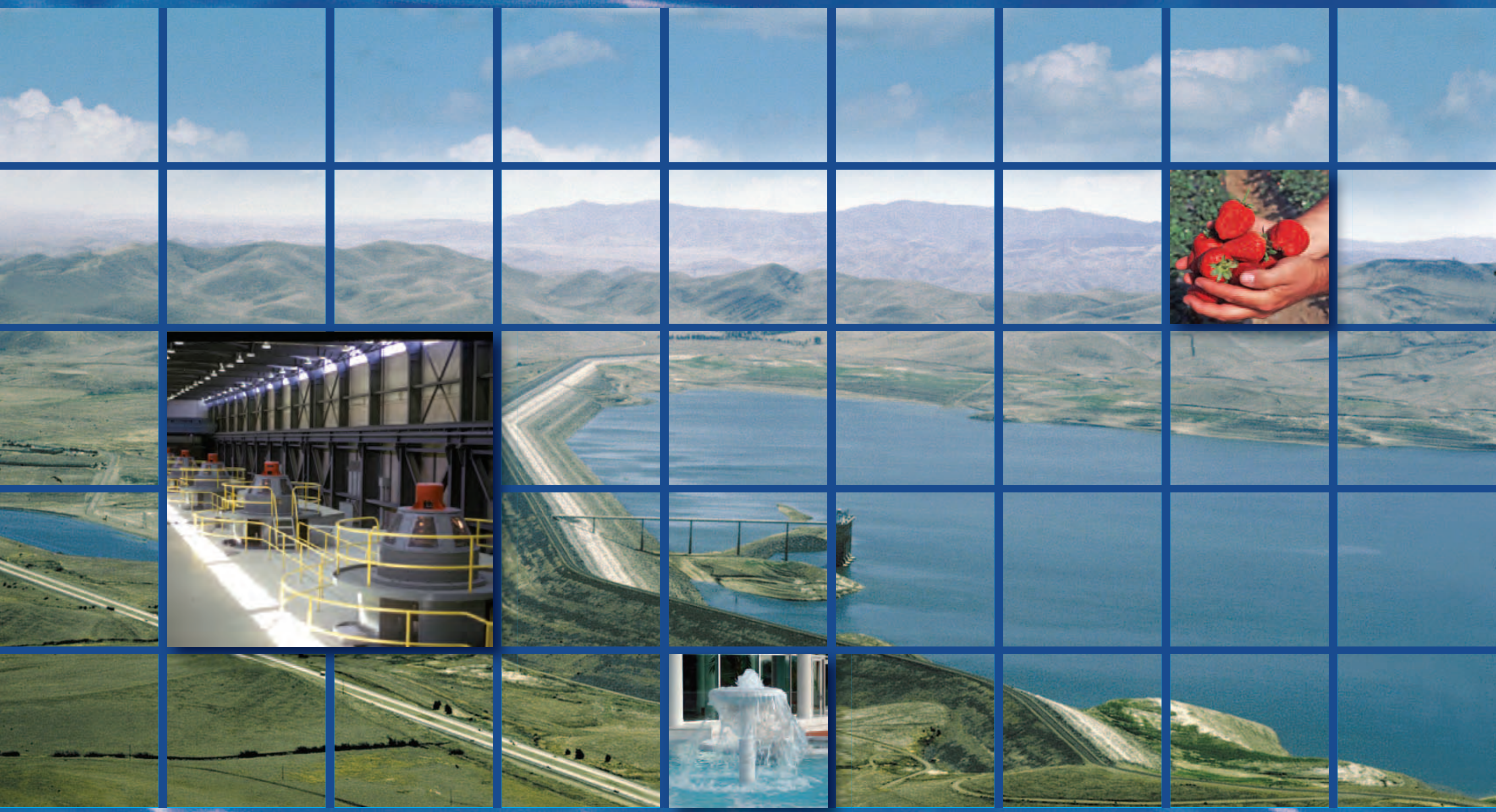
San Luis
Low Point Improvement Project

Plan Formulation Report



U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
Sacramento, California

Santa Clara Valley Water District
San Jose, California

San Luis and Delta Mendota
Water Authority
Los Banos, California

January 2011

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

San Luis Low Point Improvement Project

Plan Formulation Report

Prepared for Reclamation by CDM under Contract No. 06CS204097C

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
Sacramento, California

January 2011

Executive Summary

The San Luis Low Point Improvement Project (SLLPIP) is a feasibility study (Study) by the U.S. Department of the Interior, Bureau of Reclamation in cooperation with the Santa Clara Valley Water District (SCVWD) and the San Luis & Delta-Mendota Water Authority (SLDMWA). The SLLPIP is proposed to maintain a high quality, reliable, and cost-effective water supply for SCVWD and other contractors of the Bureau of Reclamation's San Felipe Division to ensure that these contractors receive their annual Central Valley Project contract allocations at the time and at the level of quality needed to meet water supply commitments.

Purpose of Plan Formulation Report

This Plan Formulation Report (PFR) is an interim product of the SLLPIP Study by Reclamation in cooperation with SCVWD and SLDMWA. The purpose of the Study is to determine the type and extent of Federal and regional interests in a potential project to optimize the water supply benefits of San Luis Reservoir while reducing risks to water users. The primary purposes of this PFR are to describe the formulation, evaluation, and comparison of alternative plans that address the study planning objectives, and to define a set of alternative plans to be considered in detail in the Feasibility Report and Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

Interim reports, such as this PFR, are developed to share the progress of the Study and as decision points on whether to continue with the study based on available information on the alternatives. Additional studies and documentation will follow this PFR during the ongoing feasibility study, with opportunities for public review and participation.

The low point issue was identified among the water resources problems, needs, and opportunities contained in the Complementary Actions section of the CALFED Programmatic Record of Decision (August 2000), and Reclamation received feasibility study authorization in Public Law 108-361, Section 103(f)(1)(A), the “Water Supply, Reliability, and Environmental Improvement Act.” Reclamation is the responsible Federal agency for preparing the Feasibility Report and EIS. SCVWD is the State lead agency for the investigation and preparation of the EIR.

Background

Reclamation owns and jointly operates San Luis Reservoir with the California Department of Water Resources (DWR) to provide seasonal storage for the CVP and the State Water Project (SWP). San Luis Reservoir is connected to both the Delta-Mendota Canal and the California Aqueduct (see Figure ES-1), which enables the CVP and SWP to pump water into the reservoir during the wet season (October through March) and release water into the conveyance facilities during the dry season (April through September) when demands are higher. Deliveries from San Luis Reservoir also flow west through Pacheco Pumping Plant and Conduit to the San Felipe Division of the CVP, which includes the SCVWD and the San Benito County Water District (SBCWD).

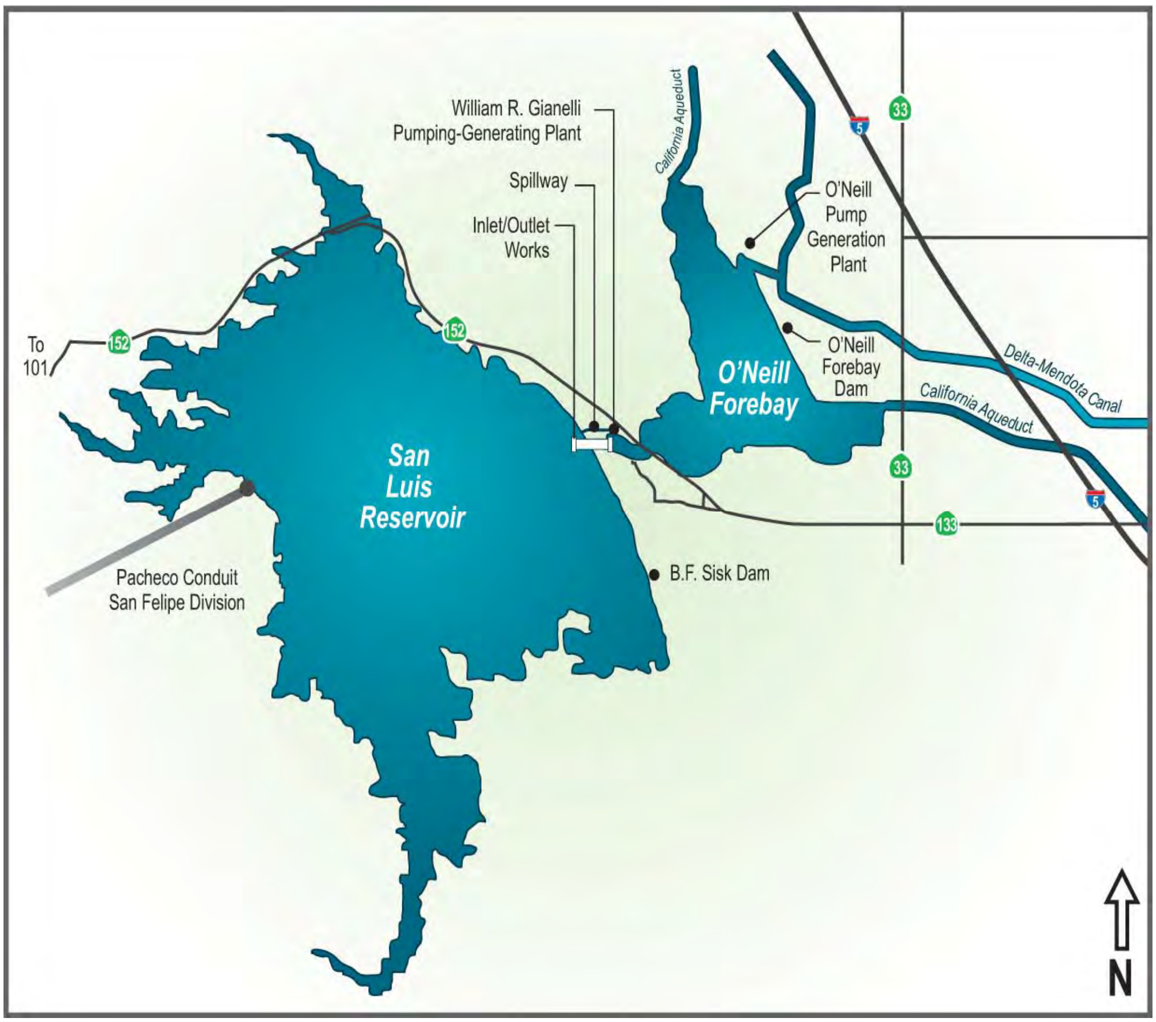


Figure ES-1. San Luis Reservoir and Associated Facilities

Problems and Needs

High temperatures and other factors in San Luis Reservoir create conditions that foster algae growth. The thickness of the algae blooms vary, but algae cells are typically observed in the water delivered through the Lower Pacheco Intake when the reservoir surface is drawn within 35 feet of the intake. The water quality within the algal blooms is not suitable for agricultural water users with drip irrigation systems in San Benito County or for municipal and industrial water users relying on existing water treatment facilities in Santa Clara County.

Figure ES-2 shows the intake and outlet facilities associated with the reservoir. As water levels decline to the point that the algae is near the Upper Pacheco Intake, that intake is no longer used. The low point issue occurs when the water levels decline to the point that the algae blooms are near the Lower Pacheco Intake.

Typically, this point occurs when water levels reach an elevation of 369 feet above mean sea level or approximately 300 thousand acre-feet (TAF) when the water is approximately 35 feet above the top of the Lower Pacheco Intake. The top of the Lower Pacheco Intake is 334 feet above mean sea level or approximately 110 TAF. The reservoir's minimum operating level is about 30 feet above the top of the Gianelli Intake; therefore, algae do not typically enter the Delta-Mendota Canal or California Aqueduct.

