Draft Environmental Impact Report

Appendix

Alternatives Development and Project Description

Pacheco Reservoir Expansion Project

November 2021

Contents

Figures

Tables

Attachment

Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
Bay Area	San Francisco Bay Area
BGP	Biogeographic Population Group
CBA	core borrow area
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CVJV	Central Valley Joint Venture
CVP	Central Valley Project
CVPIA	1992 Central Valley Project Improvement Act
DAF	dissolved air flotation
dbh	diameter measured at breast height
Delta	Sacramento-San Joaquin Delta
DIF	design and implementation feature
DPS	distinct population segment
DSOD	California Department of Water Resources, Division of Safety of Dams
DWR	California Department of Water Resources
EIR	Environmental Impact Report

ESA	Federal Endangered Species Act
GRCD	Grassland Resource Conservation District
HDPE	high density polyethylene
HP	horsepower
IAIR	Initial Alternative Investigation Report
IL4	Incremental Level 4
JPOD	Joint Point of Diversion
kV	kilovolt
M&I	municipal and industrial
mgd	million gallons per day
msl	mean sea level
MVA	megavolt amperes
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
PG&E	Pacific Gas and Electric Company
PMF	Probable Maximum Flood
PPWD	Pacheco Pass Water District
PRII	Pacheco Reservoir Inflow Index
Project	Pacheco Reservoir Expansion Project
PWRPA	Power and Water Resources Pooling Authority
QEMS	Quality and Environmental Management System
RDA	reservoir disposal area
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Recovery Plan	South-Central California Steelhead Recovery Plan
ROD	Record of Decision
RWSP	Refuge Water Supply Program
SA	Staging Area
SBA	shell borrow area
SBCWD	San Benito County Water District
SCADA	supervisory control and data acquisition

SCCC	South-Central California Coast
Semitropic	Semitropic Groundwater Banking Program
SLLPIP	San Luis Low Point Improvement Project
SPA-X	Stockpile Area X
SR 152	State Route 152
SWP	State Water Project
SWPPP	Stormwater Pollution Prevention Plan
TAF	thousand acre-feet
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Valley Water	Santa Clara Valley Water District
WAPA	Western Area Power Authority
WSIP	Water Storage Investment Program
WTP	Water Treatment Plant

Chapter 1 Introduction

This appendix describes the systematic approach that Santa Clara Valley Water District (Valley Water) applied to define the Pacheco Reservoir Expansion Project's (Project) purpose (i.e., problems) and objectives; develop and screen conceptual measures that could address the primary and secondary objectives to varying degrees; and combine conceptual measures that were retained following completion of the conceptual measures screening process to identify the Proposed Project. The conceptual measures retained were also used to develop a reasonable range of alternatives to the Proposed Project that would attain most of the basic Project objectives or avoid or substantially lessen the significant impacts initially identified by Valley Water through scoping and its internal alternative development process.

1.1 Appendix Organization

This appendix is organized as follows.

- **Chapter 1 - Introduction:** Provides a brief overview of the appendix and contents of each chapter of this appendix.
- **Chapter 2 - Alternatives Development and Alternatives Considered but Eliminated:** Describes the alternatives development process, the objectives and purpose of the Project, evaluation and screening of conceptual measures identified for each Project objective, initial alternatives development and refinement, an overview of the alternatives evaluated in detail in this Environmental Impact Report (EIR), and alternatives considered but eliminated.
- **Chapter 3 - Description of Alternatives:** Describes the Proposed Project, the No Project Alternative, and alternatives to the Proposed Project (i.e., Alternatives A through D) evaluated in detail in this EIR. For the Proposed Project and Alternatives A through D, components of the action alternatives are grouped into four categories: facility components, construction program components, operational and maintenance components, and Design and implementation features (DIF). Facility components, construction program components, operational and maintenance components are described in this appendix. DIFs are fully described in the main body of the EIR (Chapter 2) and are not repeated in this appendix.
- **Chapter 4 - References:** Provides the references cited in this appendix.

Chapter 2 Alternatives Development and Alternatives Considered but Eliminated

California Environmental Quality Act (CEQA) Guidelines § 15126.6 requires that an EIR describe a reasonable range of alternatives to the proposed project that could feasibly attain most of the basic project objectives (both primary and secondary objectives as described in section 2.2.1) and would reduce one or more significant effects of the proposed project. The CEQA Guidelines further state that an EIR need not consider every conceivable alternative to the project. The range of alternatives should be selected in such a way as to foster meaningful dialogue, informed decision making, and public participation. In addition, a "no project" alternative must be considered. An EIR is not required to consider alternatives that are infeasible. The feasibility of an alternative may be determined based on a variety of factors, such as site suitability, economic viability, consistency with applicable plans and regulatory limitations, and whether the project sponsor can reasonably acquire, control, or obtain access to an alternative site (if the sponsor already owns the alternative site) (CEQA Guidelines, §15126.6[f][1]).

2.1 Alternatives Development Process

The alternatives development for the Project included the following processes:

1. *Define Purpose and Objectives*: Water resources problems or deficiencies were clearly defined. The objectives indicate how each defined problem was targeted for improvement.

2. *Develop and Screen Conceptual Measures to Address Basic Project Objectives*: Based on the defined problems and deficiencies, a set of potential conceptual measures that could address the problems and achieve the Project objectives was developed. These conceptual measures were either retained for further consideration or deleted, based on screening criteria.

3. C*ombine Conceptual Measures, Identify Proposed Project, and Identify Alternatives that Could Feasibly Attain Most of the Basic Objectives of the Project But Would Avoid or Lessen Any of the Significant Effects of the Project*: Retained conceptual measures were combined to develop the Proposed Project and develop a reasonable range of alternatives for evaluation in the EIR.

2.2 Objectives and Purpose

2.2.1 Objectives

Primary objectives consider the basic needs that the Project intends to satisfy. The primary objectives are considered to have equal priority, with each pursued to the maximum practicable extent without adversely affecting the other objectives. Secondary Project objectives are considered to the extent possible through pursuit of the primary Project objectives.

The primary Project objectives are to:

- Increase water supply reliability and system operational flexibility to help meet municipal and industrial (M&I) and agricultural water demands in Santa Clara and San Benito

Counties during drought periods and emergencies, or to address shortages due to regulatory and environmental restrictions

- Increase suitable habitat in Pacheco Creek for federally threatened South-Central California Coast (SCCC) steelhead through improved water temperature and flow conditions

The secondary Project objectives are to:

- Improve water quality and minimize supply interruptions, when water is needed, for Santa Clara and San Benito Counties, to increase operational flexibility for south-of-Sacramento-San Joaquin Delta (Delta) contractors dependent on San Luis Reservoir
- Develop water supplies for environmental water needs at Incremental Level 4 (IL4) wildlife refuges to support habitat management in the Delta watershed

2.2.2 Purpose

Following is a description of identified major water-resources problems or deficiencies. These problems or deficiencies identify the purpose for the expansion of Pacheco Reservoir.

2.2.2.1 Decreasing Water Supply Reliability and System Flexibility

California's water supply system faces critical challenges, with demands exceeding available supplies for urban, agricultural, and environmental water uses in the San Francisco Bay Area (Bay Area) and statewide. The California Water Plan Update 2013 (DWR 2014) concludes that California is facing one of the most significant water crises in its history, with drought impacts growing and climate change affecting statewide hydrology. The California Water Plan Update 2018 further concludes that the people and ecosystems reliant upon California's water resources are increasingly vulnerable, including recent unprecedented, multi-year droughts threatening water supplies and aging infrastructure (DWR 2019). Despite significant physical improvements in water resources systems and system management over the past few decades, California still faces unreliable water supplies, continued depletion and degradation of groundwater resources, habitat and species declines, and unacceptable risks from flooding (DWR 2019; DWR 2014). Valley Water and San Benito County Water District (SBCWD) have responded to these water supply challenges by implementing and continuously evaluating innovative water supply plans and programs to diversify their water supply portfolios, including increased conservation, recycled water, groundwater banking and recharge projects, and developing additional local surface and groundwater supplies (Valley Water 2019; SBCWD et al. 2021).

> Despite the diverse water supply portfolios of Santa Clara and San Benito Counties, risks (e.g., regulatory and operational constraints, climate change, seismic events, drought, etc.) are still expected to adversely impact their long-term water supply reliability. Moreover, a Delta levee failure event or other Delta export outage could substantially impact Valley Water's and SBCWD's ability to meet water supply needs within its service area due to lack of insufficient local water storage.

Water Supply Management

Bay Area and other statewide water supplies are affected by regulatory actions to protect Delta fisheries, such as those included in Federal Endangered Species Act (ESA) biological opinions and water rights' terms and conditions. Some of these regulations include environmental flow goals and objectives, which have been implemented through restrictions on water-project export operations that curtail Delta pumping during specified time periods based on hydrologic and biologic conditions. Due to the continued decline in the Delta ecosystem—and associated impacts to protected, threatened, and endangered fish species—these regulatory actions are likely to continue to constrain water operations in the Delta. This constraint results in reduced Central Valley Project (CVP) and State Water Project (SWP) contract deliveries, adversely impacting water supply reliability in the Bay Area and adjacent regions (e.g., CVP San Felipe Division). Potential effects of climate change—including reductions in winter snowpacks and sea-level rise, discussed in more detail below—are anticipated to further reduce available water supplies for SWP and CVP exports.

In response to these challenges, each of the Bay Area water agencies has diversified its water supply portfolios. For Valley Water, this diversified water supply portfolio includes imported and local surface supplies and groundwater, conservation, water-banking operations, and water recycling. Although this diversified portfolio provides additional flexibility in responding to droughts, Valley Water customers still receive more than 45 percent of their supply from Delta exports under CVP and SWP contracts. As a result, Valley Water remains vulnerable to Delta export restrictions and statewide water supply shortages. Valley Water continues to explore expansion of existing programs and facilities, such as groundwater recharge, groundwater pumping, water recycling, conservation, and local and regional storage, and new regional and local options, such as desalination, to promote greater resource diversity. SBCWD meets approximately 50 percent of its long-term M&I and agricultural water demand with CVP water. Constraints on Delta exports and associated reduced CVP water supplies also adversely affect water supply reliability for SBCWD despite the use of a diverse portfolio approach, which includes, above-ground reservoirs, groundwater storage in and out of San Benito County during wet years, and groundwater recharge.

There are multiple challenges to maintaining and ensuring groundwater sustainability, including increasing uncertainty about the future availability of imported water, particularly with climate variability and with competing demands from overdrafted basins elsewhere. During the 2012-2016 drought, locally observed groundwater levels dropped due to extreme dry conditions. Lack of imported water during dry years to keep groundwater basins in balance, coupled with localized drought, presents risks to long-term water supply reliability.

Groundwater overdraft presents further threats to groundwater supply reliability, such as land subsidence and sea water intrusion. Valley Water actively monitors groundwater levels, land subsidence, and water quality to support operational decisions and ensure groundwater resources are protected. In addition, Valley Water manages several programs to balance pumping and groundwater recharge activities. As a result of these efforts, groundwater basins managed by Valley Water did not experience long-term subsidence during the 2012 through 2016 drought. However, future climate and hydrologic conditions may place new challenges and constraints on managing the region’s groundwater resources. Estimated CVP and SWP contract allocations for Valley Water and SBCWD (CVP only) under existing baseline conditions (i.e., 2017) are shown in Table 2-1. As shown in Table 2-1, the most significant CVP and SWP supply reductions occur in dry and critically dry years. When CVP and SWP allocations are reduced, Valley Water and SBCWD rely more on local supplies, typically groundwater, to meet demands within their service area. However, local dry periods often coincide with periods when imported CVP and SWP supplies are reduced, and opportunities to develop new local supplies are limited.

Table 2-1. Simulated Central Valley Project and State Water Project Contract Allocations for Valley Water by Water Year Type for Existing Conditions

Item	Allocations[4] (acre-feet per year) (Percentage of Total CVP/SWP Contract Amount)					
	Santa Clara Valley Water District			San Benito County Water District		
	Long-Term Average	Critical Dry Period (1929-1934)	Single Dry Year (1977)	Long-Term Average	Critical Dry Period (1929-1934)	Single Dry Year (1977)
CVP Allocations[1]	113,840 (75%)	86,533 (57%)	77,752 (51%)	24,781 (56%)	12,833 (29%)	10,836 (25%)
SWP Table A Allocations[2]	62,461 (62%)	29,982 (29%)	10,632 (11%)	--	--	--
Total CVP and SWP Allocations[3]	***176,301 (70%)***	***115,515 (46%)***	***88,384 (35%)***	***24,781 (56%)***	***12,833 (29%)***	***10,836 (25%)***

Source:

Notes:

[1] Numbers in parentheses represent percentage of Valley Water's total CVP contract amount.

[2] Numbers in parentheses represent percentage of Valley Water's total SWP contract amount.

[3] Numbers in parentheses represent percentage of Valley Water's total CVP and SWP contract amounts.

[4] Existing Conditions Baseline (2017) from CalSim II. See Water Resources and Fisheries Numerical Modeling Appendix, Chapter 2 for additional information.

Key:
-- = Not Applicable
CVP = Central Valley Project
SWP = State Water Project

Although Valley Water and SBCWD may have water allocations much less than their contract amount during dry years, CVP and SWP allocations often are greater than demands during wet years. Unfortunately, Valley Water and SBCWD are unable to take advantage of a portion of higher wet year allocations in some years due to insufficient local storage capacity.

To decrease the gap between available wet year allocations and available storage, Valley Water and other Bay Area water agencies, among others, have entered into agreements with Semitropic Water Storage District to store excess water when available (e.g., typically wet years), enabling them to take water from storage when needed (e.g., typically during dry and critically dry years). However, banking programs like Semitropic Groundwater Banking Program (Semitropic) and water exchanges are often limited by physical constraints in making deliveries under certain conditions (e.g., extreme drought, Delta export outage, conveyance limitations), and such programs are not sufficient to meet the needs of Valley Water and other Bay Area water agencies during those conditions. As a result, Valley Water and SBCWD need to improve the reliability of their water supplies, particularly in dry and critically dry years.

Drought Management

Water years 2012 through 2015 were the driest four-year period of statewide precipitation on record (CNRA 2021). The cumulative effect of these sustained dry conditions was reduced snowpack and runoff, reduced natural stream flow runoff, and limited surface water storage in reservoirs. This led to decreased surface water supplies, increased groundwater pumping, and significant effects on fish and wildlife populations (CNRA 2021). Each successive year of historic drought conditions resulted in compounded water-management challenges, including chronic shortages to M&I, environmental, agricultural, and wildlife refuge water supplies, as well as low groundwater levels. These conditions re-emphasized the pressing need for water agencies to increase and diversify their water supply portfolio to provide increased reliability, particularly to meet dry year water supply needs.

Unprecedented water management measures were taken during these drought years. On January 17, 2014, with nearly the entire state of California classified as being in severe or extreme drought conditions, Governor Jerry Brown issued a drought State of Emergency proclamation, the second time in history to declare statewide emergency due to drought (CNRA, 2021). In 2014, California Department of Water Resources (DWR) announced five percent water allocations for the 29 public water agencies with contracts for SWP supplies. In the history of the SWP, this is the lowest allocation provided to SWP M&I contractors, which supply water to 25 million Californians (DWR 2014). That same year, U.S. Department of the Interior, Bureau of Reclamation (Reclamation) announced zero allocations for CVP agricultural water contractors, zero allocations for Friant Division Class 1 and Class 2 contractors, 50 percent allocations for north- and south-of-Delta CVP M&I water contractors, 55 percent for CVP Eastside division contractors, 65 percent allocations for south-of-Delta Level 2 refuge water supply, and the lowest allocations on record for long-term Central Valley water rights holders (Reclamation 2021). Due to continued dry conditions, Reclamation announced similar CVP allocations in 2015, with the notable exception that CVP M&I allocations were reduced, to the greater of either 25 percent or the amount needed for health and safety needs. SWP allocations in 2015 also remained low, increasing to only 20 percent after some early-winter storms (Reclamation 2021; DWR 2015). Unprecedented drought conditions have also occurred in 2021, with DWR announcing five percent water allocations and south-of-Delta CVP M&I water contractors (including San Felipe division) receiving 25 percent allocations (Reclamation 2021).

Similar to other water agencies statewide, Bay Area water agencies experienced dramatic cutbacks in water supply during the 2012 through 2016 drought. For Valley Water and SBCWD, water supplies were reduced considerably due to historically low allocations from SWP and CVP. From 2012 to 2015, CVP south-of-Delta agriculture allocations dropped from 40 percent to zero percent and south-of-Delta CVP M&I allocations dropped from 75 percent to 25 percent (State Water Resources Control Board 2018). Similarly, SWP south-of-Delta contract allocations dropped from 35 percent to 20 percent from 2012 to 2015 (Coalition for a Sustainable Delta 2019). Additionally, due to the extended dry period, and with heavy reliance on local water supplies and less rain to replenish surface water and groundwater resources, local supplies also began to be depleted. Some local groundwater basins faced potential overdraft concerns, including concerns over the potential resumption of permanent subsidence if heavy groundwater reliance and limited recharge continued. In addition, except for agencies with existing long-term transfer agreements, opportunities to obtain water transfers were very limited due to the lack of available statewide water supplies.

Although Valley Water had 262,664 acre-feet of water stored in Semitropic in Kern County, it experienced challenges in withdrawing those supplies in 2014 and 2015 because the bank is located downstream from Valley Water, and the recovery of banked supplies relies on exchanges with SWP supplies from the Delta, which were limited during those dry years. In both 2014 and 2015, Valley Water's banked water was pumped into the California Aqueduct and provided to DWR, who delivered the water as part of its SWP supply to contractors south of Semitropic, while delivering an equivalent amount of SWP supply pumped from the Delta to Valley Water. Because of the limited quantity of SWP water available for exchange, Valley Water began planning of a reverse flow project in 2014 to physically move its banked water from Semitropic upstream to San Luis Reservoir. The reverse flow project resulted in an emergency $6.7 million plan to move approximately 35,000 acre-feet of water from the Semitropic backward along the California Aqueduct to San Luis Reservoir, using up to 20 diesel pumps. However, rains in late 2014 and early 2015 placed the emergency plan on hold as there were sufficient allocations to meet Valley Water and San Benito demands.

The 2012 to 2016 drought reinforced the need for Valley Water to continue investigating other options for increasing water supplies to address these challenges, such as expanding recycled water supplies, desalination, and increasing local storage. The emergency plan and other options for increasing water supplies highlight the need for Valley Water to obtain additional reliable and cost-effective dry year water supplies.

Emergency Water Supply

The State's water operations, including the reliability of SWP and CVP water supplies, rely on a fragile Delta levee system that faces increasing risks from floods, earthquakes, and climate change. Failures along the Delta's 1,100 miles of levees, due to flood events, are not a rare occurrence, with each of the 70 islands or tracts having flooded at least once since Delta lands were originally reclaimed. Since 1980, 27 Delta islands have been partially or completely flooded, including a 2004 levee break at Upper Jones Tract that caused nearly $100 million in damages. When levees fail, water rushes onto Delta islands, many of which are 25 feet or more below sea level. One result is a lowering of Delta water levels that draws saltwater into the Delta from San Francisco Bay. Multiple levee failures, or a failure when Delta inflows are low, could cause saltwater intrusion as far inland as the SWP and CVP pumping facilities. This could result in a long-term disruption of SWP and CVP exports to south-of-Delta water contractors. Since SWP and CVP water supplies comprise approximately 45 percent of Valley Water's water supply portfolio, a Delta levee failure event could substantially impact Valley Water's ability to meet M&I water supply needs within its service area. A Delta levee failure would also substantially impact the SBCWD's M&I customers, as SBCWD's water supply portfolio includes approximately 42 percent from CVP water supplies.

Numerous earthquake faults running through or near the Delta also pose a threat to levee stability, and therefore, the reliability of Valley Water's SWP and CVP water supplies and the SBCWD's CVP water supplies also. As strain continues to build up on Bay Area faults, increasing the annual risk of seismic activity, aging levees are increasingly vulnerable to earthquake-induced failure. A rare, large earthquake could likely flood 16 or more islands in the Delta, principally in the central and west Delta. Such an earthquake could significantly alter Delta flow patterns, resulting in severe, prolonged disruptions in water quality and aquatic habitat. Multiple levee failures from a major earthquake could cause SWP and CVP water exports to shut down for several months. The estimated probability that either a large flood or seismic event will impact the Delta during the next 50 years is approximately two in three (Mount and Twiss 2005).

As discussed above, global climate change has the potential to exacerbate risks from flooding or earthquakes over time through possible—although uncertain—impacts related to future air temperatures and precipitation patterns and resulting implications on sea levels. Impacts associated with a rise in sea level would likely be most significant in the Delta, where a rise in sea level would increase pressure on levees currently protecting low-lying lands. It is estimated that a 1-foot rise in sea level would increase the frequency of the 100-year peak high tide to a 10-year event (Roos 2005). Additionally, a rise in sea level would cause increased salinity intrusion from the ocean, which could degrade freshwater supplies pumped from the Delta and necessitate increased reservoir releases upstream to dilute intruding seawater, further reducing supplies of SWP and CVP water for exports.

In addition to disruption in SWP and CVP water supplies, it is uncertain whether Valley Water would be able to access water supplies stored in Semitropic in the event of a Delta levee failure that disrupted Delta exports. This is because Semitropic is located downstream from Valley Water facilities, and recovery of banked supplies requires either complex water exchanges or back-pumping, which is extremely expensive. If no, or very little, water can be exported from the Delta due to emergency conditions, there may be insufficient water available in the system to make the necessary exchanges for Valley Water to recover its banked water.

Valley Water customers in Santa Clara County also receive Hetch Hetchy water supplies from San Francisco Public Utilities Commission—a supply that is vulnerable to earthquakes. San Francisco Public Utilities Commission has made significant investment towards upgrading their system for seismic vulnerability, but due to location, this supply is still vulnerable to earthquakes.

Effects of Climate Change

Another potentially significant factor affecting Valley Water and SBCWD's water supply reliability is climate change. Potential effects of climate change are many and complex (DWR 2006; USGCRP 2018), varying both through time and geographic location across the state (Reclamation 2011a). Reclamation's Sacramento and San Joaquin Rivers Basin Study (Reclamation 2016a) forecasts substantial impacts from climate change in California's Central Valley, including significant uncertainty in statewide long-term water supply reliability. Changes in the geographic distribution, timing, and intensity of precipitation are also projected for the Central Valley (Reclamation 2011a), which could broadly impact rainfall-runoff relationships that are important for both flood management and water supply (Reclamation 2016a). Additionally, there is a potential for increased temperatures and shifts in timing of precipitation due to climate change to increase annual water demand, primarily for urban water uses, compared to a continuation of the historical climate (DWR 2014; Reclamation 2016a).

It is anticipated that with climate change, temperatures will increase, precipitation will be more prevalent in the form of rain than snow, and precipitation timing and intensity will change. Rising temperatures may significantly reduce water held in snowpacks in the Sierra Nevada as more precipitation is predicted to occur as rainfall and snowmelt is expected to occur earlier in the spring (Reclamation 2011a; DWR 2014; Reclamation 2016a; USGCRP 2018). Earlier seasonal runoff would reduce water supply space in existing Central Valley reservoirs due to increased needs for additional flood management space. These potential reductions could significantly impact available SWP and CVP water supplies, especially in reservoirs immediately upstream from large urban areas, such as Folsom Reservoir, and it could reduce the amount of available SWP and CVP water supplies available for export to Valley Water and SBCWD (CVP supplies only).

Temperature projections for the Bay Area show a shift in the timing of spring and summer heat extremes, to begin earlier in spring and extend later into September, as well as an increase in the frequency and intensity of heat waves (Valley Water 2016a; Valley Water 2021a). Locally, increasing temperatures are anticipated in Santa Clara County. Increased temperatures could result in more extreme heat and drought events, an increased wildfire risk, and increased water demands (which can be exacerbated by an increase in evaporation and water quality issues in reservoirs). Higher temperatures intensified the 2012 through 2016 drought, helped cause the lowest snowpack on record in California in 2014 through 2015, and may have accounted for one-tenth to one-fifth of the reduced soil moisture from 2012 to 2014 (USGCRP 2018). Future projections for local precipitation are not as clear. Some studies indicate storms could become more intense and rainfall patterns could change, but they would not necessarily have a large impact on average annual rainfall amounts (Valley Water 2016a; Valley Water 2021a). Atmospheric rivers, which have been responsible for many large floods in California, may increase in severity and frequency under climate change (USGCRP 2018). More severe storms could result in increased flood risk and a change in patterns that could challenge local water supply operations.

Sea-level rise could further impact Bay Area supply reliability. According to the 2018 National Climate Assessment, sea level at the Golden Gate Bridge has risen by nine inches between 1854 and 2016 as oceans have warmed and land ice has melted (USGCRP 2018). The greatest potential effect of sea-level rise on California's water supply would most likely occur in the Delta (DWR 2005). If high levels of carbon dioxide emissions continue (Representative Concentration Pathway 8.5), continued climate change could raise sea level near San Francisco by 30 inches by 2100, with a range of 19-41 inches (Griggs et al. 2017). Higher sea levels would push saltwater up into the Delta, potentially degrading freshwater quality at CVP, SWP, and other local pumping facilities. This saltwater intrusion would result in more water needed for Delta outflow standards with less water available to deliver to water contractors. To offset increased salinity intrusion, Delta pumping could be curtailed, or upstream reservoir releases could be increased.

Anticipated climate change impacts were reflected in the CWC future modeling of 2030 and 2070 statewide water operations (CWC 2016). The models include shifts in winter precipitation from snow to rain due to escalating temperatures, increasing reservoir inflows in winter and decreasing reservoir inflows in spring. The percentage of annual inflow to Trinity, Shasta, Folsom, and Oroville Reservoirs—occurring in December through March, indicating rainfall runoff—is 48 percent for historical hydrology, 56 percent for projected 2030, and 62 percent for projected 2070. The 2030 and 2070 models also include anticipated sea-level rise, resulting in higher Delta salinity levels. Resulting operations modeling for 2030 and 2070 shows reduced reservoir storage due to more inflow occurring in winter when the flood pool precludes storing the additional inflow.

Additionally, the modeling shows that increased releases will be necessary to meet Delta salinity requirements due to anticipated sea-level rise, further decreasing available water supplies. Because of these decreases in water supplies, modeling results show a reduction in SWP and CVP allocations. SWP allocations decrease from an average of 63 percent under historical hydrology to 62 percent for 2030, and a decrease to 57 percent for 2070. CVP M&I and agricultural allocations decrease from 80 percent and 50 percent (respectively) for historical hydrology, to 77 percent and 44 percent for 2030, and to 71 percent and 29 percent for 2070. These reductions are even more pronounced during drought years.

2.2.2.2 Insufficient Habitat for SCCC Steelhead

The Pajaro River watershed is the northern extent of the threatened SCCC steelhead—a species that, without serious intervention, is under threat of extinction within the next 50 years (Moyle 2008). In the early to mid-1960's, the Pajaro River watershed supported up to 2,000 spawning adults (McEwan and Jackson 1996), only to have the population plummet to less than 500 adults by 1996 (NMFS 2005). Over the years, the three watersheds mostly likely supporting the largest runs of steelhead (Pajaro, Salinas, and Carmel) have experienced more than 90 percent declines in adult run size (NMFS 2013). The Pajaro River watershed is considered severely degraded. Because the Pajaro River watershed is ecologically distinct from other watersheds within the SCCC steelhead range, its degradation has a significant effect on the distinct population segment's (DPS) spatial structure and diversity.

> The three watersheds most likely exhibiting the largest annual runs of SCCC steelhead (i.e., Pajaro, Salinas, Carmel) have experienced declines in adult run size of 90 percent or more. Without serious intervention, a majority (possibly all) of SCCC steelhead populations are likely to be extinct within the next 50 years.

Currently, Uvas Creek has the only self-sustaining steelhead population in the Pajaro River watershed. This increases the threat of extinction to the Inland Coast Range Biogeographic Population Group (BPG) because of the risks to steelhead resulting catastrophic events such as a prolonged drought or a major fire, and climate change.

Recovery Plan

To identify recovery actions for the SCCC steelhead DPS, NMFS developed the South-Central California Steelhead Recovery Plan (Recovery Plan) in 2013. The Recovery Plan describes the importance of the Pajaro River and its tributaries within the Interior Coast Range BPG. The Recovery Plan states that the SCCC steelhead require the recovery of a minimum number of viable populations within each BPG in order to conserve natural diversity, spatial distribution, and abundance. The Interior Coast Range BPG consists mostly of long alluvial valleys and many intermittent streams with historically moderate-to-low migration reliability (based on unmanaged flow regimes prior to European settlement). Because the mainstems cross alluvial valleys, steelhead adults and smolts often encounter problems migrating, particularly in dry years. As a result, the number of viable populations in this BPG has significantly decreased over the years. In the Pajaro River watershed, there are only two consistent populations – Corralitos Creek near the estuary, and Uvas Creek. Llagas Creek and Pacheco Creek only have sporadic steelhead activity due to the intermittent nature of the streams. Therefore, the Pajaro River steelhead are at a higher risk of extirpation because of the limited number of populations. Improving conditions in Pacheco Creek to support SCCC steelhead is extremely important to establishment of a functionally independent SCCC population in the Pajaro River watershed.

The Recovery Plan identified water management activities, including current dam operations and groundwater extractions, among others, as a top threat to SCCC viability in the Pajaro River watershed. Consequently, a critical proposed SCCC steelhead recovery action in the Pajaro River watershed, and on Pacheco Creek in particular, is a pattern and magnitude of water releases that provides essential habitat functions to support the life history and habitat requirements for both adult and juvenile life stages. Therefore, NMFS considers improving habitat conditions in Pacheco Creek by modifying water management activities extremely important to establishment of a functionally independent SCCC population in the Pajaro River watershed.

Insufficient Flow

The SCCC steelhead is differentiated from other steelhead DPSs along the California and Oregon coastline by their long slender body, which is adapted to the flashy streams that occur within this region. This adaptation provides a run with a high-risk, high-reward strategy [1]that exposes the fish to extended dry periods with limited to no channel flows and increases the risk of single-year population extirpation (local eradication). Pacheco Creek is subject to significant streambed percolation into the aquifers, with stream reaches that have a tendency to go dry in many years. As shown in Table 2-2, Pacheco Creek goes dry several miles downstream of Pacheco Reservoir in most years. Over the past eight years (2013 to 2020), despite some reservoir releases, Pacheco Creek at least eight miles downstream from the North Fork Dam has remained dry throughout much of the summer.

[1] If adequate flows and water temperatures are present within Pacheco Creek, suitable habitat is available to support SCCC steelhead. However, the flashy nature of the hydrology also presents high risk to fisheries within the system.

Table 2-2. Observed Mean Monthly Flow (cfs) in Pacheco Creek Approximately Eight Miles Downstream of Pacheco Reservoir

Year	2013	2014	2015	2016	2017	2018	2019	2020
Water Year Type	Dry	Critical	Critical	Below Normal	Wet	Below Normal	Wet	Dry
Jan	2	0	0	88	818	0	66	4
Feb	0	0	13	20	814	0	487	1
Mar	0	0	0	212	99	16	120	1
Apr	0	0	0	5	23	2	47	8
May	0	0	0	0	5	0	8	0
Jun	0	0	0	2	1	0	3	0
Jul	0	0	0	1	0	0	1	0
Aug	0	0	0	1	4	0	1	0
Sep	2	0	0	2	0	0	0	0
Oct	0	0	0	2	0	0	0	0
Nov	0	0	0	1	0	0	0	0
Dec	0	0	0	10	0	0	20	0

Source: USGS gage 11153000, PACHECO C NR DUNNEVILLE CA.

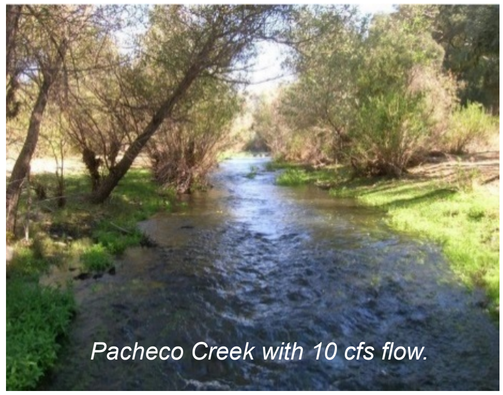
Note:
Blue highlighted text indicates flows equal to or greater than 1 cfs.

Key:
cfs = cubic feet per second

Steelhead adults require sufficient flow for passage to their spawning habitat between December and March, while juveniles require sufficient flow throughout their rearing life stage and during their downstream migration in the spring. Insufficient flows in Pacheco Creek and its tributaries, particularly South Fork Pacheco Creek and Cedar Creek, influence steelhead survival by impeding fish passage, dewatering redds, stranding juveniles, and impairing habitat by reducing riparian vegetation cover. This reduction of riparian vegetation exacerbates increased water temperatures. Pacheco Creek was historically closely connected to the aquifer, providing cold water refugia for steelhead in Pacheco Creek limiting rearing to larger pools as flows receded. For years, particularly since the early 2000s, flows have been insufficient for fish passage, resulting in very few adults successfully migrating into Pacheco Creek and severely limiting steelhead spawning (Micko and Smith 2020; 2021). The few rearing juveniles during this same time period have had reduced availability to rearing habitat resulting from large portions of dry creek beds.

When Pacheco Creek tributaries go dry, steelhead fry and juvenile habitat suitability is limited by North Fork Pacheco Reservoir releases; however, in the past reservoir releases were designed to match the timing of agricultural use downstream. Low stream flows and high water temperatures severely impact steelhead fry and juvenile survival in many years during late spring, before Pacheco Reservoir releases begin. While early summer reservoir releases can provide suitable rearing conditions, steelhead may have already been eliminated or reduced after having been restricted to the warm pools remaining from spring runoff. In addition, these reservoir releases can take several weeks to months to make their way downstream due to streambed percolation losses—leaving portions of the creek dry or with minimal flow at increased temperatures.


Pacheco Creek in the dry season.


Pacheco Creek with 10 cfs flow.

Successful adult and juvenile migration depends on high winter or spring flows in consecutive years for upstream and downstream passage. Low flows during the migration period in a single year can disrupt the SCCC steelhead lifecycle by either blocking migration, dewatering the creek, or otherwise impairing spawning or rearing habitat. Failure to provide spawning habitat or migration opportunities may lead to reduced fish populations or extirpation of the cohort. Prior field studies from the 1970s through the 1990s identified intermittent populations of SCCC steelhead in Pacheco Creek, with opportunistic migration to the creek when flows allowed upstream movement (Smith 2014). Between 2002 and 2019, low flows in Pacheco Creek led to warm temperatures and a drying streambed which reduced SCCC steelhead abundance considerably (Micko and Smith 2020). Field studies indicate that, under current conditions, only the 10 miles of Pacheco Creek downstream from the existing confluence of North Fork and South Fork Pacheco Creek may provide suitable habitat for steelhead egg incubation and fry rearing in some years (Smith, Personal Communication, 2017). Therefore, having consistent and continuous flow at a suitable temperature is essential to the survival of SCCC steelhead in Pacheco Creek.

Unsuitable Temperature

Pacheco Creek is noted to have high summer water temperatures because of factors including low flows, restricted connection to the aquifer, and limited riparian cover. Steelhead are a notably sensitive species to water temperature, with certain life stages more at risk than others (i.e., eggs and smolts). Water temperature suitability threshold criteria for steelhead, established by the U.S. Environmental Protection Agency (EPA 2003), identify temperatures that may be lethal, lead to sub-optimal growth, or create a competitive disadvantage for each life stage. The EPA water temperature suitability threshold criteria for steelhead are based upon waterways located in more mountainous Pacific Northwest topography that are snow fed and are likely lower than the temperature SCCC have adapted to in the lower elevation Pajaro watershed. The CCRWQCB has applied an evaluation guideline for water temperature based on Moyle (1976), which states that for rainbow trout (i.e., steelhead) the optimum range for growth and completion of most life stages is 55.4 to 69.8 degrees Fahrenheit (°F) (13 to 21 degrees Celsius [°C]).

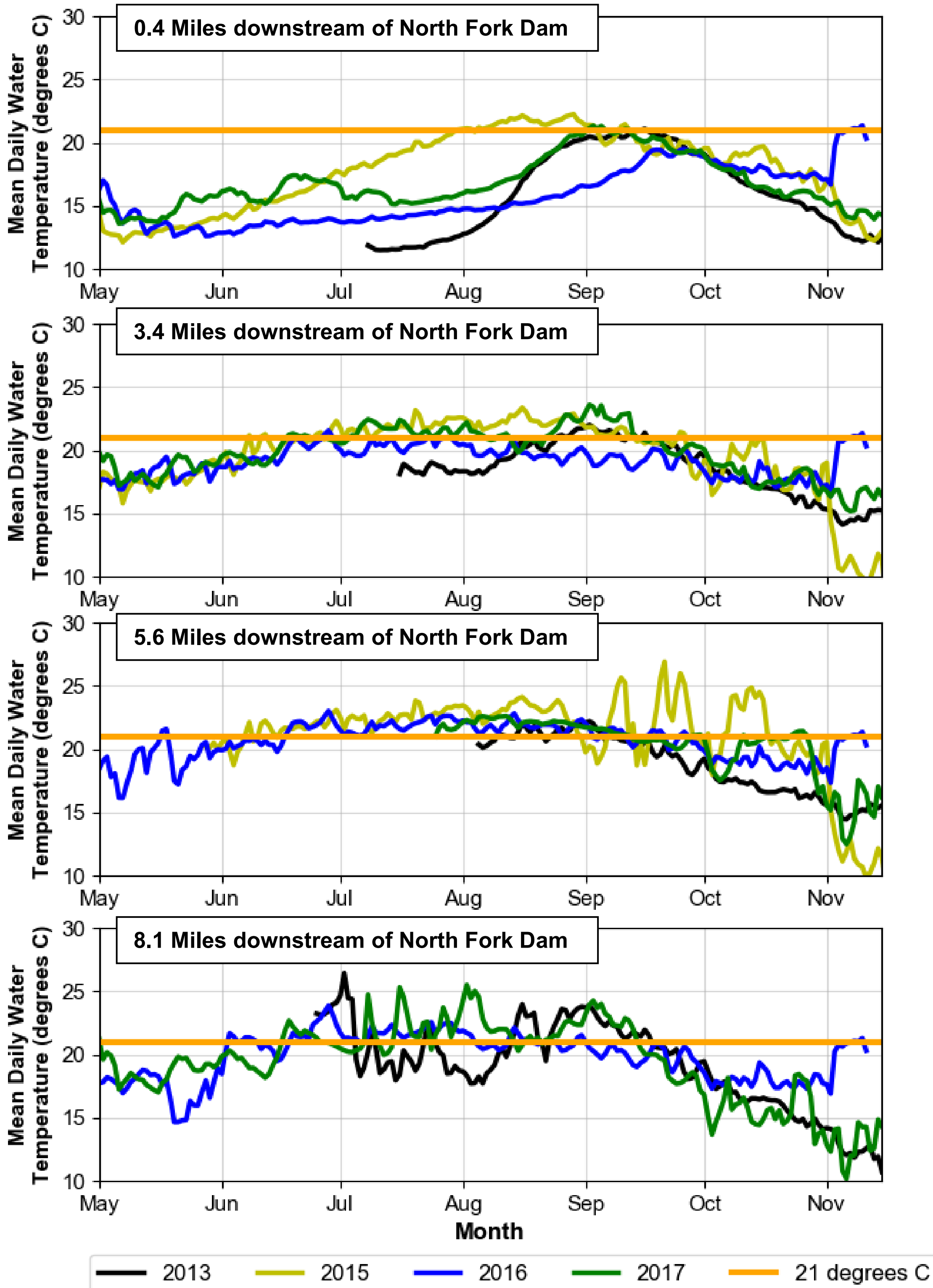
During the wet, cooler months of January through April when upstream and downstream migration, spawning, and egg incubation occur, water temperatures in Pacheco Creek are likely suitable immediately downstream of the dam. Pacheco Reservoir is usually fully mixed at a cool temperature, close to the ambient air temperature, and flows from South Fork Pacheco Creek are also seasonally cool.

Fry and juvenile rearing occurs during a 14-month window from February through April of the following year, which includes periods when Pacheco Creek typically warms, going dry in some years. Water temperatures in Pacheco Creek have been recorded annually at multiple locations between April and November since 2013 (Micko and Smith 2018). As shown in Figure 2-1, mean daily water temperatures often exceed 64.4°F (18°C) in August through October at State Route 152 (SR 152), just 0.4 miles downstream from the North Fork Dam. Several miles downstream from the dam, either water temperatures exceed 70°F (21°C) or there is no flow nearly every year from June through October as shown in Figures 2-1 and Figure 2-2. These temperatures are generally above the optimal constant temperature limit for SCCC juvenile steelhead.

As the summer progresses, the flows in South Fork Pacheco Creek cease from lack of precipitation, air temperatures increase, and water in Pacheco Reservoir warms and loses cold water storage in the lower reservoir from sustained releases. Cold water is typically depleted in July, and reservoir releases, if still occurring, can rise to a daily average of 70°F (21°C) or higher as shown in Figure 2-1) (Micko and Smith 2018). For several creek miles downstream from the dam, water temperatures become increasingly warmer and more variable in later summer due to diurnal heating and cooling. Larger steelhead generally require progressively deeper and higher velocity habitat but can tolerate higher water temperatures. However, without enough flow, excessively high temperatures can be lethal. Pacheco Creek can remain dry or at unsuitable water temperatures into October, when air temperatures begin to cool.

Climate Change

Climatologists predict an increased frequency of warm, intense rainfall events along the Central California coastline and extended periods of hot inland temperatures under climate change. These anticipated climatic extremes further threaten SCCC steelhead survival by establishing conditions where large spring flow events attract migrating adults to a reach destined for summer-time desiccation.

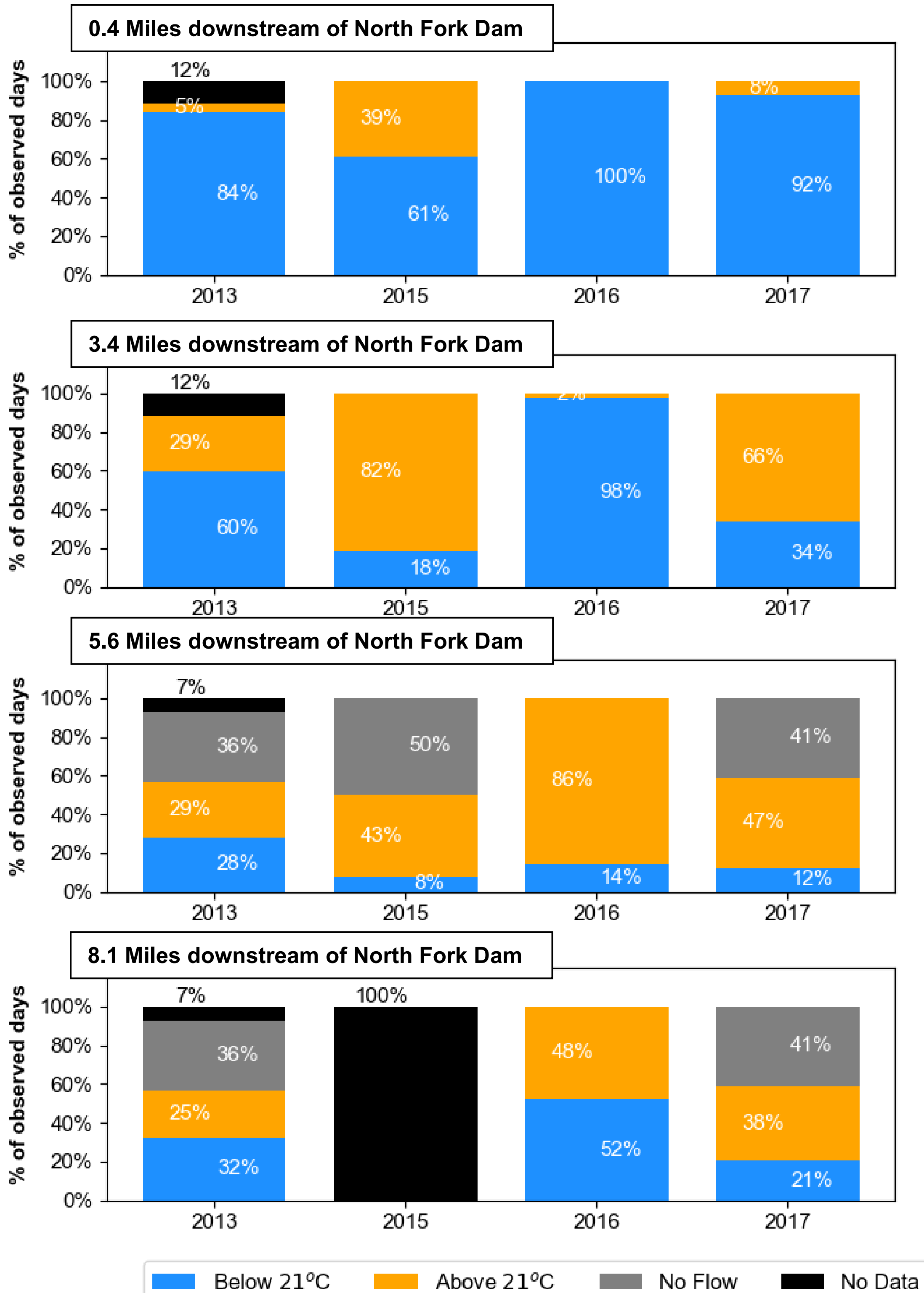


Source: Temperature data: Micko and Smith 2018.

Key:

C = Celsius

Figure 2-1. Historic Water Temperature (Mean Daily) in Pacheco Creek



Source: Micko and Smith 2018

Key:

°C = degrees Celsius

Figure 2-2. Percent of Observed Days from July Through September When Mean Daily Water Temperature is Below or Above 21°C

2.2.2.3 Degraded Quality of Drinking Water

When water levels are low at San Luis Reservoir—a main component of the CVP San Felipe Division—the quality of delivered water is impaired by algae growth and can interrupt the supply of water for Santa Clara and San Benito Counties.

The quality of delivered water from San Luis Reservoir, a main component of the CVP San Felipe Division, is impaired by algae growth when reservoir levels are low. This issue threatens the ability of Valley Water and SBCWD to provide a reliable supply of healthy, clean drinking water to millions of people in Santa Clara and San Benito Counties.

San Luis Reservoir, located approximately 6 miles east of Pacheco Reservoir, is owned and jointly operated by Reclamation and DWR to provide seasonal storage for the SWP and CVP. A portion of deliveries from San Luis Reservoir are conveyed west through the Upper and Lower Pacheco Intakes, Pacheco Tunnel, Pacheco Pumping Plant, and Pacheco Conduit to CVP San Felipe Division water contractors, which include Valley Water and SBCWD. A portion of the water supply conveyed to Santa Clara and San Benito Counties is at risk when water levels in San Luis Reservoir reach very low levels during late-summer and early-fall months.

Valley Water and SBCWD Intake Within San Luis Reservoir

High temperatures, combined with declining water levels, foster growth of an algae layer as much as 35 feet below San Luis Reservoir's surface. The water quality within the algal blooms present taste and odor problems for M&I water users relying on existing water treatment facilities. As the water levels decline to the point that the algae are in the vicinity of the Upper Pacheco Intake, as shown in Figure 2-3, that intake is no longer used. Typically, this occurs when water levels reach an elevation of 369 feet above mean sea level (msl), or at 300,000 acre-feet capacity in the reservoir. If water levels fall below 369 feet above msl, Valley Water blends water from San Luis Reservoir with local supply sources to minimize water quality issues for M&I customers. San Luis Reservoir is the only delivery route for Valley Water's CVP supplies; therefore, Valley Water cannot receive it's normal CVP supplies for M&I purposes during low-point events.

Algae Growth Within San Luis Reservoir

Following development of the initial planning milestone documents for Reclamation's San Luis Low Point Improvement Project (SLLPIP) (Reclamation 2006; Reclamation 2008), Valley Water initiated a number of efforts to address the low-point issue. While these efforts have resulted in improvements, the San Luis Reservoir low-point issue has persisted, exacerbated by the severe drought California experienced from 2012 through 2015. In addition, CVP and SWP water supplies have been increasingly constrained by regulatory actions to protect Delta fisheries, further lowering the water levels in San Luis Reservoir.

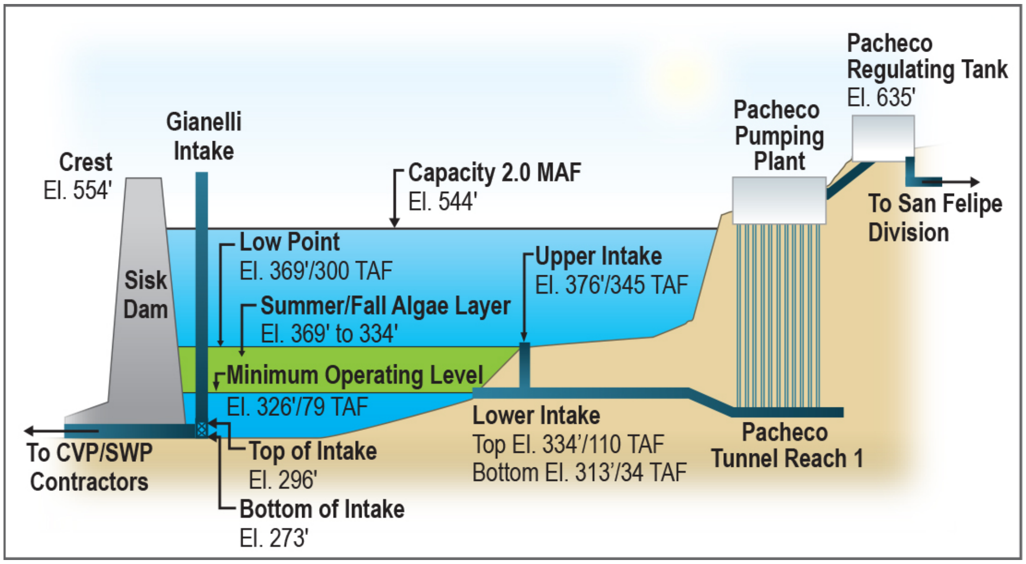


Figure 2-3. Reservoir Intake and Outlet Facilities

2.2.2.4 Insufficient Water Supply for Refuges

> Pursuant to the CVPIA Refuge Water Supply Program, Incremental Level 4 water supplies are deliveries meant to support wetlands and wildlife habitat development and management. Historically, these deliveries to wildlife refuges have been less than 50 percent of demands.

A century ago, the Central Valley contained over four million acres of natural wetlands. Since then, more than 90 percent of these wetlands have disappeared (CVJV 2006), and today only about 300,000 acres of the original area remains. Federal national wildlife refuges, managed by the U.S. Fish and Wildlife Service (USFWS), and State Wildlife Areas, managed by CDFW, comprise about one-third of this acreage, with most of the remainder in private ownership. These wildlife refuges support millions of wintering waterfowl and serve as critical stopovers for migratory birds along the Pacific Flyway, as well as providing habitat for resident birds and other wildlife, including several threatened and endangered species. Dependable water supplies of suitable quality are essential for maintaining habitat at these refuges to benefit a variety of wetland-dependent wildlife populations.

Section 3406(d) of the 1992 Central Valley Project Improvement Act (CVPIA) includes provisions for refuge water supplies for 19 specified Central Valley refuges. These water supplies include 422,251 acre-feet of Level 2 water supplies and 133,264 acre-feet of IL4 water supplies (Table 2-3). Reclamation is required to provide full Level 2 water supplies annually, while Level 4 water supply is considered the total amount of water identified for optimum wetlands and wildlife habitat development and management. IL4 water supplies are the difference between the defined Level 2 and Full Level 4 water supplies. The CVPIA requires that Reclamation provide full Level 2 supplies annually, with allowable reductions of up to 25 percent during some years. However, the CVPIA stipulates that IL4 water supplies are to be acquired in cooperation and cost-sharing with the State of California through voluntary measures, such as purchase, lease, donation, conservation, and conjunctive use.

Table 2-3. Level 2 and Level 4 Central Valley Project Improvement Act Refuge Water Supply Provisions

Refuge	Level 2 (acre-feet)	Incremental Level 4 (acre-feet)[1]	Total Level 4 (acre-feet)
North-of-Delta Refuges			
Sacramento NWR	46,400	3,600	50,000
Delevan NWR	20,950	9,050	30,000
Colusa NWR	25,000	0	25,000
Sutter NWR	23,500	6,500	30,000
Gray Lodge WA	35,400	8,600	44,000
Subtotal	***151,250***	***27,750***	***179,000***
South-of-Delta Refuges			
San Luis NWR			
San Luis Unit	19,000	0	19,000
West Bear Creek Unit	7,207	3,603	10,810
East Bear Creek Unit	8,863	4,432	13,295
Kesterson Unit	10,000	0	10,000
Freitas Unit	5,290	0	5,290
Merced NWR[2]	13,500	2,500	16,000
Grasslands WA			
Salt Slough Unit	6,680	3,340	10,020
China Island Unit	6,967	3,483	10,450
Mendota WA[3]	27,594	2,056	29,650
Volta WA	13,000	3,000	16,000
Los Banos WA	16,670	8,330	25,000
Grassland Resource Conservation District	125,000	55,000	180,000
Kern NWR	9,950	15,050	25,000
Pixley NWR[4]	1,280	4,720	6,000
Subtotal	***271,001***	***105,514***	***376,515***
Total North- and South-of-Delta	***422,251***	***133,264***	***555,515***

Source: Reclamation1989, Reclamation et al. 2001

Notes:

[1] Does not include conveyance losses.

[2] Merced NWR receives 15,000 AF of mitigation water from Merced Irrigation District, in accordance with its Federal Energy Regulatory Commission license. The additional 1,000 AF is met through groundwater pumping.

[3] Conveyance constraints for Mendota are anticipated to be addressed in the next 5-10 years (2020-2025).

[4] Conveyance constraints prevent deliveries to Pixley NWR.

Key:
AF = acre-feet
NWR = National Wildlife Refuge
WA = Wildlife Area

The Refuge Water Supply Program (RWSP) was established jointly by Reclamation and USFWS, pursuant to CVPIA Section 3406(d). In partnership with CDFW, the Grassland Resource Conservation District (GRCD), and the Central Valley Joint Venture (CVJV), the RWSP is tasked with acquiring IL4 water supplies, conveying (through groundwater pumping and wheeling) Level 2 and IL4 water supplies, and constructing infrastructure improvements to enable delivery of full IL4 supplies.

The CVPIA refuges are managed by USFWS, CDFW, and landowners of privately owned/managed wetlands in the GRCD. Grassland Water District, a member of the San Luis &

Delta-Mendota Water Authority, delivers CVP water—and other water supplies acquired through the RWSP—to Merced County wetlands within the approximately 75,000-acre GRCD. In addition to a long-term water supply contract with Reclamation to manage CVPIA water supplies provided by Reclamation for the GRCD, Grassland Water District has a conveyance contract with Reclamation to convey CVPIA water supplies to adjacent state wildlife management areas and federal wildlife refuges.

Each year, the RWSP strives to provide as much IL4 water as possible. However, full IL4 deliveries have been achieved only during wet years and only to refuges without conveyance constraints. As shown in Table 2-4, from 2002 to 2014, average annual IL4 refuge water supply deliveries were less than 50 percent of total IL4 demands (Reclamation 2016b). This is due in large part to state and federal budget shortages; conveyance constraints at certain refuges that prevent the transmission of surface water deliveries; inconsistency in the timing of water deliveries; decreased water supply availability due to in-stream flow requirements and the Delta export restrictions; and increases in the cost of water made available annually from willing sellers on the open market (CVJV 2006).

Table 2-4. Incremental Level 4 Refuge Water Acquisitions from 2002 to 2014

Fiscal Year	Incremental Level 4 Water Acquired (acre-feet)[1]	Percentage of Total Incremental Level 4 Target (133,264 acre-feet)
2002	94,690	64
2003	79,300	53
2004	77,010	51
2005	85,538	53
2006	94,622	63
2007	51,911	31
2008	41,108	23
2009	42,526	24
2010	74,038	47
2011	102,565	78
2012	59,197	41
2013	50,281	39
2014	22,579	17
Average	**67,336**	**45**

Source: Reclamation 2016b

Note:

[1] 2011 is the first year that the Water Acquisition Program began reporting purchased and non-purchased water acquired toward the Incremental Level 4 target.

2.3 Conceptual Measures Identification, Evaluation, and Screening

CEQA Guidelines 15126.6(a) specifies:

> *Alternatives to the Proposed Project. An EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives.*

As described in Section 2.3.1, this Project has multiple primary and secondary Project objectives and, potentially, vastly different options or alternatives to address each objective. In order to identify potential alternatives that could "feasibly attain most of the basic objectives of the project," conceptual measures were identified, evaluated, and screened for each Project objective. A conceptual measure is any operational or physical modification that could address one or more of the Project objectives. This approach is commonly applied for large, multi-objective water resources projects (e.g., projects focused on ecosystem restoration, water supply, flood risk management).

The water-resources problems or deficiencies used to help define the primary and secondary objectives provide the basis for the identification, evaluation, and screening of a wide array of conceptual measures. These measures were initially developed to address the specific problem or deficiency statement outlined in the previous section for each Project objective, then subjected to a screening process as described below. Alternatives to the Proposed Project were based on the retained conceptual measures that addressed the primary Project objectives.

2.3.1 Conceptual Measures Screening Criteria

For the purpose of this analysis, specific criteria were developed to evaluate and screen conceptual measures that were developed for each Project objective. The following categories were identified, in consideration of Valley Water Quality and Environmental Management System (QEMS) document No. W-730-124 (2018), to evaluate the conceptual measures during the screening process:

- Achievement: Ability to address the respective primary or secondary Project objectives independently
- Feasibility: Practicability in terms of technical, logistical, and cost constraints

Criteria were developed for each category to determine whether a conceptual measure can address the Project objectives or if it is feasible in terms of technical, logistical, and cost constraints. Measures were evaluated and assigned a *pass* or *fail* in meeting the criteria established for each category. Each category was evaluated concurrently. For example, if a conceptual measure received a *fail* in the first category, its ability to meet criteria in the second category was still evaluated. Conceptual measures that were assigned a *pass* for all screening categories were retained for further evaluation during development of alternatives for the Project.

The screening criteria for evaluating the conceptual measures under each category are described below.

2.3.1.1 Achievement Category

The Project's primary and secondary objectives are described in Section 2.1.1. The first category evaluated conceptual measures in terms of their ability to attain the respective Project objective. Each measure was assigned a *pass* or *fail*. The criteria considered for each measure to receive a *pass* or *fail* for the first category is included in Table 2-5.

2.3.1.2 Feasibility Category

The feasibility of conceptual measures in terms of their technical, logistical, and cost constraints was evaluated under the feasibility category. The methods used to analyze the criteria are described below.

Table 2-5. Achievement Category Criteria to Determine Whether a Conceptual Measure Addresses the Project Objectives

Project Objective	Criteria to Pass	Criteria to Fail
Primary Objectives		
Increase water supply reliability and system operational flexibility to help meet M&I and agricultural water demands in Santa Clara and San Benito Counties during drought periods and emergencies, or to address shortages due to regulatory and environmental restrictions.	The conceptual measure has moderate to high potential to address both the ability to provide improved long-term water supply reliability and emergency response benefits.	The conceptual measure may provide long-term water supply reliability, but uncertainty exists or there is limited potential for the measure to provide emergency response benefits. The conceptual measure has limited potential to provide improved long-term water supply reliability and emergency response benefits.
Increase suitable habitat in Pacheco Creek for federally threatened SCCC steelhead through improved water temperature and flow conditions.	The conceptual measure has high potential to increase suitable habitat in Pacheco Creek or the Pajaro River watershed.	The conceptual measure has limited potential to increase suitable habitat in Pacheco Creek or the Pajaro River watershed.
Secondary Objectives		
Improve water quality and minimize supply interruptions, when water is needed for Santa Clara and San Benito Counties, and increase operational flexibility for south-of-Delta contractors dependent on San Luis Reservoir.	The conceptual measure has moderate to high potential to improve water quality and minimize supply interruptions to increase operational flexibility for south-of-Delta contractors dependent on San Luis Reservoir.	The conceptual measure has limited potential to improve water quality and minimize supply interruptions to increase operational flexibility for south-of-Delta contractors dependent on San Luis Reservoir.
Develop water supplies for environmental water needs at IL4 wildlife refuges to support habitat management in the Delta watershed.	The conceptual measure has moderate to high potential to develop water supplies for IL4 wildlife refuges.	The conceptual measure has limited potential to develop water supplies for IL4 wildlife refuges.

Key:
IL4 = Incremental Level 4
M&I = municipal and industrial
SCCC = South-Central California Coast

Technical

Available information was used to evaluate whether a conceptual measure was technically feasible (i.e., whether it would be possible to construct, operate, and maintain it with current engineering technology) and whether there were any substantial and unreasonable geotechnical or engineering problems. Reliance on questionable or untested technology would expose the Project to substantial risk, related to achieving the Project objectives.

Logistical

A logistical constraint was considered substantial if the conceptual measure’s ability to achieve the Project objectives would involve extensive risk and/or uncertainty. Available information was used to consider each conceptual measure’s logistical feasibility regarding location, operations, infrastructure, local/state/federal laws, regulations, requirements, and topography.

Cost

The cost criterion was used to evaluate whether cost would create an unreasonable barrier to the implementation of the Project. Overall, the cost of the conceptual measure was compared to the cost of expanding Pacheco Reservoir, while assuming similar levels of physical benefits (within reason). For purposes of this evaluation, cost information for conceptual measures was based on existing studies. If existing cost information was not available, it was assumed the conceptual measure was comparable to the cost of expanding Pacheco Reservoir (within reason) based on the conceptual measure's project description. If neither of these conditions were applicable, cost was not evaluated, and therefore, was not factored into the feasibility determination of a conceptual measure.

Each measure was assigned a *pass* or *fail*. The criteria considered for each measure to receive a *pass* or *fail* for the feasibility category is included in Table 2-6.

Table 2-6. Feasibility Category Criteria to Determine Whether a Conceptual Measure is Feasible

Feasibility Category	Criteria to Pass	Criteria to Fail
Technical	The conceptual measure is technically feasible (i.e., possible to construct and operate with current engineering technology) and has no substantial and unreasonable geotechnical or engineering problems.	The conceptual measure is not technically feasible (i.e., not possible to construct and operate with current engineering technology) and/or has substantial and unreasonable geotechnical or engineering problems.
Logistical	The conceptual measure has no substantial development constraints related to location, operations, infrastructure, local/state/federal laws, regulations, requirements, and topography.	The conceptual measure has substantial development constraints related to location, operations, infrastructure, local/state/federal laws, regulations, requirements, and topography.
Cost	The cost of the conceptual measure does not create a substantial implementation barrier.	The cost of the conceptual measure creates a substantial implementation barrier.

2.3.2 Conceptual Measures and Screening Results

This section summarizes the conceptual measures considered and the reasons for either retaining or eliminating measures from further Project consideration. Descriptions of the conceptual measures, screening evaluations, and results are presented below by Project objective.

2.3.2.1 Conceptual Measures to Address Primary Project Objectives

The following conceptual measures for each primary Project objective were identified through studies, programs, projects, Project meetings, field inspections, outreach, and environmental scoping activities.

Water Supply Reliability and Emergency Response

The primary Project objective to address problems and deficiencies associated with water supply reliability and emergency response is to:

- Increase water supply reliability and system operational flexibility to help meet M&I and agricultural water demands in Santa Clara and San Benito Counties during drought periods and emergencies, or to address shortages due to regulatory and environmental restrictions.

Conceptual measures to address this primary Project objective are grouped into the following categories: water transfers and purchases, reservoir and system operations, water-use efficiency, surface water and groundwater storage, alternate water supplies, and conveyance and system modifications, as summarized below.

Water Transfers and Purchases

Water right and land retirement measures considered are summarized as follows:

- **Implement Water Transfers Within the San Felipe Division of the CVP** – This measure consists of implementing water transfers (or exchanges) within the CVP San Felipe Division to improve reliability during dry and critical years when Reclamation or DWR reduce allocations to CVP contractors. This measure would involve developing the necessary long-term implementation agreements and facilities for water transfers. Because transfers are performed on a year-to-year basis, significant uncertainty exists regarding the availability and cost of water. In dry and critical years, the supply of water decreases while the demand increases, resulting in higher prices for water, and, in some years, a very limited supply of water transfers is available. Uncertainty is highest in dry and critical years. Although the physical potential for water transfers within the study area is well established, it is assumed that even if long-term enforceable agreements could be developed, they would have only a minor effect during a crucial dry period or extended drought when CVP San Felipe Division contractors would need supplies.

- **Implement Water Transfers from Outside the San Felipe Division of the CVP** – This measure primarily consists of transferring water between users within the Central Valley to allow more efficient use of available supplies. Water purchases and transfers do not generate new water supplies, they simply consist of transferring water between a seller willing to forgo a water use for a time and a willing buyer within the Central Valley. The availability and price of a supply for purchase and then used for transfer depends on several factors such as year type, other available supplies, agricultural water availability, storage capabilities, and transmission capacity. Water transfers include both temporary and long-term (greater than one-year, as defined by DWR) transfers. Most active water transfers are temporary transfers, which depend on the water spot market.

- **Retire Agricultural Lands Within the San Felipe Division of the CVP** – This measure consists of long-term retirement of agricultural lands in the San Felipe Division of the CVP and use of the foregone agricultural supplies in Santa Clara and San Benito Counties. It is estimated that in dry and critical years, potential savings through this measure could be substantially reduced from the average annual value because it is during these water-short years that marginal lands are normally allowed to go fallow. The ability of this measure to meet future Valley Water and SBCWD M&I water demands is limited. First, as mentioned, marginal lands are already often allowed to go fallow during drought periods. Further, there would be a high degree of uncertainty regarding the institutional ability to rededicate those CVP supplies to urban uses in the San Felipe Division of the CVP, and the ability to acquire sufficient additional land rights necessary to preclude future irrigated agriculture on lands identified for inclusion in a project/program. This especially would be the case if efforts were made to acquire and retire higher-productivity lands that may lead to water savings during drought periods.

Reservoir and System Operations

Reservoir reoperation measures considered are summarized as follows:

- **Reoperate the Existing North Fork Dam to Reduce Spills** – This measure would require developing and implementing operating criteria to ensure that water supply releases from the existing North Fork Dam optimize water supply storage to reduce spills. The existing Pacheco Reservoir collects rainfall from a 66.5-square-mile watershed and releases it downstream. Pacheco Pass Water District (PPWD) has an appropriative water right that entitles it to 7,250 acre-feet per year (by storage) to be collected from about October 1 to about June 1 of each season in Pacheco Reservoir, and in the gravels underlying PPWD; being later recovered from wells for the purpose of domestic and irrigation use within the PPWD. The reservoir was designed with a storage capacity of 6,150 acre-feet. Current storage capacity is estimated at 5,500 acre-feet, a reduction of approximately 650 acre-feet from the original design due to sediment deposition behind the dam. Pacheco Reservoir is not connected to the Pacheco Conduit; therefore, it does not receive water from the CVP or SWP (Micko 2014a). Accordingly, with no connection to Pacheco Conduit, there is no opportunity to increase water supply to Valley Water.

Operations under existing conditions periodically cause the reservoir to go dry. Historical records are limited, and it appears likely that different reservoir operation strategies were employed at different times. Pacheco Reservoir storage records, available for the 29 years between 1975 and 2003, indicate that Pacheco Reservoir was full in 16 years, or 55 percent of the time. In nine of the 16 full years, the reservoir was drained entirely, and in the other seven years as much as 3,000 acre-feet was carried over in storage to the next year. This assessment assumes that ongoing operations would be consistent with the Report on Comprehensive Strategy and Instructions for Operation of Pacheco Reservoir (Micko 2014b) which optimizes groundwater recharge and steelhead habitat. Accordingly, as these operations optimize recharge, reoperation of the reservoir may not increase long-term water supply yields or drought year yields.

- **Reoperate Anderson and/or Calero Reservoirs to Store Additional CVP Water Supply** – This measure would allow for more storage in Anderson Reservoir and/or Calero Reservoir through development and implementation of operating criteria to ensure that water supply releases optimize storage space to accommodate CVP water supply (Reclamation 2008). The reservoirs could be reoperated with the intent of storing CVP supply conveyed through San Luis Reservoir during non-low-point months. Reoperation of the reservoirs may not increase long-term water supply yields or drought year yields.

- **Reoperate Other Valley Water Dams and Reservoirs to Reduce Spills** – This measure would allow for more storage in other Valley Water reservoirs (Almaden, Chesbro, Coyote, Guadalupe, Lexington, Stevens Creek, Uvas, and Vasona Reservoirs) through development and implementation of operating criteria to ensure that water supply releases optimize storage space for natural inflow. Reoperation of the reservoirs may not increase long-term water supply yields or drought year yields.

