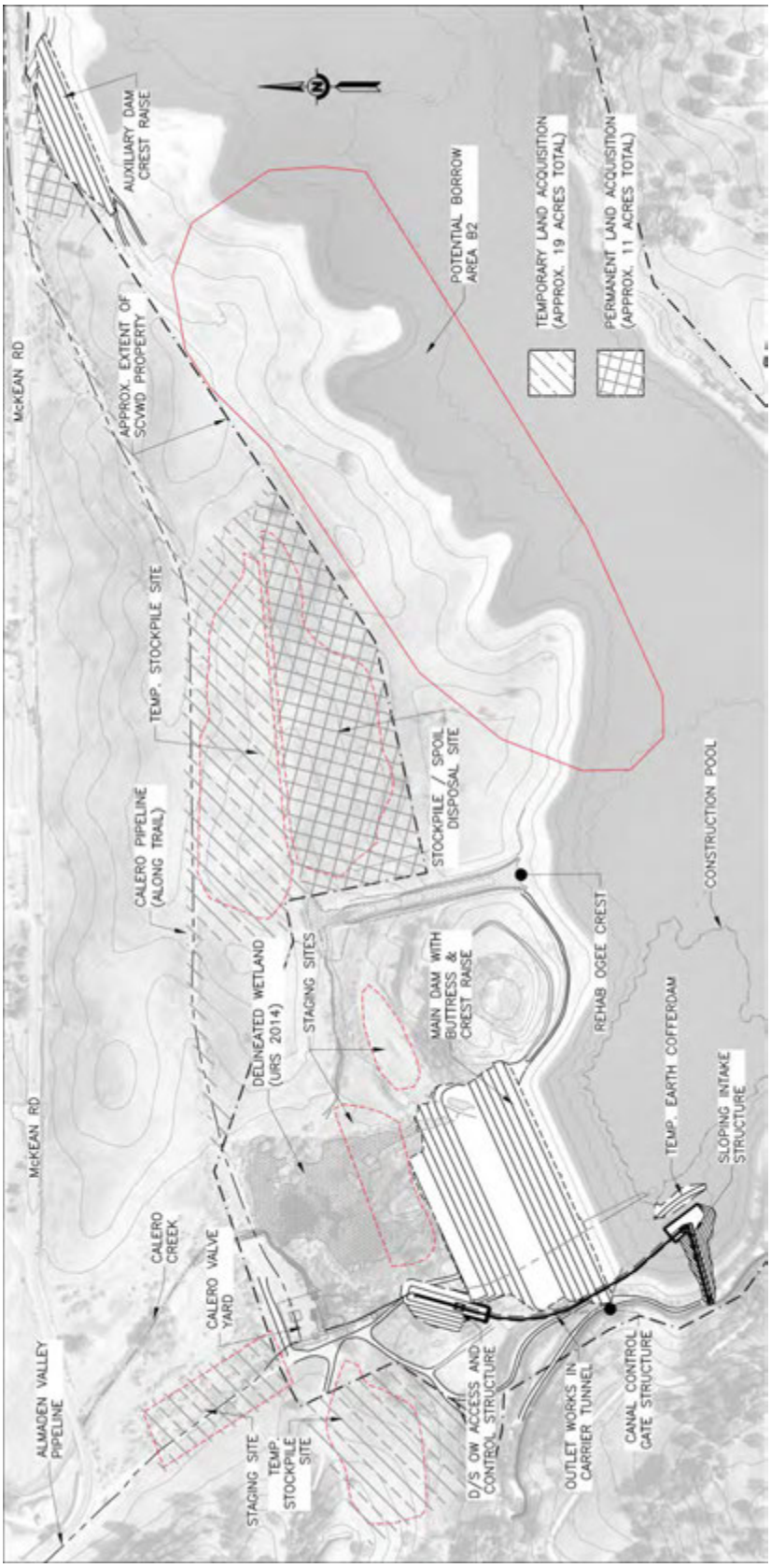
6) Outlet Works Downstream Vault and Connections: More detailed layouts were developed for the downstream control vault, valving and piping connections to the existing Almaden Valley Pipeline and Calero Valve Yard stream release piping.
7) Outlet Works Intake Structure: More detailed layouts were also developed for the control building and other operational features at the intake structure.
8) Preliminary Right of Way Requirements: Preliminary delineations were made of approximate limits for proposed land acquisition (either in fee or by easement) necessary for construction of the Auxiliary Dam Modifications, borrow/disposal areas, and temporary staging areas and haul routes.
9) Fellows Dike Breach: More detailed layout of the structure removal and breach at Fellows Dike was developed, including the disposal location of excavated material from the breach.

4.2.1 Potential Future Expansion of Calero Reservoir

Previous studies by the District have determined that up to a 30-foot high dam raise is feasible for future expansion of Calero Reservoir. The following considerations were made in refining the Staff-Recommended Alternative:

- Select buttress and drainage configurations within the main dam that can accommodate future extension or raising;
- Size the outlet conduit with adequate DSOD emergency release capacity for future reservoir capacity enlargement;
- Select an outlet works intake structure concept that can be raised in the future (e.g. ability to extend sloping intake uphill or raise shaft vertically);
- Locate the outlet works control valves beyond the downstream toe of a future larger dam;
- Consider a spillway crest structure that can be modified/raised in the future;
- Locate access roads or other key features away from future dam enlargement footprint, and;
- Consider a downstream raise of the Auxiliary Dam for the 7 foot crest raise. Future reservoir enlargement may require more extensive rebuilding of the entire Auxiliary Dam.

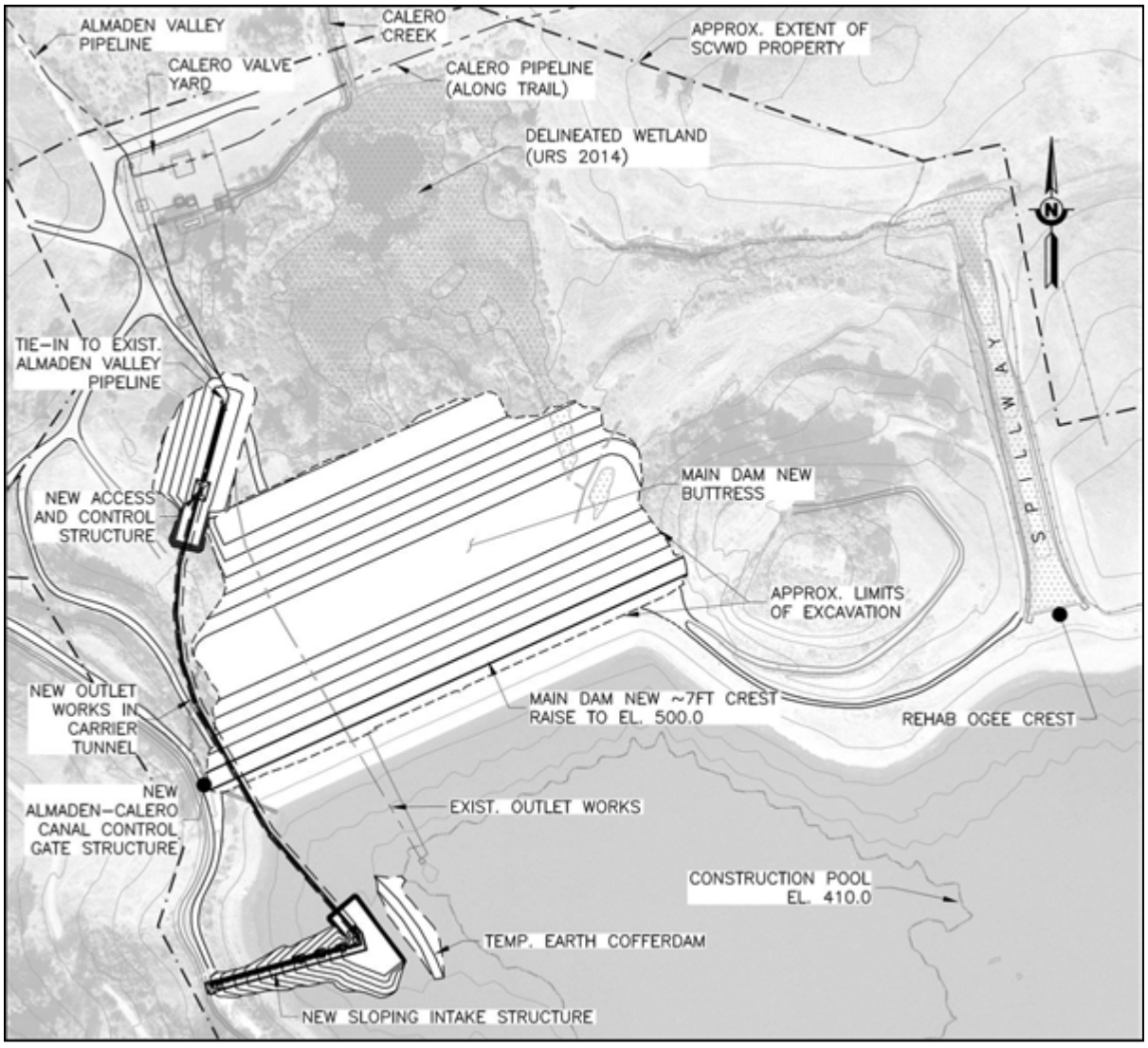
Figure 4-1: Overview of Calero Facilities with Alternative 2a-1 Modifications



4.3 Embankment Design

Alternative 2a-1 involves the removal of a portion of the downstream embankment; the excavation of alluvium beneath the removed embankment and in the valley downstream of the toe; the construction of a chimney and blanket drain; the reconstruction of the dam with a raised and widened crest; and an earth fill buttress to approximately 60% of the height of the dam, as shown in plan view in **Figure 4-2** and schematically in **Figure 4-3**. The intent of Alternative 2a-1 is to excavate and replace liquefaction-prone alluvium from underneath the downstream slope, reconstruct the dam, and construct a downstream compacted earthfill buttress that improves the overall seismic stability of the rebuilt embankment. The preliminary design of the outlet works access tunnel for the Calero Dam seismic retrofit was modeled after the outlet works at the District's Lenihan Dam.

Figure 4-2: Plan View of Main Dam Improvements

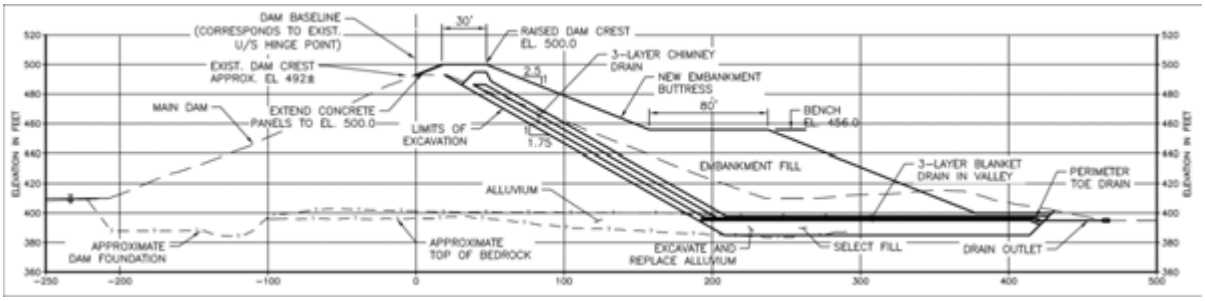


The downstream slope of the Main Dam would be excavated to bedrock for about 50 feet upstream from the current toe, and the excavation of alluvium would extend downstream about 160 feet beyond the existing toe. The inclination of the excavation would be about

1.75H:1.0V through the existing embankment, starting at about elevation 487 feet on the downstream face. The widened and raised dam and buttress would be constructed with well-compacted earth fill and would have a slope of 2.5H:1.0V, the same as the existing slope, with a bench at about El. 456. The new buttress would extend about 130 feet beyond the existing downstream toe.

The Staff-Recommended Alternative also includes the construction of a full-height filter and chimney drain for controlling the phreatic surface within the embankment and providing a seepage drainage path for reducing the potential for through-seepage. The full height chimney drain would be located between the existing embankment material and the new buttress materials (see **Figure 4-3**) and a blanket drain would be located along the buttress foundation. The chimney drain would extend up to the spillway crest elevation and be zoned with graded filter and drain material. Seepage from the chimney and blanket drains would be collected at a toe drain. The blanket drain would extend up the abutments beneath the footprint of the new buttress zone to collect seepage.

Figure 4-3: Typical Cross Section of Alternative 2a-1 (Maximum Section)



The reservoir would be fully dewatered during construction to approximately elevation 410. Excavation of the downstream foundation soils may require temporarily lowering of the groundwater table through localized dewatering measures. The earth fill material would be sourced from the existing embankment excavation and augmented by on-site borrow areas. The filter and drain materials would need to be imported from offsite sources.

The Borrow and Spoil Siting Suitability Screening Study (GEI, 2014a) indicated that suitable material similar in engineering properties to the existing embankment can be found in adequate quantities on site along the north rim of the reservoir between the spillway and the auxiliary dam (see **Figure 1-2**).

The concerns regarding embankment and abutment seepage, as mentioned in Section 2.5, will be largely addressed through the incorporation of the filter and drain system mentioned above. The buttress embankment footprint is expected to encompass historically observed and mapped seepage expressions, and therefore seepage will be directed into the internal drainage system rather than exiting on the downstream face or abutment slope. The limits of excavation, foundation preparation, and filter and drain placement would have to be confirmed during final design and construction.

Initial considerations for separation and measurement of seepage through the right abutment include an interceptor drain along the right abutment and a separate outfall and measurement location. If the dam were raised in the future, it is possible that seepage through the right abutment could increase. As a contingency, the District may consider an

upstream seepage reduction blanket to help control flow into the seepage collection system as part of the retrofit design project.

4.4 Preliminary Design for Containment and Passage of the PMF

For the Staff-Recommended Alternative, passage of PMF would be accomplished by means of a 7-foot dam crest raise at both the main and auxiliary dam. This would require some temporary crest degrading during construction for adequate incorporation of new embankment fill. The main dam raise is shown in **Figures 4-2** and **4-3.** The auxiliary dam modifications are shown in **Figures 4-4** and **4-5**. The 7-foot raise is based on conservative assumptions of a minimum 1.5 feet of freeboard required by DSOD plus 3.7 feet for wind-wave setup and runup for a total of 5.2 feet of freeboard above the PMF level. The total amount of freeboard above the spillway crest would be approximately 13 feet. The freeboard requirement would have to be approved by DSOD prior to final design.

Figure 4-4: Plan View of Auxiliary Dam Improvements

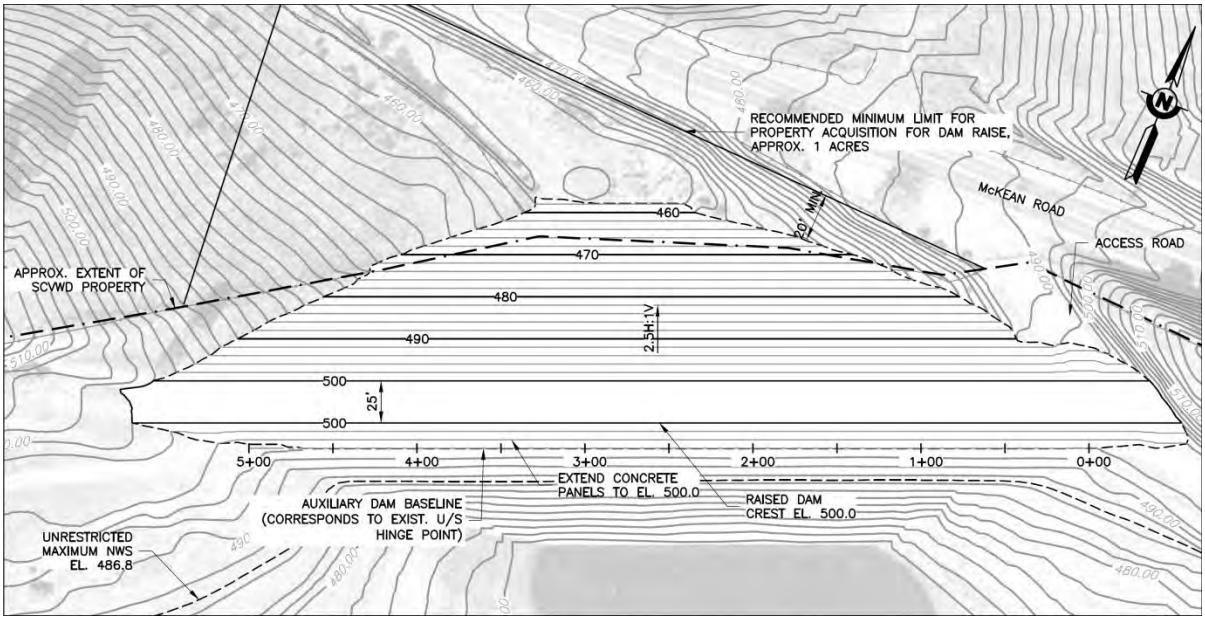
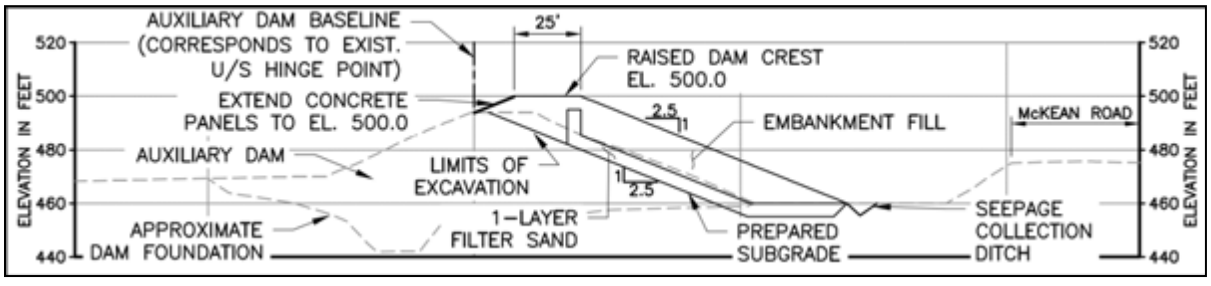


Figure 4-5: Typical Cross Section of Raised Auxiliary Dam (Maximum Section)

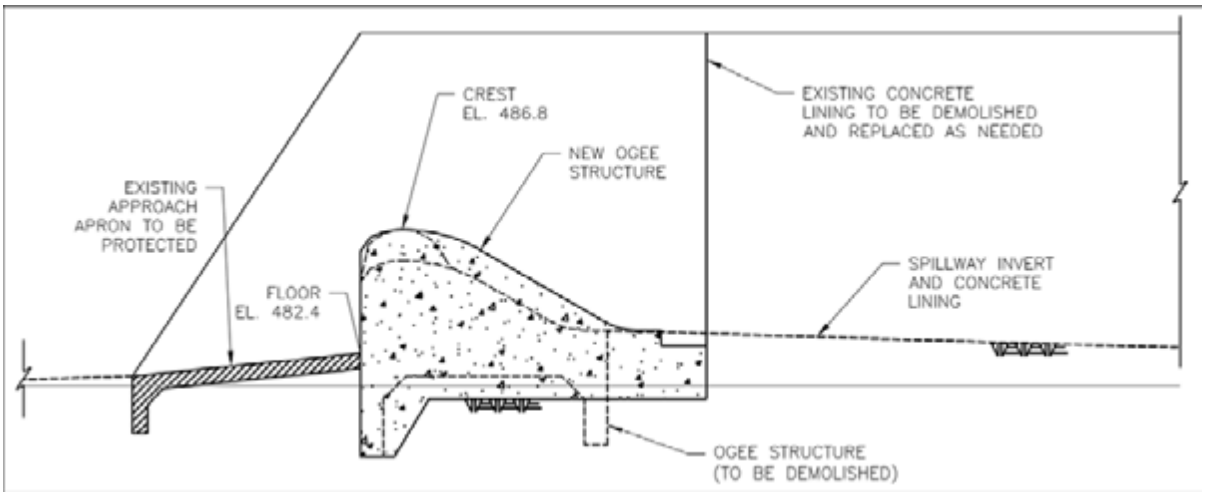


In addition to the dam crest raise at both dams, the existing spillway concrete control section would be demolished and rebuilt with a new ogee structure as shown in **Figure 4-6.**

Other final design considerations for containment and passage of the PMF should include hydraulic analysis of the spillway chute based on the new or rebuilt spillway ogee crest,

containment of the flow within the chute, as well as evaluation of drainage/erosion concerns in the channel that conveys spillway discharges back to Calero Creek.