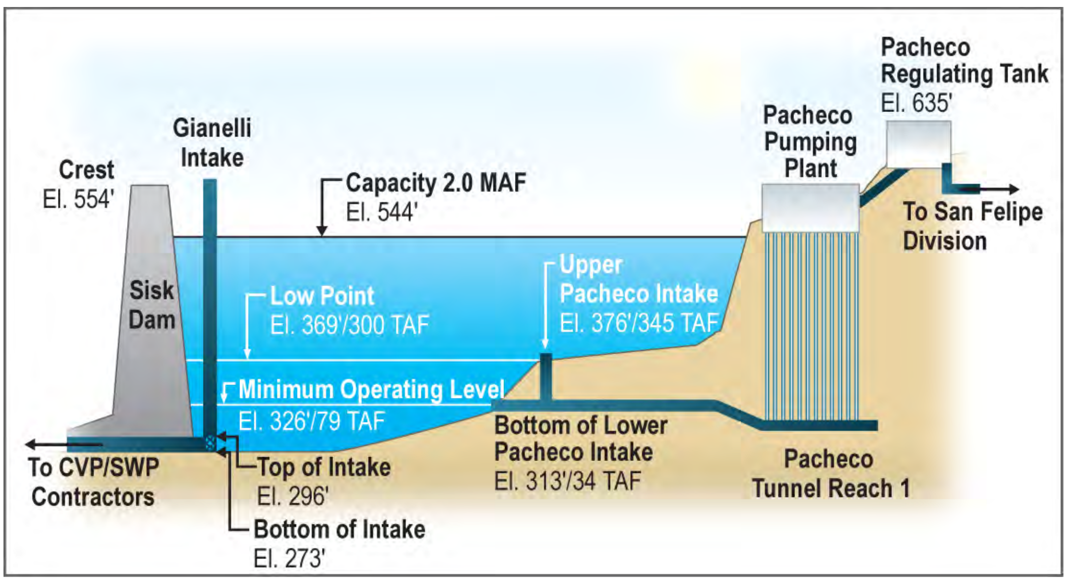


Figure ES-2. Reservoir Intake and Outlet Facilities

As water levels fall below 369 feet (300 TAF), algae blooms coupled with low water levels render the San Felipe Division's water users' CVP supply less reliable. San Luis Reservoir is the only delivery route for the San Felipe Division's CVP supplies authorized under their current CVP Water Service

Contracts (SCVWD contract No. 7-07-20-W0023 dated June 7, 1977 amended March 28, 2007; SBCWD contract No. 8-07-20-W0130 dated April 15, 1978 amended March 28, 2007). With Reclamation's authorization, SCVWD could receive a portion of its CVP supplies through the South Bay Aqueduct (SBA) when capacity is available; however, SBCWD is not able to access CVP supplies through the SBA.

CVP operators allocate water based on the full use of available Federal San Luis storage capacity and water levels are predicted to fall below 369 feet (300 TAF) for most years. Even the prediction of a low point issue can cause water supply concerns for the San Felipe Division, particularly for municipal and industrial supplies for SCVWD, because the districts must secure alternative water supplies in case disruptions occur during this period.

Maintaining water levels in the reservoir above the low point of 369 feet (300TAF) would allow deliveries to continue to the San Felipe Division; however, leaving water in the reservoir above the minimum operating level would decrease the yield of the CVP and result in decreased deliveries to all CVP contractors. The SLLPIP objectives, identified below, strive to meet the needs of both the San Felipe Division and other CVP contractors that depend on San Luis Reservoir.

Planning Objectives

The objective of the SLLPIP is to optimize the water supply benefit of San Luis Reservoir while reducing additional risks to water users.

- Avoiding supply interruptions when water is needed by increasing the certainty of meeting the requested delivery schedule throughout the year to south-of-Delta contractors dependent on San Luis Reservoir.
- Increasing the reliability and quantity of yearly allocations to south-of-Delta contractors dependent on San Luis Reservoir.
- Announcing higher allocations earlier in the season to south-of-Delta contractors dependent on San Luis Reservoir without sacrificing accuracy of the allocation forecasts.

The SLLPIP may provide opportunities for ecosystem restoration as well.

Formulation and Evaluation of Alternative Plans

Once the water resources problems, needs, and opportunities have been identified and planning objectives, constraints, and criteria have been developed, the next major elements of the plan formulation process are identifying management measures, and formulating alternative plans to meet the planning objectives.

This PFR builds on the Initial Alternatives Information Report (IAIR), published in February 2008, which documented the initial phase of the Study. The IAIR documented the problems, needs, and opportunities, and identified the planning objectives, constraints, and criteria. The IAIR identified 87 management measures to help address the low point issue; these measures were screened based on technical viability, institutional viability, and the ability to meet the project objectives. The remaining measures were combined to form 26 initial alternatives designed to perform well relative to the project objectives. The IAIR evaluated these alternatives based on how well they addressed the Federal criteria (completeness, effectiveness, acceptability, and efficiency), as prescribed in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G; WRC 1983). This evaluation produced 17 action alternatives that moved forward into the Plan Formulation Phase.

As the Study Team developed more information on the remaining 17 action alternatives, it was determined that some alternatives did not fully meet the Federal criteria. The new information and analysis resulted in the Study Team screening out 14 of these alternatives because they were not complete, fully acceptable, or suitably efficient. Table ES-1 shows the reasons for elimination for these 14 alternatives. The remaining three action alternatives, Lower San Felipe Intake Comprehensive Plan, Pacheco Reservoir Comprehensive Plan, and the Combination Comprehensive Plan, are being evaluated in further detail in addition to the no-Project/No-Action Alternative, as the basis for comparison in the environmental compliance phase of the Feasibility Study.

Table ES-1. Reasons to Eliminate Alternatives

Alternative	Criteria Triggering Elimination	Explanation
Institutional Alternative	Completeness	Cannot meet objective of avoiding supply interruptions in the long-term because many institutional measures would only have short-term availability
Algaecide Alternative	Efficiency, Acceptability	Algaecide would not be effective at depths greater than 4 feet and treating the entire reservoir would have environmental and water quality concerns because treatment would require a large amount of algaecide several times during the summer

Table ES-1. Reasons to Eliminate Alternatives

Alternative	Criteria Triggering Elimination	Explanation
Treatment at San Felipe Intake Alternative	Acceptability	Not locally acceptable as a stand-alone alternative
Treatment at Water Treatment Plants Alternative	Acceptability	Not locally acceptable as a stand-alone alternative
Treatment at Pumping Plant Alternative	Acceptability	Not locally acceptable as a stand-alone alternative
Southerly Bypass Corridor Alternative	Efficiency	Higher costs, but similar benefits, compared to the Lower Intake Alternative
Anderson Reservoir Expansion Alternative	Efficiency	Site not as efficient as the Pacheco Reservoir Alternative because it is surrounded by landslide areas and high value homes
Chesbro Reservoir Expansion Alternative	Efficiency	Site not as efficient as the Pacheco Reservoir Alternative because it is surrounded by landslide zones and would inundate residences and roadways
Lower Pacheco Reservoir Alternative	Efficiency	Site has geotechnical concerns at the foundation site that would significantly increase the engineering challenges and costs
San Benito Canyon Reservoir Alternative	Efficiency	Site not as efficient as the Pacheco Reservoir Alternative because the dam site is on the Calaveras Fault
Del Puerto Canyon Reservoir Alternative	Efficiency	Site not as efficient as the Pacheco Reservoir Alternative because the dam would be much larger (and more expensive)
Ingram Canyon Reservoir Alternative	Efficiency	Site not as efficient as the Pacheco Reservoir Alternative because the dam would be much larger (and more expensive)
Quinto Creek Reservoir Alternative	Efficiency	Site not as efficient as the Pacheco Reservoir Alternative because the dam would be much larger (and more expensive)
Los Vaqueros Expansion Alternative	Completeness	Uncertain if project would fully meet SLLPIP objectives

No Action/No Project Alternative

Under the No-Action Alternative, it is assumed that the Federal government would take no additional actions toward implementing a specific plan. The existing reservoir and conveyance system would remain in place, although operations may change. From the Federal planning perspective, the No-Action Alternative would result in the absence of a feasible project which has a Federal interest.

Comprehensive Plans

Lower San Felipe Intake Comprehensive Plan

The Lower San Felipe Intake Comprehensive Plan includes construction of a new, lower San Felipe Intake to allow reservoir drawdown to its minimum operating level without algae reaching the San Felipe Intake. 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 TAF level without creating the potential for a water supply interruption to the San Felipe Division. This comprehensive plan also includes institutional measures (exchanges, transfers, and groundwater banking) to provide a safety net in all years, allowing higher allocations earlier in the year by creating access to an additional stored water supply, available as insurance in the event that San Luis Reservoir storage is insufficient to meet the allocation.

Pacheco Reservoir Comprehensive Plan

This comprehensive plan includes expansion of the existing Pacheco Reservoir to provide storage for San Felipe Division contractors. Pacheco Reservoir would function similarly as San Luis Reservoir and store water exported from the Delta during the winter for release during the summer. During low point months, San Felipe Division contractors would receive deliveries from Pacheco Reservoir. This comprehensive plan would allow drawdown of San Luis Reservoir to its minimum operating level without interrupting deliveries to the San Felipe Division. Additionally, all CVP users would receive a small increase in allocation in some years when additional CVP supplies are available because Pacheco Reservoir would provide additional CVP storage. Two alternative sizes are being considered in this phase of the Study: (1) an 80 TAF reservoir with 55 TAF of CVP storage and a 25 TAF reservation for Pacheco Pass Water District, flood control, instream releases, and dead storage; and (2) a 130 TAF reservoir with 100 TAF of CVP storage and a 30 TAF reservation. The Pacheco Reservoir Comprehensive Plan also includes implementation of institutional measures (exchanges, transfers, and groundwater banking) to provide a safety net in all years.

Combination Comprehensive Plan

The Combination Comprehensive Plan includes multiple structural components and management measures to maximize operational flexibility and supply reliability in the San Felipe Division to address low point generated water supply curtailments or reductions. The Combination Comprehensive Plan would include increased groundwater aquifer recharge and recovery capacity, desalination, institutional measures, and the re-operation of the SCVWD raw and treated water systems. Elements not currently included in the Combination Comprehensive Plan that could be added or replace existing components, if found to be feasible and with equivalent or better cost structures, include drinking water treatment improvements, shallow groundwater pumping, and indirect potable reuse.

Plan Evaluation and Comparison

The comprehensive plan evaluation included a more detailed examination of how well each comprehensive plan meets the Federal criteria. This evaluation allowed a comparison of the comprehensive plans to determine if some plans more fully meet the criteria and if other plans should be dropped from further consideration. In this case, the three comprehensive plans generally performed well for all of the criteria. The small differences between the comprehensive plans are included in Table ES-2.

Table ES-2. Comparison of Comprehensive Plans

Comprehensive Plan	Federal Evaluation Criteria			
	Completeness	Effectiveness	Acceptability	Efficiency
Lower Intake Comprehensive Plan				Provides the greatest net benefits
Pacheco Reservoir Comprehensive Plan	Increases deliveries to all CVP contractors			Most expensive
Combination Comprehensive Plan		Would not allow full use of San Luis Reservoir	Fewer environmental impacts because no large construction projects	

Preliminary Cost Allocation

Because no preferred comprehensive plan has been selected in this PFR and estimation of benefits is incomplete, no plan for sharing of project costs between the Federal government and the various project beneficiaries has been developed. Project cost sharing will be addressed in the Study once a preferred comprehensive plan is selected, benefit estimation is completed, and detailed cost estimates for that comprehensive plan have been prepared. Two potential methods to allocate costs include the current CVP cost sharing approach and the Separable Cost-Remaining Benefit (SCRB) cost allocation, either which may serve as the basis for cost sharing of SLLPIP. These are two examples for allocating costs of a project and do not necessarily reflect the final approach that will be used for the SLLPIP.