- **Improve Delta Export and Conveyance Capability Through Coordinated CVP and SWP Operations** – This measure primarily consists of improving Delta export and conveyance capability through a more effective integrated management of surplus flows in the Delta. A specific application of the measure would be the Joint Point of Diversion (JPOD) (Reclamation 2018). JPOD operations would allow federal and State water managers to use excess or available capacity in their respective south Delta diversion facilities at the C.W. Jones and Banks Pumping Plants. Currently, little excess capacity exists in the federal pumps at C.W. Jones, but some additional capacity is available in the SWP pumps at Banks. Studies indicate that the potential added benefit to the CVP, through JPOD operations during average and critically dry years, would be about 61,000 and 32,000 acre-feet, respectively. Reclamation and DWR are actively pursuing this measure, and it is highly likely that some form of the JPOD will be implemented in the future.

Water Use Efficiency

Improved efficiency measures considered are summarized as follows:

- **Implement Additional Water Conservation and Water Use Efficiency Methods and Programs** – This measure includes implementing additional water conservation and water-use efficiency methods above what is currently anticipated. Examples of water conservation and water use efficiency methods Valley Water is evaluating under the Additional Conservation and Stormwater Projects and Programs include advanced metering infrastructure; customer side-leak repair incentives; graywater program expansion; rebates for the installation of rain barrels, cisterns, and rain gardens; partnerships to construct stormwater capture projects (e.g., basins to capture stormwater); and a flood managed aquifer project (Valley Water 2019a). These projects and programs are expected to reduce water demands by 10,000 acre-feet per year and increase natural groundwater recharge by about 1,000 acre-feet per year when fully implemented by the end of the planning horizon. Three of the projects—rain garden rebates, rain barrel/cistern rebates, and graywater program expansion—have already been implemented, and therefore were not included as part of this measure.

Surface Water and Groundwater Storage

The various surface water and groundwater storage conceptual measures considered include:

- **Raise North Fork Dam In-place to Expand Existing Pacheco Reservoir to Increase Storage** – This measure consists of increasing storage space in the existing Pacheco Reservoir by raising North Fork Dam in-place. The expanded reservoir would store CVP water delivered from the Delta to San Luis Reservoir and pumped to the Pacheco Reservoir. This measure would include a two-way pump station to be used to lift water from the Pacheco Conduit to the expanded reservoir, or the reverse when gravity flow is not possible. The expanded reservoir would also store natural inflow from the North and East Forks of Pacheco Creek. This measure was initially identified in the *Reconnaissance Level Evaluation of Alternative Dam and Reservoir Sites* prepared for Valley Water (Wahler 1993).

- **Expand Existing Pacheco Reservoir Through Construction of a New Dam to Increase Storage Space** – This measure consists of increasing storage space in the existing Pacheco Reservoir through construction of a new dam. Reservoir expansion would require decommissioning of the existing North Fork Dam and construction of a new dam at a site upstream of the existing dam. Pacheco Reservoir is located on the North Fork of Pacheco Creek, approximately 6 miles west of San Luis Reservoir. The expanded reservoir would store CVP water delivered from the Delta to San Luis Reservoir, and then pumped to the Pacheco Reservoir. This measure would include a two-way pump station to be used to lift water from the Pacheco Conduit to the expanded reservoir, or the reverse when gravity flow is not possible. The expanded reservoir would also store natural inflow from the North and East Forks of Pacheco Creek.

- **Expand Anderson Reservoir to Increase Storage Space** – This measure is expansion of the existing Anderson Dam on Coyote Creek, approximately 2 miles east of the City of Morgan Hill. This measure would raise Anderson Dam 35 feet, increasing Anderson Reservoir's capacity from 89,000 acre-feet to 189,000 acre-feet. Modifications to the existing pump station would be needed to convey water to the Cross Valley Pipeline (Reclamation 2011b).

- **Expand Chesbro Reservoir to Increase Storage Space** – This measure is expansion of Chesbro Reservoir from 9,000 acre-feet to 150,000 acre-feet (Reclamation 2019). The existing Chesbro Reservoir is on Llagas Creek, west of Morgan Hill. The reservoir expansion would require several large saddle dams along the northern and western boundary of the expanded reservoir. A new embankment would also be necessary for the main dam. To impound upstream watershed flows, associated pumping and diversion facilities would need to be constructed. The new conveyance facilities would traverse areas with high liquefaction potential and require a complex pipeline crossing Highway 101. In addition, enlargement of the existing reservoir would inundate over 40 residences in the surrounding area (Reclamation 2019).

- **Expand Uvas Reservoir to Increase Storage Space** – This measure consists of expanding storage space in Uvas Reservoir through construction of a new dam or raising the existing dam in-place. This measure would expand Uvas Reservoir by about 5,000 acre-feet to 15,000 acre-feet, reducing reservoir spills (Valley Water 2019b). Uvas Reservoir is located on Uvas Creek, which currently provides suitable steelhead habitat.

- **Expand San Luis Reservoir to Increase Storage Space** – This measure would raise the B.F. Sisk Dam and increase the capacity of San Luis Reservoir to provide approximately 16,100 acre-feet of additional south-of-Delta agricultural water supply on an average annual basis (Reclamation 2019). This measure would build upon the dam embankment expansion and foundation modifications to address the seismic concerns that are currently in final design. This additional 10 feet in embankment height would support a new water surface elevation of 554 feet and an additional 120,000 acre-feet in storage capacity. The expanded capacity would be operated in the same way as the current CVP portion of San Luis Reservoir, with the reservoir used for seasonal storage. This measure would allocate the increased capacity to the CVP only. This measure would not modify existing San Felipe Division intake structures.

- **Expand Los Vaqueros Reservoir to Increase Storage Space** – Reclamation, DWR, and Contra Costa Water District are preparing a feasibility study of the potential expansion of the Los Vaqueros Reservoir. This measure would require Valley Water to secure an agreement with Contra Costa Water District and other partners to expand the off-stream reservoir up to 275,000 acre-feet and construct a new pipeline (Transfer-Bethany) connecting the reservoir to the South Bay Aqueduct (Reclamation 2018). This measure assumes Valley Water’s share is 35,000 acre-feet of reservoir storage, which includes an emergency storage pool of 20,000 acre-feet for use during droughts (Valley Water 2019a). However, Valley Water is continuing discussions on potential levels of participation in the project.

- **Construct San Benito Reservoir to Increase Storage Space** – This measure would construct a new reservoir near the City of Hollister, south of Hollister Conduit Bifurcation, with a storage capacity of 60,000 acre-feet (Reclamation 2011b). The reservoir would provide flood control capacity for the Pajaro River, increased groundwater recharge for the aquifer area, and new recreation opportunities.

- **Construct Del Puerto Reservoir to Increase Storage Space** – This measure would construct a new off-stream reservoir on Del Puerto Creek, northwest of the City of Patterson in Stanislaus County and west of the California Aqueduct (Reclamation 2011b). Del Puerto Reservoir could create 191,000 acre-feet of new surface storage capacity. The new reservoir could store CVP supplies during wet water years.

- **Construct Ingram Canyon Reservoir to Increase Storage Space** – This measure would construct a new off-stream reservoir in Ingram Canyon, northwest of Patterson, with 330,000 acre-feet to 980,000 acre-feet storage capacity of new surface-water storage capacity (Reclamation 2011b).

- **Construct Quinto Creek Reservoir to Increase Storage Space** – This measure would construct a new off-stream surface-water storage reservoir on Quinto Creek, with 332,000 to 381,000 acre-feet of new surface-water storage capacity (Reclamation 2011b). The potential reservoir site is west of the California Aqueduct and southwest of the town of Gustine. Portions of the proposed reservoir would be in Merced County and portions would be in Stanislaus County.

- **Expand Existing or Construct New Storage in Sacramento River/San Joaquin River Watersheds** – Over 50 potential onstream and off-stream storage projects were identified in the CALFED August 2000 Initial Surface Water Storage Screening, Integrated Storage Investigation report to address regional or statewide water supply reliability issues (Reclamation 2018). Five of the potential storage sites were identified for further development in the 2000 CALFED Programmatic Record of Decision (ROD), and seven sites were identified for further consideration, but the study was deferred. Feasibility studies have been developed for each of the five potential projects: (1) Shasta Lake Enlargement (Shasta Lake Water Resources Investigation – Final Feasibility Report completed in 2015), (2) In-Delta Storage (feasibility study completed in 2015), (3) Millerton Lake Enlargement (Upper San Joaquin River Basin Storage Investigation – Draft Feasibility Report completed in 2014), (4) Sites Reservoir (North-of-the-Delta Off-Stream Storage Project – Draft Environmental Impact Statement/EIR completed in 2017), and (5) Los Vaqueros Reservoir Expansion (Final Feasibility Report completed in 2020).

- **Construct New Storage in the Sacramento-San Joaquin Delta** – This measure would convert several Delta islands into water storage facilities. In-Delta Storage is one of the five projects recommended for study in the 2000 CALFED Programmatic ROD (Reclamation 2018). The In-Delta Storage project would incorporate two islands (Webb Tract and Bacon Island) and two habitat islands (Holland Tract and Bouldin Island), similar to a measure previously proposed by the Delta Wetlands Project. The current version of the In-Delta Storage project would provide capacity to store approximately 217,000 acre-feet of water in the south Delta for water supply, water quality, and ecosystem benefits. Project operations would result in additional water deliveries to in-Delta and south-of-Delta urban and agricultural users, and additional system-wide carryover storage could improve the reliability of other CVP and SWP deliveries. The project could also be used to facilitate water transfers from upstream areas to areas south of the Delta.

- **Construct Other Local Area Storage Facilities in Other Watersheds** – Sites to construct other local area storage facilities in other watersheds include the Packwood, Coe, Los Osos, and Cedar Creeks' sites (Reclamation 2008). The topography at each of these sites could support a reservoir of at least 150,000 acre-feet. Two of these sites, Packwood and Coe Creek, are at a higher elevation than the other storage sites considered, relative to existing conveyance infrastructure, which would affect pumping costs. These two sites also have limited availability of construction materials that could be used to develop an earthfill embankment. A portion of the reservoir at the Los Osos Creek site would be within Henry W. Coe State Park. Conveyance facilities and reservoirs associated with the Henry W. Coe State Park and Los Osos Creek sites are adjacent to known faults and related seismic hazards, including the Calaveras Fault.

- **Construct Multiple Concrete Reservoirs for Additional Water Storage Space** – This measure would construct multiple concrete reservoirs/storage tanks to provide local storage space for water. A large footprint would be required for concrete reservoirs/storage tanks to provide substantial storage volumes (e.g., 50,000 to 100,000 acre-feet).

- **Expand Participation with Out-of-Basin Groundwater Storage (e.g., Semitropic Groundwater Bank) –** This measure would involve increased participation with out-of-basin groundwater banks, such as the Semitropic Groundwater Bank in Kern County. Currently, in wet and normal water years, excess supplies are stored in the local groundwater basin, local and statewide reservoirs, or the Semitropic Groundwater Bank. This helps Valley Water manage natural variations in rainfall and the associated changes in water supply availability (Reclamation 2008). Expanding participation in other out-of-basin groundwater banks could improve water supply reliability and emergency response during dry years when Valley Water draws on these reserve supplies to help meet demands (Valley Water 2019a).

- **Implement Additional In-Basin Groundwater Storage and Recovery Operations (e.g., South County Recharge Project)** – This measure includes increasing groundwater recharge capacity in the northern end of the Llagas Subbasin, either through reoperation of existing facilities or connecting existing facilities to additional water sources. This would enable Valley Water to capture more wet-season water and more effectively manage supplies and maintain groundwater levels during droughts. For example, potential components of the South County Recharge Project include Butterfield Channel pipeline extension and San Pedro Ponds improvements.

- **Dredge Bottom of Pacheco Reservoir or Any Other Existing Valley Water Reservoir** – This measure would remove all sediment and debris from within the Pacheco Reservoir and any other existing Valley Water reservoirs. The existing Pacheco Reservoir storage capacity is 5,500 acre-feet and by removing materials, it would create additional storage space for water supply. This measure would also support an environment for healthy water quality by removing excess sediment and debris that can contribute to increased turbidity and nutrient loads and decreased dissolved oxygen.

<u>Alternate Water Supplies</u>
Alternate water supply measures considered are summarized as follows:

- **Construct Monterey Bay Desalination Facility and Related Conveyance Facilities** – This measure would construct a new 317-million-gallon-per-day (mgd) desal plant adjacent to Monterey Bay and the Moss Landing Power Plant, pumping plant, and with a 96-inch-diameter potable water pipeline connecting to existing CVP San Felipe Division facilities (Reclamation 2008). This facility would expand upon (or be independent from) the facility near Moss Landing that local agencies are considering. This measure would only supply water to the San Felipe Division of the CVP during years with poor water quality at San Luis Reservoir. Other times, this measure would supply water to Monterey and Santa Cruz Counties.

- **Construct San Francisco Bay Desalination Facility and Related Conveyance Facilities** – This measure would construct a new 317-mgd desal plant with a new 102-

inch pipeline delivering water to Santa Teresa and Rinconada Water Treatment Plants (WTP). Facilities would be designed to fully replace the scheduled deliveries to Valley Water, Pajaro Valley Water Management Agency, and SBCWD from San Luis Reservoir during supply interruptions created by the low-point issue (Reclamation 2008).

- **Construct Desalination Facilities and Related Conveyance Facilities in San Francisco Bay, Monterey Bay, and San Benito County** – This measure would develop three facilities: one at San Francisco Bay, one at Monterey Bay, and one in San Benito County. A new 213-mgd desalination plant near the San Jose Regional Water Pollution Control Facility would treat water for delivery to Valley Water (Reclamation 2008).

- **Construct Bay Area Regional Desalination Project** – This measure would construct the Bay Area Regional Desalination Plant, a 10-20 mgd desalination treatment facility in eastern Contra Costa County that would be developed by Contra Costa Water District, San Francisco Public Utilities Commission, East Bay Municipal Utility District, Zone 7 Water Agency, and Valley Water (CCWD 2014). The project would rely on available capacity in an extensive network of existing pipelines and interties that already connect the agencies, as well as existing wastewater outfalls and pump stations in the region. The only new infrastructure for the project would be a treatment plant and connections to the network of interconnections that would already be in place. Once treated, water could be delivered through either EBMUD or CCWD's conveyance systems via transfers to other partner agencies.

- **Implement Additional Wastewater Reclamation** – This measure would provide Valley Water, SBCWD, and other Bay Area users with an additional, supplemental supply for non-potable uses. This measure consists of the increased use of reclaimed wastewater from Valley Water or other Bay Area wastewater treatments plants to offset potable water demands and to improve water supply reliability, particularly in dry years. Throughout the Bay Area, reclaimed wastewater is currently applied to a variety of non-potable uses such as irrigation, industrial processes, cooling tower make-up water, and aquifer recharge. This measure would include constructing new filtration and disinfection treatment systems at existing treatment plants, pump stations, distribution systems to end-users, and reservoirs (to ensure system reliability) (Valley Water 2019a). A separate distribution system would be required because reclaimed wastewater cannot be conveyed via potable water systems.

  All four of Santa Clara County's wastewater treatment plants produce reuse water for non-potable uses such as irrigation and cooling towers. Valley Water is completing a Countywide Water Reuse Master Plan that will identify a preferred mix of non-potable and potable reuse and reverse osmosis-concentrate management strategies. The placeholder for the Potable Reuse Program is an indirect potable reuse project at the Los Gatos Pond. This project involves purifying water at an expanded Silicon Valley Advanced Purification Center in the City of Alviso, pumping the water to the City of Campbell, and using the purified water for groundwater recharge in the existing ponds along Los Gatos Creek. This project assumes up to 24,000 acre-feet per year of advanced treated recycled water that would be available for groundwater recharge ponds in the Los Gatos recharge system.

Conveyance and System Modifications

Conveyance and system modification measures considered are summarized as follows:

- **Construct Conveyance from Pacheco Conduit to Other Valley Water Reservoirs to Store CVP and Other Water Supply** – This measure would construct conveyance from Pacheco Conduit to Valley Water reservoirs not currently connected to the Conduit to receive CVP and other water supplies (e.g., water purchases, long-term or short-term water transfers or exchanges) from San Luis Reservoir. The Valley Water facilities that are currently not connected to the Pacheco Conduit include Almaden, Chesbro, Coyote, Guadalupe, Lexington, Stevens Creek, Uvas, and Vasona Reservoirs. Some existing reservoir sites can provide more storage potential than other sites or are more technically feasible than others. Vasona, Stevens Creek, Guadalupe, and Almaden Reservoirs all have relatively low storage volumes when compared to other Valley Water reservoirs.

- **Construct Transfer-Bethany Pipeline Portion of the Los Vaqueros Reservoir Expansion** – This measure would construct the Transfer-Bethany Pipeline, which is one element of the larger Los Vaqueros Reservoir Expansion Project. Construction and operation of this pipeline would optimize the use of existing supplies and increase operational flexibility by enabling Valley Water to move water from Contra Costa Water District's intakes in the Delta to Valley Water's system without relying on south-of-Delta CVP and SWP pumps (Valley Water 2019a).

SCCC Steelhead Habitat
The primary Project objective to address problems and deficiencies associated with SCCC steelhead habitat is as follows:

- Increase suitable habitat in Pacheco Creek for federally threatened SCCC steelhead through improved water temperature and flow conditions.

Potential measures to address this primary Project objective include measures to improve flow and temperature conditions in Pacheco Creek, support recovery of other populations of SCCC steelhead in the Pajaro River watershed, develop conservation hatcheries, and implement National Marine Fisheries Service (NMFS) Recovery Plan actions, as summarized below.

<u>Improve Flow and Temperature Conditions in Pacheco Creek</u>
The various measures to improve flow and temperature conditions in Pacheco Creek are summarized as follows:

- **Raise North Fork Dam In-place to Expand Existing Pacheco Reservoir and Operate in Consideration of SCCC Steelhead** – This measure consists of increasing storage space in the existing Pacheco Reservoir through raising North Fork Dam in-place. This increase in storage space would allow extended operational flexibility at Pacheco Reservoir to improve habitat conditions for SCCC steelhead. The expanded reservoir would capture and store natural inflows from the North and East Forks of Pacheco Creek. As initially documented in the *Reconnaissance Level Evaluation of Alternative Dam and Reservoir Site* report, raising North Fork Dam in-place would require a long dam extension on the left abutment (Wahler 1993). The foundation of an expanded dam would be located in an area of relatively weak, sheared shale where inherent instability has caused damage to the existing spillway.

- **Reoperate Existing North Fork Dam in Consideration of SCCC Steelhead** – This measure would require developing and implementing operating criteria to ensure that groundwater extractions and water supply releases from the existing North Fork Dam provide the habitat functions and requirements necessary for all SCCC steelhead life stages. It should be noted that without the Project, it is anticipated that the existing reservoir will be operated consistent with recommendations and release rules in the 2014 Report on Comprehensive Strategy and Instructions for Operation of Pacheco Reservoir (i.e., optimized operations for SCCC steelhead habitat and groundwater recharge) (Micko 2014). Accordingly, this measure would focus on refinements to the operational rules presented in the 2014 report. It is unlikely that this measure would provide substantial SCCC steelhead benefits in Pacheco Creek because it would not result in further improved flow or temperature conditions.

- **Expand Existing Pacheco Reservoir Through Construction of a New Dam and Operate in Consideration of SCCC Steelhead** – This measure consists of increasing storage space in the existing Pacheco Reservoir through construction of a new dam. This increased storage space would allow for extended operational flexibility at Pacheco Reservoir to improve habitat conditions for SCCC steelhead. Reservoir expansion would require demolition of the existing North Fork Dam and construction of a new dam at a site upstream of the existing dam. The expanded reservoir would capture and store natural inflow from the North and East Forks of Pacheco Creek.
- **Direct Discharge of Imported Supplies to Pacheco Creek** – This measure would supplement Pacheco Creek instream flow with direct discharge of out-of-basin water to the creek for improved SCCC steelhead habitat conditions. This measure would include construction of a turn-out and pipeline at Pacheco Conduit downstream of the Pacheco Tunnel. Water for this option would draw from storage at San Luis Reservoir. The water supply would be purchased through a spot transfer market or by entering into a long-term water transfer agreement. Due to existing Pacheco Reservoir storage capacity, it is anticipated that a majority of Pacheco Creek flows would be satisfied by San Luis Reservoir supplies—particularly in late summer and fall in most water year types. Water supplies from San Luis Reservoir have high summer temperatures that are not suitable for steelhead, and imported water also impacts steelhead imprinting which increases the risk of straying adult fish.
- **Delivery of Imported Supplies to Existing Pacheco Reservoir and Subsequent Release to Pacheco Creek** – This option would use imported water to supplement Pacheco Creek flows but would change the point of discharge of out-of-basin water to Pacheco Reservoir. This approach would include construction of a turn-out, pipeline, and associated facilities to the Pacheco Conduit for delivery of water to Pacheco Reservoir. Water for this option would draw from storage at San Luis Reservoir. The supply would be purchased through a spot transfer market or by entering into a long-term water transfer agreement. Under this measure, natural inflows to Pacheco Reservoir would be supplemented when storage capacity is available. It is anticipated that the imported water would be the majority supply during drought periods, typically with warm water temperatures not suitable for steelhead. Due to the limited existing storage capacity of Pacheco Reservoir, appropriate proportions of imported water versus native water supplies would likely not be maintained, a condition that impacts steelhead imprinting and affects adult straying. Moreover, the existing storage capacity of Pacheco Reservoir cannot establish a cold-water pool sufficient to address the warmer San Luis Reservoir supplies.
- **Augment Pacheco Creek with In-Basin Groundwater** – This measure would supplement Pacheco Creek instream flow with groundwater pumped from within the Hollister area of the Gilroy-Hollister Valley Basin (defined as 3-003.03 in DWR's Bulletin 118 uniform name and numbering system) to improve SCCC steelhead habitat

conditions. This measure would feature construction of a well field near San Felipe Lake and a pipeline to deliver water to Pacheco Reservoir or for direct discharge to Pacheco Creek near the North Fork Dam. This well field would be constructed in a portion of San Benito County adjacent to Pacheco Creek in order to access geologic conditions suitable to yield up to 8,000 acre-feet of water annually. The temperature of pumped groundwater would be anticipated to be a suitable temperature for steelhead habitat.

- **Augment Pacheco Creek with Out-of-Basin Groundwater** – This measure supplements Pacheco Creek instream flows with groundwater pumped from the Llagas area of the Gilroy-Hollister Valley Basin (defined as 3-003.01 in DWR's Bulletin 118 uniform name and numbering system) to improve SCCC steelhead habitat conditions. This basin is actively managed by Valley Water through an adopted Groundwater Management Plan (Valley Water 2016b). It is considered a high-priority basin under the California Statewide Groundwater Elevation Monitoring Program, but it is not considered as being in overdraft. This measure would feature construction of a well field in the Gilroy area near Llagas Creek and a pipeline to deliver water to Pacheco Reservoir or for direct discharge to Pacheco Creek near the North Fork Dam. The well field would be constructed in Santa Clara County and located in an area that is suitable for up to 8,000 acre-feet of water annually.
- **Construct Desalination Plant and Conveyance Facilities to Pacheco Creek** – This measure would require constructing a 317-mgd desalination plant adjacent to Monterey Bay and the Moss Landing Power Plant (Reclamation 2008). This facility would expand upon (or be independent from) the facility near Moss Landing that local agencies are considering. The plant would use the existing intake at the power plant, along with supplemental intake structures, to bring seawater to the desalination plant. Water from the plant could be conveyed to Pacheco Reservoir or Pacheco Creek using new or existing pipelines.
- **Remove Existing North Fork Dam** – This measure would involve removing the existing North Fork Dam to restore natural flows through Pacheco Creek. While passage to the upper reaches of the North Fork of Pacheco Creek would be improved, the flashy nature of this system would mean prolonged periods of low (or no) flows during the late summer and fall months.

<u>Support Recovery of Other Populations of SCCC Steelhead in the Pajaro Watershed</u>
The various conceptual measures to support the recovery of other additional populations of SCCC steelhead in the Pajaro River watershed are summarized as follows:

- **Construct Desalination Plant to Offset Groundwater Pumping and Improve Passage in Corralitos Creek** – This measure is intended to improve fish passage and fish habitat in Corralitos Creek by restoring groundwater levels in the region through developing replacement supplies for existing water users. This option includes construction of a desalination plant near the City of Watsonville that would provide supplies to replace groundwater pumping and surface-water diversions in the Corralitos-Pajaro Valley Basin (defined as 3-002.01 in DWR's Bulletin 118 uniform name and numbering system). This facility would produce 7,500 acre-feet of potable water per year, which is approximately Watsonville's annual average water demand that is satisfied through groundwater pumping and the balance was diverted from Corralitos Creek. With its redwood-canopied forests in the Santa Cruz Mountains, upper Corralitos Creek provides suitable spawning and rearing habitat for SCCC steelhead. This effort would collectively reduce percolation losses through the creek bed that lead to steelhead stranding and prevention of migration. While the alternative would allow for expanded migration through the Salispuedes Creek system and the lower portions of Corralitos Creek, the alternative would not increase water supplies where fish spawn and migrate in the upper Corralitos Creek watershed.

- **Reoperate Existing Chesbro Dam and Restore Downstream Habitat to Improve Fish Passage and Suitable Habitat in Llagas Creek** – This measure would increase the availability of suitable SCCC steelhead habitat in Llagas Creek by restoring groundwater levels in the region and stream habitat downstream of the dam. Flows in Llagas Creek rapidly percolate to the underlying groundwater aquifer before reaching the mainstem Pajaro River. This measure would require developing and implementing operating criteria to ensure that groundwater management and water supply releases from the existing Chesbro Dam provide the habitat functions and requirements necessary for all SCCC steelhead life stages. A substantial amount of the supplies in Chesbro Reservoir would be required to provide enough instream flow for smolt outmigration in the spring—which could reduce the supplies available to support summer rearing downstream of the dam. Supplemental water from Uvas Reservoir, using the existing facilities, may be required.

  Stream habitat downstream of the reservoir has been substantially degraded by lack of gravel recruitment, infrequent reservoir spills to stir and clean the stream substrate, fine sediment deposition by turbid releases, and riparian encroachment and channel incision. Gravel augmentation and the reoperation of the reservoir would be able to address some of these issues, although substantial residential development has occurred along the rearing habitat downstream, further complicating habitat restoration efforts.

- **Improve Fish Passage in Uvas Creek and Supplement Instream Flow in Solis Creek** – This measure has the potential to enhance the resiliency of the existing SCCC steelhead population on Uvas Creek by restoring stream habitat and improving fish passage, both upstream and downstream of Uvas Dam. Resident rainbow trout (likely resident steelhead) occur upstream of Uvas Reservoir, so it is assumed that anadromous steelhead would survive and potentially thrive upstream of the dam. Passage above Uvas Dam may require a bypass channel and ladder, if deemed the most efficient means of passage. If a structural passage option (volitional passage) is not feasible, the other option to introduce steelhead into the upper watershed would be to implement a trap-and-haul program.

  Solis Creek is a small, seasonal tributary downstream of Uvas Dam that is important potential spawning habitat for the Uvas Creek SCCC steelhead population. While this tributary typically goes dry in early spring, the construction of conveyance infrastructure would allow for small (~1 cubic feet per second) supplemental releases from Uvas Reservoir. These augmented releases would allow steelhead fry to emigrate to Uvas Creek in the spring, significantly improving steelhead production for this population in the miles immediately downstream of the dam.

- **Reoperate Existing Uvas Dam in Consideration of SCCC Steelhead** – This measure would require developing and implementing operating criteria to ensure that groundwater extractions and water supply releases from the existing Uvas Dam provide the habitat functions and requirements necessary for all SCCC steelhead life stages. Winter Uvas Reservoir spills would be adjusted to increase the frequency, duration, and intensity of flow releases which would require the reduction or elimination of flood-protection releases. These spills could lead to processes (e.g., streambed scour, removal of saplings and underbrush that limit light) that would ultimately lead to an increase in the availability of suitable SCCC steelhead habitat.

- **Expand Chesbro Reservoir and Operate in Consideration of SCCC Steelhead** – This measure is expansion of Chesbro Reservoir on Llagas Creek from 9,000 acre-feet to 150,000 acre-feet to improve passage to fish habitat in the lower portion, through improved stream flows. See Section 2.3.2.1 for more detail on the facilities for this measure.

- **Expand Uvas Reservoir and Operate in Consideration of SCCC Steelhead** – This measure consists of expanding storage space in Uvas Reservoir through construction of a new dam or raising the existing dam in-place. See Section 2.3.2.1 for more detail on the facilities for this measure.

- **Remove Existing Chesbro Dam** – This measure would involve removing the existing Chesbro Dam to restore natural flows in Llagas Creek. While passage to the upper reaches of Llagas Creek would be improved during very wet years, the long percolating channel on the valley floor could result in very early stream dry-back in all other year types. Improved downstream passage would allow connectivity to the generally perennial habitat upstream on Casa Loma Road, which provides several miles of headwaters habitat that supports a resident rainbow trout population.

- **Remove Existing Uvas Dam** – This measure would involve removing the existing Uvas Dam to restore natural flows in Uvas Creek. While removal of the dam would increase connectivity and fish passage, the stream habitat downstream of the reservoir has declined—due to reduced gravel recruitment, substrate degradation, turbid releases, riparian encroachment, and reduced prey-item abundance—and may require additional restoration efforts.

<u>Construct Conservation Hatchery</u>

- **Construct Conservation Hatchery that Would Support Tributaries Throughout Pajaro Watershed** – This measure has the potential to increase the abundance and resiliency of steelhead populations in tributaries (i.e., Uvas, Corralitos, Llagas, and Pacheco Creeks) throughout the Pajaro River watershed. This measure would include the construction of a conservation hatchery that would supplement the natural Pajaro River steelhead population.

<u>Implement National Marine Fisheries Service Recovery Plan Actions</u>

- **Improve Steelhead Habitat in Pacheco Creek by Implementing NMFS Recovery Actions** – The recovery actions for Pacheco Creek specifically identified in the NMFS Recovery Plan include: (1) minimizing livestock grazing, (2) managing instream mining impact, and (3) developing and implementing a non-native species monitoring and control program (NMFS 2013). It is unlikely that the recovery actions would provide substantial SCCC steelhead benefits in Pacheco Creek because none of the actions would result in improved flow or temperature conditions.

2.3.2.2 Conceptual Measures to Address Secondary Project Objectives

The following conceptual measures for each secondary Project objective were identified through studies, programs, projects, Project meetings, field inspections, outreach, and environmental scoping activities.

Drinking Water Quality

The secondary Project objective to address problems and deficiencies associated with drinking water quality for Santa Clara and San Benito Counties is to:

- Improve water quality and minimize supply interruptions, when water is needed, for Santa Clara and San Benito Counties, and increase operational flexibility for south-of-Delta contractors dependent on San Luis Reservoir

Potential measures to address this secondary Project objective include water treatment, institutional agreements, surface water storage, conveyance modifications, alternate water supplies, and source-water quality control, as summarized below.

Water Treatment

The following conceptual measures focus on enhancing or adding new raw treatment capabilities:

- **Dissolved Air Flotation (DAF)** – DAF releases large quantities of microbubbles into the water to float particles, such as algae, to the water surface. Scrapers or overhead weirs physically remove the floating materials from the surface while the clear water passes through the bottom of the DAF tank (Reclamation 2008). DAF treatment could prevent the clogging of irrigation systems and filtration systems caused by algae, but it would not address taste and odor problems for drinking water.
- **Add DAF Treatment Facilities at San Felipe Intake** – This measure includes the following:
  - Adding DAF treatment works between the Pacheco Pump Station and Pacheco Tunnel
  - Pre-treating water for distribution to the CVP San Felipe Division
  - Designing to treat full-flow capacity of the Pacheco Tunnel (317 mgd or 30.1,000 acre-feet per month)
- **Add DAF Treatment Facilities at Santa Teresa** – This measure includes the following:
  - Adding DAF treatment works at Santa Teresa and Rinconada WTPs
  - Constructing new DAF treatment plants to treat CVP San Felipe Division water allocated to San Benito County and the Pajaro Pipeline
- **Add DAF Treatment Facilities at Coyote Pumping Plant** – This measure includes the following**:**
  - Adding DAF treatment works between the Santa Clara Conduit and Coyote Pump Station
  - Designing to treat full discharge of the Santa Clara Conduit (213 mgd or 20.3,000 acre-feet per month)
  - Constructing new DAF treatment plants to treat CVP San Felipe Division water allocated to San Benito County and the Pajaro Pipeline
- **Add Raw Water Ozonation Process to Treatment Train at Santa Teresa WTP** – This measure includes adding a raw water ozonation process to the treatment train at the

Santa Teresa WTP (Reclamation 2019). In a raw water ozonation process, ozone is added to raw water entering the treatment plant before the water is treated by any other processes. Ozone oxidizes taste and odor-causing compounds and other dissolved organic material released by algae. Ozone also improves clarification and filtration processes when used as a pre-oxidant. Implementation of a raw water ozonation process at the Santa Teresa WTP would require installation of a new ozone contactor, new ozone generation equipment housed in a new building, and new liquid oxygen storage facilities.

Institutional Agreements for Drinking Water Quality

- **Expand Participation with Out-of-Basin Groundwater Storage** – This measure entails Reclamation participating in an existing groundwater bank, such as the Semitropic. Reclamation would store water in the groundwater bank and request it for delivery during low-point years. Reclamation would exchange water extracted from the groundwater bank from water in San Luis Reservoir to keep water levels high in the reservoir (Reclamation 2008). Exchanged water would be delivered to the CVP San Felipe Division through San Luis Reservoir or, if delivered to Valley Water only, the South Bay Aqueduct. Water delivered through San Luis Reservoir could still be subject to seasonal algae growth in the reservoir.

- **Participate in Water Exchange or Transfer** – This measure includes exchanges or transfers that would allow Reclamation to maintain water levels in San Luis Reservoir at or above 300,000 acre-feet while continuing deliveries to contractors. Potential sources for exchanges include Metropolitan Water District, Yuba County Water Agency, and Placer County Water Agency (Reclamation 2008).

- **Develop Operating Agreements and Practices** – This measure includes CVP San Felipe Division contractors reoperating their water supply systems cooperatively to reduce reliance on CVP supplies during occurrences of the low-point issue (Reclamation 2008). Reoperation would include modifying delivery schedules or reoperating local supply reservoirs. The San Luis & Delta-Mendota Water Authority contractors would also modify operations to coordinate water supplies among member agencies. This measure would also include modification of a Valley Water agreement with San Francisco Public Utilities Commission for emergency water.

- **Reschedule Water Deliveries at San Luis Reservoir** – This measure includes rescheduling operations that would enable shifting of deliveries to the winter months for storage and holding of available water supplies for later delivery (Reclamation 2008). The CVP San Felipe Division contractors would leave some water in storage to allow higher water levels in the following year, which could reduce the likelihood of an occurrence of the low-point issue. However, water left in San Luis Reservoir may revert to CVP ownership on or around April 15 if the CVP fills up its portion of San Luis Reservoir storage.

Storage

- **Raise North Fork Dam In-place to Expand Existing Pacheco Reservoir to Increase Storage** – This measure consists of increasing storage capacity in the existing Pacheco Reservoir by raising North Fork Dam in-place. See Section 2.3.2.1 for more detail on the facilities for this measure.

- **Expand Existing Pacheco Reservoir Through Construction of a New Dam to Increase Storage Space to Minimize Supply Interruptions Due to Low-Point Events**

at San Luis Reservoir – This measure consists of increasing storage space in the existing Pacheco Reservoir through construction of a new dam. Reservoir expansion would require demolition of the existing North Fork Dam and construction of a new dam at a site upstream of the existing dam. See Section 2.3.2.1 for more detail on the facilities for this measure.

- **Expand Existing Valley Water Reservoirs (i.e., Anderson, Chesbro, or Uvas Reservoirs) to Increase Storage Space** – This measure consists of increasing storage space in the Pajaro River watershed by expanding existing Valley Water reservoirs (i.e., Anderson, Chesbro, or Uvas Reservoirs). See Section 2.3.2.1 for more detail on the facilities for this measure.

- **Expand San Luis Reservoir to Increase Storage Space** – This measure would raise the B.F. Sisk Dam and expand San Luis Reservoir to add approximately 120,000 acre-feet storage capacity. See Section 2.3.2.1 for more detail on the facilities for this measure.

- **Construct New Storage Facilities in Other Watersheds** – This measure involves constructing new storage facilities in other watersheds—such as San Benito Canyon, Del Puerto Canyon, Ingram Canyon, or Quinto Creek Reservoir. See Section 2.3.2.1 for more detail on the facilities for this measure.

Conveyance

- **Lower the San Felipe Intake** – This measure includes construction of a new, lower San Felipe Intake in San Luis Reservoir to allow reservoir drawdown to its minimum operating level without algae effects (Reclamation 2019). Moving the San Felipe Intake to an elevation equal to that of the Gianelli Intake would allow operation of San Luis Reservoir below the 300,000 acre-feet level without creating the potential for a water supply interruption to Valley Water. A tunnel and a pipeline option were evaluated for this alternative. A tunnel would be constructed beneath the reservoir floor to convey water from the new intake to the existing intake. For the pipeline option, a new 13-foot-diameter, reinforced concrete cylinder pipe would be laid along the bottom of San Luis Reservoir. This measure would provide an annual average of approximately 3,149 acre-feet of additional water M&I supply to the San Felipe Division of the CVP.

- **Construct New Conveyance Facilities** – This measure includes constructing new conveyance facilities to bypass San Luis Reservoir and/or conveying water to existing Valley Water storage facilities and reservoirs (Reclamation 2008). New conveyance options could include:

  - Holladay Aqueduct: Construction of a 26-mile bypass pipeline that would begin near the City of Patterson and extend westward to a terminus at the crest of the Diablo Range. From here, water would flow down an existing natural stream channel into Coyote and Anderson Reservoirs.

  - Northerly Bypass Corridor: Deliver water from new pump station on California Aqueduct to outlet of existing Pacheco Tunnel 2. Water would be pumped over the hills of the Diablo Range to Pacheco Conduit, bypassing San Luis Reservoir in a combination of two pipelines and a tunnel. Alternately, the intake and pump station could be constructed at the head of O’Neill Forebay.

  - Southernly Bypass Corridor: Construct pipeline and tunnel connecting O’Neill Forebay and Pacheco Pumping Plant, bypassing San Luis Reservoir.

Alternate Water Supplies

- **Construct Desalination Plant –** This measure entails constructing one or more desalination plants and conveyance facilities at potential locations in the Monterey or San Francisco Bays. Water from the plants would be conveyed to CVP San Felipe Division contractors using new or existing pipelines. See Section 2.3.2.1 for more detail on potential desalination options.

- **Enlarge South Bay Aqueduct and Expand Los Vaqueros Reservoir** – This measure entails expanding Los Vaqueros Reservoir and the South Bay Aqueduct, and developing a connection between Los Vaqueros Reservoir and Bethany Reservoir to deliver (via the California Aqueduct) up to 100,000 acre-feet to San Luis Reservoir during the low-point months (Reclamation 2008). This scenario depends on the completion of the planned South Bay Aqueduct expansion and the availability of 100,000 acre-feet of Delta supply during the summer low-point months. Reclamation could store a minimum of 180,000 acre-feet of drought year water supply in an expanded Los Vaqueros Reservoir.

Source Water Quality Control

- **Implement Algae Harvesting** – This measure includes boats with a fine strainer skimming the surface of San Luis Reservoir and collecting floating algae. Collected algae would be trucked offsite (Reclamation 2008). The Reclamation Initial Alternative Investigation Report (IAIR) estimates a removal rate of 6,000 gallons per hour. Through these algae harvesting methods, algae would only be collected and removed near the water surface. These methods cannot collect and remove algae to the 30-foot depth that algae is observed in San Luis Reservoir.

- **Apply Algaecides/Herbicides** – This measure includes applying algaecides and/or herbicides to San Luis Reservoir using boats or helicopters (Reclamation 2008). The treatments must be applied at early stages of bloom development, when the cell densities are low, to avoid release of toxins. Copper sulfate algaecides can be toxic to fish; copper chelate is less toxic. Some algae could develop a resistance to the algaecides and/or herbicides.

- **Construct Additional Intakes at the Gianelli Inlet/Outlet for Managed Stratification** – This measure consists of Reclamation constructing additional intakes at the Gianelli Inlet/Outlet in San Luis Reservoir to withdraw water at different levels, including the epilimnion (upper layer) prior to summer algae growth, allowing higher-quality water to be diverted from the Pacheco Intakes (Reclamation 2008). Because the epilimnion water would be serving the Gianelli Intake, more of the hypolimnion (lower layer) would remain available for diversion at the Pacheco Intake. Reclamation would be able to divert higher-quality water through the Pacheco Intake later into the year.

2.3.2.3 Refuge Water Supplies

The secondary Project objective to address problems and deficiencies associated with refuge water supplies is to:

- Develop water supplies for environmental water needs at IL4 wildlife refuges to support habitat management in the Delta watershed

Potential measures to address this secondary Project objective include institutional agreements, surface water and groundwater storage, and alternate water supplies, as summarized below.

Institutional Agreements for Refuge Water Supplies

Institutional agreements considered are summarized as follows:

- **Implement Long-Term Water Transfers Within the San Felipe Division of the CVP for Refuge Environmental Water Needs** – This measure consists of implementing water transfers (or exchanges) within the San Felipe Division of the CVP to increase IL4 refuge water supply deliveries in below-normal water years. This measure would involve developing the necessary long-term implementation agreements and facilities for water transfers. Because transfers are performed on a year-to-year basis, significant uncertainty exists regarding the availability and cost of water. In dry and critical years, the supply of water decreases while the demand increases, resulting in higher prices for water, and, in some years, a very limited supply of water transfers available.

- **Implement Water Transfers from Outside the San Felipe Division of the CVP for Refuge Environmental Water Needs** – This measure primarily consists of transferring water between users within the Central Valley to allow more efficient use of available supplies to increase water supply deliveries to IL4 refuges in below-normal water years. Water purchases and transfers do not generate new water supplies, they simply consist of transferring water between a seller willing to forgo a water use for a time and a willing buyer within the Central Valley. The availability and price of a supply for purchase and then used for transfer depends on several factors such as year-type, other available supplies, agricultural water availability, storage capabilities, and transmission capacity. Water transfers include both temporary and long-term (greater than one-year, as defined by DWR) transfers. The majority of active water transfers are temporary transfers, which depend on the water spot market.

Surface Water and Groundwater Storage

- **Raise North Fork Dam In-Place to Expand Existing Pacheco Reservoir for Increased Deliveries for Refuge Environmental Water Needs** – Expanding the existing Pacheco Reservoir would allow Valley Water to provide 2,000 acre-feet of firm water supplies in below normal water years to IL4 wildlife refuges. The potential supply resources for allocation to the IL4 refuge supply pool would be provided through transfers of Valley Water's CVP long-term water supply contract supplies, or through transfer of exchanges with other water districts. See Section 2.3.2.1 for a more detailed description of the facilities for this measure.

- **Construct a New Dam to Expand Existing Pacheco Reservoir for Increased Deliveries for Refuge Environmental Water Needs** – Expanding the existing Pacheco Reservoir would allow Valley Water to transfer 2,000 acre-feet of its CVP water contract supplies (in below normal water years), directly or through transfer and exchanges, in perpetuity to Reclamation's Refuge Water Supply Program for use in the IL4 refuge water supply. This long-term voluntary reallocation of CVP yield by Valley Water would be secured by an agreement between USFWS and Valley Water detailing its operation, a contract between DWR and Valley Water for the provision of grant funding through the WSIP that would require the provision of these supplies in perpetuity, and an integrated operations agreement between Reclamation and Valley Water for Pacheco Reservoir that would include the requirements for this transfer. This water could be stored in San Luis Reservoir, providing Reclamation's Refuge Water Supply Program greater flexibility in making late-season deliveries to refuges. See Section 2.3.2.1 for a more detailed description of the facilities for this measure.

- **Expand San Luis Reservoir to Allow for Increased Deliveries for Refuge Environmental Water Needs** – Expanding the existing San Luis Reservoir would allow Valley Water to transfer water supplies to IL4 wildlife refuges. The potential supply resources for allocation to the IL4 refuge supply pool would be provided through transfers of Valley Water's CVP long-term water supply contract supplies, or through transfer of exchanges with other water districts. See Section 2.3.2.1 for a more detailed description of the facilities for this measure.

- **Expand Los Vaqueros Reservoir to Increase Conservation Storage Space for Refuge Environmental Water Needs** – Under this measure, operations for the expanded reservoir would include dedicated storage for environmental water and conveyance facilities to provide environmental water supplies for environmental purposes—including San Joaquin Valley refuges. Water could be released from the point of delivery near the South Bay Pumping Plant into the California Aqueduct where it could then be delivered to the Delta Mendota Canal. From the California Aqueduct/Delta Mendota Canal, the water could then be delivered directly through subsequent conveyance facilities or stored in San Luis Reservoir for later use, to meet refuge water supply needs. See Section 2.3.2.1 for a more detailed description of the facilities for this measure.

- **Expand Existing Valley Water Reservoirs to Allow for Increased Deliveries for Refuge Environmental Water Needs** – This measure would entail expanding existing Valley Water reservoirs. Potential reservoir expansion sites include Anderson, Chesbro, or Uvas Reservoirs. Expansion of one or more of these existing reservoirs would allow Valley Water to transfer CVP water contract supplies, directly or through transfer and exchanges, in perpetuity to Reclamation's Refuge Water Supply Program for use in the IL4 refuge water supply. See Section 2.3.2.1 for a more detailed description of the facilities for these reservoir expansions.

- **Expand Existing or Construct New Storage in Sacramento River/San Joaquin River Watersheds** – Expansion of one or more of these existing reservoirs or construction of new storage in the Sacramento River/San Joaquin River watersheds would allow Valley Water to transfer CVP water contract supplies, directly or through transfer and exchanges, in perpetuity to Reclamation's Refuge Water Supply Program for use in the IL4 refuge water supply. See Section 2.3.2.1 for a more detailed description of the facilities for this measure.

- **Construct New Storage in the Sacramento-San Joaquin Delta** – Construction of new storage in the Sacramento-San Joaquin Delta would allow Valley Water to transfer CVP water contract supplies, directly or through transfer and exchanges, in perpetuity to Reclamation's Refuge Water Supply Program for use in the IL4 refuge water supply. See Section 2.3.2.1 for a more detailed description of the facilities for this measure.

- **Expand Participation with Out-of-Basin Groundwater Storage (e.g., Semitropic Groundwater Bank)** – See Section 2.3.2.1 for a more detailed description of this measure.

- **Implement Additional In-Basin Groundwater Storage and Recovery Operations (e.g., South County Recharge Project)** – See Section 2.3.2.1 for a more detailed description of this measure.

Alternate Water Supplies

An alternate water supply measure considered is summarized as follows:

- **Construct Desalination Plant and Related Conveyance Facilities for Refuge Environmental Water Needs** – This measure would require constructing a 317-mgd desalination plant adjacent to Monterey Bay and the Moss Landing Power Plant. This facility would expand upon (or be independent from) the facility near Moss Landing that local agencies are considering. The plant would use the existing intake at the power plant, along with supplemental intake structures, to bring seawater to the desalination plant. By constructing a desalination plant and related conveyance facilities, Valley Water could provide 2,000 acre-feet of firm water supplies in below-normal water years to IL4 wildlife refuges. The potential supply resources for allocation to the IL4 refuge supply pool would be provided through transfers of Valley Water's CVP long-term water supply contract supplies, or through transfer of exchanges with other water districts.

2.3.2.4 Conceptual Measures Screening Results

The screening criteria outlined in Section 2.3.1 was applied to the conceptual measures described in Section 2.3.2. Each measure received either a *pass* or *fail* designation for each category. If a measure received a *fail* designation in either screening category, it was not considered for inclusion when combining the measures and developing the Proposed Project, and action alternatives to the Proposed Project that would meet most of the Project objectives, but would avoid or substantially lessen any of the anticipated significant effects of the Proposed Project. The following discussion documents the screening results for each primary and secondary Project objective.

Water Supply Reliability and Emergency Response

Table 2-7 summarizes the screening results for conceptual measures considered to address the following primary Project objective:

- Improve water supply reliability and system operational flexibility to help meet M&I and agricultural water demands in Santa Clara and San Benito Counties during drought periods and emergencies, or to address shortages due to regulatory and environmental restrictions.

Table 2-7. Summary of Screening Results Related to Improving Water Supply Reliability and Emergency Response

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Water Transfers and Purchases							
Implement water transfers within the San Felipe Division of the CVP	F	Limited potential to improve water supply reliability and provide emergency response due to high uncertainty regarding the availability, cost, and reliability of water transfers in the future.	P	F	NE	Temporal and logistical constraints due to the high uncertainty for availability of surplus supplies during drought periods.	No
Implement water transfers from outside the San Felipe Division of the CVP	F	Limited potential to improve water supply reliability and provide emergency response due to high uncertainty regarding the availability, cost, and reliability of water transfers in the future.	P	F	NE	Temporal and logistical constraints due to the high uncertainty for availability of surplus supplies during drought periods.	No
Retire agricultural lands within the San Felipe Division of the CVP	F	Limited potential to improve water supply reliability and emergency response due to uncertainty regarding effectiveness in improving M&I water supply reliability.	P	F	NE	Has the potential to increase M&I water demands as a result of retiring agricultural lands. In addition, the retiring agricultural lands could have a negative economic impact on the region and therefore, have low acceptability throughout the region.	No
Reservoir and System Operations							
Reoperate the existing North Fork Dam to reduce spills	F	Limited potential to provide improved water supply reliability and emergency response benefits. This measure does not provide adequate storage space to improve system flexibility.	F	F	NE	Updating the existing operations of North Fork Dam could interfere with existing water rights. In addition, the existing dam is under restricted-operation criteria through an April 6, 2018 DSOD order, due to existing spillway deficiencies. The existing dam is in an area of relatively weak, sheared shale whose inherent instability caused significant damage to the existing spillway some years ago.	No
Reoperate Anderson and/or Calero Reservoirs to store additional CVP water supply	F	Limited potential to provide improvements in water supply reliability and emergency response benefits due to other existing operational requirements related to flood control and environmental releases.	P	F	NE	There are logistical constraints related to existing operational requirements for flood control and environmental releases at existing Anderson and Calero reservoirs.	No
Reoperate other Valley Water dams and reservoirs to reduce spills	F	Limited potential to provide improvements in water supply reliability and emergency response benefits due to other existing operational requirements related to flood control and environmental releases.	P	F	NE	Logistical constraints related to existing operational requirements for flood control and environmental releases at existing Valley Water reservoirs.	No
Improve Delta export and conveyance capability through coordinated CVP and SWP operations	F	Limited potential for additional reoperation benefits beyond current plans. A new COA between CVP and SWP was implemented in December 2018.	P	F	NE	A new COA between CVP and SWP was implemented in December 2018. It is unlikely additional updates to CVP and SWP coordinated operations beyond what is currently agreed upon would be implemented in the near future.	No
Water Use Efficiency							
Implement additional water conservation and water use efficiency methods and programs (i.e., Advanced Metering Infrastructure, leak repair incentives, rain barrels, stormwater capture projects etc.)	F	Moderate potential to improve water supply reliability and low potential to provide additional water supplies during emergencies.	P	P	P	Potential logistical constraints due to uncertainties associated with the level of active participation by residents, businesses, and governments.	No

Table 2-7. Summary of Screening Results Related to Improving Water Supply Reliability and Emergency Response (contd.)

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Surface Water and Groundwater Storage							
Raise North Fork Dam in-place to expand existing Pacheco Reservoir to increase storage	P	High potential to provide increased local storage space for improved long-term water supply reliability and emergency response benefits due to the measure's location and ability to store a high volume of water.	F	P	P	This measure does not compare favorably to other dam sites to expand Pacheco Reservoir due to geotechnical limitations at the existing North Fork Dam site. Raising the dam to the height required to provide adequate additional storage capacity would require a very long dam extension on the left abutment. That extension would be founded in an area of relatively weak, sheared shale whose inherent instability caused significant damage to the existing spillway some years ago.	No
Expand existing Pacheco Reservoir through construction of a new dam to increase storage space	P	High potential to provide increased local storage space for improved long-term water supply reliability and emergency response benefits due to the measure's location and ability to store a high volume of water.	P	P	N/A[2]	Meets all feasibility category criteria.	Yes
Expand Anderson Reservoir to increase storage space	P	Moderate potential to provide increased local storage space for improved long-term water supply reliability and emergency response benefits due to the measure's location and ability to store an adequate volume of water.	F	F	F	The dam site is adjacent to the Calaveras Fault and associated seismic hazards. The Silver Creek Fault passes through the area of proposed dam expansion. The existing Anderson Reservoir is surrounded by over 100 high value homes that would be inundated by an expanded reservoir as well as others potentially affected by landslides activated by the expanded reservoir. This measure does not compare to expansion of Pacheco Reservoir in terms of similar cost to achieve similar level of physical benefit.	No
Expand Chesbro Reservoir to increase storage space	P	High potential to provide increased local storage space for improved long-term water supply reliability and emergency response benefits due to the measure's location and ability to store a high volume of water.	F	P	P	The new conveyance facilities would traverse areas with high liquefaction potential. This measure would require a complex pipeline alignment through urban areas and beneath Highway 101, which could result in high conveyance costs.	No
Expand Uvas Reservoir to increase storage space	F	Limited potential to provide an adequate increase in local storage space for improved long-term water supply reliability and emergency response benefits due to the measure's inability to store a high volume of water.	P	F	P	Uvas Creek currently has an existing self-sustaining SCCC steelhead population in the Pajaro River watershed, which could present considerable regulatory constraints. Expansion of Uvas Reservoir does not compare to expansion of Pacheco Reservoir in terms of cost related to physical benefits.	No
Expand San Luis Reservoir to increase storage space	F	Moderate potential to provide increased local storage space for improved long-term water supply reliability benefits ability to store a high volume of water. Limited potential to provide an adequate increase in storage space for improved emergency response benefits for Valley Water.	P	P	P	Meets all feasibility category criteria.	No
Expand Los Vaqueros Reservoir to increase storage space	F	High potential to provide increased local storage space for improved long-term water supply reliability due to the measure's location and ability to store a high volume of water. Limited potential to provide an adequate increase in storage space for improved emergency response benefits.	P	P	P	Meets all feasibility category criteria.	No
Construct San Benito Reservoir to increase storage space	P	Moderate potential to provide increased local storage space for improved long-term water supply reliability and emergency response benefits due to the measure's location and ability to store an adequate volume of water.	F	P	P	The presence of the Calaveras Fault at the project site creates a high risk for dam stability during an earthquake event and would require extensive engineering work to minimize the chance of failure. This measure has relatively small potential storage capacity when compared to expansion of Pacheco Reservoir.	No
Construct Del Puerto Reservoir to increase storage space	F	High potential to provide increased local storage space for improved long-term water supply reliability due to the measure's ability to store a high volume of water. This measure would have uncertainty related to emergency response benefits as the project relies on maintaining adequate San Luis Reservoir storage levels in order to convey emergency supplies to Valley Water.	P	F	P	This project is being actively pursued under a separate study. There is uncertainty in the level of Valley Water participation to ensure adequate storage space to improve water supply reliability and provide emergency response benefits. There is uncertainty associated with conveyance of emergency supplies through San Luis Reservoir, which limits this conceptual measure's ability to provide emergency water supplies.	No

Table 2-7. Summary of Screening Results Related to Improving Water Supply Reliability and Emergency Response (contd.)

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Construct Ingram Canyon Reservoir to increase storage space	F	High potential to provide increased local storage space for improved long-term water supply reliability due to the measure's ability to store a high volume of water. This measure would have uncertainty related to emergency response benefits as the project relies on maintaining adequate San Luis Reservoir storage levels in order to convey emergency supplies to Valley Water.	P	P	F	Construction of Ingram Canyon Reservoir does not compare to expansion of Pacheco Reservoir in terms of similar cost to achieve similar level of physical benefit.	No
Construct Quinto Creek Reservoir to increase storage space	F	High potential to provide increased local storage space for improved long-term water supply reliability due to the measure's ability to store a high volume of water. This measure would have uncertainty related to emergency response benefits as the project relies on maintaining adequate San Luis Reservoir storage levels in order to convey emergency supplies to Valley Water.	F	P	F	Quinto Creek Reservoir would require a very large dam embankment and is located near a potentially active fault, which would create substantial geotechnical and engineering problems. This measure does not compare to expansion of Pacheco Reservoir in terms of similar cost to achieve similar level of physical benefit.	No
Expand existing or construct new storage in Sacramento River/San Joaquin River watersheds	F	High potential to provide additional storage space to improve water supply reliability. However, these projects would have limited ability to provide emergency response benefits as they are located upstream of or in the Delta.	P	F	P	These projects are being actively pursued under separate studies. There is uncertainty in the level of Valley Water participation to ensure adequate storage space to improve water supply reliability and provide emergency response benefits. The location of these projects would require water to be conveyed through the Delta, which would limit the project's ability to provide reliable emergency water supply due to the high risk associated with Delta levee system failures during seismic events.	No
Construct new storage in the Sacramento-San Joaquin Delta	F	Uncertainty regarding ability to provide improved water supply reliability. This measure would have limited potential to provide emergency response benefits as they are located in the Delta.	P	F	P	This project is being actively pursued under a separate study. There is uncertainty in the level of Valley Water participation to ensure adequate storage space to improve water supply reliability and provide emergency response benefits. The location of this project is in the Delta, which would limit the project's ability to provide reliable emergency water supply due to the high risk associated with Delta levee system failures during seismic events.	No
Construct other local area storage facilities in other watersheds	P	Various sites have moderate potential to provide increase in local storage space for improved long-term water supply reliability and emergency response benefits due to the sites' locations and ability to store an adequate volume of water.	F	F	P	Sites under consideration for construction of new local storage are adjacent to known faults and related seismic hazards, including the Calaveras Fault, and some sites would inundate substantial portions of Henry W. Coe State Park.	No
Construct multiple concrete reservoirs/storage tanks for additional water storage space	F	Limited potential to provide an adequate increase in local storage space for improved long-term water supply reliability and emergency response benefits.	F	F	NE	Multiple concrete reservoirs/storage tanks would require large footprints to provide sufficient storage volumes and require complex distribution systems to convey the water. The low visual aesthetic of multiple concrete reservoirs/storage tanks over a large footprint could introduce public acceptability issues. For these reasons, this measure has substantial technical and logistical constraints.	No
Expand participation with out-of-basin groundwater storage (e.g., Semitropic)	F	Limited potential to provide improved water supply reliability and emergency response benefits due to uncertainty regarding ability to secure additional supplies from banking facilities, especially during dry years or emergencies.	P	F	P	Water supply reserves in groundwater banks may be insufficient to meet needs throughout an extended drought or for emergency response. Groundwater banks have several operational constraints that could limit the amount of water stored and extracted. Putting water into the bank could take several years, and pumping capacity, especially in dry years, could limit the amount of withdrawal. The extraction rate would depend on Valley Water's level of participation in the bank.	No
Implement additional in-basin groundwater storage and recovery operations (e.g., South County Recharge Project)	F	High potential to provide improved water supply reliability. Limited potential to provide an adequate increase in groundwater storage for improved emergency response benefits (i.e., limited additional groundwater storage available in North County Santa Clara Subbasin).	P	P	P	Water supply reserves in groundwater banks may be insufficient to meet needs throughout an extended drought or for emergency response. Groundwater banks have several operational constraints that could limit the amount of water stored and extracted. Putting water into the bank could take several years, and pumping capacity, especially in dry years, could limit the amount of withdrawal.	No
Dredge bottom of Pacheco Reservoir or any other existing Valley Water reservoir	F	Limited potential to effectively contribute to improvements in water supply reliability or emergency response due to the measure's inability to adequately increase storage volume.	P	P	NE	Meets all feasibility category criteria.	No

Table 2-7. Summary of Screening Results Related to Improving Water Supply Reliability and Emergency Response (contd.)

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Alternate Water Supplies							
Construct Monterey Bay Desalination Facility and Related Conveyance Facilities	F	Moderate potential to improve water supply reliability and limited potential to provide additional water supplies during emergencies. This measure could produce adequate water supplies but does not have the ability to store water for emergencies.	P	F	F	Does not compare to expansion of Pacheco Reservoir in terms of similar cost to achieve similar level of physical benefit. The cost to build and operate a desalination plant is substantially higher than other conceptual measures considered. Permitting and regulatory compliance for a new desalination plant, conveyance facilities, and appurtenant structures could present substantial logistical barriers. Desalination facilities could also have moderate impacts to coastal recreation.	No
Construct San Francisco Bay Desalination Facility and Related Conveyance Facilities	F	Moderate potential to improve water supply reliability and limited potential to provide additional water supplies during emergencies. This measure could produce adequate water supplies but does not have the ability to store water.	P	F	F	Does not compare to expansion of Pacheco Reservoir in terms of similar cost to achieve similar level of physical benefit. The cost to build and operate a desalination plant is substantially higher than other conceptual measures considered. Permitting and regulatory compliance for a new desalination plant, conveyance facilities, and appurtenant structures could present substantial logistical barriers. Desalination facilities could also have moderate impacts to coastal recreation.	No
Construct Desalination Facilities and Related Conveyance Facilities in San Francisco Bay, Monterey Bay, and San Benito County	F	Moderate potential to improve water supply reliability and limited potential to provide additional water supplies during emergencies. This measure could produce adequate water supplies but does not have the ability to store water.	P	F	F	Does not compare to expansion of Pacheco Reservoir in terms of similar cost to achieve similar level of physical benefit. The cost to build and operate a desalination plant is substantially higher than other conceptual measures considered. Permitting and regulatory compliance for a new desalination plant, conveyance facilities, and appurtenant structures could present substantial logistical barriers. Desalination facilities could also have moderate impacts to coastal recreation.	No
Construct Bay Area Regional Desalination Project	F	Moderate potential to improve water supply reliability and limited potential to provide additional water supplies during emergencies. This measure could produce adequate water supplies but does not have the ability to store water.	P	P	P	Meets all feasibility category criteria.	No
Implement additional wastewater reclamation	F	Moderate potential to improve water supply reliability and limited potential to provide additional water supplies during emergencies due to the measure's inability to store water.	P	P	NE	Meets all feasibility category criteria.	No
Conveyance and System Modifications							
Construct conveyance from Pacheco Conduit to other Valley Water reservoirs to store CVP water supply	F	Moderate potential to effectively improve water supply reliability, but only in years when adequate storage space is available in other Valley Water reservoirs. Limited potential to provide additional water supply during emergencies.	P	P	NE	Meets all feasibility category criteria.	No
Construct Transfer-Bethany Pipeline portion of the Los Vaqueros Reservoir Expansion	F	Moderate potential to improve long-term water supply reliability. This measure does optimize the use of existing supplies and increases operational flexibility, but it is located in the Delta. Accordingly, there is no potential to provide emergency water supplies following a Delta levee system failure.	P	P	P	Meets all feasibility category criteria.	No

Notes:
[1] NE (i.e., not evaluated) in the cost criteria feasibility category denote that existing cost information was not available. It was assumed that the cost of the conceptual measure was comparable (within reason) to the cost of expanding Pacheco Reservoir.
[2] The expansion of Pacheco Reservoir was not evaluated on cost constraints since the criteria is based on costs relative to the Proposed Project (expansion of Pacheco Reservoir).

Key:
COA = Coordinated Operation Agreement
CVP = Central Valley Project
F = Fail
N/A = Not Applicable
NE = Not Evaluated
P = Pass
SCCC = South-Central California Coast
SWP = State Water Project
TAF = thousand acre-feet

SCCC Steelhead Habitat

Table 2-8 summarizes the screening results for conceptual measures considered to address the following primary Project objective:

- Increase suitable habitat in Pacheco Creek for federally threatened SCCC steelhead through improved water temperature and flow conditions

Table 2-8. Summary of Screening Results Related to Increasing Suitable Habitat for SCCC Steelhead

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Improve Flow and Temperature Conditions in Pacheco Creek							
Raise North Fork Dam in-place to expand existing Pacheco Reservoir and operate in consideration of SCCC steelhead	P	High potential to improve instream flow and water temperatures which would increase the availability of suitable SCCC steelhead habitat in Pacheco Creek.	F	P	P	Raising the dam to the height required to provide significant additional storage capacity would require a very long dam extension on the left abutment. That extension would be founded in an area of relatively weak, sheared shale whose inherent instability caused significant damage to the existing spillway some years ago.	No
Reoperate existing North Fork Dam in consideration of SCCC steelhead	F	Very limited potential to further improve availability of suitable habitat for SCCC steelhead. Without-project condition assumes operations identified in the *Report on Comprehensive Strategy and Instructions for Operation of Pacheco Reservoir* (2014).	F	F	P	Updating the existing operations of North Fork Dam could interfere with existing water rights. PPWD currently uses this water to recharge the aquifer along Pacheco Creek; re-operating in consideration of SCCC steelhead would directly conflict with this objective. In addition, existing spillway issues could lead to technical constraints for re-operation and use of the existing North Fork Dam.	No
Expand existing Pacheco Reservoir through construction of a new dam and operate in consideration of SCCC steelhead	P	High potential to improve instream flow and water temperatures which would increase the availability of suitable SCCC steelhead habitat in Pacheco Creek.	P	P	N/A[2]	Meets all feasibility category criteria.	Yes
Direct discharge of imported supplies to Pacheco Creek	F	High potential to improve instream flow but not water temperatures (i.e., high water temperatures of imported supplies during summer/early fall) in Pacheco Creek, leading to a limited increase in the availability of suitable SCCC steelhead habitat in Pacheco Creek.	P	F	NE	Supplies imported from San Luis Reservoir have high summer water temperature and there is a lack of dedicated capacity in Pacheco Conduit to convey imported water. Moreover, this option would lead to an exceedance of imported water ratio requirements (>50%) which can lead to imprinting issues and an increased risk of straying adult fish (NMFS 2000).	No
Delivery of imported supplies to existing Pacheco Reservoir and subsequent release to Pacheco Creek	F	Limited potential to increase the availability of suitable SCCC steelhead habitat in Pacheco Creek. High potential to improve instream flow but not water temperatures in Pacheco Creek.	P	F	NE	Existing storage capacity of Pacheco Reservoir prevents formation of cold-water pool necessary for optimal temperature conditions. Moreover, this option would lead to an exceedance of imported water ratio requirements (>50%) which can lead to imprinting issues and an increased risk of straying adult fish (NMFS 2000).	No
Augment Pacheco Creek flows with in-basin groundwater	P	High potential to improve instream flow and water temperatures which would increase the availability of suitable SCCC steelhead habitat in Pacheco Creek.	P	F	NE	Depends on depletion of an interconnected surface water and would present a significant and unreasonable adverse effect, a key metric of SGMA.	No
Augment Pacheco Creek flows with out-of-basin groundwater	P	High potential to improve instream flow and water temperatures which would increase the availability of suitable SCCC steelhead habitat in Pacheco Creek.	P	F	NE	The location of the water bearing formation necessary for this alternative would draw from the Llagas area and risks depleting an interconnected surface—leading to inconsistencies with SGMA. Out-of-basin groundwater transfers may be limited by future county ordinances in response to SGMA.	No
Construct desalination plant and conveyance facilities to Pacheco Creek	P	High potential to improve instream flow and water temperatures which would increase the availability of suitable SCCC steelhead habitat in Pacheco Creek.	P	F	F	Capital and annual costs associated with a desalination plant are substantially higher than the expansion of Pacheco Reservoir while providing similar levels of physical benefits. Moreover, this measure would require a complex pipeline alignment through urban areas and beneath Highway 101, which would trigger logistical constraints.	No
Remove existing North Fork Dam	F	High potential to decrease suitable SCCC steelhead habitat in Pacheco Creek due to reduced summer and fall flows in main stem of Pacheco Creek. High potential to increase suitable SCCC steelhead habitat during winter months in North Fork Creek upstream of the current reservoir. However, due to very limited or no flows during summer and fall months, very limited potential to increase suitable habitat in North Fork Creek during these periods.	P	F	NE	Removal of existing dam would reduce flood damage reduction benefits of existing dam.	No
Support Recovery of Other Populations of SCCC Steelhead in the Pajaro River Watershed							
Construct desalination plant to offset groundwater pumping and improve passage in Corralitos Creek	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek. There is high uncertainty related to recovery of groundwater levels to facilitate fish passage, as well as uncertainty of available suitable habitat in Corralitos Creek watershed during multiple dry years.	P	P	F	Capital and annual costs associated with a desalination plant are substantially higher than the expansion of Pacheco Reservoir while providing similar levels of physical benefits.	No

Table 2-8. Summary of Screening Results Related to Increasing Suitable Habitat for SCCC Steelhead (contd.)