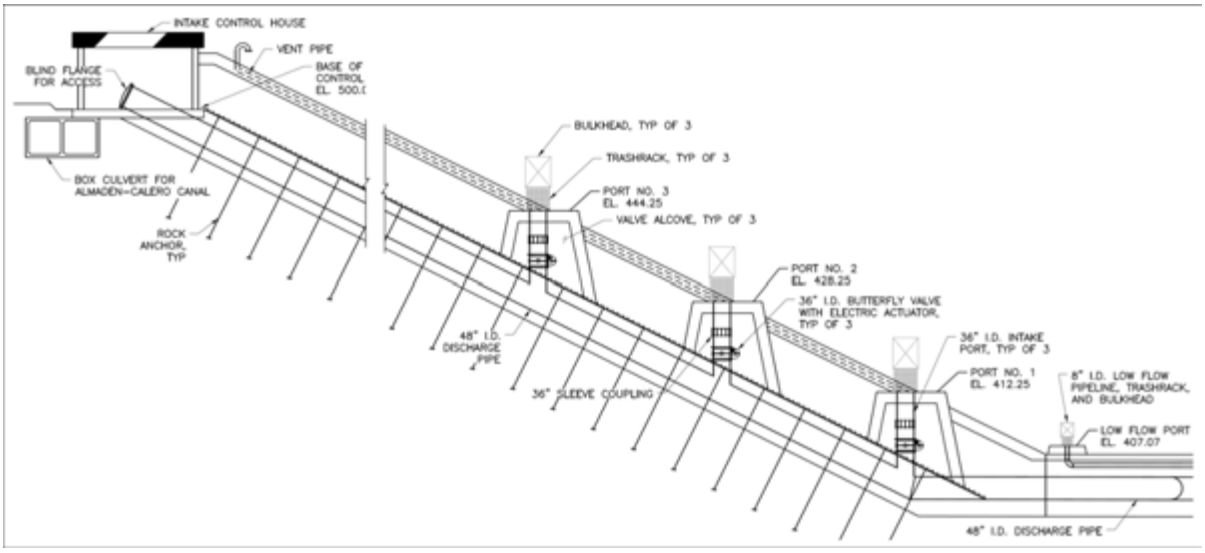
Figure 4-6: Cross Section of Rebuilt Spillway Ogee Crest



4.5 Outlet Works Design for Operations and Emergency Drawdown

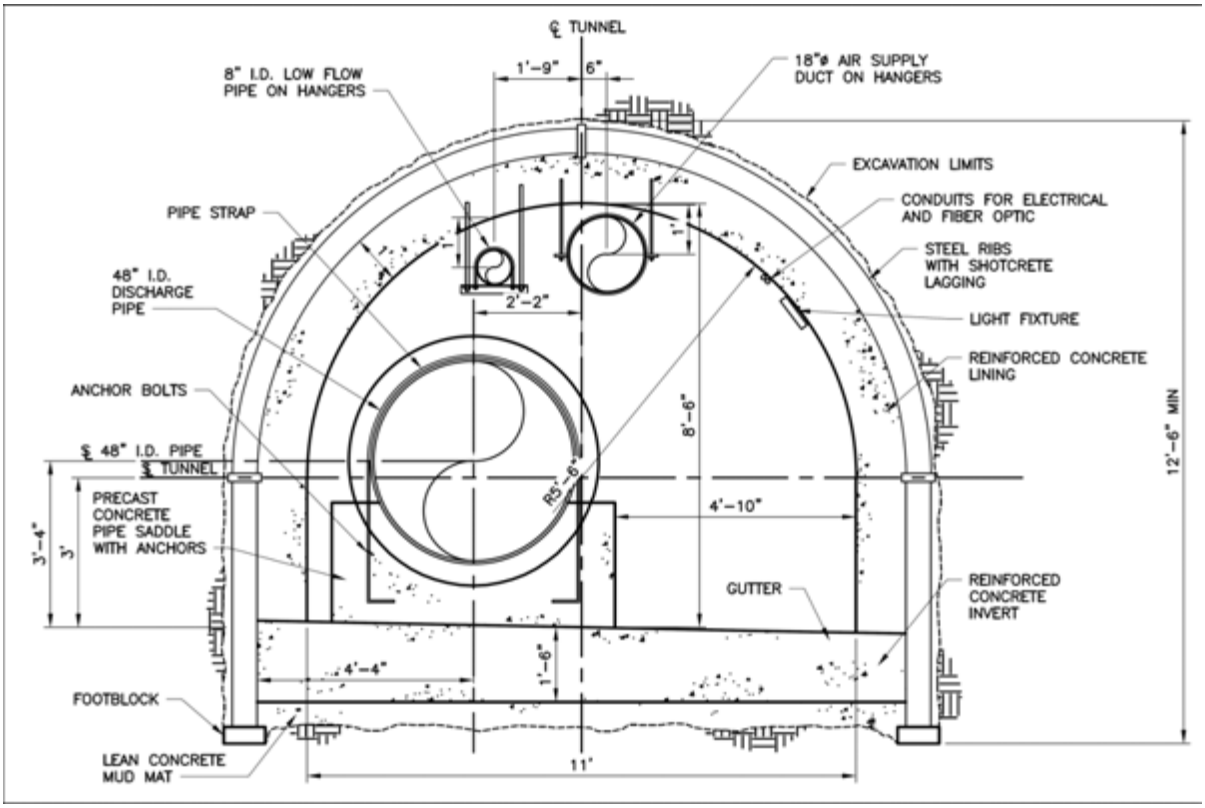
The Staff-Recommended Alternative includes a new outlet works constructed through the left abutment consisting of a sloping intake structure, an access tunnel with the main and low-flow outlet conduits, and an access and control structure at the downstream connection to the Almaden Valley Pipeline. **Figure 4-7** shows a profile view along the new sloping intake along the left abutment. **Figure 4-8** shows a cross-section view of the new access tunnel, including the 8-inch low flow conduit and 48-inch discharge pipe. Geotechnical investigations during final design will be necessary to confirm the location and alignment of the new outlet works access tunnel. In addition, the hillside stability in the vicinity of the sloping intake structure must also be confirmed during final design.

Figure 4-7: Profile of Sloping Intake Structure



An earthen cofferdam would be required to isolate the construction area for the sloping intake and left abutment tunnel. For planning purposes, it has been assumed that the cofferdam will be an earthfill structure with a sheet pile cutoff wall and crest elevation at El. 420 feet. It should be noted that this configuration assumes full reservoir drawdown (See Appendix D in Calero Alternatives Report for SCVWD Memo). The preliminary construction schedule assumes that this site would be winterized each year, due to potential expected inflows exceeding the capacity of any reasonably sized cofferdam. It is assumed that minimum streamflow releases would be made by the District using the Calero bypass pipeline, and that the existing outlet works would be available for use by the construction contractor for diversion of natural streamflow/runoff through the worksite. Once the new outlet works are completed, tested, and accepted by DSOD, the existing outlet works would be properly abandoned by grouting.

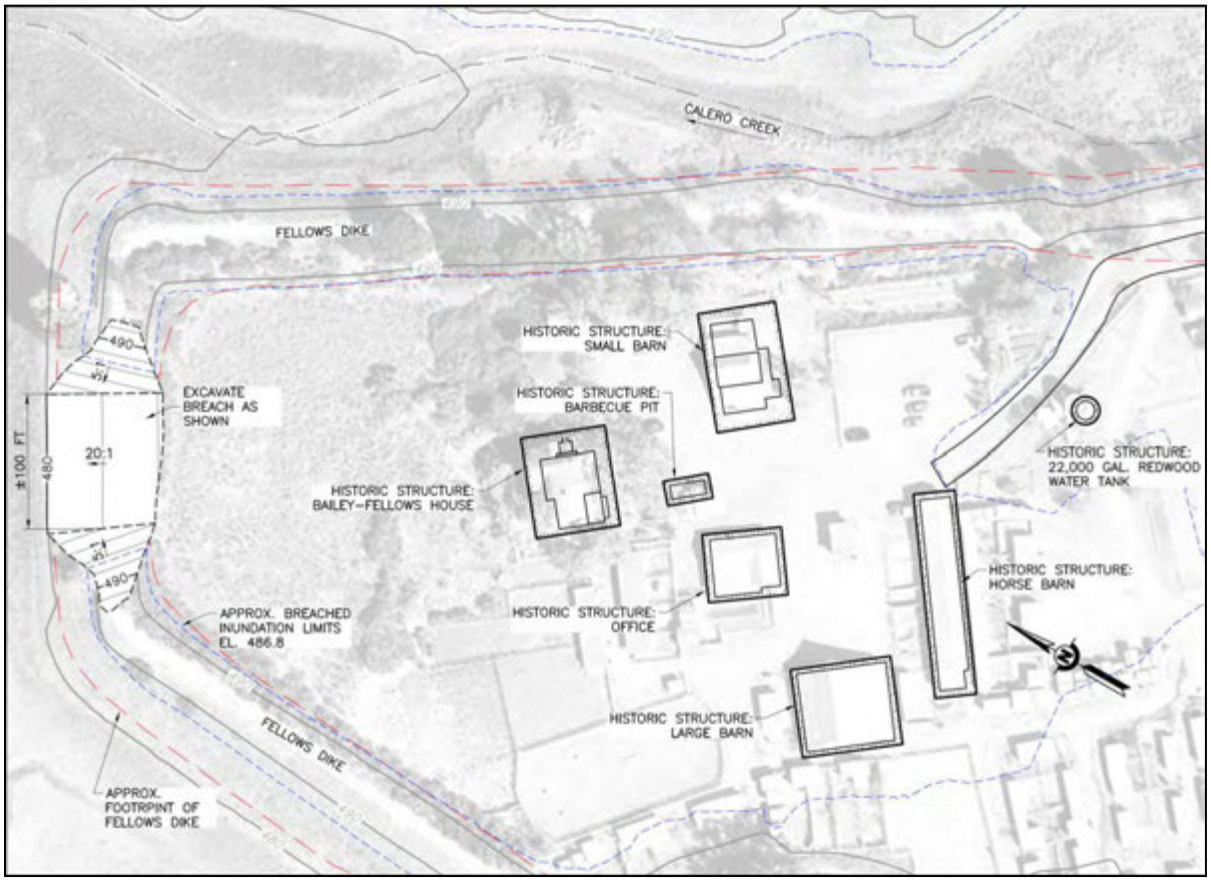
Figure 4-8: Access Tunnel and Outlet Conduit Cross Section



4.6 Preliminary Design for Fellows Dike Breach

Geotechnical investigation on Fellows Dike in 2001 (GEI, 2001) determined that the dike would require extensive improvement to bring the facility up to DSOD minimum standards before it could be certified to impound water. In 2010 the District determined that the relocation of the Bailey Ranch historic structures and breaching of Fellows Dike is the preferred course of action. **Figure 4-9** provides a preliminary design overview of the anticipated breach of Fellows Dike. Existing historic structures at this location would either be relocated outside the reservoir limits, or alternatively documented and demolished, as determined by the District during final design and permitting.

Figure 4-9: Plan View of Fellows Dike Breach and Remaining Historical Structures (to be demolished or relocated)



As indicated in **Figure 4-9**, Fellows Dike would be breached along its northern-most edge. For planning purposes, it has been assumed that the breach would be excavated from the Fellows Dike crest (approximately El. 498 feet) down to El. 480 feet for a width of roughly 100 feet, with excavation surfaces being sloped back at 5.0H:1.0V. The breach would result in approximately 2,600 CY of excavated material which would be placed along the interior of the western dike embankment. Alternatively, the breach spoil materials could be placed on the exterior of the dike to stem erosion. Also depicted are the projected inundation limits following the breach of Fellows Dike. These inundation limits are based on the unrestricted normal maximum water surface of El. 486.8 feet.

4.7 Earthwork and On Site Borrow Evaluation

The Staff-Recommended Alternative would result in a retrofitted embankment volume of approximately 390,000 cubic yards (CY). Earthwork quantities associated with this alternative would include approximately 230,000 CY of material from the excavation of the existing embankment and foundation, 75,000 CY of imported filter and drain material, 200,000 CY of material reused from the embankment and foundation excavation, and approximately 90,000 CY of material from on-site borrow sources. The assumption is that about 85 to 90% of the embankment and foundation excavation would be reused as embankment fill (i.e. unsuitable material is about 10 to 15% of the excavation volume).

There are no on-site sources of suitable filter and drain materials available from on-site borrow areas; this material will need to be imported. Approximately 50,000 CY of spoil material would be generated from embankment foundation excavation and outlet tunneling operations that would require disposal in approved spoil areas.

A screening study of preferred borrow, spoils disposal, and stockpile sites (areas) was conducted during the planning study. The following is a summary of the studies and selected sites.

- Based on field and laboratory data, Borrow Area B-2 (shown in **Figure 4-1**) appears to have suitable buttress materials for the Staff-Recommended Alternative. The Franciscan rock materials in Borrow Area B-2 (greywacke sandstone, mélange, and silicified mudstone) could be ripped and processed and would meet the strength requirements for buttress fill. However, there is a large degree of variability in block sizes, strength, and hardness in the Franciscan materials that would require further field investigation and evaluation during final design.
- Borrow Area B-2 is located adjacent to and within the rim of the reservoir, which would result in less disturbance of surrounding lands and grassland habitat. There would also be less visual impacts to surrounding areas.
- Borrow Area B-2 meets the volumetric yield requirements for embankment fill that would be required for the Staff-Recommended Alternative buttress configuration.
- Borrow Area B-2 is within close proximity to the dam site, and allows for development of reasonable ingress and egress haul routes around the perimeter of the site.
- Borrow Area B-2 is located far enough outside of the main work area for Staff-Recommended Alternative where potential impacts to work activities along the right abutment could be minimized. Excavations from Borrow Site B-2 would yield more suitable material, and have fewer disturbances to the right abutment area of the existing dam than Borrow Site B-1.
- Spoils Disposal Site SD-2 was selected for the Staff-Recommended Alternative, because it is located much closer to the dam than Site SD-4, despite the fact that it is located on County Parkland property downstream of the reservoir.
- Spoils Disposal Site SD-4 was screened for additional exploration under an original assumption that spoils material could be disposed behind the existing Fellow Dike embankment. However, the original dike breach option was retained as part of the Staff-Recommended Alternative precluding SD-4 as a viable spoils disposal site.
- Stockpile Site SS-1 was selected for consideration due to sensitive environmental habitat in close proximity of the dam, including wetland habitat associated with Calero Pond. Stockpile Site SS-1 shares a contiguous footprint with Spoils Disposal Site SD-2. Stockpile Site SS-2 was added as an alternative site, given the close proximity of this site to the toe of the existing dam and site access routes, and its hillside location outside of sensitive drainage areas.

4.8 Right of Way Needs

Construction work is anticipated to extend outside District property limits in some areas. **Figure 4-1** illustrates the areas identified for temporary and permanent land acquisition to complete the Staff-Recommended Alternative. Also delineated are areas identified for temporary borrow, stockpile, and staging, as well as permanent spoils disposal sites,

potential haul routes, and key temporary facilities such as an earth cofferdam and temporary bridge over Calero Creek.

For planning purposes, it has been estimated that approximately 19 acres of temporary land acquisition and 11 acres of permanent land acquisition (30 acres total) would be required to complete the retrofit. This estimate includes approximately one acre of permanent land acquisition for the Calero Auxiliary Dam where the retrofitted footprint associated with the 7-foot downstream crest raise would extend slightly outside District property along McKean Road. Right of way acquisition costs were excluded from the project cost estimates for the Staff-Recommended Alternative.

4.9 Environmental Impacts

Environmental impacts will be assessed in future studies and covered under the California Environmental Quality Act (CEQA). The District would serve as lead agency for CEQA compliance and the project would be evaluated in an Environmental Impact Report (EIR). The EIR would address the environmental impact of the Staff-Recommended-Alternative. A key feature of the CEQA process is the opportunity for the public to review and provide input on the project.

Environmental studies and permitting to support the CEQA process will take place concurrently with final design. Key environmental impacts to be considered during the process include, but are not limited to, protection of cultural resources, protection of biological resources, mitigation of hazardous materials, and protection of recreational usage. The CEQA process would also incorporate proactive community outreach to manage public expectations regarding changes in recreational uses as well as temporary impacts such as traffic, dust, and noise during the dam retrofit project construction.

4.10 Environmental Mitigation

Compliance with the Federal and State Endangered Species Acts would be conducted through the 2013 Santa Clara Valley Habitat Plan (VHP) process. The United States Fish and Wildlife Service and California Department of Fish and Wildlife have ceded regulatory authority under these laws to the VHP Implementing Agency in the expectation that the VHP will both simplify and shorten the regulatory process and provide for improved resource protection. The VHP covers the “take” of 18 federal and state listed species, and imposes a fee menu for mitigation of impacts to those species and to sensitive natural communities. The VHP provides coverage for special-status wildlife and plants impacted by dam seismic retrofit projects, including the Calero and Guadalupe Dams Seismic Retrofits Project. The VHP also provides coverage for borrow sites and dewatering associated with project construction.

4.11 Public Outreach

The results of the planning study will be disseminated into the community through the Calero-Guadalupe Dams Seismic Retrofits Project Community Engagement Action Plan. This living document has been created and maintained by the District, and included plans to inform the community through various media including a web-page, public meetings,

mailers, and display materials at community venues. Efforts to inform the public are ongoing and expected to continue through project completion.

4.12 Design and Permitting Issues

In preparation of the Planning Study Report, the configuration, schedule, and cost estimate for the Staff-Recommended Alternative have been refined to approximately the 15-20% level of design development. The Staff-Recommended Alternative is provided in the Preliminary Design Drawings included in **Appendix B**.

During the alternatives evaluation, several project components have been identified as either: a) areas for future design refinement, or b) additional project improvements that may be included as part of the project, but are not covered in the currently defined project requirements:

1) Borrow Material: The engineering properties and compaction requirements for borrow from the identified site(s) must be confirmed during final design with additional geotechnical investigation and laboratory testing. The extent of borrow development, quantities necessary to complete the retrofit, and construction considerations (i.e. rippability, material processing requirements, etc.) of selected borrow sources must also be further developed and confirmed during final design and permitting.
2) Freeboard, Spillway Crest Length and Dam Crest Refinement: The 7-foot dam crest raise may be decreased by 2 to 3 feet assuming a) reduction in current 5.2 feet flood freeboard requirement (3.7 feet waves plus 1.5 feet DSOD minimum) to 3.7 feet, and b) combined with some nominal lengthening of the spillway crest length. Based on recent feedback in a meeting on October 22, 2014, DSOD indicated they would be receptive to such refinement provided the total freeboard over the spillway crest was at least 10 feet, and the lengthen spillway crest did not show hydraulic convergence/wave issues in the chute.
3) Almaden-Calero Canal Control Gate: Final design can more fully consider the need for a canal control gate to prevent uncontrolled reservoir outflow based on: a) possible reductions in PMF water surface if the spillway crest length is widened nominally under item 2 above; b) more detailed evaluation of canal operations and spill potential near the canal during storm events, and c) further discussion with DSOD.
4) Fellows Dike Historic Structures Removal: The project definition will be modified to explore documentation/demolition of historic structures as an alternative to relocation.
5) Upstream Seepage Blanket: Because the reservoir would be fully lowered for construction, District staff has suggested that it may be beneficial to construct an upstream blanket on the right abutment slope to reduce seepage. The type and extent, costs, O&M requirements and potential benefits of such a blanket require additional consideration during final design.
6) Downstream Pond and Channel Improvements: The origins of the pond adjacent to the Calero Valve Yard and the linkage to water sources including dam seepage, natural groundwater, dam outlet and spillway discharges are currently being studied. The District has also identified some drainage/flooding concerns of its facilities at the toe of the dam and drainage/erosion concerns in the channel that conveys spillway discharges back to Calero Creek. Once the District determines if and how they want

to address these items, they could be addressed as part of final design and permitting of the Calero Dam Retrofit Project.

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5.0 Construction Costs and Schedule

5.1 Preliminary Cost Estimates

A comparative (construction) cost for the Staff-Recommended Alternative has been estimated at approximately $56.2 million in 2015 dollars (1st quarter 2015). The comparative cost estimate was generated in accordance with guidelines established by the Association for Advancement of Cost Engineering (AACE) as a Class 3 estimate which is assumed to include the actual installed cost within the range of -20 to +30 percent. Assumptions made in developing the construction costs included a 20% cost for unlisted items and a 20% Class 3 contingency.

Table 5-1 summarizes the estimated project costs.

Table 5-1: Estimated Project Costs

Project Element	Amount
Main Dam Seismic Retrofit and Crest Raise	$14,300,000
Spillway Improvements for PMF and Auxiliary Dam Raise	$2,300,000
Outlet Works Replacement and Abandonment of Existing Outlet Conduit	$12,300,000
Other Site Work	$5,000,000
Miscellaneous Uncosted Items @ 20%	$6,800,000
General Conditions, Bonds & Insurance	$6,100,000
Direct Construction Subtotal (DCS)	**$46,800,000**
Class 3 Contingency (20%)	$9,400,000
Estimated Construction Cost	**$56,200,000**
Design Engineering and CM Allowance (25% of DCS + Contingency)	$14,000,000
Total Estimate (2015 dollars)	**$70,200,000**

This is not the overall actual estimated project cost. Costs for right of way acquisition, replacement water supply, District administration and legal fees, planning/environmental studies and permitting, habitat restoration/mitigation costs, and relocation of historic structures are not included in the $70,200,000 estimate.

Assuming the midpoint of construction would be in 2019, estimated escalation from 2015 would be $5,600,000 making a projected project cost in 2019 dollars of $75,800,000.

5.2 Construction Schedule

Based on preliminary schedule estimates, and assuming the reservoir is fully drained for construction, the seismic and other retrofit improvements at Calero Dam could be constructed over approximately 32 to 36 months. Assuming construction begins in March 2018 as forecast by the District, construction would be completed by late 2020.

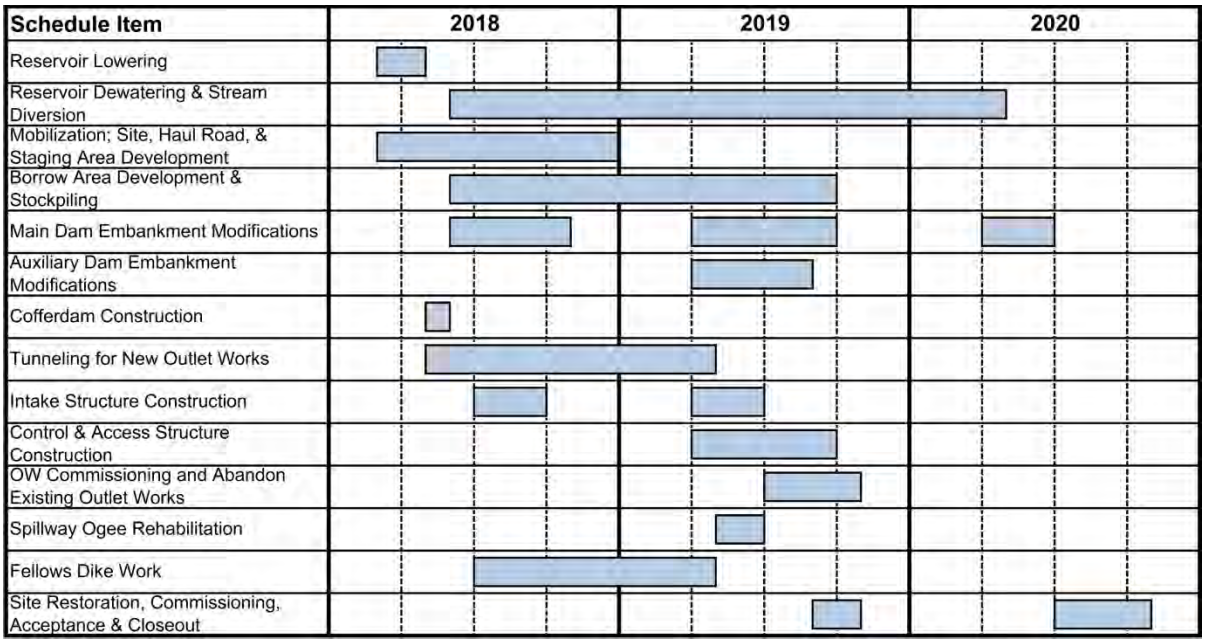
In general, construction of the Staff-Recommended Alternative would span at least two full construction seasons, with some work over the intervening winters, plus a portion of a third construction season. Key sequence assumptions made in preparing the construction schedule for the Staff-Recommended Alternative are as follows:

- As indicated by the District, the construction contract notice to proceed (NTP) would be issued by March 1, 2018 to allow a full construction season starting in April 2018.
- Reservoir lowering by the District would occur in March-April 2018 allowing access for the temporary cofferdam for sloping intake construction to occur by the end of May 2018.
- Dam earthwork would occur from April through October 2018 and 2019, with a shutdown of major earthwork during the winter rainy season. (Constructability review may indicate it is preferable to a contractor to delay start of major earthwork on the Main Dam until the second construction season, early 2019, without delaying the completion schedule.)
- The new outlet works would be constructed continuously from May 2018 through August 2019, with work occurring over the intervening winter, and completion required before abandoning the existing outlet works.
- The existing outlet works would be abandoned in late summer 2019, with completion required before completing downstream dam embankment work in fall 2019.
- Final dam crest work, upstream concrete panel construction, and instrumentation would occur in the 2020 construction season after substantial project completion.
- Fellows Dike structure removal and/or relocation and breach would occur in 2018 or 2019.

This schedule would allow refilling of Calero Reservoir beginning in September 2020 after substantial completion of the overall project. It may, however, be possible to begin a partial refilling in late 2019 after completion of the outlet works and major dam earthwork, subject to the approval of DSOD.

The generalized schedule discussed above is also presented graphically in **Figure 5-1**.