Existing Cost Sharing in the CVP Cost Allocation

When cost sharing is addressed during the Feasibility Report Phase, it is likely that one approach considered will be to allocate and assign SLLPIP costs in the same manner that existing CVP costs are allocated. This approach presumes that SLLPIP will benefit purposes in a manner similar to what is being currently served.

San Felipe Division costs are considered "out of basin" costs and are paid by only those benefiting from those facilities rather than being spread across all CVP water users. Currently, about 67 percent of San Felipe costs are allocated to M&I contractors (primarily SCVWD), 23 percent to irrigation (primarily SBCWD), and 10 percent to recreation and fish and wildlife enhancement purposes. The allocation and assignment of OM&R costs are handled in a similar manner. These cost allocations are based on the feasibility report for construction of the San Felipe Division and contractor negotiation.

SCRB Sample Cost Allocation

A second approach would apply the SCRB cost allocation method, which uses economic benefits and single-purpose alternative costs to allocate project costs and is appropriate when a project has multiple purposes. The lesser of the value of benefits and the cost of a single-purpose alternative that provides the same level of benefits is called the justifiable expenditure; it is the maximum amount that is justified to spend on obtaining the benefits. The cost of the project with a purpose in question removed is known as the separable cost and is also equal to the cost of adding the purpose back to the project. This represents the minimum cost allocation to a purpose. The separable cost for each purpose is subtracted from its justifiable expenditure, and the remainder is called remaining benefits. Remaining benefits are totaled, and the percentage distribution among projects purposes is calculated. The costs of the project that remain after all separable costs have been deducted are known as remaining joint costs and are spread among project purposes using the remaining benefits percentages. Separable costs and remaining joint costs for each purpose are added to give the total cost allocation to that purpose.

In the event that SLLPIP only serves water supply, total project cost would be allocated to water supply and then suballocated among uses based on volume of use.

Under both existing CVP repayment procedures and laws governing Reclamation-wide repayment, Federal capital and O&M costs allocated to irrigation and M&I water supply are fully reimbursable. Consideration of cost allocation and cost allocation methodology will be more thoroughly examined during the Feasibility Report Phase, as alternatives are refined.

Public Involvement and Outreach

Reclamation, SCVWD, and SLDMWA developed a public involvement plan at the beginning of the Study to provide meaningful opportunities for stakeholder participation and to inform the public. The public involvement plan identifies methods to disseminate information to stakeholders and receive feedback on ideas. Public involvement opportunities include:

- Structured series of interactive public meetings and workshops
- Briefings for governmental and nongovernmental agencies and coalitions
- Coordination with local water resources management groups
- Coordination with agencies
- Distribution of distribution of Study documents via a Website
- Project update information bulletins

Continued public and stakeholder involvement will be a critical component during the final phase of the Study, which will culminate with release of the Final Feasibility Report and its accompanying EIS/EIR.

Implementation Considerations and Uncertainties

Various uncertainties associated with the SLLPIP Study include hydrology and climate change, system operations facilities and constraints, cost estimates, and alternative refinements. Some key areas of uncertainty potentially affecting operational analyses for the Investigation include changes in Delta export regulations or policies resulting from Endangered Species Act listings or recommendations from various planning processes for the Delta. Assumptions will be refined as uncertainties regarding some of these plans and policies are resolved during the next phase of study, which may change the basis of comparison for or magnitude of the accomplishments of the comprehensive plans.

Findings

The evaluation of the comprehensive plans found that the remaining action alternatives meet all of the Federal planning criteria to some extent. All three action plans will be carried forward into the next phase of the Feasibility Study for additional review, along with the No Action/No Project Alternative, with results presented in the Feasibility Report and EIS/EIR. For this PFR, the comparison and evaluation effort did not identify a preliminary National Economic Development (NED) plan, given the narrow range of benefits and costs identified as a part of this preliminary investigation. Feasibility level analysis during the next Study phase will focus on refining both the benefit and cost estimates to support the identification of an NED plan.

Other findings include:

- All comprehensive plans satisfy the project planning objectives.
- Preliminary water supply benefit modeling indicates that benefits are similar for all comprehensive plans currently under consideration. The benefit analysis is expected to change as water supply modeling is further refined and a higher level of detail is developed for facilities proposed in the alternative plans.
- All comprehensive plans have the potential for environmental effects, and all are considered mitigable. Future studies and environmental analysis may identify additional effects that are not considered mitigable.
- Refined water supply benefit modeling and future economic analysis are expected to support the identification of a recommended plan.
- Alternative plans have been identified that result in positive net NED benefits and significant positive regional economic effects. To date, there has been strong interest at the local, regional, State, and Federal levels in a potential project to address the identified planning objectives and opportunities. This PFR concludes there is a Federal interest in continuing the Study to determine the feasibility of a project to meet the study objectives associated with supply reliability, scheduling certainty, and forecasting supplies. The degree and magnitude of the Federal interest in a potential project will be refined and quantified in the Feasibility Report, EIS/EIR, and supporting documentation.

Next Steps

- Continue the Feasibility Study (e.g., planning, engineering, environmental, social and economic, and financial analyses) in coordination with partnering agencies and concerned stakeholders, agencies, public, and tribes, which will culminate in preparation and processing of a Feasibility Report and companion EIS/EIR to address the potential effects of a recommended plan and alternatives.

- Refine comprehensive plans and develop site-specific details for facilities, mitigation features, operations, and maintenance proposed in each plan.
- Evaluate the potential environmental effects (beneficial and adverse) and present results and findings in the EIS/EIR and the Feasibility Report.
- Complete the EIS/EIR in compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) processes and procedures, and other pertinent environmental laws, regulations, guidelines, and policy.
- Complete required public involvement and outreach and agency coordination and consultation.
- Refine designs, estimates of potential benefits and costs, reevaluate and compare alternatives, and provide compelling rationale for the identification of a recommended plan. The recommended plan should be consistent with the requirements to identify the NED Plan (per P&G), Proposed Action and Preferred Alternative (per NEPA), Proposed Project and Environmentally Superior Alternative (per CEQA), and the Least Environmentally Damaging Practicable Alternative (per Clean Water Act, Section 404).
- Develop and display plan for sharing of project costs between the Federal government and the various project beneficiaries and describe implementation responsibilities in the Feasibility Report and EIS/EIR.
- Complete ability-to-pay analyses to ensure financial feasibility of the recommended plan.
- Prepare and process draft and final Feasibility Report and EIS/EIR for public review and comment, in support of decision making by Reclamation, Department of the Interior, U.S. Congress and non-Federal partners.

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Acronyms and Abbreviations

AF	acre-feet
ASIP	Action Specific Implementation Plan
Banks Pumping Plant	Harvey O. Banks Pumping Plant
BDCP	California Bay Delta Conservation Plan
BEA	Bureau of Economic Analysis
BMPs	Best Management Practices
CAA	Clean Air Act
CAC	California Agricultural Commission
CALSIM II	California Simulation Model II
CCR	California Code of Regulations
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNPS	California Native Plant Society
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DAF	dissolved air flotation
Delta	Sacramento-San Joaquin River Delta
DFG	California Department of Fish and Game
DMC	Delta Mendota Canal
DOF	California Department of Finance
DOI	U.S. Department of the Interior
DPH	California Department of Health
DPR	California Department of Parks and Recreation
DWP	Drinking Water Program
DWR	California Department of Water Resources
EDD	California Employment Development Department
EIS	Environmental Impact Statement
EIR	Environmental Impact Report
ESA	Endangered Species Act
EWA	Environmental Water Account
FPPA	Farmland Protection Policy Act
FWCA	Fish and Wildlife Coordination Act
FY	Fiscal Year
HP	horsepower
IAIR	Initial Alternatives Information Report

ITAs	Indian Trust Assets
IWRP	Integrated Water Resources Planning Study
MAF	million acre-feet
MBTA	Migratory Bird Treaty Act
mgd	million gallons per day
mg/L	milligrams per liter
M&I	municipal and industrial
MMRP	Mitigation Monitoring and Reporting Program
MSCS	Multi-Species Conservation Strategy
MWD	Metropolitan Water District
NAAQS	National Ambient Air Quality Standards
NCCP	Natural Community Conservation Plan
NCCPA	Natural Community Conservation Planning Act
NED	National Economic Development
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOD	Notice of Determination
NOx	Nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPPA	Native Plant Protection Act
msl	mean sea level
NWR	National Wildlife Refuge
OCAP	*Long Term CVP Criteria and Plan*
OM&R	operation, maintenance, and repair
PFR	Plan Formulation Report
P&Gs	*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*
PM10	particulate matter with a diameter less than 10 micrometers
ppm	parts per million
Projects	CVP and SWP
PRWFPA	Pajaro River Watershed Flood Prevention Authority
PVWMA	Pajaro Valley Water Management Agency
Reclamation	Bureau of Reclamation
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SBA	South Bay Aqueduct
SBCWD	San Benito County Water District
SCVWD	Santa Clara Valley Water District
Service	U.S. Fish and Wildlife Service
SFPUC	San Francisco Public Utilities Commission
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SLDMWA	San Luis and Delta Mendota Water Authority

SLLPIP	San Luis Low Point Improvement Project
sq.	square
SR	State Route
SRA	San Luis Reservoir State Recreation Area
Study	Feasibility Study
SWP	State Water Project
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TDS	total dissolved solids
TMDL	total maximum daily load
TOC	Total Organic Carbon
USCB	U.S. Census Bureau
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VAMP	Vernalis Adaptive Management Program
WTP	Water Treatment Plant

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Chapter 1
Introduction

The San Luis Low Point Improvement Project (SLLPIP) is a feasibility study (Study) by the U.S. Department of the Interior, Bureau of Reclamation in cooperation with the Santa Clara Valley Water District (SCVWD) and the San Luis & Delta-Mendota Water Authority (SLDMWA). The SLLPIP is proposed to maintain a high quality, reliable, and cost-effective water supply for SCVWD and other contractors of the Bureau of Reclamation's San Felipe Division to ensure that these contractors receive their annual Central Valley Project contract allocations at the time and at the level of quality needed to meet water supply commitments.

Progress and results of the SLLPIP are being documented in a series of interim reports that will culminate in a Feasibility Report and an Environmental Impact Statement/Environmental Impact Report (EIS/EIR). The feasibility study process is consistent with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) (U.S. Water Resources Council 1983), Reclamation directives and standards, local agency guidance, and applicable environmental laws. This Plan Formulation Report (PFR) is the third interim planning report in the feasibility study process and builds on the results and findings of the previous two interim planning documents (see Figure 1-1).

The first interim planning document, the Final Appraisal Report, completed in May 2006 (Reclamation), identified problems and potential solutions related to low water levels and other water resources issues associated with San Luis Reservoir and its operation, and determined if Federal interest exists in participating in a feasibility study to resolve the identified problems.

The second interim planning document, the Initial Alternatives Information Report (IAIR), was completed in February 2008 (Reclamation). It evaluated identified management measures based on SCVWD's past work on the project, other water resources studies, and the team's technical understanding of the project's problems, opportunities, and objectives. The IAIR identified 87 management measures that were grouped into six categories: Institutional Agreements, Source Water Quality Control, Water Treatment, Conveyance, Local Reservoir Storage, and Alternate Water Supplies. The management measures were screened based on technical viability, institutional viability, and the ability to meet the project objectives. The Study team developed 26 initial alternatives that are evaluated in this PFR.