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Reoperate existing Chesbro Dam and restore downstream habitat to improve fish passage and suitable habitat in Llagas Creek	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek and has low potential to achieve the NMFS Recovery Plan goal to establish additional functionally independent populations in the Pajaro River watershed.	P	F	P	Logistical constraints due to uncertainties surrounding the ability for reoperation to provide a consistent increase in habitat in Llagas Creek for all SCCC steelhead life stages, except in the very wettest years. Supplementing flows in the spring to allow for smolt outmigration would reduce the supplies necessary to support summer rearing. Moreover, updating the existing operations of Chesbro Dam could interfere with existing water rights.	No
Improve fish passage in Uvas Creek and supplement instream flow in Solis Creek	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek. In addition, Uvas Creek currently has a functional SCCC steelhead population–this option would not achieve the goal of the NMFS Recovery Plan to establish additional functionally independent populations in the Pajaro River watershed.	P	F	NE	Logistical constraints related to acceptability. A MOA for operation of Uvas Reservoir was adopted in 2012 that already outlines targeted releases for smolt outmigration, attraction flows, etc. Very limited potential for additional revisions to provide additional flows to Solis Creek.	No
Reoperate existing Uvas Dam in consideration of SCCC steelhead	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek. In addition, Uvas Creek currently has a functional SCCC steelhead population–this option would not achieve the goal of the NMFS Recovery Plan to establish additional functionally independent populations in the Pajaro River watershed.	P	F	P	Logistical constraints related to acceptability. A MOA for operation of Uvas Reservoir was adopted in 2012 that already outlines targeted releases for smolt outmigration, attraction flows, etc. Very limited potential for additional revisions to further improve the availability of habitat without impacts to flood control and existing water rights.	No
Expand Chesbro Reservoir and operate in consideration of SCCC steelhead	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek and has low potential to achieve the NMFS Recovery Plan goal to establish additional functionally independent populations in the Pajaro River watershed.	F	F	P	Chesbro Reservoir is surrounded by multiple potential landslide zones that, with reservoir expansion, would be subjected to annual wetting and drying cycles that could activate slides. Developed areas surround the reservoir and enlargement of the existing dam would inundate over 40 residences.	No
Expand Uvas Reservoir and operate in consideration of SCCC steelhead	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek. In addition, Uvas Creek currently has a functional SCCC steelhead population–this option would not achieve the goal of the NMFS Recovery Plan to establish additional functionally independent populations in the Pajaro River watershed.	P	F	F	Expansion of Uvas Reservoir does not compare to expansion of Pacheco Reservoir in terms of cost related to physical benefits. Uvas Creek currently has the only self-sustaining SCCC steelhead population in the Pajaro River watershed, which could present considerable regulatory constraints.	No
Remove existing Chesbro Dam	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek. Limited potential to increase suitable SCCC steelhead habitat in Llagas Creek without replacement water storage facilities.	P	F	NE	Conflicts with existing water rights in Llagas Creek. Removal of Chesbro Dam would also increase downstream flood risk.	No
Remove existing Uvas Dam	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek. Limited potential to increase suitable SCCC steelhead habitat in Uvas Creek without replacement water storage facilities.	P	F	NE	Conflicts with existing water rights in Uvas Creek. Removal of Uvas Dam would also increase downstream flood risk.	No
Construct Conservation Hatchery							
Construct conservation hatchery that would support tributaries throughout Pajaro River watershed	F	Would not directly improve suitable SCCC steelhead habitat in Pacheco Creek. While a conservation hatchery program could complement the overall recovery effort, the role of such a program does not substitute for the extensive restoration of habitat function, value, and connectivity that is required to support SCCC steelhead recovery.	P	P	P	Meets all feasibility category criteria.	No
Implement NMFS Recovery Plan							
Minimize livestock grazing and agricultural runoff to maintain or restore aquatic habitat functions	F	Limited potential to increase suitable SCCC steelhead habitat in Pacheco Creek since it would not provide the extensive restoration of habitat function and connectivity that is required to support steelhead recovery.	P	P	P	Meets all feasibility category criteria.	No

Table 2-8. Summary of Screening Results Related to Increasing Suitable Habitat for SCCC Steelhead (contd.)

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Manage instream mining impacts	F	Limited potential to increase suitable SCCC steelhead habitat in Pacheco Creek since it would not provide the extensive restoration of habitat function and connectivity that is required to support steelhead recovery.	P	P	P	Meets all feasibility category criteria.	No
Develop and implement a non-native species monitoring and control program	F	Limited potential to increase suitable SCCC steelhead habitat in Pacheco Creek since it would not provide the extensive restoration of habitat function and connectivity that is required to support steelhead recovery.	P	P	P	Meets all feasibility category criteria.	No

Notes:
[1] NE (i.e., not evaluated) in the cost criteria feasibility category denote that existing cost information was not available. It was assumed that the cost of the conceptual measure was comparable (within reason) to the cost of expanding Pacheco Reservoir.

Key:
F = Fail
N/A = Not Applicable
NE = Not Evaluated
NMFS = National Marine Fisheries Service
P = Pass
PPWD = Pacheco Pass Water District
SCCC = South-Central California Coast
SGMA = Sustainable Groundwater Management Act

Drinking Water Quality

Table 2-9 summarizes the screening results for conceptual measures considered to address the following secondary Project objective:

- Improve water quality and minimize supply interruptions, when water is needed, for Santa Clara and San Benito Counties, and increase operational flexibility for south-of-Delta contractors dependent on San Luis Reservoir

Table 2-9. Summary of Screening Results Related to Drinking Water Quality

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Water Treatment							
Add DAF treatment facilities at San Felipe Intake	F	Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. DAF is less effective and more difficult to operate than current treatment methods.	F	P	F	DAF is difficult to operate. In addition, retrofitting the newly updated treatments plants with DAF is not a cost-effective solution for the low-point issue.	No
Add DAF Treatment Facilities at Santa Teresa	F	Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. DAF is less effective and more difficult to operate than current treatment methods.	F	P	F	DAF is difficult to operate. In addition, retrofitting the newly updated treatments plants with DAF is not a cost-effective solution for the low-point issue.	No
Add DAF Treatment Facilities at Coyote Pumping Plant	F	Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. DAF is less effective and more difficult to operate than current treatment methods.	F	P	F	DAF is difficult to operate. In addition, retrofitting the newly updated treatments plants with DAF is not a cost-effective solution for the low-point issue.	No
Add raw water ozonation process to treatment train at Santa Teresa WTP	P	High potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. Modifications to the Santa Teresa WTP to address the negative impacts associated with increased algae during low points would prevent supply interruptions during low point events. The measure would fully replace interrupted M&I supply in all low point years.	P	P	F	This measure does not compare favorably to expansion of Pacheco Reservoir in terms of cost to achieve similar level of physical benefit.	No
Institutional Agreements							
Expand participation with out-of-basin groundwater storage (e.g., Semitropic)	F	Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors due to uncertainty regarding ability to withdraw water from groundwater banks during low point events.	P	F	P	The utility of groundwater banks is limited by the availability of supplies to store in the bank, as well the need for early notice to the bank to withdraw the stored water. The operational constraints associated with groundwater banking present significant uncertainty in the availability of water supplies.	No
Participate in water exchange or transfer	F	Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties due to uncertainty regarding ability to obtain full quantity of water supplies needed in every year with a low point issue.	P	F	F	Exchanges and transfers depend on numerous factors, including the spot market, the sellers' willingness to participate, and available Delta export capacity, that introduce uncertainty into the quantity, price, and reliability of available water supplies. In addition, transfers, particularly during dry years, can be an expensive water supply source.	No
Develop operating agreements and practices	F	Moderate potential to increase operational flexibility for south-of-Delta contractors due to ability of measure to allow full exercise of San Luis Reservoir. Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties due to uncertainty in ability for measure to reduce demands at San Luis Reservoir and occurrences of low point issue.	P	F	NE	Substantial coordination with other agencies would be required to reduce late summer demands for San Luis Reservoir. In addition, there is significant uncertainty regarding the potential for reduced demands to address the low point issues.	No
Reschedule water deliveries at San Luis Reservoir	F	Moderate potential to increase operational flexibility for south-of-Delta contractors due to ability of measure to allow full exercise of San Luis Reservoir. Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties due to operational constraints at San Luis Reservoir. If rescheduled water is not used by April 15th, the water reverts to CVP water without refund and is not available to address the low point problem.	P	F	NE	Measure presents significant operational constraints and potential operational risks. Water left in San Luis Reservoir may revert to CVP ownership on or around April 15 if the CVP fills up its portion of San Luis Reservoir storage.	No

Table 2-9. Summary of Screening Results Related to Drinking Water Quality (contd.)

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Storage							
Raise North Fork Dam in-place to expand existing Pacheco Reservoir to increase storage	P	High potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. The expanded reservoir would increase Valley Water's ability to fully utilize CVP allocations, with largest increases in dry and critical years, and would develop new local water supplies from Pacheco Creek watershed. The measure would replace interrupted municipal and industrial supply in most low point years.	F	P	P	Raising the dam to the height required to provide significant additional storage capacity would require a very long dam extension on the left abutment. That extension would be founded in an area of relatively weak, sheared shale whose inherent instability caused significant damage to the existing spillway some years ago.	No
Expand existing Pacheco Reservoir through construction of a new dam to increase storage space to minimize supply interruptions due to San Luis Reservoir low point issues	P	High potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. The expanded reservoir would increase Valley Water's ability to fully utilize CVP allocations, with largest increases in dry and critical years, and would develop new local water supplies from Pacheco Creek watershed. The measure would replace interrupted municipal and industrial supply in most low point years.	P	P	P	Meets all feasibility category criteria.	Yes
Expand existing Valley Water reservoirs (Anderson, Chesbro, and Uvas Reservoirs) to increase storage space	P	High potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. Storage facilities on the west side of San Luis Reservoir would provide an alternate source of supply for CVP San Felipe Division and fully exercise San Luis Reservoir for other south-of-Delta contractors.	F	F	F	Expanding existing Valley Water reservoirs does not compare favorably to expansion of Pacheco Reservoir in terms of cost to achieve similar levels of physical benefit. In addition, some storage options (Anderson, Chesbro) present significant technical and logistical challenges, including dam sites adjacent to faults and crossings over highways.	No
Expand San Luis Reservoir to increase storage space	P	Moderate potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. Storage facilities on the west side of San Luis Reservoir would provide an alternate source of supply for CVP San Felipe Division and fully exercise San Luis Reservoir for other south-of-Delta contractors.	P	P	F	Expansion of San Luis Reservoir does not compare favorably to expansion of Pacheco Reservoir in terms of cost to achieve similar level of physical benefit.	No
Construct new storage facilities in other watersheds	P	Moderate potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. Storage facilities on the east side of the San Joaquin Valley would allow San Luis Reservoir water levels to stay above 300 TAF in some years, addressing the algae-related interruptions.	P	P	F	Constructing new storage facilities in other watersheds would be less cost efficient than other storage measures.	No
Conveyance							
Lower the San Felipe Intake	P	Moderate potential to increase operational flexibility for south-of-Delta contractors due to ability of measure to allow full exercise of San Luis Reservoir. Moderate potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties. A new intake at a lower level would avoid algae-related supply interruptions.	P	P	F	This measure does not compare favorably to expansion of Pacheco Reservoir in terms of cost to achieve similar level of physical benefit.	No
Construct new conveyance facilities	P	High potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. New bypass facilities would provide a direct CVP San Felipe Division water conduit that did not route water through San Luis Reservoir; therefore, these alternatives would completely avoid reservoir-related interruptions for the CVP San Felipe Division.	P	P	F	This measure does not compare favorably to expansion of Pacheco Reservoir in terms of cost to achieve similar level of physical benefit.	No

Table 2-9. Summary of Screening Results Related to Drinking Water Quality (contd.)

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Alternate Water Supplies							
Construct desalination plant and related conveyance facilities	P	High potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. A desalination facility would provide an alternate source of supply for the CVP San Felipe Division and fully exercise for San Luis Reservoir for other contractors.	P	F	F	Permitting and regulatory compliance for a new desalination plant, conveyance facilities, and appurtenant structures could present significant barriers. In addition, capital and annual costs associated with a desalination plant are substantially higher than the expansion of Pacheco Reservoir while providing similar levels of physical benefits.	No
Enlarge South Bay Aqueduct and expand Los Vaqueros Reservoir	F	Moderate potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. However, conveyance limitations within the CVP San Felipe Division might not allow these alternate water supplies to reach all users and prevent all supply interruptions.	P	P	P	Meets all feasibility category criteria.	No
Source Water Quality Control							
Implement algae harvesting	F	Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. Algae harvesting would reduce algae layer and slow reservoir declines to prevent algae-related supply interruptions. However, measure would need to be supplemented with banking and exchanges to slow water level declines.	P	P	F	Algae harvesting presents no significant technical, logistical, or cost challenges. However, the measure has limited potential to meet the objective and does not compare favorably to expansion of Pacheco Reservoir in terms of similar cost to achieve similar level of physical benefit.	No
Apply algaecides/herbicides	F	Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. Application of algaecides would reduce algae layer and slow reservoir declines to prevent algae-related supply interruptions. However, measure would need to be supplemented with banking and exchanges to slow water level declines.	P	F	P	Application of algaecides on San Luis Reservoir could affect biological resources in the reservoir by causing the bioaccumulation of toxic algaecides in fish and birds that inhabit the reservoir. Algaecides could also affect San Luis Reservoir water quality by raising the concentration of toxics in the water quality. Therefore, there are potential challenges permitting the measure.	No
Construct additional intakes at the Gianelli Inlet/Outlet for managed stratification	F	Limited potential to improve water quality and minimize supply interruptions for Santa Clara and San Benito Counties and increase operational flexibility for south-of-Delta contractors. The water supply benefit provided by managed stratification and DAF treatment at the Gianelli Inlet/Outlet would not prevent interruptions to CVP San Felipe Division supply in all years. Measure would need be coupled with operating agreements to allow full exercise of San Luis Reservoir.	P	P	F	Managed stratification would cause only minor, temporary construction-related impacts. However, this measure does not compare favorably to expansion of Pacheco Reservoir in terms of cost to achieve similar level of physical benefit	No

Notes:
[1] NE (i.e., not evaluated) in the cost criteria feasibility category denote that existing cost information was not available. It was assumed that the cost of the conceptual measure was comparable (within reason) to the cost of expanding Pacheco Reservoir.

Key:
CVP = Central Valley Project
DAF = Dissolved Air Flotation
F = Fail
M&I = municipal and industrial
NE = Not Evaluated
P = Pass
TAF = thousand acre-feet
WTP = Water Treatment Plant

Refuge Water Supplies

Table 2-10 summarizes the screening results for conceptual measures considered to address the following secondary Project objective:

- Develop water supplies for environmental water needs at IL4 wildlife refuges to support habitat management in the Delta watershed.

Table 2-10. Summary of Screening Results Related to Increasing Refuge Water Supplies

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Institutional Agreements							
Implement water transfers within the San Felipe Division of the CVP to supply refuge environmental water needs	F	Limited potential to increase IL4 refuge water supplies deliveries due to high uncertainty regarding the availability, cost, and reliability of water transfers in the future.	P	F	NE	This measure has regulatory constraints due to the inability of Reclamation, DWR, and USFWS to enter into long-term agreements to provide IL4 water supplies. Short-term transfers from water acquired on the spot market is also an unreliable supply as demonstrated by historical inability of IL4 programs to provide water supplies in all years.	No
Implement water transfers from outside the San Felipe Division of the CVP to supply refuge environmental water needs	F	Limited potential to increase IL4 refuge water supplies deliveries due to high uncertainty regarding the availability, cost, and reliability of water transfers in the future.	P	F	NE	This measure has regulatory constraints due to the inability of Reclamation, DWR, and USFWS to enter into long-term agreements to provide IL4 water supplies. Short-term transfers from water acquired on the spot market is also an unreliable supply as demonstrated by historical inability of IL4 programs to provide water supplies in all years.	No
Surface Water and Groundwater Storage							
Raise North Fork Dam in-place to expand existing Pacheco Reservoir to allow for increased deliveries to meet refuge environmental water needs	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increased storage space.	F	P	P	This measure does not compare favorably to other dam sites due to geotechnical limitations at the existing North Fork Dam. Raising the dam to the height required to provide additional storage capacity would require a very long dam extension on the left abutment. That extension would be founded in an area of relatively weak, sheared shale whose inherent instability caused significant damage to the existing spillway some years ago.	No
Construct new dam to expand existing Pacheco Reservoir to allow for increased deliveries to meet refuge environmental water needs	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increased storage space.	P	P	P	Meets all feasibility category criteria.	Yes
Expand San Luis Reservoir to allow for increased deliveries to meet refuge environmental water needs	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increased storage space.	P	P	F	Expansion of San Luis Reservoir does not compare favorably to expansion of Pacheco Reservoir in terms of cost to achieve similar level of physical benefit.	No
Expand Los Vaqueros Reservoir to increase conservation storage space for refuge environmental water needs	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increased storage space.	P	P	P	Meets all feasibility category criteria.	Yes
Expand existing Valley Water reservoirs to allow for increased deliveries to meet refuge environmental water needs	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increased storage space. Some reservoir sites have higher potential than others to increase conservation storage space.	F	F	F	Some storage options (Anderson and Chesbro) present significant technical and logistical challenges, including dam sites adjacent to faults, surrounded by high value homes, and conveyance routing across highways. Some reservoir expansion projects do not compare to the expansion of Pacheco Reservoir in terms of cost to achieve similar level of physical benefits.	No
Expand existing or construct new storage in Sacramento River/San Joaquin River watersheds to meet refuge environmental water needs	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increased storage space.	P	P	P	Meets all feasibility category criteria.	Yes
Construct new storage in the Sacramento-San Joaquin Delta to meet refuge environmental water needs	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increased storage space.	P	P	P	Meets all feasibility category criteria.	Yes
Expand participation with out-of-basin groundwater storage (e.g., Semitropic Groundwater Bank)	F	Limited potential to provide increase in IL4 refuge water supply deliveries due to uncertainty regarding ability to secure additional supplies from groundwater banking facilities, especially during certain water year types.	P	F	P	Groundwater banks have several operational constraints that could limit the amount of water stored and extracted. Putting water into the bank could take several years, and pumping capacity, especially in certain water year types, could limit the amount of withdrawal. The extraction rate would depend on Valley Water's level of participation in the groundwater bank.	No

Table 2-10. Summary of Screening Results Related to Refuge Water Supplies (contd.)

Conceptual Measure	Achievement Category Screening Results	Summary of Achievement Category Evaluation	Feasibility Category Screening Results			Summary of Feasibility Category Evaluation	Retain Measure (Yes/No)
			Technical	Logistical	Cost[1]		
Implement additional in-basin groundwater storage and recovery operations (e.g., South County Recharge Project)	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increased storage space.	P	P	P	Meets all feasibility category criteria.	Yes
Alternate Water Supplies							
Construct desalination plant and related conveyance facilities to supply environmental water needs	P	High potential to increase IL4 refuge water supply deliveries through transfers or exchanges due to increase in water supply.	P	F	F	This measure does not compare to expansion of Pacheco Reservoir in terms of cost to achieve similar level of physical benefits. The cost to build and operate a desalination plant is substantially higher than other conceptual measures considered. Brine disposal could have substantial impacts on biological resources near the outfall and moderate impacts to water quality. Desalination facilities could also have moderate impacts to coastal recreation.	No

Notes:
[1] NE (i.e., not evaluated) in the cost criteria feasibility category denote that existing cost information was not available. It was assumed that the cost of the conceptual measure was comparable (within reason) to the cost of expanding Pacheco Reservoir.

Key:
CVP = Central Valley Project
DWR = California Department of Water Resources
F = Fail
NE = Not Evaluated
P = Pass
USFWS = United States Fish and Wildlife Service

Summary of Conceptual Measures Screening Results

Prior to moving forward with formulation of the Project alternatives, the following outcomes of the conceptual measure screening process were considered:

- Some conceptual measures considered under the secondary objectives were already being pursued under independent studies or projects; therefore, Valley Water will not investigate these measures further.
- In some cases, the success of a conceptual measure is contingent on the implementation of other conceptual measures. Multiple conceptual measures in conjunction may better address the Project objective(s) than measures evaluated individually.

Table 2-11 summarizes the conceptual measures that were retained following completion of the conceptual measures screening process. As identified in Table 2-11, if a conceptual measure is being pursued under an independent study or project, it was not evaluated further as part of this Project. The remaining retained conceptual measures, highlighted in blue, for the primary and secondary Project objectives were combined to formulate the Proposed Project and action alternatives presented in the EIR.

Table 2-11. Retained Conceptual Measures by Project Objective

Objectives		Conceptual Measures that Passed the Screening Process
Primary Objectives	Water Supply Reliability and Emergency Response	Expand existing Pacheco Reservoir through construction of a new dam to increase storage space[1]
	Suitable Habitat for SCCC Steelhead	Expand existing Pacheco Reservoir through construction of a new dam to increase suitable SCCC steelhead[1]
Secondary Objectives	Drinking Water Quality	Expand existing Pacheco Reservoir through construction of a new dam to increase storage space to minimize supply interruptions due to low point events at San Luis Reservoir[1]
	Refuge Water Supplies	Construct a new dam to expand existing Pacheco Reservoir to allow for increased deliveries to meet refuge water supply needs[1]
		Expand Los Vaqueros Reservoir to increase conservation storage space for refuge environmental water needs[2]
		Expand existing storage or construct new storage in Sacramento River/San Joaquin River watersheds to meet refuge environmental water needs[2]
		Construct new storage in the Sacramento-San Joaquin Delta to meet refuge environmental water needs[2]
		Implement additional in-basin groundwater storage and recovery operations (e.g., South County Recharge Project)[2]

Notes:
[1] Conceptual measures highlighted in blue indicate those conceptual measures that were incorporated into action alternatives.
[2] Conceptual measure is currently being pursued under an independent study or project. These conceptual measures were not incorporated into any of the action alternatives.

Key:
SCCC = South-Central California Coast

2.4 Initial Alternatives Development and Refinement

In addition to the identification of conceptual measures carried forward in the alternative development process, preliminary evaluations of dam types and most suitable dam site locations were conducted to narrow the range of potential alternatives. Subsequent to the issuance of the 2017 Notice of Preparation and Initial Study, Valley Water considered six dam types and four dam site locations on North Fork Pacheco Creek. Early evaluations eliminated concrete and roller compacted concrete dam types; the majority of construction materials would need to be imported from off-site. To further narrow the considered dam types, Valley Water subjected each dam type to an initial screening process using criteria related to effectiveness, efficiency, completeness, and acceptability. Based on this screening process, concrete-face earthfill and asphalt core dam types were removed from further consideration, while earthfill and hardfill dam types were retained. The hardfill dam would be constructed of a hardfill mix of cement and fly ash surrounded by a conventional concrete mix on the upstream and downstream faces of the dam while the earthfill dam would be constructed with an impervious, fine-grained, and low-plasticity clay core flanked by an outer shell of compatible fill. To narrow the number of potential dam site locations, information from previous studies and results of on-going geologic investigations were considered. Through this process, two dam sites most immediately upstream of North Fork Dam were retained. Enlargement of the existing North Fork Dam was eliminated due to geotechnical limitations at the site.

Table 2-12 summarizes the different facilities, including dam types, dam sites, reservoir sizes, SR 152 access improvements, and operational scenarios, including habitat release patterns and level of SBCWD participation considered in the development of the Proposed Project. However, not all possible combinations of facility options were included in this evaluation. For example, reservoir capacity was only modified for the upstream site. The smaller reservoir size (i.e., 96,000 acre-feet) was included at the upstream dam site in an effort to provide a reasonable range of feasible alternatives with respect to potential differences in benefits, costs, and environmental impacts versus a larger reservoir size.

Table 2-12. Facilities and Operations Considered in the Development of Alternatives

Facilities	
Dam Site Location	• Upstream[1] • Downstream[2]
Dam Type	• Earthfill • Hardfill
Reservoir Capacity	• 96,000 acre-feet • 140,000 acre-feet
SR 152 Access Improvements[3]	• Permanent tight diamond interchange • Temporary overcrossing • Temporary at-grade intersection with traffic signal and roundabout • Temporary at-grade intersection with traffic signal and widening of SR 152
Operational Scenarios	
Target Flows in Pacheco Creek	• Fixed flow targets[4] • Variable flow targets[5]
San Benito County Water District Participation	• No participation (0%) • 10% participation

Notes:

[1] Upstream dam site is located 2.2 miles upstream from the confluence of North Fork Pacheco Creek and South Fork Pacheco Creek.

[2] Downstream dam site is located 0.9 mile upstream of the confluence of North Fork Pacheco Creek and South Fork Pacheco Creek.

[3] Coordination with Caltrans is on-going related to the acceptability, considering safety and traffic impacts, of different options for SR 152 access improvements.

[4] Releases to Pacheco Creek from the expanded reservoir and associated downstream flow targets vary depending on water year type and reflect input received from regulatory agencies and Water Storage Investment Program funding agencies.

[5] Releases to Pacheco Creek from the expanded reservoir and associated downstream flow targets are consistent across all water year types and are based on the Pacheco Reservoir Expansion Project Initial Study (see Attachment A of the Public and Agency Scoping Process Appendix) and Water Storage Investment Program application for the Pacheco Reservoir Expansion Project (Valley Water 2017).

Key:
% = percent
SR 152 = State Route 152

Table 2-13 presents the initial set of action alternatives that Valley Water carried forward for consideration as the Proposed Project. The alternatives listed in this table are presented with a numerical/alpha naming convention based on initial design efforts. As the physical benefits (e.g., M&I water supply quantities, amount of suitable habitat for SCCC steelhead) would not vary considerably based on dam site location or dam type, and coordination with potential funding partners (e.g., California Department of Fish and Wildlife for SCCC steelhead habitat benefits, SBCWD) to refine operational scenarios was ongoing, all of the alternatives listed in Table 2-13 had common operational priorities. At this initial point in the alternative development process, all of these alternatives incorporated Pacheco Creek flow targets that were consistent across all water year types and were based on the Pacheco Reservoir Expansion Project Initial Study (see Attachment A of the Public and Agency Scoping Process Appendix) and Water Storage Investment Program application for the Pacheco Reservoir Expansion Project (Valley Water 2017) and assume no participation by SBCWD. This approach allowed for direct comparison of the physical benefits, tradeoffs and costs of the various dam site, dam type, and reservoir capacity combinations.

Table 2-13. Summary of Combination of Facility and Operations of Initial Alternatives

Initial Alternative[1]	Facilities			Operations	
	Dam Site	Expanded Reservoir Capacity	Dam Type	Pacheco Creek Flow Target	San Benito County Water District Participation
1a	Downstream	140 TAF	Earthfill	Fixed flow targets[2]	0%
1b	Downstream	140 TAF	Hardfill	Fixed flow targets[2]	0%
5a	Upstream	140 TAF	Earthfill	Fixed flow targets[2]	0%
5b	Upstream	140 TAF	Hardfill	Fixed flow targets[2]	0%
6	Upstream	96 TAF	Earthfill	Fixed flow targets[2]	0%

Notes:

[1] Numbering based upon alternatives evaluated during Alternatives Analysis Workshop on May 12, 2020. As the physical benefits would not vary considerably based on dam site location or dam type, and coordination with potential funding partners to refine operational scenarios was ongoing at the time of the workshop, the initial alternatives evaluated incorporated common operational priorities. Alternatives 1a, 1b, 5a, 5b, and 6 each incorporate the same operational priorities (i.e., fixed flow targets in Pacheco Creek and 0-percent participation by San Benito County Water District). Alternatives 2, 3, 4, 7, and 8 reflected similar facilities as Alternatives 1a, 1b, 5a, 5b, and 6, but reflected variations in operations, and therefore were not evaluated.

[2] Releases to Pacheco Creek from the expanded reservoir and associated downstream flow targets are consistent across all water year types and are based on the Pacheco Reservoir Expansion Project Initial Study (see Attachment A of the Public and Agency Scoping Process Appendix) and Water Storage Investment Program application for the Pacheco Reservoir Expansion Project (Valley Water 2017).

Key:

% = percent

TAF = thousand acre-feet

2.5 Alternatives Evaluated in the Environmental Impact Report

The initial alternative development process resulted in the identification of five action alternatives that collectively provide a reasonable range of alternatives to be evaluated in the EIR in addition to the No Project Alternative. By using scoring and weighting factors related to effectiveness, efficiency, completeness, and acceptability, the five action alternatives were given a final score and ranked based on their associated scores. The top ranked alternative was Alternative 5b, the hardfill dam located at the upstream dam site with an expanded reservoir size of 140 thousand acre-feet (Valley Water 2021b). Since this initial alternative evaluation and ranking, this alternative has been identified as the Proposed Project. The Proposed Project and remaining action alternatives have been refined to include updated designs for additional Project facilities (e.g., property owner access roads, power transmission lines, SR 152 access improvements), construction methods (e.g., water handling during construction at new dam site, water sources during construction), and operational scenarios (e.g., variable Pacheco Creek flow targets informed by agency coordination, SBCWD participation, and associated operations).

Table 2-14 summarizes the primary facility and operational variations for the Proposed Project and action alternatives evaluated in this EIR.

Table 2-14. Major Variations in Facilities and Operations Among the Proposed Project and Alternatives A Through D

Alternative	Facilities				Operations	
	Dam Site	Expanded Reservoir Capacity	Dam Type	SR 152 Access Improvements	Pacheco Creek Flow Schedule Releases	SBCWD Participation
Proposed Project	Upstream	140 TAF	Hardfill	Permanent tight diamond interchange	Variable[1]	10%
Alternative A	Upstream	140 TAF	Earthfill	Temporary overcrossing	Fixed[2]	0%
Alternative B	Upstream	96 TAF	Earthfill	Temporary at-grade intersection with traffic signal and roundabout	Fixed[2]	0%
Alternative C	Downstream	140 TAF	Hardfill	Temporary at-grade intersection with traffic signal and widening of SR 152	Variable[1]	10%
Alternative D	Downstream	140 TAF	Earthfill	Permanent tight diamond interchange	Fixed[2]	0%

Notes:

[1] Releases to North Fork Pacheco Creek from the expanded reservoir vary depending on water year type and reflect input received from regulatory agencies and Water Storage Investment Program funding agencies.

[2] Releases to North Fork Pacheco Creek from the expanded reservoir and associated downstream flow targets are consistent across all water year types and are based on the Pacheco Reservoir Expansion Project Initial Study (see Attachment A of the Public and Agency Scoping Process Appendix) and Water Storage Investment Program application for the Pacheco Reservoir Expansion Project (Valley Water 2017).

Key:
SBCWD = San Benito County Water District
SR 152 = State Route 152
TAF = thousand acre-feet

When compared to the Proposed Project, each of the four action alternatives meets the Project objectives to various degrees, while reducing one or more of the anticipated significant impacts that would result from implementation of the Proposed Project.

The Proposed Project under consideration in this EIR has been modified since it was originally presented and evaluated in the 2017 Notice of Preparation and Initial Study at the onset of scoping. Alternative D most closely reflects the project described in the Notice of Preparation and Initial study issued in 2017.

2.6 Alternatives Considered but Eliminated

CEQA requires an EIR to describe a range of reasonable alternatives to the project or to the location of the project that would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project. As discussed in Section 2.2, the Project objectives (primary and secondary) were used to define the fundamental purposes of the Proposed Project, including improving agricultural and M&I water supply reliability and emergency response, increasing suitable habitat for SCCC steelhead, improving drinking water quality related to the San Luis Low Point issue, and increasing refuge water supplies.

Accordingly, Valley Water developed and considered over 50 conceptual measures to address the Project purposes related to:

- Water transfers and purchases, reservoir and system operations, water use efficiency, surface water and groundwater storage, alternate water supplies, and conveyance and system modifications;
- Flow and temperature conditions in Pacheco Creek, recovery of other additional populations of SCCC steelhead in the Pajaro River watershed, conservation hatchery, and National Marine Fisheries Service Recovery Plan actions;
- Water treatment, institutional agreements, water storage, conveyance, alternate water supplies, and source water quality control; and
- Institutional agreements and surface water and groundwater storage.

As described in Section 2.3, the conceptual measures identified and subjected to Valley Water's screening process eliminated many conceptual measures from further consideration based on their: 1) achievement of Project objectives (i.e., ability to address the respective primary or secondary Project objectives independently) and 2) feasibility (i.e., practicability in terms of technical, logistical, and cost constraints). In addition to the conceptual measures described in Section 2.3, based on scoping comments Valley Water considered a proposal to transport freshwater from Alaska or southern Mexico via ultra-large marine submersible boats. This alternative was rejected due to achievement of Project objectives considerations. Specifically, there is uncertainty regarding ability to provide improved water supply reliability. This measure would have limited potential to provide emergency response benefits due to limited ability to provide water supplies stored locally and available during an emergency.

As described in Section 2.4, Valley Water initially considered multiple alternative dam types and locations potentially capable of providing additional water storage capacity to meet the Project objectives, including six dam types and four dam site locations on North Fork Pacheco Creek. Early evaluations eliminated concrete and roller compacted concrete dam types as the majority of construction materials would need to be imported from off-site. Concrete-face earthfill and asphalt core dam types were removed from further consideration, while earthfill and hardfill dam types were retained. The number of potential dam site locations were narrowed based on information from previous studies and results of on-going geologic investigations. Enlargement of the existing North Fork Dam was eliminated due to geotechnical limitations at the site.

Chapter 3 Description of Alternatives

3.1 Overview

This chapter describes the No Project Alternative and five action alternatives, including the Proposed Project. The action alternatives include the Proposed Project, and four other action alternatives (Alternatives A through D). Each of the action alternatives includes construction and operation of a new dam, including appurtenant structures,[2] and an expanded reservoir on North Fork Pacheco Creek. All five action alternatives also include construction and operation of water conveyance facilities to and from the new dam to Pacheco Conduit, decommissioning of the existing North Fork Dam and restoration of North Fork Pacheco Creek channel between the existing dam and the new dam, construction of access and roadway improvements, power and transmission line upgrades, utilities relocations, and development of borrow, disposal, stockpile, and staging areas. Under all action alternatives, the expanded reservoir would be operated to capture and store natural inflow, to make targeted releases into the restored reach of North Fork Pacheco Creek, and to convey water back and forth between the expanded reservoir and Pacheco Conduit.

To avoid or substantially reduce impacts, key components of the facilities and operations of the other action alternatives (i.e., Alternatives A through D) were varied, including the dam site location, reservoir capacity, dam type, target flows to Pacheco Creek, and level of SBCWD usage of the expanded reservoir, as detailed below:

- **Facilities**
    - **Dam Site Location**: The action alternatives include two dam site locations. The upstream dam site is located 2.2 miles upstream from the confluence of North Fork Pacheco Creek and South Fork Pacheco Creek. The downstream dam site is located 0.9 miles upstream of the creeks' confluence.
    - **Reservoir Capacity**: Action alternatives reflect one of two reservoir capacity sizes: either 140,000 acre-feet or 96,000 acre-feet. The 96,000 acre-feet reservoir size was developed for the upstream dam site to avoid inundation impacts on Henry Coe State Park.
    - **Dam Type**: Each action alternative includes a new dam, either an earthfill dam or a hardfill dam. For hardfill dams, the spillway and inlet/outlet structures are integrated into the dam. For the earthfill dams, the inlet/outlet structure and spillway are constructed as separate and independent facilities from the dam.
    - **State Route 152 Access Improvements**: Each action alternative includes one of four options to improve access at the SR 152 and Kaiser-Aetna Road intersection. These four options include: at-grade intersection with traffic signal and widening of SR 152, at-grade intersection with traffic signal and roundabout, permanent tight diamond overpass/interchange, and temporary overcrossing.

[2] Appurtenant structures means the structure or machinery incident to or annexed to a dam that is built to operate and maintain a dam, including spillways, either in a dam or separate from the dam; low level outlet works; and water conduits such as tunnels or, pipelines, located either through the dam or through the abutments of the dam.

- **Operations**
  - **Pacheco Flow Schedule Releases**: Two release patterns from the expanded reservoir to North Fork Pacheco Creek are included in the alternatives and consist of: (1) target flows that are consistent across water year types, based on the Pacheco Reservoir Expansion Project Initial Study (see Attachment A of the Public and Agency Scoping Process Appendix) and the Water Storage Investigation Program (WSIP) application submitted to the California Water Commission (Valley Water 2017); and (2) target flows that vary based on water year type, refined from the Initial Study/WSIP application flows based on ongoing regulatory agency and WSIP funding agency coordination.
  - **San Benito County Water District Participation:** SBCWD may utilize a portion of the expanded reservoir capacity and associated conveyance facilities as part of their water storage and conveyance system. The action alternatives vary in the level of SBCWD participation, ranging from 0 to 10 percent of the expanded reservoir storage.

Table 3-1 summarizes the primary facility and operational variations for the five action alternatives.

Table 3-1. Major Variations in Facilities and Operations Among the Proposed Project and Alternatives A Through D

Alternative	Facilities				Operations	
	Dam Site	Expanded Reservoir Capacity	Dam Type	SR 152 Access Improvements	Pacheco Creek Flow Schedule Releases	SBCWD Participation
Proposed Project	Upstream	140 TAF	Hardfill	Permanent tight diamond interchange	Variable[1]	10%
Alternative A	Upstream	140 TAF	Earthfill	Temporary overcrossing	Fixed[2]	0%
Alternative B	Upstream	96 TAF	Earthfill	Temporary at-grade intersection with traffic signal and roundabout	Fixed[2]	0%
Alternative C	Downstream	140 TAF	Hardfill	Temporary at-grade intersection with traffic signal and widening of SR 152	Variable[1]	10%
Alternative D	Downstream	140 TAF	Earthfill	Permanent tight diamond interchange	Fixed[2]	0%

Notes:

[1] Releases to North Fork Pacheco Creek from the expanded reservoir vary depending on water year type and reflect input received from regulatory agencies and Water Storage Investment Program funding agencies.

[2] Releases to North Fork Pacheco Creek from the expanded reservoir and associated downstream flow targets are consistent across all water year types and are based on the Pacheco Reservoir Expansion Project Initial Study (see Attachment A of the Public and Agency Scoping Process Appendix) and Water Storage Investment Program application for the Pacheco Reservoir Expansion Project (Valley Water 2017).

Key:

SBCWD = San Benito County Water District

SR 152 = State Route 152

TAF = thousand acre-feet

3.1.1 No Project Alternative

Under the No Project Alternative, Valley Water would not construct and operate a new dam, or related facilities, in the Pacheco Creek watershed, and the Pacheco Reservoir would not be expanded. Valley Water and SBCWD would continue to operate and maintain their existing facilities to deliver water supply to customers and would maximize delivery of their CVP allocations consistent with associated water contract terms and environmental regulations. No new emergency storage would be provided to Valley Water or SBCWD, or to their customers.

Since 2017, the North Fork Dam has been under restricted operation criteria due to existing spillway deficiencies (e.g., damage to the spillway). PPWD, in coordination with DWR's Division of Safety of Dams (DSOD), is developing plans to perform repairs of the existing spillway consistent with DSOD requirements. Under the No Project Alternative, repairs to the existing spillway are anticipated to be complete allowing the existing reservoir to be operated at full capacity. For the purpose of describing the No Project Alternative, it is assumed that the existing Pacheco Reservoir would be operated consistent with recommendations and release rules in the 2014 Report on Comprehensive Strategy and Instructions for Operation of Pacheco Reservoir (i.e., optimized operations for SCCC steelhead habitat and groundwater recharge) (Micko 2014). In 2016, the existing dam and reservoir were operated generally consistent with these recommendations and release rules.[3]

Table 3-2 presents the range of monthly releases to North Fork Pacheco Creek that the existing dam and reservoir would make under these recommendations and release rules, to the extent possible, under the No Project Alternative. Additional details on set of release rules are provided in Exhibit 1 in Attachment A. The prescribed monthly baseflow from May through January is set based on reservoir storage levels on May 1, subject to monthly adjustments, while monthly baseflows in February through April are set based on reservoir storage levels at the beginning of each respective month. The April pulse flow magnitude is set based on reservoir storage levels and regional water supply and hydrologic conditions as determined on April 1. The monthly release targets for May through January are higher if the reservoir is at full capacity starting May 1. The monthly release targets are lower or zero in drier years when the existing Pacheco Reservoir has very low storage levels due to minimal or no inflow. From November through April, if the watershed is saturated and consistent streamflow is maintained in Pacheco Creek due to contributions from South Fork Pacheco Creek and other uncontrolled tributaries, releases from the existing North Fork Dam are reduced to zero cubic feet per second (cfs).

3.1.2 Components of Action Alternatives

Components of the action alternatives are grouped into four categories: facility components, construction program components (e.g., construction methods, materials sourcing, staging and stockpiling areas), operational components (e.g., water supply for Valley Water and SBCWD, releases to Pacheco Creek, and deliveries to wildlife refuges), and DIFs. Facility components, construction program components, operational and maintenance components are described in greater detail below. DIFs are fully described in the main body of the EIR (Chapter 2) and are not repeated in this appendix.

[3] Due to either severe drought or DSOD operational restrictions, operations of the existing dam and reservoir have been constrained. Accordingly, operations of the existing dam and reservoir by PPWD in 2016, which were generally consistent with the 2014 Report on Comprehensive Strategy and Instructions for Operation of Pacheco Reservoir, best indicate how PPWD would operate the existing dam under future conditions. Severe drought conditions occurred in 2015 with limited precipitation and corresponding low inflows into the existing Pacheco Reservoir, constraining operations of the existing dam and reservoir. Since 2017, the existing dam and reservoir have been subject to restricted operations imposed by DSOD due to spillway deficiencies.

Table 3-2. Range of Monthly Reservoir Release Targets under No Project Alternative

Month	Baseflow	Pulse Flow	
	Range of Monthly Reservoir Release Baseflow Target [1] (cfs)	Potential Pulse Flow Release Target Magnitude (cfs)	Pulse Flow Duration (Days)
January	0 to 9[2]	--	--
February	0 to 9[2]	--	--
March	0 to 9[2]	--	--
April	0 to 9[2]	0, 21, 25, 30[3]	30[3]
May	0 to 11	--	--
June	0 to 12	--	--
July	0 to 13	--	--
August	0 to 13	--	--
September	0 to 13	--	--
October	0 to 13	--	--
November	0 to 10[2]	--	--
December	0 to 9[2]	--	--

Source: Developed from Micko 2014

Notes:

[1] Release baseflow target values are determined monthly based on actual storage and volume required to extend continuous release into mid-winter. Releases are continuous for the entire month.

[2] Releases are reduced to 0 cfs in the months of November, December, January, February, March, or April when the watershed is sufficiently saturated to sustain a base flow in Pacheco Creek.

[3] If determined to be feasible based on juvenile steelhead presence in Pacheco Creek, passage conditions in the Pajaro River, and water supply risk, a 30-day pulse flow may be made in lieu of a baseflow release. Pulse target magnitude varies depending on storage, depth to groundwater in Pacheco Valley, and streamflow conditions in Pacheco Creek.

Key:
cfs = cubic feet per second

3.2 Facilities

The five action alternatives would include a range of common facilities. Each action alternative would include a new dam, spillway, inlet/outlet works, conveyance pipeline, tunnels, pump station and associated utilities, channel modifications and restoration, and vehicular access improvements. While the general types of facilities are common across all action alternatives, the facilities themselves have variations (e.g., dam type, size, spillway type) and their respective site layouts differ. Exhibits 2 through 6 in Attachment A present the proposed facilities associated with the Proposed Project and Alternatives A through D, respectively. Each facility, as included in the action alternatives, is described in subsections below. Table 3-3 provides a summary of the facilities and associated physical features of each action alternative. The descriptions of these facilities are based on the current designs and best available information; however, the designs of these facilities will be refined as the design process advances. The quantities, sizes, and volumes provided below for the various facilities represent the maximum estimated that could be expected based on available information.

Table 3-3. Summary of Facilities and Physical Features of the Proposed Project and Alternatives A Through D

Facility	Proposed Project	Alternative A	Alternative B	Alternative C	Alternative D
Dam, Reservoir, and Appurtenant Structures					
Dam					
Dam Site	Upstream	Upstream	Upstream	Downstream	Downstream
Dam Type	Hardfill	Earthfill	Earthfill	Hardfill	Earthfill
Dam Height above Streambed at Downstream Toe (feet)	320	325	275	315	320
Reservoir					
Active Storage Capacity (acre-feet)[1]	139,900	139,900	96,100	139,700	139,700
Surface Area at Full Pool (acres)	1,367	1,367	1,072	1,381	1,381
Spillway	Spillway incorporated into dam face; 130-feet wide uncontrolled ogee spillway with a rectangular cross section	Located on west abutment; 130-feet wide uncontrolled ogee spillway with a rectangular cross section	Located on west abutment; 130-feet wide uncontrolled ogee spillway with a rectangular cross section	Spillway incorporated into dam face; 130-feet wide uncontrolled ogee spillway with a rectangular cross section	Located on east abutment; 85-feet wide uncontrolled ogee spillway with a rectangular cross section
Inlet/Outlet Works	Integrated into hardfill dam structure, 3 adits and 1 low-level bypass	Located on east abutment; 3 adits and 1 low-level bypass	Located on east abutment; 3 adits and 1 low-level bypass	Integrated into hardfill dam structure, 3 adits and 1 low-level bypass	Located on west abutment; 3 adits and 1 low-level bypass
Water Conveyance Facilities					
Pipelines/Tunnel between New Dam and Pacheco Conduit	10,800 feet of 114-inch pipelines, including 350-feet of tunneling under SR 152 and South Fork Pacheco Creek	10,300 feet of 114-inch pipelines, including 350-feet of tunneling under SR 152 and South Fork Pacheco Creek tunnel	10,800 feet of 114-inch pipelines, including 350-feet of tunneling under SR 152 and South Fork Pacheco Creek	5,200 feet of 114-inch pipeline, including 350-feet of tunneling under SR 152 and South Fork Pacheco Creek	4,500 feet of 114-inch pipelines, including 350-feet of tunneling under SR 152 and South Fork Pacheco Creek
Replacement of Pacheco Conduit Section	Replace 910 feet of Pacheco Conduit	Replace 910 feet of Pacheco Conduit	Replace 910 feet of Pacheco Conduit	Replace 910 feet of Pacheco Conduit	Replace 910 feet of Pacheco Conduit
Pump Station	Located 1.2 miles downstream of new dam; 490 cfs capacity with bi-directional flow	Located 1.2 miles downstream of new dam; 490 cfs capacity with bi-directional flow	Located 1.2 miles downstream of new dam; 490 cfs capacity with bi-directional flow	Located 1.0 mile downstream of new dam; 490 cfs capacity with bi-directional flow	Located 1.0 miles downstream of new dam; 490 cfs capacity with bi-directional flow

Table 3-3. Summary of Facilities and Physical Features of the Proposed Project and Alternatives A Through D (contd.)

Facility	Proposed Project	Alternative A	Alternative B	Alternative C	Alternative D
Existing North Fork Dam Decommissioning and Channel Restoration					
Existing North Fork Dam Decommissioning	Decommissioning of existing North Fork Dam, spillway, and outlet tunnel	Decommissioning of existing North Fork Dam, spillway, and outlet tunnel	Decommissioning of existing North Fork Dam, spillway, and outlet tunnel	Decommissioning of existing North Fork Dam, spillway, and outlet tunnel	Decommissioning of existing North Fork Dam, spillway, and outlet tunnel
Channel Restoration	Restore 1.8 miles of channel within existing reservoir inundation area from new dam site to existing dam site, targeting spawning and rearing habitat for SCCC steelhead	Restore 1.4 miles of channel within existing reservoir inundation area from new dam site to existing dam site, targeting rearing habitat for SCCC steelhead	Restore 1.4 miles of channel within existing reservoir inundation area from new dam site to existing dam site, targeting rearing habitat for SCCC steelhead	Restore 0.5 miles of channel within existing reservoir inundation area from new dam site to existing dam site, targeting spawning and rearing habitat for SCCC steelhead	Restore 0.3 miles of channel within existing reservoir inundation area from new dam site to existing dam site, targeting rearing habitat for SCCC steelhead
Utilities					
New Electrical Substation	70kV/4.16kV substation rated at 13.44/17.92 MVA	70kV/4.16kV substation rated at 13.44/17.92 MVA	70kV/4.16kV substation rated at 13.44/17.92 MVA	70kV/4.16kV substation rated at 13.44/17.92 MVA	70kV/4.16kV substation rated at 13.44/17.92 MVA
New Power Transmission Line	4.1 miles of 70kV line (26 poles) and local distribution circuits (lines)	4.1 miles of 70kV line (26 poles) and local distribution circuits (lines)	4.1 miles of 70kV line (26 poles) and local distribution circuits (lines)	4.6 miles of 70kV line (29 poles) and local distribution circuits (lines)	4.6 miles of 70kV line (29 poles) and local distribution circuits (lines)
New Water/Wastewater Facilities	New well for potable water and septic tank and leach-line system for wastewater disposal at pump station	New well for potable water and septic tank and leach-line system for wastewater disposal at pump station	New well for potable water and septic tank and leach-line system for wastewater disposal at pump station	New well for potable water and septic tank and leach-line system for wastewater disposal at pump station	New well for potable water and septic tank and leach-line system for wastewater disposal at pump station
New Telecommunications	Permanent communications facilities to transmit instrumentation and control data	Permanent communications facilities to transmit instrumentation and control data	Permanent communications facilities to transmit instrumentation and control data	Permanent communications facilities to transmit instrumentation and control data	Permanent communications facilities to transmit instrumentation and control data
Relocation of Existing Utilities	Relocation of existing telecommunication utilities affected by construction activities	Relocation of existing telecommunication utilities affected by construction activities	Relocation of existing telecommunication utilities affected by construction activities	Relocation of existing telecommunication utilities affected by construction activities	Relocation of existing telecommunication utilities affected by construction activities

Table 3-3. Summary of Facilities and Physical Features of the Proposed Project and Alternatives A Through D (contd.)

Facility	Proposed Project	Alternative A	Alternative B	Alternative C	Alternative D
Permanent and Construction (Temporary) Access					
SR 152 Access Improvements at Kaiser-Aetna Road	Permanent tight diamond interchange	Temporary overcrossing	Temporary at-grade intersection with traffic signal and roundabout	Temporary at-grade intersection with traffic signal and widening of SR 152 (added lane)	Permanent tight diamond interchange
Frontage Road and Dam Access Roads	1.6-mile paved frontage road and 2.0 miles of additional paved roads for construction and permanent access	1.6-mile paved frontage road and 2.0 miles of additional paved roads for construction and permanent access	1.6-mile paved frontage road and 2.0 miles of additional paved roads for construction and permanent access	1.6-mile paved frontage road and 1.0 mile of additional paved roads for construction and permanent access	1.6-mile paved frontage road and 2.2 miles of additional paved roads for construction and permanent access
Pacheco Conduit Tie-in Access Road	Expansion of existing private driveway on SR 152 and 400-foot gravel road for construction and permanent access	Expansion of existing private driveway on SR 152 and 400-foot gravel road for construction and permanent access	Expansion of existing private driveway on SR 152 and 400-foot gravel road for construction and permanent access	Expansion of existing private driveway on SR 152 and 400-foot gravel road for construction and permanent access	Expansion of existing private driveway on SR 152 and 400-foot gravel road for construction and permanent access
Auxiliary Access Road	4.0 miles of gravel roads to provide axillary access during construction and operation	3.7 miles of gravel roads to provide axillary access during construction and operation	3.8 miles of gravel roads to provide axillary access during construction and operation	1.7 miles of gravel roads to provide axillary access during construction only	1.7 miles of gravel roads to provide axillary access during construction only
Property Access Roads	Improvements to 3 existing access roads, 1.9, 20.7, and 7.3 miles in length, for property owner access	Improvements to 3 existing access roads, 1.9, 20.7, and 7.3 miles in length, for property owner access	Improvements to 3 existing access roads, 1.9, 20.7, and 7.3 miles in length, for property owner access	Improvements to 3 existing access roads, 1.9, 20.7, and 7.3 miles in length, for property owner access	Improvements to 3 existing access roads, 1.9, 20.7, and 7.3 miles in length, for property owner access
Observation Trail	Trail from dam access road to restored stream channel	Trail from dam access road to restored stream channel	Trail from dam access road to restored stream channel	Trail from dam access road to restored stream channel	Trail from dam access road to restored stream channel
Temporary Construction Access Roads	7.2 miles of gravel roads for temporary construction access	7.2 miles of gravel roads for temporary construction access	7.3 miles of gravel roads for temporary construction access	8.9 miles of gravel roads for temporary construction access	11.3 miles of gravel roads for temporary construction access

Table 3-3. Summary of Facilities and Physical Features of the Proposed Project and Alternatives A Through D (contd.)

Facility	Proposed Project	Alternative A	Alternative B	Alternative C	Alternative D
Other Items					
Demolition of Existing Structures	Demolition of structures within new facility footprints and the expanded reservoir inundation area	Demolition of structures within new facility footprints and the expanded reservoir inundation area	Demolition of structures within new facility footprints and the expanded reservoir inundation area	Demolition of structures within new facility footprints and the expanded reservoir inundation area	Demolition of structures within new facility footprints and the expanded reservoir inundation area
Watershed Management/ Shoreline Buffer and Shoreline Access	Acquisition and management of 200-foot buffer along expanded reservoir shoreline and new boat ramp dam for maintenance and emergency access purposes located upstream of the new dam.	Acquisition and management of 200-foot buffer along expanded reservoir shoreline and new boat ramp dam for maintenance and emergency access purposes located upstream of the new dam.	Acquisition and management of 200-foot buffer along expanded reservoir shoreline and new boat ramp dam for maintenance and emergency access purposes located upstream of the new dam.	Acquisition and management of 200-foot buffer along expanded reservoir shoreline and new boat ramp dam for maintenance and emergency access purposes located upstream of the new dam.	Acquisition and management of 200-foot buffer along expanded reservoir shoreline and new boat ramp dam for maintenance and emergency access purposes located upstream of the new dam.

Note:

[1] Active storage volume determined by the difference between reservoir volume at full pool and dead pool volume. Active storage values are rounded when referencing alternatives. For example, for Alternative A, the active storage of 139,900 acre-feet is referenced as 140 TAF.

Key:
cfs = cubic feet per second
kV = kilovolt
MVA = megavolt ampere
SCCC = South-Central California Coast
SR 152 = State Route 152
TAF= thousand acre-feet

3.2.1 Dam

All action alternatives include either a new hardfill or earthfill dam. Hardfill dams associated with the Proposed Project and Alternative C would be built using a hardfill mix covered with concrete facing on both the upstream and downstream faces. Earthfill dams associated with Alternatives A, B, and D would be constructed with a low permeability earthfill core, with permeable material in the dam's upstream shell and earth or rock material in the downstream shell. For either dam type, the dam and appurtenant facilities would be constructed consistent with DSOD requirements. The dam and outlet works must be operable immediately after a Maximum Credible Earthquake,[4] and must be capable of resisting the Safety Evaluation Earthquake[5] without uncontrolled releases from the reservoir. The spillway and outlet works must remain fully operable and accessible following the Safety Evaluation Earthquake.

3.2.1.1 Foundation

For either dam type, the new dam would be founded on bedrock and all soils and landslide debris would be removed from the dam foundation. Dam foundation requirements are based on the zones within the dam and are dependent on foundation rock strength, degree of weathering, and fracturing. Hardfill dams would be founded on moderately/slightly weathered rock. The foundation objective for the earthfill dam type is moderately weathered rock for the embankment shells, and moderately/slightly weathered rock for the core. The average excavation depth to construct the dam foundation at the upstream site (Proposed Project and Alternatives A and B) would be 30 feet to moderately weathered rock and 40 feet to moderately/slightly weathered rock. For the downstream dam site (Alternatives C and D), it is estimated that foundation excavation would range from 20 feet to 70 feet.

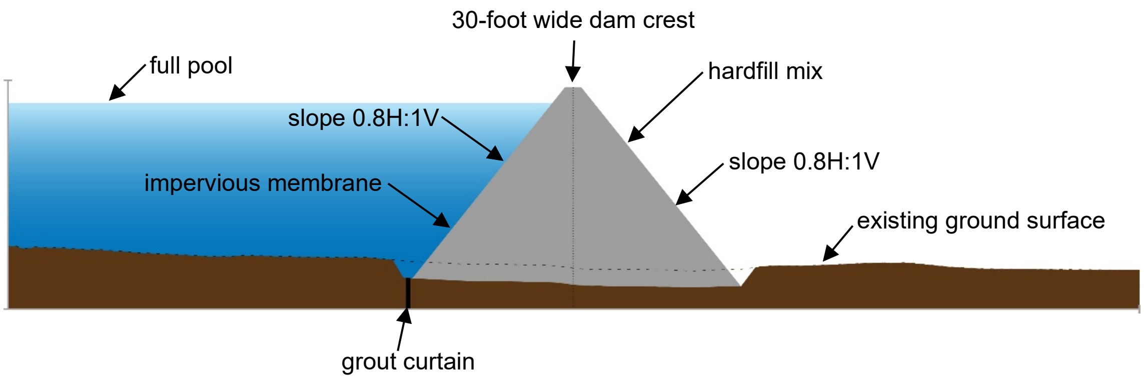
To reduce seepage through the foundation of the new dam regardless of type or location, a two-line grout curtain with grout holes in each line, in opposing directions, would be constructed for all action alternatives. The purpose of dam foundation grouting is to intersect and fill fractures and voids within the rock mass to improve mass characteristics, reduce the hydraulic conductivity of the foundation, and to reduce seepage under the dam. The preliminary depth of the grout curtain depends on the depth to relatively impervious rock. The grout curtain depth, measured perpendicular from the foundation surface, would be up to 200 feet for all alternatives. For an earthfill dam, the grout curtain would be constructed under the core or within the upstream face of the dam. For a hardfill dam, the grout curtain would be constructed at the upstream dam toe.

3.2.1.2 Hardfill Dam

The Proposed Project and Alternative C include a new dam structure constructed of a hardfill mix surrounded by a conventional concrete mix on the upstream and downstream faces of the dam. A typical cross section for the hardfill dams of the Proposed Project and Alternative C is presented in Figure 3-1. At either location, a hardfill dam would have similar upstream and downstream slopes of approximately eight-tenths horizontal per one vertical (0.8H:1V). The body of the dam would be constructed of hardfill mix based on the results of future mix design studies that would include varying the amounts and proportions of cement and fly ash to produce hardfill that meets both strength and workability requirements. Lift thickness would be approximately 12 inches, but this thickness may vary depending on the overall hardfill aggregate gradation. Aggregate for the hardfill mix will be sourced from on-site borrow areas.

[4] The Maximum Credible Earthquake is the largest earthquake magnitude that could occur along a recognized fault or within a particular seismotectonic province or source area under the current tectonic framework.
[5] The Safety Evaluation Earthquake is the earthquake that produces the maximum level of ground motion for which a structure is to be designed or evaluated.

The upstream and downstream faces of the dam would be constructed of conventional concrete placed during hardfill construction. An impervious membrane would be used on the upstream side of the dam to reduce seepage through the dam's hardfill body. Seepage control through the dam's hardfill body is needed to enhance the stability of the dam by reducing uplift pressures. On the downstream face, the hardfill would be placed and compacted against curbs. The spillway would be built over the dam and faced with conventional reinforced concrete.



Note: Not to scale

Figure 3-1. Typical Cross Section for Hardfill Dam

To further reduce seepage, foundation grouting would be performed from the upstream toe area. A drainage gallery would be installed upstream of the hardfill dam with drain holes that extend into the dam's foundation. The gallery permits drilling equipment for future grouting and drain maintenance, if needed. A comparison of the physical features and quantities for the hardfill dams associated with the Proposed Project and Alternative C is provided in Table 3-4. Table 3-5 summarizes the physical features of the expanded reservoirs for the Proposed Project and Alternative C.

Table 3-4. Physical Features and Quantities for Hardfill Dams Associated with the Proposed Project and Alternative C

Item	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir
Dam Crest Elevation (feet, above msl)	766	718
Full Pool Elevation (feet, above msl)	741	693
Dam Freeboard[1] (feet)	25	25
Operating Range (feet, above msl)	480-741	460-693
Dam Height Above Streambed at Downstream Toe (feet)	320	315
Dam Height Above Foundation (feet)	349	338
Dam Crest Length (feet)	1,840	2,200
Dam Crest Width (feet)	30	30
Foundation Excavation (CY)	926,000	1,603,000
Hardfill Mix (CY)	3,565,400	4,213,300
Concrete (CY)	34,000	40,600

Note:
[1] As defined by DSOD, freeboard is the vertical distance from the spillway crest to the dam crest. The objective of freeboard is to prevent overtopping of the dam under extreme conditions.

Key:
CY = cubic yard
DSOD = Division of Safety of Dams
msl = mean sea level
TAF = thousand acre-feet

Table 3-5. Physical Features of Expanded Reservoir for the Proposed Project and Alternative C

Item	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir
Reservoir Volume at Full Pool (acre-feet)	140,300	141,200
Dead Pool Volume[1] (acre-feet)	400	1,500
Active Storage Volume[2,3] (acre-feet)	139,900	139,700
Surface Area at Full Pool (acres)	1,367	1,381
Shoreline of Expanded Reservoir (miles)	35.2	34.7

Notes:
[1] Dead or inactive storage refers to water in the reservoir that cannot be drained by gravity through the dam's outlet works.
[2] Active storage volume determined by the difference between reservoir volume at full pool and dead pool volume.
[3] Storage values may not total due to rounding.

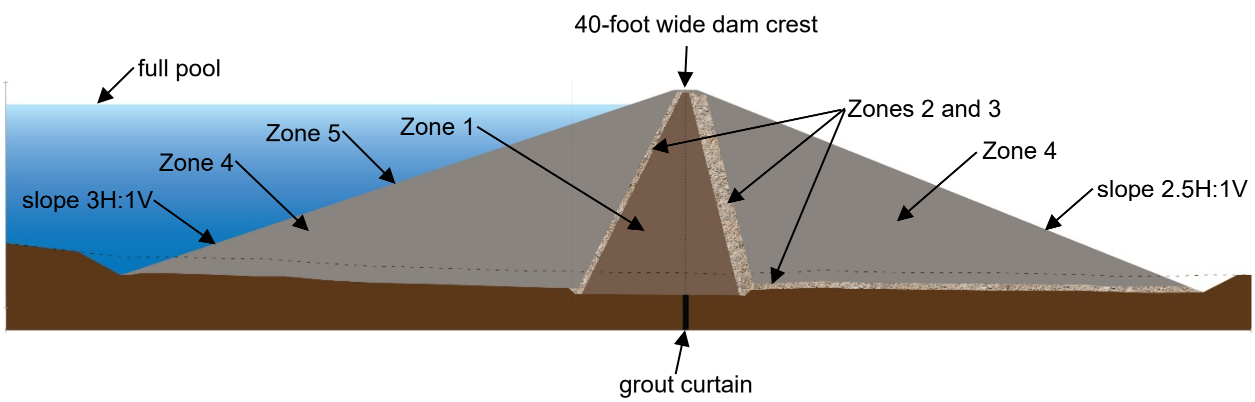
Key:
TAF = thousand acre-feet

3.2.1.3 Earthfill Dam

Alternatives A, B, and D include a new earthfill dam structure, built with an impervious core flanked by an outer shell of compatible fill. The design of the earthfill dam structure would be similar for Alternatives A, B, and D. A typical cross section for Alternatives A, B, and D is shown in Figure 3-2. In addition to the impervious core and outer shell, the earthfill dam design consists of the following features:

- A filter and drain system to control seepage through the dam and foundation;
- A downstream sand chimney filter to protect the impervious core;
- A gravel chimney drain located downstream of the chimney filter to convey drainage to a gravel blanket beneath the downstream compatible fill zone;
- A gravel blanket drain to convey seepage from the impervious core, which would overlie from the foundation beneath the downstream compatible fill zone to the downstream toe of the dam;
- Sand filter zones above and beneath the gravel blanket drain to protect the gravel drain from contamination of the overlying compatible fill and underlying foundation materials; and
- A riprap layer to protect the upstream slope of the dam from reservoir wave action.

For Alternatives A, B, and D, the new earthfill dam would be a zoned structure, with various material types being used to create the embankment dam inclusive of the features described above. The materials would be laid and placed in zones as shown in the dam's cross section presented in Figure 3-2. The core of the earthfill dam (Zone 1) would be constructed of fine-grained, low-plasticity clay sourced from on-site borrow areas described in Section 3.3.3.2. The core would slope down at an inclination of 0.5H:1V in the upstream direction and 0.25H:1V in the downstream direction.



Note: Not to scale

Figure 3-2. Typical Cross Section for Earthfill Dam

The chimney and blanket filters (Zone 2) and the chimney and blanket drains (Zone 3) would be constructed of sand and gravel imported from commercial sources. The shells of the dam (Zone 4) would be constructed using materials from required excavations and supplemented with material from shell borrow areas on site. Once the shell construction is complete, the earthfill dam embankment would have an upstream slope of 3H:1V and a downstream slope of 2.5H:1V. A 3-foot-thick riprap layer (Zone 5) would be placed on the upstream slope for protection against wave erosion. A 2-foot-thick bedding layer would be placed under the riprap to prevent erosion of the underlying embankment materials into the riprap.

For Alternative D, an 8-foot-thick filter would be placed between the upstream shell and the core. A drainage chimney would be placed between the core and downstream shell and consist of an 8-foot filter next to the core, a 5-foot drain layer, and a 3-foot filter layer between the drain and the downstream shell. The drainage blanket between the foundation bedrock and the downstream shell would consist of a 6-foot-thick drain between 3-foot-thick filters. For the upstream earthfill dams included in Alternatives A and B, the overall filter design would be similar to the downstream dam filter design included in Alternative D. The upstream dam designs include a 10-foot-wide chimney filter downstream of the core to prevent piping of the core material into the 10-foot-wide chimney drain. Like the downstream dam design, a 5-foot-thick blanket drain would be placed on the downstream shell foundation to convey seepage water from the embankment and the foundation. Then 3-foot-thick filters would be placed above and below the blanket drain to prevent it from being contaminated. Table 3-6 summarizes the physical features and quantities for earthfill dams associated with Alternatives A, B, and D. Table 3-7 summarizes the physical features of the expanded reservoirs for Alternatives A, B, and D.

Table 3-6. Physical Features and Quantities for Earthfill Dams Associated with Alternatives A, B, and D

Item	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative D Downstream, Earthfill Dam TAF Reservoir
Dam Crest Elevation (feet, above msl)	766	730	718
Full Pool Elevation (feet, above msl)	741	705	693
Operating Range (feet, above msl)	480-741	480-705	460-693
Dam Freeboard (feet)[1]	25	25	25
Dam Height above Streambed at Downstream Toe (feet)	325	275	320
Dam Height above foundation (feet)	363	327	349
Dam Core Elevation (feet, above msl)	763	727	714
Dam Crest length (feet)	1,740	1,350	2,260
Dam Crest width (feet)	40	40	40
Dam Core Crest Width (feet)	10	10	10
Foundation Excavation (CY)	3,087,500[2]	2,477,500[2]	4,420,000
Earthfill (CY)	8,937,000	6,782,000	13,100,000
Core Material (CY)	1,650,000	1,270,000	2,700,000
Filter and Drain (CY)	872,000	780,000	932,000

Notes:

[1] As defined by DSOD, freeboard is the vertical distance from the spillway crest to the dam crest. The objective of freeboard is to prevent overtopping of the dam under extreme conditions.

[2] For Alternatives A and B, foundation excavation quantities reflect excavation quantities required for both the dam foundation and spillway.

Key:
CY = cubic yard

Key:
mean sea level
TAF = thousand acre-feet

Table 3-7. Physical Features of Expanded Reservoir for Alternatives A, B, and D

Item	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
Reservoir Volume at Full Pool (acre-feet)	140,300	96,500	141,200
Dead Pool Volume[1] (acre-feet)	400	400	1,500
Active Storage Volume[2,3] (acre-feet)	139,900	96,100	139,700
Surface Area at Full Pool (acres)	1,367	1,072	1,381
Shoreline of expanded reservoir (miles)	35.2	30.2	34.7

Notes:
[1] Dead or inactive storage refers to water in the reservoir that cannot be drained by gravity through the dam's outlet works.
[2] Active storage volume determined by the difference between reservoir volume at full pool and dead pool volume.
[3] Storage values may not total due to rounding.

Key:
TAF = thousand acre-feet

3.2.2 Spillway

All action alternatives include the construction of a new spillway associated with the new dam to facilitate releases from the expanded reservoir. There are two spillway types, each specific to the dam type, either hardfill or earthfill. The spillways are designed to accommodate the Probable Maximum Flood (PMF) with sufficient residual freeboard[6].

3.2.2.1 Hardfill Dam Spillways

The Proposed Project and Alternative C would include an 130-feet wide uncontrolled ogee spillway (a type of spillway designed with a downstream shape to correspond with free falling water) with a rectangular cross section incorporated into the hardfill dam structure and positioned near the center of the dam to guide discharge directly into the stilling basin and downstream channel. Spillway features would include a chute on the downstream face of the dam and a stilling basin at the downstream toe of the dam. Downstream of the stilling basin, spillway discharges would be conveyed through a riprap lined return channel into the restored North Fork Pacheco Creek channel (see Section 3.2.5.2). All concrete features of the spillway would be constructed with conventional reinforced concrete. As described in Section 3.2.7.2, a new road would be constructed to allow permanent access to the dam and spillway at either location. The road would be located along the dam's crest and a bridge would be built over the spillway. Table 3-8 summarizes the physical features of the spillways associated with the hardfill dams for the Proposed Project and Alternative C.

[6] Residual freeboard is the vertical clearance available between the water surface and the top of the dam.