Figure 5-1: Preliminary Construction Schedule for SRA



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Appendix A

Table A-1: Calero Dam Pertinent Data (Modified from Calero Main and Auxiliary Dam Supporting Technical Information Document (STID), Appendix D, Pertinent Data Table; Geosyntec, 2012b)

Location	Santa Clara County, 12 miles south of downtown San Jose
Dam No.	CA 72-003, National ID. No. CA00288
Latitude/ Longitude	Calero Main Dam: 37°10'59.7"N, 121°47'32.4"W Calero Auxiliary Dam: 37°11'15.5"N, 121°46'49. 3"W
Stream/River	Calero Creek
Project Function	Storage for conservation, groundwater recharge and flood control. Backup storage of imported water supplies.
Datum	District has converted to NAVD 1988 which is 2.8 feet higher than NGVD 1929 at this location. Original construction documents were based on local datum that has been estimated to be 2.89 feet lower than NAVD 1988.
Drainage Area	7.1 sq. miles
Reservoir Capacity	9934 acre-feet (note 1)
Reservoir Area	337 acres at NHWL El. 483.9 ft (El. 486.8 ft NAVD88)(note 2)
Dam Type	Main Dam: Compacted earthfill with upstream concrete face Auxiliary Dam: Compacted earthfill with upstream concrete face
Height	Main Dam: 90 ft Auxiliary Dam: 40 ft
Dam Crest Length/Width	Main Dam: 840 ft long, 20 ft wide Auxiliary Dam: 510 ft long, 25 ft wide
Dam Crest Elev.	Main and Auxiliary Dams: Design El. 490 ft (El. 492.9 ft NAVD88); current surveyed minimum elevation El. 489.3 (El. 492.2 NAVD88)
Spillway Crest Elev.	El. 483.9 (El. 486.8 NAVD88) (note 3)
Reservoir Elev.	El. 483.9 (El. 486.8 NAVD88) (NHWL DSOD certificate); Restricted to El. 469.3 ft (El. 472.2 NAVD88), ~ 20 feet of freeboard As of October 13, 2011, restriction was changed to El. 464.5 ft (El. 467.4 NAVD88), ~ 25 feet freeboard

Outlet Type/Capacity	Low-level outlet: • Capacity 280 cfs • Inlet: 42-inch hydraulically operated slide gate valve • 36-inch steel outlet pipe in concrete jacket. Invert El. 392.1 (El. 394.9 NAVD88). 481 ft long • 30-inch butterfly valve located in valve vault at the dam toe, which is used solely for isolation of the pipeline downstream of outlet pipe. Invert 389.5 ft (392.4 NAVD88) • Typically operated with valve in the Calero valve yard.
Slopes	Main Dam: • Upstream and Downstream : 2.5 H:1 V Auxiliary Dam: • Upstream: 2.5 H:1 V • Downstream: 2.5 H:1 V, upper 7 ft 1.8H to 1V
Hazard Classification	DSOD Total Class Weight 30 High Consequence on DSOD Consequence-Hazard Matrix Treated as extreme consequence for SSE1B study
Original Construction	1935
Modifications	1962: Dam crest and spillway crest raised 1966: Piezometers installed 1972: Piezometers installed 1977: Piezometers installed 1981: Outlet works modified and connected to the Almaden Valley pipeline. 1991: Grout curtain installed 2006/07: 26 vibrating wire piezometers and 2 inclinometers installed as part of DIP 2010: 5 Vibrating wire piezometers installed

Notes:

1) There are different estimates of reservoir capacity, ranging from 9934 acre-feet (SCVWD website) to 10,410 acre-feet (DSP, 2005).
2) From DSOD Bulletin 17. 2005 DSP indicates reservoir surface area 347 acres at full pool.
3) From Bulletin 17. 2005 DSP indicates spillway crest at 483.5 ft. However, DSP may be in error. DSOD certificate indicate raised (sacked concrete) spillway weir at 483.9 (NGVD29)

Appendix B

Calero Dam Seismic Retrofit Project Requirements

FINAL DRAFT Project Requirements CALERO DAM

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

District Project Manager: Bal Ganjoo

Planning Consultant: GEI Inc.

FINAL DRAFT (Revision 7 - 3/6/14)

No.	Project Requirements	Reference Document/ Version/Page	Identified Phase for Incorporation		Comments	Implementation Strategy	Actual Implementation during Design Phase	Team Sign-off, Date/ Remarks	Monitoring Strategy
			Planning	Design					
GENERAL									
1	All facilities associated with the Project, outlet works, spillway, and their appurtenances shall have a useful life of at least 50 years without requiring major repairs.	Project Requirements Workshop (Internal) on 9/11/13	X	X	A specific life line standard is not referenced. However, it is common engineering and planning practice to assume major infrastructure will remain in service 100-years or more. Specific materials and designs of specific major components (i.e. outlet pipes) should be designed to remain in service for at least 50 - years without major rehabilitation or replacement. Pertinent USACE design manuals and other industry standards are recommended for estimating major feature service life. Refer to USACE ER 1110-2-8159 for typical major infrastructure design life requirements.				
2	Comply with all DSOD safety requirements/guidelines, and use engineering judgment consistent with the state-of-the-practice.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
3	Construction of the Project shall be substantially complete by June 2019.	Project Requirements Workshop (Internal) on 9/11/13	X	X	DSOD letter dated 3/23/2012				
4	Seismic Performance. The project shall be designed such that after MCE loading, the project will not suffer catastrophic failure (such as breach of the dam) and all features necessary to ensure dam safety will remain operational (such as the ability to quickly lower the reservoir).	Project Requirements Workshop (Internal) on 9/11/13	X	X	Seismic performance for ancillary facilities, access roads, and instrumentation and controls systems will be addressed as part of design. Consideration will be given to distinguishing performance for both an operating basis earthquake (OBE) and the MCE.				
5	The District has the following post-MCE service level requirements that shall be incorporated to the extent practical within the retrofit project area (a) Ancillary structures housing valves or other mechanical/electrical equipment shall not fail during the Maximum Credible Earthquake (MCE) and any resulting structural damage shall not prohibit access for inspection and/or operation of mechanical and electrical systems, (b) Access roads to the dam embankment and appurtenances shall remain accessible by standard passenger vehicles for inspection and readily repairable by dozer or grader to facilitate repairs following the MCE, (c) instrumentation and surveillance monitoring equipment for the dam embankment and appurtenances shall remain operational immediately following the MCE, including communication links to District headquarters, and (d) Power and SCADA controls required to operate the intake, outlet works, spillway gates (if applicable), and other appurtenances shall not be disrupted following the maximum credible earthquake.	Project Requirements Discussion February 18, 2014	X	X	There are portions of this requirement they may not be possible to guarantee. The planners and designers should identify specific issues, as they are encountered to agree upon a path forward.				
6	An independent source of back-up power should be incorporated into the Project. This may be propane generators , UPS or other suitable power source.	Project Requirements Workshop (Internal) on 9/11/13		X	Provisions for back-up power to be addressed by the design consultant.				
7	For planning include cost estimates for replacement of all blockhouses. Design should include the evaluation and design of replacement blockhouses, as necessary.	Project Requirements Workshop (Internal) on 9/11/13	X	X					

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

District Project Manager: Bal Ganjoo

Planning Consultant: GEI Inc.

FINAL DRAFT (Revision 7 - 3/6/14)

No.	Project Requirements	Reference Document/ Version/Page	Identified Phase for Incorporation		Comments	Implementation Strategy	Actual Implementation during Design Phase	Team Sign-off, Date/ Remarks	Monitoring Strategy
			Planning	Design					
8	Storage of boring log (geotechnical investigation) sample for geotechnical investigation; obtain District's warehouse's confirmation for approximately one year storage after construction is complete.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
TECHNICAL - EMBANKMENT									
1A	The embankment requirements for the project will require discussion and agreement with DSOD. Requirements noted below may require modification as the project continues.	Project Requirements discussion 2.18.14	X	X	**Black & Veatch:** Suggest keeping samples throughout construction + some amount of time				
1	The dam embankment shall have sufficient freeboard to safely pass the PMF without overtopping, and to meet DSOD freeboard requirements.	PMC - per PC comments on previous revisions	X	X	Parapet walls to meet freeboard are not anticipated to meet DSOD requirements				
2	Embankment shall have adequate stability, and any deformation post MCE shall not pose a dam safety risk and shall be readily repairable.	PMC - per PC comments on Revision 2	X	X					
3	Embankment seepage shall be safely controlled using filters, drains, cutoffs and/or other methods. USBR and/or other industry standards should be used in design.	PMC - per PC comments on Revision 2	X	X					
4	If borrow is required by the project alternative, designs should make use of on-site borrow sources if possible.	PMC - per PC comments on Revision 2	X	X					
5	Modifications to the project shall consider the possibility of future raising of the dam by about 30 feet, and planning shall incorporate this consideration in the design of new features.	PMC - per H.Desai comments on Revision 2	X	X	Specific design considerations for a future dam raise include: locating outlet works, intake structures, and other major features outside of an enlarged embankment foot print, specifying strengths and compaction requirements of new fill such that the new fills could likely be incorporated in new raises, and consideration of potential earth loads of a new dam on new underground features, and sizing outlet pipes to handle additional reservoir head.				
TECHNICAL - OUTLET WORKS									
1	The new outlet works shall meet the DSOD emergency drawdown criteria. For reservoirs that impound over 5,000 acre-feet of water, the outlet system should be capable of lowering the maximum storage depth by 10 percent within 7 days and draining its full contents within 90 days.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
2	The new outlet intake shall be compatible with a potential future dam raise of 30 feet, as well as the existing dam height.	Project Requirements Workshop (Internal) on 9/11/13	X	X					

FINAL DRAFT Project Requirements CALERO DAM

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

District Project Manager: Bal Ganjoo

Planning Consultant: GEI Inc.

FINAL DRAFT (Revision 7 - 3/6/14)

No.	Project Requirements	Reference Document/ Version/Page	Identified Phase for Incorporation		Comments	Implementation Strategy	Actual Implementation during Design Phase	Team Sign-off, Date/ Remarks	Monitoring Strategy
			Planning	Design					
3	The new outlet works shall be capable of providing flow releases to Calero Creek in accordance with current operations.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
4	The outlet works shall remain fully operable and accessible following the Maximum Credible Earthquake (MCE). For the outlet works damage to the existing conduit is acceptable only to the point where it does not compromise flow carrying capacity of the system commensurate with DSOD emergency drawdown criteria or normal operations that provide for flows to Calero Creek. Further, the outlet works must remain accessible for repairs that allow the system to remain fully operational.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
5	Any modifications to the intake structure shall consider sedimentation and operations and maintenance in selection of the intake port elevation(s).	Project Requirements Workshop (Internal) on 9/11/13		X	Verify with Jae Abel in regards to reservoir temperature requirements, if any. Design consultant will be responsible for refining intake elevations based on sedimentation, temperature, or other factors.				
6	If necessary, the existing outlet conduit, intake, and the outlet structures should be abandoned as per DSOD requirements	Project Requirements Workshop (Internal) on 9/11/13		X					
7	If a new outlet is planned, it is preferred by the district to be a carrier pipe in an oversized tunnel, to facilitate inspection and maintenance	Project Requirements Discussion 2/18/14	X	X					
8	Evaluate the replacement of the hydraulic lines, such that they are not in contact with water.	Project Requirements Workshop (Internal) on 9/11/13		X					
9	Perform inspection of outlet pipe. This will assist in determining to construct a new outlet or to continue to use existing outlet and connect to new intake.	Project Requirements Workshop (Internal) on 9/11/13	X						
10	If new outlet tunnel option is selected, it shall be constructed in such a way as to absolutely minimize leakage into tunnel.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
11	If new outlet tunnel option is selected, all lighting and emergency lighting should be water tight design and installed according to manufacturer specifications in order to ensure effective and long lasting performance.	Project Requirements Workshop (Internal) on 9/11/13		X	Valve travel time to match the existing valves (but not less than 15 minutes full travel) and is to move continuously (not pulsed).				
12	If new outlet tunnel option is selected, it shall accommodate trench grates to efficiently eliminate any water that collects in the tunnel in order to avoid any slip hazards.	Project Requirements Workshop (Internal) on 9/11/13		X					
13	If new outlet tunnel option is selected, a paging system (such as Gaitronics or similar) shall be installed with necessary receivers/transmitters to effectively communicate.	Project Requirements Workshop (Internal) on 9/11/13		X					

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

District Project Manager: Bal Ganjoo

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FINAL DRAFT (Revision 7 - 3/6/14)

No.	Project Requirements	Reference Document/ Version/Page	Identified Phase for Incorporation		Comments	Implementation Strategy	Actual Implementation during Design Phase	Team Sign-off, Date/ Remarks	Monitoring Strategy
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15	Replace 30" outlet valve. Current pipe through dam is 36" and downstream pipe is 48". Valve limits flow capacity.	M. Devore, Project Requirements Workshop (Internal) on 9/11/13	X	X					
16	Remove old siphon pipes.	M. Devore, Project Requirements Workshop (Internal) on 9/11/13	X	X					
17	Evaluate the feasibility of installing bi-directional pump station to increase outflow and allow for pumping into reservoir when needed.	M. Devore, Project Requirements Workshop (Internal) on 9/11/13	X	X	The pipes and valves should be sized to facilitate bi-directional flow. A pump station itself is considered outside of the project scope.				
18	New intakes will require inspection gallery. Required by Dam Safety Unit	M. MooersProject Requirements Workshop (Internal) on 9/11/13	X	X					
19	If a new outlet is planned as part of the project, the new outlet shall include a low-flow system such that the downstream environmental creek flows can be continually maintained.	PMC per H. Desai comments	X	X					
TECHNICAL - SPILLWAY									
1	The spillway shall be capable of safely routing past the downstream toe of the dam, storm flows in accordance with HMR 58/59.	DSOD	X	X					
2	The spillway for the Project shall remain fully operable and accessible following the MCE.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
3	Install screening at weep holes in spillway to keep amphibians and other animals from nesting there.	T. Neudorf, Project Requirements Workshop (Internal) on 9/11/13		X					
4	Need system to maintain vegetation at upper edges of spillway. Access and safety must be addressed in whatever is chosen. Spillway should included fall harness anchor points	M. Devore, Project Requirements Workshop (Internal) on 9/11/13		X					
5	Replace weir if the spillway needs to be changed.	M. Mooers, Project Requirements Workshop (Internal) on 9/11/13	X	X					

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

District Project Manager: Bal Ganjoo

Planning Consultant: GEI Inc.

FINAL DRAFT (Revision 7 - 3/6/14)

No.	Project Requirements	Reference Document/ Version/Page	Identified Phase for Incorporation		Comments	Implementation Strategy	Actual Implementation during Design Phase	Team Sign-off, Date/ Remarks	Monitoring Strategy
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6	To the extent practical, any spillway modifications shall consider the potential for a future dam raise, and the robustness of the spillway for future modification associated with dam raising.	PMC	X	X					
MAINTENANCE									
1	Guard valves shall be provided upstream of the main control valves to facilitate ease of maintenance and inspection of the outlet pipe(s).	Project Requirements Workshop (Internal) on 9/11/13	X	X					
2	Outlet works shall be configured such that the intake and outlet pipe(s) can be inspected without lowering or dewatering the reservoir.	Project Requirements Workshop (Internal) on 9/11/13	X	X	The …uirement that to the extent prac… conduits required for strea… drawdown, and distribution of w…t they can be visually inspected and maintained by District staff. The Planning Consultant is advised to refer to the intake and outlet works at Austrian Dam (Lake Elsman) or San Antonio Reservoir for examples of where man access has been provided for inspection and maintenance.				
3	Main control valves and structure should be easy to access, inspect, and maintain. Meaning special equipment or training should not be needed for maintenance of valves.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
4	Use of low maintenance valves such as stainless steel cone valves.	Project Requirements Workshop (Internal) on 9/11/13		X					
5	Intake structure sloped (as opposed to vertical) so that it can be inspected by walking through it.	Project Requirements Workshop (Internal) on 9/11/13	X	X	If difficult topography or geologic conditions make a sloping intake impractical, the district should be consulted regarding alternate approaches.				
6	Use of standard off the shelf (available/reliable) parts to the extent possible. Parts should be relatively common, such that special manufacturing and long lead ordering would not be required for replacement parts.	Project Requirements Workshop (Internal) on 9/11/13		X	Do not use butterfly valves, too many issues with cavitations, vibration, noise, and requires long dissipation. Prefer using smaller sized valves.				
7	Ability to replace oil during preventative maintenance (if oil is used), without requiring lowering of the reservoir.	Project Requirements Workshop (Internal) on 9/11/13		X					
8	Horizontal cylinders or lockout valves on underwater gates and valves.	Project Requirements Workshop (Internal) on 9/11/13		X					
9	Use of non-hazardous hydraulic fluid (no oil) for hydraulic systems for the upstream valves and gates.	Project Requirements Workshop (Internal) on 9/11/13		X					

Black & Veatch:
Modified from previous comment, however GEI should confirm this is consistent with their scope of work

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

District Project Manager: Bal Ganjoo

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FINAL DRAFT (Revision 7 - 3/6/14)

No.	Project Requirements	Reference Document/ Version/Page	Identified Phase for Incorporation		Comments	Implementation Strategy	Actual Implementation during Design Phase	Team Sign-off, Date/ Remarks	Monitoring Strategy
			Planning	Design					
10	Ability to isolate hydraulic pumps and connect backups. Hydraulic piping should have a minimum of connections.	Project Requirements Workshop (Internal) on 9/11/13		X					
12	Stainless steel shall be used wherever and whenever possible and practical to prevent corrosion of metallic parts such as valves, hydraulic lines.	Project Requirements Workshop (Internal) on 9/11/13		X	larger metallic items such as trash racks, etc are not included in the requirement				
13	Metallic components shall have adequate corrosion protections. Catholic protection should be utilized as required.	Project Requirements Workshop (Internal) on 9/11/13		X					
FELLOWS DIKE									
1	The staff-recommended alternative in the PSR(2010) for the Fellows Dike project produced by the District shall be incorporated into the Calero Dam PSR.	Project Requirements Workshop (Internal) on 9/11/13	X	X	All historical structures to be moved away from the area of inundation.				
OPERATIONS									
1	All upstream valves and gates should have position, as well as full-range indicators.	Project Requirements Workshop (Internal) on 9/11/13		X					
2	Valves associated with the outlet works shall be sized specific to their function (do not want one size fits all). Need to be able to control releases to within 20% or so many cfs. 1. Dam, Low Flow: 0 - 10 cfs. 2. Dam, Mid Flow: 0 - 200 cfs The high flow outlet shall be sized to meet emergency drawdown criteria, and may be a full port valve.	J. Sparkman, Project Requirements Workshop (Internal) on 9/11/13	X	X	Design Consultant to clarify requirement based on discussion with valve expert.				

FINAL DRAFT Project Requirements CALERO DAM

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

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FINAL DRAFT (Revision 7 - 3/6/14)

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			Planning	Design					
3	Valve / Gate Operations - Communication: Telephone communication (for communication w/ RWTP and for Dam Safety) - All valves should have a position indicator locally and remote (SCADA, etc.) - Power: Ability to disconnect power source and apply lock and tag and/or horizontal cylinders for underwater gates - Lighting: Inside/outside lighting with security covers; cage on lighting fixture - Security - Alarm when local control of valves are initiated - Flow Release Alarm for warning public of discharge	Project Requirements Workshop (Internal) on 9/11/13		X					
4	Security & Monitoring -Dam vaults/control structures will secured with District provided security locks. -PTZ w/ infrared CC cameras to monitor dam infrastructure.	Project Requirements Workshop (Internal) on 9/11/13		X					
5	Any large valves/gates that will not be automated will require manual operation shall incorporate means of attaching a portable electric motorized device for operation.	Project Requirements Workshop (Internal) on 9/11/13		X					
6		J. Sparkman, Project Requirements Workshop (Internal) on 9/11/13	X	X	Requirement removed per J. Sparkman. The previous intent was to modify the downstream channel capacity to safely pass the emergency release flows without flooding neighbors. This is still a desired goal, but it is realized it may not be in the scope of the project. New project features should be located outside of the flood elevation to the extent practical				
7	Install ability to release water to creek and pipeline at same time.	J. Sparkman, Project Requirements Workshop (Internal) on 9/11/13	X	X					
8	Install better valve scenario allow for repairs.	J. Sparkman, Project Requirements Workshop (Internal) on 9/11/13	X	X	The intent of this requirement is to have all valves easily opera table by a single person without special training or equipment.				
9	Creek channel needs to be fixed to manage pond and related issues, including maintenance problems caused by pond grass and algae.	M. Mooers, Project Requirements Workshop (Internal) on 9/11/13 (See Environmental Section for additional related items)	X	X					

Black & Veatch:
The requirement was removed as noted.