Figure 1-1. Feasibility Study Planning Process

1.1 Purpose and Scope of Report

The primary purposes of this PFR are to:

- Describe the planning objectives for the Study
- Describe the formulation and refinement of comprehensive plans to address the planning objectives
- Present the results of initial comprehensive plan evaluations
- Compare accomplishments and potential effects of the alternative plans
- Define a set of plans to be considered in detail in the Feasibility Report and EIS/EIR

This PFR is not a decision document; it is a report based on available information at this stage of the feasibility study process. Additional studies and documentation (e.g., Feasibility Report, EIS/EIR) will follow this PFR during the Study, with continued opportunities for public review and participation in compliance with National Environmental Policy Act (NEPA), California Environmental Quality Act (CEQA), and other pertinent laws and regulations.

The scope of the report includes the following topics:

- Description of the plan formulation process, including water resources problems and needs in the study area warranting Federal consideration; planning objectives and opportunities; and planning constraints, principles, and criteria used to help guide the feasibility study (Chapter 1).
- Description of existing and likely future water resources and related conditions in the study area (Chapter 2).
- Description of management measures, and from these measures, the formulation and evaluation of a set of initial alternatives to address the

planning objectives and opportunities, and screening of initial alternatives and subsequent comprehensive plans for continued study. (Chapter 3).

- Description of features and evaluation of accomplishments, effects, costs, and benefits of comprehensive plans (Chapter 4).
- Comparison of comprehensive plans and conclusions regarding which alternatives merit further study (Chapter 5).
- Implementation considerations; compliance with applicable laws, policies, and plans; and identification of stakeholder and public involvement considerations (Chapter 6).
- Summary of findings for this PFR and future actions and schedule for the feasibility study (Chapter 7).

1.2 Authorization and Appropriation

The SLLPIP Study is authorized by Title I of Public Law 108-361, CALFED Bay-Delta Authorization Act (October 25, 2004, 118 Stat. 1694), also known as the Water Supply, Reliability, and Environmental Improvement Act (Act). Section 103(f)(1)(A) of the Act authorized the Secretary of the Interior to "expend funds for feasibility studies, evaluation, and implementation of the San Luis Low Point Improvement Project, except that Federal participation in any construction of the expanded Pacheco Reservoir shall be subject to future congressional authorization."

1.3 Study Area Location and Description

The Study area (Figure 1-2) includes San Luis Reservoir and its related storage infrastructure, the Central Valley Project (CVP) San Felipe Division, and the CVP service areas of the SLDMWA (which also includes the San Felipe Division).

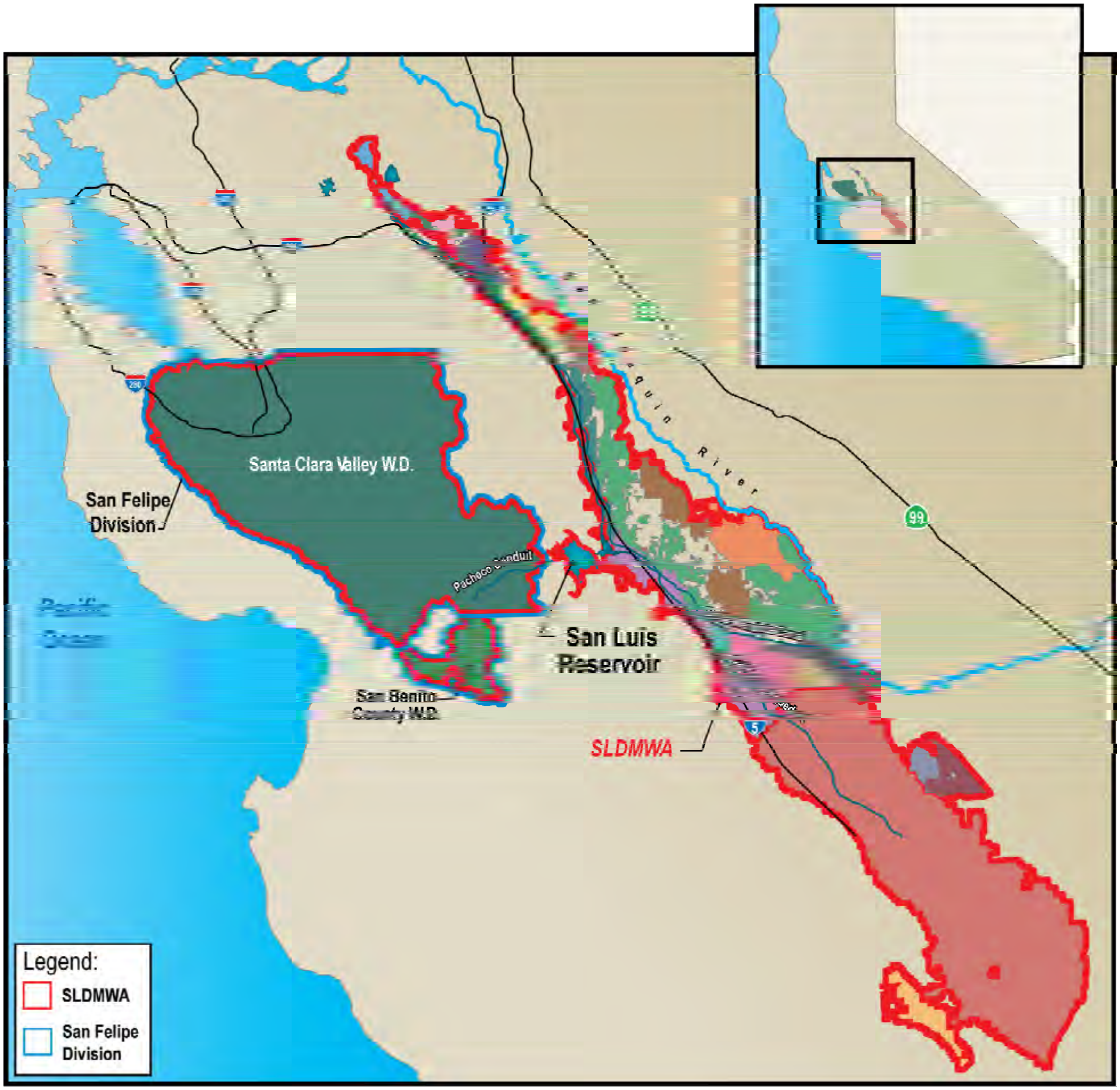

Figure 1-2. Study Area

1.4 Project Background

Reclamation owns and jointly operates San Luis Reservoir with the California Department of Water Resources (DWR) to provide seasonal storage for the CVP and the State Water Project (SWP). San Luis Reservoir is capable of receiving water from both the Delta-Mendota Canal (DMC) and the California Aqueduct (see Figure 1-3), which enables the CVP and SWP to pump water into the reservoir during the wet season (October through March) and release water into the conveyance facilities during the dry season (April through September) when demands are higher. Deliveries from San Luis Reservoir also flow west through Pacheco Pumping Plant and Conduit to the San Felipe Division of the CVP, which includes the SCVWD and the San Benito County Water District (SBCWD).

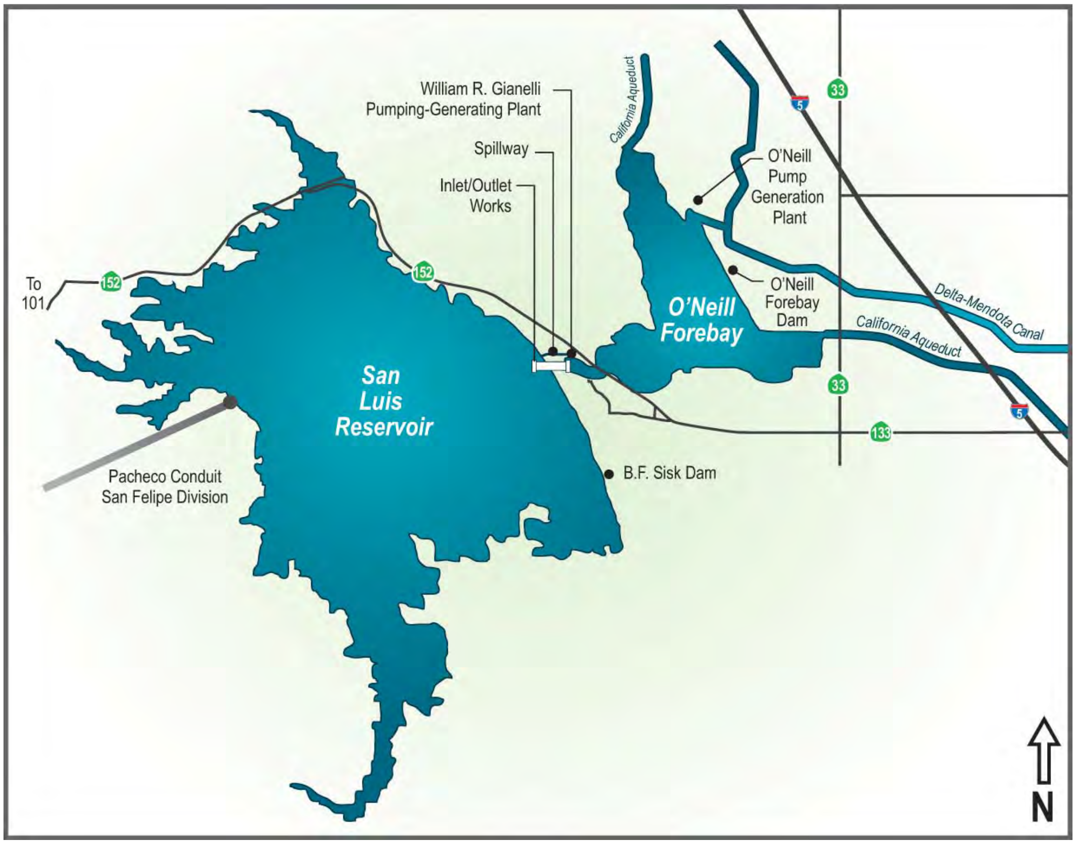

Figure 1-3. San Luis Reservoir and Associated Facilities

High temperatures and factors in San Luis Reservoir create conditions that foster algae growth. The thickness of the algae blooms vary, but algae cells are typically observed in the water delivered through the Lower Pacheco Intake when the reservoir surface is drawn within 35 feet of the intake. The water quality within the algal blooms is not suitable for agricultural water users with drip irrigation systems in San Benito County or for municipal and industrial water users relying on existing water treatment facilities in Santa Clara County.

Figure 1-4 shows the intake and outlet facilities associated with the reservoir. As water levels decline to the point that the algae is near the Upper Pacheco Intake, that intake is no longer used. Low point conditions occur when the water levels decline to the point that the algae blooms are near the Lower Pacheco Intake. Typically, this point occurs when water levels reach an elevation of 369 feet above mean sea level or approximately 300 thousand acre-feet (TAF), when the water is approximately 35 feet above the top of the Lower

Pacheco Intake. The top of the Lower Pacheco Intake is 334 feet above mean sea level or approximately 110 TAF. The reservoir's minimum operating level is about 30 feet above the top of the Gianelli Intake; therefore, algae do not typically enter the DMC or California Aqueduct.