Table 3-8. Physical Features for Hardfill Dam Spillways for the Proposed Project and Alternative C

Item	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir
Spillway Crest Elevation (feet, msl)	741	693
Spillway Length (feet)	440	440
Spillway Width (feet)	130	130
Peak PMF Outflow (cfs)	34,240[1]	34,240[1]
Peak PMF Surcharge (feet)	17.8	17.8
Wind/Wave Runup + setup (with 95% confidence)[2] (feet)	1.5	1.5
Spillway Freeboard (feet)	4.2	4.2

Notes:
[1] This is based on a discharge coefficient of 3.5 and spillway width of 130 feet.
[2] This is based on wind data compiled for Anderson Reservoir from Gilroy and Morgan Hill CIMIS gauges based on annual maximum wind speeds regardless of direction.

Key:
CIMIS = California Irrigation Management Information System
msl = mean sea level
PMF = probable maximum flood
TAF = thousand acre-feet

3.2.2.2 Earthfill Dam Spillways

Alternatives A, B, and D would include an uncontrolled ogee spillway with a rectangular cross section. The spillway features include an approach channel, an ogee crest weir, a discharge chute, and a stilling basin, all constructed of reinforced concrete and founded on bedrock. The spillway entrance would include an ogee weir that would transition to a spillway chute comprised of gradual slope, drop, and steep slope sections, and a United States Bureau of Reclamation (USBR) Type II stilling basin to dissipate energy. Downstream of the stilling basin, spillway discharges would be conveyed through a riprap lined return channel into the restored North Fork Pacheco Creek channel. For Alternatives A and B, the spillway would be located adjacent to the west abutment of the proposed earthfill dam. For Alternative D, the spillway would be located adjacent to the east abutment of the proposed earthfill dam. To accommodate the spillway crest and entrance near each alternative's respective abutment (west abutment for Alternatives A and B, east abutment for Alternative D), a roller-compacted concrete block would be constructed. The spillway would be formed from a 4-foot-thick concrete slab with reinforced walls tied structurally into the spillway slab or anchored into mass concrete. The physical features and quantities for the earthfill dam spillways associated with Alternatives A, B, and D are summarized in Table 3-9.

Table 3-9. Physical Features and Quantities for Earthfill Dam Spillways for Alternatives A, B, and D

Item	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
Spillway Crest Elevation (feet, msl)	741	705	693
Spillway Length (feet)	1,450	1,350	2,600
Spillway Width (feet)	130	130	85
Rock Excavation (CY)	-[6]	-[6]	422,000
Earth Excavation (CY)	-[6]	-[6]	685,000
Structural Reinforced Concrete (CY)	2,600	2,600	39,000[5]
Mass Concrete (CY)	7,050	8,200	42,000
Peak PMF Outflow (cfs)	34,240[2]	36,890[2]	33,950[1]
Peak PMF Surcharge (feet)	17.8	18.7	22.5
Wind/Wave Runup + setup (with 95% confidence)[3] (feet)	1.5	<= 1.5[4]	2.2
Spillway Freeboard (feet)	4.2	3.3	2.5

Notes:
[1] This is based on a spillway width of 85 feet.
[2] This is based on a discharge coefficient of 3.5 and a spillway width of 130 feet.
[3] This is based on wind data compiled for Anderson Reservoir from Gilroy and Morgan Hill CIMIS gauges based on annual maximum wind speeds regardless of direction.
[4] Runup/setup calculations were not performed for the 96 TAF reservoir at upstream site, but they would be approximately the same or slightly less than the values calculated for the 140 TAF reservoir.
[5] Alternative D requires construction of tie-back retaining walls upslope of the spillway. Spillway quantities reflect concrete volumes for both spillway and tie-back retaining walls.
[6] Spillway excavation quantities for Alternatives A and B are included in Table 3-6 under “Foundation Excavation” row.

Key:
cfs = cubic feet per second
CIMIS = California Irrigation Management Information System
CY = cubic yard
msl = mean sea level
PMF = probable maximum flood
TAF = thousand acre-feet

The spillway designs for Alternatives A, B, and D are similar. For Alternatives A and B, both spillways are designed with a 130-foot-wide crest. The spillway and chute would have a uniform width and terminate in a stilling basin that would dissipate the energy during high discharge events. The side channel spillway entrance would include an ogee weir. After leaving the stilling basin, spillway discharges would be conveyed through a riprap-lined outlet channel into the North Fork Pacheco Creek channel.

For Alternative D, the spillway crest would be an 85-foot-long ogee weir. The spillway chute would be a rectangular cross section beginning at 85 feet wide, and gradually narrowing to 60 feet wide. To accommodate the spillway crest and entrance near the east abutment of the dam, a mass concrete gravity wall would be constructed. Near the dam crest, a mass concrete gravity wall would serve as the right wall of the spillway channel. Tie-back retaining walls would be used to buttress historic landslides along the top left side of the spillway. A stilling basin would dissipate the energy during high discharge events. After leaving the stilling basin, spillway discharges would be conveyed through a riprap-lined outlet channel into the restored Pacheco

Creek channel. For Alternative D, most of the spillway and approach channel would be excavated within landslide materials and sandstone/siltstone.

3.2.3 Inlet/Outlet Works

The inlet/outlet works for both the hardfill and earthfill dams would consist of the following structures:

- an intake system (integrated into dam for hardfill, separate control shaft tower structure for earthfill) with three adits (welded steel pipes installed in tunnels) at varying elevations and a low-flow bypass intake located upstream of the dam,
- an outlet tunnel containing a low-flow bypass pipeline and an outlet conduit, and
- an outlet/bifurcation structure.

These structures would facilitate bi-directional water transfers to and from the Pacheco Conduit via the conveyance pipeline and pump station, and provide emergency evacuation discharges and targeted releases to North Fork Pacheco Creek.

3.2.3.1 Sizing of Inlet/Outlet Works

The inlet/outlet works components and facilities were designed for both normal operation and to meet reservoir evacuation requirements per DSOD guidelines (DWR 2018). Under normal operating conditions, the inlet/outlet facility would convey up to 490 cfs to/from Pacheco Conduit and simultaneously release up to 50 cfs to North Fork Pacheco Creek. The maximum combined release from the adits and outlet conduit to the creek would be 1,500 cfs, achieved by limiting water velocity in the conduit to a maximum of 7 feet per second to reduce prolonged exposure to high water velocities that could damage components (e.g., cavitation, abrasion). The outlet facilities were also designed to have sufficient capacity to evacuate the reservoir quickly should an unsafe condition develop at the dam (e.g., emergency drawdown of reservoir). The DSOD guidelines for emergency drawdown rate for large reservoirs are based on a dam having the capability to: (1) lower the reservoir elevation by an amount equal to 10 percent of the hydraulic head behind the dam in 7 days (hydraulic head is defined as the elevation difference between the normal maximum water surface and the dead pool water surface); and (2) evacuate the reservoir to dead pool elevation within 120 days. Under emergency drawdown conditions, the adits and outlet conduit could exceed maximum water velocity criteria and release up to 3,000 cfs.

3.2.3.2 Inlet/Outlet Works for Hardfill Dam

For the upstream and downstream hardfill dams (Proposed Project and Alternative C), the inlet/outlet works would be integrated into the hardfill dam structure. The inlet/outlet works would consist of an intake tower, a concrete-encased steel-lined pressure outlet conduit, three adits on the upstream slope of the dam, a bypass intake and pipeline, a drain, and an outlet/bifurcation structure. To enhance dissolved oxygen in the lower portion of the reservoir, when needed, a hypolimnetic aeration system would be located near the lower adit inlet. The concrete-encased steel-lined pressure outlet conduit would be located east of the spillway and cast through the bottom of the dam. All concrete features of the inlet/outlet works would be constructed with conventional reinforced concrete. The emergency outlet and bypass control valves would be positioned to discharge into an armored spillway outlet channel.

For the Proposed Project and Alternative C, the inlet/outlet works intake tower and adits would be located within a portion of the dam east of the spillway. The three adits would be installed through the upstream face of the dam and would connect to a standpipe in the intake tower at different elevations as shown in Table 3-10. Valves at the connection of the adits to the standpipe would allow flow in and out of the reservoir at the different elevations. The outlet conduit would connect to the bottom of the standpipe in the intake tower, and would extend through the downstream portion of the dam, approximately 400 feet to a connection to the outlet/bifurcation structure. The outlet conduit and adits would have bi-directional flow depending on the reservoir release and fill operational scenarios, and they would be used for emergency reservoir evacuation and transfers of water in and out of the Pacheco Conduit.

Table 3-10. Physical Features and Quantities for Hardfill Dam Inlet/Outlet Works for the Proposed Project and Alternative C

Item	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir
Adits - Number/Size	3, 72 inch	3, 72 inch
Low-Flow Bypass – Number/Size	1, 36 inch	1, 36 inch
Maximum Emergency Release (cfs)	3,000	3,000
Maximum Normal Operating Release (cfs)	1,500	1,500
Adit Elevations (feet, msl)	480, 570, 660	460, 530, 600
Bypass Intake Elevation (feet, msl)	480	460

Key:
cfs = cubic feet per second
msl = mean sea level
TAF = thousand acre-feet

The outlet conduit would bifurcate in the outlet/bifurcation structure via a wye branch encased in a concrete thrust block. One branch would extend towards North Fork Pacheco Creek for emergency releases and the other branch, the conveyance pipeline, would extend downstream to the pump station and further to the tie-in with Pacheco Conduit. The thrust block would be configured to carry the hydraulic loading in the wye branch and would also provide axial restraint to the outlet conduit from the closed valve thrust. Discharges from the outlet conduit and low-flow bypass pipeline would be controlled by an 84-inch valve and a 20-inch valve, respectively, and be conveyed to the restored North Fork Pacheco Creek channel via a riprap lined swale.

The low-flow bypass intake and low-flow bypass pipeline would be installed for low flow releases to North Fork Pacheco Creek. The low-flow bypass pipeline would extend from the bypass intake, through the body of the dam, to the outlet/bifurcation structure, where bypass flows would be discharged to North Fork Pacheco Creek. The bypass intake would be located upstream of the adits approximately 600 feet northwest of the intake tower, a location that would minimize drawing imported water into the bypass intake that had recently been released into the reservoir. The low-flow bypass intake would be a reinforced concrete structure with a trash rack. The low-flow bypass pipeline would be located parallel to the outlet conduit as it passes underneath the dam. An isolation valve installed on the low-flow bypass pipeline would be accessed via the intake tower and would allow the low-flow bypass pipeline to be isolated at the intake tower and dewatered. An air vacuum valve would be required for the intake tower to minimize potential for damage to the low-flow bypass pipeline during dewatering operations due to a vacuum condition. It is assumed that no special-status fish species would be present in the expanded reservoir, and therefore, no fish protection is required.[7]

The outlet/bifurcation structure would be a reinforced concrete structure that serves the following purposes: a) discharge point for emergency releases to North Fork Pacheco Creek, b) discharge point for bypass flows to North Fork Pacheco Creek, c) inter-connection between the outlet conduit and low-flow bypass pipeline, and d) connection to the conveyance pipeline. While the low-flow bypass pipeline could be operated separately from the outlet conduit, the interconnection in the outlet/bifurcation structure would provide additional operational flexibility and allow releases to the creek to be pulled from the low-flow bypass pipeline, or one of the adits as long as water was not being pumped into the reservoir.

3.2.3.3 Inlet/Outlet Works for Earthfill Dam

The general design of the inlet/outlet works described in this section is similar for Alternatives A, B, and D; although, the inlet/outlet works for Alternative D (downstream dam site) would be located on the east abutment, whereas the inlet/outlet works for Alternatives A and B (upstream dam site) would be on the west abutment.

The inlet/outlet works for the earthfill dam would consist of the following components, each of which are described in more detail below:

- Intake control shaft structure and adits
- A 114-inch-internal-diameter welded steel outlet conduit, installed in a horseshoe inlet/outlet tunnel backfilled with concrete.
- A 36-inch, welded steel low-flow bypass pipeline, installed in a horseshoe inlet/outlet tunnel backfilled with concrete.
- Outlet/bifurcation structure

The intake control shaft structure for the inlet/outlet works would consist of a single 32-foot-inner-diameter vertical shaft containing a 114-inch-diameter welded steel standpipe. The intake system would consist of three 72-inch adits that extend horizontally from the standpipe at varying elevations for filling and drawing from the reservoir. To enhance dissolved oxygen in the lower portion of the reservoir, when needed, a hypolimnetic aeration system would be located near the lower adit inlet. Near the bottom of the shaft, a 12.5-foot-internal-diameter horseshoe shaped connector tunnel would contain a 114-inch-diameter steel pipe connecting the standpipe to the outlet conduit. The outlet conduit would be a 114-inch-diameter welded steel liner, extending from the intake control shaft to the outlet/bifurcation structure (housed in inlet/outlet tunnel). The outlet conduit and adits would have bi-directional flow depending on the reservoir release and fill operational scenarios, and they would be used for emergency reservoir evacuation and transfers of water in and out of the Pacheco Conduit. Physical features and quantities for the earthfill dam inlet/outlet works for Alternatives A, B, and D are summarized below in Table 3-11.

[7] Currently, no special-status fish species reside in the existing Pacheco Reservoir. Expansion of the Pacheco Reservoir under any action alternative would not introduce special status fish species to the expanded reservoir.

Table 3-11. Physical Features and Quantities for Earthfill Dam Inlet/Outlet Works for Alternatives A, B, and D

Item	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
Adits -Number/Size	3, 72 inch	3, 72 inch	3, 72 inch
Low-Flow Bypass – Number/Size	1, 36 inch	1, 36 inch	1, 36 inch
Maximum Emergency Release (cfs)	3,000	3,000	3,000
Maximum Normal Operating Release (cfs)	1,500	1,500	1,500
Adit Elevations (feet, msl)	480, 570, 660	480, 552, 624	460, 530, 600
Bypass Intake Elevation (feet, msl)	480	480	460
Intake Control Shaft Structure Excavation Depth (feet)	230	230	330
Outlet Tunnel Length (feet)	2,500	2,500	3,300
Low-Level Bypass Open-Cut Pipeline Length (feet)	700	700	300

Key:
cfs = cubic feet per second
msl = mean sea level
TAF = thousand acre-feet

A 16-foot-internal-diameter horseshoe inlet/outlet tunnel would extend from the upstream tunnel portal at the bypass intake to the downstream outlet tunnel portal. This inlet/outlet tunnel would house both the outlet conduit (from the connection point with connector tunnel at the intake control shaft structure) and a 36-inch-diameter welded steel, low-flow bypass pipeline. The bypass intake and bypass pipeline would provide low flow releases to North Fork Pacheco Creek. The low-flow bypass pipeline intake would be located upstream from the adits, a location that would minimize drawing imported water into the bypass intake that had recently been released into the reservoir. It is assumed that no special-status fish species would be present in the expanded reservoir, and therefore, no fish protection is required. A hydraulic valve would allow the low-flow bypass pipeline to be isolated at the inlet and dewatered. An air vacuum valve would be required for the bypass intake to mitigate potential damage to the low-flow bypass pipeline during dewatering operations due to a vacuum condition.

The 16-foot-internal-diameter horseshoe outlet tunnel would be excavated through bedrock and be constructed under the respective dam abutment (east abutment for Alternatives A and B, west abutment for Alternative D) to pass diversion flows during construction and to house the permanent outlet conduit and low-flow bypass pipeline. During construction of the dam and prior to operation, the tunnel would be supported and sized to convey flows up to a 100-year flood event. After construction of the dam, the outlet tunnel would be backfilled with concrete around the low-flow bypass pipeline upstream of the intake control shaft, and around the low-flow bypass pipeline and the outlet conduit downstream of the intake control shaft.

The outlet/bifurcation structure would be a reinforced concrete structure that serves the following purposes: a) discharge point for emergency releases to North Fork Pacheco Creek, b) discharge point for bypass flows to North Fork Pacheco Creek, c) inter-connection between the outlet conduit and low-flow bypass pipeline, and d) connection to the conveyance pipeline. While the low-flow bypass pipeline could be operated separately from the outlet conduit, the interconnection in the outlet/bifurcation structure would provide additional operational flexibility and allow releases to the creek to be pulled from the low-flow bypass pipeline, or one of the adits as long as water was not being pumped into the reservoir.

The outlet conduit would bifurcate in the outlet/bifurcation structure via a wye branch encased in a concrete thrust block. One branch would extend towards North Fork Pacheco Creek for emergency releases and the other branch, the conveyance pipeline, would extend downstream to the pump station and further to the tee with the Pacheco Conduit. The thrust block would be configured to carry the hydraulic loading in the wye branch and would also provide axial restraint to the outlet conduit from the closed valve thrust. Discharges from the outlet conduit and bypass system would be controlled via an 84-inch valve and 20-inch valve, respectively, and be conveyed to North Fork Pacheco Creek via a riprap lined swale.

3.2.4 Water Conveyance Between Expanded Reservoir and Existing Pacheco Conduit

All action alternatives include water conveyance facilities, including a pipeline and pump station, to allow for the transfer of water between the expanded reservoir and Pacheco Conduit. Water supplies from San Luis Reservoir would be conveyed via Pacheco Conduit and then through the new conveyance pipeline and pump station to the expanded reservoir. Water supplies from the expanded reservoir would also be conveyed through the new pipeline and pump station to Pacheco Conduit for delivery to Valley Water and/or SBCWD (see Section 3.4 for additional information on operations). Pacheco Conduit currently conveys water from San Luis Reservoir to Santa Clara and San Benito Counties. Table 3-12 summarizes the physical features of the conveyance pipeline and pump station associated with the action alternatives. For each action alternative, the conveyance pipeline would extend from the outlet/bifurcation structure downstream to the pump station and further to the new Pacheco Conduit tie-in point. Exhibits 7 through 11 in Attachment A illustrate the conveyance pipeline alignments for the Proposed Project and Alternatives A through D, respectively.

The conveyance pipeline would be a single 114-inch-internal-diameter, welded steel pipeline with a capacity of 490 cfs (matching the existing Pacheco Conduit capacity) that would connect Pacheco Conduit to the new pump station and reservoir. This conveyance pipeline would allow for delivery of imported water from Pacheco Conduit to the expanded reservoir for future release and would also provide for reservoir releases to Pacheco Conduit. This pipeline would be approximately 10,800 feet long for the Proposed Project, 10,300 feet long for Alternatives A and B, 5,200 feet long for Alternative C, and 4,500 feet long for Alternative D. The conveyance pipeline would include permanent structures for appurtenances, such as air/vacuum valves, drains, and blowoffs.

For each action alternative, the conveyance pipeline would tie into Pacheco Conduit southeast of the existing North Fork Dam site, approximately 400 feet south of SR 152. The connection would be made with a tee and two new 120-inch motorized valves on Pacheco Conduit, upstream and downstream of the tie-in point. A similar valve would be placed on the new conveyance pipeline. All valves would be housed in a vault structure with removable roof sections for maintenance. Approximately 910 feet of the existing prestressed concrete cylindrical Pacheco Conduit would be removed and replaced with a single 114-inch-internal-diameter, welded steel pipe at the tie-in point. The length of the pipe to be removed and replaced (i.e., 910 feet) was calculated based on the thrust at the tie-in to the existing conduit. Two motorized butterfly valves, each with a 12-inch bypass, would be located on the existing conduit upstream and downstream of the tie-in point.

Table 3-12. Physical Features of Water Conveyance Pipeline and Pump Station for the Proposed Project and Alternatives A Through D

Item	Proposed Project and Alternatives A and B	Alternatives C and D
Water Conveyance Pipeline		
Length (feet)	Proposed Project: 10,800 Alternatives A and B: 10,300	Alternative C: 5,200 Alternative D: 4,500
Diameter (inches)	114	114
Pump Station		
Distance Downstream from New Dam (miles)	1.2	1
Maximum Flow (cfs)	490	490
Flow Direction	Two-way, both to and from the reservoir	Two-way, both to and from the reservoir
Pumps – Number/Type	6 two-stage pumps 3 single stage pumps	6 two-stage pumps 3 single stage pumps
Pumps –Total Horsepower	17,500	17,500
Pump Station Facilities Footprint (acres)	3.5	3.5
Ground Surface Elevation at Pump Station (feet, above msl)	450	410
100-year storm event water surface elevation (feet, above msl)	424.5	404.1

Key:
cfs = cubic feet per second
msl = mean sea level

The majority of the new pipeline would be installed via traditional open-trench methods with the exception of the segment under Pacheco Creek and SR 152, which would be installed via tunneling. Approximately 350 linear feet of tunneling would be required for all action alternatives. The new pipeline crossing under Pacheco Creek and SR152 would be concrete encased in accordance with Caltrans guidelines.

3.2.4.1 Pump Station

All action alternatives include the construction of a new two-way pump station to pump water into and out of the expanded reservoir via the conveyance pipeline. At the connection point to Pacheco Conduit the maximum hydraulic head would be approximately 638 feet. When taking into account the operating ranges of the proposed reservoirs, this would require a “two-way” system operating both by gravity and through a pump station in order to pull water from the reservoir or put water into the reservoir, depending on reservoir water level and operating conditions.

The pump station would contain several isolation valves and pressure reduction valves to allow bi-directional operation. Isolation valves would enable the pump station to deliver water to, or pump water from, the reservoir. Pressure-reducing valves would reduce excess pressure head under certain gravity-flow conditions when needed, and is bypassed at all other times. Additionally, pressure relief valves and surge control would be required to prevent over-pressurization of Pacheco Conduit. To provide facility security and minimize noise levels in the surrounding area, the pumps would be housed in a building constructed of fire retardant materials. An overhead gantry crane would be provided for pump maintenance. Buried valves would be enclosed in vault structures to allow for inspection and maintenance requirements. A flow meter would be installed near the pump station to measure bi-directional flow. To minimize noise levels generated by the pump station, under Alternatives C and D due to proximity to sensitive noise receptors, the pump station would be completely enclosed or shielded with a solid barrier, providing, at a minimum, an 8-dBA reduction of noise levels.

The new pump station would need to meet a wide range of lift and flow requirements, including the need to accommodate flows up to 490 cfs. The single pump station is proposed to contain six, two-stage vertical turbine pumps (five pumps in operation plus one standby) and three single-stage vertical turbine pumps (two pumps in operation and one in standby). Two-stage pump motors are approximately 3,500 horsepower (HP) each for a total maximum operating load of 17,500 hp.

For the alternatives associated with the upstream dam site (Proposed Project and Alternatives A and B) as shown in Exhibits 7, 8 and 9 in Attachment A, respectively, the pump station would be located 1.2 miles downstream of the new dam at an elevation of approximately 450 feet above mean sea level. The pump station and associated facilities would have an approximate footprint of 420 feet by 360 feet (3.5 acres), including the pump station building, parking areas, and electrical substation. For Alternatives C and D, as shown in Exhibits 10 and 11 in Attachment A, respectively, the pump station would be downstream of the existing North Fork Dam, approximately 1 mile downstream of the new dam, with a similar 3.5-acre footprint to alternatives with upstream dam sites, and installed on a pad at an elevation of 410 feet above mean sea level. Table 3-12 summarizes the physical features of the pump station associated with the Proposed Project and Alternatives A through D.

3.2.5 Existing North Fork Dam Decommissioning and Channel Restoration

All action alternatives would include decommissioning the existing North Fork Dam and appurtenant facilities, and restoration of the historic channel within the inundation area of the existing reservoir between the new dam site (per alternative) and the existing dam site. Flows entering the restored channel would leave the expanded reservoir in the form of outlet-released flows to North Fork Pacheco Creek (as either emergency releases or bypass flows) or spillway The existing North Fork Dam, its facilities, decommissioning, and channel restoration are described below.

3.2.5.1 Existing North Fork Dam Decommissioning

Under all action alternatives, the existing North Fork Dam and appurtenant facilities would be decommissioned.[8] The embankment of the dam would be removed down to an elevation of approximately 390 feet above msl. The excavation would extend into both abutments until native materials were encountered, with the exception of embankment fill in the core trench which would be left in place and would be integrated with the channel restoration described in the below section.

The existing inlet and outlet structures would be demolished and removed from the site, while the outlet pipe would be abandoned in place (i.e., filled with grout). The concrete lining of the spillway and the concrete facing on the upstream slope of the dam would be demolished and removed from the site, and the scour pool downstream of the existing spillway would be filled and regraded to facilitate passage of aquatic organisms (e.g., fish) and convey flows released from the new dam associated with each action alternative. Additional earthwork would be done where necessary to restore and stabilize the side slopes along the spillway, and native plantings

[8] Decommissioning of a dam generally involves the removal or partial removal of the main dam to allow for stream or river flow through the historic channel. In addition, other appurtenant facilities such as the spillway, and inlet/outlet works would be demolished/removed, or abandoned-in-place (e.g., filling an existing pipe with concrete or other suitable material and left in place).

would be placed within the inundation area of the existing reservoir. Both bridges at the toe of the dam would be demolished and removed from the site. For Alternative D, the conveyance pipeline would be constructed across North Fork Pacheco Creek in the area where the existing dam would be decommissioned, as shown in Exhibit 11 in Attachment A.

3.2.5.2 Channel Restoration

Under all action alternatives, the historic channel of North Fork Pacheco Creek within the inundation area of the existing reservoir would be restored between the existing North Fork Dam and the downstream end of the spillway return channel and outlet works return channel of the new dam associated with each action alternative. This channel restoration process would involve the development of three channels downstream of the new dam to route reservoir outflows into North Fork Pacheco Creek, including:

- Spillway return channel to restoration channel
- Outlet works return channel to restoration channel
- Restoration channel between new dam site (either upstream or downstream site) and downstream of the existing dam site (immediately downstream and inclusive of the scour pool below the existing dam spillway)

The first channel would extend the return channel for the spillway and connect further downstream to the start of the restoration channel. The second channel would be an outlet works return channel that would convey emergency releases from the outlet works/bifurcation structure to the restoration channel downstream. The outlet works return channel would be a trapezoidal channel lined with riprap designed to convey up to 3,000 cfs from the outlet works/bifurcation structure during emergency drawdown operations. The low-flow bypass pipeline would extend downstream from the outlet works/bifurcation structure, adjacent to the outlet works return channel, to convey flow schedule releases directly into the restoration channel.

The third channel would be a restoration channel that would begin at the confluence of the spillway return channel and the outlet works return channel. The restoration channel would extend to a point downstream of the existing North Fork Dam (i.e., downstream of scour pool of existing spillway), and restore the historical North Fork Pacheco Creek channel (i.e., the portion inundated by the existing Pacheco Reservoir and North Fork Dam). To mimic the general form and geomorphological features of North Fork Pacheco Creek, the restoration channel would generally be aligned with the historic channel and designed as a meandering channel with locally varying width, depth, gradient, and substrate types along its course. The restoration channel would convey typical daily flows (e.g., baseflow and pulse flow releases) between the channel banks, and would incorporate woody debris, boulders, cobbles, and/or rootwads to create natural velocity breaks, dissipate flows, and support habitat complexity. Generally, the restoration channel would be aligned to the historical channel low elevation points, which in some locations would require removal of sediment accumulated since construction of the existing North Fork Dam within portions of the historic channel. Where sediment accumulations necessitate, excavation of floodplains capable of functioning at a range of flood flows would occur. During high flow events (e.g., spills, emergency releases, and environmental pulse flows), these historic and/or constructed floodplains would allow flows to spread out, establishing hydrologic connectivity and promoting growth of riparian vegetation communities like those occurring upstream along North Fork Pacheco Creek (e.g., mixed riparian woodland along the banks of the primary channel, sycamore alluvial woodland along secondary channels and low floodplain terraces, and oak woodlands around the periphery of the riparian zone). As shown in Table 3-13, the total length of restored channel would vary by alternative depending on dam site location and dam type.

Table 3-13. Restoration Channel Characteristics for the Proposed Project and Alternatives A Through D

Item	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
SCCC Steelhead Life Stage Focus for Restoration Channel	Spawning and Rearing Habitat	Rearing Habitat Only	Rearing Habitat Only	Spawning and Rearing Habitat	Rearing Habitat Only
Approximate Restoration Channel Length[1] (miles)	1.8	1.4	1.4	0.5	0.3

Notes:
[1] Restoration channel length estimated along historic North Fork Pacheco Creek alignment between spillway associated with new dam (including approximately 450-foot-long spillway return channel) to downstream of scour pool of existing dam and spillway.

Key:
SCCC = South-Central California Coast

For all action alternatives, the creek channel would be restored by developing and implementing a stable geomorphic channel design that would include riffle-pool-run habitat patterning, designed to neither aggrade nor degrade, for the entire length of the restored creek section. The slope and habitat patterning would be similar to channel sections along North Fork Pacheco Creek immediately upstream of the existing reservoir and along South Fork Pacheco Creek. Habitat structures would be designed with maximum drop heights to ensure passage by adult and juvenile steelhead. Bank stabilizing materials would limit streambank erosion, and native riparian vegetation, including willows and sycamores, would be planted along the banks of the restoration channel to initiate growth of a new riparian canopy. Native plantings in the historic and/or constructed floodplains would be made to stabilize floodplains, provide hydraulic resistance to overbank flow, and limit erosion. Stream bank protection may be required along limited segments of the restored channel on the left bank (eastern bank) adjacent to proposed facilities (e.g., permanent access road, pipeline, and pump station associated with the Proposed Project and Alternatives A and B). Bank protection measures would be determined during design and may consist of buried log toe protection or buried rock rip rap to prevent channel scour and erosion from encroaching on new or existing infrastructure.

For the Proposed Project and Alternatives A through D, the restoration channel would be designed to provide suitable habitat for one or more life stages of SCCC steelhead in Pacheco Creek:

- The Proposed Project and Alternative C, which maintain a minimum 8 cfs baseflow in North Fork Pacheco Creek (see Section 3.4.1 for additional detail on reservoir operations) would focus on providing both spawning and rearing habitat for SCCC steelhead. The Proposed Project and Alternative C would incorporate placement of appropriate gravels to facilitate SCCC steelhead spawning. Gravel would be obtained, potentially sourced from on-site, as uncrushed, rounded river rock, free of debris and organic material. To maximize the benefit to SCCC steelhead, gravel would be washed and sorted to meet specific size criteria. If gravel is not available from on-site sources, it would be obtained from a commercial source.

- Alternatives A, B, and D, which maintain a minimum 2 cfs baseflow in North Fork Pacheco Creek, would focus on providing rearing habitat for SCCC steelhead (see Section 3.4.1 for additional information on flow releases to Pacheco Creek). To keep adult SCCC steelhead from entering the restored channel and spawning during winter months when flows are subject to high variation, a physical barrier may be placed and operated (seasonally) on North Fork Pacheco Creek near the confluence with South Fork Pacheco Creek.

3.2.6 Utilities

Under all action alternatives, new electrical/power, water and wastewater facilities would be developed. In addition, existing utilities affected by construction activities would also be relocated.

3.2.6.1 New Electrical Substation and Power Transmission Lines

Under all action alternatives, a new 70 kilovolt (kV)/4.16 kV substation rated at 13.44/17.92 megavolt ampere (MVA), and a new 70 kV overhead single transmission line circuit would be constructed and operated to provide power to the dam and appurtenant facilities and water conveyance facilities, including the pump station and outlet works. The electrical transmission lines ties into an existing Pacific Gas and Electric Company (PG&E) transmission line about 4 miles east of the new reservoir, which is the closest location with available capacity about equal to that required to operate the pumps and other facilities. Table 3-14 summarizes the physical features and quantities of the new electrical and power facilities associated with the Proposed Project and Alternatives A through D.

Electrical Substation

Under all n alternatives, a new electrical substation rated at 13.44/17.92 MVA would be constructed and operated adjacent to the pump station. The substation would provide power needed to operate the pumps, valves, and all other power requirements associated with proposed facilities. For the Proposed Project and Alternatives A through D, the substation would be located within the pump station footprint, respective of the action alternative. Exhibits 7 through 11 show the pump station location for the Proposed Project and Alternatives A through D, respectively. For all action alternatives, the electrical substation would include a control building to house the equipment required for proper functioning of the facility, such as switchgear, control and relay panels, supervisory control and data acquisition (SCADA) equipment, battery, battery charger and similar equipment.

Table 3-14. Physical Features and Quantities of the New Electrical and Power Facilities Associated with the Proposed Project and Alternatives A Through D

Item	Proposed Project and Alternatives A and B (Upstream)	Alternatives C and D (Downstream)
Electrical Substation		
Rated Load (MVA)	13.44/17.92	13.44/17.92
70 KV Transmission Line		
Length (miles)	4.1	4.6
Number of Poles	26	29
Height of Poles above Ground Surface (feet)	90-120	90-120
Total Cut/Fill for Pole Foundations, Pole/Transmission Line Work Areas and Staging Area/Landing Zone (CY)	36,200	37,900
Imported Fill for Staging Area/Landing Zone (CY)	17,000	17,000

Key:
CY = cubic yard
KV = kilovolts
MVA = megavolt ampere

70 kV Power Transmission Lines

Under all action alternatives, the new substation would require an intertie to an existing PG&E transmission line for power supply. The intertie is proposed to be located at or about Fifield Road/Dinosaur Point Road and north of SR 152. The transmission line alignment would begin at the eastern PG&E 70kV intertie connection point located off of Fifield Road and terminate at either the upstream substation location for the Proposed Project and Alternatives A and B, or the downstream substation location for Alternatives C and D. The transmission line alignments and pole locations for the Proposed Project and Alternatives A through D are shown in Exhibits 2 through 6 in Attachment A, respectively.

The transmission line routes would essentially run as a “straight line” due west from the PG&E 70kV intertie location to the substation termination point as described above (4.1 miles of line to the substation for the upstream alternatives, 4.6 miles of line to the substation for the downstream alternatives). The length of the transmission line would require 26 poles to implement the route from the PG&E intertie point to the upstream substation, and 29 poles to implement the route from the PG&E intertie point to the downstream substation. A 70-foot right-of-way along the transmission line alignment would facilitate operation and maintenance activities.

Engineered tubular steel poles, manufactured to resist corrosion with an average weight of 15,000 pounds, would be directly embedded in the ground. The height of the poles would range from 90 feet to 120 feet above the ground surface and are estimated to have a 4-foot-pole-diameter at their base. At each pole location, a 50-foot by 100-foot area would be graded to provide a level work area to facilitate pole installation and pulling/tensioning of the transmission lines. Pole embedment (foundation) depths would be 15 feet. Foundations for the poles would be developed with surrounding soil and/or with concrete or aggregate as backfill. The transmission line poles would support the transmission line conductors and an overhead optical ground wire for static protection and communication requirements between the substation and the PG&E facilities. Each pole would have a cross arm assembly adequately spaced to minimize avian impacts.

Local Distribution Circuits

For all action alternatives, power to localized facilities would be supplied from the substation switchgear and transformed down to a suitable utilization voltage at each load location (valves, lighting, buildings, etc.). The distribution circuits to these loads would be accomplished via underground duct banks using insulated copper cables. In general, the duct banks would be incorporated into the trench for the conveyance pipeline but separated as required. For crossing under SR 152 and Pacheco Creek, the electrical conduits would be installed in a bore, concrete encased in accordance with Caltrans guidelines, and separated at least 6 feet from the tunnel bore for the conveyance pipeline.

Backup Power

For all action alternatives, backup power up to approximately 750 kW for operating critical facilities such as valves, controls systems, lights, and cooling would be provided by a stationary diesel generator located adjacent to the electrical substation. Backup power would be used only during outages and very limited testing periods as part of maintenance activities. Backup power would not be used for operating pumps. Accordingly, backup power would be used on an infrequent basis. Diesel fuel to run the generators for up to 4 days would be stored in a 5,500-gallon tank at the diesel generator location.

3.2.6.2 New Water/Wastewater Facilities

Under all action alternatives, a new well with a capacity up to 10 gallons per minute would be developed near the pump station to provide a source of potable water for workers and visitors to the facility. The well would be drilled to a depth of approximately 500 feet. Wastewater disposal for restroom facilities at the pump station would be provided via a septic tank and leach line assembly.

3.2.6.3 New Telecommunications

For all action alternatives, permanent communications would be required to transmit instrumentation and control data, for security, and for safety of personnel working at the site. The communication system would provide for redundancy (e.g., main system and backup). These new telecommunication facilities would be co-located with other facilities (e.g., water conveyance pipeline, permanent access roads).

3.2.6.4 Relocation of Existing Utilities

Under all action alternatives, existing utilities affected by facilities construction would be relocated. These utilities include a singular telephone pole and sections of buried telephone line that are located immediately north of, and parallel to, SR 152 initiating at Kaiser-Aetna Road and extending east. The telephone pole requiring relocation is located within the footprint of the frontage road described in Section 3.2.7.2 below. Portions of the telephone line requiring relocation are also within the footprint of the frontage road described in Section 3.2.7.2 below. The telephone pole and telephone line would be relocated immediately adjacent to the new frontage road.

3.2.7 Permanent and Temporary Access

All action alternatives include a combination of new permanent and temporary roads and improvements to allow access to the new dam and facilities, nearby properties of existing landowners, and construction areas (e.g., staging, borrow, stockpiling, and disposal areas). Primary vehicular access to the dam site would be provided by an improved SR 152/Kaiser-Aetna Road intersection that would connect to a new permanent frontage road accessed from

Kaiser-Aetna Road. The new frontage road would connect Kaiser-Aetna Road to a series of new permanent roads to provide access for long-term operation and maintenance at the dam and appurtenant facilities. Temporary roads would be constructed to allow for site access during construction. Additionally, a permanent observation trail would be constructed to allow for docent led tours along the restored portion of North Fork Pacheco Creek. The permanent and temporary access facilities are described in greater detail in the subsections below and are summarized as follows:

- SR 152 Access Improvement – Either an improved at-grade crossing, temporary overcrossing, or permanent interchange, all at Kaiser-Aetna Road
- Permanent Access Roads:
    - Frontage and Dam Access Roads – Paved frontage road off Kaiser-Aetna Road, parallel to SR 152, connecting Kaiser-Aetna Road to new paved dam access roads and temporary construction roads
    - Pacheco Conduit Tie-In Access Road – Improved paved driveway off eastbound SR 152 used to access tie-in location of conveyance conduit to existing Pacheco Conduit
    - Auxiliary Access Road – Gravel road off Kaiser-Aetna Road used as an alternate access road to dam sites
    - Property Owner Access Roads – Gravel roads to provide access to the property owners whose existing roads would be affected by inundation from an expanded reservoir
- Temporary Construction Access Roads
- Observation Trail

3.2.7.1 SR 152 Access Improvements

All action alternatives include modifications and improvements to the SR 152/Kaiser-Aetna Road intersection that would facilitate access to the construction site for the new dam and associated facilities. To improve access at the SR 152 and Kaiser-Aetna Road intersection, one of four options is included as part of each action alternative, including two options for at-grade crossings at the SR 152/Kaiser-Aetna Road intersection, a permanent tight diamond interchange at the SR 152/Kaiser-Aetna Road intersection, and a temporary overcrossing at the SR 152/Kaiser-Aetna Road intersection. During construction of any of the four options, the existing at-grade SR 152/Kaiser-Aetna Road crossing would remain in operation and utilized during this time.

Permanent Interchange

The Proposed Project and Alternative D include a permanent, paved tight diamond interchange consistent with Caltrans standards located at the SR 152/Kaiser-Aetna Road intersection, including an overpass over SR 152. The interchange would be connected to a new paved frontage road north of, and parallel to SR 152 to provide access to the dam site during construction and permanently after construction. This permanent interchange would be used both during the construction period and would provide long-term access to the dam and other facilities for operations and maintenance activities. The interchange would be located along a level grade on SR 152 to the west of the existing access to the dam site. The new tight diamond interchange would include a 35.5-foot-wide overpass, on and off-ramps with a 4-foot left shoulder, 12-foot lane, an 8-foot right shoulder, and would accommodate the truck traffic necessary for construction of dam and other facilities. The new tight diamond interchange would also include permanent lighting on the bridge consistent with Caltrans standards. In addition, new gravel access roads would be developed for adjacent property owners. Exhibit 12 in Attachment A provides a schematic of the permanent interchange for SR 152 at Kaiser-Aetna Road and associated roadway improvements.

Temporary Overcrossing

Alternative A would include a temporary overcrossing consistent with Caltrans standards located at the SR 152/Kaiser-Aetna Road intersection. This temporary overcrossing would include a temporary bridge over SR 152 west of the existing SR 152/Kaiser-Aetna Road intersection. The temporary overcrossing would also include temporary lighting on the bridge consistent with Caltrans standards. Exhibit 13 in Attachment A provides a schematic of the temporary overcrossing of SR 152 at Kaiser-Aetna Road and associated roadway improvements. The eastbound and westbound left turn lane (adjacent to the center median) onto Kaiser-Aetna Road and the private driveway would be removed temporarily. As a result, eastbound and westbound traffic would make a right turn, instead of a left turn, at the SR 152/Kaiser-Aetna Road intersection. Westbound traffic turning right at the SR 152/Kaiser-Aetna Road intersection would either continue on Kaiser-Aetna Road to the north, or use the new temporary overcrossing travel up and over the new overpass to the south side of SR 152 towards the adjacent private parcels. Eastbound traffic turning right at the SR 152/Kaiser-Aetna Road intersection would either follow the road towards the adjacent private parcels on the south side of SR 152, or use the new temporary overcrossing to travel over SR 152 and onto Kaiser-Aetna Road. Traffic on Kaiser-Aetna Road would either turn right onto SR 152 if westbound, or use the temporary overcrossing to cross SR 152 and turn right onto SR 152 if eastbound. Following the construction period, the overcrossing would be removed, and the area would be restored similar to existing site conditions.

Temporary At-Grade Crossing – Roundabout

Alternative B would include an at-grade crossing SR 152 at Kaiser-Aetna Road. An at-grade crossing is in place currently at the intersection of SR 152 and Kaiser-Aetna Road, and this crossing would be maintained and improved as part of this alternative. To improve access to the construction areas, the existing left turn movements from SR 152 to Kaiser-Aetna Road would be temporarily closed in both directions and a temporary roundabout/turnaround would be installed in a location south of the SR 152/Kaiser-Aetna Road intersection.

A new temporary two-phase demand actuated traffic signal at the intersection would be installed to further facilitate traffic flow at this location. The existing right turn pockets would remain open at the intersection in both directions and additional deceleration length for these pockets would be provided. The closure of the left turn movements would force only right turns onto Kaiser-Aetna Road from SR 152 and onto SR 152 from Kaiser-Aetna Road. The added roundabout/turnaround and signalized intersection would therefore facilitate traffic through the intersection, to and from the construction sites in the vicinity of the new dam, and to and from the nearby area. Exhibit 14 in Attachment A provides a schematic of the temporary traffic signal and roundabout at SR 152 at Kaiser-Aetna Road and associated roadway improvements.

Table 3-15 summarizes the traffic routing through the intersection during the construction period. Eastbound vehicles on SR 152 destined for the northern portion of Kaiser-Aetna Road to turn right at the intersection, use the temporary roundabout/turnaround in order to pass through the signalized intersection, and cross the highway onto Kaiser-Aetna Road. Westbound SR 152 traffic destined for the south side of Kaiser-Aetna Road would turn right at the intersection and use the north side of Kaiser-Aetna Road as a turnaround, to facilitate crossing of the signalized intersection. Lastly, additional improvements would include pavement delineation, pavement marking, advanced signal warning flashing beacon, and roadside signs. Lighting would also be provided at the at-grade crossing. Following construction, the temporary traffic signal and roundabout would be removed from the intersection, and the area would be restored similar to existing site conditions.

Table 3-15. Traffic Routing at SR 152 and Kaiser-Aetna Road for Alternative B

Vehicles Traveling On	Destination	Method
Eastbound SR 152	North Kaiser-Aetna Road	Right turn at intersection; use roundabout to turnaround and go through signalized intersection.
Westbound SR 152	South Kaiser-Aetna Road	Right turn at intersection; use north side of Kaiser-Aetna Road for turnaround (near Farmer’s Market Road) and go through signalized intersection.
North Kaiser-Aetna Road	Eastbound SR 152	Go through intersection to roundabout/turnaround; use roundabout to turnaround and make right turn onto SR 152.
South Kaiser-Aetna Road	Westbound SR 152	Go through intersection to use north side of Kaiser -Aetna Road for turnaround (near Farmer’s Market Road) and make right turn onto SR 152.

Key:
SR 152 = State Route 152

Temporary At-Grade Crossing – Widening

Under Alternative C, the existing at-grade crossing of SR 152 and Kaiser-Aetna Road would be temporarily improved consistent with Caltrans standards during the construction period. Improvements would include the addition of a full phase traffic signal and lane widening of SR 152. To improve access to the construction sites for the dam and other facilities located north of SR 152 during construction, SR 152 would be widened from two to three lanes in the vicinity of the highway’s intersection with Kaiser-Aetna Road in both the eastbound and westbound directions to accommodate the dam construction truck and auto vehicle demand. The new lanes would extend variable lengths, respective of their direction of travel and whether they are turning onto or exiting from Kaiser-Aetna Road. The lane expansions, respective of location, are summarized as follows:

- Westbound SR 152 traffic, east of intersection – Third lane would open 1,000 feet before intersection and would include a 250-foot lane opening followed by a 750-foot storage length. A separate right turn lane would run parallel to the added westbound lane, for turns onto Kaiser-Aetna Road north. This turn lane would be constructed with a 530-foot deceleration length, ending at the intersection.

- Westbound SR 152 traffic, west of intersection – Third lane would extend 1,500 feet west of the intersection. For the first 300 feet of this lane, a fourth lane would run parallel to the new westbound lane to serve vehicles turning from the southbound Kaiser-Aetna Road onto westbound SR 152. This turn lane would be closed with a 600-foot drop lane taper following the 300 feet of open lane. The third lane would then extend 600 additional feet. Beyond the 1,500 feet of open lane, the lane would be closed following a 780-foot lane drop taper.

- Eastbound SR 152 traffic, west of intersection – Third lane would open 1,000 feet before intersection and would include a 250-foot lane opening followed by a 750-foot storage length. This added third lane would facilitate traffic through the intersection and permit right turns onto Kaiser-Aetna Road south.

- Eastbound SR 152 traffic, east of intersection – Third lane would extend 600 feet east of the intersection. Beyond the lane extension, a 780-foot lane drop taper would be installed to reduce the highway back down to two lanes.

At the intersection during the construction period, a temporary full phase demand actuated traffic signal with dedicated left turn movement would be installed to facilitate traffic flow. Exhibit 15 in Attachment A provides a schematic of the temporary traffic signal and widening of SR 152 at Kaiser-Aetna Road and associated roadway improvements. Additional improvements would include pavement delineation, pavement marking, advanced signal warning flashing beacon, and roadside signs. Lighting would also be provided at the at-grade crossing. Following construction, the temporary traffic signal and added traffic lanes would be removed from the intersection, and the area would be restored similar to existing site conditions.

3.2.7.2 Permanent Access Roads

The following sections describe the permanent access roads included as part of all action alternatives, including the frontage, dam, auxiliary, Pacheco Conduit tie-in and property access roads.

Frontage Road

All action alternatives include the construction of a 1.6-mile paved frontage road connecting the proposed SR 152 access improvement at Kaiser-Aetna Road to a series of permanent paved roads that would provide access to the spillway, dam crest, pump station and other facilities after construction (see Dam Access Roads discussion below). The frontage road, common to all action alternatives, also would serve as a construction access road and generally follows an alignment located immediately north of the current SR 152 alignment. The frontage road would be 30 feet wide with two 12-foot paved lanes with two 3-foot soft shoulders for slope rounding/shoulder backing. The roadway would be constructed of a 12-inch layer of aggregate base, overlaid with a 7.2-inch-thick layer of hot mix asphalt. Storm drainage runoff from portions of the frontage road would be combined with the existing storm drainage system of westbound SR 152. Exhibits 2 through 6 in Attachment A illustrate the frontage road included with the Proposed Project and Alternatives A through D, respectively. The physical characteristics and quantities for the frontage road included in all action alternatives are summarized in Table 3-16.

Table 3-16. Physical Features and Quantities for Permanent Frontage Road for the Proposed Project and Alternatives A Through D

Item	Proposed Project and Alternatives A Through D
Roadway Characteristics	
Roadway Surface	Asphalt
Type	Permanent
Total Width[1] (feet)	30
Length of Road (feet/miles)	8,600/1.6
Total Roadway Footprint Area (acres)	9.3
Earthwork Quantities	
Cut (CY)	42,000
Fill (CY)	2,100
Net Cut/Fill[2](CY)	39,900
Structural Section Quantities	
Aggregate Base/Gravel (CY)	9,800
Hot Mix Asphalt (CY)	9,560

Notes:

[1] Total width reflects two 12-foot-wide lanes and two 3-foot-wide shoulders.

[2] A positive value indicates net fill is required (e.g., import of fill material). A negative value indicates net cut is required (e.g., disposal of excess cut materials).

Key:

CY = cubic yard

Dam Access Roads

Under each action alternative, a series of paved access roads would be constructed to provide access during construction and access to the spillway, dam crest, pump station and other facilities after construction. Each road would be a total of 30 feet wide with two 12-foot paved lanes and two 3-foot gravel shoulders. The roadway would be constructed of a 12-inch layer of aggregate base (gravel), overlaid with a 7.2-inch-thick layer of hot mix asphalt. These permanent roadways would accommodate maintenance and emergency vehicle turn radius requirements. The physical characteristics and quantities for the dam access roads for all action alternatives are summarized in Table 3-17. Below is a description of the dam access roads included for each alternative:

- Proposed Project – The dam access road for the Proposed Project follows the existing access road on the east side of the Pacheco Reservoir. This access road is approximately 2 miles long and provides access to the hardfill dam crest, outlet/bifurcation structure, and pump station, with vehicle turnaround area at the outlet/bifurcation structure. An additional vehicle turnaround/parking area would be located at the western end of the dam's crest at the access road's terminus, where six parking spots (9,700 square feet) would be constructed. This access road would require a new bridge (230 feet long, 30 feet wide) with multiple piers across North Fork Pacheco Creek, downstream of the existing North Fork Dam. An additional new bridge (136 feet long, 30 feet wide) would be constructed to cross over the spillway of the new dam. The profile elevations of the road range from 417 feet to 766 feet, with a maximum grade of 16 percent. Exhibit 7 in Attachment A illustrates the permanent dam access roads for the Proposed Project.

- Alternative A – The dam access road for Alternative A follows the same alignment as the dam access road for the Proposed Project. The design features and characteristics are the same as the Proposed Project, with the 30-foot-wide cross section, the same connections to the dam facilities, and associated turnaround/parking areas. Like the

Proposed Project, the dam access road for Alternative A would provide access to would also require the construction of two bridges. One bridge (230 feet long, 30 feet wide) with multiple piers would be constructed to cross North Fork Pacheco Creek and another (240 feet long, 30 feet wide) would be constructed to cross the dam's spillway along the west abutment. Exhibit 8 in Attachment A illustrates the permanent dam access roads for Alternative A.

- Alternative B – The dam access road for Alternative B follows the same alignment as the dam access road for the Proposed Project. The design features and characteristics are the same as the Proposed Project, with the 30-foot-wide cross section, the same connections to the dam facilities, and associated turnaround/parking areas. However, for Alternative B, the profile elevation range is from 417 feet to 738 feet with a maximum grade of 14 percent. The lower elevation is due to the lower capacity of 96 TAF, compared to the 140 TAF capacity for the Proposed Project and Alternative A. The access road would also include two bridges, similar to the Proposed Project and Alternative A. The spillway bridge would span 180 feet with a 30 foot-width. The bridge crossing North Fork Pacheco Creek would span 230 feet with a 30-foot width and include multiple piers. Exhibit 9 in Attachment A illustrates the permanent dam access roads for Alternative B.

- Alternative C – The dam access road for Alternative C follows the existing access road alignment on the east side of the existing reservoir. This road is approximately 1 mile in length and has a total width of 30 feet, with two 12-foot paved lanes and two 3-foot gravel shoulders. A new bridge (136 feet long, 30 feet wide) would be constructed to cross over the proposed spillway. For this access road, the elevations range from 417 feet to 720 feet and have a maximum grade of 16 percent. This access road would require a new bridge (230 feet long, 30 feet wide) with multiple piers across North Fork Pacheco Creek to provide access to the proposed pump station, downstream of the existing North Fork Dam. An additional segment of road would serve as an extension of the frontage road, providing access to the outlet/bifurcation structure. Exhibit 10 in Attachment A illustrates the permanent dam access roads for Alternative C.

- Alternative D – The dam access road for Alternative D extends along the west side of the proposed dam and would provide access to the pump station, dam face, and dam crest with a series of switchbacks. This primary access road would have a total width of 30 feet, with two 12-foot paved lanes and two 3-foot aggregate (gravel) shoulders. The length of this road is approximately 1.3 miles. Also included in Alternative D is a secondary dam access road which would be located on the eastern side of the proposed earthfill dam. This secondary dam access road would require a bridge (230 feet, 30 feet wide) with multiple piers across North Fork Pacheco Creek. An additional bridge (91 feet long, 36 feet wide) would be constructed to cross over the proposed spillway. For this secondary access road, a box culvert would be required to cross North Fork Pacheco Creek to provide access to the proposed pump station, just downstream of the existing North Fork Dam location. This road has the same cross section as the primary access road and is approximately 1 mile in length. For both primary and secondary access roads, the elevations range from 417 feet to 718 feet and have a maximum grade of 16 percent. Exhibit 11 in Attachment A illustrates the permanent dam access roads for Alternative D.

Table 3-17. Physical Features and Quantities for Permanent Dam Access Roads for the Proposed Project and Alternatives A Through D

Item	Proposed Project Upstream, 140 TAF, Hardfill Dam	Alternative A Upstream, 140 TAF, Earthfill Dam	Alternative B Upstream, 96 TAF, Earthfill Dam	Alternative C Downstream, 140 TAF, Hardfill Dam	Alternative D Downstream, 140 TAF, Earthfill Dam
Roadway Characteristics					
Roadway Surface	Asphalt	Asphalt	Asphalt	Asphalt	Asphalt
Roadway Length (feet/miles)	10,600/2.0	10,600/2.0	10,500/2.0	5,000/1.0	11,900/2.2[3]
Total Width[1] (feet)	30	30	30	30	30
Elevation Range (feet, above msl)	417-766	417-766	417-738	417-720	417-718
Maximum Grade	16%	16%	14%	15%	16%
Total Roadway Footprint Area (acres)	23.3	24.2	23.3	13.9	30.6
Earthwork Quantities					
Cut (CY)	268,200	268,800	301,000	263,200	297,600
Fill (CY)	217,400	217,400	182,800	134,800	189,100
Net Cut/Fill[2] (CY)	51,300	51,300	118,200	128,400	108,500
Structural Section Quantities					
Hot Mix Asphalt (CY)	11,040	11,040	11,040	5,270	12,940
Aggregate Base/Gravel (CY)	9,400	9,400	9,400	4,480	13,950

Notes:

[1] Total width reflects two 12-foot-wide lanes and two 3-foot-wide shoulders.

[2] A positive value indicates net fill is required (e.g., import of fill material). A negative value indicates net cut is required (e.g., disposal of excess cut materials).

[3] Roadway consists of primary segment up the face of the dam (6,800 feet) and secondary segment to along the eastern portion of the North Fork Pacheco Creek channel (5,050 feet).

Key:
CY = cubic yard
msl = mean sea level

Pacheco Conduit Tie-In Access Road

All action alternatives would include a new road to access the tie-in location of the conveyance pipeline with the existing Pacheco Conduit, which is located south of SR 152. The new access road would improve an existing private driveway located just north of the conduit tie-in location. This driveway has a “right in/right out” entrance/exit criteria, meaning vehicles can only enter via eastbound SR 152, and can only exit back onto eastbound SR 152. The driveway would be widened and improved to Caltrans standards for driveways connecting with a State Highway and would allow for the accommodation of construction trucks. Other improvements include widening of the driveway and shoulder as well as any grading needed as a result of the highway shoulder widening. An existing gate on the driveway would be shifted roughly 75-feet south to accommodate large construction trucks, and pavement would extend up to the new gate location. The new access road would be 400 feet (approximately 0.1 miles) of 24-foot wide, two-way 4-inch aggregate base (gravel) road, and would include a large turnaround area in front of the valve structure at the tie-in location. This turnaround would be large enough to facilitate the turnaround and exiting of construction trucks from the tie-in location and also will provide space for vehicle parking.

Auxiliary Access Road (via Kaiser-Aetna Road)

The Proposed Project and Alternatives A and B include construction of a permanent auxiliary access road to connect Kaiser-Aetna Road to the downstream toe of the new dam and to areas west of the restored portions of North Fork Pacheco Creek. This auxiliary road would be comprised of three segments as shown in Exhibits 2 through 4 and Exhibits 7 through 9. This road would be constructed on native material and surfaced with aggregate base (gravel) to provide auxiliary access to the upstream dam location. The auxiliary access road would be a single lane road. Existing roadways would be improved, where required, through performing light grading, adding of an aggregate base (gravel) to the road surface, and incorporating drainage improvements, such as culverts. Where possible, the access roads would follow existing grades throughout the alignment. Where the existing roadway has a grade steeper than 20 percent, the roadway would be regraded to a maximum of 20 percent.

For Alternatives C and D, where the dam is located at the downstream site, the auxiliary access road would be temporary and not maintained following the construction period. The physical characteristics and quantities for the auxiliary access roads for the Proposed Project and Alternatives A Through D are summarized in Table 3-18.

Table 3-18. Physical Features and Quantities for Auxiliary Access Road for the Proposed Project and Alternatives A Through D

Item	Proposed Project and Alternatives A and B	Alternatives C and D
Roadway Characteristics		
Roadway Surface	Aggregate Base (Gravel)	Aggregate Base (Gravel)
Type	Permanent	Temporary
Width[1]	Single Lane	Single Lane
Length of Road (feet/miles)		
Elevation Range (feet, above msl)	481-1,372	481-1,372
Maximum Grade (%)	20	20
Total Roadway Footprint Area (acres)	9.9	3.7
Earthwork Quantities		
Cut (CY)	13,060	740
Fill (CY)	103,400	87,260
Net Cut/Fill[2](CY)	90,260	86,530
Structural Section Quantities		
Aggregate Base/Gravel (CY)	3,630	1,560

Notes:
[1] Construction quantity estimates based upon 14-foot roadway width.
[2] A positive value indicates net fill is required (e.g., import of fill material). A negative value indicates net cut is required (e.g., disposal of excess cut materials).

Key:
CY = cubic yard
msl = mean sea level

Property Access Roads

All action alternatives include private permanent roads to allow landowners access to their property where existing access roads would be inundated by the expanded reservoir. These property access roads would primarily follow existing access roads in the area developed by landowners over time. The existing access roads would be improved, where required, through performing light grading, adding of an aggregate (gravel) base to the road surface, and incorporating drainage improvements, such as culverts. Where possible, the access roads would follow existing grades throughout the alignment. The physical characteristics and quantities for the property access roads are summarized in Table 3-19 and are further described below:

- Lawler Property Access Road from Kaiser-Aetna Road (Lawler South) – The existing Lawler property access road off Kaiser-Aetna Road would be improved to better facilitate entry onto the Lawler property via Kaiser-Aetna Road. This improved access road connects Kaiser-Aetna Road with portions of the Lawler property located south of the expanded reservoir. This road is approximately 1.9 miles in length with an elevation range of 809 feet to 1,663 feet above mean sea level, and no pullouts would be included in the proposed improvements.
- Lawler Property Access Road from Fifield Road (Lawler North) – To provide access to the Lawler property north of the expanded reservoir, improvements to this access road would begin at the intersection of SR 152 and Fifield Road east of the existing reservoir. The existing road would be improved as needed and follow the existing Fifield Road and Red Mountain Road alignment into the reservoir area to the Lawler Property. The access road would follow these existing roads for approximately 20.7 miles and would have an elevation range of 778 feet to 2,337 feet. The existing profile grade would be maintained as-is, and no pullouts would be included in the proposed improvements.
- Jin Property Access Road – This property access road would begin at the existing access road just south of the existing North Fork Dam. The existing dam access road would be used to provide access to the beginning of the improved road from SR 152. The access road would run on the eastern side of the reservoir and follow an existing access road alignment up to the Jin Property. This access road would be approximately 7.3 miles in length with an elevation range of 475 feet to 1,879 feet. The existing profile grade would be maintained as-is, and no pullouts would be included in the proposed improvements.

Observation Trail

All action alternatives allow for docent-led educational tours to be conducted of new facilities, including dam and appurtenant structures, pump station, and the restored section of North Fork Pacheco Creek. These tours could include school tours, industry tours, etc. To facilitate these tours, an observation trail from the dam access road to the restored stream channel would be constructed and maintained. The observation trail would initiate near the pump station (per alternative) and would parallel the eastern side of the restored channel within the inundation area of the existing reservoir. To facilitate access for educational tours, the pump station parking lot and top of the dam would be developed to provide a turnaround for visiting buses.

Table 3-19. Physical Features and Quantities for Property Owner Access Roads for the Proposed Project and Alternatives A Through D

Item	Lawler South Property Access Road	Lawler North Property Access Road	
Roadway Characteristics			
Roadway Surface			
Length of Property Access Road (feet/miles)	10,300/1.9	109,200/20.7	38,600/7.3
Width[1]	Single Lane	Single Lane	Single Lane
Elevation Range (feet, above msl)	670-1,668	778-2,337	475-1,879
Maximum Grade (%)	25	34	34
Total Permanent Roadway Footprint Area (acres)	3.7	35	11
Structural Section Quantities			
Aggregate Base/Gravel (CY)	1,760	18,870	6,670
Earthwork Quantities			
Cut (CY)	270	0[3]	9,546
Fill (CY)	9,190	0[3]	4,057
Net Cut/Fill (CY)[2]	8,921	0[3]	-5,489

Notes:
[1] Construction quantity estimates based upon 14-foot roadway width.
[2] A positive value indicates net fill is required (e.g., import of fill material). A negative value indicates net cut is required (e.g., disposal of excess cut materials).
[3] Assumes limited light grading only.
Key:
CY = cubic yard

3.2.7.3 Temporary Construction Access Roads

All action alternatives include temporary construction access roads connected to the permanent construction access/frontage road described above to provide access to the borrow, staging, disposal, and stockpile areas. Temporary access roads would be necessary for mobilization and site access during construction. Some of the staging areas would be accessible through existing access roads provided the roads would be modified and widened or otherwise improved for construction traffic. Temporary roads would also be required to reach the higher elevations on the construction site where excavation activities would begin. Each temporary access road would typically be a 24-foot-wide, aggregate (gravel) surface road. The physical characteristics and quantities for the temporary construction access roads for all action alternatives are summarized in Table 3-20. Exhibits 16 through 20 in Attachment A illustrate the temporary construction access roads for the Proposed Project and Alternatives A Through D, respectively. Exhibits 21 through 25 in Attachment A provide additional detail for the temporary construction access roads near the new dam site associated with the Proposed Project and Alternatives A through D, respectively.

Table 3-20. Physical Features and Quantities for Temporary Construction Access Roads for the Proposed Project and Alternatives A Through D

Item	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
Roadway Characteristics					
Roadway Surface	Aggregate (Gravel)	Aggregate (Gravel)	Aggregate (Gravel)	Aggregate (Gravel)	Aggregate (Gravel)
Total Length (linear feet/miles)	35,600/7.2	38,100/7.2	38,700/7.3	46,800/8.9	59,400/11.3
Width (feet)	24	24	24	24	24
Total Roadway Area (acres)	51.4	50.5	51.4	53.8	46.8
Earthwork Quantities					
Cut (CY)	2,339,200	2,317,600	2,339,200	3,445,700	3,325,800
Fill (CY)	1,783,000	1,700,500	1,783,000	1,461,000	1,450,100
Net Cut/Fill (CY)[1]	-556,200	-617,100	-556,200	-1,984,700	-1,875,600

Notes:
[1] A positive value indicates net fill is required (e.g., import of fill material). A negative value indicates net cut is required (e.g., disposal of excess cut materials).

Key:
CY = cubic yard

3.2.8 Structure Demolition

Existing structures located within new facility footprints and the expanded reservoir inundation area would be demolished under all action alternatives. These structures include a residential building, outbuildings for equipment or livestock, wells, septic tank, leach field, livestock corrals, and fencing associated with the ranch operations within the inundation area and limited other improvements outside of the inundation areas (e.g., fencing and livestock corrals adjacent to Fifield Road). Additional structures associated with the existing North Fork Dam that would be demolished include those described in the North Fork Dam Decommissioning section including the small building on the crest and the bridges over North Fork Pacheco Creek and the spillway. The structures to be demolished would be the same for all action alternatives. The demolished materials would be disposed of in local or other identified permitted landfills in compliance with applicable requirements.

3.2.9 Watershed Management/Shoreline Buffer and Shoreline Access

A shoreline buffer of 200 feet around the expanded reservoir would be acquired through fee title or easement by Valley Water as part of all action alternatives. This watershed management/shoreline buffer area would be managed to minimize water quality effects from land use activities. Due to existing land management practices within Henry W. Coe State Park, no acquisition of shoreline buffer areas would occur within park boundaries. To provide access to the shoreline of the expanded reservoir, a ramp would be constructed to provide boat access for maintenance and emergency purposes. For all action alternatives, the boat ramp would be located immediately upstream of the new dam.

3.3 Construction

This section describes the activities necessary to construct the facilities included as part of the Proposed Project and Alternatives A through D, including overall construction schedule and sequencing, methods for constructing facilities, and overall construction program elements. Overall construction program elements include on-site staging, borrow, disposal and stockpiling areas; commercial material sources; off-site disposal; water sources during construction; temporary work areas; and work force, equipment, truck trips, and haul routes.

3.3.1 Construction Schedule and Sequencing

As shown in Table 3-21, the proposed in-field construction duration for the action alternatives ranges from five to seven years. While the durations vary, the sequencing of the construction activities would be similar across action alternatives. Exhibits 26 through 30 in Attachment A illustrate the sequencing and duration of construction activities for the Proposed Project and Alternatives A through D, respectively. Under all action alternatives, construction is proposed to be initiated in 2025.

Table 3-21 Construction Duration for the Proposed Project and Alternatives A Through D

Item	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
Construction Duration[1] (years)	6.7	6.4	5.8	7.3	7.2

Note:
[1] Construction duration reflects proposed time with in-field construction activities. Durations do not reflect initial office-based activities (e.g., notice to proceed, critical submittal development).

Key:
TAF = thousand acre-feet

Construction activities would generally occur up to six days a week throughout the year for the Proposed Project and Alternatives A through D. Table 3-22 summarizes the typical timing and work hours, including daytime and nighttime hours, for construction of the facilities associated with the Proposed Project and Alternatives A through D.

Table 3-22. Typical Timing and Work Hours for Facilities Construction for the Proposed Project and Alternatives A Through D

Item	Proposed Project and Alternative C	Alternatives A, B, and D
Dam, Spillway, and Inlet/Outlet Structure		
Dam Foundation Excavation	Typically, five days per week, two 10-hours shifts per day between April 15 and November 15 and one 10-hour shift between November 15 and April 15. Saturdays are reserved for equipment maintenance and to provide for catch-up work, if needed.	Same as Proposed Project and Alternative C
Main Dam Construction	Typically, five days per week (Monday-Friday), two 10-hours shifts per day throughout year.[1] Saturdays are reserved for equipment maintenance and to provide for catch-up work, if needed.	Typically, five days per week (Monday-Friday), two 10-hours shifts per day between April 15 and November 15.[2] Saturdays are reserved for equipment maintenance and to provide for catch-up work, if needed.
Tunnel Excavations for Inlet/Outlet Structures	Not applicable	Up to six days per week, 24 hours per day Sundays may be used for equipment maintenance, if needed
Spillway and Inlet/Outlet Structure	Same as main dam construction	Typically, five days per week (Monday-Friday), up to two 10-hours shifts per day throughout year
Other Facilities		
Water Conveyance Pipeline South of SR 152	Typically, Monday-Saturday, daytime hours. Construction materials would be delivered and unloaded during off-peak hours.	Same as Proposed Project and Alternative C
Pacheco Conduit Replacement	Up to seven days a week and 24 hours/day[5]	Same as Proposed Project and Alternative C
SR 152 Access Improvements[3]	Typically, Monday-Saturday, daytime hours; limited nighttime work	Same as Proposed Project and Alternative C
Power Transmission Lines[4]	Typically, Monday-Saturday, daytime hours between July 15 and December 1	Same as Proposed Project and Alternative C
All Other Facilities	Typically, Monday-Saturday, daytime hours	Same as Proposed Project and Alternative C

Notes:

[1] Weather conditions may limit placement of hardfill during winter months.

[2] Generally, no placement between November 15 and April 15 due to difficulties in placing core materials during the precipitation season.

[3] Includes all SR 152 access improvement options including permanent tight diamond interchange, temporary overcrossing, temporary at-grade intersection with traffic signal and widening of SR 152, and temporary at-grade intersection with traffic signal and roundabout. Nighttime activities may include lane closures of SR 152 to perform various road improvement activities such as installation of temporary k-rail, lane striping/pavement marking, etc.

[4] Power transmission line construction would primarily be performed via helicopter and would occur outside of bald and golden eagle breeding and nesting seasons. Timeframes may be modified based on coordination with U.S. Fish and Wildlife Service and California Department of Fish and Wildlife.

[5] Construction of the tie-in with Pacheco Conduit and the replacement of the Pacheco Conduit segment would require an outage of the facility. As Pacheco Conduit conveys Central Valley Project water supplies for both Valley Water and San Benito County Water District, seven day a week and 24 hour per day construction is proposed in order to minimize the duration of outage of Pacheco Conduit.