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

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FINAL DRAFT (Revision 7 - 3/6/14)

No.	Project Requirements	Reference Document/ Version/Page	Identified Phase for Incorporation		Comments	Implementation Strategy	Actual Implementation during Design Phase	Team Sign-off, Date/ Remarks	Monitoring Strategy
			Planning	Design					
10	Access to valve controls to be maintained throughout construction	M. Devore, Project Requirements Workshop (Internal) on 9/11/13		X					
11	Need to evaluate power needs and ensure adequate power is installed to dam and valve yard.	M. Devore, Project Requirements Workshop (Internal) on 9/11/13	X	X					
12	Valves to be electrically operated, and suitable for continuous operation. Motors to be rated for continuous duty.	E-mail received from Jerry Alexander (Control Systems) 9/11/13.		X					
13	The discharge valves should match the existing valve timing or at least have not less than 15 minutes for full stroke operation. For larger flow potential situations a full stroke duration should be 30 minutes.	E-mail received from Jerry Alexander (Control Systems) 9/11/13.		X					
14	Valves to have the following remote control interface signals: Position status, Position indication, and OPEN / CLOSE command signals (see Jerry Alexander's 9/11/13 e-mail for further circuit details).	E-mail received from Jerry Alexander (Control Systems) 9/11/13.		X					
15	Local manual operators and lights (to be used if remote controls are not available or not functioning properly)	E-mail received from Jerry Alexander (Control Systems) 9/11/13.		X					
16	Unit 545 electrical, I&C and SCADA personnel should review the valve and actuator submittals prior to installation.	E-mail received from Jerry Alexander (Control Systems) 9/11/13.		X					
INSTRUMENTATION									
1	Install new/improved instrumentation at dam. Planning shall consider conceptual instrumentation plans in cost estimating and transitioning to design phase of project.	James Nelson, Project Requirements Workshop (Internal) on 9/11/13	X	X					

FINAL DRAFT Project Requirements CALERO DAM

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

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FINAL DRAFT (Revision 7 - 3/6/14)

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2	Instrumentation shall be designed and installed at the dam to measure seepage flows, seepage turbidtity,embankment pore pressures, foundation pore pressures, settlement, tunnel deformations and ground movement, and outlet flows and temperatures, and any other information needed to understand the dam performance and determine safety. Instruments should be compatible with District automation systems	PMC		X					
3	Turbidity meters will need to be installed at the seepage weir and as appropriate. Turbidity meter will need to be automated.	J. Nelson, Project Requirements Workshop (Internal) on 9/11/13		X	Design Consultant to clarify requirement based on discussion with turbidity meter expert. Jim Nelson to supply turbidity meter product data.				
4	Flow measuring devices shall be incorporated into the outlet works for the full range of flows.	Project Requirements Workshop (Internal) on 9/11/13		X					
5	Seepage collection system shall have automated weir data connection to ADAS.	J. Nelson, Project Requirements Workshop (Internal) on 9/11/13		X					
6	Critical instruments impacted during construction will need to be replaced or relocated and connected to ADAS and SCADA.	J. Nelson, Project Requirements Workshop (Internal) on 9/11/13		X					
7	Critical survey monuments and benchmarks impacted during construction will need to be replaced or relocated .	J. Nelson, Project Requirements Workshop (Internal) on 9/11/13		X					
8	Instrumentation shall include remote sensing and observation of the dam, such as robotic survey equipment and cameras.	Project Requirements Discussion 2/18/14		X					
CONSTRUCTION									
1	Reservoir levels during construction shall not exceed operating restrictions based on agreement with the DSOD. Other construction considerations are likely to further restrict levels.	Project Requirements Workshop (Internal) on 9/11/13	X	X	There is currently an operational requirement of maintaining an emergency supply of 4,000 ac-ft and a smaller fish pool. This requirement may be possible to change during consultation with appropriate board approval. The planner should assume that the pool can be lowered for construction after fuurther clarification during alternatives analysis.				
2	The spillway and existing outlet works shall remain operable and serviceable such that winter flows can be passed in any given year that construction requires these systems to be taken off-line. Further, construction shall be scheduled such that the spillway and outlet works are off-line for no more than one construction season.	Project Requirements Workshop (Internal) on 9/11/13	X	X					

FINAL DRAFT Project Requirements CALERO DAM

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

District Project Manager: Bal Ganjoo

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FINAL DRAFT (Revision 7 - 3/6/14)

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3	If the reservoir is lowered to facilitate construction, this work shall be carefully coordinated with District Operations. Further, a Plan should be developed that, to the maximum extent possible, beneficially uses stored reservoir water that needs to be discharged to facilitate lowering of the water surface elevation, including diversions for water supply or water storage.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
4	Summer flow releases should anticipate need for discharge of flows in the range of **0-10** cfs.	Project Requirements Workshop (Internal) on 9/11/13	X	X	It is a goal to match temperature of discharge, pre-project, however the temperature of the existing discharges are variable and matching these flows may not make sense. It is possible to utilize distribution system to make releases to creek.				
5	Evaluate power requirements as part of the planned 2 year design period and procure appropriate upgrades to power at site prior to award of a construction contract.	Project Requirements Workshop (Internal) on 9/11/13		X					
6	If the reservoir is lowered to facilitate construction, the drawdown plan must meet requirements of HCP, Maximum releases are 20 cfs (dry season, May 1 - Oct 31) and 75 cfs (wet season, Nov. 1- April 31). Dewatering coordination between all 3 (Almaden/Calero/Guadalupe) projects will need to take place. Minimum releases are 1 cfs for the entire year	T. Neudorf, Project Requirements Workshop (Internal) on 9/11/13	X	X	Planning Consultant instructed to base evaluations on requirements for flow released indicated in the SCVHCP.				
7	If the reservoir is lowered to facilitate construction, the reservoir dewatering plan shall be included as part of the project CEQA review.	Project Requirements Workshop (Internal) on 9/11/13	X	X					
8	Mercury Diffuser System will need to be protected during construction.	Project Requirements Workshop (Internal) on 9/11/13		X					
ENVIRONMENTAL									
1	If the reservoir is lowered to facilitate construction, flow measurements shall be taken within 100-feet of reservoir drawdown discharge point.	T. Neudorf, Project Requirements Workshop (Internal) on 9/11/13		X					
2	Determine baseline turbidity prior to construction and implementation of Turbidity Monitoring Plan, during construction.	Project Requirements Workshop (Internal) on 9/11/13		X					
3	Implement the Conservation Strategies outlined within the SCVHCP/NCCP as it relates to the California tiger salamander	SCVHCP		X					
4	Implement the Conservation Strategies outlined within the SCVHCP/NCCP as it relates to the California red-legged frog	SCVHCP		X					

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

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FINAL DRAFT (Revision 7 - 3/6/14)

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5	Impact assessment and implement mitigations to reduce impacts to Steelhead downstream of the reservoir.	Project Requirements Workshop (Internal) on 9/11/13		X					
6	Pre-construction Surveys & Mitigation Strategies developed for various species not covered by the Santa Clara Valley HCP/NCCP: - San Francisco dusky footed wood rat - Migratory birds - Raptor Nests - Special status vegetation	T. Neudorf, Project Requirements Workshop (Internal) on 9/11/13		X					
7	Specific trees subject to damage or removal, or trees that qualify as Protected Trees should be identified. In the event that Protected Trees may be subject to damage and removal, a Mitigation & Monitoring Plan will be prepared by a qualified forester, arborist or restoration ecologist prior to the start of construction.	Project Requirements Workshop (Internal) on 9/11/13		X					
8	Evaluate need for Archaeological & Paleontological Monitoring during Construction.	Project Requirements Workshop (Internal) on 9/11/13		X					
9	From Construction Project Requirements - Creek channel needs to be fixed to eliminate pond and related issues, including maintenance problems caused by pond grass and algae.: Pond at Calero will need to be studied and documented to ensure this is not a breeding ground for the Reg Legged Frog or California Tiger Salamander before repairs to or re-routing of creek channel.	T. Neudorf, Project Requirements Workshop (Internal) on 9/11/13	X	X					
10	Geotechnical explorations will require proper environmental clearance which may indicate work is categorically exempt from CEQA or may require mitigation to support a negative declaration. Seasonal restrictions of work may apply, depending on the environmental concerns associated with specific exploration locations.	T. Neudorf, Project Requirements Workshop (Internal) on 9/11/13	X	X					
11	The discharge piping shall have a port, to allow future injection of muscle eradication/containment chemicals.	Per discussion with Mike Devore 2/20/14		X					
Permit Condition									
1	Obtain Categorical Exemption for Design Phase geotechnical investigations (Seepage/Outlet Works/Spillway)	Project Requirements Workshop (Internal) on 9/11/13		X	Design Consultant to prepare.				

FINAL DRAFT Project Requirements CALERO DAM

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

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FINAL DRAFT (Revision 7 - 3/6/14)

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2	Provide notice & obtain permits if necessary from California Department of Fish and Wildlife, USACE & RWQCB for Design Phase geotechnical investigations within the reservoir.	Project Requirements Workshop (Internal) on 9/11/13		X	Design Consultant to prepare.				
3	Obtain mitigated neg-dec for design phase geotechnical investigations as needed	Project Requirements Workshop (Internal) on 9/11/13		X	Design Consultant to prepare.				
4	Obtain USACE Verified Wetland Delineation	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
5	Biological Assessment for Project including dewatering if proposed	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
6	Obtain USACE Individual Permit for Construction (Section 404 of the Clean Water Act)	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
7	Obtain/Demonstrate USACE National Historic Preservation Act Section 106 Compliance	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
8	Obtain USFWS ESA Coverage via SCVHCP	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
9	Obtain NMFS ESA Section 7 Permit, will require Biological Opinion for Central California Coast Steelhead and critical Habitat	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
10	Obtain RWQCB 401 Water Quality Certification for project	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
11	Obtain California Department of Fish & Wildlife 1602 Permit	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
12	Obtain DSOD Permit & Approvals (pre-construction approval of plans & specifications)	Project Requirements Workshop (Internal) on 9/11/13		X	Design Consultant/District				
13	State of California Dept. of Industrial Relations - Divisions of Occupational Safety and Health - Mining and Tunneling Unit Permit required; Underground Classification with respect to the quantities of flammable gas or vapors.	Project Requirements Workshop (Internal) on 9/11/13		X	Designer/District to prepare.				
14	Santa Clara County Grading Permit	Project Requirements Workshop (Internal) on 9/11/13		X	Design Consultant/District				

PROJECT # 91084020 - CALERO AND GUADALUPE DAMS SEISMIC RETROFIT PROJECT - CALERO DAM

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FINAL DRAFT (Revision 7 - 3/6/14)

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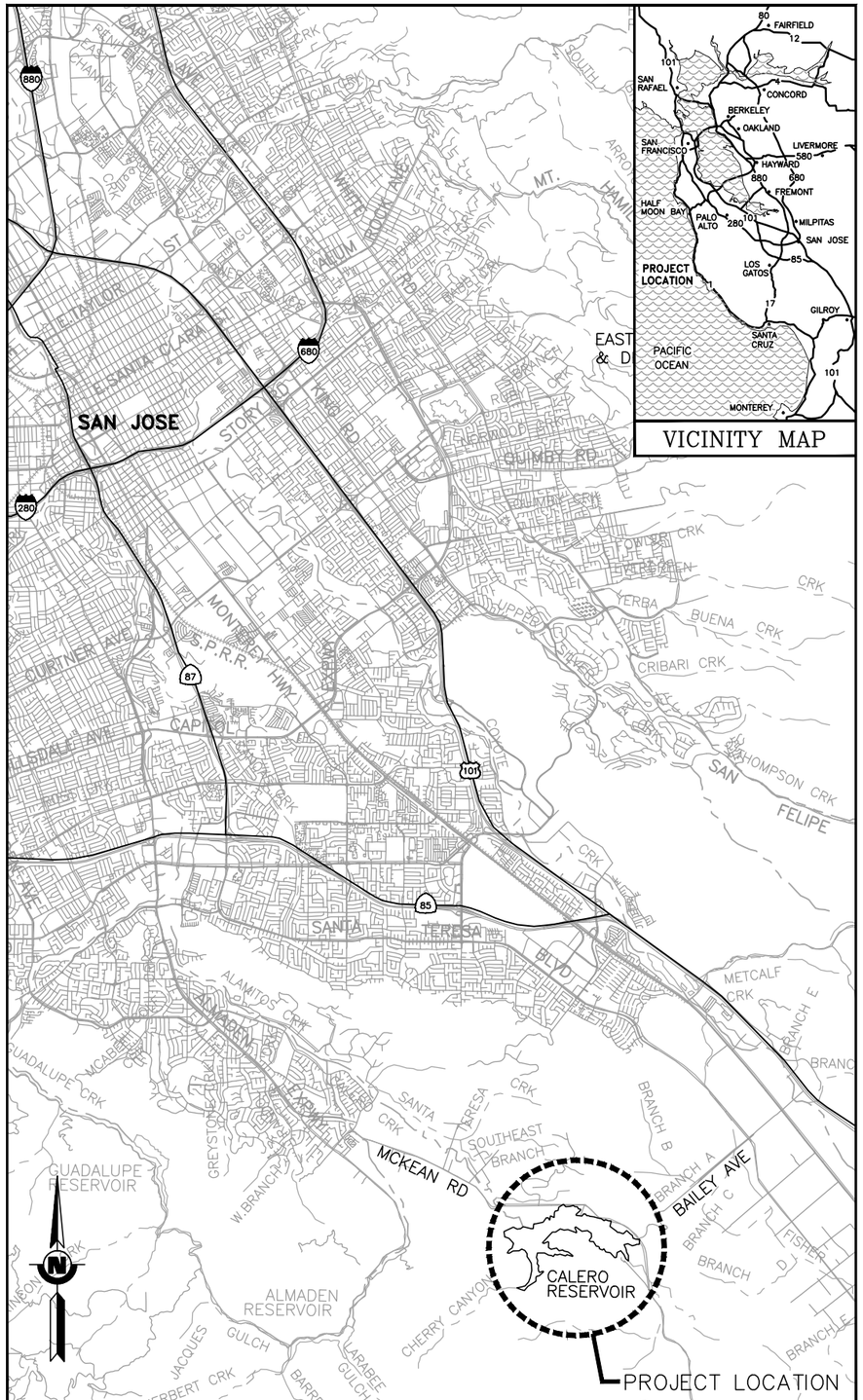
15	Santa Clara County Tree Removal Permit	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
16	Santa Clara County Design Review for visual impacts	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
17	Obtain Encroachment Permits	Project Requirements Workshop (Internal) on 9/11/13		X	Design Consultant/District				
18	Obtain Bay Area Air Quality Management District Permits/Approvals for: - Generators larger than 50hp; - Compliance with Asbestos ATCM (CA Code Title 17, Sec. 93105)	Project Requirements Workshop (Internal) on 9/11/13		X	Planning Consultant to prepare.				
19	Obtain peizometer well permits	Project Requirements Workshop (Internal) on 9/11/13		X	District				

Appendix C

Calero Dam Staff Recommended Alternative Drawings

Sheet No.	Drawing No.	Drawing Title
General Drawings		
1	G-1	Vicinity / Project Area Map and List of Drawings
2	G-2	Abbreviations and Notes
3	G-3	Overall Site Map and Key Plan
4	G-4	Existing Facilities at Calero Main Dam
5	G-5	Site Use Plan – Main Dam, Auxiliary Dam, Spillway, Stockpile, Staging, Disposal, and Borrow Areas
6	G-6	Borrow, Stockpile and Miscellaneous Details
Embankment Drawings		
7	E-1	Main Dam Crest Raise & Buttress Plan
8	E-2	Main Dam Excavation & Drainage Plans
9	E-3	Main Dam Profiles
10	E-4	Main Dam Cross Sections
11	E-5	Auxiliary Dam Plan, Profile and Sections
Outlet Works Drawings		
12	O-1	Outlet Works Plan & Profile
13	O-2	Outlet Works Intake Plan, Profile and Sections
14	O-3	Intake Control House General Arrangement
15	O-4	Access Tunnel and Pipeline Trench and Cross Sections
16	O-5	Outlet Valve House General Arrangement
Spillway Drawings		
17	S-1	Spillway Plan, Profile and Sections
Fellows Dike Drawings		
18	F-1	Fellows Dike



VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

LOCATION MAP
SCALE: 1"=5,000'

VICINITY MAP

PRELIMINARY DESIGN DRAWINGS
FOR
STAFF–RECOMMENDED ALTERNATIVE
FOR
CALERO DAM AND RESERVOIR

SEISMIC RETROFIT PROJECT
SAN JOSE, CALIFORNIA

Santa Clara Valley Water District SM

PREPARED BY:

GEI Consultants

REGISTERED PROFESSIONAL ENGINEER
WILLIAM A. RETTBERG
No. GE 2145
CIVIL
STATE OF CALIFORNIA

WILLIAM RETTBERG, P.E.
PROJECT MANAGER

FINAL
04-22-15

LIST OF DRAWINGS

SHEET NO	SHEET CODE	TITLE
1	G-1	VICINITY / PROJECT AREA MAP AND LIST OF DRAWINGS
2	G-2	ABBREVIATIONS AND NOTES
3	G-3	OVERALL SITE MAP AND KEY PLAN
4	G-4	EXISTING FACILITIES AT CALERO MAIN DAM
5	G-5	SITE USE PLAN - MAIN DAM, AUXILIARY DAM, SPILLWAY, STOCKPILE, STAGING, DISPOSAL AND BORROW AREAS
6	G-6	BORROW, STOCKPILE, AND MISCELLANEOUS DETAILS
7	E-1	MAIN DAM CREST RAISE & BUTTRESS PLAN
8	E-2	MAIN DAM EXCAVATION AND DRAINAGE PLANS
9	E-3	MAIN DAM PROFILES
10	E-4	MAIN DAM CROSS SECTIONS
11	E-5	AUXILIARY DAM PLAN, PROFILE, AND SECTIONS
12	O-1	OUTLET WORKS PLAN & PROFILE
13	O-2	INTAKE PLAN, PROFILE AND SECTIONS
14	O-3	INTAKE CONTROL HOUSE GENERAL ARRANGEMENT
15	O-4	TUNNEL AND PIPELINE SECTION AND DETAILS
16	O-5	OUTLET VALVE HOUSE GENERAL ARRANGEMENT
17	S-1	SPILLWAY PLAN, PROFILE AND SECTION
18	F-1	FELLOWS DIKE

PROJECT NUMBER
132838–0

SHEET CODE
G–1

SHEET NUMBER:
1 OF 18

DOCUMENT NUMBER: CAL_01_G-1-Cover

ABBREVIATIONS

ALIGN – ALIGNMENT
APPROX – APPROXIMATE

CL – CLEARANCE
CLR – CLEAR
CONC – CONCRETE

DIA – DIAMETER
DISTRICT – SCVWD
DSOD – CA DIVISION OF SAFETY OF DAMS
D/S – DOWNSTREAM

EL – ELEVATION
EXIST – EXISTING

FT – FEET

GEI – GEI CONSULTANTS, INC.

HORIZ – HORIZONTAL
HJW – HJW GEOSPATIAL, INC.

ID – INSIDE DIAMETER
INV – INVERT

MIN – MINIMUM

NMWS – NORMAL MAXIMUM WATER SURFACE
N/A – NOT APPLICABLE

NO – NUMBER
NTS – NOT TO SCALE

OD – OUTSIDE DIAMETER

REINF – REINFORCED
REQ'D – REQUIRED

S – SLOPE
SCCPRD – SANTA CLARA COUNTY PARKS AND RECREATION DEPARTMENT
SCVWD – SANTA CLARA VALLEY WATER DISTRICT
SHT – SHEET
SPECS – SPECIFICATIONS
SRA – STAFF RECOMMENDED ALTERNATIVE
STD – STANDARD
STL – STEEL

TYP – TYPICAL

URS – URS CORPORATION
U/S – UPSTREAM

VERT – VERTICAL

WS – WATER SURFACE
W/ – WITH

& – AND
@ – AT
℄ – CENTERLINE
Ø – DIAMETER
℘ – PROPERTY LINE

LEGEND

PROPERTY LINE
NORMAL MAXIMUM WATER SURFACE
DSOD RESTRICTED WATER SURFACE ELEVATION
WATER COURSE
PRELIMINARY HAUL ROUTE
APPROXIMATE LIMIT OF STOCKPILE, BORROW, DISPOSAL, OR STAGING AREA AS NOTED

GENERAL NOTES

1. THESE DRAWINGS REPRESENT THE CONFIGURATION AND KEY FEATURES OF THE DISTRICT'S STAFF RECOMMENDED ALTERNATIVE (SRA) CONSISTENT WITH AN APPROXIMATE 20% LEVEL OF DESIGN CONCEPT DEVELOPMENT. AS SUCH, ADDITIONAL INVESTIGATIONS, ANALYSES AND FINAL DESIGNS WILL BE REQUIRED TO FURTHER DEVELOP THE 30%, 60%, 90% AND 100% DESIGN DRAWINGS, SPECIFICATIONS AND SUPPORTING INFORMATION NEEDED FOR DISTRICT REVIEW, DSOD REVIEW, AND OTHER APPROVALS PRIOR TO BIDDING AND CONSTRUCTION.

2. THE SRA IS BASED UPON EXISTING INFORMATION PROVIDED BY THE DISTRICT INCLUDING THE FINAL REPORT SSE1B – SEISMIC STABILITY EVALUATION OF CALERO MAIN DAM AND CALERO AUXILIARY DAM, BY URS CORPORATION, OCTOBER 2012; AS WELL AS PLANNING LEVEL EVALUATIONS BY GEI CONSULTANTS AS SUMMARIZED IN THE CALERO DAM PROBLEM DEFINITION REPORT, DATED SEPTEMBER 2014 AND THE CALERO DAM ALTERNATIVES REPORT, REVISED MARCH 2015. THE FINAL DESIGN CONSULTANT WILL NEED TO FURTHER CONFIRM AND VERIFY THE INFORMATION TO FORM THE BASIS FOR FINAL DESIGN.

3. THE VERTICAL DATUM IS NAVD88 FEET (AT THIS SITE NAVD88 IS APPROXIMATELY EQUAL TO NGVD29+2.89 FT).

4. THE HORIZONTAL COORDINATE SYSTEM IS BASED ON CA ZONE III, NAD 83.

5. REGIONAL TOPOGRAPHY IS FROM 2006 USGS LiDAR. IN THE DAM AND RESERVOIR VICINITY THE SOURCE OF THE AERIAL IMAGERY AND SURVEY DATA IS THE NOVEMBER 2002 AERIAL SURVEY BY HJW.

6. TO THE BEST OF OUR KNOWLEDGE, THESE DRAWINGS MEET THE DISTRICT'S PROJECT REQUIREMENTS FOR THE SRA. HOWEVER, THE FINAL DESIGN CONSULTANTS, IN CONCERT WITH THE DISTRICT, DSOD AND OTHER ENVIRONMENTAL AND REGULATORY AGENCIES, WILL BE REQUIRED TO CRAFT THE SRA TO MEET THE DISTRICT'S REQUIREMENTS AND ALL OTHER REGULATORY PERMITS AND APPROVALS.

7. TUNNEL PORTALS AND ALIGNMENT, AND INTAKE STRUCTURE LOCATION ARE PRELIMINARY AND WILL REQUIRE ADDITIONAL GEOTECHNICAL INVESTIGATIONS TO CONFIRM FINAL LOCATION AND CONFIGURATION.

8. DISTRICT WILL FULLY LOWER THE RESERVOIR PRIOR TO CONSTRUCTION AND WILL HALT DELIVERY OF RAW WATER DURING CONSTRUCTION. AFTER INITIAL RESERVOIR LOWERING BY THE DISTRICT, THE CONTRACTOR SHALL BE RESPONSIBLE FOR TEMPORARY DIVERSION OF NATURAL RESERVOIR INFLOW THROUGH THE WORKSITE AND MAY USE THE EXISTING OUTLET WORKS FOR SUCH PURPOSES. IF NECESSARY, THE DISTRICT WILL SATISFY MINIMUM DOWNSTREAM FLOW REQUIREMENTS DURING CONSTRUCTION USING THE CALERO BYPASS PIPELINE. CONTRACTOR SHALL CONTINUOUSLY MAINTAIN, PROTECT AND OPERATE THE EXISTING OUTLET WORKS IN A FULLY SERVICEABLE CONDITION, INCLUDING POTENTIAL EMERGENCY USE, UNTIL THE NEW OUTLET WORKS IS SUBSTANTIALLY COMPLETE AND ACCEPTED FOR USE BY THE DISTRICT, FINAL DESIGN CONSULTANT, AND DSOD.

9. THERE ARE DELINEATED WETLANDS DOWNSTREAM OF THE MAIN DAM (URS 2014) AND OUTLET WORKS. THE FINAL DESIGN CONSULTANT WILL NEED TO ADDRESS AND PROTECT THESE WETLANDS TO THE MAXIMUM PRACTICABLE EXTENT SUBJECT TO ENVIRONMENTAL PERMIT CONDITIONS – TO BE DETERMINED.

10. PRELIMINARY DESIGN CONCEPT IS BASED ON THE REMOVAL OF A PORTION OF THE MAIN DAM EMBANKMENT, REMOVAL OF THE FOUNDATION SOIL BELOW THE REMOVED EMBANKMENT AND NEW BUTTRESS (ALLUVIAL AND COLLUVIAL SOILS). THE EXCAVATION WILL EXPOSE UNDISTURBED FRANCISCAN COMPLEX SEDIMENTARY FORMATION ROCK; CONFIRMATION BY GEOLOGIC INSPECTION; AND REMOVAL OF LOOSE, DESICCATED, WET OR OTHERWISE DAMAGED FOUNDATION MATERIALS IMMEDIATELY PRIOR TO PLACEMENT OF EMBANKMENT BUTTRESS MATERIAL. THE DAM FOUNDATION OBJECTIVE AND PREPARATION REQUIREMENTS WILL BE REFINED DURING FINAL DESIGN BY THE FINAL DESIGN CONSULTANT, AND SUBJECT TO CONFIRMATION BY DSOD.