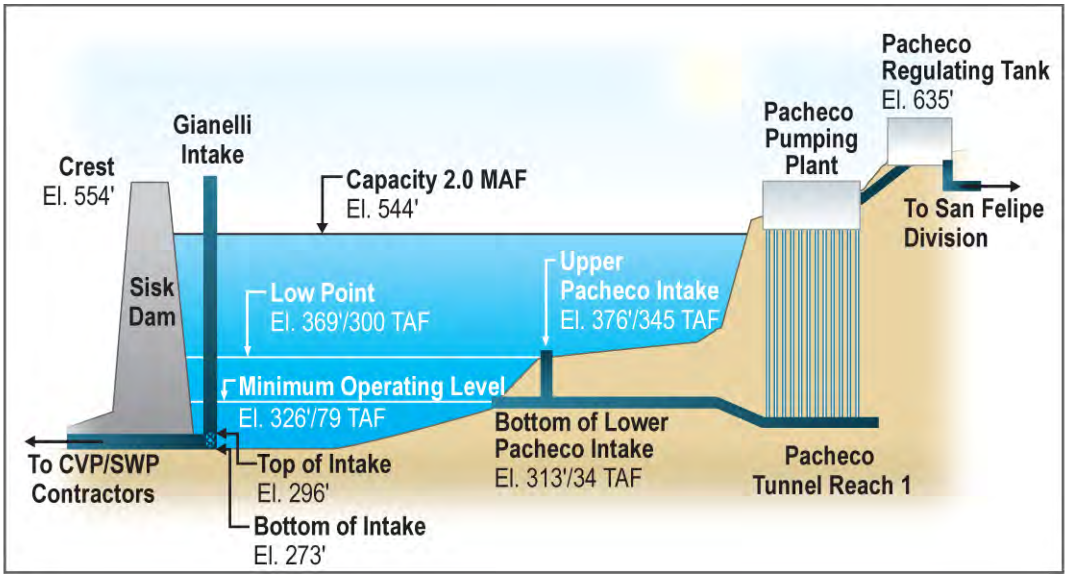

Figure 1-4. Reservoir Intake and Outlet Facilities

As water levels fall below 369 feet (300 TAF), algae blooms coupled with low water levels render the San Felipe Division's water users' CVP supply less reliable. San Luis Reservoir is the only delivery route for the San Felipe Division's CVP supplies authorized under their current CVP Water Service Contracts (SCVWD contract No. 7-07-20-W0023 dated June 7, 1977 amended March 28, 2007; SBCWD contract No. 8-07-20-W0130 dated April 15, 1978 amended March 28, 2007). With Reclamation's authorization, SCVWD could receive a portion of its CVP supplies through the South Bay Aqueduct (SBA) when capacity is available; however, SBCWD is not able to access CVP supplies through the SBA.

CVP operators allocate water based on the full use of available Federal San Luis storage capacity and water levels are forecasted to fall below 369 feet (300 TAF) for most years. Even the prediction of low point conditions can cause water supply concerns for the San Felipe Division, particularly for municipal and industrial supplies for SCVWD, because the districts must secure alternative water supplies in case disruptions occur during this period.

The CALFED Record of Decision (ROD) identifies the need for a "bypass canal to the San Felipe Unit at the San Luis Reservoir." The ROD recommended the allocation of California Proposition 13 funds administered by DWR to complete studies of the bypass canal and expanded local storage. Using these Proposition 13 funds, SCVWD initiated the SLLPIP in 2001 and completed the Draft Alternatives Screening Report in 2003. The report develops and screens alternatives to address the low point issue. In October 2004, the Project transitioned into a stronger partnership with Reclamation and the initiation of the federal feasibility study.

1.5 Problems, Needs, and Opportunities

This section describes the problems associated with the San Luis Reservoir low point issue and potential opportunities resulting from implementation of the SLLPIP. This identification of problems and opportunities supports the analysis of comprehensive plans.

1.5.1 Problems

The San Luis Reservoir low point issue causes two main water resource problems that need to be addressed by the SLLPIP: reduced certainty of meeting south-of-Delta delivery schedules during the year and decreased water supply reliability for south-of-Delta contractors.

Multiple factors affect the predictability of delivery schedule and reliability of water supplies for south-of-Delta contractors, including growth in water demands, increasingly stringent regulatory requirements, and potential restricted operations because of the San Luis Reservoir low point constraints. These multiple factors, in addition to the uncertainty of hydrologic conditions, contribute to CVP and SWP water supply reliability issues. This section further describes the demonstrated need for the SLLPIP.

Factors Contributing to the Problems

Growth in Water Demand Water demands exceed supplies in many areas of California, including the San Felipe Division. (Chapter 2 provides additional information about conditions in the Study area.) Because of growing statewide demands, both CVP and SWP facilities are expected to be severely stressed in the future. CVP contract amounts are not expected to increase; however, CVP M&I demands have increased and demand on the SWP is anticipated to increase to the full “Table A”[1] amount. The effect of water supply shortages will become more severe as demands increase

The California Department of Finance projects that California’s population will increase from 38.8 million in 2009 to 49.2 million in 2030 and 59.5 million in 2050, with some of the major growth occurring in south Central Valley and inland southern California counties (Department of Finance 2007 and 2010). Water demands already exceed supplies throughout California, stressing the

[1] Table A is a tool for apportioning available water supply and cost obligations under the SWP contract. When the SWP was being planned, the amount of water projected to be made available to the contractors was 4.2 million acre-feet (MAF) per year. Table A lists by year and acre-feet the portion of the 4.2 MAF deliverable to each contractor. DWR makes annual allocations as a percent of Table A amounts.

system severely during dry water years. Increasing water demands associated with this population growth will place additional pressure on CVP and SWP operations and facilities to meet contract allocations.

Water demand in the San Felipe Division is projected to grow with increases in population and expansion of the economy. SCVWD estimates that its future water demands will increase by 67.6 TAF, or about 18 percent, from 2004 to 2030 (SCVWD 2005a). The SCVWD *Integrated Water Resources Planning Study* (SCVWD 2005b) projects that dry year water shortages will grow over time within the SCVWD service area, from approximately 50 TAF in 2010 to 75 TAF by 2040, assuming that the San Luis Reservoir low point issue has been remedied. (If the low point issue is not addressed, this shortage would likely increase even more.)

SCVWD's water supply portfolio, which includes conjunctively managed groundwater basins recharged with both local and imported surface supplies, direct use of imported supplies, and storage in the Semitropic Water Storage District's groundwater bank in Kern County, is fully dedicated to meeting Santa Clara County's current and projected future demands. SCVWD's capacity to satisfy future demands is contingent upon the reliable delivery of imported surface supplies without supply interruptions caused by the low point issue.

In order to reduce the likelihood of supply interruptions when potential low point conditions are forecasted, SCVWD adjusts its water operations by securing transfers delivered through the SBA and using surface and groundwater resources from within the District that would otherwise be reserved for use in response to drought shortages and emergency outages. The adjustments may not necessarily be cost efficient and could be detrimental to the long-term sustainability of contractors' water supply with the potential to lead to larger water supply shortages. The adjustments in water operations occur whether or not the forecasted low point condition occurs.

Water demands in SBCWD are also projected to increase. SBCWD estimates that municipal and industrial (M&I) demands will increase from 10.7 TAF in 2002 to 11.5 TAF in 2020 and agricultural demands will increase from 54.1 TAF in 2002 to 74.9 in 2020. One of the uses of CVP supplies in SBCWD is to protect local groundwater basins and reduced CVP deliveries would likely increase the SBCWD groundwater use and cause an overdraft. The SBCWD's CVP supply is its only imported water supply source.

Other CVP and SWP contractors' demands are also likely to increase in the future, primarily due to M&I demand increases associated with statewide population growth. M&I contractors in the SLDMWA, such as the City of Tracy, are experiencing these increases in demands. In addition, the Metropolitan Water District of Southern California (MWD), which is an SWP contractor, projects that its M&I water demands will increase from 4.1 million acre-feet (MAF) in 2010 to 4.7 MAF by 2040 (MWD 2005). Increases in SWP demands could affect carryover storage quantities in San Luis Reservoir and change the frequency of low point conditions.

Regulatory Requirements Operation of the CVP and SWP has been constrained by water quality and environmental protection regulations, and potential changes could result in further constraints. Provisions of the Federal Endangered Species Act (ESA), Water Rights Decisions, Coordinated Operations Agreement, the CVP Improvement Act (CVPIA), Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, Central Valley Regional Water Quality Control Board Basin Plan Amendments, the Bay Delta Conservation Plan, and new legislation based on recommendations made in the Delta Vision Strategic Plan could affect the water supply reliability for contractors that rely on water deliveries from the Delta. Some of these regulations and institutional changes have:

- Reduced the amount of water delivered to the Delta for later delivery to south-of-Delta users, in order to support threatened and endangered fish protection efforts;

- Reduced amounts of water that can be conveyed through the Delta during certain periods of the year in order to prevent negative impacts to water quality, water levels, and fish in the Delta; and

- Reserved a portion of the CVP yield for delivery to environmental uses.

These actions have affected the total supply of water available to CVP and SWP operators for delivery to contractors.

Project Operations The Federal share (47.6%) of San Luis Reservoir is managed by Reclamation's Central Valley Operations Office and the State of California (State) share (52.4%) is managed by the SWP Operation Control Office. Water is pumped into San Luis Reservoir during the non-irrigation wet season (October through March), when supplies exceed demand for Delta water. The reservoir is typically drawn down during the dry season (April through September) when irrigation occurs.

Operational goals of both the CVP and SWP are to maximize annual water delivery under their respective contracts and to do so (to the extent possible) without drawing the reservoir down to the minimum level. The water elevation in San Luis Reservoir during the late summer and early fall periods varies from year to year depending on various conditions. These conditions include the amount of stored water carried over from the previous year (carryover water), the volume of water that can be delivered through the Delta (usually depending on hydrologic conditions and regulatory restrictions on Delta exports), demands of Federal and State contractors, and operational decisions made by Reclamation and DWR.

In most years, the storage level in San Luis Reservoir has remained above 300 TAF, which corresponds to the water surface elevation at which the low point conditions are likely to occur. The reservoir has not been drawn down to its minimum operating pool of 79 TAF since the San Felipe Division began receiving deliveries in 1987. During the drought events in 1977, 1989, and 2008, the reservoir was drawn down to below 500 TAF. San Luis Reservoir was drawn down to a storage level of 79 TAF to facilitate repairs in 1981 and 1982. While the reservoir has fallen below 300 TAF in very few years, Reclamation has forecasted low reservoir levels in other years that could affect water deliveries to the San Felipe Division. These forecasts have not been accurate because SWP contractor demands have been lower than estimated and some SWP water was left in the reservoir as carryover storage, but changing water supply conditions and increasing demands make continued long-term storage above 300 TAF unlikely. As discussed previously, even the prediction of low point conditions can cause SCVWD to take actions that may affect long-term water supplies.

San Luis Reservoir has a maximum drawdown rate of 2 feet per day as a dam safety measure. During periods of high demand, the maximum drawdown rate can limit the availability of water stored in San Luis Reservoir and require cooperation among contractors dependent on the reservoir, to share the constrained supply.

Problems to be Addressed by the SLLPIP

Delivery Schedule Certainty Low levels in San Luis Reservoir during the summer could affect the ability of the CVP and SWP to meet contractor schedules during peak demands because of supply interruptions generated by the San Luis Reservoir low point issue.

San Luis Reservoir water is delivered to south-of-Delta contractors. Reclamation requests a delivery schedule from each contractor and then approves the appropriate schedules. The San Felipe Division deliveries, however, are subject to potential interruption during the summer months in some years because of the low point issue. The frequency of forecasts and occurrences of low point conditions are projected to increase in the future. The San Felipe Division contractors' ability to adjust operations to fully mitigate impacts associated with the low point issue will diminish over time as local supplies, currently reserved for use during drought events and emergency outages, are relied on to replace interrupted CVP supplies.

Other CVP contractors may also experience scheduling constraints related to storage in San Luis Reservoir. In 2008, the CVP experienced water management challenges caused by low carryover from 2007 and Delta pumping limitations from court-ordered delta smelt protections. Reclamation limited both total allocations to contractors and the amounts that contractors could request from June through August. The summer limitations were necessary in part because of low storage in San Luis Reservoir.

Contractors have the greatest need for water supply from San Luis Reservoir during the summer when water demands are typically at their peak. For contractors, decreased water deliveries during the peak demands pose the greatest risks of potential economic and environmental losses associated with a water shortage. Regulatory changes, project operations, and growth in water demand will increase the pressure on San Luis Reservoir supplies in the future.