Key:
N/A = Not applicable
SR 152 = State Route 152

3.3.2 Construction Sequencing and Methods for Facilities

3.3.2.1 Permanent and Temporary Access Construction Methods

Prior to large-scale construction activities of the dam, spillway, inlet/outlet works, pump station, pipeline, and other facilities under all action alternatives, various access improvements would be completed to facilitate construction crews and equipment entering and exiting the construction areas for these facilities. Under all action alternatives, SR 152 access improvements, frontage road, permanent dam access roads, and Pacheco Conduit tie-in access road would be constructed early in the construction period. The frontage road, permanent dam access roads, and Pacheco Conduit tie-in access road would be used for both temporary construction access and permanent access to facilities. The permanent dam access roads would be a continuation of the frontage road that connects to Kaiser-Aetna Road and SR 152 access improvements. In addition, temporary construction access roads are proposed to provide access to staging, borrow, stockpiling and disposal areas. The contractor would determine the optimum location and alignment of the temporary access roads. Construction sequencing of the temporary access roads would be developed in the advanced stages of the design. Prior to completion of the SR 152 access improvements and frontage road, construction crews and equipment would use the existing access from SR 152 used for operations and maintenance of North Fork Dam and the existing Kaiser-Aetna Road intersection for construction activities north of SR 152. Prior to completion of the SR 152 access improvements, large, construction-related trucks would enter and exit during non-peak hours.

SR 152 Access Improvements

As described in Section 3.2.7.1, all action alternatives include modifications and improvements to the SR 152 and Kaiser-Aetna Road intersection that would facilitate access to the construction site for the new dam and associated facilities. Valley Water is closely coordinating with Caltrans in the development of these SR 152 access improvements. As described in Section 3.5.2.6, a Traffic Management Plan would be developed in coordination with Caltrans detailing timing and duration of construction activities (e.g., lane closures, signage, use of temporary barriers).

Under all action alternatives, due to the high traffic volumes, construction activities on SR 152 would be sequenced to minimize impacts to the traveling public. Through a multi-step approach, the existing number of lanes would be maintained, and shoulder widths would vary from a minimum of 2 feet to 10 feet, where feasible. Any damage to the existing facilities/elements that is caused by the action alternatives would be repaired in a timely manner. Temporary concrete railing (K-rail) and temporary traffic screen would be used for traffic and worker safety.

During construction, temporary or long-term shoulder closures would occur on both eastbound and westbound directions on SR 152 during daytime or nighttime, while travel lane closures would only occur during nighttime and weekends. Advance warning signs, construction area signs and changeable message signs would be placed at appropriate locations to alert traffic to these conditions.

<u>Permanent Tight Diamond Interchange</u>

The permanent tight diamond interchange, as included in the Proposed Project and Alternative D, would be constructed in phases. The existing at-grade intersection at Kaiser-Aetna Road would be maintained for vehicle access (e.g., providing local residents, local businesses, and construction-related vehicles access) during the construction of the permanent interchange. The construction phases for the permanent interchange include:

- Construction Phase 1 – Existing general-purpose travel lanes would be maintained while construction of the interchange begins. First phase activities would include construction of westbound on and off ramps, retaining walls, northside bridge abutment, and initial realignment of local roads on the north Kaiser-Aetna Road.

- Construction Phase 2 – Existing general-purpose travel lanes would be maintained while construction of the interchange proceeds. Second phase activities would include construction of eastbound on and off ramps for eastbound traffic, retaining walls, southside bridge abutment, and realignment of local roads on the south Kaiser Aetna Road.
- Construction Phase 3 – The bridge overcrossing work, final pavement for the interchange, pavement striping, pavement marking, roadside signs and all other work would be completed. Temporary K-rail, construction area signs and other temporary roadside signs would be removed. At the end of this phase, all the roadway-related construction work would be completed for the permanent interchange.

Temporary Overcrossing

The temporary overcrossing included in Alternative A would be constructed in phases. The existing at-grade intersection at Kaiser-Aetna Road would be maintained for vehicle access (e.g., providing local residents, local businesses, and construction-related vehicles access) during the construction of the temporary overcrossing. The construction phases for the temporary overcrossing include:

- Construction Phase 1 – Existing general-purpose travel lanes would be maintained while construction of the overcrossing begins. First phase activities would include construction of SR 152 westbound acceleration and deceleration lanes, retaining walls, northside bridge abutment, and initial realignment of local roads on the north Kaiser-Aetna Road.
- Construction Phase 2 – Existing general-purpose travel lanes would be maintained while construction of the overcrossing proceeds. Second phase activities would include construction of SR 152 eastbound acceleration and deceleration lanes, retaining walls, southside bridge abutment, and realignment of local roads on the south Kaiser-Aetna Road.
- Construction Phase 3 – The bridge overcrossing work, final pavement for the overcrossing approach roads, pavement striping, pavement marking, roadside signs and all other work would be completed. Temporary K-rail, construction area signs and other temporary roadside signs would be removed.
- Construction Phase 4 – Removal of the temporary overcrossing would occur following construction of all other facilities (e.g., dam, spillway, inlet/outlet works, pump station, water conveyance pipeline). Removal of the temporary overcrossing would include removal of bridge structure, on and off ramps, and other features (roadside sign, conflicting pavement marking). The Kaiser-Aetna Road intersection would be restored to original conditions, or better.

Temporary At-Grade Crossings – Roundabout and Widening

To minimize impacts to existing traffic, construction would be phased under either of the two temporary at-grade crossing options (i.e., temporary at-grade intersection with traffic signal and roundabout under Alternative B, temporary at-grade intersection with traffic signal and widening of SR 152 under Alternative C). Construction of either of the two temporary at-grade crossing options would require widening for acceleration and deceleration lanes. Construction of the temporary at-grade crossing widening option would require outside shoulder closure for widening of mainline, to add one extra through lane on SR 152. The construction staging would include temporary nighttime lane closures for short durations for placement of temporary K-rail for shoulder closures. Exposed objects would be properly shielded by a temporary crash cushion, Midwest guard rail, or similar feature.

Generally, both lanes of SR 152 traffic in each direction would be maintained during construction of either of the at-grade options. However, during nighttime and weekend periods, temporary closures of one lane may be required for pavement overlay, pavement striping, pavement marking and installation of the traffic signal. Advance warning signs, construction area signs and changeable message signs would be placed at appropriate locations to alert traffic to the conditions. Temporary railing (K-rail) would be utilized for traffic and worker safety.

The phased construction sequencing for these two SR 152 access options are similar:

- Construction Phase 1 – Placement of temporary K-rail at the existing edge of travel way on westbound SR 152 to facilitate construction of outside widening of acceleration and deceleration lanes in the westbound direction.
- Construction Phase 2– Placement of temporary K-rail at the existing edge of travel way on eastbound SR 152 to facilitate the construction of outside widening of eastbound acceleration and deceleration lanes.
- Construction Phase 3 – The temporary traffic signal, pavement striping, pavement marking, roadside signs, advance traffic signal warning signs and flashing beacons, along with all the work outside of Caltrans right of way including the roundabout on the south Kaiser-Aetna Road with connection to local roads would be completed.
- Construction Phase 4 – Restore the Kaiser-Aetna Road intersection to its original condition following the completion of construction of all other facilities (e.g., dam, spillway, inlet/outlet works, pump station, water conveyance pipeline). This phase of construction would consist of removal of the roundabout; pavement striping and pavement marking; and removal of roadside signs, advance warning signs and traffic signal.

Pacheco Conduit Tie-In Access Road

As described in 3.2.7.2, under all action alternatives, to access the location of the proposed Pacheco Conduit tie-in connection site, vehicles would enter the site via an existing private driveway off eastbound SR 152 near the tie-in location. This access would provide both temporary construction access as well as permanent access. This driveway has a “right in/right out” entrance/exit criteria, meaning vehicles can only enter via eastbound SR 152, and can only exit back onto eastbound SR 152. Construction efforts would include widening SR 152 in the eastbound direction adjacent to the driveway, placement of temporary K-rail at the existing edge of travel way, and temporary closure of the outside shoulder. Additionally, night-time lane closures in the eastbound direction would accommodate truck traffic entry to the work site during the construction period. As described in Section 3.5.2.6, a Traffic Management Plan would be prepared in coordination with Caltrans to identify traffic-related requirements during construction (e.g., lane closures, use of flaggers at the driveway entrance to regulate the ingress and egress of delivering trucks for traffic safety; provisions for the nighttime work). The proposed improvement includes upgrading the existing driveway to current Caltrans design standards, this driveway will be stop controlled.

Permanent Access Roads

As described in 3.2.7.2, under all action alternatives, permanent access roads connecting various dam facilities, such as the spillway, outlet/bifurcation structure, pump station, and dam crest would be constructed. In order to improve access to the project site, portions of these roadway alignments where appropriate would be constructed in construction years one and two prior to beginning large-scale dam construction activities. The proposed permanent access road pavement's typical structural section would include subgrade, aggregate base, and a hot mix asphalt surface. An appropriate storm drain system with drain inlets and a cross drainage system would also be included. The proposed improvement would include roadway excavation, embankment fill, regrading, retaining wall to support cut or fill condition, cross culverts, roadside guide signs, and parking lots/turnaround areas on the dam crest or near the intake control shaft structure, the outlet/bifurcation structure, and/or the pump station area. A portion of the permanent access road construction sequencing would be coordinated with dam construction, specifically the dam crest road, spillway road and bridge, and intake control shaft structure area access road when applicable (for earthfill alternatives).

Temporary Construction Access Roads

As described in 3.2.7.3, under all action alternatives, construction access roads connecting staging, borrow, disposal and stockpile areas would be temporary and would not be maintained following completion of construction. The proposed temporary construction access roads would be surfaced with aggregate (gravel) and would require roadway excavation and grading to provide access to staging, borrow, stockpiling and disposal areas. For temporary access roads outside the new inundation area, initial grading activities would include scraping topsoil to the edge of the access road as slopes permit to facilitate decommissioning and revegetation efforts after use. Following the construction period, temporary roads would be decommissioned. Decommissioning of the temporary roads would include replacement of topsoil where applicable (e.g., outside of new inundation area and in areas with suitable slopes) in conjunction with light grading to provide for long-term drainage, and removing potholes, ditches, or deep low spots, so that no water ponding on the road surface would occur. The contractor would be responsible for removing any temporary construction materials placed on the road alignment such as culverts or any other man-made materials. Any aggregate (gravel) used for roadway surfacing or similar materials (e.g., rock) would be left in place. After final grading, these areas would be revegetated with native species in consideration of physical characteristics (e.g., slope, soils, water availability).

3.3.2.2 Existing North Fork Dam Decommissioning and Channel Restoration Construction Methods

Existing North Fork Dam Decommissioning

As described in Section 3.2.5.1, under all action alternatives, following initial mobilization and construction of access improvements, removal of the existing North Fork Dam would begin in the late spring when reservoir inflows cease and once the existing reservoir is fully drained. This drawdown would be controlled to avoid any triggering of additional movement of the mapped landslides at the new dam sites upstream. Removal of the existing dam would proceed from the top down to prevent steep slopes and to minimize the potential for slope failure. The historical thalweg elevation of North Fork Pacheco Creek (approximately elevation 385 to 390 feet) would be used as the invert elevation for the restoration channel. The dam would be removed above this elevation that accommodates the restoration channel and an engineered slope above the channel restoration on both sides of the channel until the existing grades are encountered. Once the dam is removed to that elevation, additional earthwork, including bank stabilization, channel restoration, and any planned riparian and aquatic habitat enhancements, would be performed. Material excavated from the dam deemed suitable for earth fill, would be used for construction of the cofferdam. These materials would be hauled directly to the cofferdam site. Unsuitable material would be placed in an identified disposal area. Sand, gravel, cobbles, and rock may be segregated from the excavated material and used for site restoration. Concrete, steel, and similar waste would be recycled or disposed of off-site.

The existing inlet and outlet structure and concrete lining of the spillway would be demolished and removed from the site, and the outlet pipe would be plugged in with concrete at both ends and abandoned in place. Additional earthwork would be completed where necessary to restore and stabilize the side slopes along the spillway. Both bridges at the toe of the dam would be demolished and removed from the site.

Channel Restoration

Under all action alternatives, channel restoration efforts would be performed in two phases to minimize impacts to water quality during construction. Phase one would begin in the summer of construction year two (after winter runoff) with the initial excavation of a channel adequate to convey flows between the new dam site and existing dam site. Channel dimensions would vary depending on stream gradient, sediment deposition, and historic channel characteristics. This excavation would focus on portions of the restoration channel where high concentrations of fine sediment accumulated within the existing reservoir. Excavated materials would be stockpiled temporarily above the active floodplain for later disposal at approved on-site disposal areas. This would reduce the potential for episodic increase in turbidity and suspended sediment in response to flood flows. This channel would also be located to provide for tributary inflow of water and sediment into the restoration channel, reconnecting these tributaries to the North Fork Pacheco Creek. The downstream terminus of the restoration channel will be constructed to ensure the channel gradient and geometry (width and depth) provides unimpeded upstream and downstream passage for SCCC steelhead and other aquatic organisms. At some locations within the phase one channel construction, bank stabilization measures (e.g., rip rap) may be necessary to reduce the erosion of reservoir sediments. At the end of phase one, a functional fish barrier would be installed and operated downstream of the North Fork Dam outlet scour pool to ensure that salmonids would not have access to the restoration channel until the completion of phase two.

Phase two would begin in the summer before the final year of construction when the alluvial material has had sufficient time to drain and dry out. At that time, final excavation and/or placement of material necessary to restore a functional reach of North Fork Pacheco Creek to support anadromous salmonids and other aquatic and riparian dependent species would occur. Additional grading and/or placement of material would occur to reestablish the channel gradient, width/depth ratio, and substrate necessary to provide steelhead spawning and rearing habitat (per alternative). Revegetation would occur to support the development of native riparian and floodplain vegetation communities along the restoration channel and within floodplain areas (including tributaries). Areas upslope of the restoration channel and floodplain would be revegetated with native species in consideration of soils, slope, and water availability.

Dewatering sumps and/or seepage collection trenches would be used to collect and control seepage associated with excavation activities within channel restoration areas. Once captured, dewatered water would be used for on-site construction water needs (e.g., dust control) or would be stored on-site in temporary containment basins or tanks to allow sediments to settle. Following settlement, captured water not used for on-site construction water needs would be discharged into a jurisdictional water in accordance with regulatory requirements. The management, monitoring, and discharge of water associated with construction activities would require a National Pollution Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activities, including the development of a Stormwater Pollution Prevention Plan (SWPPP) (see Section 3.5.2.5 for additional information on SWPPP development).

3.3.2.3 Dam, Spillway and Inlet/Outlet Works Construction Methods

Hardfill Dam Construction

Hardfill dam construction, associated with the Proposed Project and Alternative C, would consist of construction of a cofferdam (and associated facilities to handle water at the dam site during construction), foundation excavation/preparation, and main dam construction. Main dam construction also would encompass spillway and inlet/outlet work construction.

Cofferdam Construction for Hardfill Dam

During year two of construction, prior to the start of main dam construction, a temporary intake (upstream of the dam location) and diversion pipe, low-flow bypass intake and separate low-flow bypass pipeline, and outlet conduit would be constructed. Open-trench construction methods would be used for the diversion pipeline, low-flow bypass pipeline, and outlet conduit.

Following the completion of these intakes and pipeline facilities, a cofferdam would be constructed during the dry season of year three, upstream of the new dam footprint (see Exhibit 31 of Attachment A). Foundation preparation for the cofferdam would consist of removal of all alluvium from the valley bottom and surficial soils along the abutments down to acceptable bedrock within the cofferdam footprint. Material used to construct the cofferdam would be sourced from compatible on-site borrow sources or sourced from the dam foundation excavation and removal of North Fork Dam.

New Hardfill Dam Construction

Dam foundation activities common to the hardfill alternatives (Proposed Project and Alternative C) would include excavation of existing channel alluvial and colluvial materials to moderately weathered bedrock; loading and hauling excavated materials in the foundation footprint to disposal areas; foundation shaping to reduce potential for cracking of the hardfill; removal of weak material and backfilling the depressions with concrete; and excavating or treating with dental concrete (e.g., concrete used to fill voids) any steep stepped surfaces to flatter surfaces. In addition to excavators, the foundation excavation is proposed to include controlled blasting.[9] Two rows of curtain grouting holes would be bored and filled beneath the upstream toe of the hardfill dam to reduce seepage through the foundation and uplift pressures under the dam. A reinforced concrete plinth (concrete beam) at the upstream toe of the dam would also be constructed.

The hardfill aggregates will be excavated and/or blasted from identified on site borrow sites, processed, and stockpiled for testing prior to use in the construction of the main dam. Up to two controlled blasts per month, generally one blast every other week, would be conducted for foundation excavation and borrow site development. The processed aggregates will be hauled to batch plants located in the designated staging areas for mixing with designed amounts of cement, fly ash and water to produce the desired hardfill mix. A test fill program in the field would be used to evaluate hardfill excavation and processing, demonstrate placement techniques, and to obtain full-scale field samples for pre-construction mix design testing. The test fill program would use the same equipment and processing procedures to generate the aggregate gradation as proposed for the main dam production. The hardfill mix would be hauled in trucks or through a conveyor system to the dam site and placed in 12-inch lifts and compacted. While the hardfill is being placed, the intake control shaft structure and adits/ports, both components of the inlet/outlet works, would be constructed into the dam itself. A concrete

[9] Controlled blasting is a technique of blasting, which is used to reduce the amount of over break and to control ground vibrations. The different types of controlled blasting techniques are pre-splitting, smooth blasting, line drilling, perimeter blasting, and cushion blasting. The intent of controlled blasting is to limit the projectile debris (e.g., rock) and minimize associated shaking and noise caused by the blasting.

face slab will be constructed on the upstream face of the dam to minimize water penetration into the body of the hardfill dam. Other activities would include installing instrumentation and monitoring the performance of the dam during and after construction.

Hardfill Dam Spillway Construction

The hardfill dam would include a stepped concrete spillway constructed within the middle of section of the dam. A stilling basin would be constructed at the toe of the spillway to dissipate energy prior to releasing flows back to the restoration channel. Reinforced concrete training walls would be constructed on each side of the spillway and stilling basin to contain the discharge flows. The spillway crest would allow for inclusion of bridge piers to enable traversing the spillway.

Earthfill Dam Construction

Earthfill dam construction common to the earthfill alternatives (Alternatives A, B, and D) would consist of construction of a cofferdam, foundation excavation/preparation, and dam construction. Construction of the new dam would encompass multiple components including construction of the main dam structure, spillway, and the inlet/outlet works.

Cofferdam Construction for Earthfill Dam

Prior to the start of main dam construction, a cofferdam would be constructed during the dry season when flows in Pacheco Creek are low. The cofferdam would be constructed at the upstream toe of the new dam footprint to support diversion of stream flows during the embankment dam construction. The foundation and embankment of the cofferdam would be constructed so that the structure would be incorporated directly into the main embankment structure. Site preparation activities would include construction of the inlet/outlet conveyance tunnel in the abutment rock of the dam.

The temporary cofferdam would be constructed following or concurrent with completion of the outlet tunnel construction. Foundation preparation for the cofferdam would be similar to that for the main embankment and would consist of removal of all alluvium from the valley bottom and surficial soils along the abutments down to acceptable bedrock within the cofferdam footprint. Material used to construct the cofferdam would be sourced from compatible on-site borrow sources, or sourced from the dam foundation excavation, spillway excavation, and removal of North Fork Dam.

New Earthfill Dam Construction

Initial preparation of the dam footprint would consist of clearing and grubbing of vegetation, removal of soft sediments and other deleterious materials, and shaping of the abutment side slopes. Installation of slope support during excavation may be needed to account for the mapped landslides at the respective dam sites and to guard against shallow-slope failures during construction. Dam foundation construction would include excavation of existing-channel colluvium, alluvial, landslide material, and completely to highly weathered rock to moderately weathered bedrock; loading and hauling excavated materials in the foundation footprint to stockpiles; cleaning of the foundation beneath the core and earth fill zones; treating the surface of the impervious-core foundation by excavating shear zones and backfilling with dental concrete/grout (e.g., using concrete or grout to fill voids in); and setting up, mixing, and injecting grout for the grout curtain, drilling grout holes, and injection of grout to form a grout curtain beneath the core. In addition to excavators, the foundation excavation is proposed to include controlled blasting. Two rows of curtain grouting holes would be bored and filled beneath the impervious core zone to reduce seepage through the foundation. The materials excavated from the foundation area would be stockpiled; the majority of these materials would be reused in the downstream shell.

New earthfill dam construction activities would include processing, excavating, loading, hauling, placing, and compacting of impervious core and shell materials from their respective borrow areas. The shell borrow materials excavation may include controlled blasting. Up to two controlled blasts per month, generally one blast every other week, would be conducted for foundation excavation and borrow site development. Processing materials at the borrow sites would include, at a minimum, removal of oversize particles and moisture conditioning. Drain, riprap, and filter materials would be sourced from local commercial vendors or facilities. Construction activities associated with these materials would include loading and transporting material from an on-site source and placing and compacting material in the embankment. Additional moisture conditioning may be required at the dam site as the materials are placed and compacted. Other activities would include installing instrumentation and monitoring the performance of the embankment during and after construction.

Earthfill Dam Spillway Construction

Spillway construction for the earthfill alternatives would consist of completing excavation to final grades; formwork and placement of concrete for the base and walls of the spillway approach channel, drainage beneath the base slab, chute, and stilling basin; and final grading and erosion protection for the excavation slopes. For the spillway associated with Alternative D, several reinforced structural walls, a mass concrete gravity wall on the right side of the spillway, and tie-back retaining walls would be constructed with similar means as the spillway (i.e., excavation to final grades, formwork, and placement of concrete). In addition, a spillway bridge would be constructed to provide access.

Earthfill Dam Inlet/Outlet Works Construction

After the existing reservoir is drained, the upstream and downstream portal would be constructed and the 16-foot-diameter horseshoe outlet tunnel (to house a 114-inch-internal-diameter outlet conduit and the 36-inch-diameter low-flow bypass pipeline) would be excavated using conventional mining techniques. The horseshoe outlet would be used to divert winter flows around the dam construction site. An additional temporary cofferdam would be constructed to help excavate the portals. The intake control shaft structure would be constructed adjacent to the outlet tunnel using a soldier pile and lagging support system when in soil and a shotcrete and rock dowel system when in rock. The upper, middle, and lower 8-foot-diameter horseshoe shaped adit tunnels at varying elevation would then be excavated into the shaft. A low-flow bypass pipeline would be constructed by open trench methods. The adits and the inlet/outlet tunnel would be lined. Forming and placement of concrete would be necessary for the inlet/outlet tunnel and portals and the vertical intake control shaft structure.

The foundations of the pipelines would extend into competent soil or rock materials in several areas. Some controlled rock blasting may be required during construction. Conveyance pipeline in cut-and-cover trenches would require bedding and initial backfill using imported granular materials. Final backfill would consist of on-site soil materials. Construction of above ground buildings and procurement and installation of the mechanical equipment associated with the hydraulic structures would take place after the other major construction activities associated with the dam and reservoir have been completed.

Water Handling During Construction at New Dam Site

During the construction of all action alternatives, water entering the dam construction area would be handled by use of a cofferdam and run-of-river system (e.g., similar to natural hydrograph). Because of the variations between the inlet/outlet works between action alternatives, the specific water handling approaches during dam construction vary by dam type per action alternative.

Table 3-23 summarizes the key activities for water handling during construction for both the hardfill and earthfill dams, as included in the Proposed Project and Alternative C, and Alternatives A, B and D, respectively.

Table 3-23. Water Handling Activities During New Hardfill and Earthfill Dam Construction

Proposed Project and Alternative C - Hardfill Dams[1]		Alternatives A, B and D - Earthfill Dams[1]	
Construction Year[1]	**Activity**	**Construction Year[1]**	**Activity**
1	• Continue operation of existing North Fork Dam and Pacheco Reservoir, including releases to Pacheco Creek	1	• Continue operation of existing North Fork dam and Pacheco Reservoir, including releases to Pacheco Creek
2	• Decommission North Fork Dam and existing Pacheco Reservoir • Construct temporary intake and diversion pipeline/outlet conduit • Creek flows continue to pass through creek bed	2	• Decommission North Fork Dam and existing Pacheco Reservoir • Begin inlet/outlet tunnel construction • Creek flows continue to pass through creek bed
3	• Construct cofferdam • Winter and summer flows would be conveyed through the diversion pipeline/outlet conduit as dam is built	3	• Construct cofferdam • Summer flows would be pumped around dam construction area • Winter flows would be conveyed through inlet/outlet tunnel as dam is built
4-7	• Winter and summer flows would be conveyed through the diversion pipeline/outlet conduit as dam is built • For portion of Year 7, flows would be pumped around dam construction area allowing for valve installation	4-7	• Summer flows would be pumped around dam construction area (to allow for inlet/outlet work construction) • Winter flows would be conveyed through inlet/outlet tunnel as dam is built
8 & Beyond	• Remove cofferdam • Operate expanded reservoir	8 & Beyond	• Operate expanded reservoir

Notes:
[1] The Proposed Project is used as representative alternative for hardfill dams. Alternative D is used as representative alternative for earthfill dams.

<u>Hardfill Dam Water Diversion</u>

For the Proposed Project and Alternative C, water would be handled at the dam site by use of a run-of-river system, passing creek flows through the preexisting creek channel prior to cofferdam construction, and diverting water through the dam site via a diversion system following cofferdam construction, as shown in Exhibit 31 of Attachment A. In the initial year of construction, no changes to operations of the existing North Fork Dam would occur and flows would be allowed to pass through the creek bed. Within the dam construction area during year two of construction, inflows would be routed through the preexisting channel, while a temporary intake would be constructed upstream of the new hardfill dam site and a diversion pipeline/outlet conduit would be excavated through the dam site. In year three, cofferdam construction would begin, and creek flows would be diverted through the diversion pipeline/outlet conduit instead of following the preexisting channel. While the hardfill dam is being raised during construction years four through seven, creek flows would continue to be diverted through the diversion pipeline/outlet conduit. Valves would be installed in the final year of construction. Upon completion of the hardfill dam and inlet/outlet works construction and approval from DWR DSOD, operations of the expanded reservoir operations would begin, and inflow would be impounded by the hardfill dam.

Earthfill Dam Water Diversion

For Alternatives A, B and D, water would be handled at the dam site by use of a run-of-river system as shown in in Exhibit 32 of Attachment A. Within the dam construction area prior to coffer dam construction, creek flows would pass through the preexisting creek channel. Following cofferdam construction, water would be pumped around the dam site during dry periods (allowing for construction of inlet/outlet work facilities), and water would be diverted through the outlet tunnel during wet periods. In the initial year of construction, no changes to operations of the existing North Fork Dam would occur and flows would be allowed to pass through the creek bed. During year two of construction, the existing dam would be decommissioned, and excavation of the outlet tunnel would begin including construction of a temporary cofferdam to facilitate tunnel portal construction. The outlet tunnel would be excavated from both the upstream and downstream portals. In year three, construction of the cofferdam in the new embankment dam's upstream toe would commence. Following cofferdam construction, inflows to the construction area from April through November would be pumped around the construction area, while flows from November through April would be diverted through the outlet tunnel. Upon completion of the earthfill dam and inlet/outlet works construction and approval from DWR DSOD, operations of the expanded reservoir would begin, and inflow would be impounded by the earthfill dam.

Dewatering

Under all action alternatives, groundwater would likely seep into the dam foundation area during excavation and would require control and handling during excavation, grouting, foundation cleanup and treatment, and initial embankment fill operations. Dewatering wells, well points, sumps, and/or seepage collection trenches would be required to collect and control seepage within the dam foundation. Once captured, dewatered water would be used for on-site construction water needs (e.g., dust control) or would be stored on-site in temporary containment basins or tanks to allow sediments to settle. Following settlement, captured water not used for on-site construction water needs or would be discharged into a jurisdictional water in accordance with regulatory requirements (e.g., NPDES construction general permit). Foundation seepage would include seepage past cofferdams upstream of the foundation area and groundwater seepage into the excavation from the abutments. Seepage into the foundation area would vary depending on the stage of dam construction. Seepage would likely be the lowest during foundation excavation and construction of the main cofferdam. Seepage would increase during storm events and when the reservoir level behind the cofferdam temporarily rises as storm flows pass through the temporary diversion facilities.

3.3.2.4 Water Conveyance Between Expanded Reservoir and Existing Pacheco Conduit Construction Methods

Water Conveyance Pipeline

For all action alternatives, open-trench construction methods would be used for most pipeline installation; tunneling methods would be used for crossings where trenching methods are not feasible or where restrictions warrant other construction methods (e.g., below South Fork Pacheco Creek and SR 152).

Open-Trench

The trench width for the conveyance pipeline installation would be up to approximately 65 feet wide and depths would range from 15 to 50 feet. Where required for safety or to minimize excavation, trenches would be braced with a trench box or shoring. The active work area along the open trench would generally extend about 20 feet on both sides of the trench. When the new pipeline is in place, backfill would be placed in the trench. Minimum soil coverage would be 4 feet. The as-built surface elevation would generally match the original ground surface elevation. At initiation of pipeline construction, the topsoil would be stripped and stockpiled. Following pipeline installation, topsoil would be replaced, and the area would be revegetated with native species. Pipeline materials (e.g., piping, backfill material) would be stored along the pipeline route within the construction easement.

Tunneling

Based on the geological conditions and the conveyance pipe size, an approximately 11-foot-diameter tunnel excavation would be required for the approximately 350-foot-long trenchless crossing. The trenchless crossing would be approximately 12 feet below the channel of South Fork Pacheco Creek and would have up to 28 to 32 feet of cover under SR 152. The trenchless construction will need to minimize ground settlement to meet tight tolerances under SR 152 to meet the Caltrans standards. During detailed design of the trenchless crossing/tunnel, analyses will identify the minimum slurry pressure required to achieve excavation face stability and maintain surface ground movements within acceptable levels. Once tunneling begins, ground movement will be monitored at regular intervals to determine whether the ground is responding as predicted to confirm the design calculations and to allow for refinements of the tunneling operation to achieve the appropriate balance of parameters before tunneling beneath the creek.

Shafts would be required for the trenchless crossing beneath SR 152 and South Fork Pacheco Creek to launch and receive the tunneling machine. Each shaft would be approximately 25 feet wide and 100 feet long. The northern shaft would have a maximum depth of approximately 28 feet and the southern shaft would have a maximum depth of approximately 45 feet. Each shaft would have a leveled working area to launch/retrieve the tunneling machine. Beyond this, the bottom of excavation would be graded to the pipe invert elevation. The temporary shaft support design would consist of a piling system and may include an internal bracing system.

Replacement of Existing Pacheco Conduit

Under all action alternatives, the existing prestressed concrete cylindrical Pacheco Conduit would be removed from service in the late fall or early winter; this removal from service would be coordinated with the routine annual maintenance activities of the conduit that also require removal from service. Segments of the existing Pacheco Conduit would be removed and the new tie-in connection and approximately 910 feet of new steel pipe would be installed via open-trench construction methods. Service in Pacheco Conduit would then be restored. The estimated outage duration of Pacheco Conduit is approximately two months. Construction area requirements for the replacement of Pacheco Conduit would be similar to those described for the conveyance pipeline, including trench widths and active work areas. Similar to the open trench construction described for the conveyance pipeline, for the conduit replacement trench, topsoil would be stripped and stockpiled. Following conduit replacement, topsoil would be replaced, and the area would be revegetated with native species.

As part of the replacement of Pacheco Conduit, two motorized valves, each with a bypass, would be installed along the replaced section of Pacheco Conduit, located immediately upstream and downstream of the tie-in. A similar valve and bypass would be installed on the new conveyance pipeline. A vault structure would be constructed to house the three valves.

Construction of the vault structure would include excavation and dewatering, preparing foundations, preparing formwork and pouring concrete, and installing valves and equipment.

Dewatering

Under all action alternatives, dewatering during pipeline construction would be accomplished with a trench sump and an engine-driven dewatering pump on an as-needed basis, depending on groundwater conditions during construction. Pit sumps, groundwater wells, or a combination of both may be used to dewater the excavation. Once captured, dewatered water would be used for on-site construction water needs (e.g., dust control) or would be stored on-site in temporary containment basins or tanks to allow sediments to settle. Following settlement, captured water not used for on-site construction water needs or would be discharged into a jurisdictional water in accordance with regulatory requirements (e.g., NPDES construction general permit). If needed for the operation of pipeline sending and receiving pits, dewatering wells may be constructed to adequately dewater the construction area. Groundwater would be treated similarly to that encountered during open-trench construction.

Post-construction, the dewatering wells would be capped and abandoned in compliance with applicable requirements (i.e., Valley Water's Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County).

New Pump Station Construction

For all action alternatives, construction methods for the pump station, surge tanks, and electrical substation would consist of excavation and dewatering for subfloors, foundations, and building pads; preparing formwork and pouring concrete; installation of pumps and equipment; and final finishing of the pump station building interior. Site grading would be performed to develop a parking lot adjacent to the building. A potable well would be installed consistent with Santa Clara County requirements (i.e., Valley Water's Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County). A septic system would also be constructed adjacent to the pump station consistent with Santa Clara County requirements (i.e., 2013 Onsite Wastewater Treatment Systems (Septic) Ordinance).

3.3.2.5 Utilities Construction Methods

70 kV Power Transmission Line Construction

Under all action alternatives, transport of all grading equipment, drilling equipment, power poles, and poles and spools of transmission wire to each pole location, with the possible exception of the most eastern pole adjacent to the Staging Area (SA) 15 (see "Construction Staging Areas and Batch Plants" below and Exhibits 16 to 20 in Attachment A), would be by helicopter. Depending on the payload, light, medium, and heavy-lift helicopters may be used in the construction of this transmission line. When available, existing ranch roads and trails would be used to provide access for personnel and to transport relatively lightweight materials and equipment. Where no access trails are available, all equipment, materials, and possibly personnel would be helicoptered to the pole location.

Due to various types of environmental constraints (e.g., wind, temperature) and seasonal restrictions (e.g., eagle breeding and nesting season), power line construction would occur over several construction years, beginning in construction year two.

The transmission line would be strung (i.e., wire would be installed) via helicopter. This construction approach would eliminate the need for road improvements and limit the amount of land disturbance required to install the transmission line. Based on the proposed construction approach for installing the wire (i.e., "pole-to-pole"), separate pulling/tensioning areas are unlikely to be needed. The overall approach would be to utilize smaller reels with only sufficient wire capacity to string the wires pole-to-pole (plus 10 percent) and attaching them to the insulators as individual segments. The sag would also be accomplished individually pole-to-pole with a relatively small tensioning rig or by aerial assistance. Utilizing this method would allow installation without further land area requirements other than needed to accomplish the drilling of the holes and backfilling as required at each pole location for the installation of the direct burial poles. Installing the wire would be sequenced with the drilling operations so that the wire installation pole-to-pole can be accomplished after the drilling and backfilling at pole site(s) are completed and the associated equipment is removed.

3.3.2.6 Vegetation Clearing, Removal, and Disposal Construction Methods

All action alternatives would require varying amounts of clearing, removal, and disposal of vegetation within specific portions of areas subject to inundation, as well as areas necessary to construct proposed facilities. Based on California Native Plant Society's 2020 online version of *A Manual of California Vegetation*, seventeen land cover types that occur throughout the construction and inundation area were categorized into five vegetation assemblages: forest, brush, riparian, grasslands and barren (CNPS 2020). These vegetation assemblages are referred to in the discussion of clearing, removal, and disposal of vegetation.

Five discrete clearing zones have been defined to characterize the degree and location of clearing for each action alternative. Each of the five clearing zones has a prescribed definition and respective approach to vegetation clearing and removal as shown in Table 3-24. Exhibits 33 through 37 of Attachment A illustrate the clearing zone areas for the Proposed Project and Alternatives A through D, respectively.

Table 3-24. Vegetation Clearing Zone Descriptions for the Proposed Project and Alternatives A Through D

Clearing Zone	Description of Clearing Zone Area	Clearing Prescription
Clearing Zone 1	From dam site to a distance 500 feet upstream of submerged water intake structure and upslope to an elevation equal to full pool level.	Clearing of all vegetation in forest and brush vegetation assemblages. No clearing is proposed for riparian, grasslands or barren vegetation assemblages.
Clearing Zone 2	Extends 2 miles upstream from Zone 1. Includes area downslope 100 feet from full pool elevation. Excludes tributary arms of expanded reservoir.	Clearing of all trees 8 inches dbh and greater in forest vegetation assemblage on slopes less than 60 percent. No clearing is proposed for brush, riparian, grasslands or barren vegetation assemblages.
Clearing Zone 3	Areas subject to inundation, excluding Zones 1, 2, and 4.	No clearing proposed.
Clearing Zone 4	Temporary roads, staging areas and borrow areas within the full pool inundation area.	Total clearing and removal of all vegetation assemblages other than barren on all slopes.
Clearing Zone 5	Construction activity areas: dam footprint and appurtenant features; temporary and permanent roads; power transmission line alignment and associated power transmission line staging area, water conveyance pipeline alignment and pumpstation footprint; and borrow and disposal sites.	Total clearing and removal (all land cover types/all slopes). Lands under power transmission lines would be cleared in conformance with federal and state requirements.

Key:
dbh = diameter measured at breast height

Within Zone 1, vegetation within forest and brush vegetation assemblages would be cleared to minimize the potential risk to dam and appurtenant infrastructure (including submerged intakes/outlets and spillway) from debris, and/or if it would affect reservoir water quality.

Clearing of other vegetation assemblages (e.g., riparian) would not be necessary as these assemblages would not be produce organic debris that would substantially impact proposed facilities or water quality. Removal of cleared vegetation from Zone 1 may occur on slopes of 60 percent or less; mechanical removal of cleared vegetation on slopes in excess of 60 percent would not occur within this zone to reduce resource impacts and address safety issues. Prescribed fire would be considered as a removal/disposal technique on slopes in excess of 60 percent to reduce fuel loads or minimize resource impacts at select locations within this zone.

Within Zone 2, trees 8 inches in diameter measured at breast height (dbh) and greater within forest vegetation assemblage on slopes less than 60 percent would be cleared along the main body of the expanded reservoir 100 feet downslope from the full pool elevation. No vegetation would be cleared in any of the tributary arms of the expanded reservoir. Removal of cleared vegetation from Zone 2 may occur on slopes of 60 percent or less.

Within Zone 3, no clearing of any vegetation would occur. As shown in Table 3-24, vegetation clearing and removal within Zones 4 and 5 would occur prior to, or coincident with grading and excavating activities.

Vegetation Clearing Techniques

Vegetation clearing techniques would include manual (human power), herbivore (livestock) and mechanized. Manual techniques would typically be used for trees 8 inches dbh and greater for forest and riparian vegetation assemblages. In addition to chainsaws of various sizes, hand tools (e.g., machete) may be used to cut brush and riparian vegetation assemblages where equipment access is restricted by physical or regulatory requirements (e.g., fire restrictions). When manual techniques would be used, the scale of the area requiring clearing would be a key consideration.

Mechanized techniques would be used to clear vegetation in forest, brush and riparian assemblages dependent on the site conditions (i.e., diameter and density of vegetation, slope and access). Mechanized equipment used for clearing would include bulldozers and excavators (machines that have the ability to push/pull over trees and scrape vegetation); machine head cutters and masticators that can cut forest, brush, and riparian vegetation assemblages (size of equipment is dependent on density and diameter of vegetation); and feller-bunchers (used to cut vegetation and then grab it as it’s cleared for removal).

Prescribed fire may also be a technique used for clearing forest, brush, and grassland vegetation assemblages at locations where fuel loads and climatic conditions are conducive. Both manual (e.g., hand crews) and mechanized (e.g., bulldozers, helicopters) may be used depending on prescriptive requirements unique to the type and location of prescribed fire treatment. Table 3-25 provides an estimate of the area (acres) and volume (tons) of vegetation subject to clearing within each zone, by action alternative.

Vegetation Removal Techniques

Vegetation removal techniques that would be used are largely dependent on slope, density and diameter of vegetation which can vary dramatically within the respective clearing zones. Removal of vegetation on low and moderate slopes (i.e., slopes less than 60 percent) would primarily be accomplished using mechanical techniques. Mechanical techniques would include mowing, mastication, crushing, chipping, brush raking, roller chopping and chaining. Both wheeled and tracked based skidders and loaders as well as ground-based cable yarders would be used as site conditions allow. Non-mechanical techniques include prescribed fire (hand piling, machine piling, broadcast burning), herbivore grazing/browsing, and hand piling may also be used under certain conditions (e.g., removal of brush by livestock on steep slopes).

Table 3-25. Estimates of Vegetation Subject to Clearing, Removal, and Disposal for the Proposed Project and Alternatives A Through D

Clearing Zone	Type	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
Clearing Zone 1	Acres Cleared	16.8	14.7	19.6	5.3	41.9
	Tons[1]	508	393	484	232	1,210
Clearing Zone 2	Acres Cleared	84.1	137.8	91.4	58.4	58.3
	Tons[1]	2,958	4,551	3,099	1,996	1,981
Clearing Zone 3	Acres Cleared	0	0	0	0	0
	Tons[2]	0	0	0	0	0
Clearing Zone 4	Acres Cleared	115.3	32.7	92.4	159.1	153.2
	Tons[1]	3,162	428	3,049	4,924	3,922
Clearing Zone 5	Acres Cleared	277.2	437.3	406.0	193.3	369.5
	Tons[1]	4,847	9,339	8,654	3,949	8,549
Totals	Acres Cleared	493.4	622.5	609.4	416.1	622.9
	Tons[1]	11,475	14,711	15,286	10,440	15,662

Note:

[1] The estimate of fuel volumes is presented as tons per acre cleared based on acreage, approximate tree size, density of vegetation and percent canopy cover. These values also took into consideration values presented in the Forest Service Field Guide for Identifying Fuel Models (USDA Forest Service 2009).

[2] Clearing Zone 3 will not be cleared under any alternative; the volume is not applicable.

Key:

TAF = thousand acre-feet

Vegetation Disposal Techniques

A variety of disposal techniques would be used to dispose of vegetation within the various clearing zones. The following techniques would be used depending on the type, amount, and condition of vegetation subject to either on-site use or off-site disposal:

- On-site use of chips, slash or logs for erosion control or ecological restoration (including on-site mulch development and use)
- On-site disposal of chips, slash or logs using burial or burning techniques
- Off-site transport to recycling, cogeneration or biochar[10] facility
- Off-site transport to permitted disposal facility

On-site, for the purposes of this discussion, includes vegetation either left-in-place after clearing, or use/disposal associated with other construction activities of all action alternatives. Left-in-place would apply to Clearing Zones 1 and 2 on slopes in excess of 60 percent and

[10] Biochar is a charcoal-like substance that's made by burning organic material from agricultural and forestry wastes (also called biomass) in a controlled process called pyrolysis. During pyrolysis biomass is burned in a container with very little oxygen. As the biomass burns, it releases little to no contaminating fumes. During the pyrolysis process, the organic material is converted into biochar, a stable form of carbon that can't easily escape into the atmosphere.

essentially means that there would be no removal or disposal after clearing occurs on steep slopes. Material used in conjunction with construction activities (e.g., restored channel, borrow and disposal areas) could include cut brush/slash, chips, branches, logs, whole trees, and stumps. The on-site disposal of chips, cut brush/slash, logs/large branches, and whole trees/stumps/root wads would be incorporated into facility designs (e.g., erosion control, site restoration, mitigation actions, be treated with prescribed fire or buried).

Off-site disposal includes removal from the construction area and transported to locations outside the Project Area for various forms of reuse (e.g., landscape, cogeneration fuel, biochar production). Off-site disposal would also require transport of biomass that cannot be reused to an approved disposal site (e.g., landfill).

Under all action alternatives, vegetation clearing, removal, and disposal activities would occur in phases to accommodate construction and inundation schedules. These activities within Clearing Zones 4 and 5 would be concurrent with the grading and excavation efforts associated with the construction of each facility (e.g., dam, permanent roads, pipeline) or development of borrow, disposal, and staging areas, as applicable. The specific type and location where these would occur within these two clearing zones are largely dependent on slope (i.e., landform) and vegetation assemblage. Generally, the steeper the slope, the more limitations there are with respect to clearing, removing, and disposing of vegetation. The following slope categories serve as guidelines for what equipment, methods, or techniques may be used for these activities:

- 0-30 percent slopes – Slopes where wheeled or track vehicles and heavy equipment can operate to perform clearing, removal, and disposal activities
- 30-60 percent slopes – Slopes where track vehicles can function for clearing, removal, and disposal of vegetation under certain conditions
- 60+ percent slopes – Slopes in excess of 60 percent are typically limited to manual clearing and essentially unavailable for tracked equipment to remove and dispose of material

Vegetation Removal Timing

For forest vegetation assemblages in Zones 1 and 2, all trees 8 inches dbh and greater would be cleared before bird breeding season begins[11] over multiple years. These clearing efforts would be initiated once access improvements at SR 152 and Kaiser-Aetna Road are completed. To the extent possible, tree clearing in Zones 4 and 5 would occur outside the nesting bird season (e.g., September 1 to January 15). This would minimize the amount of habitat available that could be used by breeding and nesting migratory birds within the forest vegetation assemblages prior to full inundation.

Within those areas associated with brush vegetation assemblages in Zone 1, clearing, removal, and disposal activities would be deferred to the later years in the construction schedule (e.g., years five through eight). This would reduce the potential for this vegetation assemblage to reestablish to a point where it could provide breeding and nesting habitat for migratory birds prior to inundation. To the extent possible, brush clearing in Zones 1, 4 and 5 would occur outside the nesting bird season (e.g., September 1 to January 15).

[11] Clearing during bird breeding season would require breeding bird surveys which could result in delay of clearing of specific locations where breeding and/or nesting activity is documented until juveniles have left the nest.

3.3.3 Overall Construction Program

3.3.3.1 Construction Staging Areas and Batch Plants

All action alternatives would include temporary roads for mobilization and site access during construction. These temporary construction access roads would be connected to the new permanent dam access roads and facilitate transportation to the staging, borrow, disposal, and stockpile areas.

Construction Staging Areas

Under all action alternatives, facilities construction would require the use of several staging areas to allow for temporarily storage of materials and equipment, contractor and construction management offices, and parking for workers and construction vehicles. Staging areas for the Proposed Project and Alternative C would also be used for aggregate processing for the hardfill dam mix. Exhibits 16 through 20 in Attachment A present the proposed construction staging areas associated with the Proposed Project and Alternatives A through D, respectively. Exhibits 21 through 25 in Attachment A provide additional detail for the construction staging areas for the Proposed Project and Alternatives A through D, respectively. A summary of the size of each staging area for the Proposed Project and Alternatives A through D is presented in Table 3-26.

Table 3-26. Summary of Staging Areas for the Proposed Project and Alternatives A through D

Staging Area	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir (acres)	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir (acres)	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir (acres)	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir (acres)	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir (acres)
SA-1	3.9	3.9	3.9	3.9	3.9
SA-2	1.4	1.4	1.4	1.4	1.4
SA-3	9.1	--	--	--	--
SA-4	2.9	2.9	2.9	2.9	2.9
SA-5	12	9.8	9.8	12	12
SA-6	14.6	14.6	14.6	14.6	14.6
SA-7	1.2	1.2	1.2	1.2	1.2
SA-8	3.8	3.8	3.8	3.8	--
SA-9	6.3	6.3	6.3	6.3	--
SA-10	8.9	8.9	8.9	5.3	--
SA-11	6.2	--	--	--	--
SA-12	10.8	7.4	9.1	--	--
SA-13	1	1	1	1	1
SA-14	0.4	0.4	0.4	0.4	0.4
SA-15	1.2	1.2	1.2	1.2	1.2
Total	83.7	62.8	64.5	54.0	38.6

Key:
SA = staging area
TAF= thousand acre-feet

Development of the staging areas SA-1 through SA-14 would include light grading however neither heavy grading nor tree removal is proposed for these staging areas. To accommodate use of helicopters for power transmission line construction, development of SA-15 would require grading and placement of aggregate to level the area and provide a stable landing zone. For SA-15, the topsoil would be stripped and stockpiled prior to grading, and upon completion of power transmission line construction, aggregate would be removed and disposed of off-site, topsoil would be replaced, and the site would be revegetated with native species in consideration of physical characteristics (e.g., slope, soils, water availability).

3.3.3.2 On-Site Borrow, Disposal, and Stockpiling Areas

Sources of on-site materials for construction of the hardfill or earthfill dam include shell borrow areas (SBA), core borrow areas (CBA), dam and spillway foundation excavation sites, and the existing dam site. Exhibits 16 through 20 in Attachment A present the proposed construction on-site borrow, disposal, and stockpiling areas associated with the Proposed Project and Alternatives A through D, respectively. Exhibits 21 through 25 in Attachment A provide additional detail for the on-site borrow, disposal, and stockpiling areas for the Proposed Project and Alternatives A through D, respectively.

Preparation of the shell and core borrow areas would include stripping and stockpiling of topsoil, excavation, sorting of materials, slope stabilization, and implementation of any associated work access or material processing areas. The cut slopes for the borrow areas used to construct the core would be designed to be stable after use. In the construction and processing of the borrow areas, the topsoil would be stripped and stockpiled for use in areas of revegetation. After construction, borrow areas within the expanded reservoir inundation area would be shaped to drain during reservoir operations (e.g., fill and drawdown) and include erosion control treatments, if appropriate (e.g., most borrow areas would have exposed weathered rock and erosion control treatments would not be applied to these areas). After construction, borrow areas located outside of inundation areas of the expanded reservoir would be graded and contoured for drainage to prevent rainwater from pooling.

On-Site Material Borrow Areas

Two types of borrow areas have been designated for the action alternatives: shell borrow areas and core borrow areas. For all action alternatives, shell borrow areas would be excavated to provide material for the hardfill dam aggregate (hardfill mix) and earthfill dam shells. Core borrow areas would be excavated to provide material for the earthfill dam core as part of Alternatives A, B, and D. In total, there are two core borrow areas and four shell borrow areas throughout the construction area. The general borrow area plan for the Proposed Project and Alternatives A through D is shown in Exhibits 16 through 20, respectively.

<u>Shell Borrow Areas</u>

Under all action alternatives, up to four shell borrow areas would be excavated to provide material for the hardfill dam aggregate (hardfill mix) and earthfill dam shells. The area and total estimated volume of available material from each shell borrow area for the Proposed Project and Alternatives A through D is summarized in Table 3-27. Topsoil would be removed from the shell borrow areas and stored at the edge of the borrow site, or at designated storage or stockpile areas, the underlying materials extracted, and topsoil replaced. For shell borrow areas located outside of the new inundation area, after the processing of the material excavated from the borrow areas is completed and the sites are restored to stable condition, the topsoil would be replaced and the site would be revegetated with native species in consideration of physical characteristics (e.g., slope, soils, water availability).

Table 3-27. Summary of Shell Borrow Area Size and Volumes for the Proposed Project and Alternatives A through D

Shell Borrow Area	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir		Alternative A Upstream, Earthfill Dam 140 TAF Reservoir		Alternative B Upstream, Earthfill Dam 96 TAF Reservoir		Alternative C Downstream, Hardfill Dam 140 TAF Reservoir		Alternative D Downstream, Earthfill Dam 140 TAF Reservoir	
	Area (Acres)	Volume (MCY)[1]	Area (Acres)	Volume (MCY)[1]	Area (Acres)	Volume (MCY)[1]	Area (Acres)	Volume (MCY)[1]	Area (Acres)	Volume (MCY)[1]
SBA-1	23.0	3.1	23.0	3.1	23.0	3.1	23.0	3.1	23.0	3.1
SBA-2	--	--	--	--	--	--	28.2	4.3	28.2	4.3
SBA-3	17.6	2.2	32.7	5.1	17.6	2.2	17.6	2.2	17.6	2.2
SBA-4	11.9	0.8	11.9	0.8	11.9	0.8	11.9	0.8	11.9	0.8
Total Available[2]	--	4.1	--	10.7	--	7.6	--	6.9	--	10.4
Total Required[2]	--	2.9	--	7.6	--	5.6	--	3.5	--	6.9

Notes:
[1] All volumes are in-situ in the borrow area.
[2] Excludes the waste that would be part of the excavation.
Key:
SBA = shell borrow area

Core Borrow Areas

Core borrow areas would only be required for the earthfill dam alternatives (Alternatives A, B, and D). For Alternatives A, B, and D, CBA-1 would be used as the primary borrow source for the core material and CBA-2 would serve as a reserve source of material. Processing of borrow, such as crushing for aggregate and removal of oversize rocks and initial moisture conditioning for core material, would take place within these borrow areas. The area and total estimated volume of available material from each core borrow area for Alternatives A, B, and D is summarized in Table 3-28.

CBA-1 used to construct the earthfill dam core would also be used as a disposal area. Topsoil would be removed from the core borrow areas and stored at the edge of the borrow site, or at a designated storage or stockpile areas, the underlying clay material extracted, disposal materials placed (CBA-1 only), and topsoil replaced. After the processing of the material excavated from the borrow areas is completed and the sites are restored to stable condition, the topsoil would be replaced and the site would be revegetated with native species in consideration of physical characteristics (e.g., slope, soils, water availability).

Table 3-28. Summary of Core Borrow Area Size and Volumes for Alternatives A, B, and D

Core Borrow Area	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir		Alternative B Upstream, Earthfill Dam 96 TAF Reservoir		Alternative D Downstream, Earthfill Dam 140 TAF Reservoir	
	Area (Acres)	Volume (MCY) [1]	Area (Acres)	Volume (MCY) [1]	Area (Acres)	Volume (MCY) [1]
CBA-1	88.5	2.7	88.5	2.7	88.5	2.7
CBA-2	21.6	0.5	21.6	0.5	21.6	0.5
Total Volume Available[2]	--	2.6	--	2.6	--	2.6
Total Volume Required [2]	--	1.4	--	1.0	--	1.4

Notes:
[1] All volumes are in-situ in the borrow area.
[2] Excludes the waste that would be part of the excavation.

Key:
CBA = core borrow area
MCY = million cubic yards

On-Site Stockpile Areas
Although the new earthfill dams associated with Alternatives A, B, and D would be constructed in large part from local materials quarried from nearby borrow areas, on-site core materials and imported filter and drain materials would be stockpiled. Stockpile areas would be used for moisture conditioning of core materials prior to placement. As shown in Exhibits 22 and 23, Stockpile Area 1 (SPA-1) is the same for Alternatives A and B, respectively. SPA-1 for Alternatives A and B is approximately 21.2 acres in size. Exhibit 25 presents the location of SPA-1 for Alternative D. SPA-1 for Alternative D is approximately 29.2 acres in size.

Batch Plants
All action alternatives include the development of batch plants located within staging areas or borrow areas to allow for material mixing on site during construction. Consistent with the staging areas identified in Table 3-26 for each Action Alternative, the contractor would set up an on-site concrete batch plant at one of the following staging areas: SA-3, SA-4, SA-5, SA-7, SA-8, SA-9, SA-10, SA-11, or SA-12. Due to proximity of sensitive receptors (e.g., residences) or other considerations (e.g., distance from facilities requiring concrete), the on-site concrete batch plant would not be located in SA-1, SA-2, SA-6, SA-13, SA-14, and SA-15. These proposed staging areas would be able to accommodate the concrete batch plant which is estimated to require 2 acres. For the Proposed Project and Alternative C, which include hardfill dams, the contractor would also set up a hardfill batch plant in a borrow area near the dam. The borrow areas identified in Table 3-27 for the Proposed Project and Alternative C would be able to accommodate the hardfill batch plant which is estimated to require 4 acres.

On-Site Disposal Areas
Under all action alternatives, unsuitable or excess material from foundation, existing dam, and borrow area excavations would be disposed of in designated reservoir disposal areas (RDA). Summarized in Table 3-29, RDA-1 and RDA-3 are located downstream of the upstream dam site below the maximum pool elevation of the downstream dam alternatives (Alternatives C and D). RDA-2, RDA-4, and RDA-5 are located within the expanded reservoir upstream of the upstream dam site, below the full pool elevation (e.g., inundation area of expanded reservoir) of both the upstream and downstream dam alternatives. The area excavated in CBA-1 for the earthfill dam alternatives would also be used for disposal of excess waste materials from the

dam and spillway foundation excavations. In addition to the RDAs identified in Table 3-29, portions of the inundation area of the existing Pacheco Reservoir between the new dam and existing dam would also be used for disposal. Disposal within this existing inundation area would occur in areas at elevations above the channel and floodplain restoration areas described in Section 3.2.5.2 in a manner that provides for unimpaired flow of water and sediment from tributaries to the North Fork Pacheco Creek restoration channel.

Disposal areas would be designed and graded to promote surface water drainage and minimize ponding or standing water. For disposal areas outside of the expanded reservoir inundation area, once the disposal areas are restored to a stable condition, the topsoil would be imported from on-site stockpiles or from approved off-site commercial sources to cap these areas. These areas would be revegetated with native species in consideration of physical characteristics (e.g., slope, soils, water availability) at conclusion of construction.

Table 3-29. Summary of Reservoir Disposal Areas for the Proposed Project and Alternatives A Through D

Reservoir Disposal Areas	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir		Alternative A Upstream, Earthfill Dam 140 TAF Reservoir		Alternative B Upstream, Earthfill Dam 96 TAF Reservoir		Alternative C Downstream, Hardfill Dam 140 TAF Reservoir		Alternative D Downstream, Earthfill Dam 140 TAF Reservoir	
	Area (Acres)	Volume (MCY)	Area (Acres)	Volume (MCY)	Area (Acres)	Volume (MCY)	Area (Acres)	Volume (MCY)	Area (Acres)	Volume (MCY)
RDA-1	20.0	1.4	--	--	--	--	41.2	3.0	41.2	3.0
RDA-2	20.1	1.7	20.1	1.7	20.1	1.7	20.1	1.7	--	--
RDA-3	--	--	--	--	--	--	20.3	1.8	--	--
RDA-4	17.6	1	--	--	--	--	--	--	--	--
RDA-5	17.9	1.1	--	--	--	--	--	--	--	--
CBA-1	--	--	88.5	1.7	88.5	1.3	--	--	88.5	2
Total Available Volume	--	5.2	--	3.4	--	3.0	--	6.5	--	5
Total Required Volume	--	3.8	--	3.1	--	2.5		4.9	--	4.1

Key:
RDA = reservoir disposal area
MCY = million cubic yards

3.3.3.3 Commercial Sources for Construction Materials

Under all action alternatives, material needed for construction is primarily from on-site borrow areas as described above. However, filter, drain, concrete aggregate, cement/fly ash, rebar, and riprap materials would most likely need to be supplied from off-site commercial sources. The most likely sources for these materials are three quarries between 27 and 35 miles west of the construction area (Granite Construction Company and Stevens Creek Quarry, respectively) and one quarry about 33.5 miles east of the construction area (Vulcan Materials Company). For Alternatives A, B, and D, due to the large quantities of imported filter and drain materials needed, a portion of the materials would need to be stockpiled on-site ahead of placement. Table 3-30 summarizes the key construction materials proposed to be sources from off-site commercial sources.

Table 3-30. Summary of Key Construction Materials from Off-Site Commercial Sources

Materials	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
Filter and Drain (CY)	--	872,000	780,000	--	932,000
Riprap (CY)	--	85,000	80,000	--	85,000
Cement and Flyash (CY)	500,000-1,000,000[1]	100,000-300,000[2]	20,000-200,000[2]	500,000-1,000,000[1]	100,000-300,000[2]
Roadway Aggregate (CY)	50,100	50,100	50,100	43,100	52,600
Hot Mix Asphalt (CY)	20,600	20,600	20,600	14,830	22,500

Notes:
[1] The volume of cement and flyash required for hardfill material will be informed by test fill program.
[2] Cement needed for spillway, pump station, grouting, shaft, and other facilities.

Key:
CY = cubic yard

3.3.3.4 Offsite Disposal

Waste materials not suitable for disposal in the identified on-site disposal areas, such as materials from dam decommissioning (e.g., concrete, rebar), existing building and utility demolition, would be hauled to an authorized offsite location for recycling or disposal (e.g., RJR Recycling, Recology South Valley Organic Composting Facility, Billy Wright Landfill). Valley Water would explore creative recycling approaches including recycling vegetative materials for use as compost, biochar, and/or fuel for cogeneration power plants before relying on landfills to dispose of solid waste. Concrete materials, as feasible, would be recycled on-site by the contractor. Table 3-31 summarizes the estimated off-site solid waste disposal requirements and concrete recycling by construction year for the Proposed Project and Alternatives A thorough D.

Table 3-31. Summary of Off-Site Disposal by Construction Year for the Proposed Project and Alternatives A through D

Alternative	Type	Annual Quantity by Construction Year (Tons/Year)								Total (Tons)
		1	2	3	4	5	6	7	8	
Proposed Project	Solid Waste	313	3,002	938	938	938	938	938	748	8,844
	Recycled Concrete	-	-	65	261	261	261	261	-	1,159
Alternative A	Solid Waste	313	3,002	938	938	938	938	938	436	8,525
	Recycled Concrete	-	152	261	261	261	239	152	-	1,386
Alternative B	Solid Waste	313	3,002	938	938	938	938	748	-	7,891
	Recycled Concrete	-	152	261	261	261	261	-	-	1,250
Alternative C	Solid Waste	313	3,002	938	938	938	938	938	1,139	9,239
	Recycled Concrete	-	-	65	261	261	261	261	195	1,363
Alternative D	Solid Waste	313	3,002	938	938	938	938	859	826	8,844
	Recycled Concrete	-	152	261	261	261	239	152	65	1,454

3.3.3.5 Water Sources During Construction

Various water supply sources would be used during construction of the new dam and associated facilities under all action alternatives. Of the construction activities discussed throughout Section 3.2, six activities would require substantial water use. These activities include:

- Dust Control (all action alternatives) – Water for dust control would be needed throughout the entire construction duration. The major areas requiring dust control are the temporary access roads, the shell and core borrow area excavations, the existing embankment excavation, the spillway excavation for earthfill alternatives, and the dam foundation excavation.
- Embankment Earthwork (Alternatives A, B, and D only) – When embankment materials are excavated, they would require moisture conditioning prior to placement and compaction.
- Hardfill Mix (Proposed Project and Alternative C only) – The hardfill mix would be developed on-site. Water would be required to mix with aggregate, cement, and/or fly ash.
- Foundation Grouting and Concrete (all action alternatives) – Foundation grouting and concrete consists of the grout curtain and surface treatment of the foundation with slush grout, backfill concrete, and dental concrete, all of which would require water for mixing.
- Moisture Conditioning at Disposal Areas (all action alternatives) – Water for conditioning of materials during placement at disposal areas would be needed throughout the construction period.
- Concrete Structures (all action alternatives) – The major concrete structures included as part of the action alternatives consist of the spillway, inlet/outlet works, and pump station/substation pad. Water would be required for concrete mixing.

Construction water needs would vary throughout the construction period, depending on the type of construction activities occurring. The estimated maximum annual demand for the Proposed Project and Alternatives A through D is presented in Table 3-32.

Table 3-32. Construction Water Needs by Construction Year for the Proposed Project and Alternatives A Through D

Construction Year	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir (million gallons/year)	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir (million gallons /year)	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir (million gallons /year)	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir (million gallons /year)	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir (million gallons /year)
Year 1	3.6	3.6	3.6	2.6	2.6
Year 2	20.8	33.0	30.1	27	15.2
Year 3	17.4	21.6	17.4	27.1	12.0
Year 4	72.2	59.5	57.9	53.0	56.0
Year 5	71.9	61.6	56.8	53.0	69.1
Year 6	70.6	61.6	56.8	50.7	69.1
Year 7	70.6	38.3	6.0	55.1	66.4
Year 8	4.8	1.3	--	24.7	50.7
Totals	331.9	280.5	228.6	293.2	341.1

Key:
MGD = million gallons per day
TAF = thousand acre-feet

To meet the construction water demands of the action alternatives, up to four potential sources of construction water would be utilized:

- Connection to Pacheco Conduit (temporary and permanent)
- Groundwater Wells
- Import from commercial sources
- Local runoff and dewatering activities

For all action alternatives, the majority of construction water would be provided though temporary and permanent connections to Pacheco Conduit. A temporary connection to Pacheco Conduit would be developed during the initial year of construction. Prior to the completion of the temporary connection to Pacheco Conduit, construction water would be sourced from commercial sources and groundwater wells. Following the initial year of construction, construction water would be sourced from either the temporary or permanent connection to Pacheco Conduit except for very limited periods during conduit outages (e.g., scheduled outages required to conduct maintenance activities, unscheduled outages/emergencies). During these limited outages of Pacheco Conduit, water would be sourced from commercial sources and groundwater wells. Water from local runoff and dewatering activities would be used throughout the construction period, as available.

Connection to Pacheco Conduit

Most of the water needed for construction activities would come from the Pacheco Conduit. Two types of connections to Pacheco Conduit would be made: a temporary connection (to an existing air valve or blowoff) and via the use of the permanent connection. A temporary connection to the Pacheco Conduit would be completed during the first year of construction. A temporary water supply, either trucked in from a commercial source or from on-site groundwater wells, would be required until the construction of temporary connection is completed. A temporary tie-in would involve construction of a 12-inch-diameter high density polyethylene (HDPE) pipe above ground and extend to near the proposed pump station (per Proposed Project and Alternatives A through D, respectively). The pipe would cross the South Fork Pacheco Creek on an approximately 100-foot-long pipe rack bridge and run beneath the SR 152 bridge just west of the intersection of SR 152 and El Toro Road. A temporary connection to the conduit would take approximately six weeks to construct. An existing air valve or blow off would be used for the temporary connection to Pacheco Conduit; development of this temporary connection would not result in any disruption of the water supply through Pacheco Conduit.

The permanent connection would be constructed as described above (see Section 3.3.2.4, “Replacement of Existing Pacheco Conduit”). The permanent connection and conveyance pipeline would be constructed near the pump station where the water could be accessed. Similar to the period prior to the construction temporary tie-in to Pacheco Conduit, during outages of Pacheco Conduit, a temporary water supply trucked in from a commercial source or from on-site groundwater wells, would be required.

Groundwater Wells

The potable water well that would be developed to serve the pump station associated with each action alternative is also proposed to be used for construction water prior to establishment of the conduit source and during outages of Pacheco Conduit. Additional wells are proposed be installed at locations around the site to supplement construction water supply during the first year of construction (i.e., prior to establishment of temporary tie-in to Pacheco Conduit and during outages of Pacheco Conduit). On-site groundwater is proposed to be accessed and used by constructing a series of groundwater wells. Up to 5 on-site wells would be constructed consistent with Santa Clara County requirements (i.e., Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County (Valley Water 2013) or updated requirement), each drilled to a depth of approximately 500 feet. Well yields would need to be confirmed by test wells, but generally wells drawing from fracture-rock aquifers yield 10 gallons per minute or less. The groundwater wells may be relatively closely spaced within several hundred feet from each other. The wells would be located away from construction traffic and borrow sites but within the temporary construction areas and permanent footprint of facilities and/or existing/future reservoir inundation areas. It is estimated that the well system would take approximately eight weeks to construct and would include temporary storage (e.g., tanks) and power facilities (e.g., generators). The groundwater wells would be completed in the first year of construction. Other than the well which would be developed to serve the pump station, other wells would be decommissioned by filling the entire well casing with cement-based sealing materials following the construction period.

Import from Commercial Source

If wells or a connection to the Pacheco Conduit are not yet installed, offsite commercial sources would be used for sources of water during construction during the initial year of construction and during outages of Pacheco Conduit. During these times, portions of the water needed for construction activities would be imported via trucks from outside sources. During the initial year of construction, available sources for commercial water include sources located along SR 152, such as Casa De Fruta, approximately 7 miles southwest of the construction site.

Local Runoff and Dewatering Activities

Local runoff collected behind the cofferdam would be used for construction activities (e.g., dust abatement). Also, water developed through dewatering activities, such as dam foundation construction, sediment removal from within the existing reservoir inundation area (as required), and pipeline construction, would be used to meet a portion of the construction water requirements (e.g., dust control for roadways).

3.3.3.6 Temporary Work Areas

Under all action alternatives, temporary work areas would be established to facilitate construction of new facilities and replacement of existing facilities (e.g., existing utilities, segment of Pacheco Conduit). Table 3-33 summarizes the temporary work areas for each facility type for the Proposed Project and Alternatives A through D.