Cal_02_G-2-Abbreviations and Notes

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE 04-22-15
DESIGN N.K.S.
DRAWN N.K.S.
CHECKED J.G.H.

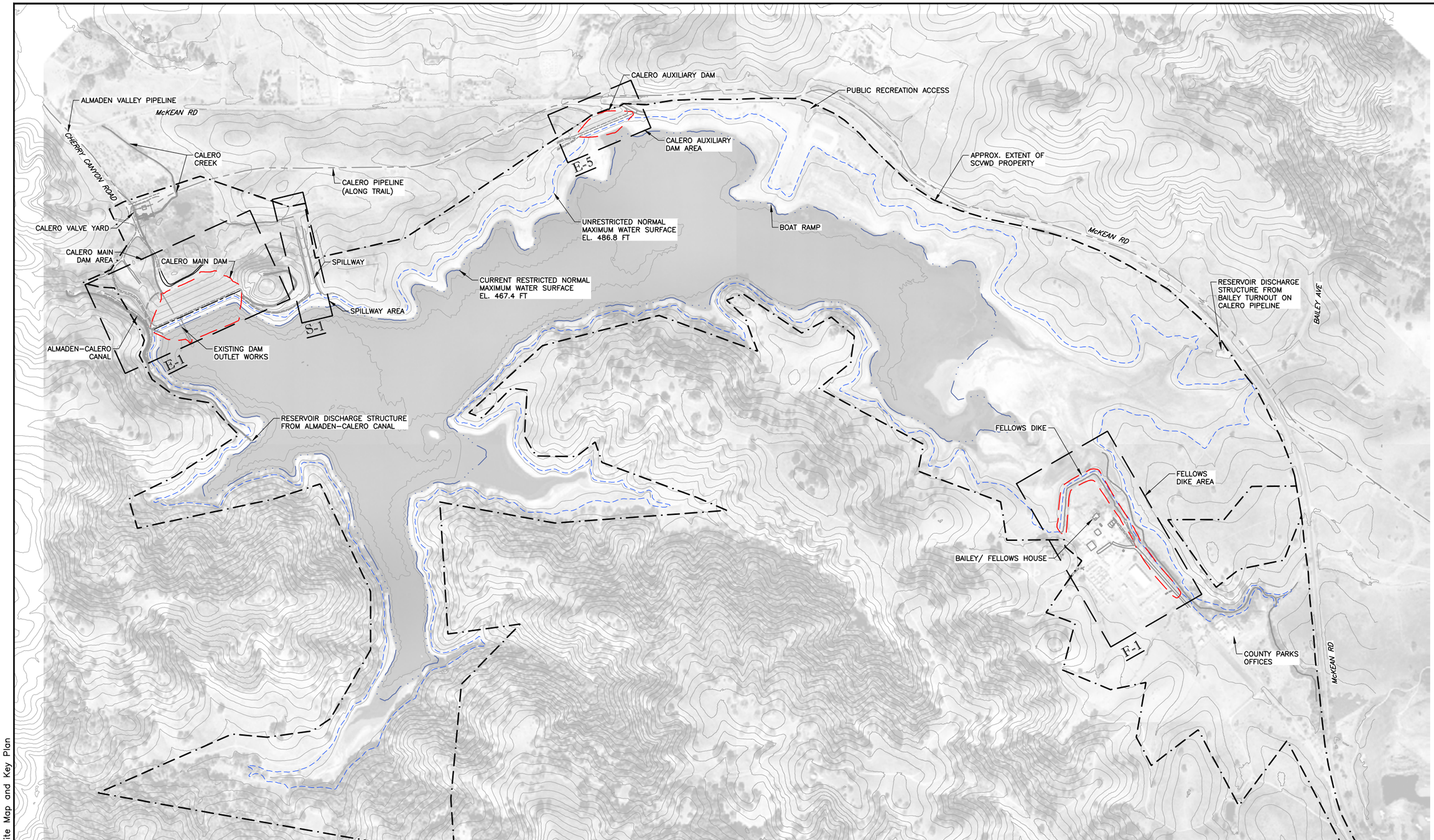
ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

Santa Clara Valley Water District
ACCEPTED BY DISTRICT
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:
CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE
ABBREVIATIONS AND NOTES

SCALE
AS NOTED
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
1328380
SHEET CODE:
G-2
SHEET NUMBER:
2 OF 18



PLAN

SCALE: 1"=400'

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04–22–15
DESIGN	N.K.S.
DRAWN	N.K.S.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF–RECOMMENDED ALTERNATIVE

OVERALL SITE MAP AND KEY PLAN

SCALE: AS NOTED

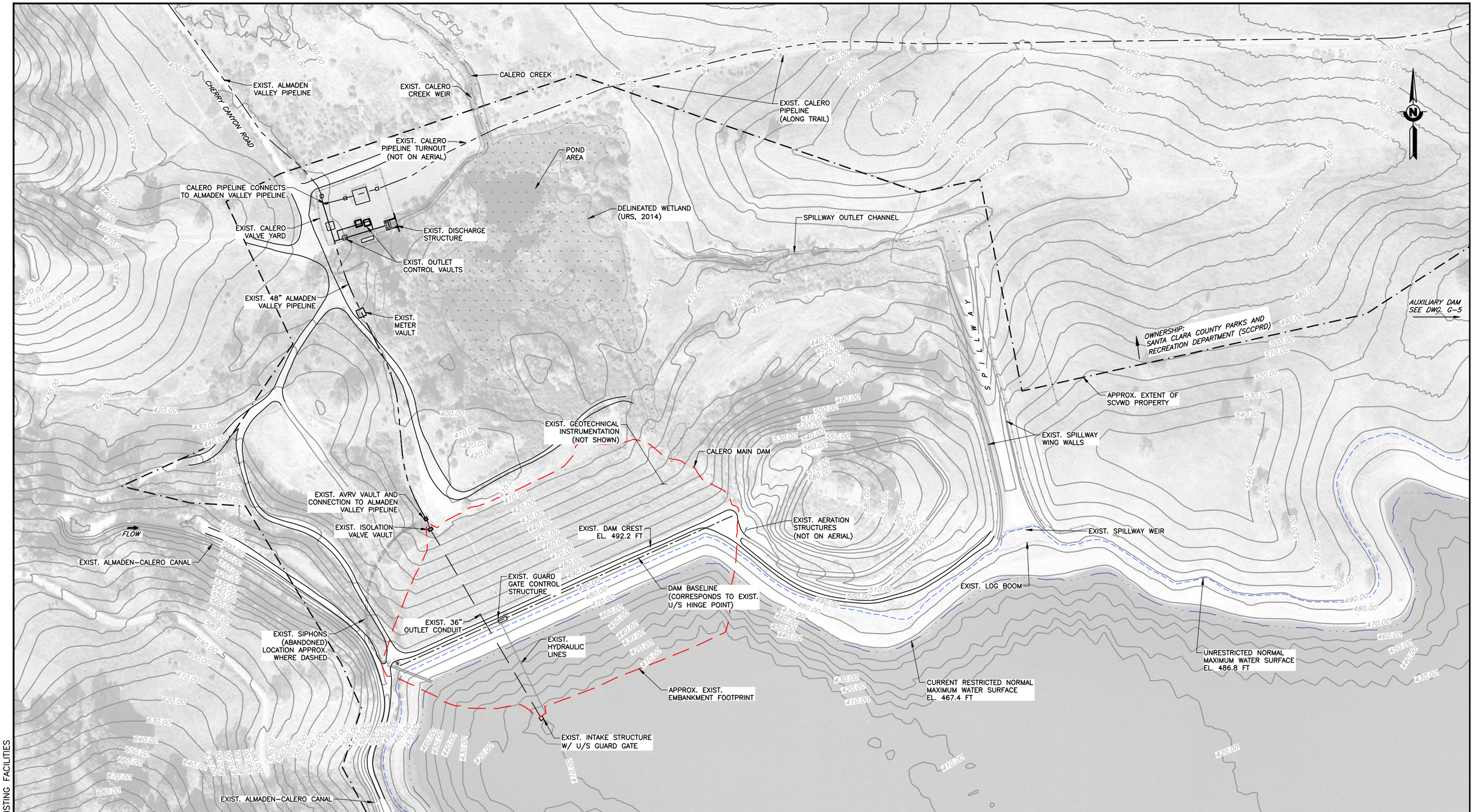
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 1328380

SHEET CODE: G-3

SHEET NUMBER: 3 OF 18

Cal_03_G-3-Overall Site Map and Key Plan



PLAN

SCALE: 1"=100'

Cal_04_G-4-EXISTING FACILITIES

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04-21-15
DESIGN	N.K.S.
DRAWN	N.K.S.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

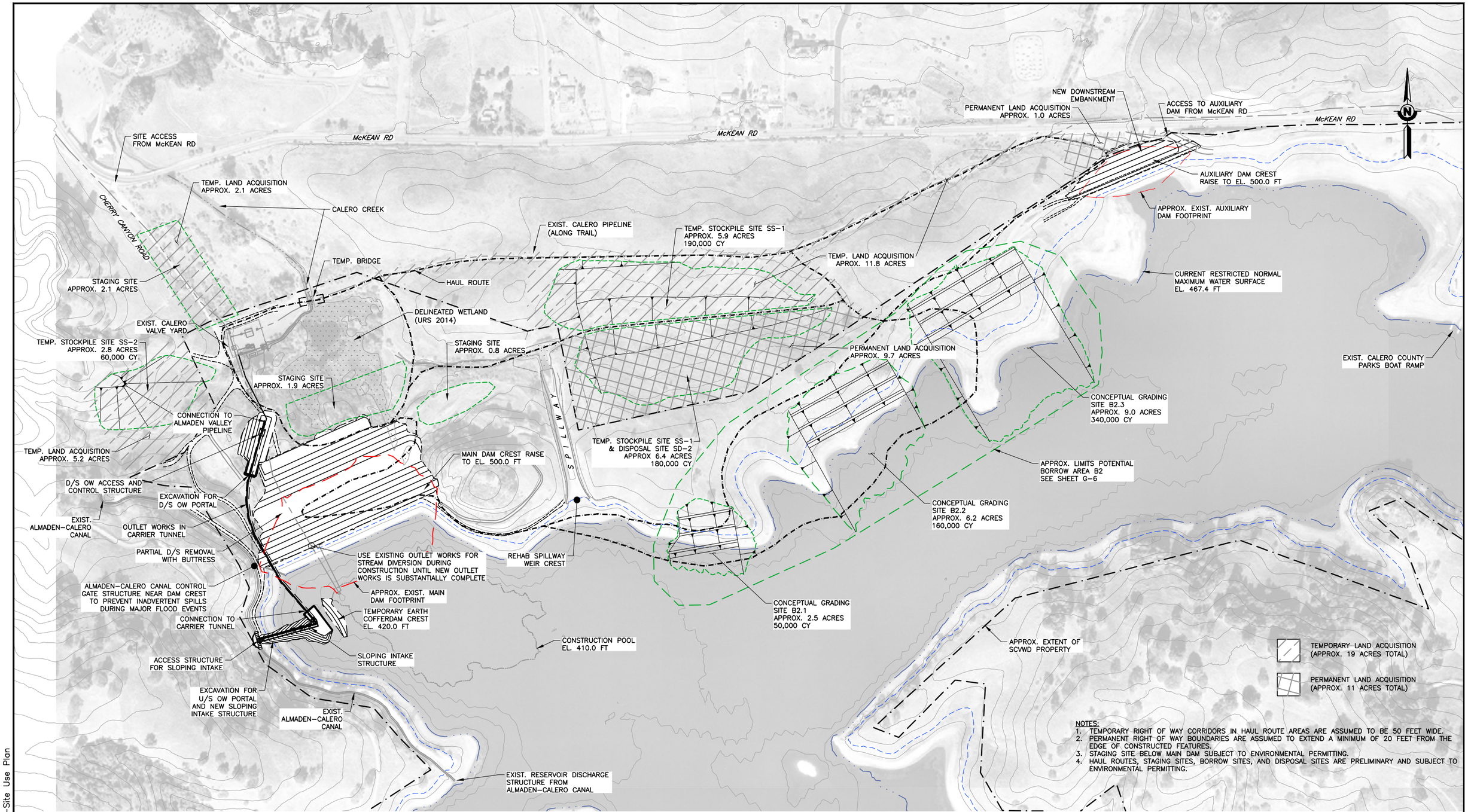
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE

EXISTING FACILITIES
AT CALERO MAIN DAM

SCALE	AS NOTED
VERIFY SCALES	0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER	1328380
SHEET CODE:	G-4
SHEET NUMBER:	4 OF 18



NOTES:
1. TEMPORARY RIGHT OF WAY CORRIDORS IN HAUL ROUTE AREAS ARE ASSUMED TO BE 50 FEET WIDE.
2. PERMANENT RIGHT OF WAY BOUNDARIES ARE ASSUMED TO EXTEND A MINIMUM OF 20 FEET FROM THE EDGE OF CONSTRUCTED FEATURES.
3. STAGING SITE BELOW MAIN DAM SUBJECT TO ENVIRONMENTAL PERMITTING.
4. HAUL ROUTES, STAGING SITES, BORROW SITES, AND DISPOSAL SITES ARE PRELIMINARY AND SUBJECT TO ENVIRONMENTAL PERMITTING.

PLAN

SCALE: 1"=200'

Cal_05_G-5-Site Use Plan

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE 04-22-15
DESIGN N.K.S.
DRAWN N.K.S.
CHECKED J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE

SITE USE PLAN – MAIN DAM, AUXILIARY DAM, SPILLWAY, STOCKPILE, STAGING, DISPOSAL, AND BORROW AREAS

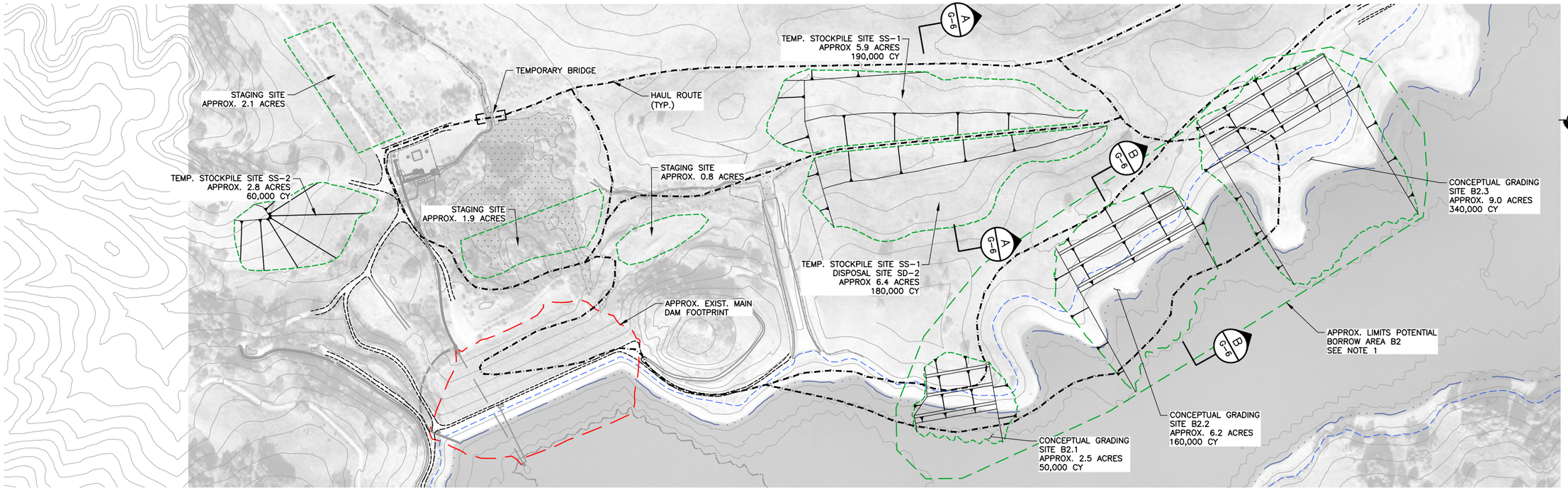
SCALE: AS NOTED

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 1328380

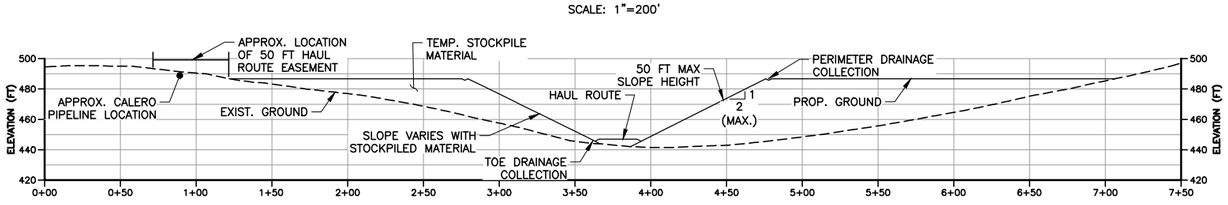
SHEET CODE: G-5

SHEET NUMBER: 5 OF 18



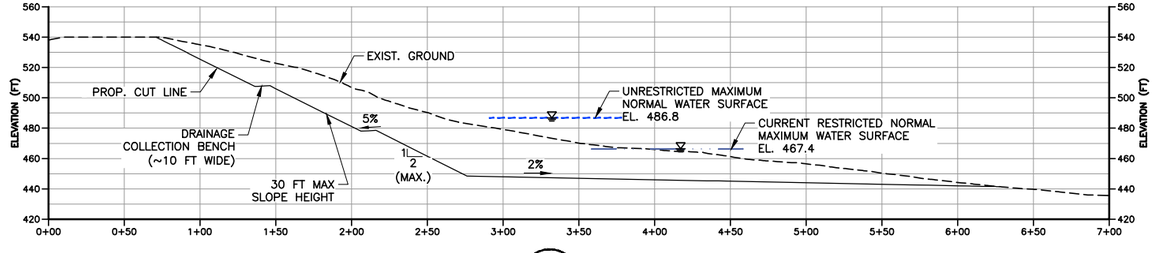
PLAN

SCALE: 1"=200'



SECTION A G-6 TYP. HILLSIDE STOCKPILE SITE SS-1/SD-2

SCALE: 1" = 50'



SECTION B G-6 TYP. HILLSIDE BORROW CUT SITE B2.2

SCALE: 1" = 50'

NOTES:
1. IT IS ASSUMED THAT STAGING AND STOCKPILING FOR BORROW SCREENING AND PROCESSING OPERATIONS WILL BE ESTABLISHED AT THE PERIPHERY OF GRADING AREAS WITHIN THE DELINEATED POTENTIAL BORROW AREA BOUNDARY.
2. THE BORROW AREAS, STOCKPILE AREAS, STAGING AREAS, DISPOSAL AREAS, AND HAUL ROUTES ARE PRELIMINARY AND SUBJECT TO CONFIRMATION BY THE FINAL DESIGN CONSULTANT, ENVIRONMENTAL PERMITTING, AND LAND ACCESS.
3. EXCAVATION SLOPES ARE PRELIMINARY AND SUBJECT TO CONFIRMATION DURING FINAL DESIGN.

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE 04-22-15
DESIGN N.K.S.
DRAWN N.K.S.
CHECKED J.G.H.

ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

Santa Clara Valley Water District

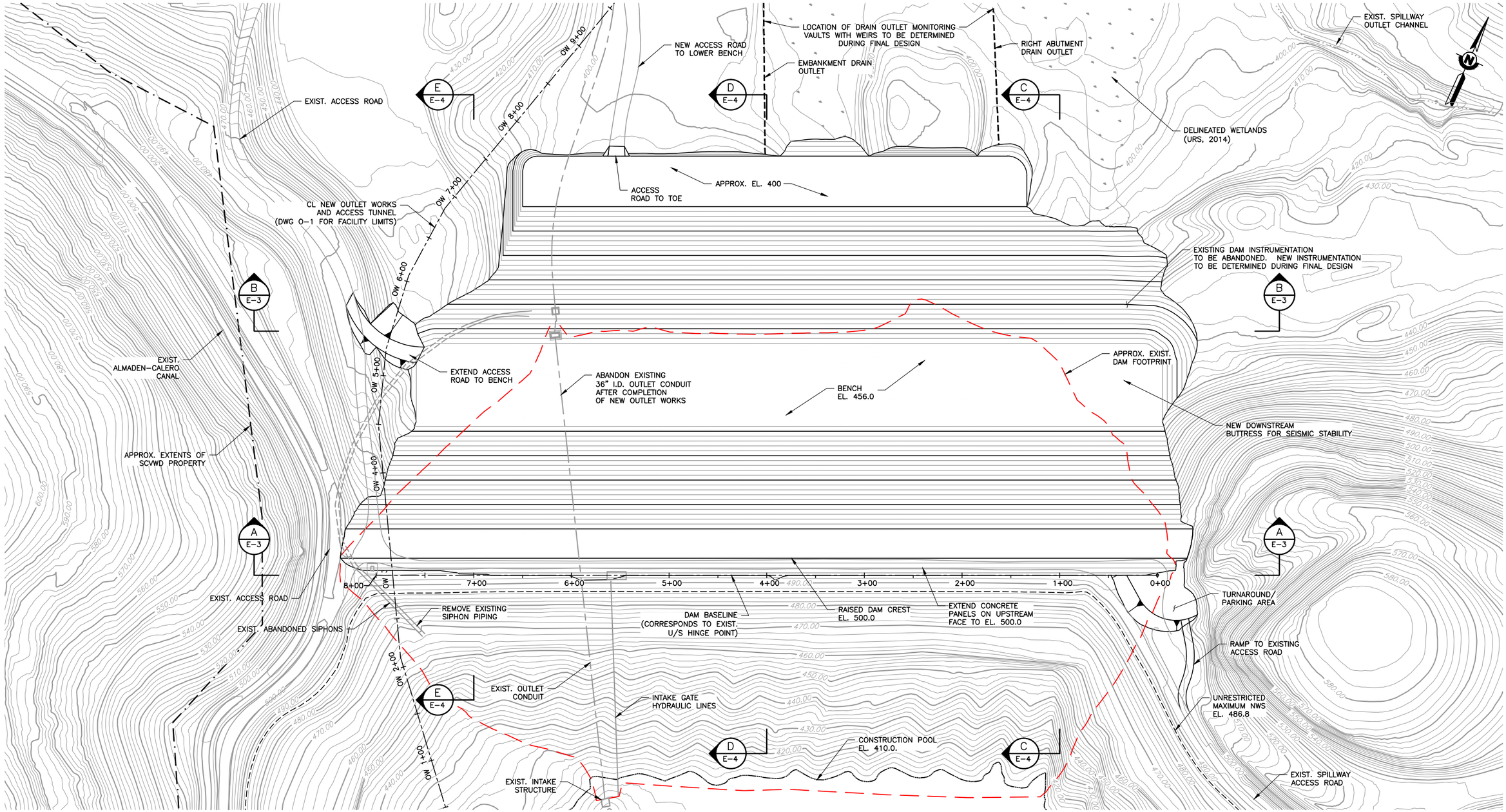
ACCEPTED BY DISTRICT
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:
CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE
BORROW, STOCKPILE, AND MISCELLANEOUS DETAILS

SCALE: AS NOTED
VERIFY SCALES 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 1328380
SHEET CODE: G-6
SHEET NUMBER: 6 OF 18