Water Supply Reliability Decreased water supply reliability affects contractors' ability to meet water demands. More stringent flow and water quality requirements in the Delta have restricted the amount of water that the CVP and SWP can pump. These limitations are causing water supply reliability concerns for south-of-Delta contractors.

The contractors' need for increased water supply reliability may compete with the need to provide delivery schedule certainty, described above. Full exercise of the storage in San Luis Reservoir would cause reservoir levels to fall below 300 TAF and interrupt deliveries to the San Felipe Division.

Low Early Allocations Among south-of-Delta contractors, water supply reliability concerns have created interest in increasing CVP allocations earlier in the year. Reclamation forecasts annual CVP allocations so that its contractors can anticipate CVP water supplies and adjust operations accordingly. Reclamation bases the allocation forecasts on water supply available in storage, anticipated increases in storage and supply from inflow, and potential delivery limitations created by water quality and environmental regulations. These allocations are established in stages, and generally are adjusted to be more accurate in each subsequent month through the spring, as more is known about water supply conditions. Early season forecasts are conservative, because conditions related to hydrologic patterns and use of environmental water are uncertain and Reclamation does not want to forecast allocations that cannot later be delivered.

The conservative early allocation is designed to help prevent delivery shortfalls later in the season, but has adverse effects on agricultural users who rely on the April allocation to finalize planting decisions for the season. Farmers may plant less acreage, plant lower value crops, or have difficulties in obtaining financing due to low water forecasts. The conservative early allocation also can prompt CVP contractors to secure water transfers or pump more groundwater, which are generally more expensive water supply options. Increased allocations in later months result in allocated water being unused due to planting decisions made prior to the final allocations. At the end of the year, as a result of conservative estimates, San Luis Reservoir may carry over some water that could have been used to meet contractor demands.

The biggest unknown related to water availability from February through June is environmental water. Operators are uncertain of water needs for environmental purposes during this period, so they use “placeholders” to save water to meet these needs. If less water is used during a given month, then more water is available during the summer for use.

1.5.2 Opportunities

Full Exercise of Storage in San Luis Reservoir

Implementation of the SLLPIP could allow the CVP and SWP to fully exercise San Luis Reservoir storage each year without the potential for supply interruption to the San Felipe Division during the summer months. Reclamation would be able to use the full storage capacity of the reservoir without any concerns about water levels falling below 300 TAF.

Improved Water Quality

During the late summer months, when San Luis Reservoir reaches low water levels that could trigger a low point issue, the San Felipe Division contractors might not be able to treat San Luis Reservoir water with their existing treatment facilities because of dense algae blooms. The algae could clog treatment plants’ filters and could prevent clean water from passing through them. Algae-laden water also could clog irrigation systems for agricultural water users in the San Felipe Division. Implementing the SLLPIP could result in water quality improvements for M&I and agricultural customers beyond those possible in the future without the project.

Avoidance of Costs for Water Transfers and Other Alternative Supplies

Because of decreased imported water supplies, contractors must often find alternate sources of water to meet demands. Some contractors purchase water on a year-to-year basis through water transfers. Depending on the hydrologic year and location of source water, transfers can range in price from $175 to $200 per acre-foot (AF) for north-of-Delta supplies and $400 to $900 per AF for south-of-Delta supplies. Average transfer prices are around $350 to $400 per AF, with higher prices during dry years. (Mizuno 2008) Additional wheeling costs for deliveries through Project facilities could increase these transfer prices; for example, MWD charges $260 per AF for use of its conveyance facilities. DWR also charges a fee to convey supplies through the SWP system. The SLLPIP could reduce contractor need to identify additional water sources obtained through transfers or other sources.

Increased Cooperation

San Luis Reservoir is central to both CVP and SWP operations and requires coordination among Reclamation, DWR, and contractors. Implementing the SLLPIP could further facilitate multi-agency cooperation by offering additional benefits for M&I, agricultural, and environmental water uses. SLLPIP could increase the ability of all agencies to work together to maximize potential benefits of San Luis Reservoir storage to all south-of-Delta contractors and water uses.

Avoidance of System Conflict

Reclamation currently plans its operations of San Luis Reservoir to reach the minimum operating level of 79 TAF, knowing that water levels are unlikely to decrease below 300 TAF because of historical SWP operations where contractors are storing carryover water in San Luis Reservoir. If the cushion provided by SWP operations were not available, CVP operators would be forced to decide whether the reservoir should stay above 300 TAF to allow continued deliveries to San Felipe and interrupt some deliveries to contractors east of San Luis Reservoir, or be allowed to drop below 300 TAF to utilize the water in storage and interrupt San Felipe deliveries. Reclamation can draw the reservoir down to 79 TAF, but would likely receive substantial political pressure to maintain water levels that avoid supply interruptions to the San Felipe Division. This could result in conflict among CVP users. Implementing the SLLPIP could avoid this conflict within the CVP system.

Operational Flexibility

Operational flexibility allows water agencies to manage water supplies efficiently by increasing supply and storage options. Several SLLPIP measures would include new storage facilities or alternate water supplies within a local water agency. In years that the low point is not an issue, the local agency could use the additional storage for local water supplies, which would allow the agency to maximize use of surface and groundwater to meet both current and future water demands.

Ecosystem Restoration

Increased south-of-Delta supplies, stored in San Luis Reservoir during the summer months to avoid San Felipe Division supply interruption, could be delivered to south-of-Delta National Wildlife Refuges as a part of the CVPIA Level 4 water delivery commitments.

1.6 Planning Objectives

SLLPIP objectives were developed based on the above-stated problems and opportunities. The objective of the SLLPIP is to optimize the water supply benefit of San Luis Reservoir while reducing additional risks to water users by:

- Avoiding supply interruptions when water is needed by increasing the certainty of meeting the requested delivery schedule throughout the year to south-of-Delta contractors dependent on San Luis Reservoir.

- Increasing the reliability and quantity of yearly allocations to south-of-Delta contractors dependent on San Luis Reservoir.
- Announcing higher allocations earlier in the season to south-of-Delta contractors dependent on San Luis Reservoir without sacrificing accuracy of the allocation forecasts.

The SLLPIP may provide opportunities for ecosystem restoration.

The above objectives distinguish between certainty of meeting delivery schedules and the reliability of supplies. More specifically, the first objective is related to predictably meeting contractors' delivery schedules throughout the year as opposed to the second objective, which strives to increase yearly allocations to more closely match the contractual entitlements.

The objectives for predictably meeting delivery schedules and increased annual allocations could lead to conflicts regarding San Luis Reservoir operations. These issues are relevant to south-of-Delta contractors dependent on San Luis Reservoir. San Luis Reservoir serves as a storage facility to increase reliability for CVP contractors in the Central Valley. CVP contractors rely on both exports from the Jones Pumping Plant and San Luis Reservoir to meet summer demands. Full exercise of the reservoir helps to maximize CVP supplies, but any constraint in the release of water from San Luis Reservoir could limit supplies. The Jones Pumping Plant does not have enough pumping capacity to fully meet demands alone and CVP operators store additional water in San Luis Reservoir during the winter, when demands are low, to help meet summertime needs. If San Luis Reservoir dropped below the minimum conservation pool during times of high demands, the CVP would not be able to meet those demands and contractors would experience a supply interruption.

The San Felipe Division relies on San Luis Reservoir to receive its CVP allocation. Water supply interruptions are caused by water levels falling below approximately 300 TAF, which triggers water quality concerns in the San Felipe Division that render the water unusable with existing treatment facilities. If water quality in San Luis Reservoir becomes a problem, then the San Felipe Division will not have useable water supply from CVP with its existing facilities. SBCWD has no access to any other imported water without the CVP supply. In the future, maximizing CVP supplies and changing storage patterns for State contractors might increase the frequency of the low point issue and the risk of supply interruptions to the San Felipe Division.

Avoiding water supply interruptions for the San Felipe Division is a trade-off with increasing water supply reliability for other south-of-Delta contractors. San Felipe Division water supply interruptions are currently avoided because SWP contractors have left water in storage, thus maintaining water levels in San Luis Reservoir above approximately 300 TAF. However, increasing CVP and SWP water supply reliability requires the full use of the CVP and SWP water stored in San Luis Reservoir and a corresponding increase in the risk of supply interruptions for the San Felipe Division.

Similarly, allowing earlier confirmation of definitive allocations has some trade-offs with the other two objectives. Announcing higher allocations earlier in the year increases the risk that the CVP and SWP may not be able to supply the water that was forecasted—a decrease in water supply reliability. The SLLPIP will attempt to meet these three objectives without having to trade one for the other by developing safety nets to protect against supply interruptions.

1.7 Prior Studies, Projects and Programs

Federal, State, and local agencies are participating throughout California in a wide range of other projects and programs that have the potential to influence water supply conditions for both San Luis Reservoir and the water agencies within the Study Area. The projects and programs listed below are in the Study Area and potentially relevant to the Study.

1.7.1 CALFED Storage Investigations

CALFED is evaluating the development of new surface water storage as a potential water management tool to meet the objectives of the CALFED Bay-Delta Program (CALFED 2000).

Shasta Lake Water Resources Investigation

The Shasta Lake Water Resources Investigation (SLWRI), a feasibility-level study by Reclamation's Mid-Pacific Region, is being conducted under the general authority of Public Law 96-375 and the CALFED Bay-Delta Authorization Act. These statutes direct the Secretary of the Interior to engage in feasibility studies related to enlarging Shasta Dam and Reservoir. The SLWRI primary study area encompasses: Shasta Dam and reservoir; inflowing rivers and streams, including the Sacramento River, McCloud River, Pit River, and Squaw Creek; and the Sacramento River downstream to Red Bluff Diversion Dam.

The problems and needs in the SLWRI study area were translated into primary and secondary planning objectives. The primary objectives of the SLWRI are to increase the survival of anadromous fish populations in the Sacramento River, primarily upstream from the Red Bluff Diversion Dam; and increase water supplies and supply reliability for agricultural, M&I, and environmental purposes to help meet current and future water demands, with a focus on enlarging Shasta Dam and Reservoir. The secondary objectives include, to the extent possible, preserving, restoring, and enhancing ecosystem resources in the Shasta Lake area and along the upper Sacramento River; reducing flood damages and improving public safety along the Sacramento River; developing additional hydropower capabilities at Shasta Dam; and preserving and increasing recreational opportunities at Shasta Lake.

The SLWRI Initial Alternatives Information Report was completed in 2004 and a Notice of Intent to prepare an EIS was published in 2005 (Federal Register 2005). The SLWRI Plan Formulation Report was completed in 2007.

Los Vaqueros Enlargement

Contra Costa Water District (CCWD), Reclamation, and DWR have jointly undertaken a series of studies to analyze the feasibility of expanding Los Vaqueros Reservoir while adhering to reservoir expansion principles established by CCWD. The project has two primary objectives and one secondary objective.

1. Develop water supplies for environmental water management that supports fish protection, habitat management, and other environmental water needs.

2. Increase water supply reliability for water providers within the San Francisco Bay Area, to help meet municipal and industrial water demands during drought periods and emergencies, or to address shortages due to regulatory and environmental restrictions.

Secondary Objective:

3. Improve the quality of water deliveries to municipal and industrial customers in the San Francisco Bay Area, without impairing the project's ability to meet the environmental and water supply reliability objectives stated above.

Several interim planning documents have been produced, such as the Initial Alternatives Information Report in September 2005, the Initial Economic Evaluation for Plan Formulation in July 2006, and the Design, Estimate, and Construction Review Report in September 2007.

Federal authorization for the Investigation was provided initially in Public Law 108-7, the omnibus appropriations legislation for fiscal year 2003. Subsequent authorization was provided in Public Law 108-361, the Water Supply, Reliability, and Environmental Improvement Act of 2004.