Table 3-33. Temporary Work Areas for Facilities for the Proposed Project and Alternatives A Through D

Facility/Item	Temporary Work Area
Dam, Spillway, and Inlet/Outlet Works	
Dam	200 feet from permanent facility footprint
Spillway	50 feet from permanent facility footprint[1]
Water Conveyance	
Pipeline – Open Trench	50 feet on each side of alignment (100 feet total)
Pipeline – Microtunneling Shafts	60 feet on each side of alignment (120 feet total)
Replacement of a Portion of the Existing Pacheco Conduit	50 feet on each side of alignment (100 feet total)
Pump Station	25 feet from permanent facility footprint
Existing North Fork Dam Decommissioning	50 feet from facility footprint
Permanent Access	
SR 152 Access Improvements	15 feet from temporary or permeant features
Frontage Road	15 feet on each side of roadway footprint[1]
Dam Access Roads	15 feet to west of roadway footprint
Pacheco Conduit Tie-In Road	15-foot on each side of roadway footprint[2]
Auxiliary Access Roads	15-foot on both sides of roadway footprint[2]
Property Owner Access Roads	20-foot on both sides of traveled way
Utilities	
Power Transmission Line Pole Construction	50-foot on each side of alignment (100 feet total)
Above-Ground Telecommunication Relocation	20 feet on each side of alignment (40 feet total)
Other	
Temporary Construction Water Pipeline	15 feet on each side of alignment (30 feet total)

Notes:
[1] Temporary work area for spillways associated with Alternatives A, B and D only (e.g., alternatives with new earthfill dams). Spillways associated with the Proposed Project and Alternative C are integrated into dam.
[2] Roadway footprint includes traveled way, road shoulders, and extent of cut/fill for roadway construction

Key:
SR 152 = State Route 152

3.3.3.7 Work Force and Equipment

Table 3-34 presents the estimated on-site workers (average)for construction of the Proposed Project and Alternative C. Table 3-35 presents the estimated on-site workers (average) for construction of Alternatives A, B, and D. During the peak of construction, the on-site workers would consist of multiple crews of construction workers plus construction management personnel.

Table 3-36 provides a list of the typical construction equipment that would be on-site during construction for the Proposed Project and Alternatives A through D. Equipment may be removed from the site when no longer needed for construction activities.

Table 3-34. Estimated Average Number of On-Site Workers During Construction Period for Proposed Project and Alternative C

Time Period		Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir			Alternative C Downstream, Hardfill Dam 140 TAF Reservoir		
		Day	Night	Total[1]	Day	Night	Total[1]
Year 1	February to December	100	65	165	100	65	165
Year 1/2	January	80	50	130	80	50	130
Year 2	February to December	240	160	400	240	160	400
Year 2/3	January	120	85	205	120	85	205
Year 3	February to December	210	135	345	210	135	345
Year 3/4	January	140	90	230	140	100	240
Year 4	February to December	250	160	410	250	160	410
Year 4/5	January	140	95	235	140	100	240
Year 5	February to December	210	135	345	210	135	345
Year 5/6	January	140	100	240	140	100	240
Year 6	February to December	250	160	410	250	160	410
Year 6/7	January	140	100	240	140	100	240
Year 7	February to December	250	160	410	250	160	410
Year 7/8	January	120	85	205	120	85	205
Year 8	February to December				230	160	390

Notes:

[1] For each on-site worker, one commuter trip utilizing SR 152 would be required to access construction areas.

Key:

TAF = thousand acre-feet

Table 3-35. Estimated Average Number of On-Site Workers During Construction Period for Alternatives A, B and D

Time Period		Alternative A Upstream, Earthfill Dam 140 TAF Reservoir			Alternative B Upstream, Earthfill Dam 96 TAF Reservoir			Alternative D Downstream, Earthfill Dam 140 TAF Reservoir		
		Day	Night	Total[1]	Day	Night	Total[1]	Day	Night	Total[1]
Year 1	April 15 to November 15	150	105	255	140	95	235	170	110	280
Year 1/2	November 15 to April 15	120	80	200	110	75	185	130	90	220
Year 2	April 15 to November 15	360	240	600	340	225	565	400	260	660
Year 2/3	November 15 to April 15	190	120	310	170	120	290	200	140	340
Year 3	April 15 to November 15	320	205	525	300	195	495	340	230	570
Year 3/4	November 15 to April 15	220	140	360	200	135	335	230	160	390
Year 4	April 15 to November 15	380	245	625	350	235	585	410	270	680
Year 4/5	November 15 to April 15	220	140	360	200	135	335	230	160	390
Year 5	April 15 to November 15	320	205	525	300	195	495	340	230	570
Year 5/6	November 15 to April 15	220	140	360	200	135	335	230	160	390
Year 6	April 15 to November 15	380	245	625	350	235	585	410	270	680
Year 6/7	November 15 to April 15	220	140	360	200	135	335	230	160	390
Year 7	April 15 to November 15	380	245	625				410	270	680
Year 7/8	November 15 to April 15	190	120	310				200	140	340
Year 8	April 15 to November 15							390	260	650

Notes:
[1] For each on-site worker, one commuter trip utilizing SR 152 would be required to access construction areas.

Key:
TAF = thousand acre-feet

Table 3-36. Typical Construction Equipment for Proposed Project and Alternatives A Through D

Type	Proposed Project and Alternative C	Alternatives A and B	Alternative D
Earthmoving Equipment	• 231 HP Dozer • 520 HP Dozer with Disc • 5.5 CY Loader • 231 HP Tractor with Blade • 7 CY Excavator • 20 CY Excavator • 30 Ton Compactor • 67 Ton Off Hwy Truck • 6000 Gallon Water Truck	• 140 HP Dozer • 231 HP Dozer • 520 HP Dozer with Disc • 5.5 CY Loader • 231 HP Tractor with Blade • 7 CY Excavator • 20 CY Excavator • 30 Ton Compactor • 67 Ton Off Hwy Truck • 6000 Gallon Water Truck	• 140 HP Dozer • 231 HP Dozer • 520 HP Dozer with Disc • 5.5 CY Loader • 231 HP Tractor with Blade • 7 CY Excavator • 20 CY Excavator • 30 Ton Compactor • 67 Ton Off Hwy Truck • 6000 Gallon Water Truck
Concrete Equipment	• Concrete Mixer • 90 YPH Trailer Mounted Concrete Pump • Concrete Vibrator-Normal • Concrete Truck	• Concrete Mixer • 90 YPH Trailer Mounted Concrete Pump • Concrete Vibrator-Normal • 8 YPH Wet Shotcrete Pump (Swing 750) • Shotcrete Plant 50CY (Wet)	• Concrete Mixer • 90 YPH Trailer Mounted Concrete Pump • Concrete Vibrator-Normal • 8 YPH Wet Shotcrete Pump (Swing 750) • Shotcrete Plant 50CY (Wet)
Utility Equipment	• 600 CFM Diesel Compressor • 300 Amp Diesel Welder	• 160 CFM Diesel Compressor • 600 CFM Diesel Compressor • Welder 300 Amp Diesel Welder	• 160 CFM Diesel Compressor • 375 CFM Diesel Compressor • Welder 300 Amp Diesel Welder
Hoisting Equipment	• 50 Ton Truck Crane • 75 Ton Crawler Crane • Motorized Manlift 66 Feet	• 50 Ton Truck Crane • 75 Ton Crawler Crane • Motorized Manlift 66 Feet	• 50 Ton Truck Crane • 75 Ton Crawler Crane • Motorized Manlift 66 Feet
Drilling and Tunneling Equipment	• 4-inch Air Track Drill • Horizontal Auger • Pile Hammer and Lead, 41,000 foot-pound • 90-foot Hydraulic Bolting Rig	• 4-inch Air Track Drill • Horizontal Auger • Pile Hammer and Lead, 41,000 foot-pound • 90-foot Hydraulic Bolting Rig	• 4-inch Air Track Drill • Horizontal Auger • Pile Hammer and Lead, 41,000 foot-pound • 90-foot Hydraulic Bolting Rig
Paving Equipment	• Asphalt Paver (225 HP) • Double Steel Drum Roller (142 HP) • Skip Loader (68 HP) • Asphalt Grinder	• Asphalt Paver (225 HP) • Double Steel Drum Roller (142 HP) • Skip Loader (68 HP) • Asphalt Grinder	• Asphalt Paver (225 HP) • Double Steel Drum Roller (142 HP) • Skip Loader (68 HP) • Asphalt Grinder

Table 3-36. Typical Construction Equipment for the Proposed Project and Alternatives A Through D (contd.)

Type	Proposed Project and Alternative C	Alternatives A and B	Alternative D
Aerial Equipment	• Heavy Lift Helicopter	• Heavy Lift Helicopter	• Heavy Lift Helicopter
Other Vegetation Clearing, Removal, and Disposal Equipment	• Chainsaws 25 CC • Medium Feller/Buncher 175 HP • Large Feller/Buncher 300 HP • Medium Skidder 175 HP • Large Skidder 175 HP • Loader Rubber Tired 300 HP • Masticator on Excavator 175 HP • Whole Tree Chipper 300 HP • Large Diameter Chipper/Shredder 100 HP • Cable Yarder 160 HP • Rotary Mower 25 HP • Small Diameter Chipper 25 HP • Tractor/Loader/Backhoe 25 HP • Tractor/Loader/Backhoe 175 HP • Masticator on Excavator 175 HP • Flail/Mulcher on Excavator 260 HP	• Chainsaws 25 CC • Medium Feller/Buncher 175 HP • Large Feller/Buncher 300 HP • Medium Skidder 175 HP • Large Skidder 175 HP • Loader Rubber Tired 300 HP • Masticator on Excavator 175 HP • Whole Tree Chipper 300 HP • Large Diameter Chipper/Shredder 100 HP • Cable Yarder 160 HP • Rotary Mower 25 HP • Small Diameter Chipper 25 HP • Tractor/Loader/Backhoe 25 HP • Tractor/Loader/Backhoe 175 HP • Masticator on Excavator 175 HP • Flail/Mulcher on Excavator 260 HP	• Chainsaws 25 CC • Medium Feller/Buncher 175 HP • Large Feller/Buncher 300 HP • Medium Skidder 175 HP • Large Skidder 175 HP • Loader Rubber Tired 300 HP • Masticator on Excavator 175 HP • Whole Tree Chipper 300 HP • Large Diameter Chipper/Shredder 100 HP • Cable Yarder 160 HP • Rotary Mower 25 HP • Small Diameter Chipper 25 HP • Tractor/Loader/Backhoe 25 HP • Tractor/Loader/Backhoe 175 HP • Masticator on Excavator 175 HP • Flail/Mulcher on Excavator 260 HP

Key:
CC = cubic centimeters
CFM = cubic feet per minute
CY = cubic yard
HP = horsepower
YPH = yard per hour

3.3.3.8 Truck Trips and Haul Routes

Under all action alternatives, several construction activities would lead to increases in traffic generation on roadways near the Project site. These activities would include hauling of equipment and material to and from the Project work sites and daily arrival and departure of construction workers. Construction trucks on local roadways would include dump trucks, concrete trucks, water tankers, and other delivery trucks. Dump trucks and other large construction vehicles would be used for import of materials (e.g., filter materials for earthfill dams, cement and fly ash for hardfill dams) and removal of waste (e.g., demolition of structures). Other trucks would be used to deliver heavy construction equipment, job trailers, concrete forming materials, piping materials, piles, other facility equipment and supplies, and other miscellaneous deliveries. Some deliveries of large construction equipment (e.g., excavators), equipment to be installed at facilities (e.g., pumps, valves), and construction materials (e.g., power poles, pipe) would be transported as over-sized loads.

Based on the location of the construction sites associated with the action alternatives, it is likely that construction workers would use a combination of local roads and SR 152 on their daily commute. However, the majority of the commuter trips would use the same roads, primarily SR 152 and a short portion of Kaiser-Aetna Road. Because of the duration and material demands of each action alternative, the number of truck trips required for the construction activities described above varies among the action alternatives. The number of truck trips per construction year associated with importing materials onto the construction sites and removing waste materials is shown in Table 3-37. All construction vehicles and commuter vehicles would access the construction area by utilizing SR 152. Construction truck trips and commuter trips are estimated to be distributed evenly between the westbound and eastbound travel directions on SR 152. Table 3-38 presents the peak estimated hourly volumes for construction related vehicles (e.g., autos for on-site workers and heavy trucks for importing materials/removing waste) during the construction period.

Table 3-37. Estimated Number of Truck Trips Per Year During Construction Period for the Proposed Project and Alternatives A Through D

Time Period	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir			Alternative A Upstream, Earthfill Dam 140 TAF Reservoir			Alternative B Upstream, Earthfill Dam 96 TAF Reservoir			Alternative C Downstream, Hardfill Dam 140 TAF Reservoir			Alternative D Downstream, Earthfill Dam 140 TAF Reservoir		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
Year 1	4,642	4,642	9,285	3,484	3,484	6,968	2,351	2,351	4,702	1,989	1,989	3,978	3,654	3,654	7,309
Year 2	4,534	4,534	9,067	3,501	3,501	7,003	2,370	2,370	4,740	1,976	1,976	3,951	3,805	3,805	7,610
Year 3	383	383	765	635	635	1,270	638	638	1,276	406	406	812	734	734	1,469
Year 4	5,522	5,522	11,044	8,446	8,446	16,892	7,848	7,848	15,697	4,333	4,333	8,666	8,765	8,765	17,531
Year 5	5,522	5,522	11,044	8,446	8,446	16,892	7,848	7,848	15,697	5,805	5,805	11,611	8,765	8,765	17,531
Year 6	5,522	5,522	11,044	7,972	7,972	15,943	7,466	7,466	14,933	5,805	5,805	11,611	8,765	8,765	17,531
Year 7	5,522	5,522	11,044	4,066	4,066	8,132	266	266	532	5,805	5,805	11,611	8,239	8,239	16,479
Year 8	128	128	255	53	53	106	--	--	--	4,333	4,333	8,666	3,286	3,286	6,571

Key:
-- = not applicable
TAF = Thousand acre-feet

Table 3-38. Peak Estimated Hourly Volumes for Construction Related Vehicles During the Construction Period for the Proposed Project and Alternatives A Through D

Time Period	Peak Hour Volumes			Traffic Composition (Percent)		
	Trucks	Autos	Total	Trucks	Autos	Total
Proposed Project	21	125	146	14%	86%	100%
Alternative A	17	190	207	8%	92%	100%
Alternative B	16	178	194	8%	92%	100%
Alternative C	22	125	147	15%	85%	100%
Alternative D	18	207	225	8%	92%	100%

Key:
% = percent

3.4 Operations and Maintenance

3.4.1 Operations

Under the Proposed Project and Alternatives A through D, facilities associated with the expanded reservoir, including the inlet/outlet works, pipeline, pump station, and telecommunications utilities, would be remotely operated by Valley Water, and power transmission facilities would be operated by Power and Water Resources Pooling Authority (PWRPA), Western Area Power Authority (WAPA), or PG&E. These facilities and expanded reservoir would be operated to increase water supply reliability and system operational flexibility, help meet M&I and agricultural water demands during drought periods and emergencies, increase suitable habitat for SCCC steelhead in Pacheco Creek, and improve water quality and minimize water supply interruptions related to San Luis Reservoir low point issues. Operations would entail:

- Capturing and storing natural inflows during wetter periods for release during dry periods, both annually (i.e., capture winter flows for summer release and use), and across multiple years (i.e., capturing and storing water during wetter years for release and use during drier years and/or emergencies), and
- Integrating the expanded reservoir within Valley Water (Proposed Project and Alternatives A through D) and SBCWD (Proposed Project and Alternative C only) water supply and distribution systems to optimize use of all available supplies, including CVP and SWP supplies, other imported supplies, other local surface supplies, and conjunctive use/groundwater recharge.

Major operational components of the action alternatives are provided in Table 3-39.

3.4.1.1 Natural Inflow and Integrated Water Management Operations

Under all action alternatives, inflows to the expanded reservoir would include a combination of natural inflows from the surrounding watershed and contract CVP supplies transferred from San Luis Reservoir via the Pacheco Conduit. Valley Water and SBCWD do not plan to acquire water for storage from sources other than the CVP or North and East Fork Pacheco Creek at this time. If any transfer water were proposed for storage in the future, such transfers would undergo appropriate Project-specific environmental review at that time.

Natural Inflow

Under all action alternatives, the expanded reservoir would capture and store natural inflows from North and East Fork Pacheco Creek. These inflows are typically realized during the wet season, from December through April, and are influenced by timing and amount of precipitation, antecedent soil and vegetation conditions, and evapotranspiration. Based on historical data, annual inflow volumes are estimated to range between approximately 50,000 acre-feet in wetter years to less than 50 acre-feet in the driest years, with a long-term historical average of 12,600 acre-feet and 13,100 acre-feet for the proposed upstream (Proposed Project and Alternatives A and B) and downstream (Alternatives C and D) dam sites, respectively. For supporting information on inflow hydrology, see Chapter 3 of the Water Resources and Fisheries Numerical Modeling Appendix.

Table 3-39. Summary of Major Operational Components of the Proposed Project and Alternatives A Through D

Operational Component	Proposed Project Upstream, Hardfill Dam 140 TAF Reservoir	Alternative A Upstream, Earthfill Dam 140 TAF Reservoir	Alternative B Upstream, Earthfill Dam 96 TAF Reservoir	Alternative C Downstream, Hardfill Dam 140 TAF Reservoir	Alternative D Downstream, Earthfill Dam 140 TAF Reservoir
Valley Water Active Storage Volume (acre-feet)	125,910	139,900	95,000	125,730	139,700
SBCWD Active Storage Volume (acre-feet)	13,990	0	0	13,970	0
Total Active Storage (acre-feet)	139,900	139,900	95,000	139,700	139,700
Flow Release Schedule to Pacheco Creek	Variable[1]	Fixed[2]	Fixed[2]	Variable[1]	Fixed[2]
Habitat Storage Reserve (acre-feet)	35,000	55,000	55,000	35,000	55,000
IL4 Refuge Deliveries in Below Normal Water Years[3] (acre-feet)	2,000	2,000	2,000	2,000	2,000

Notes:

[1] Releases to North Fork Pacheco Creek from the expanded reservoir and associated downstream flow targets vary depending on water year type and reflect input received from regulatory agencies and Water Storage Investment Program funding agencies.

[2] Releases to North Fork Pacheco Creek from the expanded reservoir and associated downstream flow targets are consistent across all water year types and are based on the Pacheco Reservoir Expansion Project Initial Study (see Attachment A of the Public and Agency Scoping Process Appendix) and Water Storage Investment Program application for the Pacheco Reservoir Expansion Project (Valley Water 2017).

[3] Below Normal water years as defined by the Sacramento Valley Water Year Index.

Key:
IL4 = Incremental Level 4
SBCWD = San Benito County Water District
Valley Water = Santa Clara Valley Water District

Flood Management

To avoid increasing flood risk compared to the No Project Alternative, the Proposed Project and Alternatives A through D would make at least 5,500 acre-feet of storage capacity available in the expanded reservoir at the beginning of the wet season to capture natural inflows. If necessary, storage capacity would be made available by releasing water to Pacheco Conduit until the expanded reservoir was 5,500 acre-feet below full capacity. Under the Proposed Project and Alternatives A through D, the expanded reservoir would not be operated with flood risk management as an objective, but additional incidental flood benefits would be achieved through the enlarged storage capacity of the expanded reservoir regardless of the dam capacity or site location.

Storage Capacity Distribution

As documented in a memorandum of understanding signed in 2018, SBCWD and Valley Water have agreed to explore a water storage and water resource allocation plan that would allow SBCWD to share up to 10 percent of the costs and benefits of the expanded reservoir. Under the Proposed Project and Alternative C, SBCWD and Valley Water would be allocated 10 percent and 90 percent, respectively, of the capacity of the expanded reservoir and the pipeline conveying supplemental CVP inflows into the expanded reservoir. SBCWD would be allocated 10 percent of the natural inflows and be responsible for 10 percent by volume of the scheduled flow releases to North Fork Pacheco Creek, while Valley Water would be allocated 90 percent of natural inflows and be responsible for 90 percent by volume of the scheduled flow release to North Fork Pacheco Creek. The evaporative loss of SBCWD stored water would be proportional to their volume in storage relative to total volume in storage.

Under Alternatives A, B, and D, Valley Water would be allocated 100 percent of the storage capacity of the expanded reservoir and 100 percent of the natural inflows and would be responsible for all scheduled flow releases to North Fork Pacheco Creek.

Water Supply Reliability

All action alternatives would enable Valley Water (Proposed Project and Alternatives A through D) and SBCWD (Proposed Project and Alternative C only) to better coordinate water supplies and more fully utilize CVP allocations by integrating the expanded reservoir into their local and imported water supply portfolio, providing operational flexibility and reliability under a range of conditions.

Valley Water and SBCWD each have contracts to receive M&I and agricultural water supplies from the CVP, subject to annual South-of-Delta allocations. Under the Proposed Project and action alternatives, the contract maximums associated with these contracts would remain unchanged, but Valley Water and SBCWD would modify their CVP delivery pattern from San Luis Reservoir.

Relative to the No Project Alternative, average CVP deliveries from San Luis Reservoir in the winter through early summer months would be increased to enable conveyance to and storage of CVP supplies in the expanded reservoir. These supplemental inflows would be conveyed when CVP supplies exceeded Valley Water (Proposed Project and Alternatives A through D) and SBCWD (Proposed Project and Alternative C only) raw water demands, or when CVP supplies otherwise could not have been delivered and/or stored locally as part of integrated system operations. Delivery of greater CVP supplies in the winter and spring, relative to the No Project Alternative, would also enable Valley Water (Proposed Project and Alternatives A through D) and SBCWD (Proposed Project and Alternative C only) to pump water into the expanded reservoir that is generally cooler and of better quality compared to water pumped from San Luis Reservoir in the summer and fall months. CVP supplies would generally be pumped into the expanded reservoir at intake elevations that minimize warming of the cold-water pool.

Relative to the No Project Alternative, average CVP deliveries from San Luis Reservoir through Pacheco Conduit in the summer and fall months would be reduced and offset by withdrawals from the expanded reservoir back into Pacheco Conduit. Depending on hydrologic and storage conditions, Valley Water (Proposed Project and Alternatives A through D) and/or SBCWD (Proposed Project and Alternative C only) would withdraw water supplies from the expanded reservoir to supplement deliveries to their water systems in periods when raw water demands exceed other available supplies, generally in drier years and typically during summer and fall months.

Annual volumes of CVP supplies pumped into and withdrawals from the expanded reservoir would depend upon annual CVP allocations, demands within Valley Water (Proposed Project and Alternatives A through D) and SBCWD (Proposed Project and Alternative C only) service areas, availability of other water supplies, storage levels in the expanded reservoir, and conveyance limitations of Pacheco Conduit. The annual volume of CVP supplies pumped into the reservoir would vary considerably depending on the identified considerations. Based on the Valley Water's Water Evaluation And Planning System (WEAP) model simulation under future conditions for the Proposed Project, results showed a range from zero acre-feet in a critical water year up to approximately 47,200 acre-feet in a wet water year. For Alternative A, results showed a range from zero acre-feet in multiple critical water years up to approximately 38,300 acre-feet during a below normal water year. For Alternative B, results showed a range from zero acre-feet in multiple critical water years up to approximately 30,500 acre-feet during a dry water year. For Alternative C, results showed a range from zero acre-feet in a critical water year up to approximately 43,200 acre-feet during a wet water year. For Alternative D, results showed a range from zero acre-feet in multiple critical water years up to approximately 37,700 acre-feet.

Operations During San Luis Reservoir Low Point Events

When San Luis Reservoir total storage drops below 300,000 acre-feet, algae at the surface of the reservoir may be entrained into the San Felipe Division intake, reducing the quality of CVP water delivered through the Pacheco Conduit. To improve the quality of water conveyed to Valley Water during these times, referred to as low point events, under all action alternatives, Valley Water would generally reduce the amount of CVP water delivered from San Luis Reservoir and increase withdrawals from the expanded reservoir into the Pacheco Conduit. The blended combination of expanded reservoir withdrawals and CVP supplies from San Luis Reservoir would be delivered to Valley Water's water treatment plants. Blend ratios would depend on concentration and type of algae present in San Luis Reservoir. Following low point events when water levels in San Luis Reservoir have risen, Valley Water would resume full delivery of CVP supplies from San Luis Reservoir to its treatment plants and to the expanded reservoir.

Operations During Emergencies

Under all action alternatives, the expanded reservoir would be operated to provide water supplies to Valley Water (Proposed Project and Alternatives A through D) and/or SBCWD (Proposed Project and Alternative C only) during emergencies, which may include:

- A major levee failure in the Sacramento-San Joaquin Delta, which would significantly degrade water quality,
- A major earthquake that would disrupt the ability of Valley Water and/or SBCWD to import water into their service area(s),
- Regional infrastructure failures, or
- Extended drought periods that result in supply interruptions.

In the event of an emergency, Valley Water (Proposed Project and Alternatives A through D) and/or SBCWD (Proposed Project and Alternative C only) would meet demands by withdrawing water from the expanded reservoir while storage remained above the habitat storage reserve (see Section 3.4.1.2 for description of habitat storage reserve). If a water supply interruption were determined to be an imminent risk to essential public health and safety, the Board of Directors of either agency could make an emergency declaration and Valley Water (Proposed Project and Alternatives A through D) and/or SBCWD (Proposed Project and Alternative C only) could continue to withdraw water from the expanded reservoir, including the habitat storage reserve, to meet demand.

CVPIA Incremental Level 4 Refuge Deliveries

Under Alternatives A, B, and D, Valley Water would provide 2,000 acre-feet to the CVPIA RWSP for allocation to the Incremental Level 4 (IL4) water supply pool in Below Normal water years as defined by the Sacramento Valley Water Year Index. Under the Proposed Project and Alternative C, Valley Water and SBCWD would provide 1,800 acre-feet and 200 acre-feet, respectively, to the CVPIA IL4 RWSP for allocation to IL4 refuges in Below Normal years. To provide these supplies, Valley Water and SBCWD would transfer portions of their current CVP contract allocation, directly or through exchanges, to the RWSP. The delivery schedule of CVP water would be flexible and could be made available directly from the Delta-Mendota Canal or via exchange using CVP water stored in San Luis Reservoir. This voluntary reallocation of CVP supplies would be secured by an agreement between the USFWS, California Department of Fish and Wildlife (CDFW), Reclamation, and Valley Water detailing the mechanisms and timing for delivery of this supply, and a contract between DWR, CDFW, and Valley Water for the provision of funding through the WSIP specific to this refuge water supply.

3.4.1.2 Releases to North Fork Pacheco Creek

Under all action alternatives, water for release to North Fork Pacheco Creek would be drawn into a low flow bypass pipeline located upstream of the dam and released from a bifurcation structure located near the toe of the new dam. When necessary, and if no supplemental CVP inflows were being pumped into the expanded reservoir, water could be withdrawn selectively from adits at different elevations for temperature control purposes and released through the bifurcation structure into North Fork Pacheco Creek. Timing and magnitude of releases would be based on a monthly flow schedule intended to increase suitable habitat for SCCC steelhead. Releases from the expanded reservoir into North Fork Pacheco Creek would also flow into mainstem Pacheco Creek and percolate through the streambed into the underlying groundwater subbasins, to be later pumped by PPWD.

All action alternatives are subject to one of two flow release schedules: Fixed Flow or Variable Flow. The Fixed Flow Schedule was generally presented in the 2017 Initial Study and was based on recommendations in the 2014 Report on Comprehensive Strategy and Instructions for Operation of Pacheco Reservoir (Micko 2014). Under the Fixed Flow Schedule (Alternatives A, B, and D), flow targets would remain constant across all water year types, and releases are generally targeted towards improving juvenile rearing habitat conditions and facilitating smolt outmigration. Since the Initial Study was released in 2017, an alternate flow schedule, the Variable Flow Schedule, was developed in a series of workshops as part of a collaborative process between Valley Water and stakeholder agencies, including but not limited to NMFS, USFWS, CDFW, SWRCB, and the California Water Commission. Under the Variable Flow Schedule (Proposed Project and Alternative C only), flow targets would vary across water year type, and releases would be made to facilitate smolt outmigration, support adult attraction, improve juvenile rearing habitat conditions in North Fork and mainstem Pacheco Creek, and improve the survival of steelhead eggs and fry. Flow releases would be managed with consideration of potential effects on aquatic species and native riparian vegetation communities in Pacheco Creek.

The major components of the Variable Flow Schedule and Fixed Flow Schedule are described in the following sections. Under all action alternatives, these flow schedules may be modified during the initial filling of the reservoir to account for actual hydrology during this period. Figure 3-3 presents key locations and physical features associated with Variable and Fixed Flow Schedules for the Proposed Project and Alternatives A through D.

Variable Flow Schedule for the Proposed Project and Alternative C

The flow release schedule for the Proposed Project and Alternative C is shown in Table 3-40 and reflects key components of the North Fork Pacheco Creek natural hydrograph: winter baseflows, pulse flows for adult attraction in January, February, and March that vary by water year type, pulse flows for juvenile outmigration in April and May, and summer baseflows that vary by water year type. Baseflows would be released continuously from the expanded reservoir, while pulse flows would typically be scheduled for release at the end of the month. To conserve water for releases during summer and drier years, the scheduled pulse flow would not be released from the new dam in a month if either of the following conditions were met:

- If a spill event occurred during the month, which resulted in a release of water from the dam equivalent to or greater than the scheduled pulse flow, or
- If the pulse flow target magnitude and duration intended to be released from the dam were exceeded at U.S. Geological Survey (USGS) streamgage 11153000 in Pacheco Creek (approximately 8 miles downstream of the confluence of North Fork and South Fork Pacheco Creek) due to the flow contributions from unregulated tributaries to Pacheco Creek.

Table 3-40. Flow Release Schedule Under the Proposed Project and Alternative C (Variable Flow Schedule)

Month	Baseflow					Pulse Flow									
	Continuous Releases from New Dam Outlet (cfs)					Pulse Flow Target Magnitude at New Dam Outlet[1,4] (cfs)					Pulse Flow Duration[1,4] (days)				
PRII Water Year	W	AN	BN	D	C	W	AN	BN	D	C	W	AN	BN	D	C
January	8	8	8	8	8	30	30	35	35	0	5	5	5	5	0
February	8	8	8	8	8	30	30	45	45	30	5	5	5	5	5
March	8	8	8	8	8	30	30	50	45	35	8	8	8	8	8
April	8	8	8	8	8	25	25	25	25	25	14[2]	14[2]	14[2]	14[2]	14[2]
May	10	10	10	10	8	25	25	25	25	25	7	7	7	7	7
June	11	11	11	10	8[3]	--	--	--	--	--	--	--	--	--	--
July	13	13	13	10	8[3]	--	--	--	--	--	--	--	--	--	--
August	13	13	13	10	8[3]	--	--	--	--	--	--	--	--	--	--
September	13	13	13	10	8[3]	--	--	--	--	--	--	--	--	--	--
October	13	13	13	10	8[3]	--	--	--	--	--	--	--	--	--	--
November	11	11	11	9	8	--	--	--	--	--	--	--	--	--	--
December	9	9	9	9	8	--	--	--	--	--	--	--	--	--	--

Notes:

[1] The scheduled pulse flow would not be released in a given month if the target pulse flow magnitude and duration were exceeded at USGS streamgage 11153000 in Pacheco Creek.

[2] 14-day total duration reflects two separate 7-day duration pulses.

[3] Baseflow releases may be reduced to induce dryback in drought periods (may occur in Critical inflow years).

[4] Pulse flows during January, February, and March would support adult SCCC Steelhead attraction. Pulse flows during April and May would support SCCC Steelhead smolt outmigration.

Key:

-- = Not applicable
AN = Above Normal
BN = Below Normal
C = Critical
cfs = cubic feet per second
D = Dry
PRII = Pacheco Reservoir Inflow Index
SCCC = South-Central California Coast
USGS = U.S. Geological Survey
W = Wet

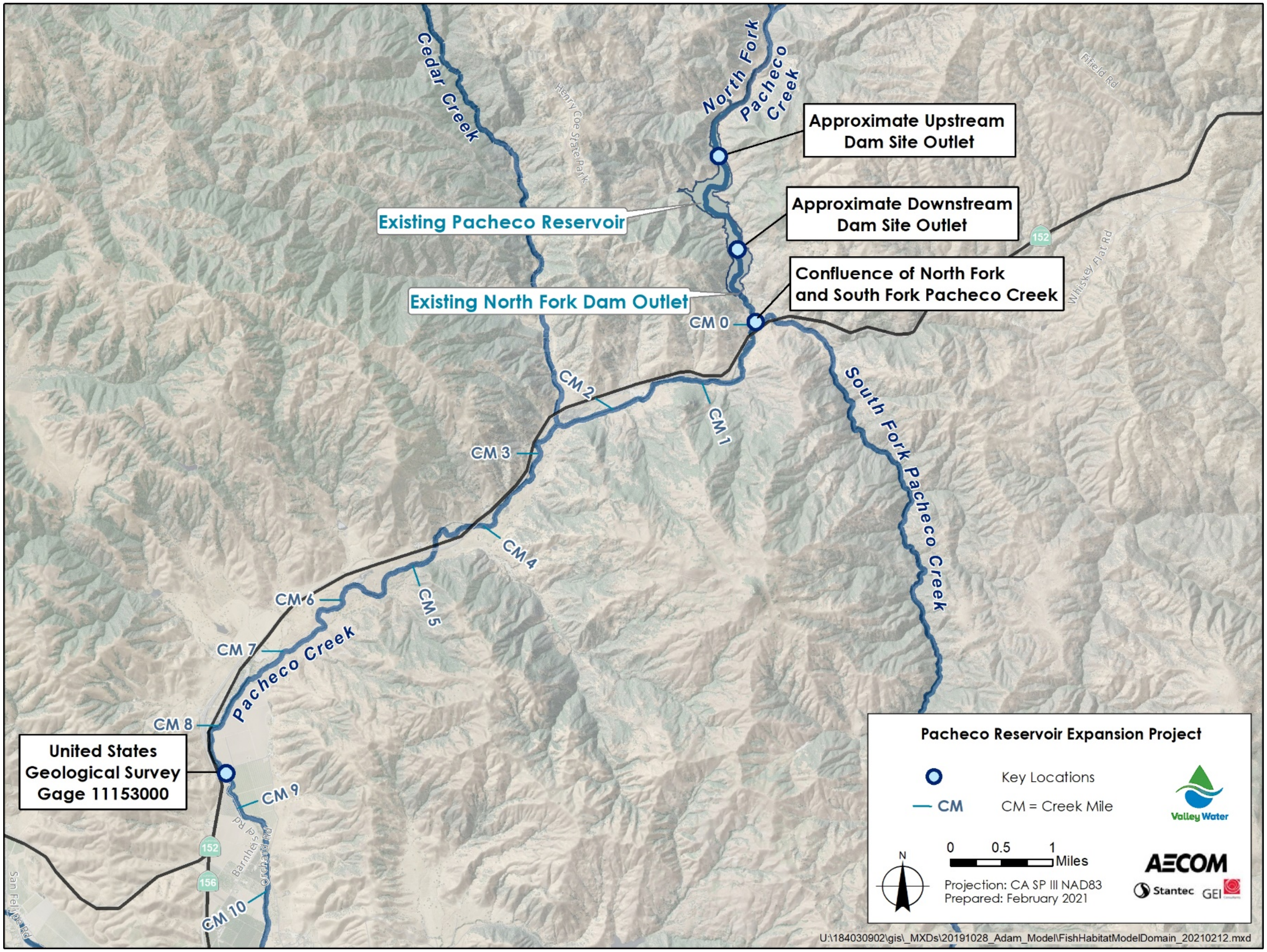


Figure 3-3. Key Locations and Physical Features Associated with Variable and Fixed Flow Schedules

Water Year Type Determination

A monthly determination of water year type would be made based on a Pacheco Reservoir Inflow Index (PRII). The PRII was developed by specifying ranges of annual inflow exceedance percentages that correspond to five Sacramento Valley Index water year types: Wet, Above Normal, Below Normal, Dry, and Critical. The corresponding upper and lower bounds on annual inflow to the expanded reservoir for each water year type exceedance range were calculated from modeled historical annual unimpaired inflow from 1922 to 2003. An inflow index was developed for each dam location to reflect small changes in drainage area and resulting unimpaired inflow, as shown in Table 3-41 for the Proposed Project and Table 3-42 for Alternative C. For additional information on inflow hydrology for the expanded reservoir, see Chapter 3 of the Water Resources and Fisheries Numerical Modeling Appendix.

Using all years of a given water year type, a mean cumulative monthly inflow was calculated starting at the beginning of the hydrologic year (i.e., October 1) and extending through the end of each subsequent month. These cumulative inflows serve as threshold values for determining monthly water year type and the corresponding baseflow and pulse flow targets for the following month. For example, for both the Proposed Project and Alternative C, if cumulative inflow through December is 500 acre-feet, a Below Normal water year type would be assigned for January since cumulative inflow exceeds the threshold of 400 acre-feet for Below Normal years but is less than the 600 acre-feet threshold for Above Normal years. If the cumulative inflow increases to 5,000 acre-feet at the end of January, the February water year type would be changed to Above Normal. Once the wet season is over in May, cumulative inflow from the prior October through May would be used to determine water year type for assigning baseflows through December.

Table 3-41. Pacheco Reservoir Inflow Index Thresholds for the Proposed Project

Pacheco Reservoir Inflow Index Water Year Type	**Wet**	**Above Normal**	**Below Normal**	**Dry**	**Critical**
Annual Inflow Exceedance (percent)	0 – 30	31 – 45	46 –66	67 – 86	87 –100
Estimated Annual Inflow Range (acre-feet)	50,000 – 20,000	20,000 – 12,500	12,500 – 4,800	4,800 – 1,500	1,500 – 0
End of Month	**Cumulative Monthly Inflow Thresholds (acre-feet)**				
December	1,000	600	400	200	0
January	6,000	4,000	1,000	800	0
February	13,000	8,000	3,400	1,000	0
March	20,000	12,000	3,800	1,100	0
April	20,000	12,500	4,800	1,500	0
May	20,000	12,500	4,800	1,500	0

Note:
[1] Annual flow exceedance represents the percentage of years the annual inflow would be exceeded. For example, as shown under critical years, inflows to the reservoir would exceed 1,500 acre-feet in 87 percent of the years.

Table 3-42. Pacheco Reservoir Inflow Index Thresholds for Alternative C

Pacheco Reservoir Inflow Index Water Year Type	Wet	Above Normal	Below Normal	Dry	Critical
Annual Inflow Exceedance[1] (percent)	0 – 30	31 – 45	46 –66	67 – 86	87 –100
Estimated Annual Inflow Range (acre-feet)	52,000 – 21,000	21,000 – 13,000	13,000 – 5,000	5,000 – 1,600	1,600 – 0
End of Month	**Cumulative Monthly Inflow Thresholds (acre-feet)**				
December	1,000	600	400	200	0
January	6,000	4,000	1,000	800	0
February	14,000	10,000	3,500	1,000	0
March	21,000	12,000	4,000	1,200	0
April	21,000	13,000	5,000	1,600	0
May	21,000	13,000	5,000	1,600	0

Note:
[1] Annual flow exceedance represents the percentage of years the annual inflow would be exceeded. For example, as shown under critical years, inflows to the reservoir would exceed 1,600 acre-feet in 87 percent of the years.

Baseflows

Under the Proposed Project and Alternative C, as shown in Table 3-39, baseflows would be released continuously from the expanded reservoir in all months. Winter and spring (January through April) baseflows are intended to contribute towards maintaining suitable SCCC steelhead spawning conditions in North Fork Pacheco Creek, from the outlet of the new dam to the confluence with South Fork Pacheco Creek. These baseflows would combine with the unregulated flow from South Fork Pacheco Creek to provide suitable spawning conditions in most PRII water year types in Pacheco Creek and would provide an opportunity for adults to access and spawn in North Fork Pacheco Creek in the restored stream channel downstream of the new dam and in the South Fork Pacheco Creek and its tributaries. Summer and fall (June through December) baseflows proposed in Wet, Above Normal, and Below Normal water years would not vary by year type and are intended to maintain suitable steelhead rearing habitat to approximately 8 miles downstream of the new dam outlet. These baseflows would be increased in magnitude during warmer summer months to improve water temperature conditions for rearing steelhead. In Dry and Critical water years, releases in June through November would be lowered (i.e., relative to wet, above normal, and below normal year types) to conserve water for multi-year droughts and allow for dryback induced mortality of non-native or invasive riparian vegetation in lower Pacheco Creek. These baseflows are intended to sustain suitable rearing habitat to approximately 6 miles downstream of the new dam outlet. These baseflows would be subject to further reduction as discussed in ”Dryback and Additional Environmental Pulse Flow Management” section below.

Adult SCCC Steelhead Attraction Pulse Flows

Under the Proposed Project and Alternative C, adult attraction pulse flows in January, February, and March, shown in Table 3-39, are intended to attract steelhead into Pacheco Creek, and to provide unobstructed passage for adult steelhead through Pacheco Creek to both the North Fork and South Fork. In each month, flow would be monitored at USGS streamgage 11153000 Pacheco Creek Near Dunneville to check if the adult attraction pulse flow target magnitude and duration from Table 3-39 were exceeded. If the targets were not exceeded by the last week of the month, the pulse flow magnitude shown in Table 3-39 would be released from the dam outlet. To enhance attraction of adult steelhead into Pacheco Creek, adult attraction pulse flow releases would be timed, to the extent possible, with prescribed adult attraction pulse releases made by Valley Water from Uvas Reservoir to Uvas Creek when rule curve criteria were met, and with runoff from Uvas Creek tributaries and other Upper Pajaro tributaries.

SCCC Steelhead Smolt Outmigration Pulse Flows
Under the Proposed Project and Alternative C, smolt outmigration pulse flows in April and May are consistent across all year types and are intended to facilitate smolt outmigration and provide unobstructed passage downstream in North Fork Pacheco Creek and through Pacheco Creek. The smolt outmigration pulse flow may also enhance outmigration of kelts (spawned out adult steelhead returning to the ocean). Two 7-day duration pulse flows would be made in April, while one 7-day duration pulse flow would be made in May. In each month, flow would be monitored at USGS streamgage 11153000 Pacheco Creek Near Dunneville to check if the smolt outmigration pulse flow target magnitude and duration from Table 3-39 were exceeded. If the targets were not exceeded by the first and third week of April of the first week of May, the pulse flow magnitude shown in Table 3-39 would be released from the dam outlet. To the extent possible, smolt outmigration pulse flow releases would be timed with other prescribed smolt outmigration pulse releases by Valley Water from Uvas Reservoir to maximize flows through the Pajaro River channel and increase smolt outmigration success.

Habitat Storage Reserve
Under the Proposed Project and Alternative C, a 35,000-acre-foot habitat storage reserve would be maintained to provide suitable flows and water temperatures for steelhead in North Fork and mainstem Pacheco Creek during multi-year droughts. If the expanded reservoir storage decreased to 35,000 acre-feet, the reserve would be managed independent of water supply operations to provide flow releases to North Fork Pacheco Creek according to the Variable Flow Schedule. If Valley Water and/or SBCWD made an emergency declaration for health and safety purposes, they would be able to withdraw water supply from the habitat storage reserve.

Dryback and Additional Environmental Pulse Flow Management
Under the Proposed Project and Alternative C, in years when adult migration most likely does not occur due to lack of hydrologic connectivity in the Pajaro River system, and other steelhead life stages within Pacheco Creek are not likely to be present to benefit from summer/fall baseflows (e.g., June – October), reservoir releases for summer/fall baseflows may be reduced to develop water supplies to create later environmental pulse flows. Such reductions in summer/fall baseflows would allow portions of Pacheco Creek to go dry (i.e., dryback of Pacheco Creek). The dryback would mimic the intermittent character of the natural system and help maintain a functional stream ecosystem that addresses the needs of native riparian communities such as California sycamore alluvial woodlands, a CDFW sensitive natural community. These operations would be intended to reduce growth and potentially contribute to mortality in willows that may establish near the edge of the perennial flow footprint and compete with California sycamore woodlands; lower groundwater tables to promote sycamore tap root growth; and reduce invasive and predatory fish and wildlife species that may establish due to the perennial nature of summer baseflows in most water year types.

Under the Proposed Project and Alternative C, based on specified trigger criteria (described below), the flow schedule would be modified by reducing releases from June through October, with the intent of creating a dry creek bed and receding groundwater table within mainstem Pacheco Creek down to at least Highway 156, where perennial flow is observed to reemerge from groundwater aquifers into Pacheco Creek. Releases may be reduced to no less than 2 cfs, but the minimum release rate in any year would be set to ensure the cumulative inflow from October of the previous calendar year through June of the current year was released from June through October. As dryback would be implemented during critical years when baseflows are relatively low (i.e., 8 cfs), ramping rates would be set at 1 cfs every four hours in order to reduce the risk of stranding fish. Implementation of a dryback by Valley Water would be based on both of the following trigger threshold criteria being met:

- No dryback operation implemented in the previous five years, and
- Cumulative inflow to the expanded reservoir from October through April is less than the Dry year minimum inflow threshold of 1,600 acre-feet.

Once the trigger criteria are met, a decision to implement summer dryback would be made in May by Valley Water in coordination with the appropriate regulatory agencies. The decision may also be informed by additional criteria, including how often flow at USGS 11159000 Pajaro River at Chittenden streamgage was less than 45 cfs—the approximate threshold for adult steelhead passage over critical riffles—in each month from January through March, no adult steelhead observed spawning in Pacheco Creek from January through March, and the timing and effectiveness of previous dryback operations on managing the natural system, including willow management and non-native species control.

The difference between the flow volume that would have been released based on the flow schedule and the reduced flow volume released during a dryback period would constitute a “dryback volume.” The dryback volume would be managed for release as a high magnitude, short duration environmental pulse flow in the appropriate winter season in a subsequent non-dryback year. The environmental pulse flow would be released to transport sediment, scour soil, substrate, and other non-native plants that may establish near the edge of the perennial flow footprint, and contribute to other geomorphic processes that may benefit maintenance of steelhead habitat. This environmental pulse flow magnitude would be limited by the discharge capacity of the outlet conduit of the new dam and would not exceed the bankfull flow in Pacheco Creek, estimated to be approximately 1,500 cfs with a magnitude that varies throughout the creek. Timing and duration of the pulse flow would be based on the following criteria:

- Storage is above the habitat reserve threshold,
- Carried out in January, February, or early March to generally coincide with the ripening and dispersal of sycamore seeds and adult steelhead migration, and
- Timed to not coincide with a peak flow from unregulated tributaries that could result in property damage downstream.

Timing of the environmental pulse flow would be determined in coordination with the appropriate regulatory agencies. To the extent possible, the environmental pulse flow would be timed to occur on the receding limb of a similar magnitude or larger natural pulse event to extend the energy of a natural pulse event and avoid independently destroying redds (nests dug by steelhead in stream gravel) that may be present in Pacheco Creek. Prior to conducting an environmental pulse flow, Valley Water would implement protocols and procedures such as notifying downstream residents of upcoming environmental pulse flows, as needed.

Fixed Flow Schedule for Alternatives A, B, and D

Under Alternatives A, B, and D, Valley Water would make releases from the expanded reservoir to meet average monthly flow targets at the confluence of North Fork and South Fork Pacheco Creek as shown in Table 3-43. Mean monthly baseflow targets would remain fixed from year to year and range from 10 to 14 cfs, with higher flow targets to improve rearing conditions in the summer. A 15-day pulse flow target of 30 cfs would support juvenile outmigration in March and April. From November through May, if flows in South Fork Pacheco Creek as measured at the confluence of North Fork and South Fork Pacheco Creek exceed the monthly baseflow target, releases from the expanded reservoir would be reduced to 2 cfs to preserve a larger cold-water pool that could be released during summer months and multi-year droughts. In March and April, if flows in South Fork Pacheco Creek exceeded 30 cfs for the first 15 days of each month, releases from the expanded reservoir would be reduced to 2 cfs for the month and the pulse flow would not be released.

Table 3-43. Average Monthly Flow Targets in Pacheco Creek Under Alternatives A, B, and D (Fixed Flow Schedule)

Month	Baseflow	Pulse Flow	
	Mean Monthly Baseflow Target at Confluence of North Fork and South Fork Pacheco Creek[1] (cfs)	Pulse Flow Target at Confluence of North Fork and South Fork Pacheco Creek (cfs)	Pulse Flow Duration (Days)
January	10[1]	--	--
February	10[1]	--	--
March	10[1]	30[1]	15[2]
April	10[1]	30[1]	15[2]
May	12[1]	--	--
June	13	--	--
July	14	--	--
August	14	--	--
September	14	--	--
October	14	--	--
November	10[1]	--	--
December	10[1]	--	--

Source: Releases generally derived from Micko 2014

Notes:

[1] Releases from the expanded reservoir would be reduced to 2 cfs when flows from South Fork Pacheco Creek exceeded the mean monthly baseflow target.

[2] 15-day total duration reflects two distinct pulses: one 7-day duration pulse and one 8-day duration pulse.

Key:
cfs = cubic feet per second

Under Alternatives A, B, and D, a 55,000-acre-foot habitat storage reserve would be maintained to provide suitable flows and water temperatures for steelhead in North Fork and mainstem Pacheco Creek during multi-year droughts. If the expanded reservoir storage decreased to 55,000 acre-feet, the reserve would be managed independent of water supply operations to provide flow releases to North Fork Pacheco Creek according to the Fixed Flow Schedule. If Valley Water and/or SBCWD made an emergency declaration for health and safety purposes, they would be able to withdraw water supply from the habitat storage reserve.

Flow Schedule Implementation

Once the expanded reservoir is operational, the annual flow schedule would be implemented month-by-month starting each October as outlined in Table 3-44. The implementation timeline identifies when Valley Water is anticipated to coordinate with regulatory agencies and other appropriate stakeholders.

Table 3-44. Annual Flow Schedule Implementation Timeline for the Proposed Project and Alternatives A Through D

Timeframe	Actions for the Proposed Project and Alternative C	Actions for Alternatives A, B, and D
All Months	• Conduct monitoring, gather data, and evaluate conditions	• Conduct monitoring, gather data, and evaluate conditions
October through December	• Continue reservoir baseflow releases according to current year water year type • Begin tracking cumulative water year inflow to the expanded reservoir to establish next year water year type • If dryback operations were in place, continue releasing 2 cfs (October)	• Release baseflow per flow schedule (October) • Monitor flow at North Fork and South Fork Pacheco Creek confluence and adjust reservoir releases accordingly to meet baseflow targets (November and December)
January through April	• Release continuous baseflow per flow schedule • Monitor flow at USGS gage 11153000 Pacheco Creek Near Dunneville and release adult attraction pulse flow, if required (January – March), based on water year type • Monitor flow at USGS gage 11153000 Pacheco Creek Near Dunneville and release smolt outmigration pulse flow, if required (April) • If necessary, monitor lower Pajaro River USGS stream gages to inform possible dryback decision • If necessary, Valley Water convenes a meeting with the regulatory agencies and appropriate stakeholders to determine the release schedule for an environmental pulse flow	• Monitor flow at North Fork and South Fork Pacheco Creek confluence and adjust reservoir releases accordingly to meet baseflow and/or pulse flow targets
April or May	• If necessary, Valley Water convenes a meeting with regulatory agencies and appropriate stakeholders to review dryback triggers	
May	• Monitor flow at USGS gage 11153000 Pacheco Creek Near Dunneville and release smolt outmigration pulse flow, if required	• Monitor flow at North Fork and South Fork Pacheco Creek confluence and adjust reservoir releases accordingly to meet baseflow targets
June through September	• Release baseflow based on water year type per flow schedule or implement dryback if trigger criteria met and recommended regulatory agencies and appropriate stakeholders	• Release baseflow per flow schedule

Key:
USGS = United States Geological Survey

3.4.1.3 Monitoring Program

Under all action alternatives, Valley Water would rely on monitoring efforts to implement and verify the flow schedule. Monitoring efforts required to implement the flow schedules for the Proposed Project and Alternatives A through identified in Table 3-45 for the expanded reservoir, Pacheco Creek, and within the region.

Table 3-45. Monitoring Efforts for Flow Schedule Implementation for the Proposed Project and Alternatives A Through D

Monitoring Effort and Location	Data	Monitoring Objective
Expanded Reservoir		
Expanded reservoir instrumentation	• Reservoir storage elevations • Air temperature • Supplemental CVP inflows into reservoir • Discharge to North Fork Pacheco Creek • Discharge to Pacheco Conduit • Water temperature at multi-level inlet/outlets	• Reservoir storage volume • Reservoir inflows and outflows • Evaporation • Reservoir release water temperature
San Luis Reservoir water temperature	• Water temperature at existing CDEC PPP station	• Water temperature of CVP inflows
Pacheco Creek		
Valley Water gage downstream of the North Fork and South Fork confluence (Alternatives A, B, and D)	• Discharge • Gage height	• Stream flow • Water depth in stream
USGS gage 11153000 Pacheco Creek Near Dunneville (Proposed Project and Alternative C)	• Discharge • Gage height	• Streamflow • Water depth in stream
Regional		
USGS gage 11154200 Uvas Creek Near Gilroy USGS gage 11153640 Llagas Creek Near Gilroy USGS gage 11159000 Pajaro River at Chittenden USGS gage 11159500 Pajaro River at Watsonville	• Discharge	• Magnitude and timing of flows in system to inform timing of adult attraction pulse flows, juvenile outmigration pulse flows, and dryback implementation

Key:
CDEC = California Data Exchanger Center
CVP = Central Valley Project
PPP = Pacheco Pumping Plant
USGS = United States Geological Survey

3.4.1.4 Adaptive Management Plans

Under all action alternatives, Valley Water would develop and implement adaptive management plans in cooperation with appropriate regulatory agencies to be consistent with WSIP and regulatory requirements. The plans would be finalized concurrent with the contracts for WSIP public benefits with CDFW and DWR. The approach for developing adaptive management plans is discussed below for the three public benefits for which Valley Water has received conditional WSIP funding: (1) ecosystem improvement in Pacheco Creek, (2) ecosystem improvement in the San Joaquin River watershed, and (3) emergency storage.

Ecosystem Improvement in Pacheco Creek

In coordination with appropriate regulatory agencies and stakeholders,[12] Valley Water would develop an adaptive management plan that could allow for future flow schedule refinements based on observed conditions in Pacheco Creek. As a preliminary step, Valley Water would establish a charter to formalize plan participants, decision making protocol, and dispute resolution processes. The plan would establish specific management objectives and performance measures, with a primary focus on providing suitable habitat conditions for SCCC steelhead, and a secondary focus on protecting sycamore alluvial woodland and other special status resources. The management objectives and performance measures would form the basis of a structured evaluation process that would allow Valley Water and stakeholders to assess monitoring data, develop a scientific understanding of causative factors of flow schedule effectiveness or shortcomings, and propose strategies and techniques to adjust, refine, and/or modify flow schedule components based on observed outcomes.

If changes to the flow schedule are proposed based on new information gained through adaptive management, Valley Water would prepare supplemental environmental documentation, as necessary (e.g., new significant environmental impact, increased severity of previously disclosed significant impacts). However, any adjustments to the flow schedules are not to exceed the total volume of water that would be released consistent with the Variable Flow Schedule (Proposed Project and Alternative C) or the Fixed Flow Schedule (Alternatives A, B, and D).

Ecosystem Improvement in the San Joaquin River Watershed

The coordinated distribution of IL4 refuge water supplies to the RWSP in the San Joaquin River watershed follows an inter-agency and stakeholder engagement process led by Reclamation. Valley Water would attend annual RWSP coordination meetings to share information related to existing water supply resources and identify potential actions that could help prepare for delivery of IL4 refuge water supplies in Below Normal water years. Valley Water would also participate in adaptive management discussions led by Reclamation to determine when and where available surface water supplies could be put to their highest and best use.

Emergency Storage

A formal adaptive management plan for emergency storage would be developed concurrent with the contract for WSIP public benefits with DWR. The adaptive management process for emergency supplies includes an after-action review of the event precipitating the need for the emergency water supply. With respect to use of Pacheco Reservoir emergency water supplies, the after-action review should consider the following: need and use of supplies, additional actions, and additional facilities. As part of that adaptive management plan, Valley Water

[12] Regulatory agencies and stakeholders that may be engaged in adaptive management plan include NMFS, USFWS, USACE, Reclamation, CDFW, State Water Resources Control Board, Santa Clara Valley Habitat Agency, San Benito County Water District, or other key regulatory agencies and stakeholders.

anticipates making modifications to its Emergency Action Plan[13] for water delivery operations, including modifications to the after-action review that outlines evaluation protocol following emergency water supply use (e.g., modifying protocols in consideration of an expanded Pacheco reservoir being integrated with other Valley Water facilities).

3.4.2 Maintenance

Under all action alternatives, Valley Water would perform maintenance activities for all proposed facilities, except for power transmission lines. Maintenance activities would generally include facility and equipment inspections, preventive maintenance, and repairs. The expanded reservoir and associated facilities would be unstaffed and operated/monitored via telemetry remotely. Maintenance of the expanded reservoir and facilities is proposed to include weekly inspection trips in the first year of operation. Inspection trips would be reduced in frequency over time with trips every two weeks in years two through five of operation and monthly trips starting in year six. Post-construction operation and maintenance of the Project facilities is estimated to require an average of one worker vehicle trip per month to conduct inspections and maintenance of facilities. Maintenance of proposed facilities would be expected to generate less than one ton of solid waste, including both organic and inorganic materials on a yearly basis.

Maintenance for Project facilities would include debris removal, vegetation control, rodent control, erosion control and protection, routine inspections (dam, spillway, inlet/outlet works, pipelines, pumping plant, roads, bridges, power transmission lines, other utilities, and miscellaneous infrastructure), painting, cleaning, repairs/minor replacements, and other routine tasks to maintain facilities in accordance with design standards after construction and commissioning. Routine visual inspection of the facilities would be conducted to monitor performance and prevent mechanical and structural failures of Project elements.

Maintenance activities associated with the proposed inlet/outlet works would include cleaning and removal of sediments, debris, and biofouling materials. These maintenance actions could require suction dredging or mechanical excavation around adits; dewatering; or use of underwater diving crews, boom trucks or rubber wheel cranes, and raft- or barge-mounted equipment.

Maintenance activities associated with the proposed conveyance pipeline would likely occur once per year, with possible additional inspections and maintenance needed after storm or flood events. Dewatering for inspection may occur in 5-year cycles or when a pipeline problem is suspected. Maintenance activities for the pump station would generally include equipment inspections, preventive maintenance, repair, and periodic replacement of mechanical equipment.

Under all action alternatives, PWRPA, WAPA, or PG&E would perform maintenance activities on power transmission lines, which would include routine inspections and repair of the transmission line poles, hardware, grounding, signage, foundation, embedment, and any other attached equipment. Annual inspections would also be conducted to assess line sag and ground clearance. Maintenance activities would include insulator washing and tree trimming to prevent or remove vegetation from encroaching on the transmission lines. For inspections and/or repairs and maintenance, existing ranch roads and trails would be used to provide vehicular access (e.g., light duty trucks) for personnel and to transport relatively lightweight materials and equipment. Where no access trails are available, inspections may be conducted

[13] An Emergency Action Plan outlines strategies, resources, plans, and procedures for responding to an incident, natural or man-made, that threatens life (including delivery of water for health and safety purposes), property, or the environment.

via helicopter, and if necessary, equipment, materials and possibly personnel needed for repairs and/or maintenance would be helicoptered to the transmission line corridor.

Chapter 4 References

4.1 Chapter 1

Not Applicable

4.2 Chapter 2

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Draft Environmental Impact Report

Appendix

Alternatives Development and Project Description

Attachment A

Exhibits for the Proposed Project and Alternatives A, B, C, and D

Pacheco Reservoir Expansion Project

November 2021

List of Exhibits

Exhibit 1. Monthly Flow Release Rules for the No Project Alternative (Existing Pacheco Reservoir)

May[1]		June[1]		July[1]		August[1]		September[1]		October[1]		November[1,2]		December[1,2]		January[1,2]		February[2]	March[2]	April[2]		
Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Baseflow Release (cfs)	Baseflow Release (cfs)	Baseflow Release (cfs)	Baseflow Release (cfs)	Pacheco Reservoir Storage (AF)	Pulse Flow Release[3] (cfs)
500	0.4	470	0.5	440	0.5	410	0.5	380	0.5	350	0.5	153	0.8	104	0.7	58	0.7	Releases in cfs = minimum of (1st of Month storage in acre-feet divided by 100) or (January baseflow release)			**0 to 700**	0
750	0.8	700	0.9	650	1.0	590	1.0	530	1.0	470	1.0	235	1.2	161	1.1	93	1.1				**700 to 1,000**	0, 21
1,000	1.2	930	1.3	850	1.5	760	1.5	670	1.5	580	1.5	307	1.7	208	1.5	117	1.7				**1,000 to 1,250**	0, 25
1,250	1.5	1,160	1.7	1,060	1.9	940	1.9	820	1.9	710	1.9	378	2.1	255	1.8	141	1.8				**1,250 to 1,700**	0, 30
1,500	1.9	1,380	2.1	1,250	2.4	1,100	2.4	950	2.4	810	2.4	450	2.5	302	2.2	165	2.2				**1,700 to 4,750**	0
1,750	2.3	1,610	2.6	1,460	2.9	1,280	2.9	1,100	2.9	930	2.9	531	2.9	359	2.6	200	2.6				**4,750 to 5,000**	0, 21
2,000	2.7	1,840	3.0	1,660	3.4	1,450	3.4	1,240	3.4	1,040	3.4	613	3.3	415	3.0	234	3.0				**5,000 to 5,300**	0, 21, 25
2,250	3.1	2,060	3.5	1,850	3.9	1,610	3.9	1,370	3.9	1,140	3.9	675	3.7	452	3.3	248	3.3				**5,300 to 5,500**	0, 21, 25, 30
2,500	3.6	2,280	4.0	2,040	4.4	1,770	4.4	1,500	4.4	1,240	4.4	746	4.2	499	3.7	272	3.7					
2,750	4.0	2,500	4.5	2,230	5.0	1,920	5.0	1,610	5.0	1,310	5.0	828	4.6	556	4.1	307	4.1					
3,000	4.4	2,730	5.0	2,430	5.6	2,090	5.6	1,750	5.6	1,420	5.6	900	5.0	603	4.4	331	4.4					
3,250	4.9	2,950	5.5	2,620	6.1	2,240	6.1	1,860	6.1	1,500	6.1	981	5.4	660	4.8	365	4.8					
3,500	5.4	3,170	6.1	2,810	6.7	2,400	6.7	1,990	6.7	1,590	6.7	1,053	5.8	707	5.2	389	5.2					
3,750	5.8	3,390	6.6	3,000	7.3	2,550	7.3	2,100	7.3	1,670	7.3	1,135	6.2	764	5.5	424	5.5					
4,000	6.3	3,610	7.1	3,190	7.9	2,700	7.9	2,210	7.9	1,740	7.9	1,196	6.7	801	5.9	438	5.9					
4,250	6.8	3,830	7.7	3,370	8.5	2,850	8.5	2,330	8.5	1,820	8.5	1,268	7.1	848	6.3	462	6.3					
4,500	7.3	4,050	8.2	3,560	9.1	3,000	9.1	2,440	9.1	1,900	9.1	1,349	7.5	905	6.7	496	6.7					
4,750	7.8	4,270	8.7	3,750	9.7	3,150	9.7	2,550	9.7	1,970	9.7	1,441	7.9	972	7.0	541	7.0					
5,000	8.3	4,490	9.3	3,940	10.3	3,300	10.3	2,660	10.3	2,050	10.3	1,513	8.3	1,019	7.4	565	7.4					
5,250	8.8	4,710	9.8	4,120	10.9	3,450	10.9	2,780	10.9	2,130	10.9	1,584	8.7	1,066	7.8	589	7.8					
5,500	9.2	4,930	10.4	4,310	11.5	3,600	11.5	2,890	11.5	2,200	11.5	1,656	9.1	1,113	8.1	613	8.1					
5,750	9.7	5,150	11.0	4,500	12.2	3,750	12.2	3,000	12.2	2,280	12.2	1,748	9.6	1,180	8.5	658	8.5					
6,000	10.3	5,370	11.6	4,680	12.8	3,890	12.8	3,100	12.8	2,340	12.8	1,819	10.0	1,226	8.9	682	8.9					
6,150	10.6	5,500	11.9	4,790	13.2	3,980	13.2	3,170	13.2	2,380	13.2	1,852	10.2	1,245	9.1	687	9.1					

Source: Developed from Micko 2014

Notes:

1 On the first of each month, releases from Pacheco Reservoir are adjusted to the listed release value adjacent to the lowest listed storage value exceeded by actual monthly storage in Pacheco Reservoir. Releases are maintained for the entire month.

2 From November through April, releases from Pacheco Reservoir are reduced to 0 cfs once cumulative rainfall starting October 1 exceeds 15 inches, the estimated precipitation needed to saturate the watershed and maintain consistent streamflow in Pacheco Creek.

3 If determined to be feasible based on juvenile steelhead presence in Pacheco Creek, passage conditions in the Pajaro River, and water supply risk, a 30-day pulse flow is released from Pacheco Reservoir in lieu of a baseflow release. Pulse flow magnitude is determined based on Pacheco Reservoir storage, Pacheco Valley depth to groundwater, and estimated inflows to Pacheco Creek below Pacheco Reservoir.