Col_06_G-6-Borrow, Stockpile, and Miscellaneous Details



PLAN

SCALE: 1"=50'

Col_07_E-1-Main Dam Plan

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04-22-15
DESIGN	P.J.E.
DRAWN	P.J.E.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE

MAIN DAM
EMBANKMENT PLAN

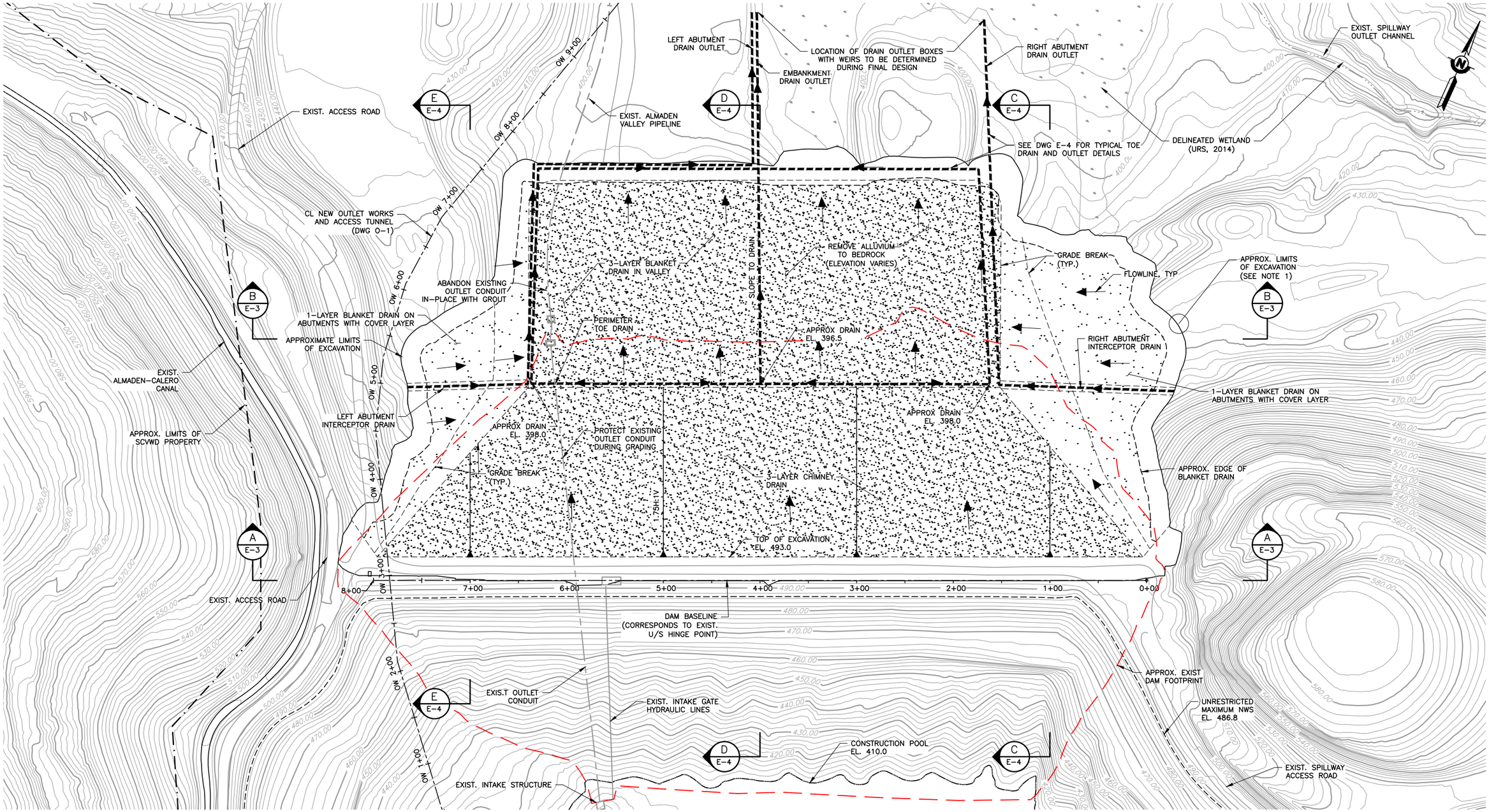
SCALE: AS NOTED

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 1328380

SHEET CODE: E-1

SHEET NUMBER: 7 OF 18



NOTE:
1. LIMITS OF EXCAVATION AND CONSTRUCTION OF FILTER BLANKET TO BE CONFIRMED DURING FINAL DESIGN, AND ADJUSTED IN FIELD BASED ON CONDITIONS ENCOUNTERED IN THE FIELD.

PLAN
SCALE: 1"=50'

DRAINAGE VECTOR
3-LAYER BLANKET OR CHIMNEY DRAIN
1-LAYER BLANKET DRAIN

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04-22-15
DESIGN	P.J.E.
DRAWN	P.J.E.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

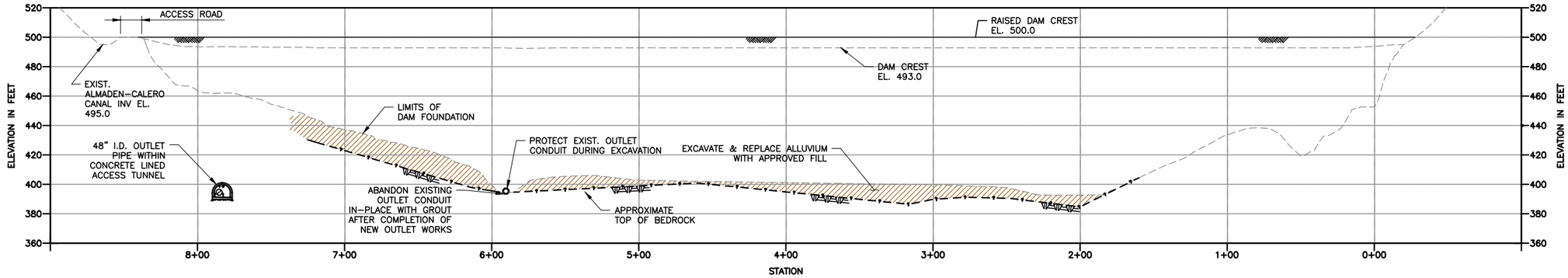
Santa Clara Valley Water District
ACCEPTED BY DISTRICT
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:
CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE
MAIN DAM
EXCAVATION AND DRAINAGE PLAN

SCALE: AS NOTED
VERIFY SCALES: 0 1" — BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

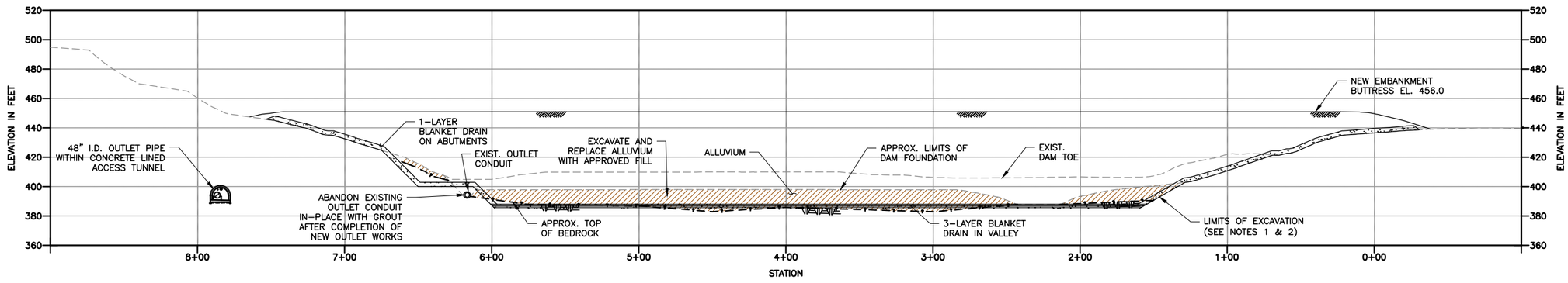
PROJECT NUMBER: 1328380
SHEET CODE: E-2
SHEET NUMBER: 8 OF 18

Cal_08_E-2-Main Dam Excavation Plan



SECTION A / E–1 MAIN DAM PROFILE ALONG DAM AXIS

SCALE: 1" = 40'



SECTION B / E–1 MAIN DAM PROFILE ALONG DAM TOE

SCALE: 1" = 40'

NOTE:
1. LIMITS OF EXCAVATION AND CONSTRUCTION OF FILTER BLANKET TO BE CONFIRMED DURING FINAL DESIGN, AND ADJUSTED IN FIELD BASED ON CONDITIONS ENCOUNTERED IN THE FIELD.
2. FINAL BEDROCK EXCAVATION LINE WILL BE SUBJECT TO MEETING THE FOUNDATION OBJECTIVE AND FIELD APPROVAL BY DSOD.

Cal_09_E–3–Main Dam Profiles

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04–22–15
DESIGN	P.J.E.
DRAWN	P.J.E.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF–RECOMMENDED ALTERNATIVE

MAIN DAM PROFILES

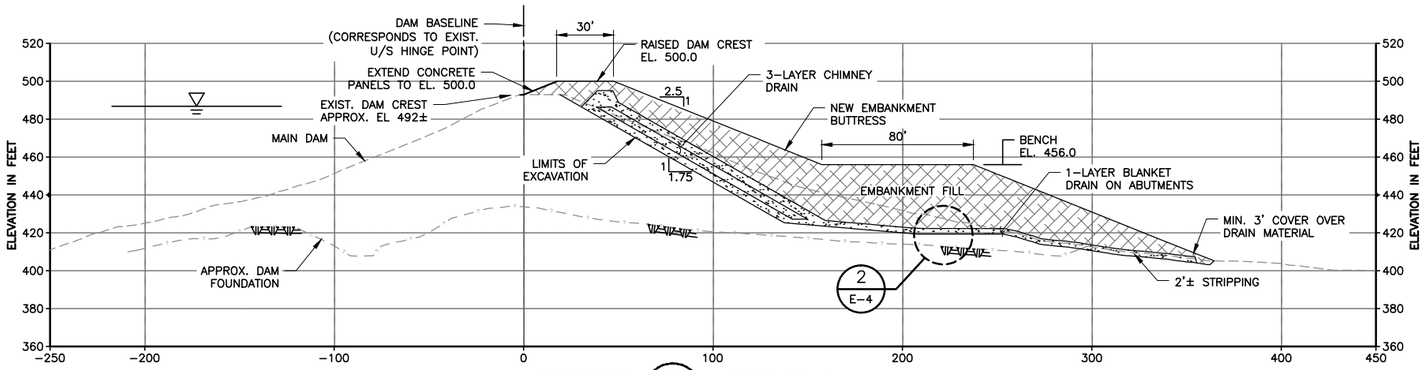
SCALE: AS NOTED

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 1328380

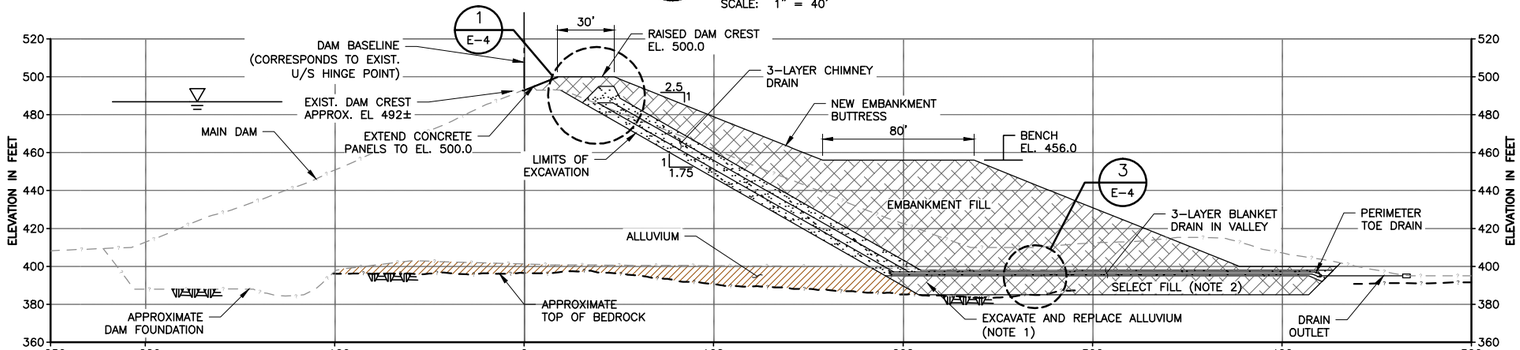
SHEET CODE: E–3

SHEET NUMBER: 9 OF 18



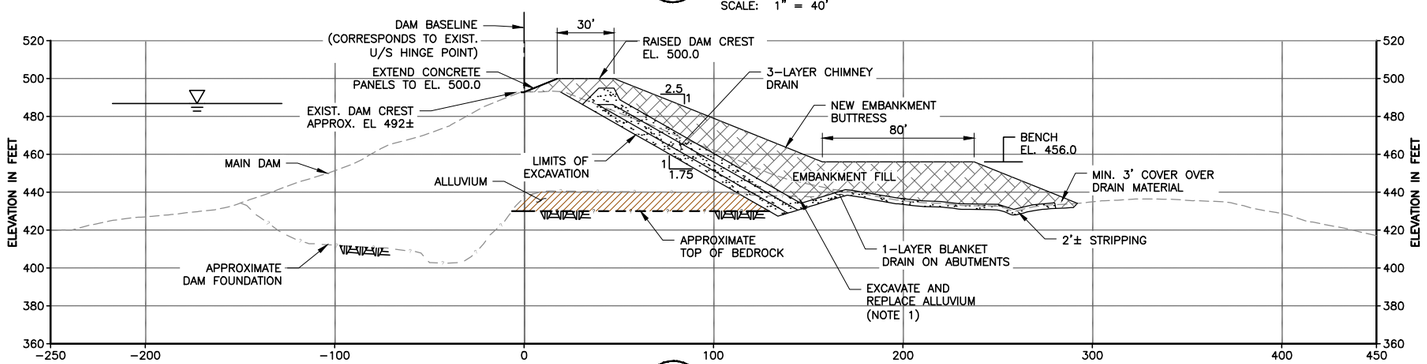
SECTION C E-1 MAIN DAM STA 1+00

SCALE: 1" = 40'



SECTION D E-1 MAIN DAM STA 4+00

SCALE: 1" = 40'

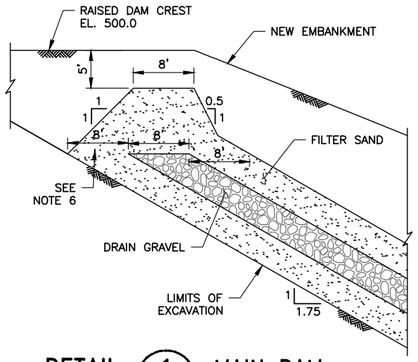


SECTION E E-1 MAIN DAM STA 7+00

SCALE: 1" = 40'

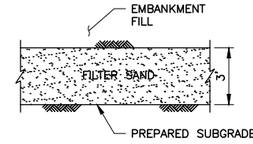
NOTES:

1. EXCAVATE FOUNDATION TO REMOVE ALLUVIUM AND EXPOSE FIRM, UNDISTURBED SEDIMENTARY FORMATION TO MEET APPROVED FOUNDATION OBJECTIVE.
2. SELECT FILL PLACED ON PREPARED FOUNDATION. SPECIFICATIONS TO BE DETERMINED DURING FINAL DESIGN.
3. PLACE 12-INCHES OF TOPSOIL AND SEED FINISHED EMBANKMENT SLOPES.
4. PLACE 12-INCHES OF GRAVEL ROAD SURFACING ON FINISHED DAM CREST.
5. DAM INSTRUMENTATION NOT SHOWN. NEW DAM INSTRUMENTATION TO BE DETERMINED DURING DESIGN.
6. CHIMNEY DRAIN LAYER SHOWN AS 8' WIDE FOR CONTRACTIBILITY; MINIMUM HORIZONTAL WIDTH IS 5' PER LAYER.



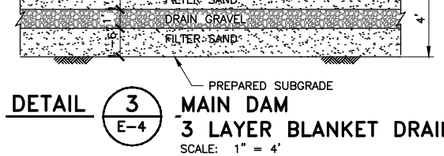
DETAIL 1 E-4 MAIN DAM CHIMNEY DRAIN

SCALE: 1" = 10'



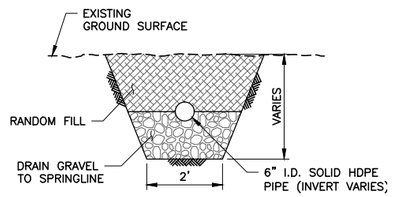
DETAIL 2 E-4 MAIN DAM 1 LAYER BLANKET DRAIN

SCALE: 1" = 4'



DETAIL 3 E-4 MAIN DAM 3 LAYER BLANKET DRAIN

SCALE: 1" = 4'



DETAIL 4 E-3 MAIN DAM OUTLET DRAIN

SCALE: 1" = 2'

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE
04-22-15
DESIGN
P.J.E.
DRAWN
P.J.E.
CHECKED
J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE

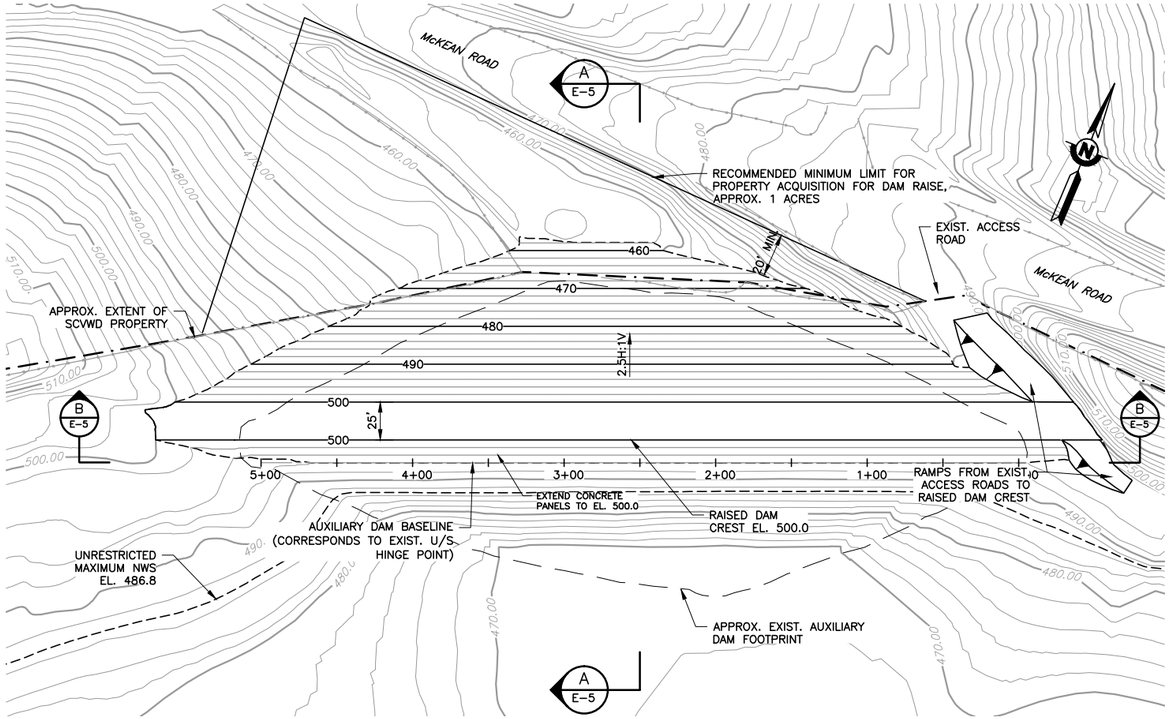
MAIN DAM
CROSS SECTIONS

SCALE	PROJECT NUMBER
AS NOTED	1328380
VERIFY SCALES 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET CODE: E-4
	SHEET NUMBER: 10 OF 18

Cal_10_E-4-Main Dam Sections

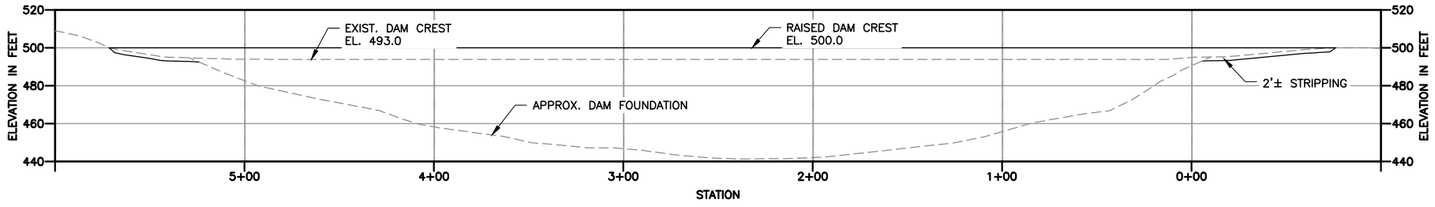
NOTES:

1. PLACE 12–INCHES OF TOPSOIL AND SEED FINISHED EMBANKMENT SLOPES.
2. PLACE 12–INCHES OF GRAVEL ROAD SURFACING ON FINISHED AUXILIARY DAM CREST.