Reclamation and CCWD released a Draft EIS/EIR in February 2009 and a Final EIS/EIR in March 2010. On March 31, 2010, the CCWD Board of Directors approved Alternative 4 of the Final EIS/EIR to expand Los Vaqueros Reservoir from 100 TAF to 160 TAF.

North-of-the-Delta Offstream Storage Investigation

The North-of-the-Delta Offstream Storage (NODOS) Investigation is a feasibility study being conducted by DWR and Reclamation. The NODOS Investigation is evaluating potential offstream surface water storage projects in the Sacramento Valley to enhance water management flexibility, increase the reliability of supplies, reduce diversions on the Sacramento River during critical fish migration periods, and provide storage and operational benefits to other CALFED programs, including Delta water quality

In evaluating these objectives, the NODOS Investigation will address opportunities for ancillary hydropower generation benefits, recreation, and flood damage reduction. Federal authorization for the Investigation was provided initially in Public Law 108-7, the omnibus appropriations legislation for fiscal year 2003. Subsequent authorization was provided in Public Law 108-361, the Water Supply, Reliability, and Environmental Improvement Act of 2004.

The NODOS feasibility study will identify Federal and State interests in a new offstream reservoir that could provide up to 1.8 million AF of storage for water supply reliability to the region for urban, agricultural, and environmental uses. Project planning will culminate in a Feasibility Report and EIS/EIR. Reclamation and DWR have completed an Initial Alternatives Information Report (May 2006) and a Plan Formulation Report (September 2008).

Upper San Joaquin River Basin Storage Investigation

The Upper San Joaquin River Basin Storage Investigation (Upper San Joaquin Investigation) is a feasibility study also being performed by Reclamation and DWR. The objectives of the Upper San Joaquin Investigation are: enhance water temperature and flow conditions in the San Joaquin River and increase water supply reliability for agricultural and urban water users in the Friant Division, San Joaquin Valley areas, and other regions.

Federal authorization for the Upper San Joaquin Investigation was provided initially in Public Law 108-7, the omnibus appropriations legislation for fiscal year 2003. Subsequent authorization was provided in Public Law 108-361, the Water Supply, Reliability, and Environmental Improvement Act of 2004. Section 227 of the State of California Water Code authorizes DWR to participate in water resources investigations. The Upper San Joaquin Investigation Study area encompasses the SJR watershed upstream from Friant Dam and the portions of the San Joaquin and Tulare Lake hydrologic regions served by the Friant-Kern and Madera Canals. Reclamation and DWR completed an Initial Alternatives Information Report on the Upper San Joaquin Investigation in June 2005.

1.7.2 San Luis Drainage Feature Re-evaluation

The purpose of the San Luis Drainage Feature Re-evaluation Project is to identify a plan to provide agricultural drainage service to the CVP's San Luis Unit in accordance with the Ninth District Circuit Court decision that Reclamation must provide drainage service to the San Luis Unit. The San Luis Drainage Feature Re-evaluation Project could affect operations of the San Luis Reservoir by altering the schedule for water deliveries.

Drainage service has been defined as managing the regional shallow groundwater table by collecting and disposing shallow groundwater from the root zone of drainage-impaired lands and/or reducing contributions of water to the shallow groundwater table through land retirement. The Record of Decision, signed in March 2007, selected the In-Valley/Water Needs Alternative for implementation. This alternative includes collection systems, reuse areas, treatment, and disposal facilities, as well as the retirement of 194,000 acres of farmland. The In-Valley/Water Needs Alternative would retire enough lands to balance the internal water demand of the San Luis Unit with the expected available supply.

1.7.3 Delta-Mendota Canal Recirculation Feasibility Study

The Delta-Mendota Canal Recirculation Study is identified in its authorizing legislation as part of Reclamation's overall Program to Meet Standards. The Delta-Mendota Canal Recirculation Study will determine whether Reclamation can, through the use of excess capacity in export pumping and conveyance facilities, provide greater flexibility in meeting the existing water quality standards and flow objectives for which the CVP has responsibility, reduce the demand on water from New Melones Reservoir (for use to improve water quality and flow), and assist the Secretary of the Interior in meeting any obligation to CVP water contractors using the New Melones Reservoir. Reclamation completed the Initial Alternatives Information Report in March 2008.

1.7.4 Central Valley Project Improvement Act

Implementation of the CVPIA changed the management of the CVP by making fish and wildlife protection a project purpose, equal to water supply for agricultural and urban uses. The CVPIA affects exports of water from the Delta to San Luis Reservoir and increases operational pressures on the reservoir to meet south-of-Delta water demands. CVPIA Section 3406 (b)(2) authorized and directed the Secretary of the Interior, among other actions, to dedicate and manage 800 TAF of CVP yield annually for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized in CVPIA, to assist the State in its efforts to protect the waters of the San Francisco Bay-Delta Estuary, and to help meet obligations legally imposed on the CVP under State or Federal law following the date of enactment of the CVPIA.

CVPIA Section 3406(d)(1) required that the Secretary immediately provide specific quantities of water to the refuges referred to as “Level 2” supplies. The CVPIA requires delivery of the Level 2 water in all year types except critically dry water year conditions, when it can be reduced by 25 percent. Section 3406(d)(2) of the CVPIA refers to “Level 4” refuge water supplies, which are the quantities required for optimum habitat management of the existing refuge lands. Level 4 water supplies amount to about 163 TAF above Level 2 water supplies. The availability of Level 4 refuge water supplies are influenced by the availability of water for transfer from willing sellers.

1.7.5 Operations Criteria and Plan

The Long Term CVP Operations Criteria and Plan (OCAP), prepared by Reclamation and DWR in 2004, serves as a baseline description of the facilities and operating environment of the CVP and SWP. The OCAP identifies the many factors influencing the physical and institutional conditions and decision-making process under which the CVP and SWP currently operate; it explains regulatory and legal requirements and describes alternative operating models and strategies. The immediate objective of the OCAP was to provide operations information for the Endangered Species Act (ESA) Section 7 consultation.

In 2005, results of annual surveys designed to indicate population levels of several pelagic organisms, including the delta smelt, were showing a precipitous decline. Reclamation re-initiated ESA consultation on OCAP with the USFWS based on new information regarding the delta smelt, including the apparent decline in the population. In December 2007, the U.S. District Court for the Eastern District of California issued an Interim Remedial Order in Natural Resources Defense Council, et al. v. Kempthorne to provide additional protection of the Federally-listed delta smelt pending completion of a new Biological Opinion (BO) on the continued operation of the CVP and SWP. Reclamation published a revised Biological Assessment in August 2008.

Based on Reclamation’s Biological Assessment and internal and external review teams made up of delta smelt experts, the USFWS issued a BO on December 15, 2008. In the BO, USFWS determined that CVP and SWP operations proposed in OCAP would jeopardize the continued existence of the delta smelt. USFWS identified a reasonable and prudent alternative (RPA) that would minimize adverse effects of the CVP and SWP on the delta smelt. The RPA includes specific flow requirements, action triggers, and monitoring stations to provide for successful delta smelt migration and spawning, and larval and juvenile survival, growth, rearing, and recruitment within the Bay-Delta.

In their June 4, 2009 BO, NMFS responded with a finding that CVP and SWP operations, as proposed in the BA, would jeopardize the continued existence of listed salmon, steelhead, sturgeon, and killer whales. NMFS identified a reasonable and prudent alternative (RPA) that would avoid jeopardy to the listed salmon, steelhead, sturgeon, and killer whales. The RPA includes specific flow requirements, action triggers, infrastructure improvements, and monitoring stations to provide for successful salmon, steelhead, and sturgeon migration and spawning, and larval and juvenile survival, growth, rearing, and recruitment.

In May 2010, Judge Oliver Wanger with the United States District Court for the Eastern District of California released two sets of findings on the USFWS and NMFS biological opinions. Judge Wanger found that both biological opinions included actions that were not supported by the best available science, and that Reclamation needs to complete a NEPA analysis of the biological opinions before adopting them to consider the impacts to humans and the human environment. These findings may alter SWP and CVP operations.

1.7.6 CVPIA Contract Renewals

The CVP has approximately 250 water service contracts. Reclamation has negotiated renewals of long term water service contracts for all CVP contractors, including those within the SLLPIP Study Area, as required by CVPIA Section 3404(c). As mandated by Section 3404(c), irrigation contracts have a term not exceeding 25 years and municipal and industrial contracts have a term not exceeding 40 years. Most contracts have been renewed; those contracts not yet renewed will be executed upon completion of the re-initiated consultation on the long term operations of the CVP. All water service contracts contain terms and conditions for the delivery and use of CVP water, for the repayment of applicable capital construction costs, and for the reimbursement of annual operation and maintenance expenditures.

Reclamation recognizes that hydrologic, regulatory, and operational uncertainties constrain its ability to deliver CVP water and that such uncertainties may increase in importance as future water demands increase. Because of uncertainties, competing demands, and variable supplies, Reclamation and its contractors recognize that delivery of full contract quantities is not guaranteed and that deliveries may be equal to or less than historic deliveries. The SLLPIP may increase Reclamation’s ability to deliver greater quantities of water. Furthermore, improved operations of San Luis Reservoir may provide a more reliable water supply for CVP contractors.

1.7.7 Delta-Mendota Canal/California Aqueduct Intertie

Reclamation has prepared an EIS for the DMC/California Aqueduct Intertie to address operations and maintenance constraints of the CVP. Reclamation issued a Record of Decision in December 2009 and the project has received construction funds from the American Recovery and Reinvestment Act. Overall, the Intertie action alternatives are intended to meet the project purpose and objectives of meeting current water supply demands, allowing for the maintenance and repair of the CVP Delta export and conveyance facilities, and providing operational flexibility to respond to emergencies related to both the CVP and the SWP. The Proposed Action consists of constructing and operating a pumping plant and pipeline connection between the DMC and the California Aqueduct. The Intertie would allow the DMC and California Aqueduct to share conveyance capacity and could be used to transfer water in either direction. To transfer water from the DMC to the California Aqueduct, the Intertie would include a pumping plant at the DMC that would allow up to 467 cubic feet per second (cfs) to be pumped from the DMC to the California Aqueduct via an underground pipeline. This additional 467 cfs would allow the Tracy Pumping Plant to pump at its designed and permitted maximum of 4,600 cfs. Additionally, water could be transferred from the California Aqueduct to the DMC. Because the California Aqueduct is approximately 50 feet higher in elevation than the DMC, up to 900 cfs flow could be conveyed from the California Aqueduct to the DMC through the Intertie using gravity flow.

1.7.8 South Delta Improvements Program

The South Delta Improvements Program (SDIP) is one element of the preferred CALFED Program that was identified in the CALFED ROD as part of the programmatic solution to achieve the goals of water supply reliability, water quality, ecosystem restoration, and levee system integrity. The December 2006 SDIP Final EIS/EIR describes this program in detail. The SDIP alternatives consist of two major components: a physical/structural component and an operational component. The SDIP physical/structural component includes construction and operation of permanent operable gates at up to four locations in south Delta channels to protect fish and meet the water level and, through improved circulation, water quality needs for local irrigation diversions; channel dredging to improve water conveyance; and modification of 24 local agricultural diversions. The operational component considers raising the permitted diversion limit into the SWP Clifton Court Forebay from 6,680 cfs to 8,500 cfs.

The proposed project is to be implemented in two stages, the first being the physical/structural component and the second relating to the operational changes. Only Stage 1 is proposed at this time. Stage 2 is being deferred and will include making a decision on the operational component of SDIP

Stage 1 will include making a decision on the physical/structural component. The physical/structural component includes:

- Replacing the seasonal barrier with a permanent operable fish control gate on the head of Old River
- Replacing the three seasonal temporary agricultural control barriers with permanent operable gates on Middle River, Grant Line Canal, and Old River
- Dredging portions of Middle River and Old River and possibly West, Grant Line, Victoria, and North canals to improve flows in the south Delta channels

During the permitting process, NMFS indicated in June 2009 that it will not consider permitting the SDIP until three years of fish predation studies are completed at the temporary barrier.