Key:
AF = acre-feet
cfs = cubic feet per second

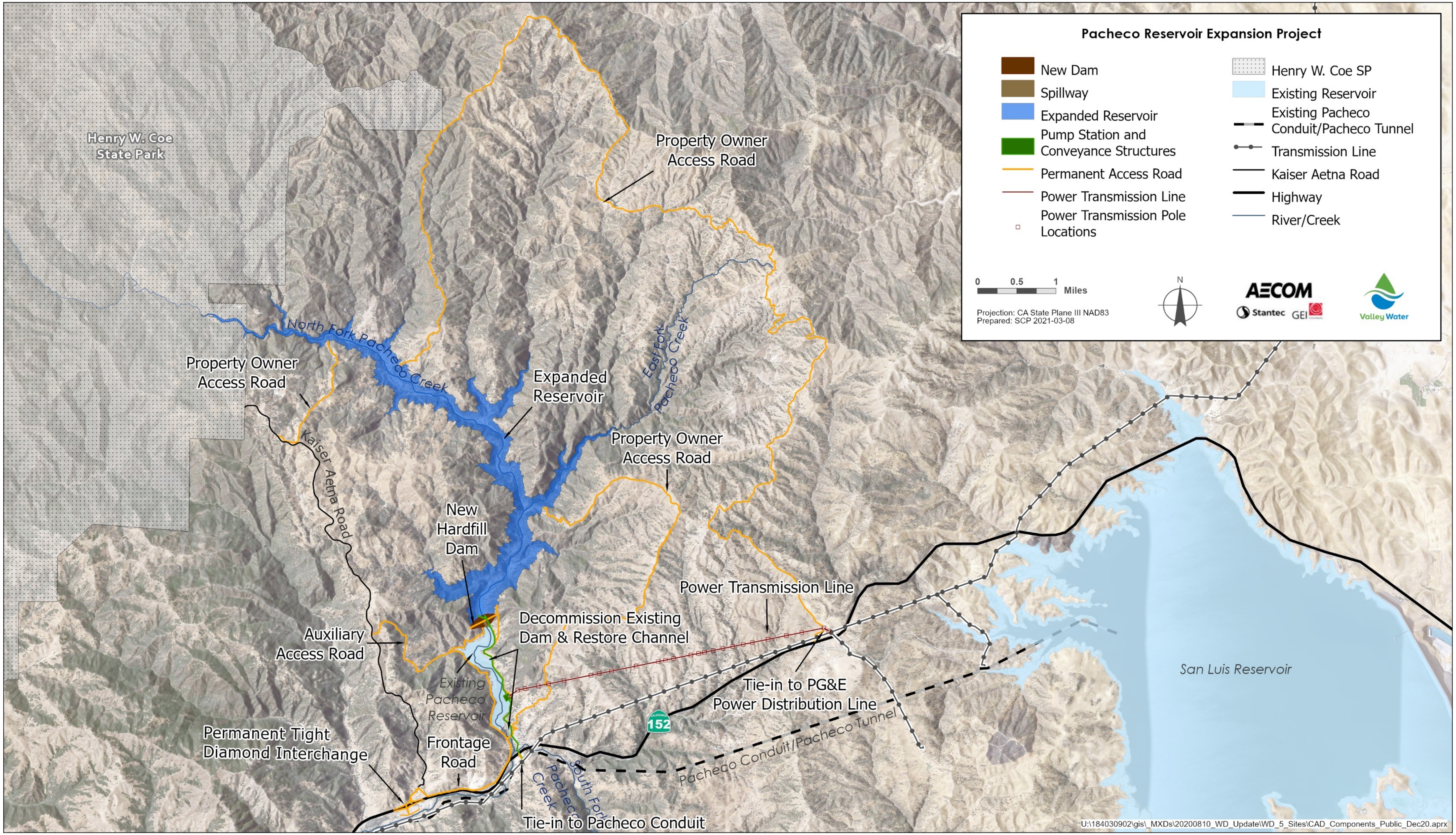


Exhibit 2. Permanent Facilities and Expanded Reservoir for the Proposed Project (Upstream, Hardfill Dam - 140 TAF Reservoir)

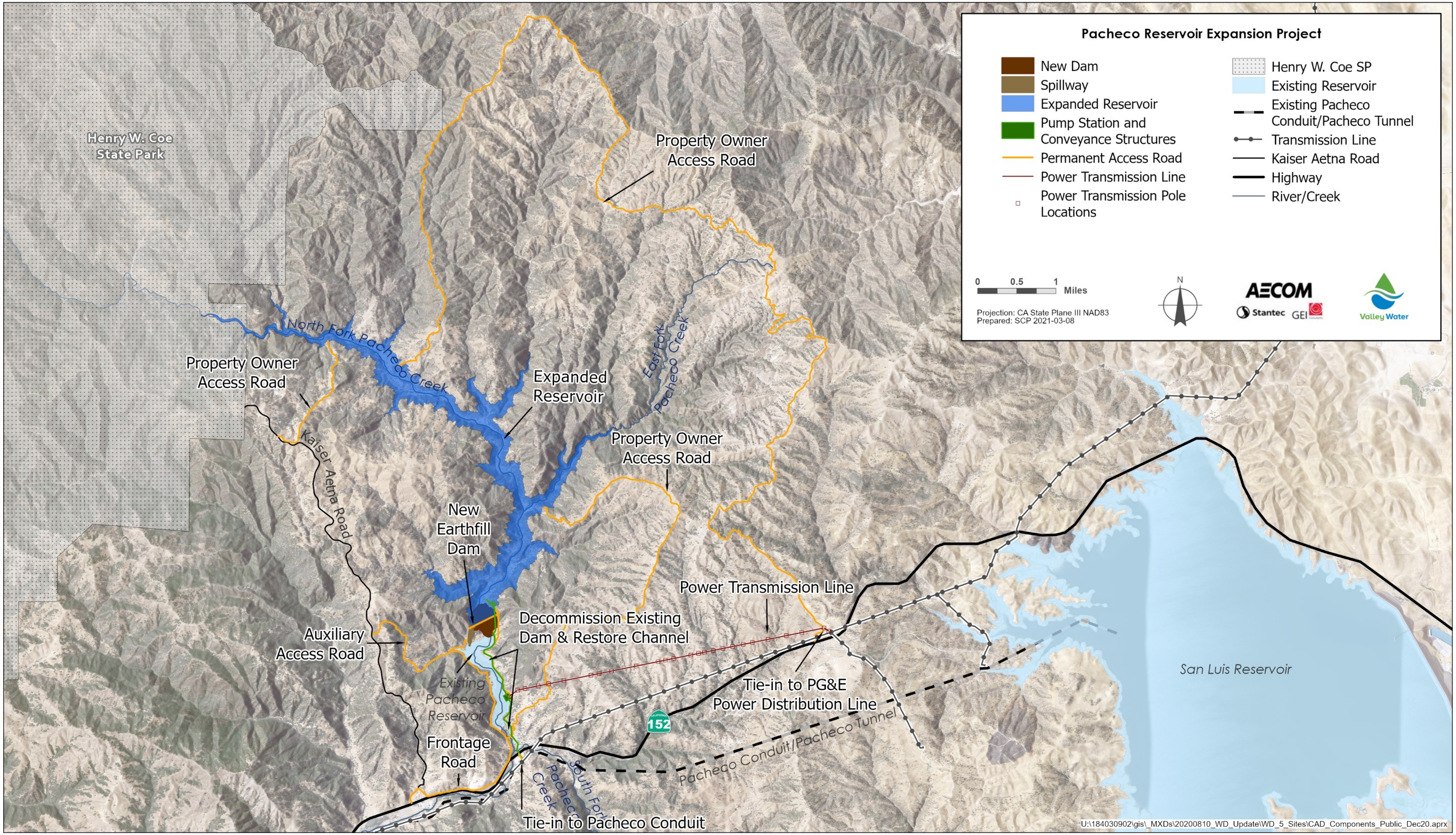


Exhibit 3. Permanent Facilities and Expanded Reservoir for Alternative A (Upstream, Earthfill Dam - 140 TAF Reservoir)

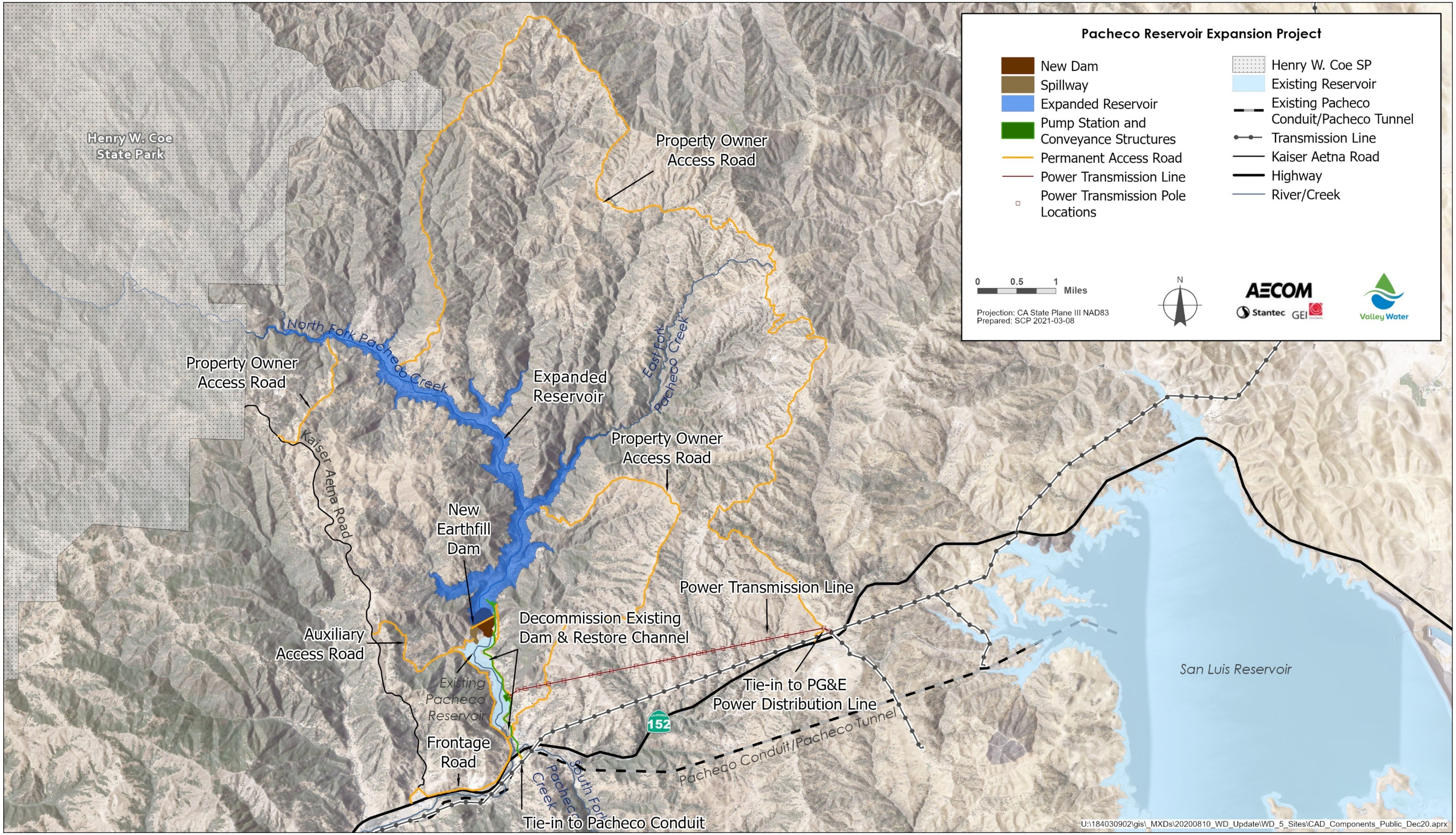


Exhibit 4. Permanent Facilities and Expanded Reservoir for Alternative B (Upstream, Earthfill Dam - 96 TAF Reservoir)

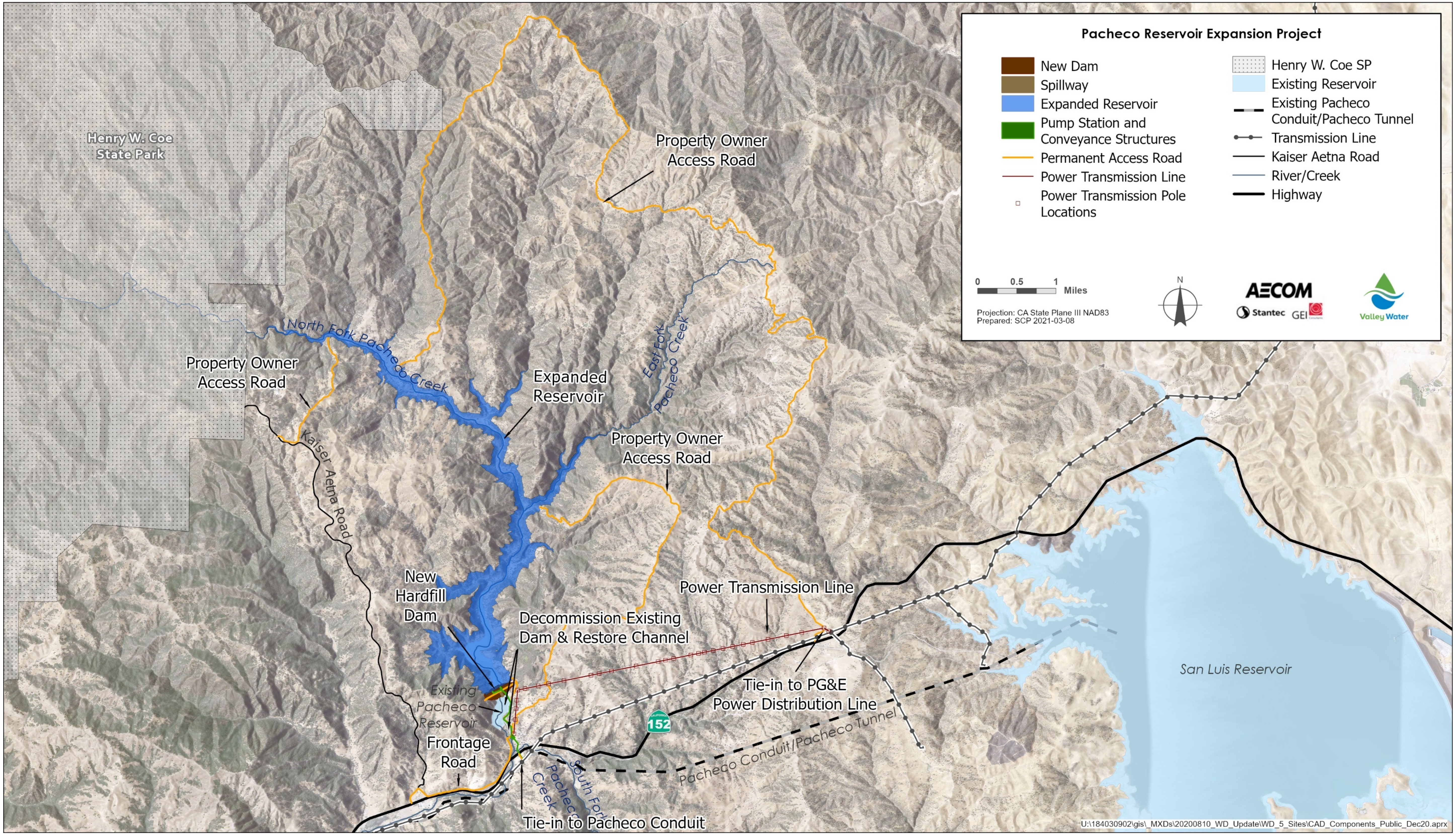


Exhibit 5. Expanded Reservoir and General Facility Layout for Alternative C (Downstream, Hardfill Dam - 140 TAF Reservoir)

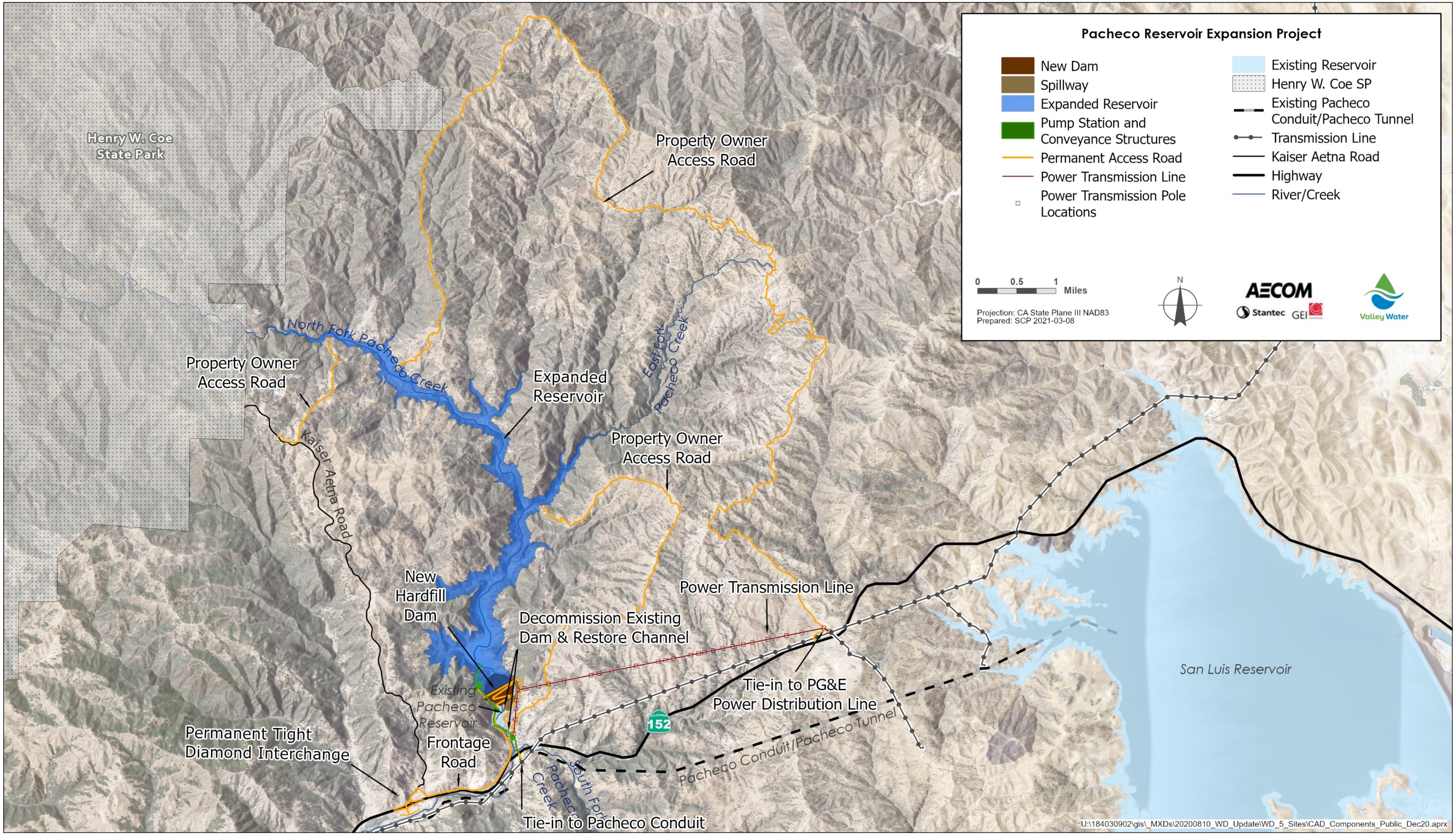


Exhibit 6. Permanent Facilities and Expanded Reservoir for Alternative D (Downstream, Earthfill Dam - 140 TAF Reservoir)

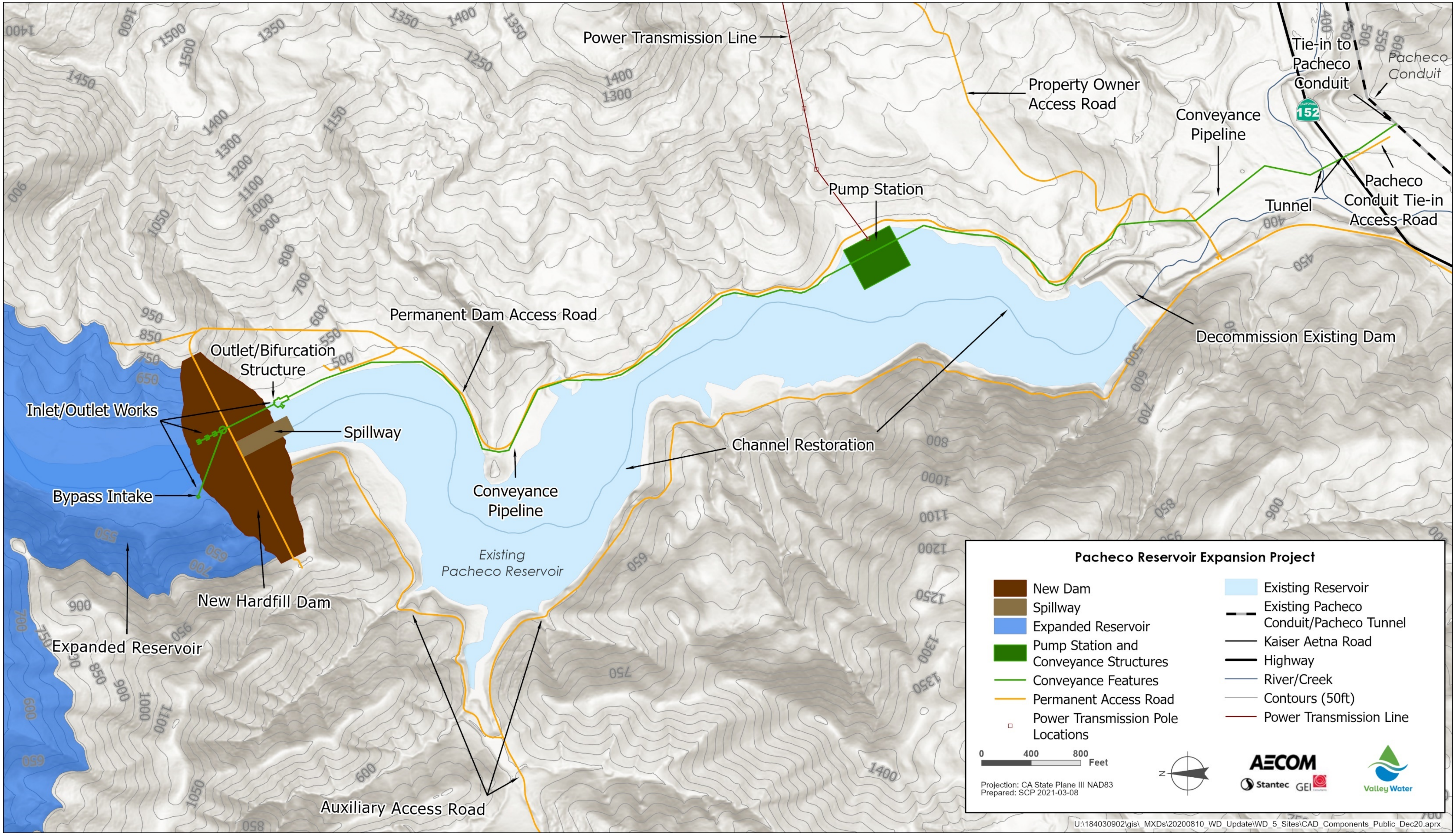


Exhibit 7. Permanent Facilities for the Proposed Project - Dam Site and Water Conveyance Facilities Detail

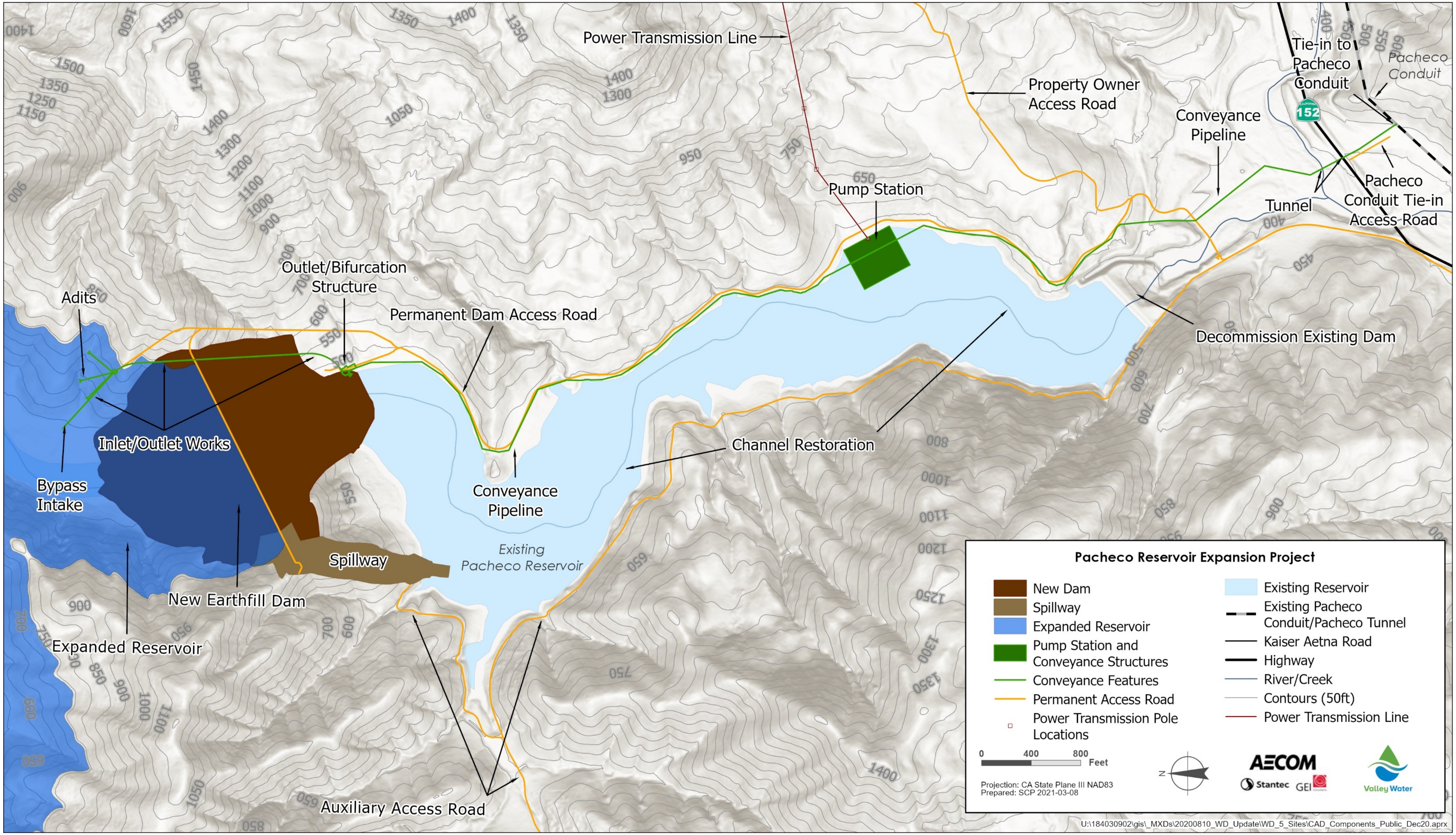


Exhibit 8. Permanent Facilities for Alternative A - Dam Site and Water Conveyance Facilities Detail

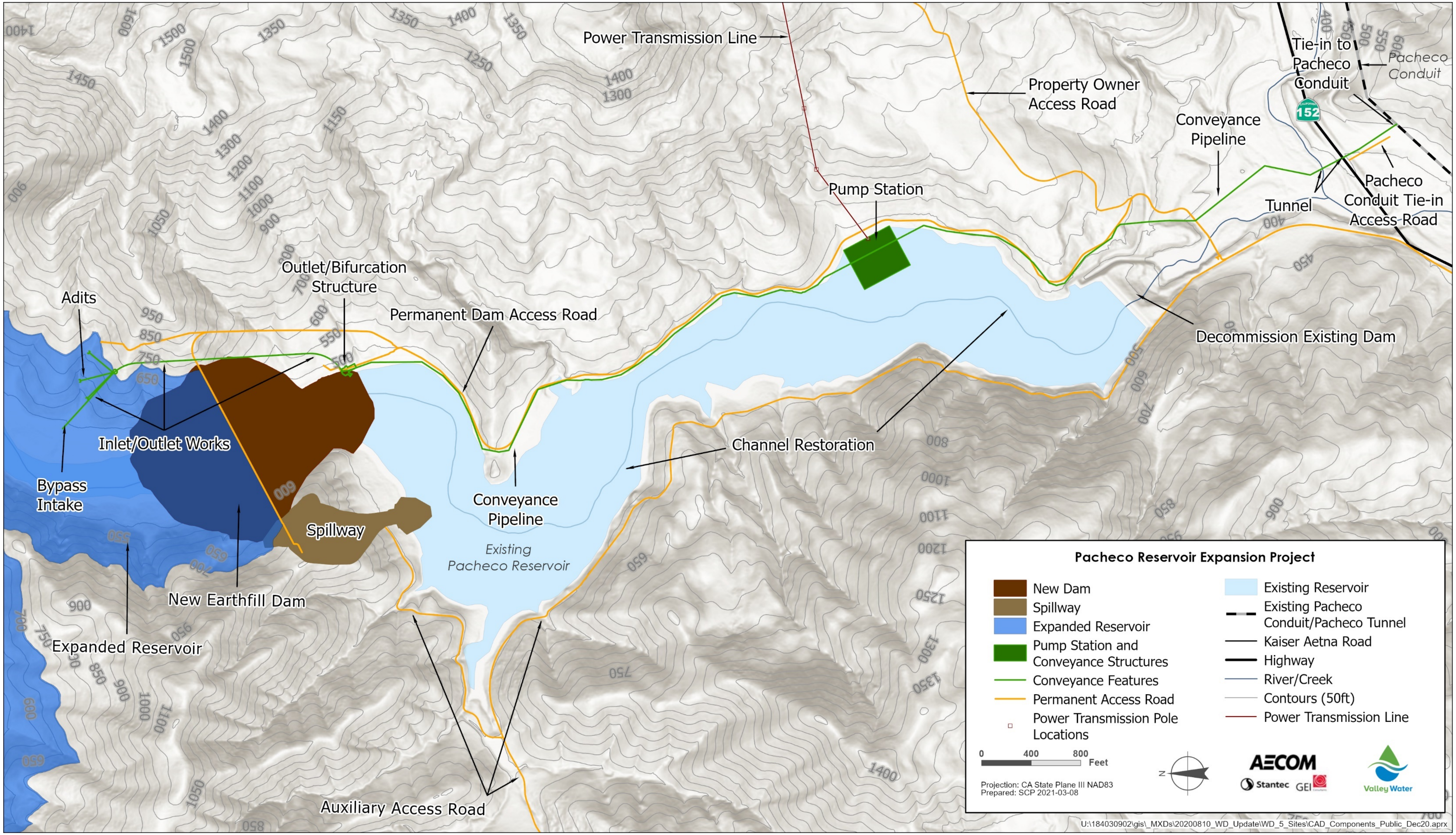


Exhibit 9. Permanent Facilities for Alternative B - Dam Site and Water Conveyance Facilities Detail

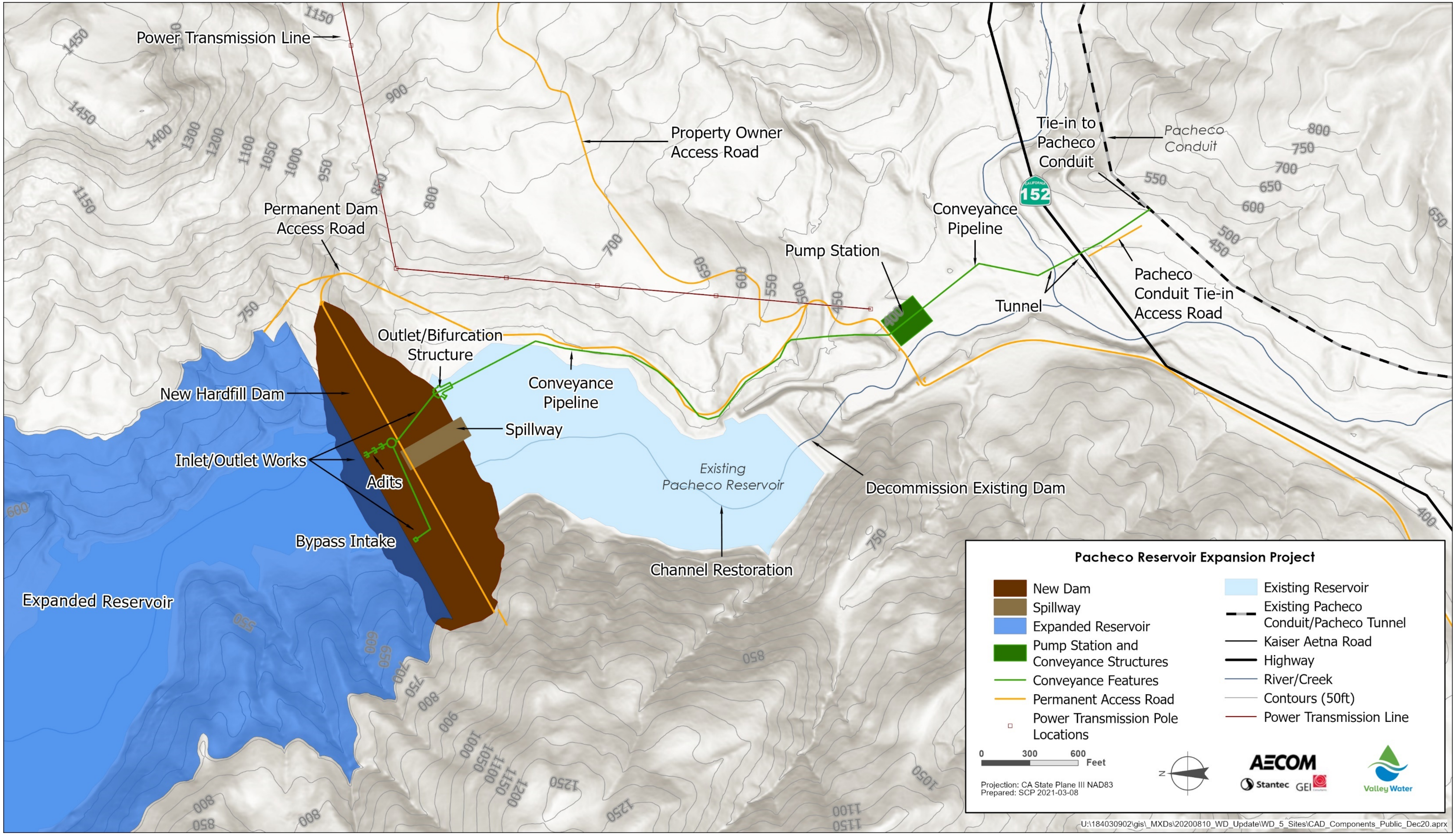


Exhibit 10. Permanent Facilities for Alternative C - Dam Site and Water Conveyance Facilities Detail

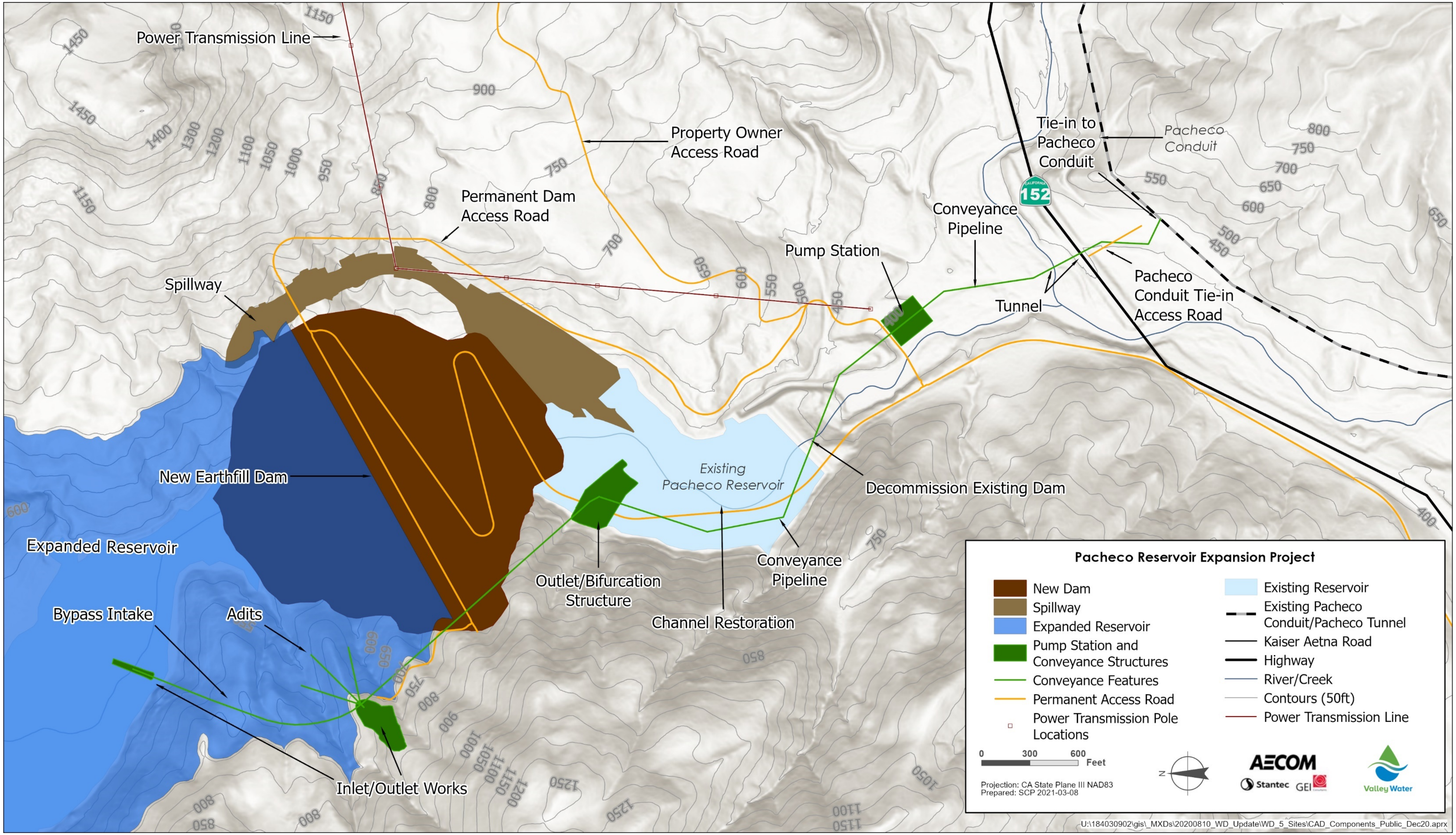


Exhibit 11. Permanent Facilities for Alternative D - Dam Site and Water Conveyance Facilities Detail

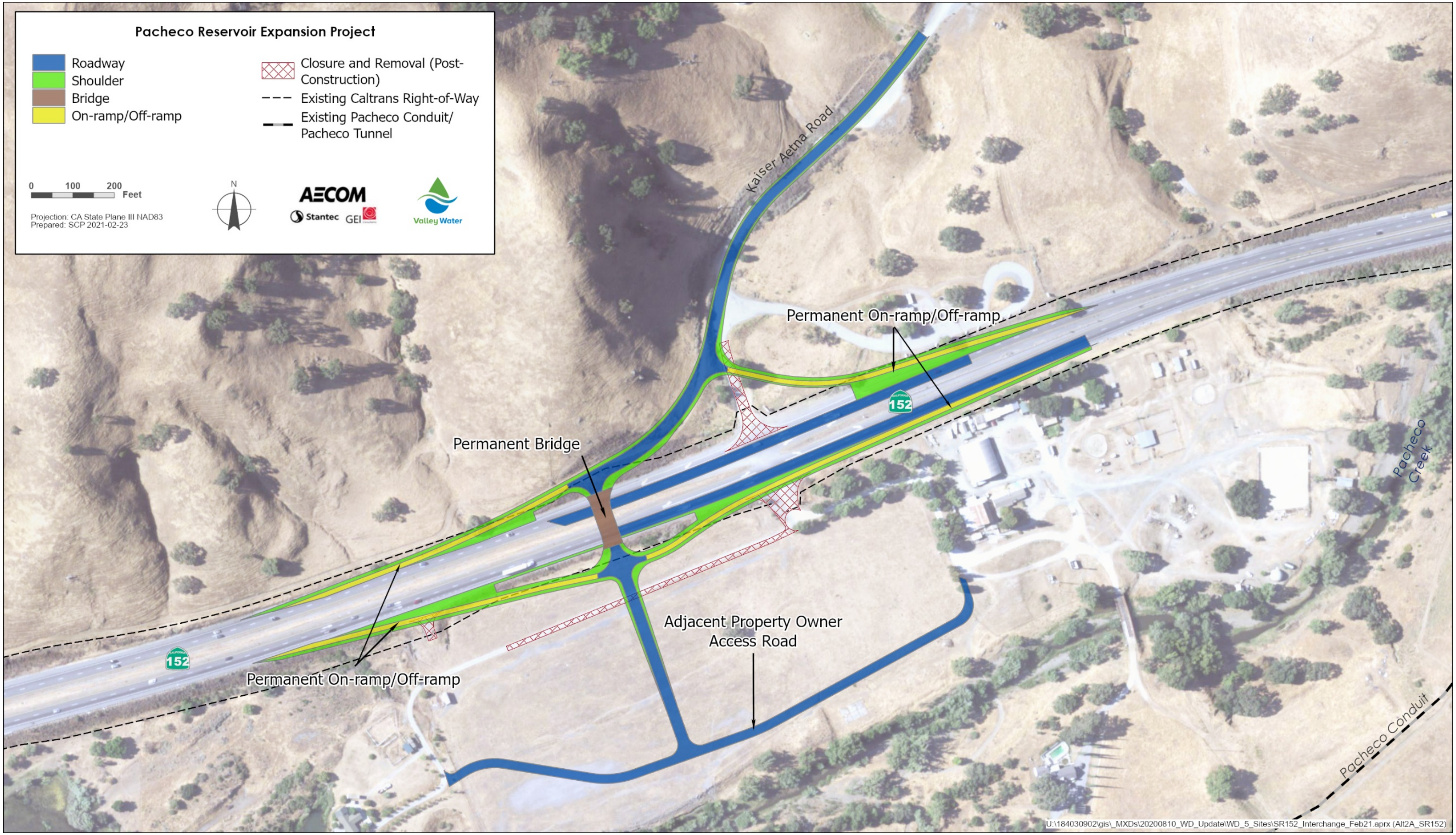


Exhibit 12. Schematic for Permanent SR 152 and Kaiser-Aetna Road Tight Diamond Interchange for the Proposed Project and Alternative D

Exhibit 13. Schematic for Temporary Overcrossing of SR 152 at Kaiser-Aetna Road for Alternative A

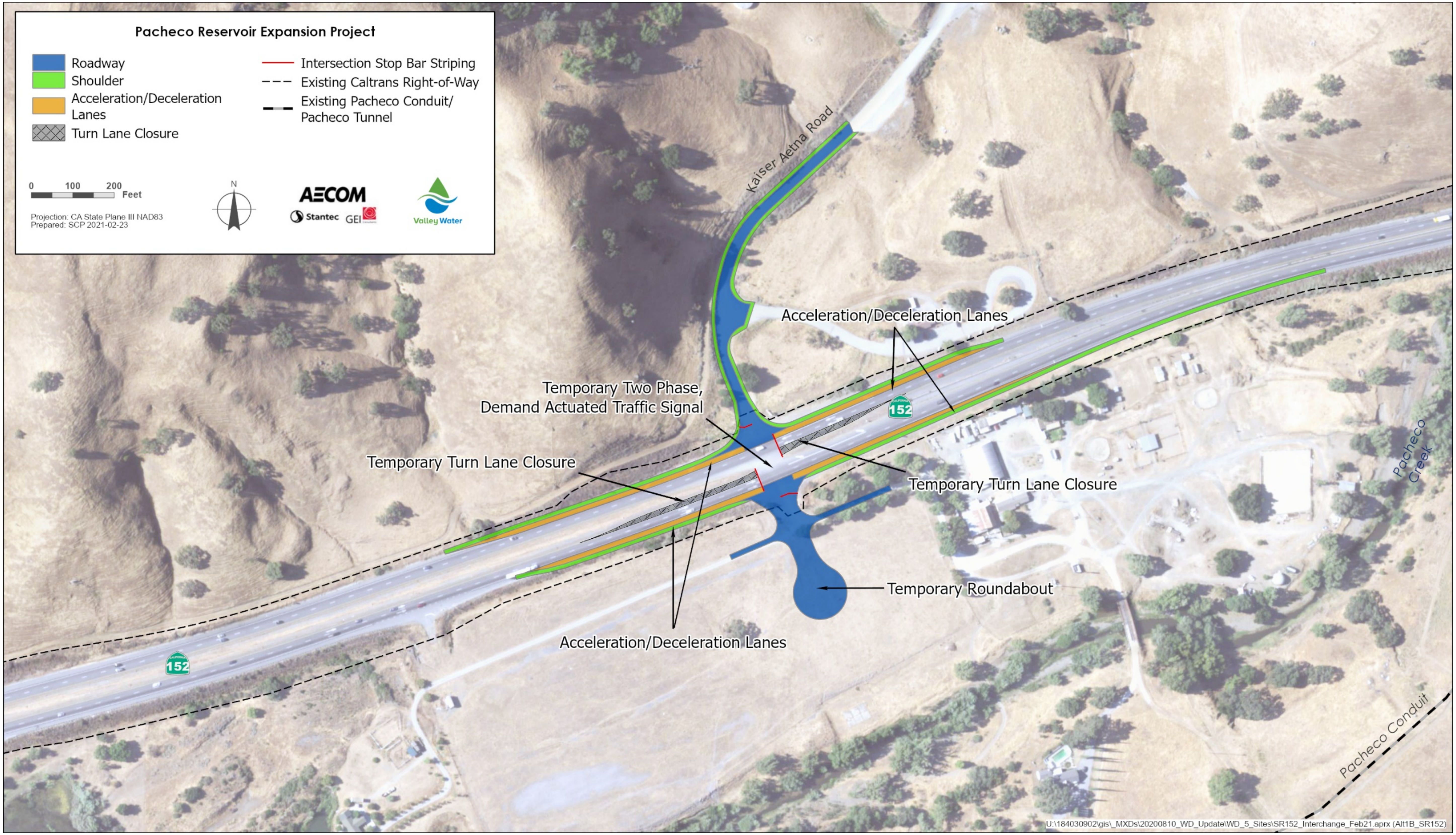


Exhibit 14. Schematic for Temporary Traffic Signal and Roundabout at SR 152 and Kaiser-Aetna Road for Alternative B

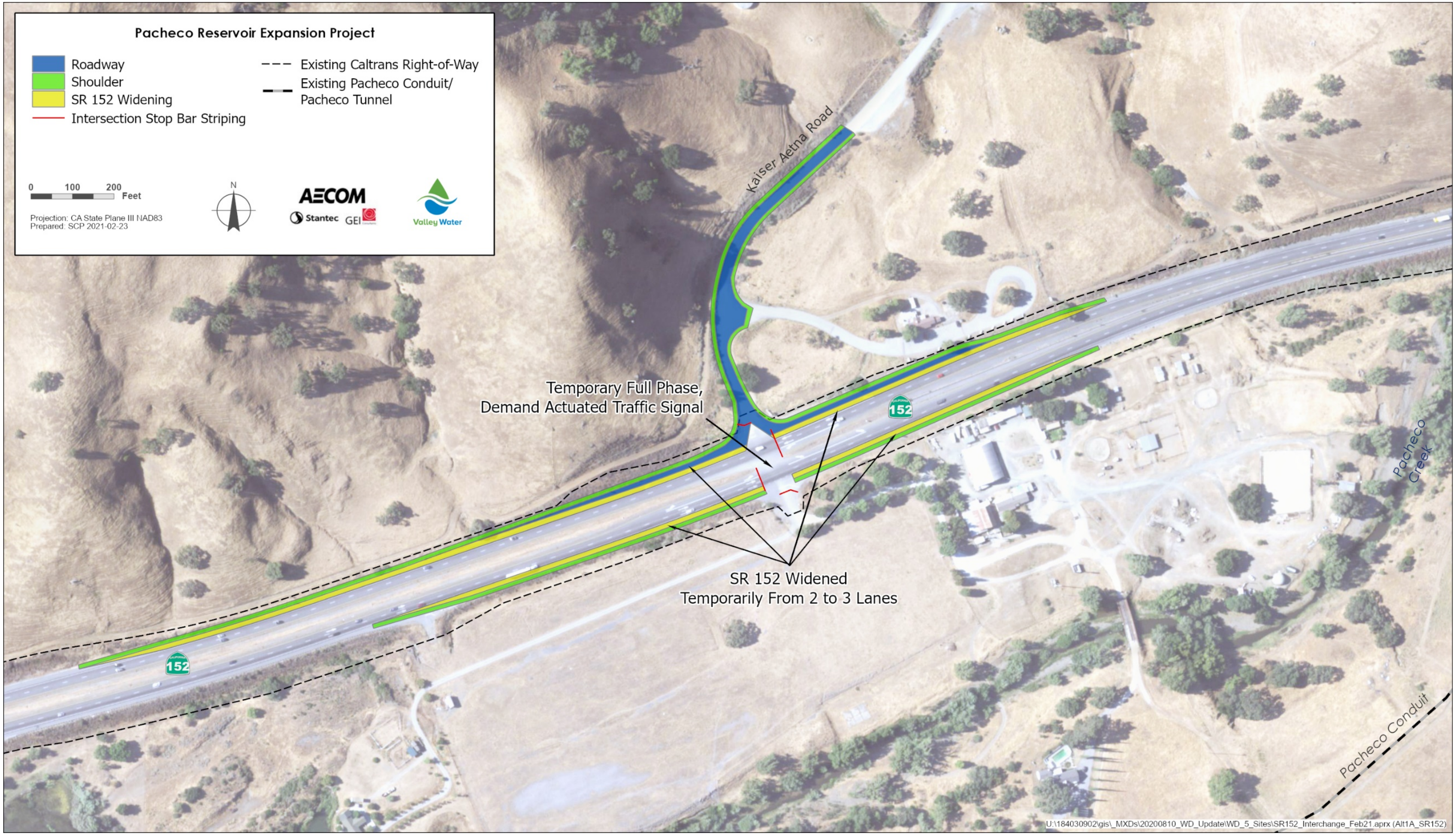


Exhibit 15. Schematic for Temporary Traffic Signal and Widening of SR 152 at Kaiser-Aetna Road for Alternative C

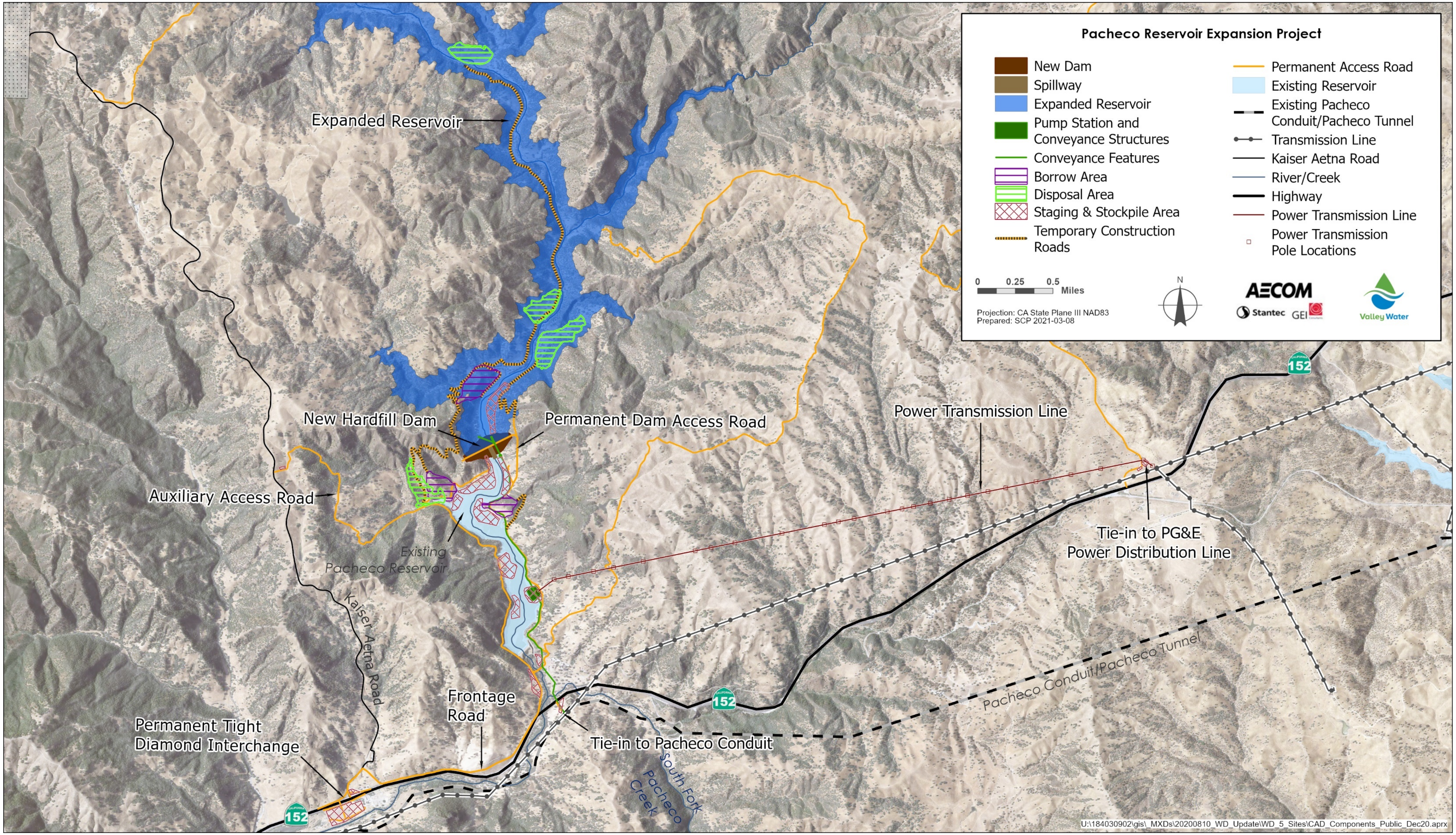


Exhibit 16. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for the Proposed Project. See Exhibit 21 for more detail.

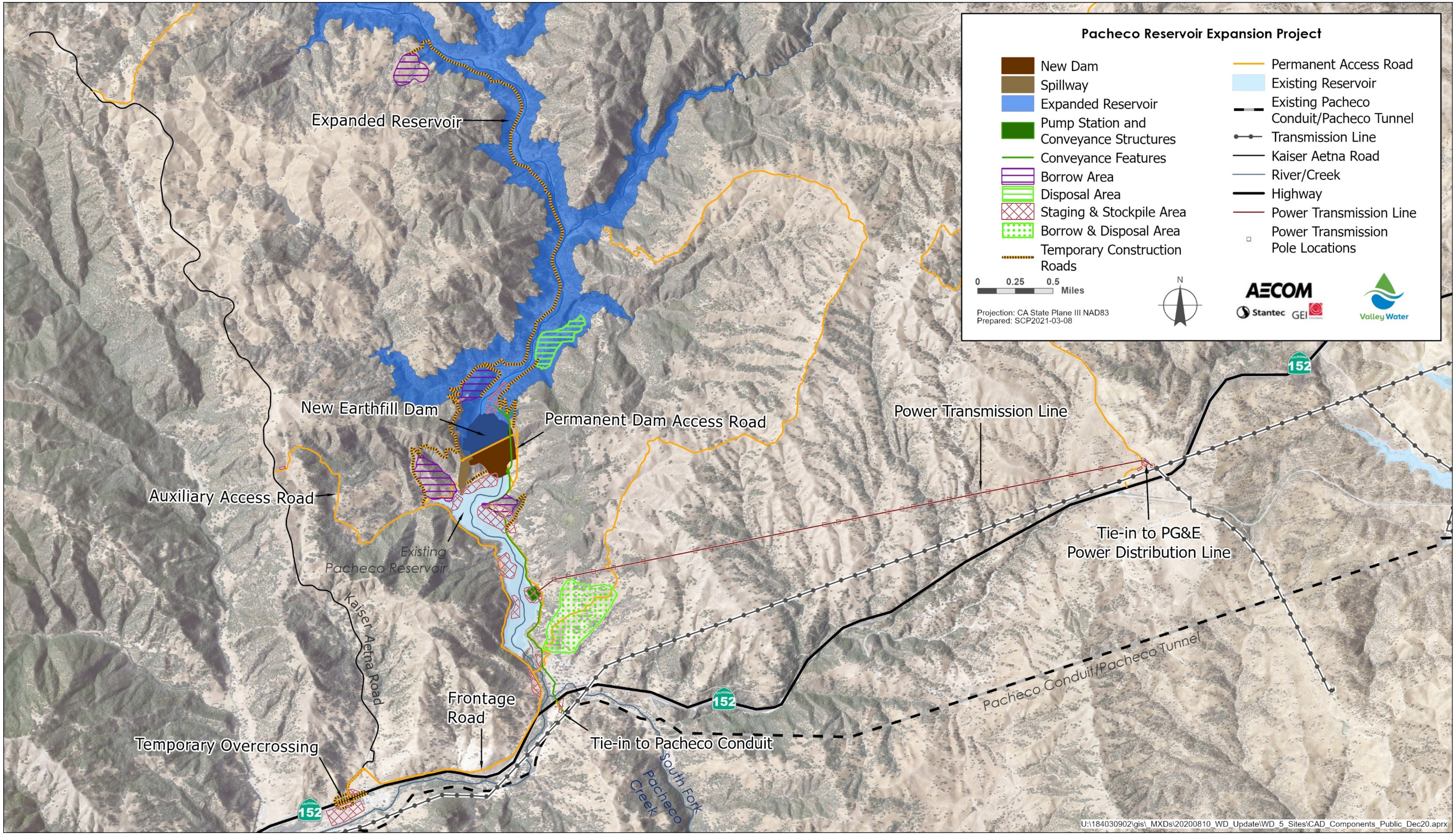


Exhibit 17. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for Alternative A. See Exhibit 22 for more detail.

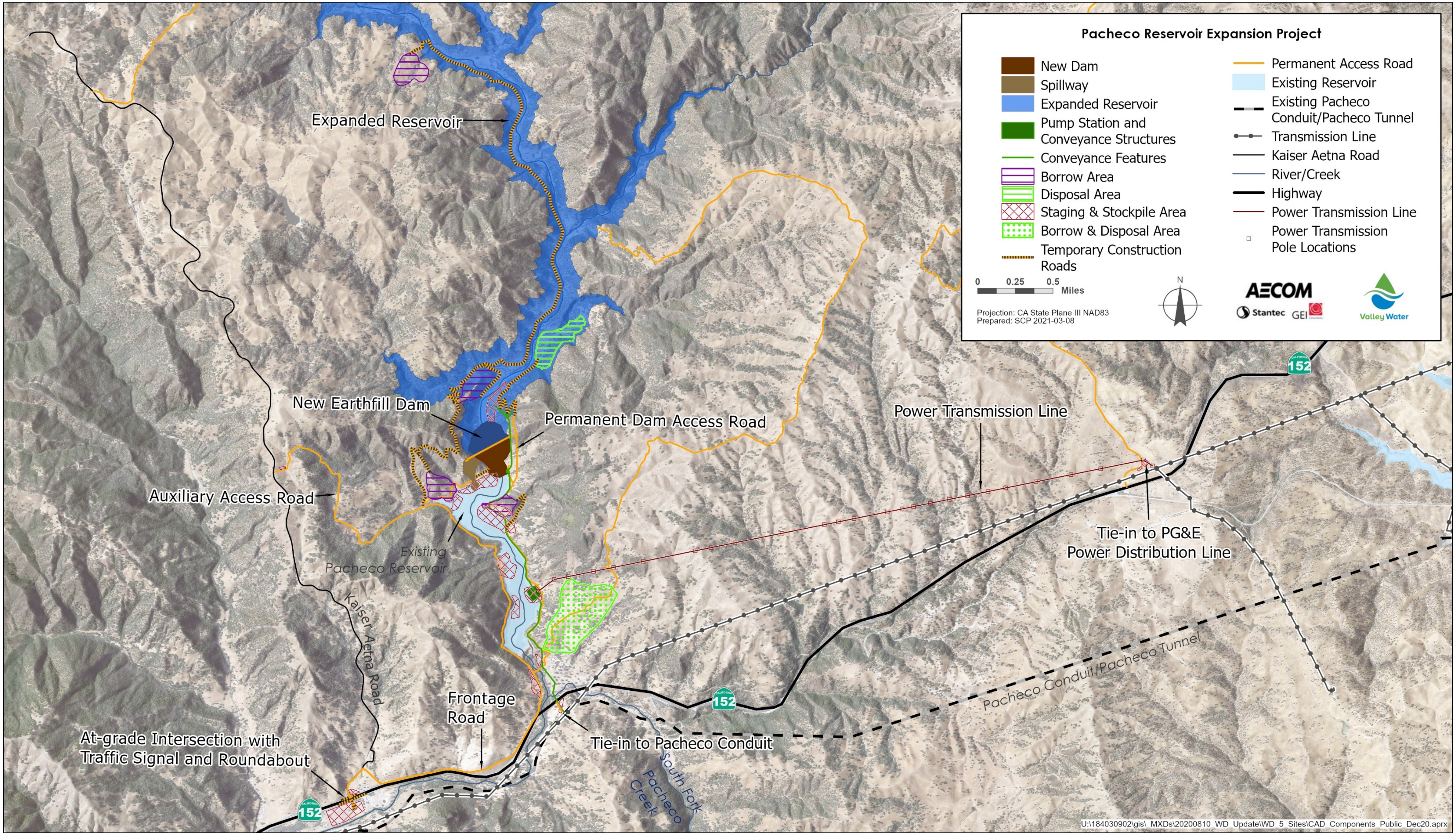


Exhibit 18. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for Alternative B. See Exhibit 23 for more detail.

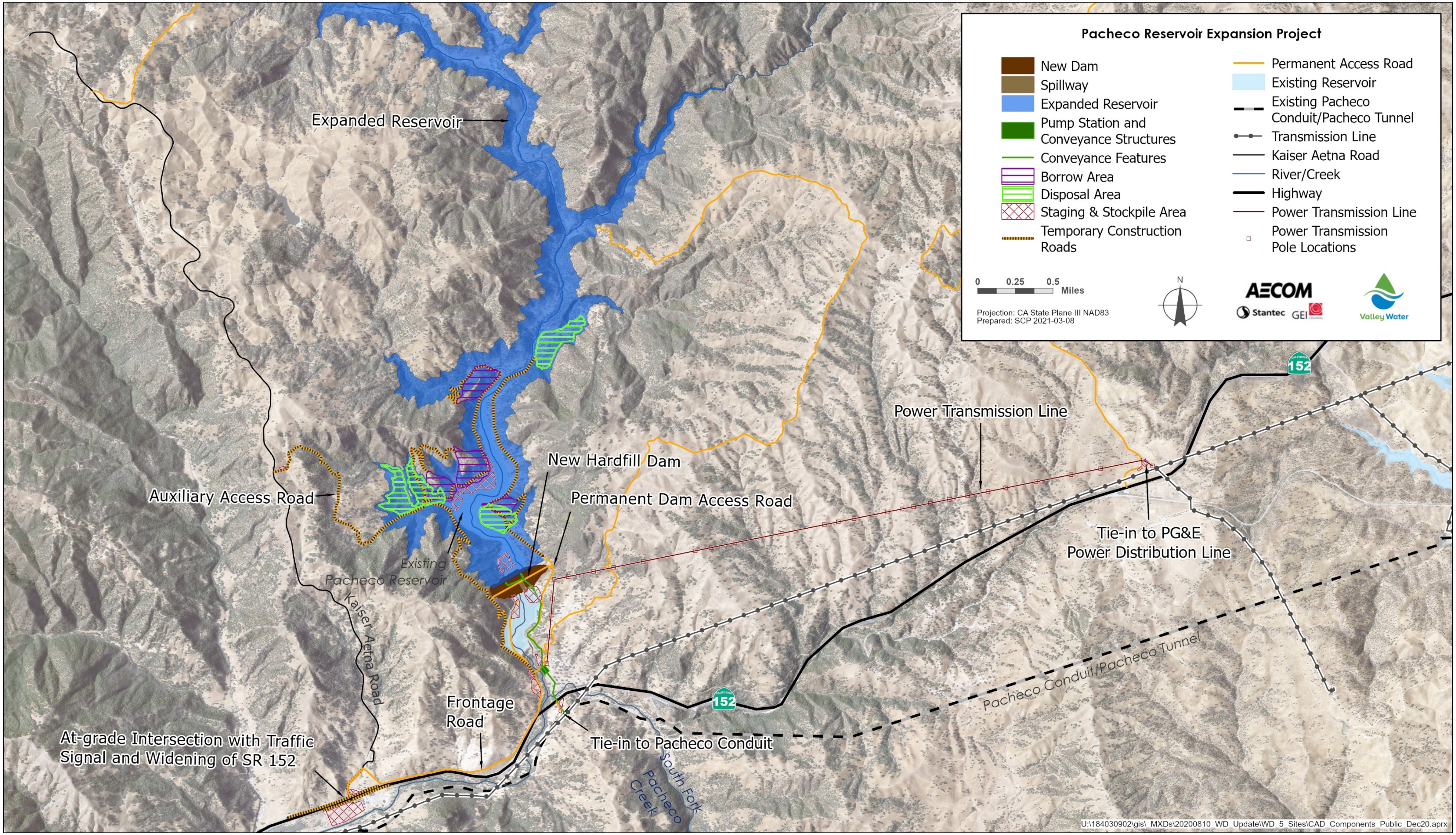


Exhibit 19. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for Alternative C. See Exhibit 24 for more detail.

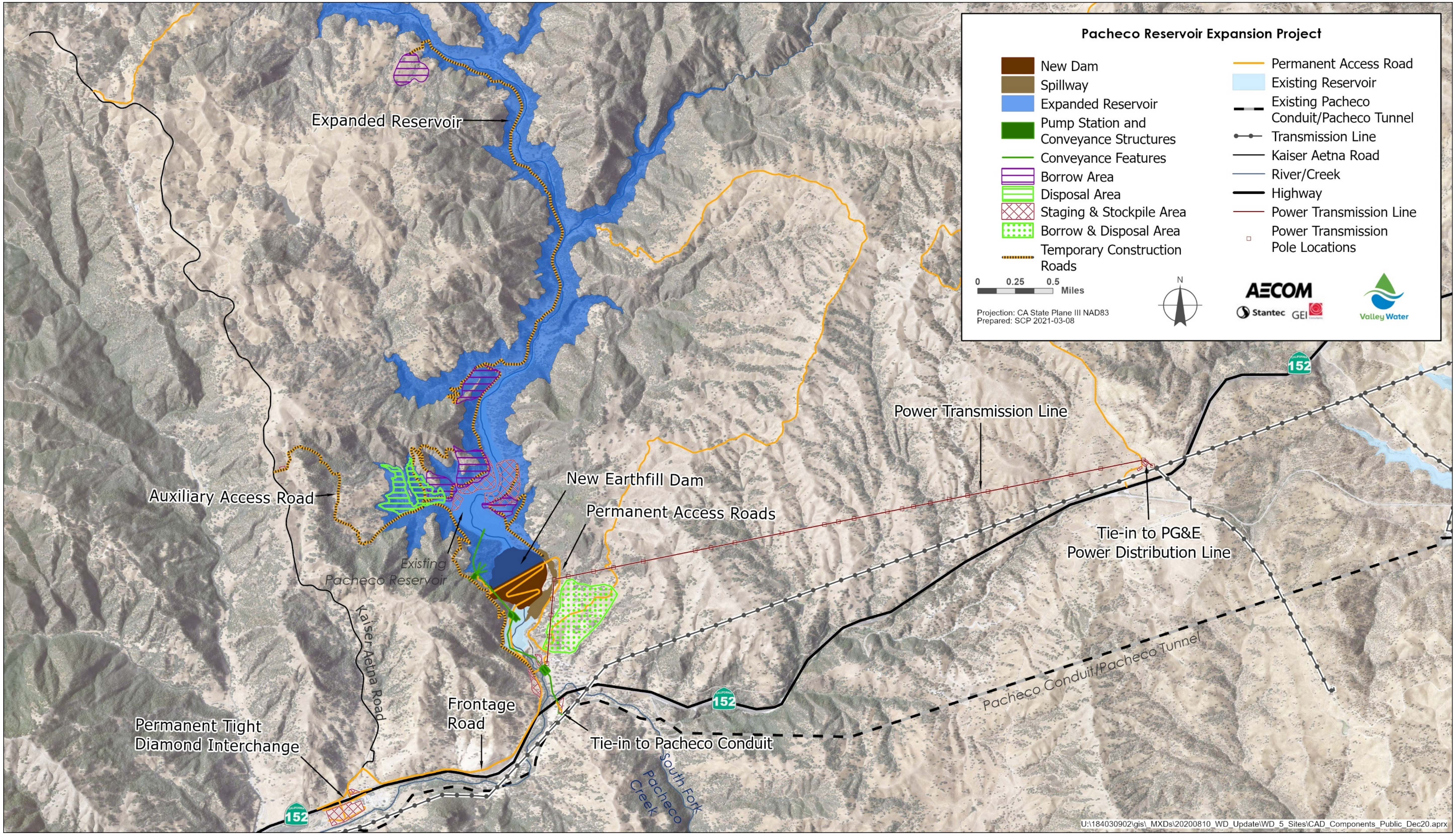


Exhibit 20. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for Alternative D. See Exhibit 25 for more detail.