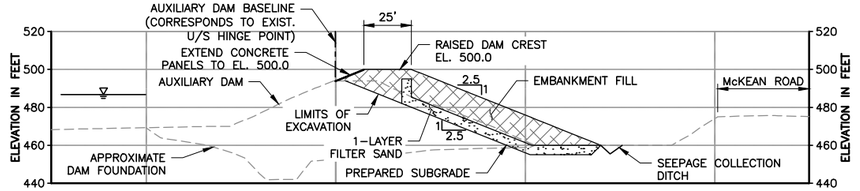
PLAN

SCALE: 1"=50'



SECTION B E–5 AUXILIARY DAM PROFILE ALONG DAM AXIS

SCALE: 1" = 40'



SECTION A E–5 AUXILIARY DAM STA 2+50

SCALE: 1" = 40'

Col_11_E–5–Aux Dam Plan, Profile, Sections

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04–22–15
DESIGN	P.J.E.
DRAWN	P.J.E.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF–RECOMMENDED ALTERNATIVE

AUXILIARY DAM
PLAN, PROFILE, AND SECTION

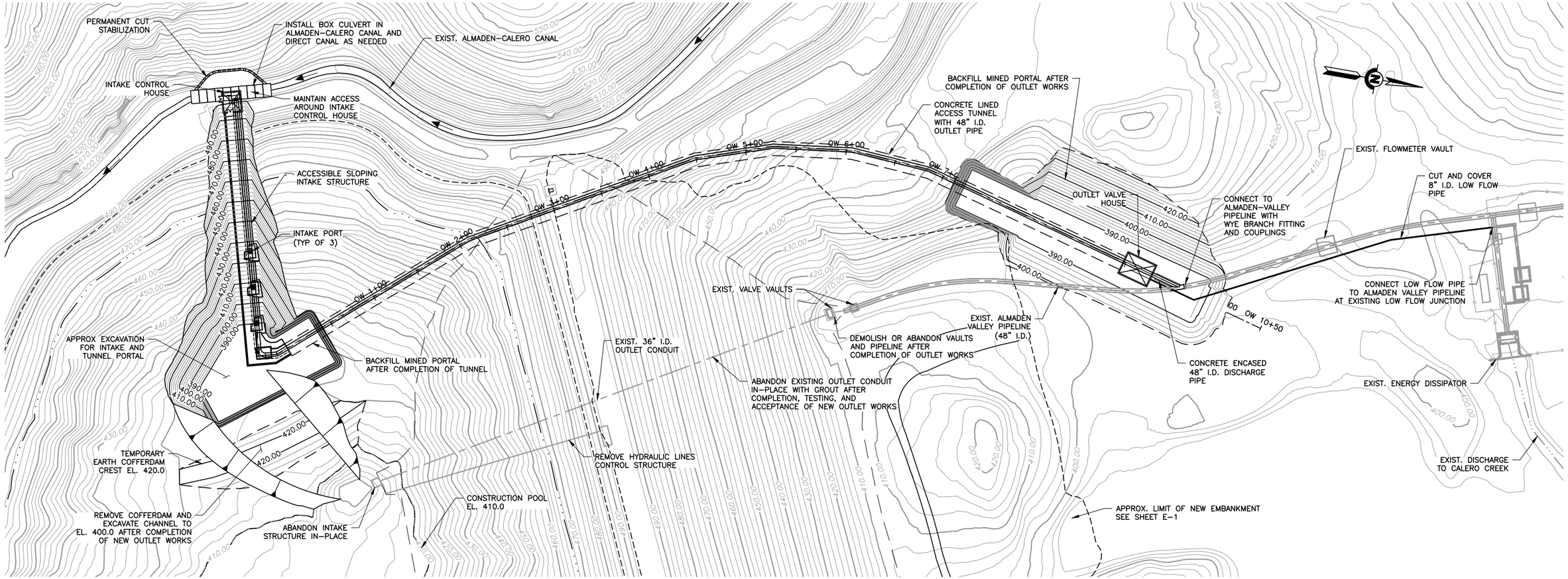
SCALE: AS NOTED

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 1328380

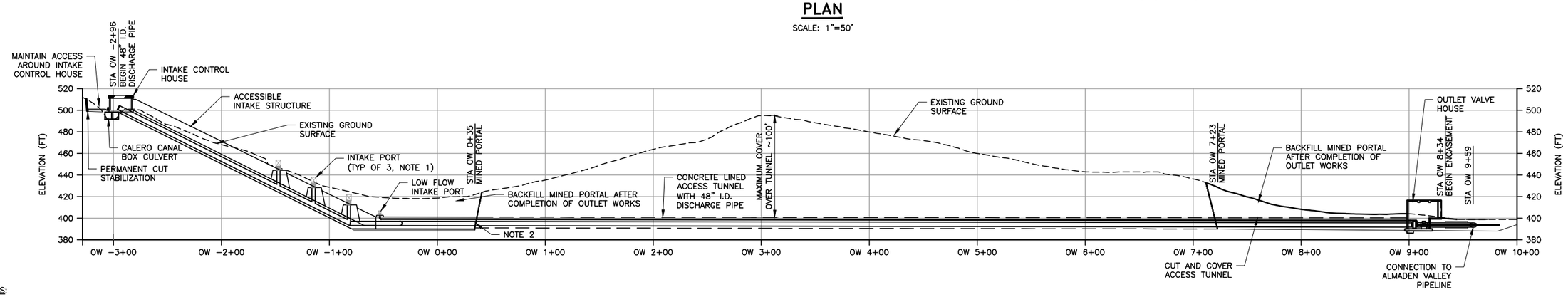
SHEET CODE: E–5

SHEET NUMBER: 11 OF 18



PLAN

SCALE: 1"=50'



PROFILE

SCALE: 1"=50'

NOTES:

1. FINAL NUMBER AND ELEVATION OF INTAKE PORTS TO BE DETERMINED DURING FINAL DESIGN.
2. INSTALL TEMPORARY TUNNEL BULKHEAD AT UPSTREAM TUNNEL PORTAL TO PREVENT DOWNSTREAM FLOODING DURING WINTER RAINY SEASON.

Cal_12_0–1–OW Plan and Profile

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04–22–15
DESIGN	P.J.E.
DRAWN	P.J.E.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

ACCEPTED BY DISTRICT

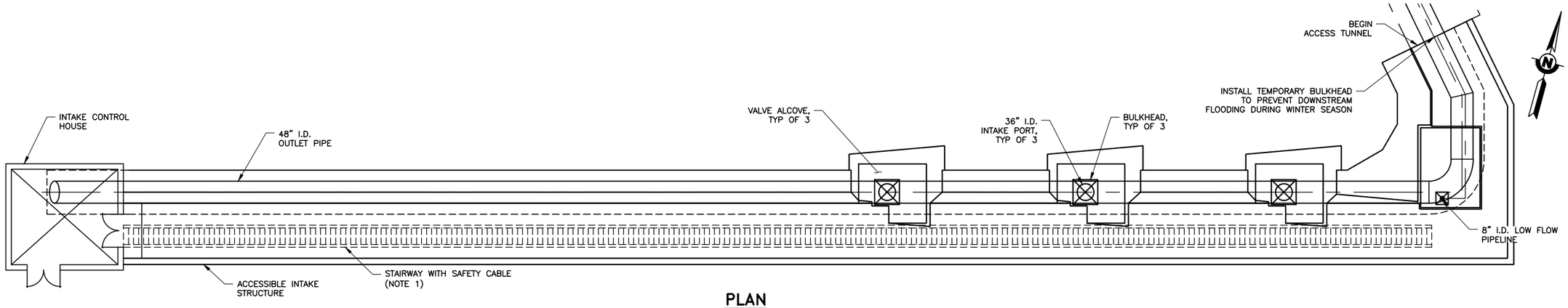
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF–RECOMMENDED ALTERNATIVE

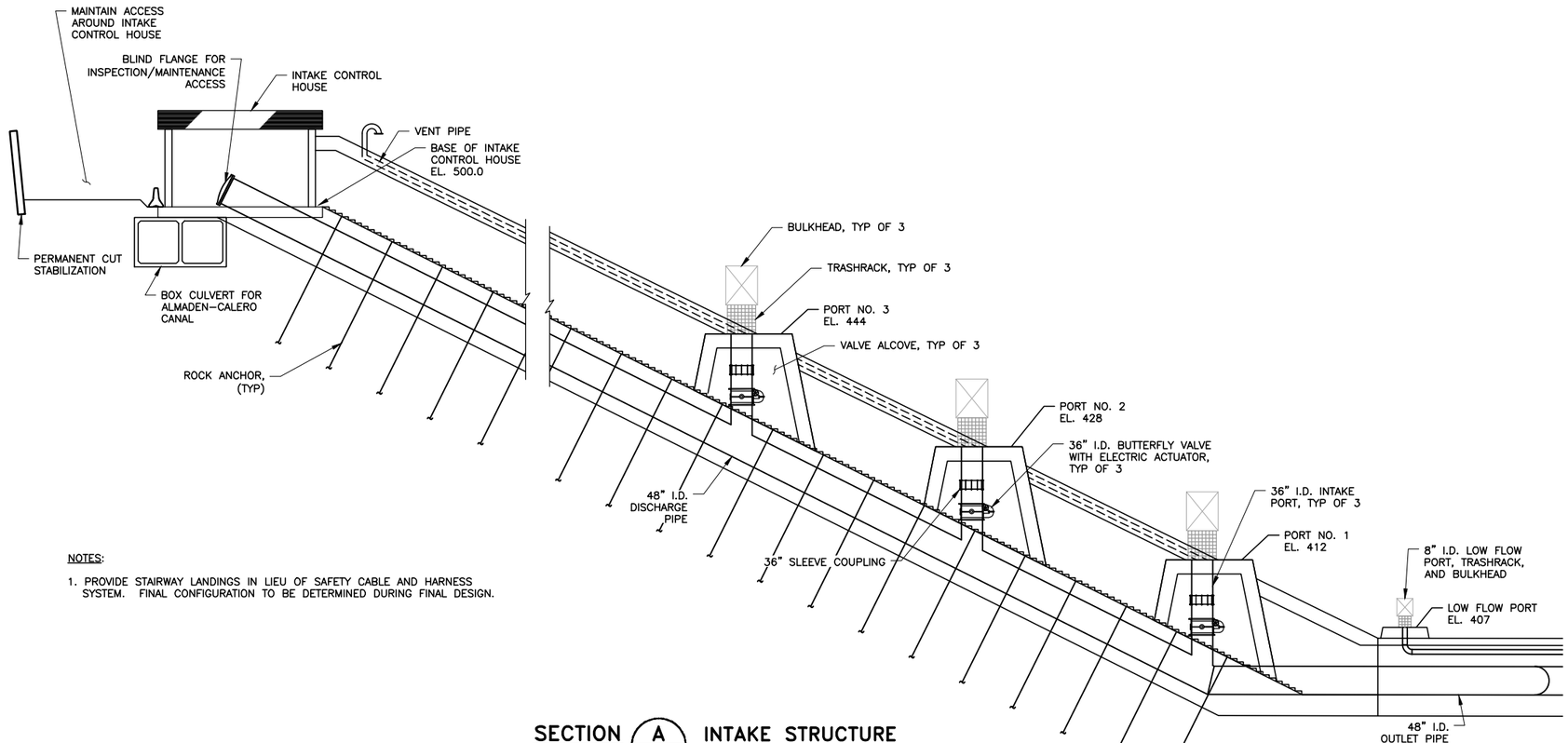
OUTLET WORKS
PLAN AND PROFILE

SCALE	AS NOTED
VERIFY SCALES	0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER	1328380
SHEET CODE:	0–1
SHEET NUMBER:	12 OF 18



PLAN

SCALE: 1"=10'

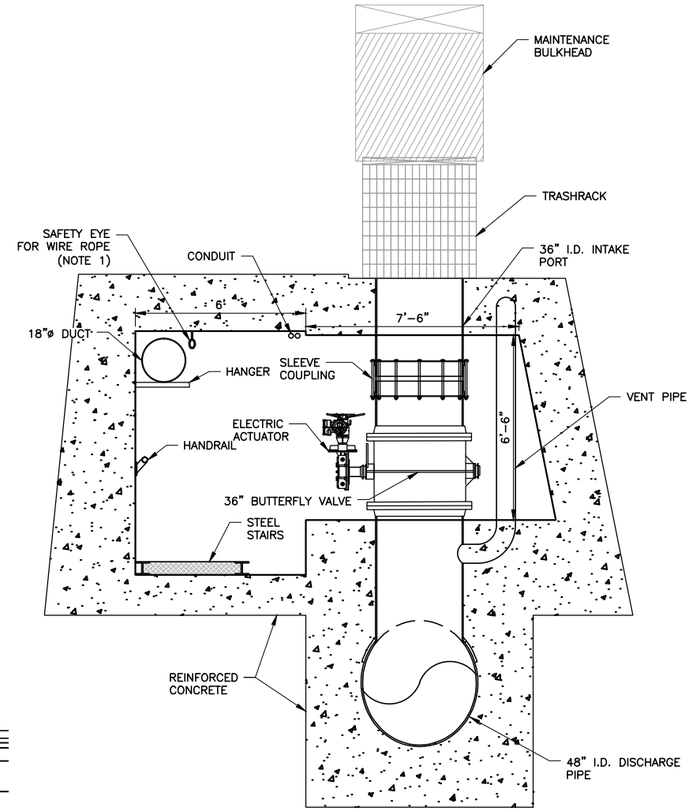


NOTES:

1. PROVIDE STAIRWAY LANDINGS IN LIEU OF SAFETY CABLE AND HARNESS SYSTEM. FINAL CONFIGURATION TO BE DETERMINED DURING FINAL DESIGN.

SECTION A/0-2 INTAKE STRUCTURE

SCALE: 1" = 10'



TYPICAL SECTION -/- VALVE ALCOVE

SCALE: 3/8" = 1'

Cal_13_0-2-Intake Plan and Section

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04-22-15
DESIGN	P.J.E.
DRAWN	P.J.E.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

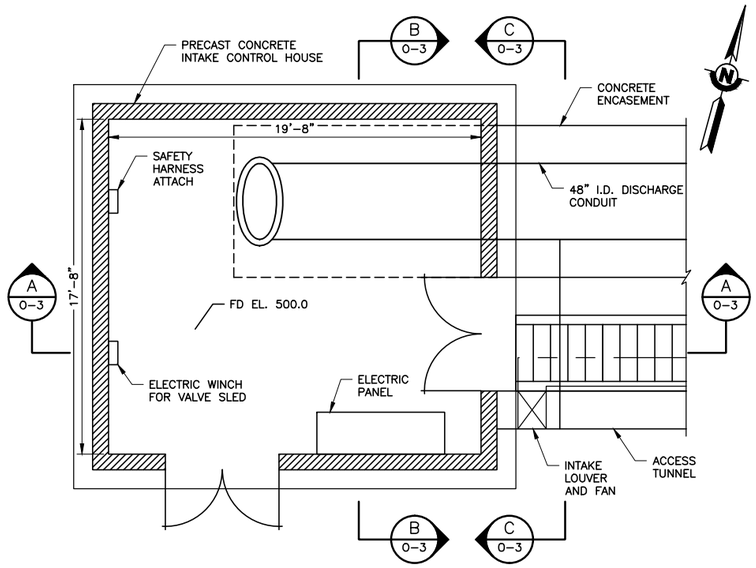
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE

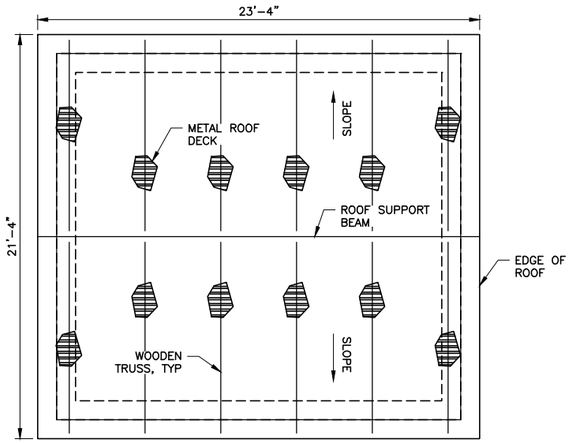
OUTLET WORKS
INTAKE STRUCTURE
PLAN AND SECTIONS

SCALE	PROJECT NUMBER
AS NOTED	1328380
VERIFY SCALES 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET CODE: 0-2
	SHEET NUMBER: 13 OF 18



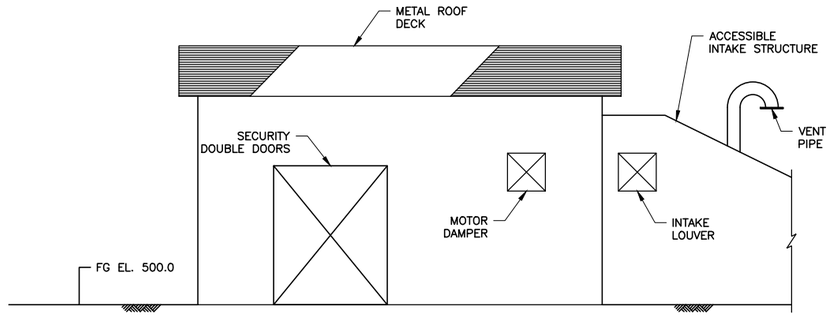
FLOOR PLAN

SCALE: 1/4" = 1'



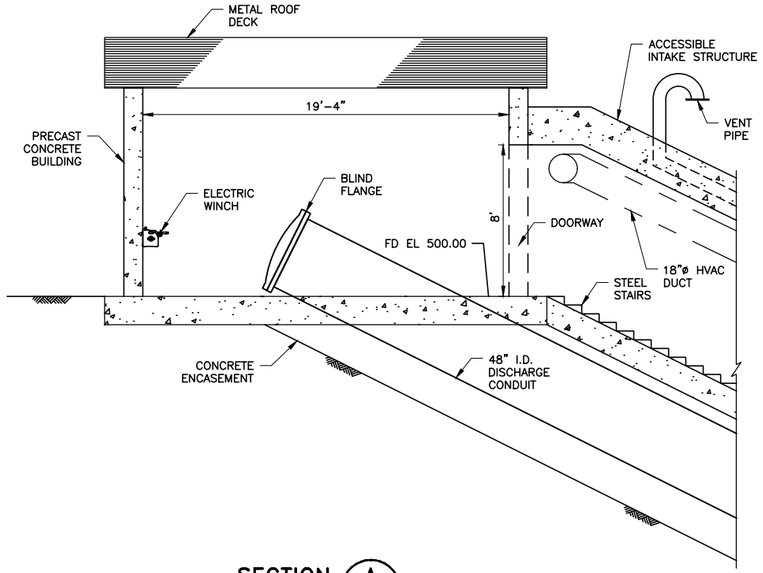
ROOF PLAN

SCALE: 1/4" = 1'



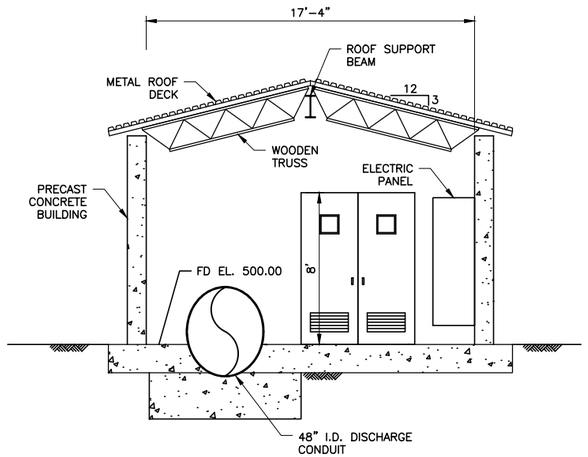
NORTH ELEVATION

SCALE: 1/4" = 1'



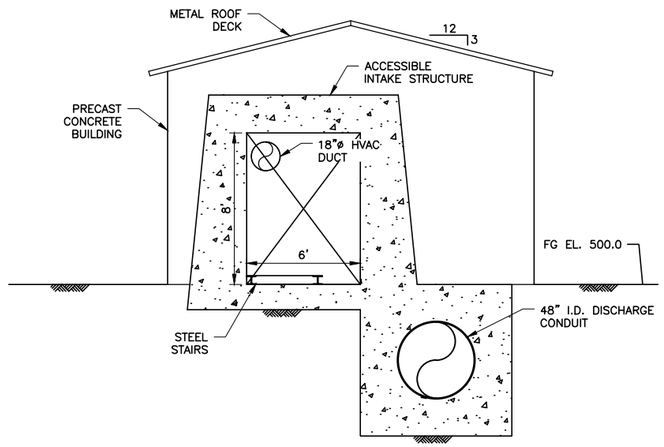
SECTION A 0-3

SCALE: 1/4" = 1'



SECTION B 0-3

SCALE: 1/4" = 1'



SECTION C 0-3

SCALE: 1/4" = 1'

Calero_14_0-3-Intake Control House

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE
04-22-15
DESIGN
P.J.E.
DRAWN
P.J.E.
CHECKED
J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE

INTAKE CONTROL HOUSE
GENERAL ARRANGEMENT

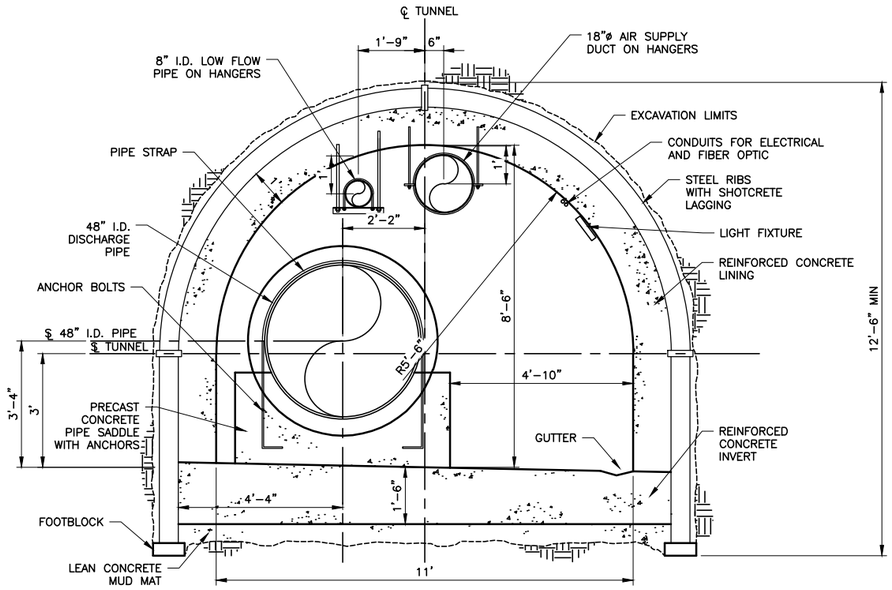
SCALE: AS NOTED

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

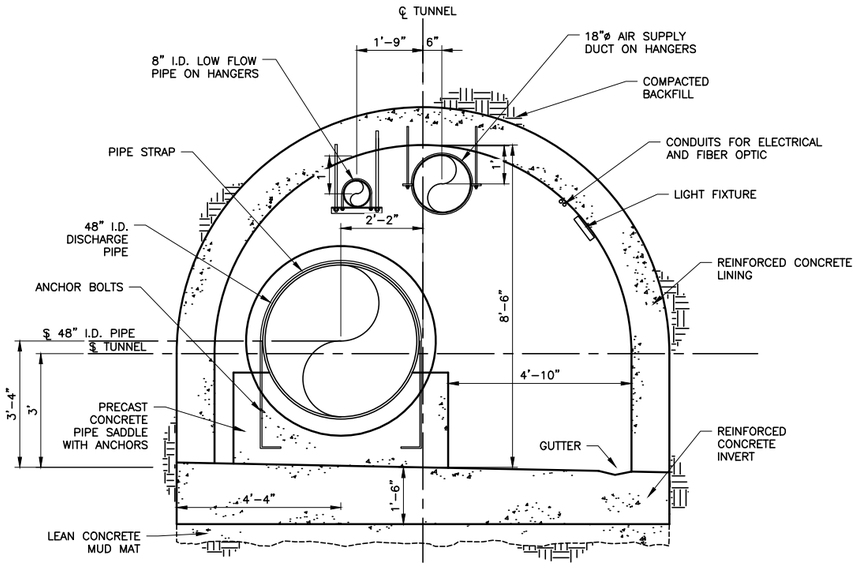
PROJECT NUMBER: 1328380

SHEET CODE: 0-3

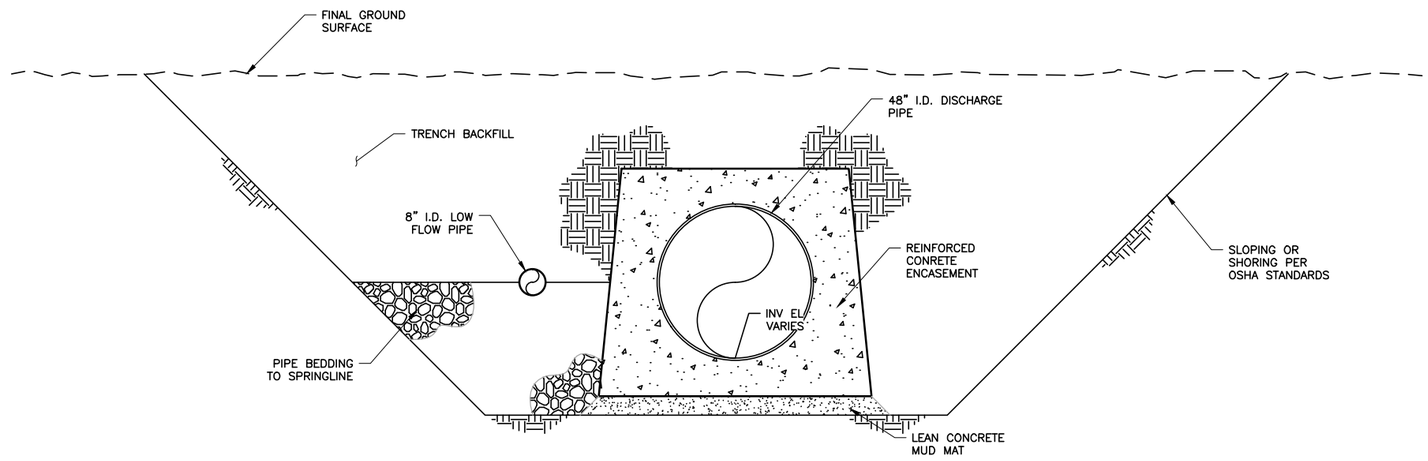
SHEET NUMBER: 14 OF 18



TYPICAL SECTION A – ACCESS TUNNEL – MINED SECTION
STA OW 0+35 TO OW 7+23
SCALE: 1/2" = 1'



TYPICAL SECTION B – ACCESS TUNNEL – CUT AND COVER SECTION
STA OW 7+23 TO OW 8+98 AND 0+35 TO 0+50
SCALE: 1/2" = 1'



TYPICAL SECTION C – PIPE TRENCH
STA OW 9+34 TO OW 9+58
SCALE: 1/2" = 1'

Cal_15_0-4-Tunnel and Pipeline Details

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04–22–15
DESIGN	P.J.E.
DRAWN	P.J.E.
CHECKED	J.G.H.

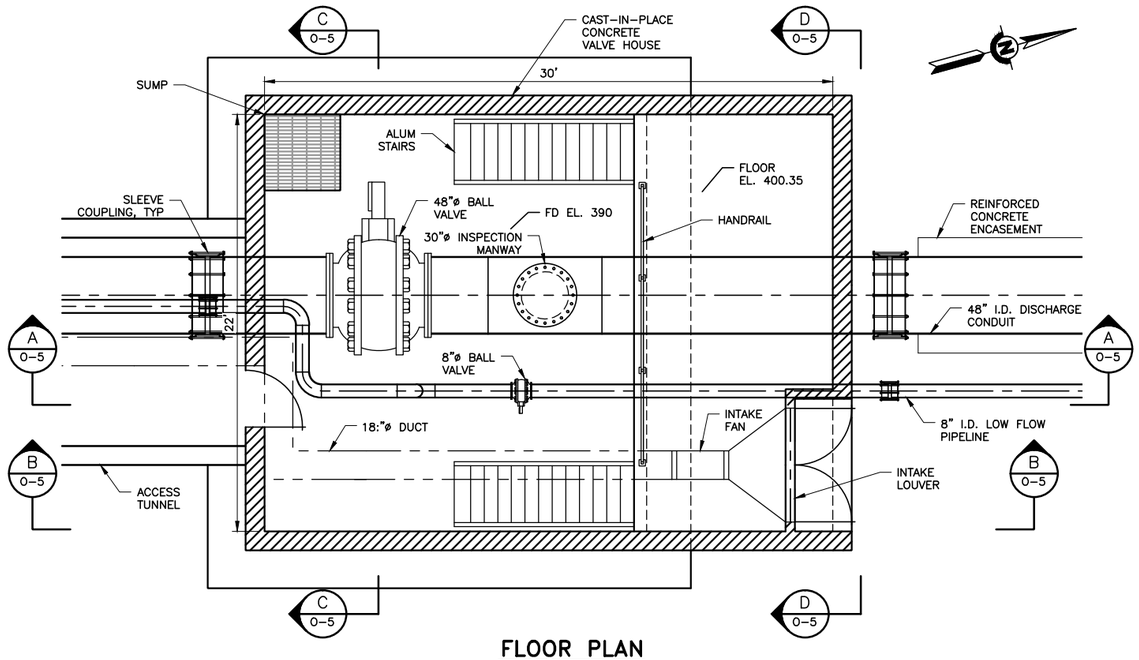
ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

Santa Clara Valley Water District
ACCEPTED BY DISTRICT
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:
CALERO DAM SEISMIC RETROFIT PROJECT
STAFF–RECOMMENDED ALTERNATIVE
ACCESS TUNNEL AND PIPE TRENCH CROSS SECTIONS

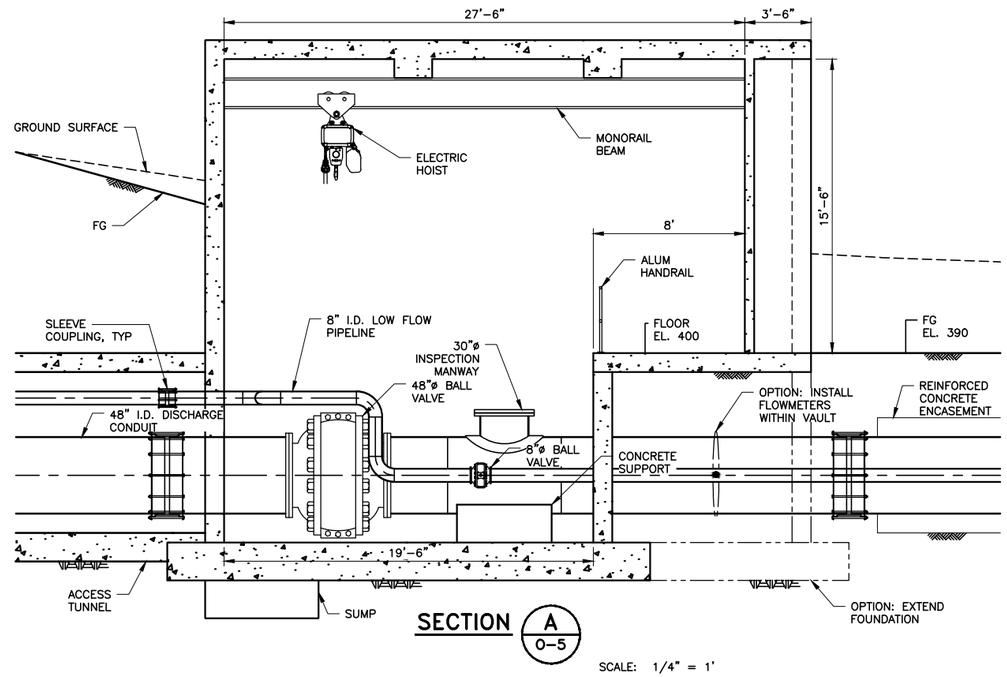
SCALE: AS NOTED
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 1328380
SHEET CODE: 0–4
SHEET NUMBER: 15 OF 18



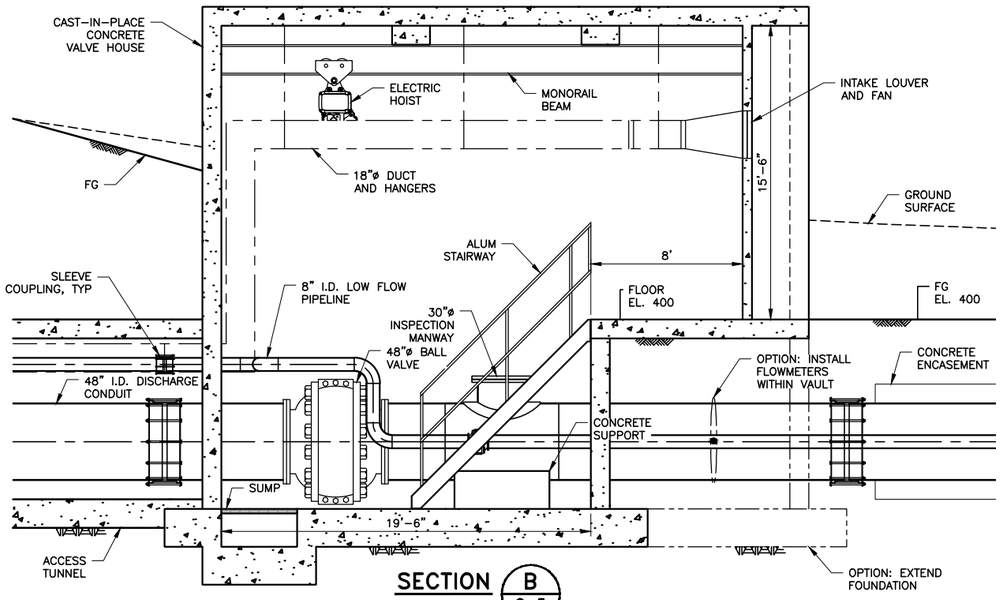
FLOOR PLAN

SCALE: 1/4" = 1'



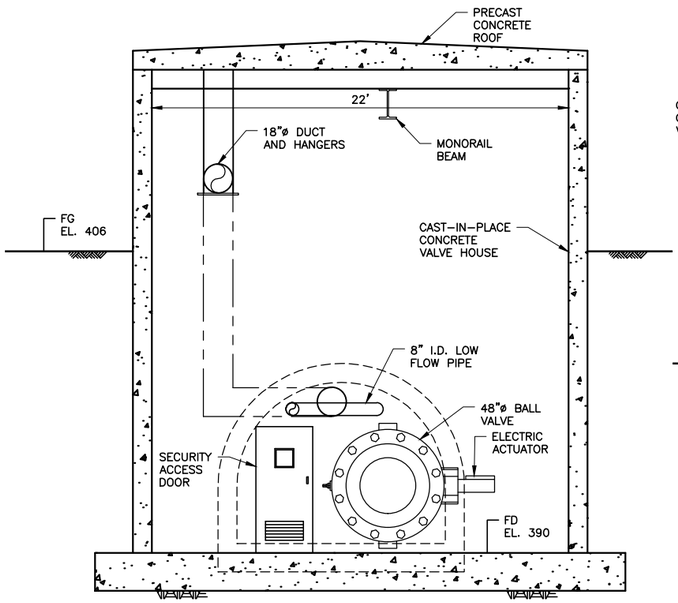
SECTION A 0-5

SCALE: 1/4" = 1'



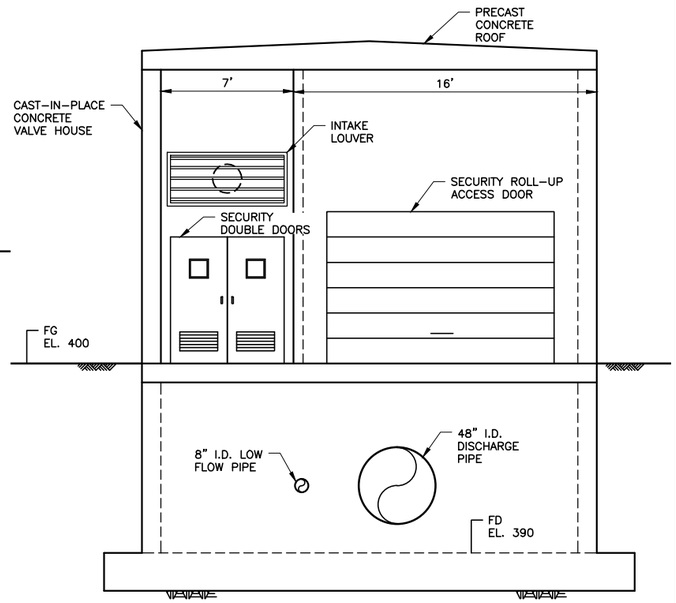
SECTION B 0-5

SCALE: 1/4" = 1'



SECTION C 0-5

SCALE: 1/4" = 1'



SECTION D 0-5

SCALE: 1/4" = 1'

Cal_16_0-5-Downstream Valve House

REV	DESCRIPTION	DATE	APPR.

REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE 04-22-15
DESIGN P.J.E.
DRAWN P.J.E.
CHECKED J.G.H

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE

OUTLET VALVE HOUSE
GENERAL ARRANGEMENT

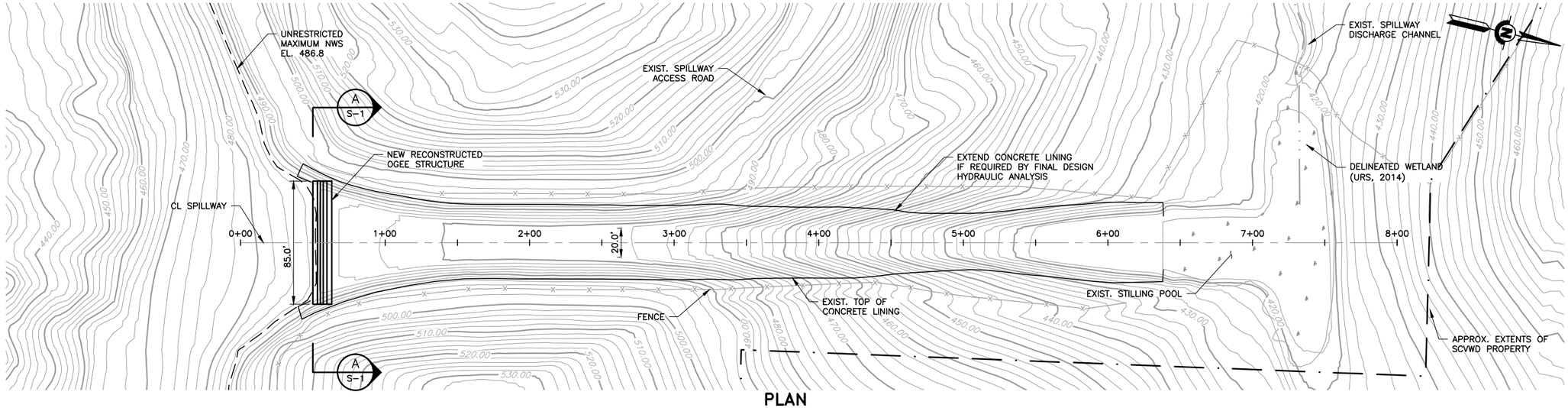
SCALE: AS NOTED

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 1328380

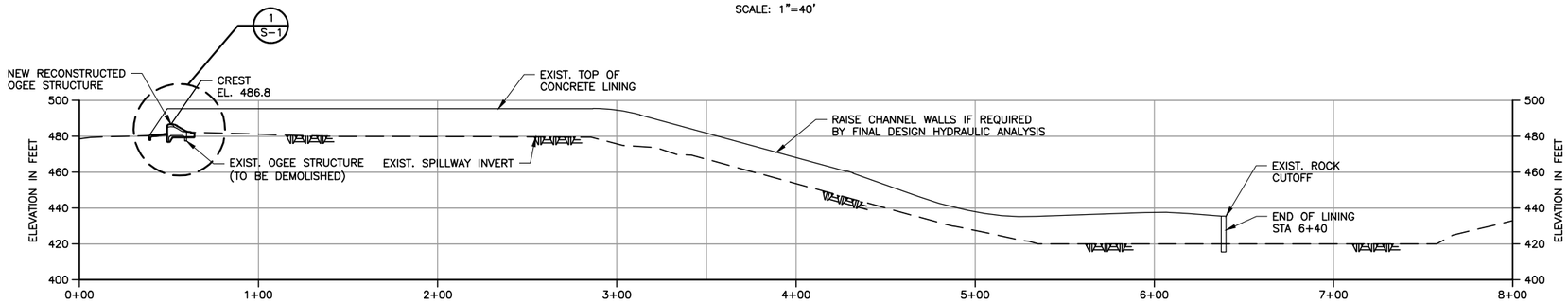
SHEET CODE: 0-5

SHEET NUMBER: 16 OF 18



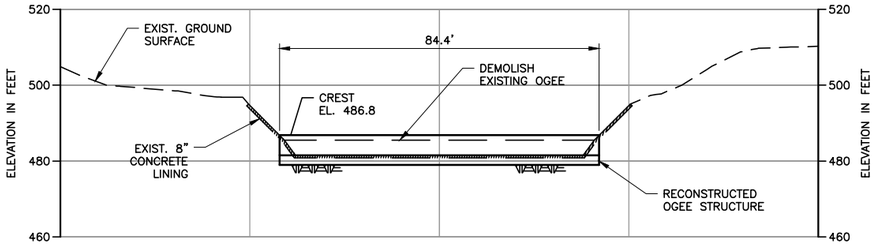
PLAN

SCALE: 1"=40'



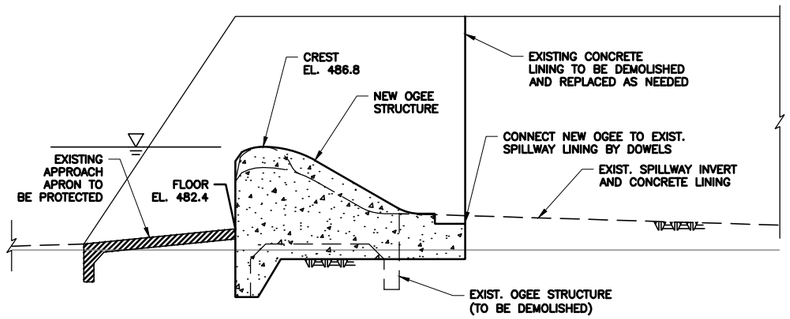
VIEW (–/–) PROFILE SPILLWAY CL

SCALE: 1" = 40'



SECTION A/S-1 STA 0+50

SCALE: 1" = 20'



DETAIL 1/S-1 SPILLWAY NEW OGEE

SCALE: 1" = 5'

CAD_GD-C-3011-32454

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04-22-15
DESIGN	P.J.E.
DRAWN	P.J.E.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

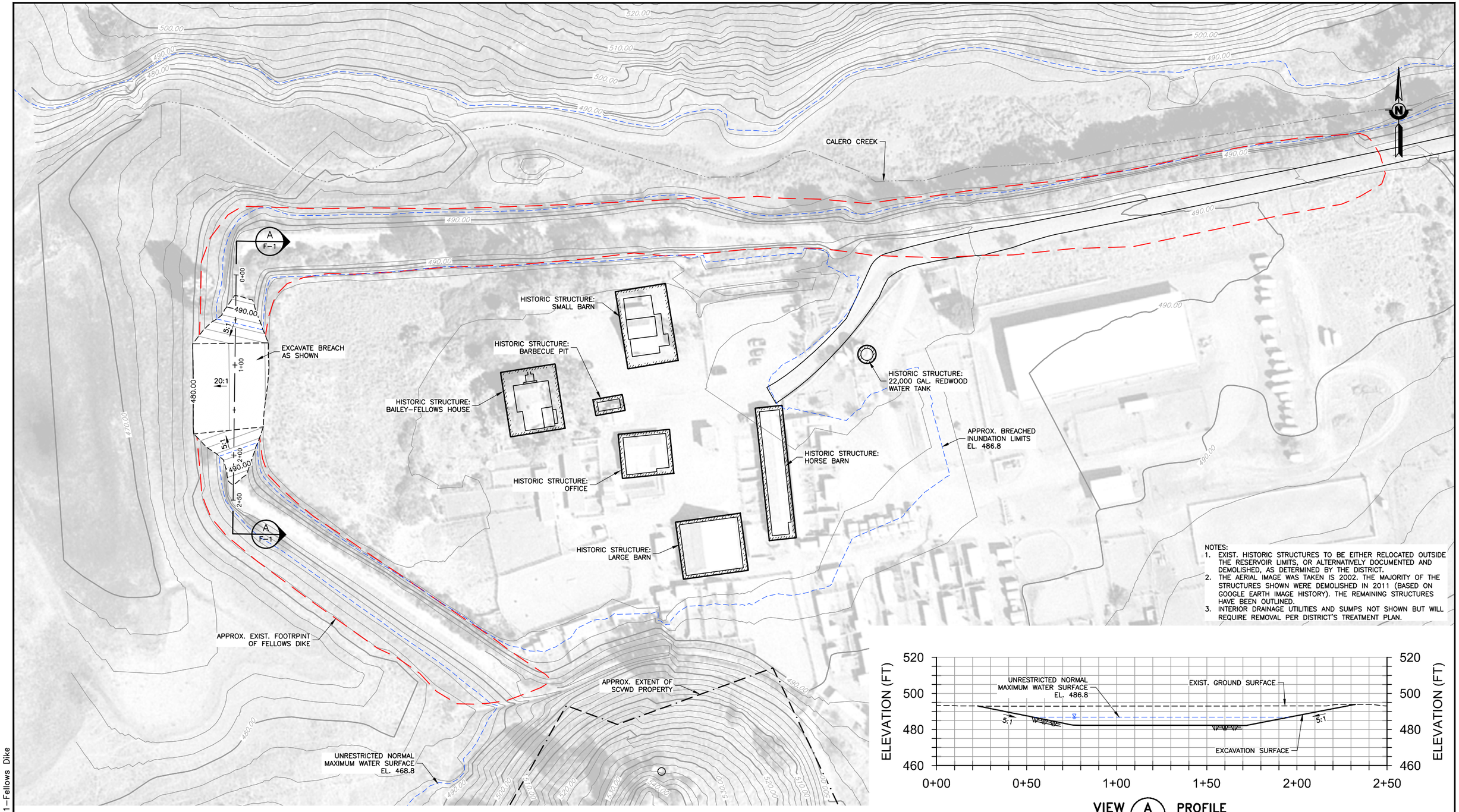
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF-RECOMMENDED ALTERNATIVE

SPILLWAY
PLAN, PROFILE, AND SECTIONS

SCALE	AS NOTED
VERIFY SCALES	0 1"
	BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER	1328380
SHEET CODE:	S-1
SHEET NUMBER:	17 OF 18



NOTES:
1. EXIST. HISTORIC STRUCTURES TO BE EITHER RELOCATED OUTSIDE THE RESERVOIR LIMITS, OR ALTERNATIVELY DOCUMENTED AND DEMOLISHED, AS DETERMINED BY THE DISTRICT.
2. THE AERIAL IMAGE WAS TAKEN IS 2002. THE MAJORITY OF THE STRUCTURES SHOWN WERE DEMOLISHED IN 2011 (BASED ON GOOGLE EARTH IMAGE HISTORY). THE REMAINING STRUCTURES HAVE BEEN OUTLINED.
3. INTERIOR DRAINAGE UTILITIES AND SUMPS NOT SHOWN BUT WILL REQUIRE REMOVAL PER DISTRICT'S TREATMENT PLAN.

PLAN
SCALE: 1"=50'

VIEW A F–1 PROFILE FELLOWS DIKE BREACH
SCALE: 1" = 50'

Cal_18_F–1–Fellows Dike

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES

GEI Consultants

DATE	04–22–15
DESIGN	N.K.S.
DRAWN	N.K.S.
CHECKED	J.G.H.

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

Santa Clara Valley Water District

ACCEPTED BY DISTRICT

PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:

CALERO DAM SEISMIC RETROFIT PROJECT
STAFF–RECOMMENDED ALTERNATIVE
FELLOWS DIKE

SCALE	AS NOTED
VERIFY SCALES	0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER	1328380
SHEET CODE:	F–1
SHEET NUMBER:	18 OF 18