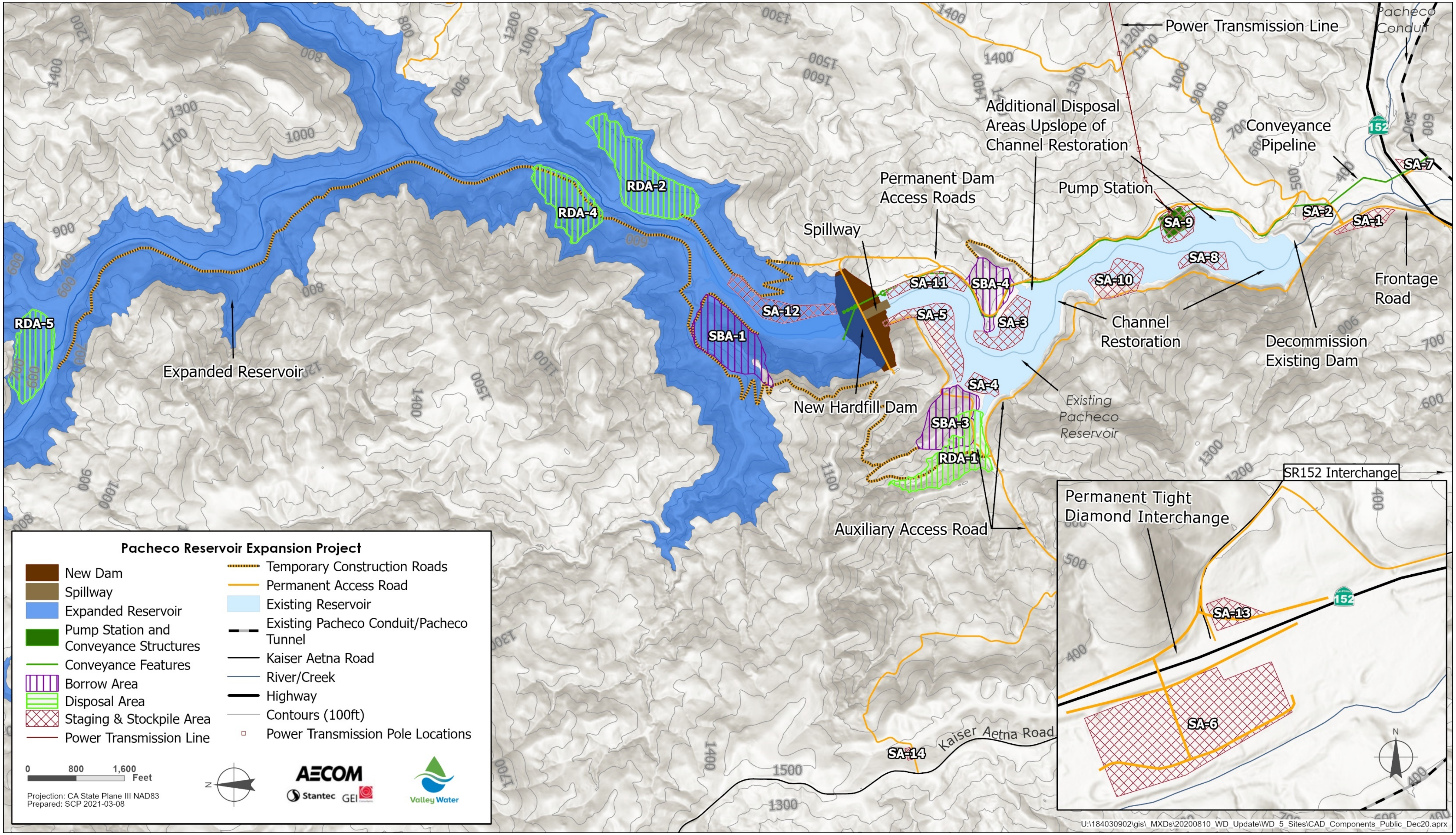


Exhibit 21. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for the Proposed Project - Dam Site Area Detail

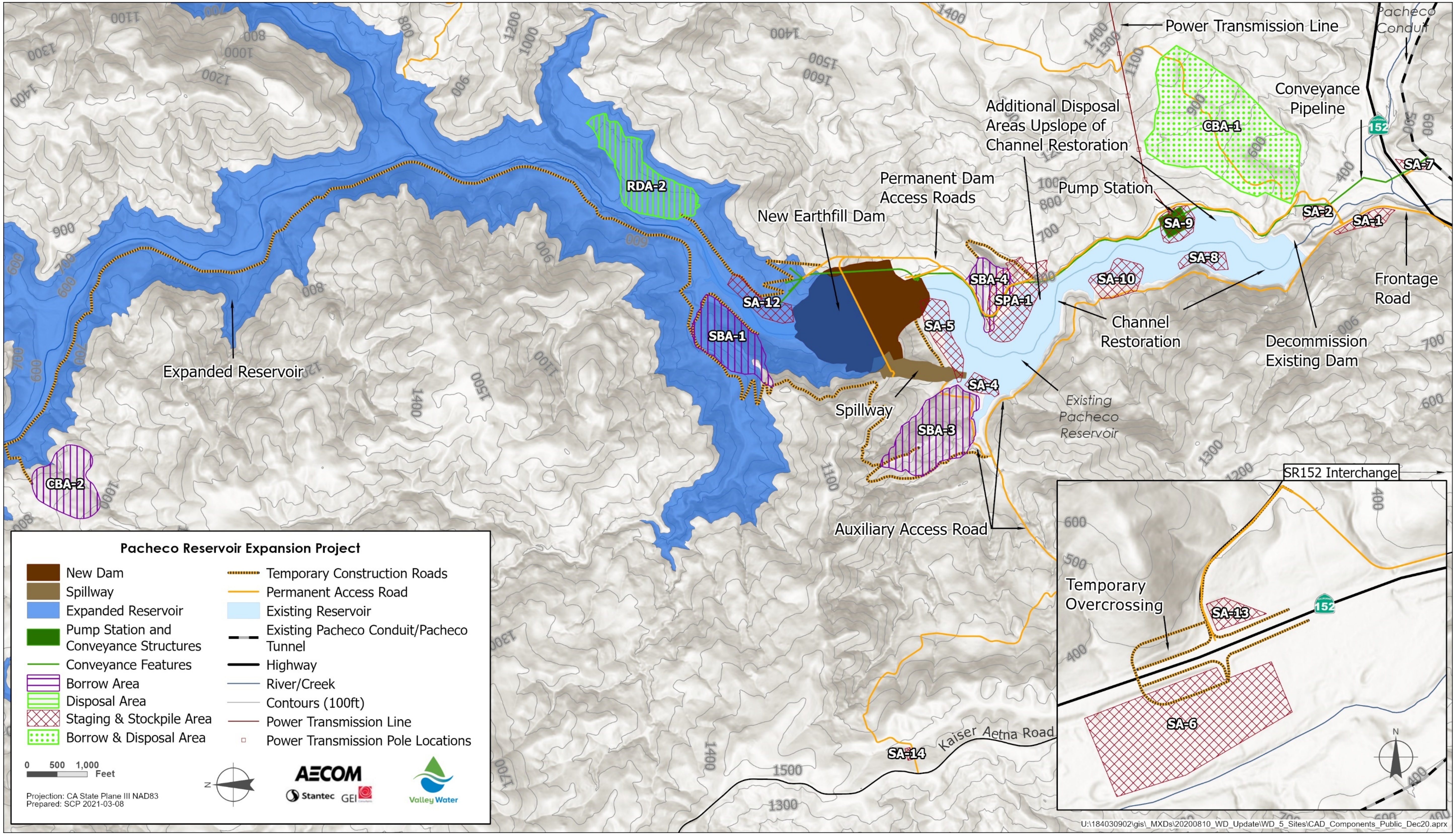


Exhibit 22. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for Alternative A - Dam Site Area Detail

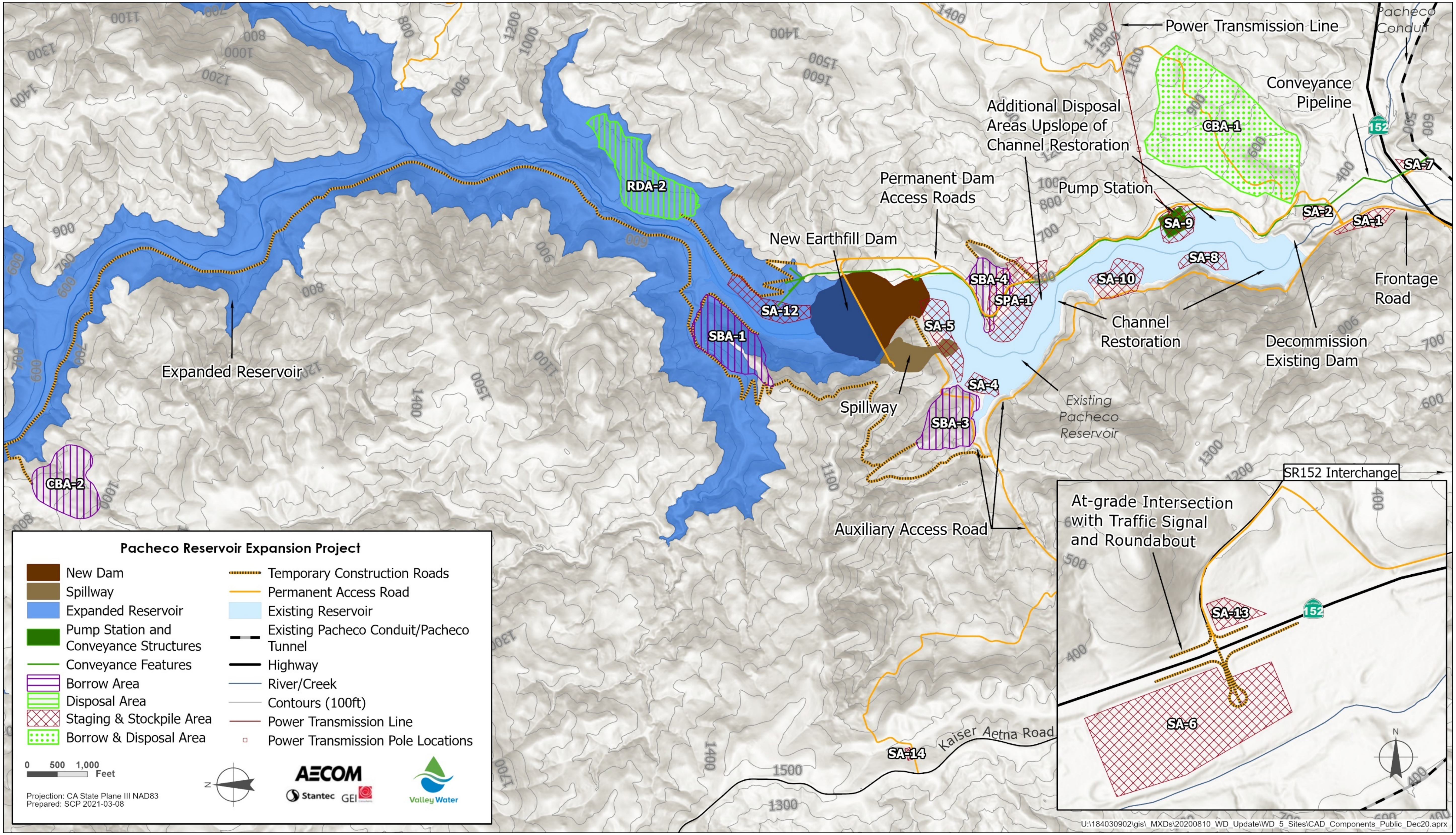


Exhibit 23. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for Alternative B - Dam Site Area Detail

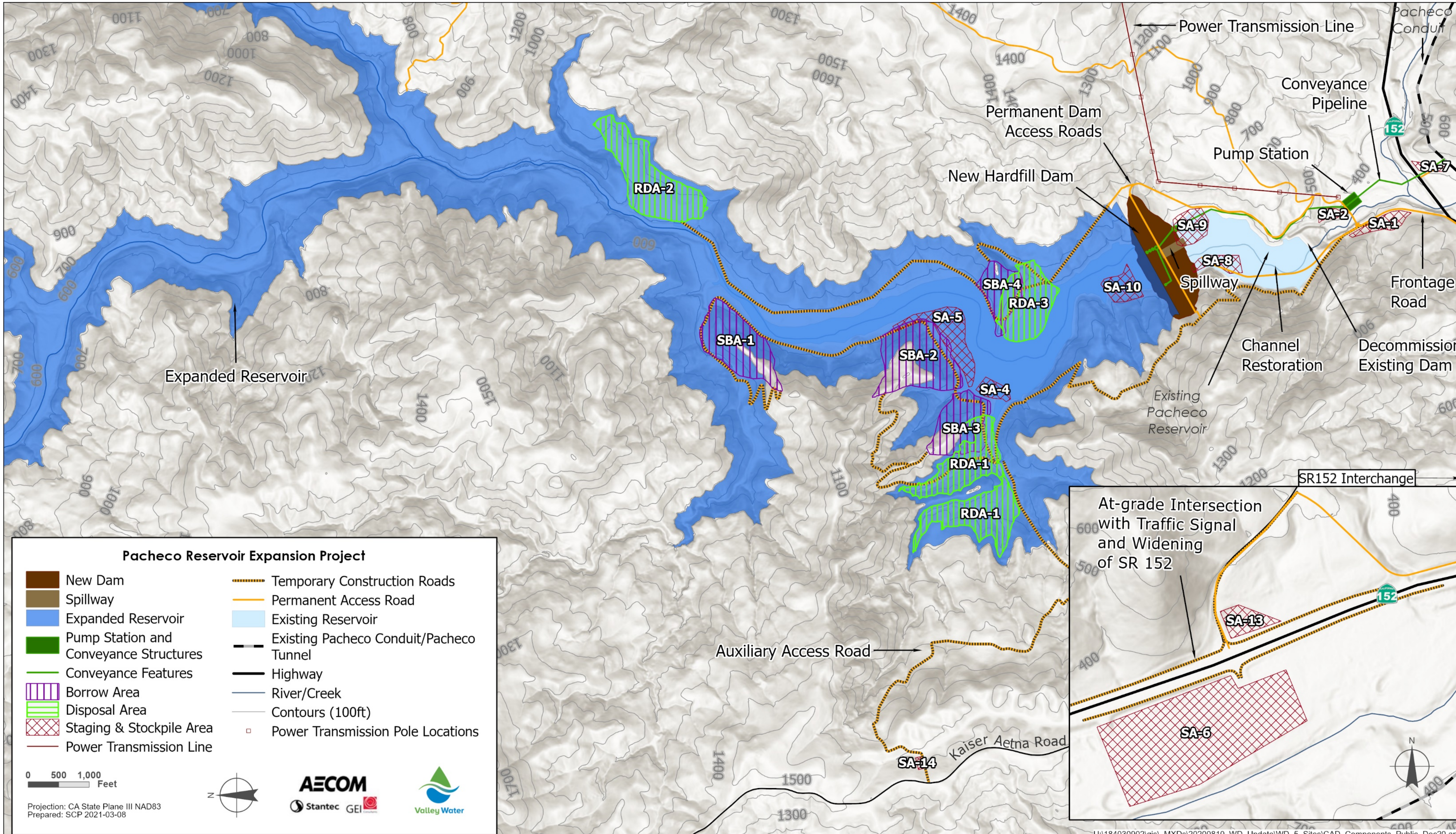


Exhibit 24. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for Alternative C - Dam Site Area Detail

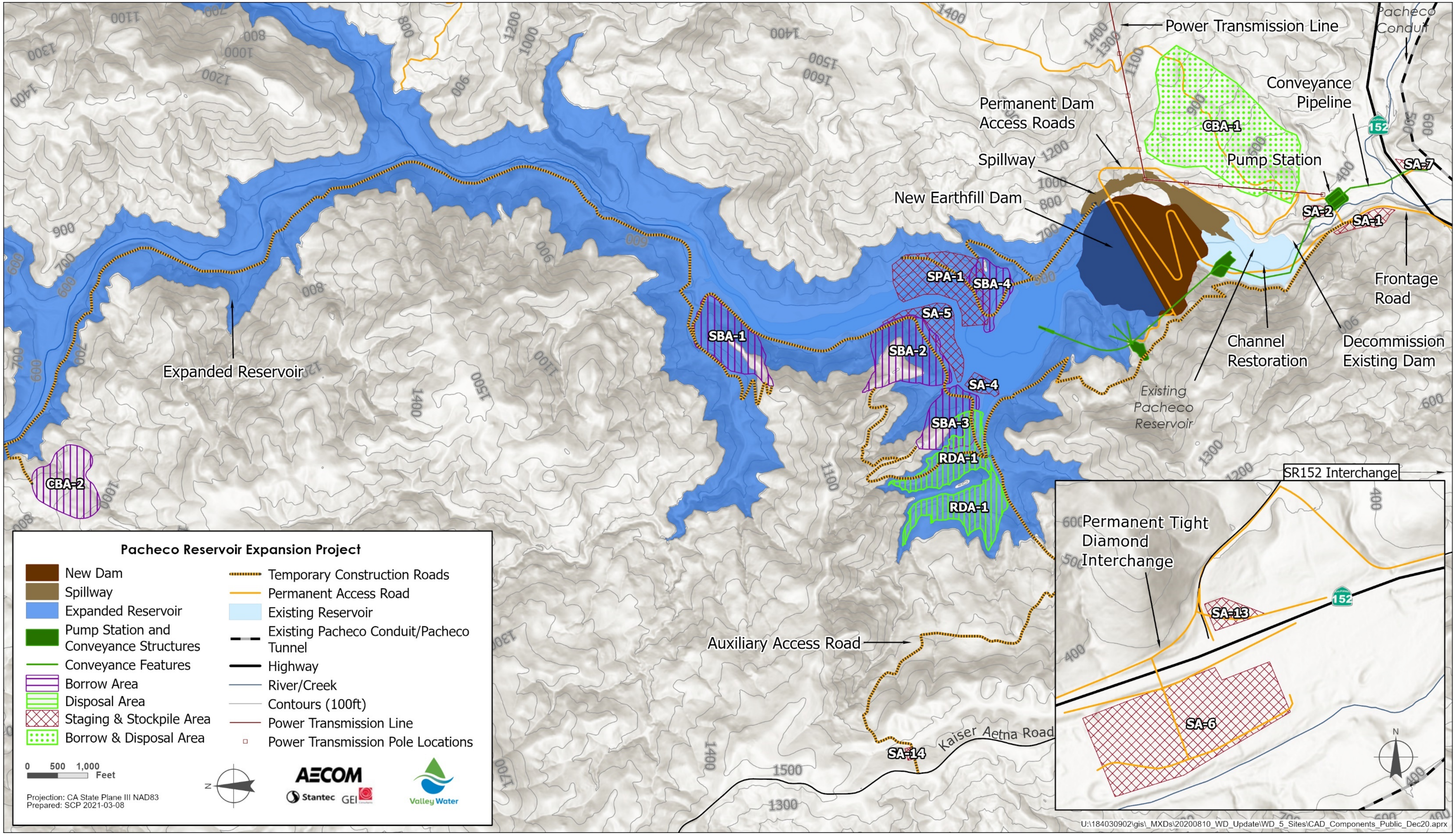
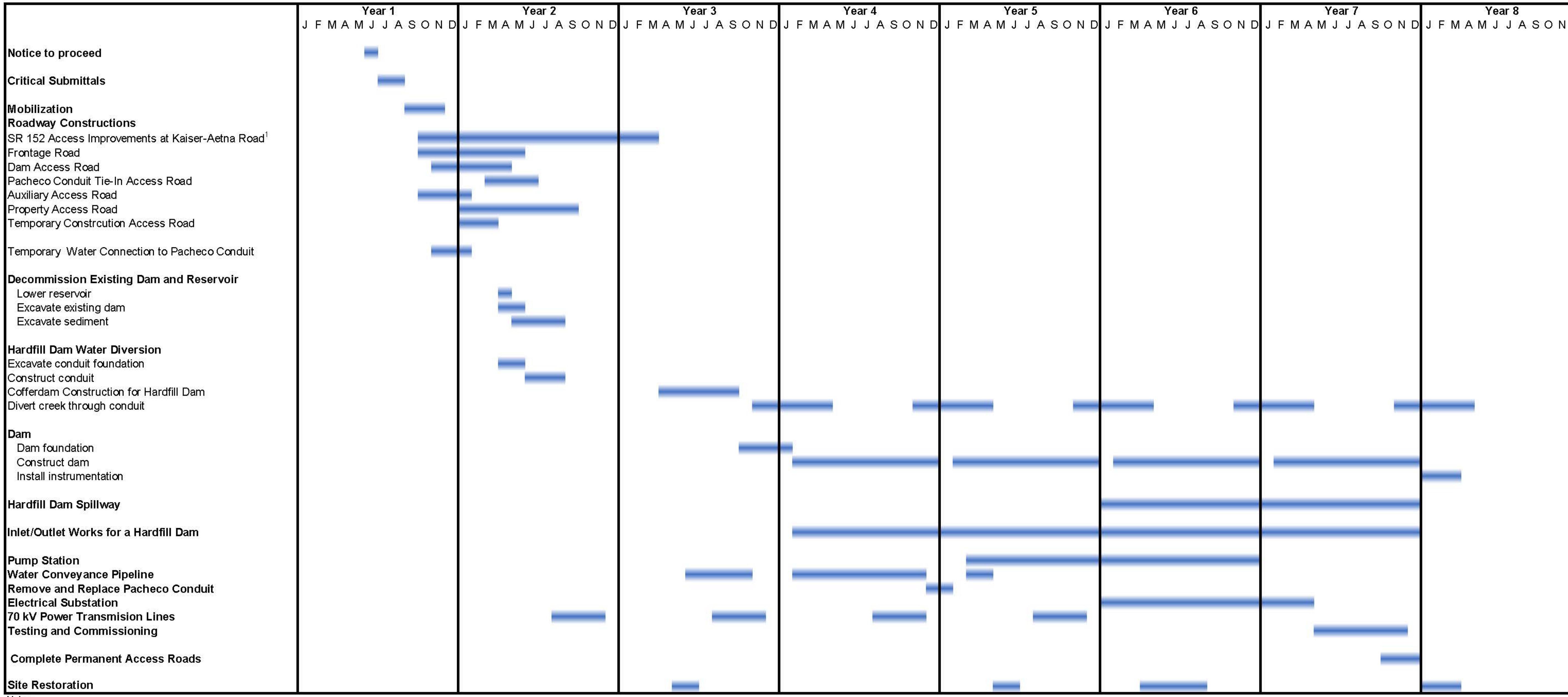
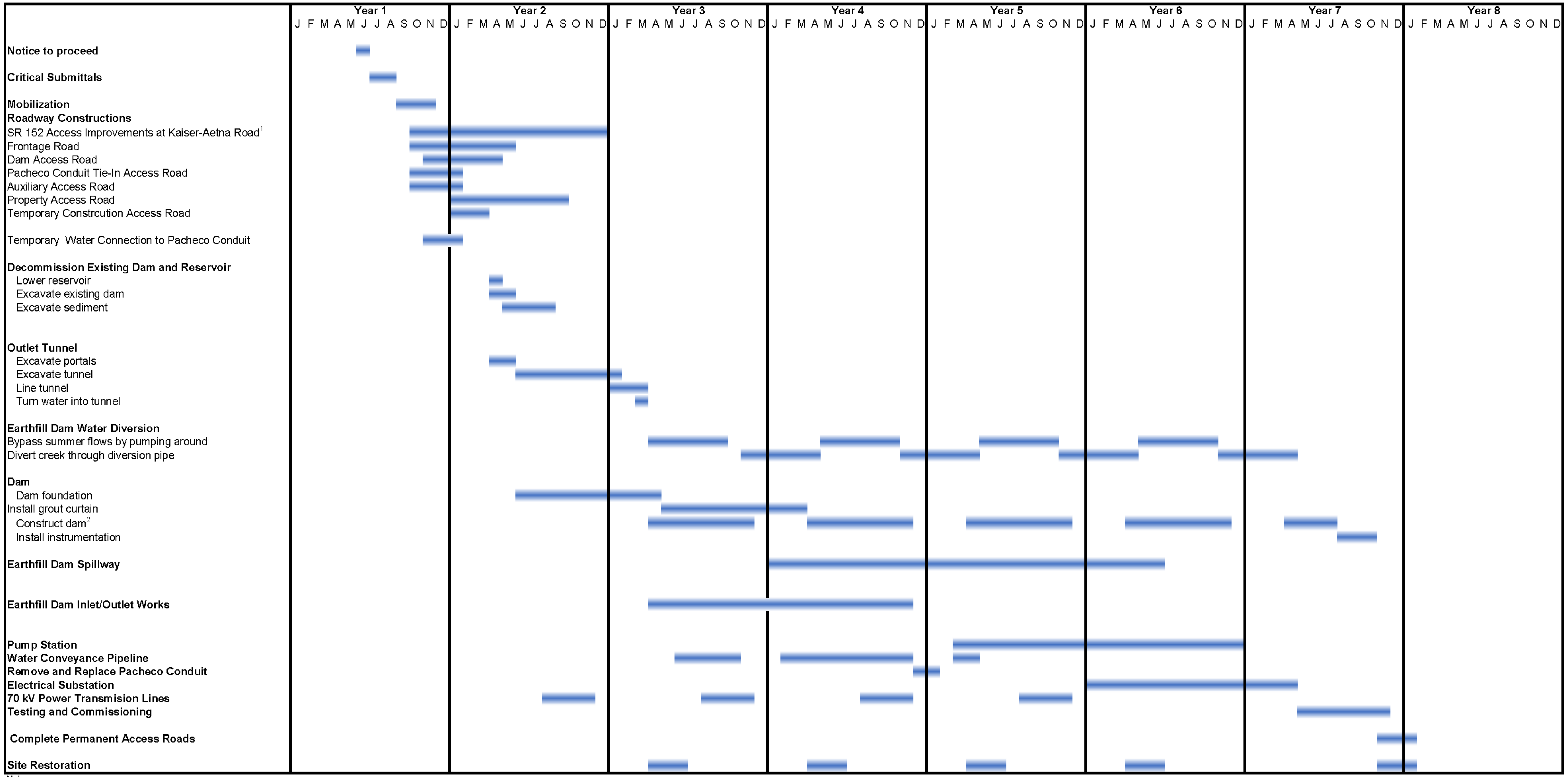


Exhibit 25. Borrow, Disposal, Staging and Stockpiling Areas and Construction Access Roads for Alternative D - Dam Site Area Detail



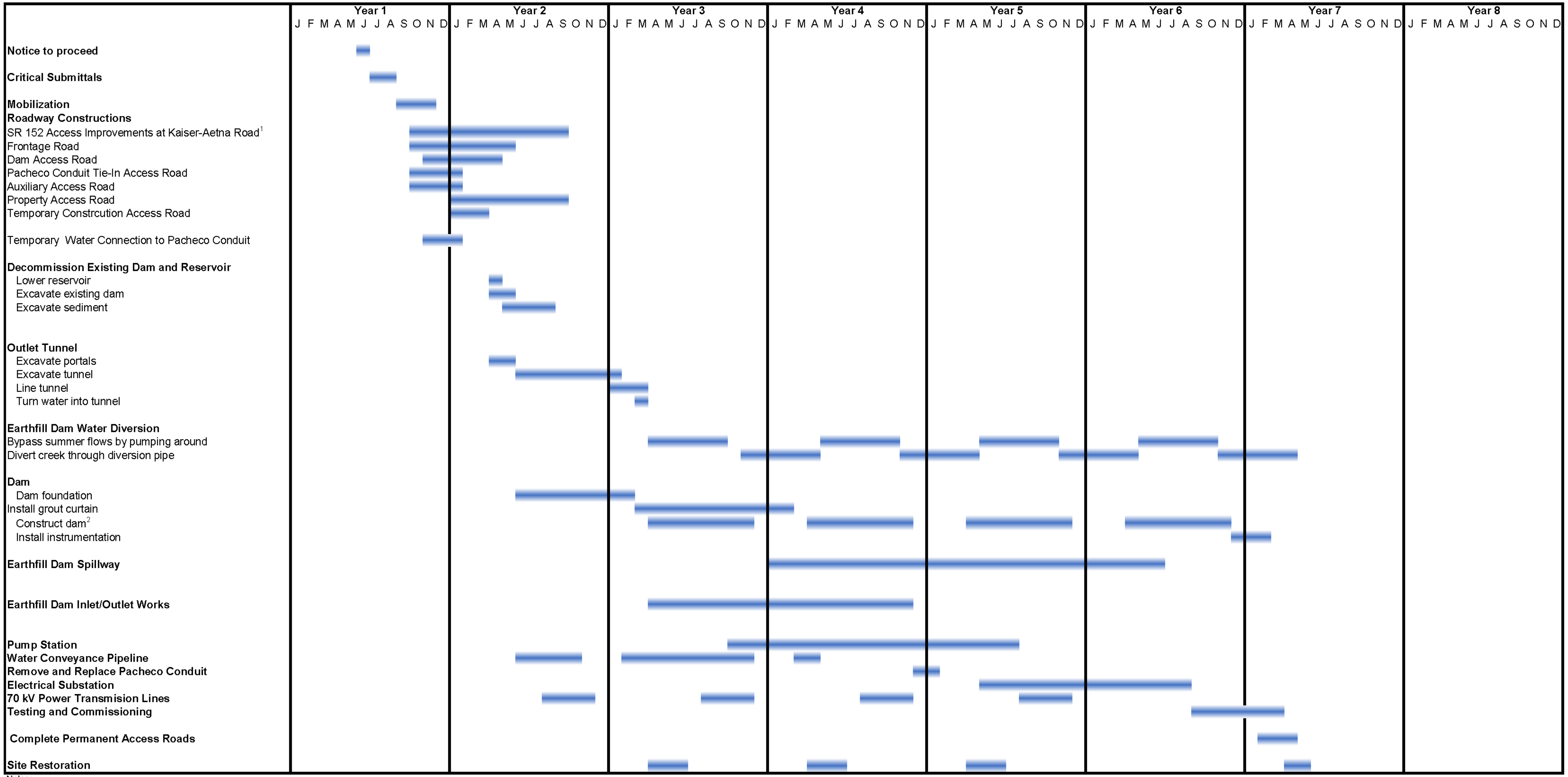
Notes:
[1] SR 152 Access Improvements at Kaiser-Aetna Road includes permanent tight diamond interchange at SR 152

Exhibit 26. Construction Schedule and Sequencing for the Proposed Project



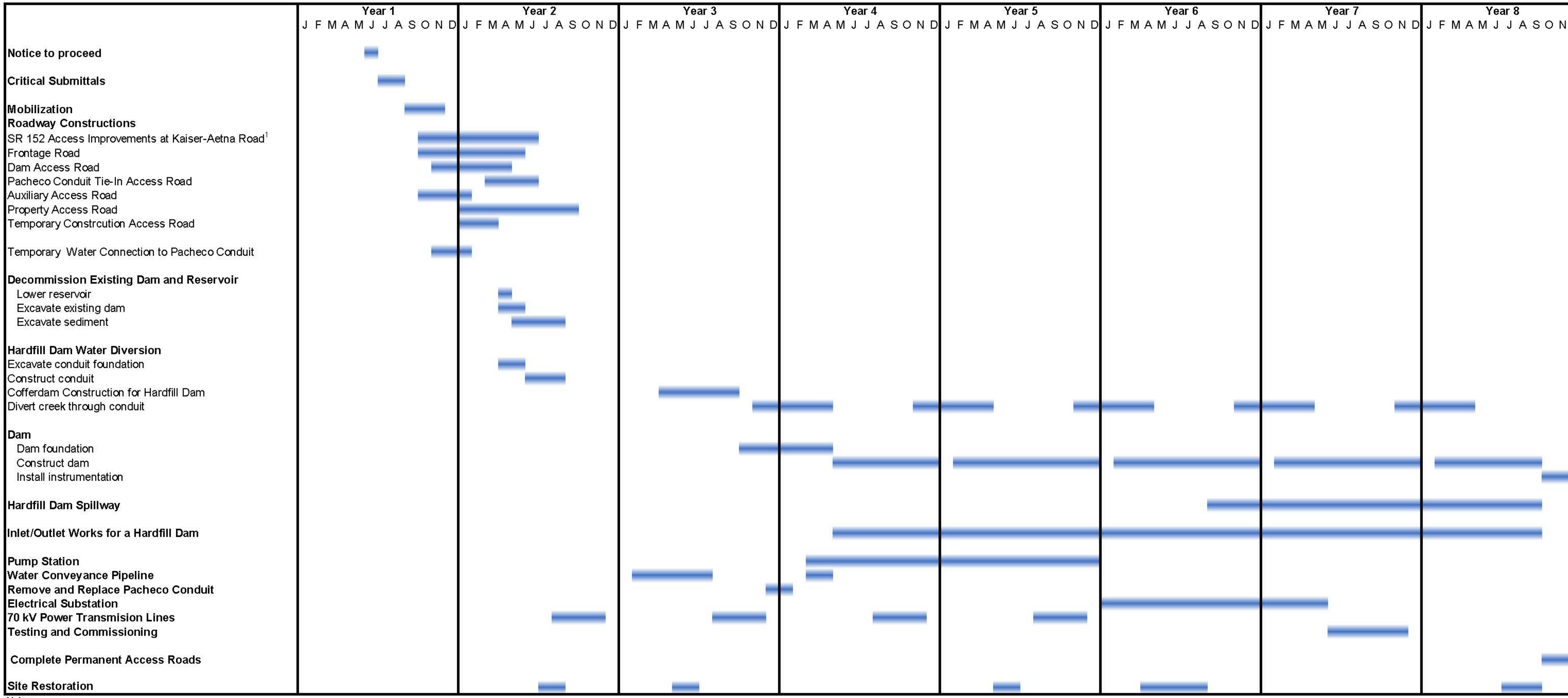
Notes:
[1] SR 152 Access Improvements at Kaiser-Aetna Road includes temporary overcrossing at SR 152
[2] Construction of the cofferdam would occur from April to November during Year 3 of construction

Exhibit 27. Construction Schedule and Sequencing for Alternative A



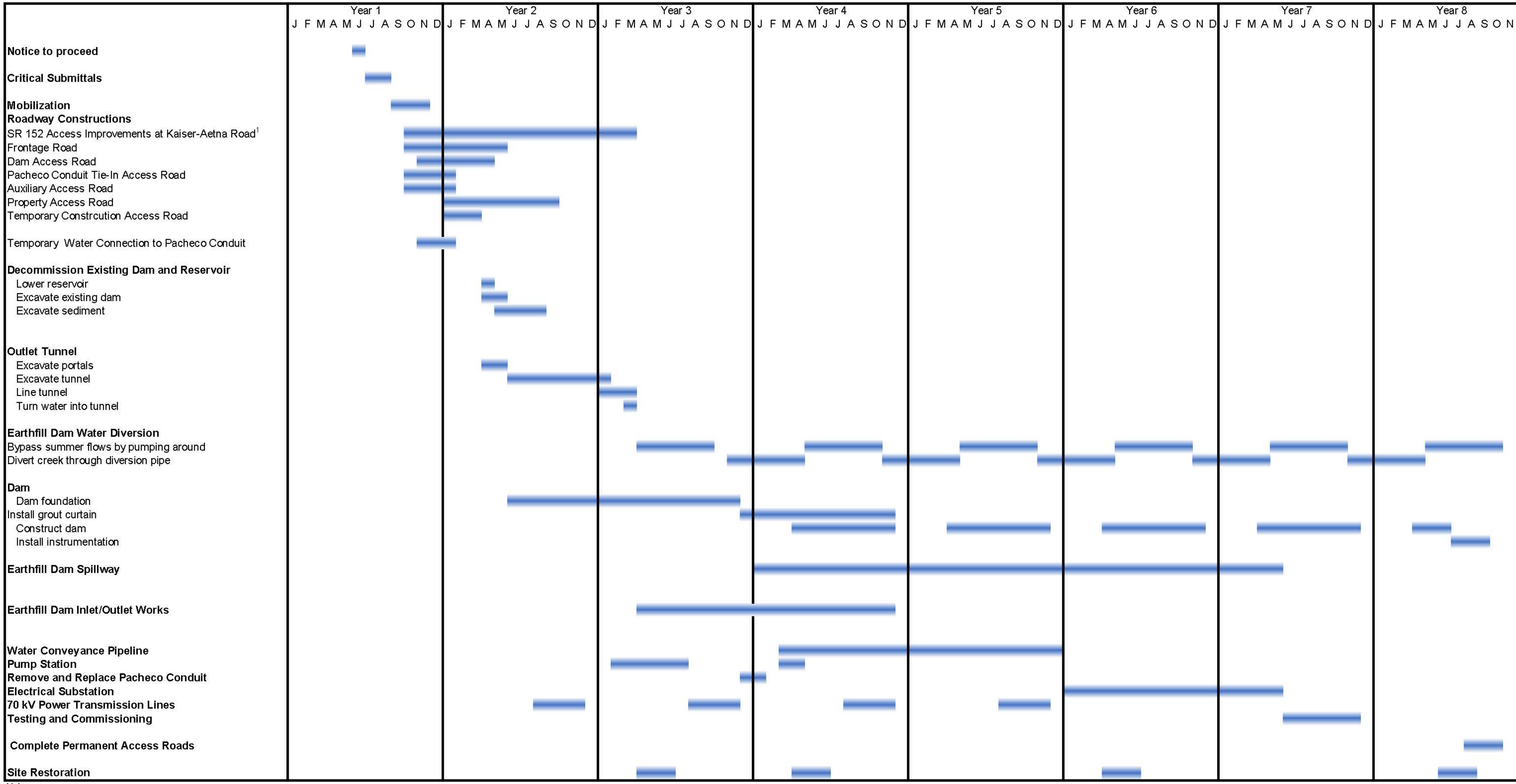
Notes:
[1] SR 152 Access Improvements at Kaiser-Aetna Road includes temporary at-grade intersection with traffic signal and roundabout at SR152
[2] Construction of the cofferdam would occur from April to November during Year 3 of construction

Exhibit 28. Construction Schedule and Sequencing for Alternative B



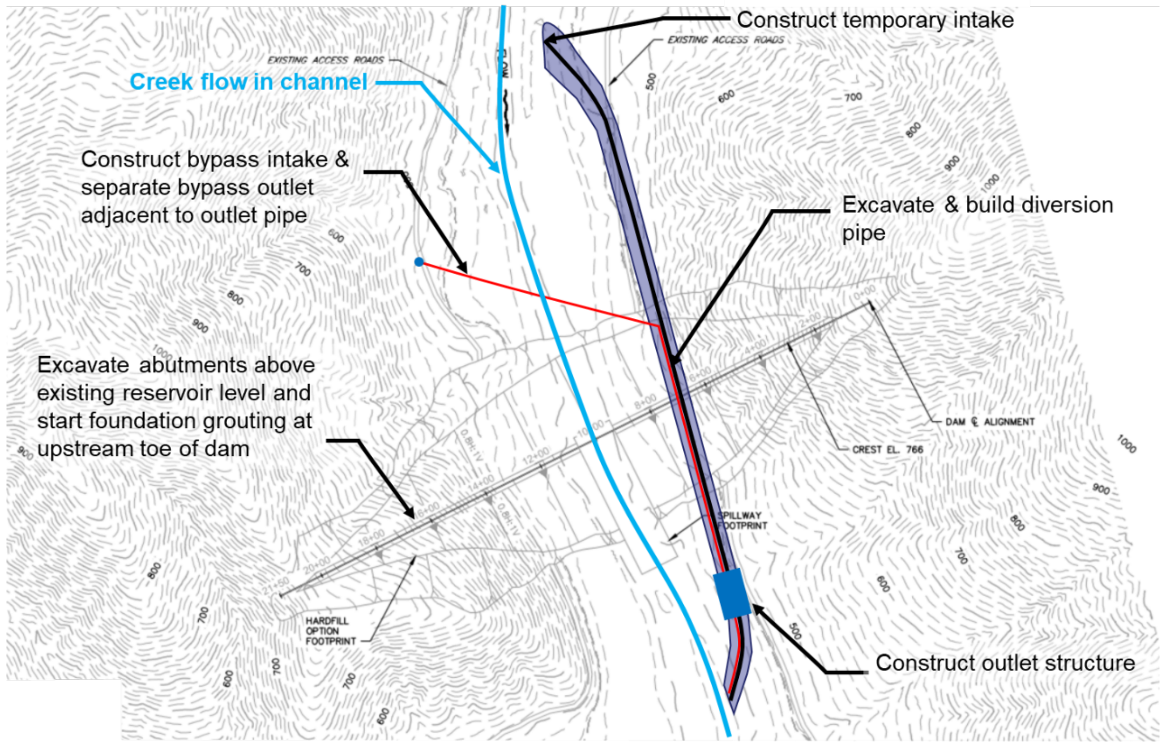
Notes:
[1] SR 152 Access Improvements at Kaiser-Aetna Road includes temporary at-grade intersection with a traffic signal and widening of SR 152

Exhibit 29. Construction Schedule and Sequencing for Alternative C

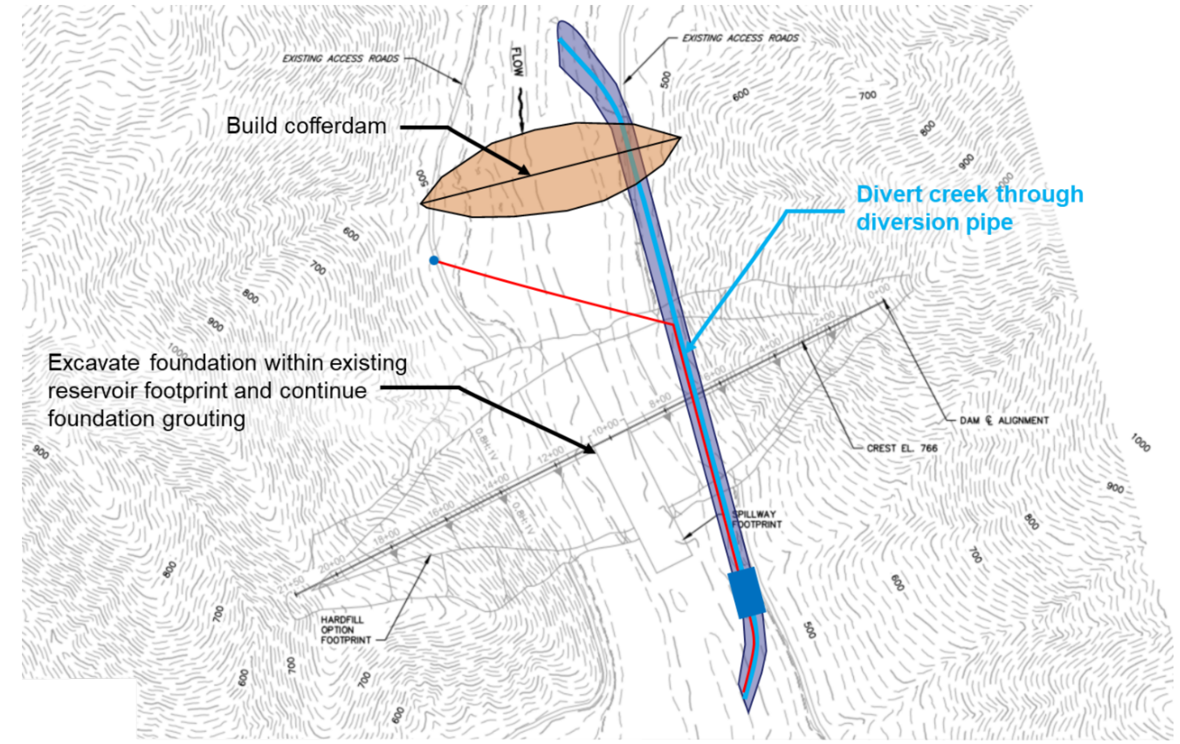


Notes:
[1] SR 152 Access Improvements at Kaiser-Aetna Road includes Permanent tight diamond interchange

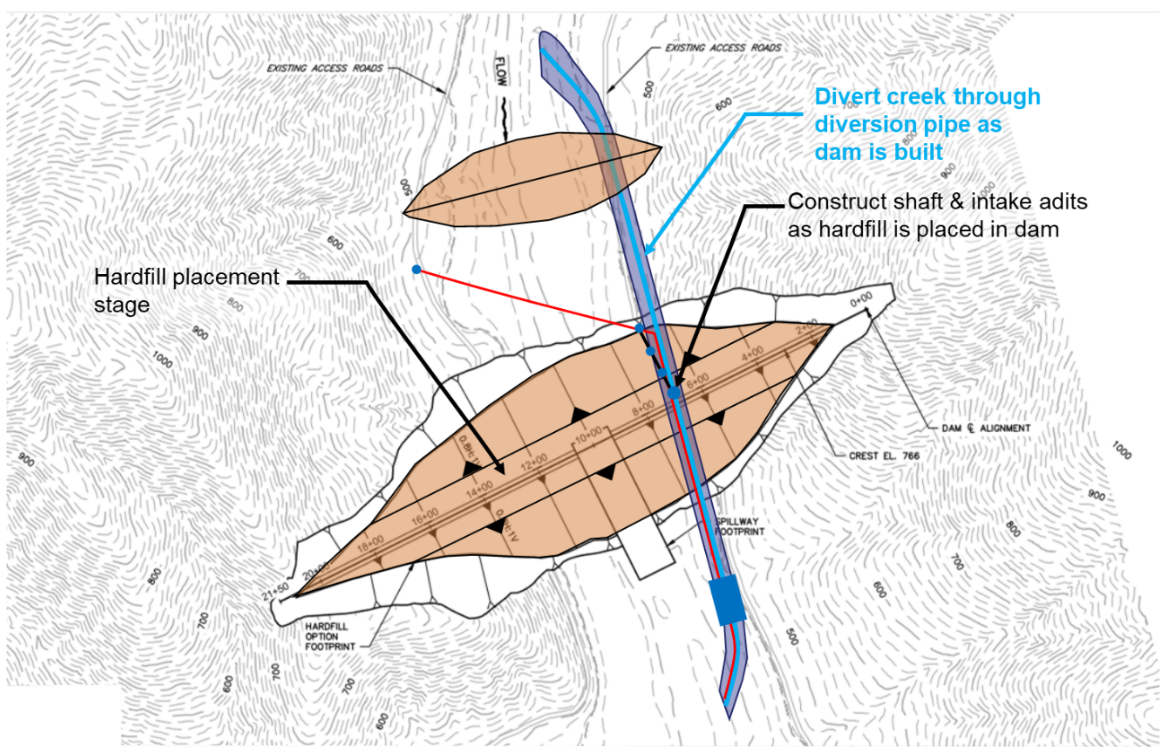
Exhibit 30. Construction Schedule and Sequencing for Alternative D



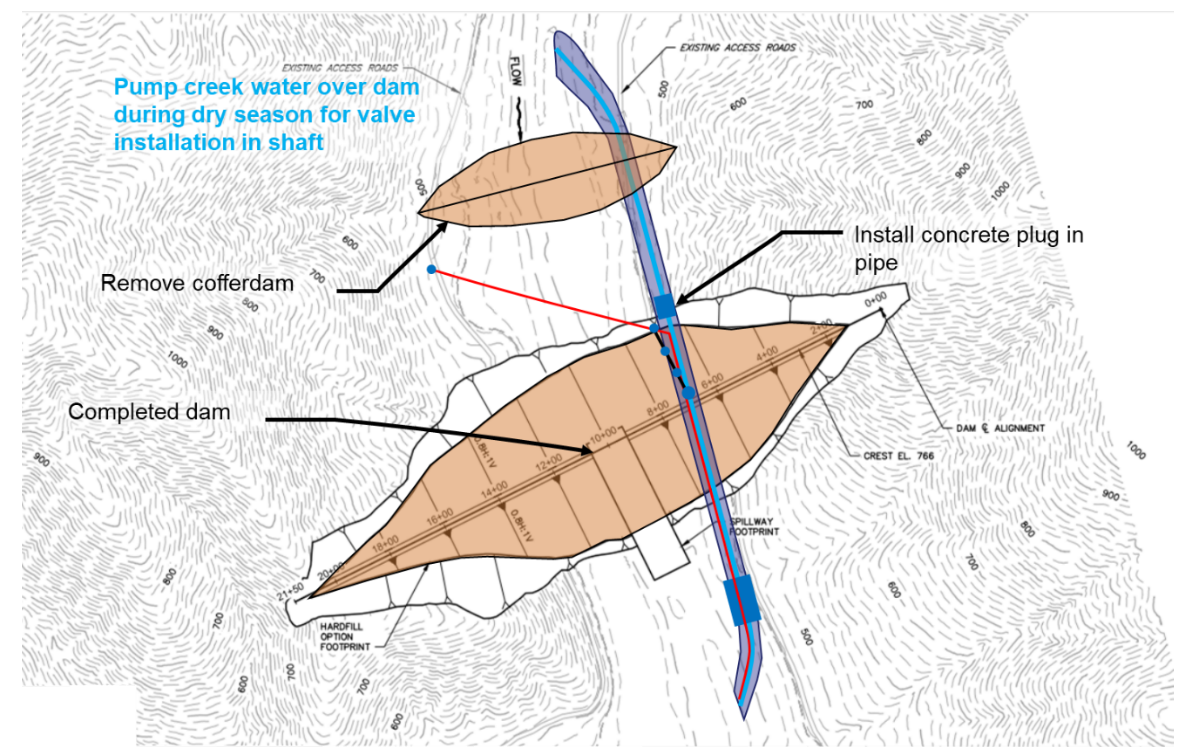
Year 1-2: Mobilize (Year 1) and Construct Diversion Pipe (Year 2)



Year 3: Build Cofferdam and Divert Creek



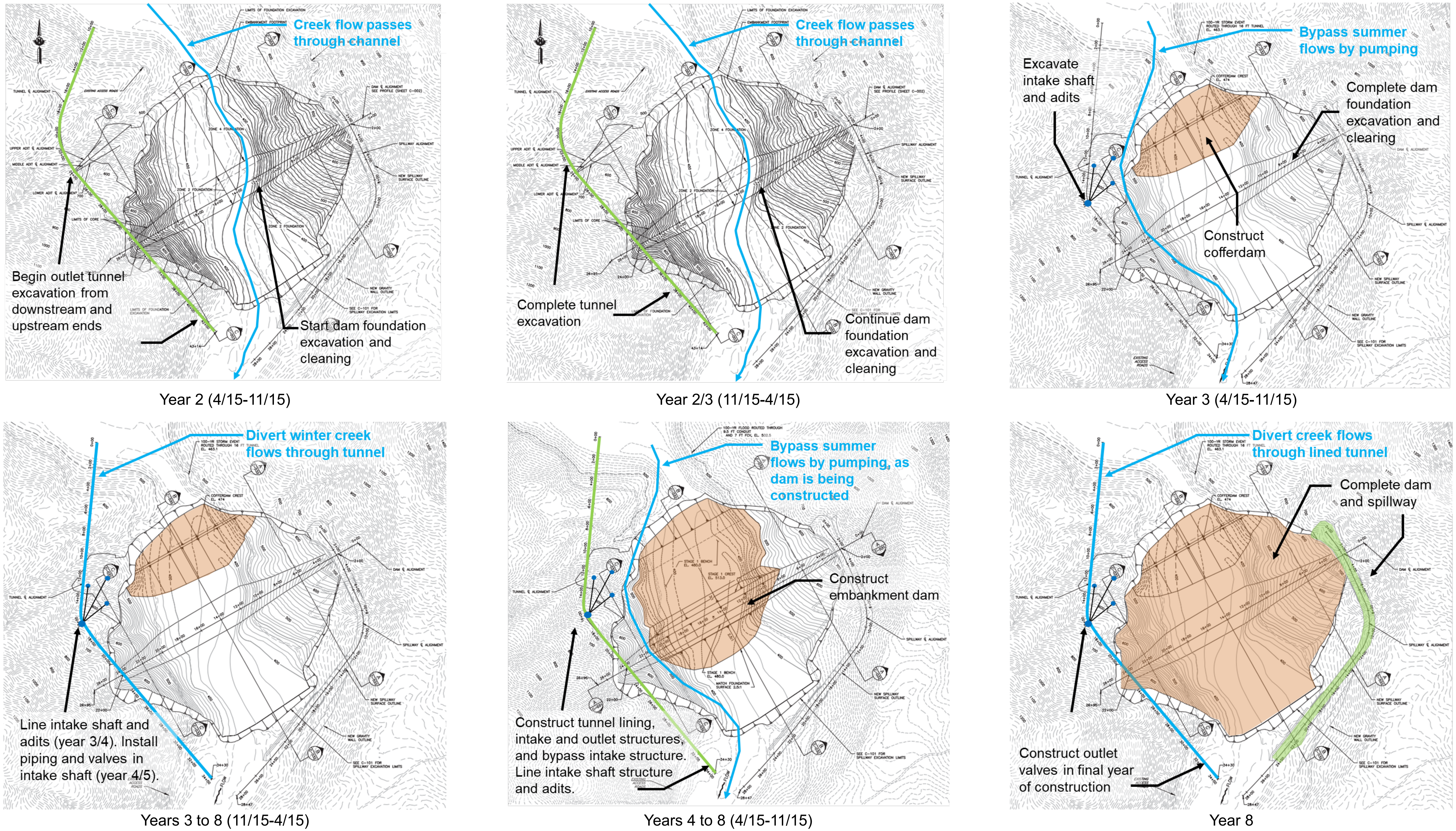
Years 4-7: Construct Shaft and Intake Adits during Dam Construction



Years 7-8: Install Valves in Shaft at Completion of Dam Construction and Remove Cofferdam

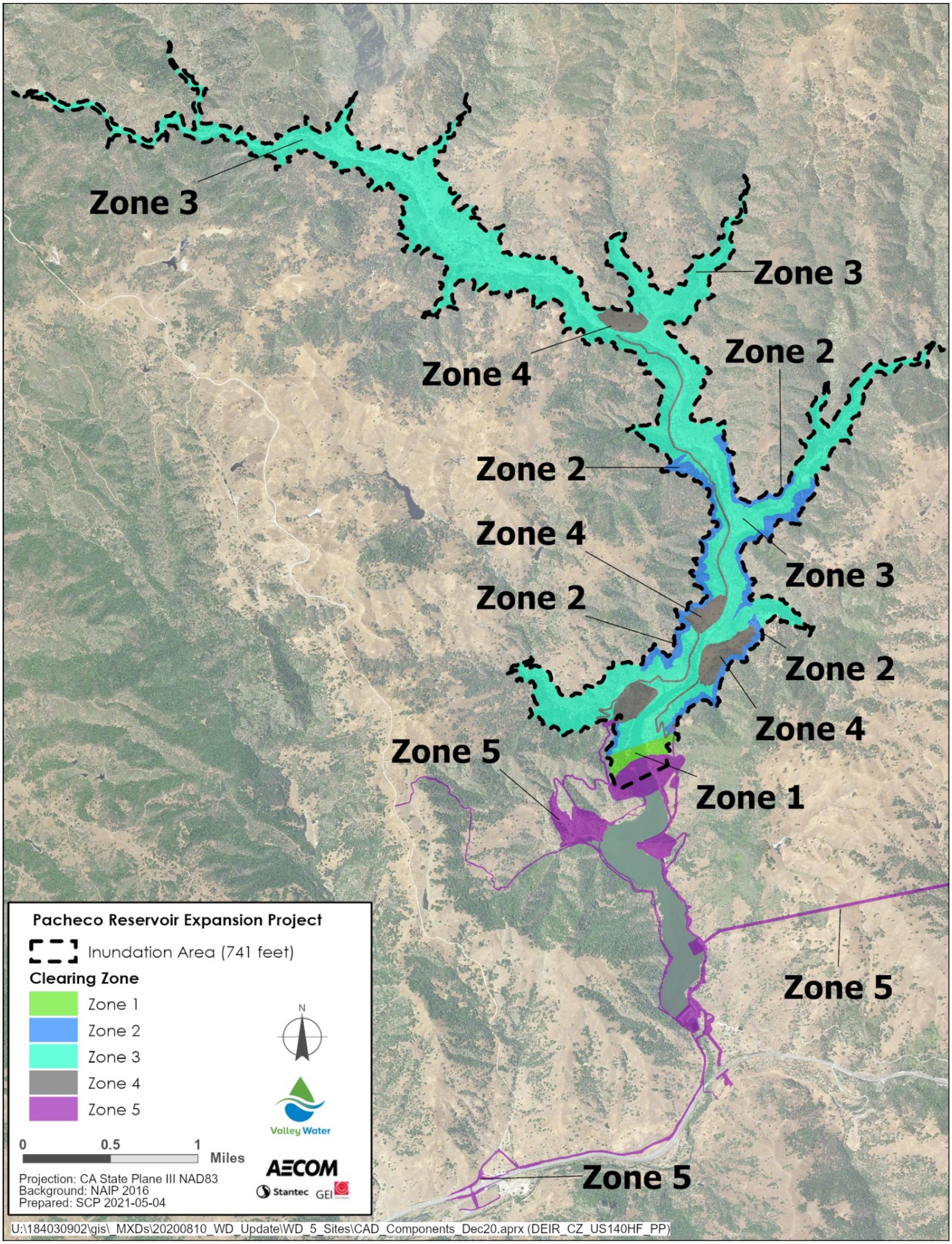
Note: Schematic for illustration purposes only; not to scale. Schematics reflect hardfill dam at upstream location. Approach to water handling at new dam site would be similar at both upstream and downstream dam site locations.

Exhibit 31. Schematic of Water Handling During Construction at New Hardfill Dam Site for the Proposed Project and Alternative C



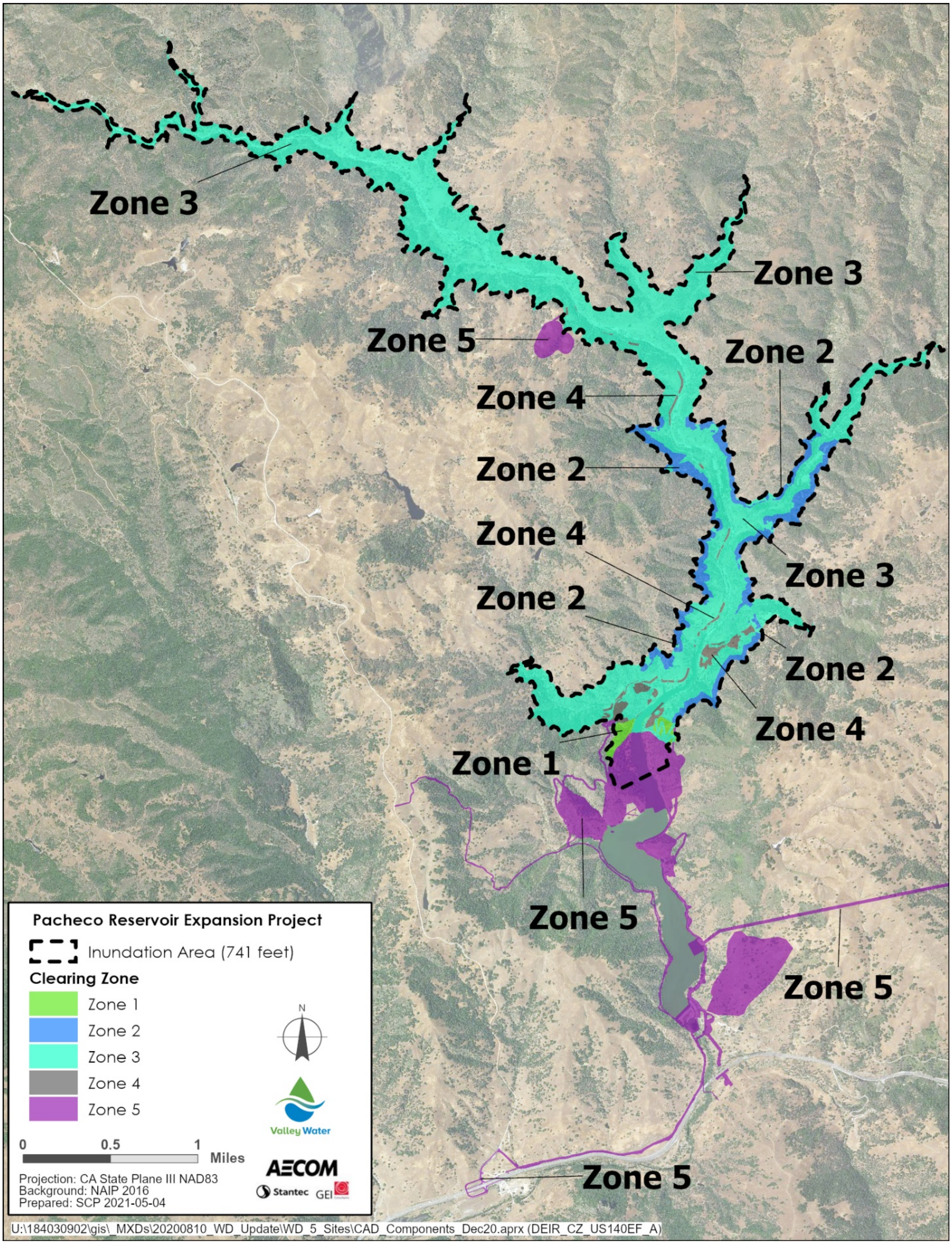
Note: Schematic for illustration purposes only; not to scale. Schematics reflect earthfill dam at downstream location. Approach to water handling at new dam site would be similar at both upstream and downstream dam site locations.

Exhibit 32. Schematic of Water Handling During Construction at New Earthfill Dam Site for Alternatives A, B, and D



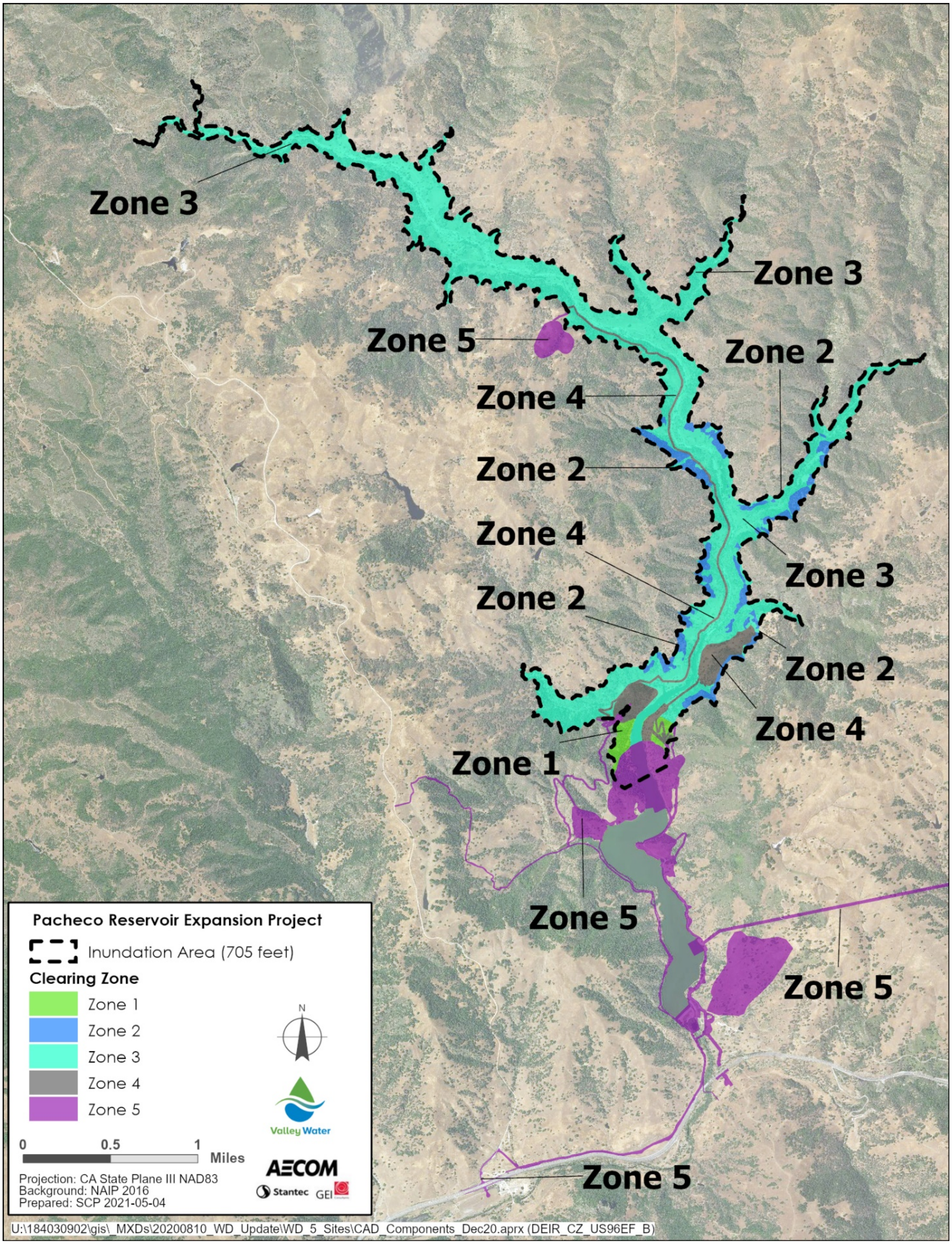
Note: Clearing along power transmission line alignment would extend east as shown in Exhibit 2.

Exhibit 33. Clearing Zone Areas for the Proposed Project



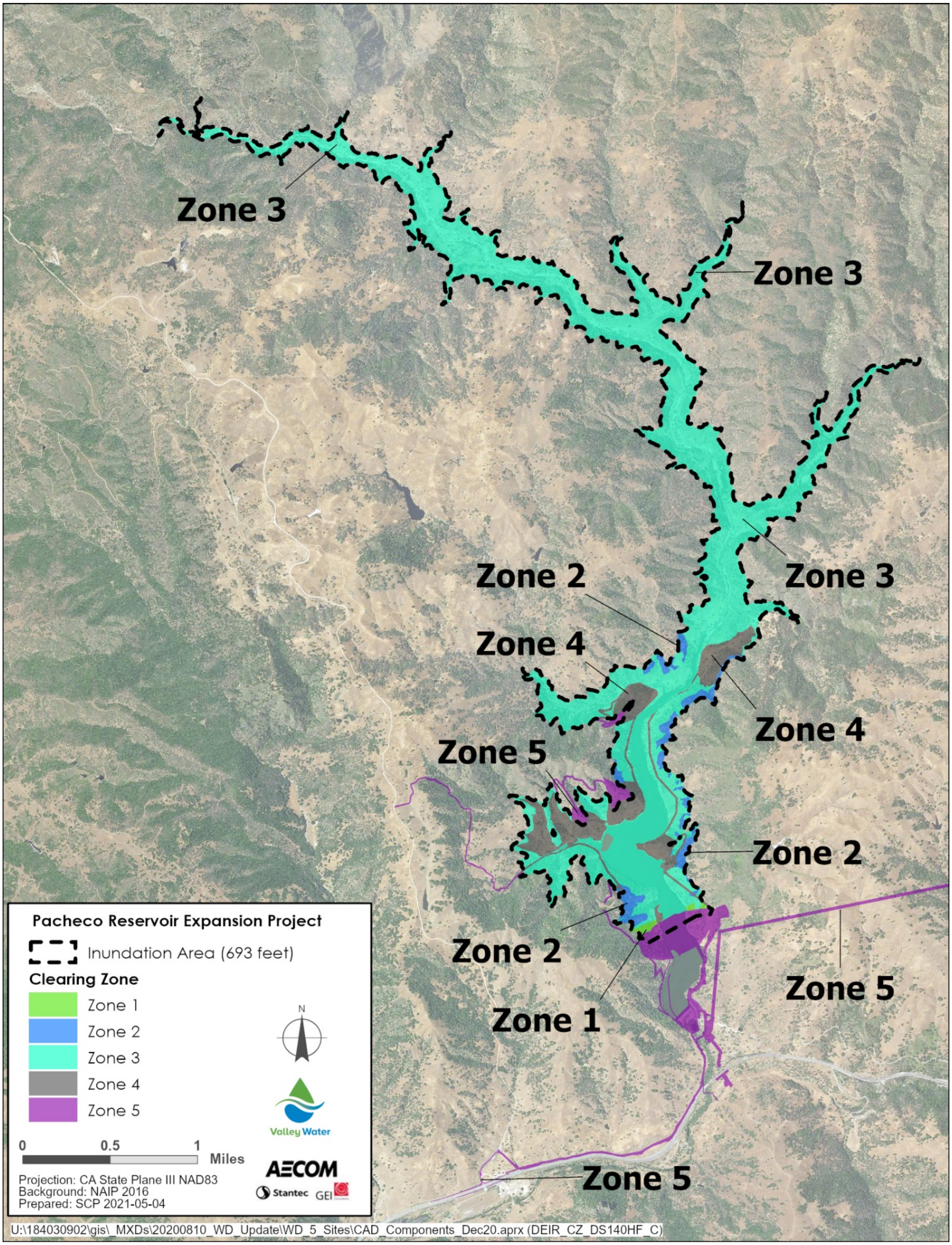
Note: Clearing along power transmission line alignment would extend east as shown in Exhibit 3.

Exhibit 34. Clearing Zone Areas for Alternative A



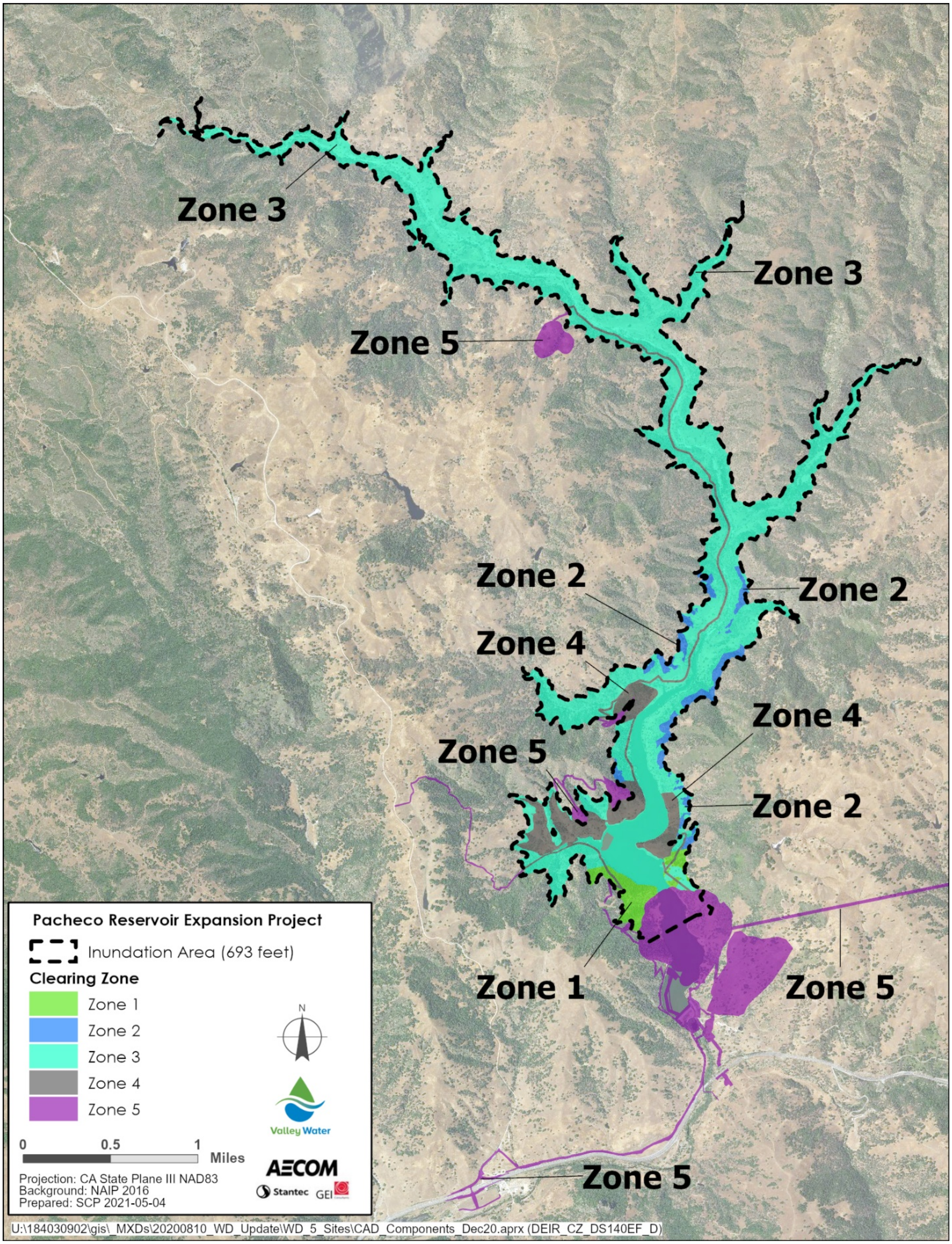
Note: Clearing along power transmission line alignment would extend east as shown in Exhibit 4.

Exhibit 35. Clearing Zone Areas for Alternative B



Note: Clearing along power transmission line alignment would extend east as shown in Exhibit 5.

Exhibit 36. Clearing Zone Areas for Alternative C



Note: Clearing along power transmission line alignment would extend east as shown in Exhibit 6.

Exhibit 37. Clearing Zone Areas for Alternative D