1.7.9 Sacramento Valley Water Management Program

The Sacramento Valley Water Management Program (SVWMP) is a collaborative effort to increase water supplies for farms, cities, and the environment by responding to water rights issues associated with implementation of the 1995 Delta Water Quality Control Plan.

Since 1996, the State Water Resources Control Board (SWRCB) has engaged in proceedings to determine responsibility for meeting water quality standards in the Delta. SWRCB has completed Phases 1 through 7 of these proceedings, leading to the issuance of Water Right Decision 1641 (D-1641), and SWRCB continues to focus on Phase 8, involving water right holders on the Sacramento River and its tributaries. Through the SVWMP efforts, a Short-Term Settlement Agreement was executed in February 2003 by approximately 40 water districts and water users within the Sacramento River Watershed (Upstream Water Users), Reclamation, DWR, USFWS, CDFG, Contra Costa Water District, and SWP contractors representing agricultural and municipal water users in Southern California, the central coast, and the San Joaquin Valley.

The Short Term Settlement Agreement process calls for implementing multiple, short-term, 10-year, water management projects that will provide a source of new water to meet local water supply needs and to make water available during dry years to the SWP and CVP to assist in meeting SWRCB 1995 WQCP flow-related objectives. The parties intend, through development of multiple groundwater projects and storage release projects, for the upstream water users will develop capacity to annually produce up to 185 TAF of water that would otherwise not be available in the Sacramento River. These projects would be owned and operated by the Upstream Water Users.

Reclamation and DWR issued a Notice of Intent and Notice of Preparation, respectively, in August 2003 to prepare a Programmatic EIS/EIR to analyze the potential effects of implementing five categories of short-term projects: water management, reservoir operations, system improvements, surface water and groundwater planning, and other non-structural actions such as water transfers.

1.7.10 Bay Delta Conservation Plan

The Bay Delta Conservation Plan (BDCP) is a Habitat Conservation Plan and Natural Communities Conservation Plan being prepared to meet the requirements of the Federal Endangered Species Act (FESA), and California Endangered Species Act (CESA), respectively for water operations and management activities in the Delta. Specifically, the State of California Department of Water Resources will seek an incidental take permit (ITP) under Section 10 of the FESA for continued water operations and deliveries through the Delta. Mirant Power, Incorporated will seek an ITP under Section 10 of the FESA for the diversion of water for power operations in the Delta. The BDCP will also be used, if feasible, by Reclamation as the basis for FESA section 7 compliance, resulting in the issuance of biological opinions and Incidental Take Statements to Reclamation for their participation and implementation of the BDCP.

These incidental take authorizations will allow for the incidental take of threatened and endangered species resulting from covered activities and conservation measures associated with water operations of the SWP and CVP, including facility improvements and maintenance activities, operational activities related to water transfers, new Delta conveyance facilities, and habitat conservation measures included in the BDCP.

Federal and State water contractors participating in the BDCP include Metropolitan Water District of Southern California, Kern County Water Agency, SCVWD, Zone 7 Water Agency, SLDMWA, and Westlands Water District. BDCP conservation measures will likely include new and improved water supply conveyance actions and habitat conservation as well as the associated monitoring and adaptive management. DWR issued a Notice of Preparation of a joint EIR/EIS on February 13, 2009. Reclamation, USFWS, and NFMS jointly issued a Notice of Intent to prepare an EIR/EIS and conduct scoping meetings on February 13, 2009.

1.7.11 Delta Stewardship Council

The Governor of the State of California initiated the Delta Vision through Executive Order S-17-06 establishing an independent Blue Ribbon Task Force responsible for the development of a durable vision for sustainable management of the Delta. The work of the Task Force included two phases, the Vision that was completed in December 2007 and the Strategic Plan that was completed in October 2008. The Vision focused on two co-equal goals of Delta restoration and water supply reliability. The Strategic Plan consists of 12 integrated and linked recommendations that are meant to be implemented together over time.

Key recommendations included significant increases in conservation and water system efficiency, new water conveyance and storage facilities, and new governance for the Delta region. The Vision also recommended seven near-term actions that include improving flood protection, ecosystem restoration, and water supply and reliability.

In November 2009, Senate Bill X7 1 created the Delta Stewardship Council, established the Sacramento-San Joaquin Delta Conservancy, and restructured the Delta Protection Commission. The Delta Stewardship Council is charged with developing and implementing a Delta Plan to further the two co-equal goals identified through the Delta Vision process.

Chapter 2
Existing and Future Conditions

2.1 Existing Conditions

This chapter expands upon existing and future condition information compiled in previous project phases. Rather than repeat information from the IAIR, this section focuses on further defining water supply and water quality information that is helpful in plan formulation. Information on the remaining resource areas is available in the IAIR. The new information is used to forecast potential impacts to aid in the comparison of alternatives during the plan formulation phase. Section 2.1 of this chapter describes the existing water supply and water quality conditions in the study area, and Section 2.2 describes the expected future conditions if the SLLPIP is not implemented. These sections do not include changes associated with the related studies from Section 1.7 because these studies are still in preliminary phases.

2.1.1 Water Supply and Supporting Infrastructure

San Luis Reservoir

San Luis Reservoir provides approximately 2,028 TAF of off-stream storage capacity for the SWP and CVP. Reclamation manages 47.6 percent of the reservoir's capacity for the CVP and DWR, owner of the SWP, operates the remaining 52.4 percent. San Luis Reservoir has a maximum elevation of 544 feet[1] and a minimum operating pool elevation of 326 feet (79 TAF). Reclamation has established a maximum drawdown rate of two feet per day for dam safety purposes (SCVWD 2003a).

Figure 2-1 shows monthly storage in San Luis Reservoir from 1968 through 2007. Storage is highly variable throughout the year as the reservoir refills in the fall and winter months and releases water in spring and summer to meet CVP and SWP demands. Water supply interruptions to the San Felipe Division can occur when the reservoir reaches a storage level of approximately 300 TAF or less. In most years, the storage level in San Luis Reservoir has remained above 300 TAF. As Figure 2-1 shows, San Luis Reservoir was drawn down to a storage level of 79 TAF to facilitate repairs in 1981 and 1982. During the drought events in 1977 and 1989, the reservoir was drawn down to below 300 TAF. While not shown on the figure, the reservoir was also drawn down to approximately 220 TAF during the drought event in 2008.

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1 All elevations provided in this report are relative to mean sea level.

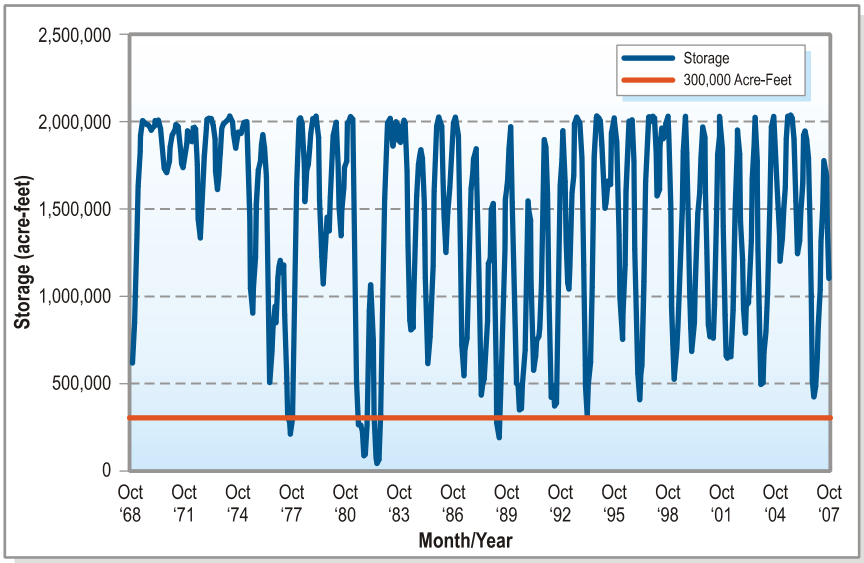

Figure 2-1. Monthly Storage in San Luis Reservoir from 1968 to 2007
Source: DWR CDEC 2008

Table 2-1 presents the average monthly storage in San Luis Reservoir from 1970 through 2005. On average, July, August, and September have the lowest storage, while February, March, and April have the highest storage.

Table 2-1. Average Monthly Storage in San Luis Reservoir (1970 through 2005)

Month	Storage AF
January	1,625,503
February	1,758,768
March	1,873,800
April	1,861,271
May	1,670,058
June	1,350,091
July	1,036,780
August	889,680
September	993,363
October	1,105,076
November	1,246,906
December	1,401,088

Source: DWR CDEC 2007

During the fall and winter months (October through March), water is delivered to O'Neill Forebay directly from the SWP's California Aqueduct at Check 12. Water is also pumped from the CVP's Delta-Mendota Canal into O'Neill Forebay via the O'Neill Pumping-Generating Plant. The William R. Gianelli

(Gianelli) Pumping-Generating Plant then pumps the water from O’Neill Forebay into San Luis Reservoir, where it is stored until demands begin to increase when it is then used to supplement water from the Delta. Inflow from the California Aqueduct to O’Neill Forebay was 2,517 TAF in 2002 and 3,166 TAF in 2003. Pumping from the Delta-Mendota Canal into O’Neill Forebay was 1,192 TAF in 2002 and 1,309 TAF in 2003. Water pumped from the Delta-Mendota Canal made up about 30 percent of the total inflow volume to O’Neill Forebay during 2002 and 2003 (State of California 2007).

Releases from San Luis Reservoir into O’Neill Forebay are made via the Gianelli Intake[2] and the Gianelli Pumping-Generating Plant. Releases are made through turbines, which generate electricity. Irrigation water flows east into the San Luis Canal, a federally owned and operated section of the California Aqueduct that is 102.5 miles long and stretches from the O'Neill Forebay southeast to an area just west of Kettleman City.[3] Occasionally, water is also released from O’Neill Forebay back into the Delta-Mendota Canal, allowing the O’Neill Pumping Plant to generate electricity.

The San Felipe Division withdraws water directly from San Luis Reservoir via two intakes on the west side of the reservoir: the Upper Pacheco Intake at elevation 376 feet (345 TAF of storage), and the Lower Pacheco Intake at elevation 334 feet (110 TAF of storage). Water then moves west through the Pacheco Tunnel Reach 1 to the Pacheco Pumping Plant. From the plant, water is lifted to Reach 2 of the Pacheco Tunnel and through the Pacheco Conduit to the bifurcation of the Santa Clara and Hollister Conduits. From this point, water is distributed to San Felipe Division contractors for irrigation and M&I uses.

Pacheco Reservoir

North Fork Dam and Pacheco Reservoir are on the North Fork of Pacheco Creek, 0.4 miles from Pacheco Pass Highway (Highway 152) in Santa Clara County. Pacheco Pass Water District owns and operates Pacheco Reservoir for the primary purpose of supplying groundwater recharge to the Hollister Area subbasin of the Gilroy-Hollister Valley Groundwater Basin (DWR 2004). Pacheco Reservoir is 1.9 miles long, and has a capacity of 6,143 AF and a surface area of 205 acres. The North Fork Dam crest elevation is 478 feet (SCVWD 2002). Storage in Pacheco Reservoir is highest during the months of January through June. Releases from Pacheco Reservoir are made in the fall for groundwater recharge.

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[2] The top of the Gianelli Intake is at an elevation of 296 feet and the bottom is at an elevation of 273 feet.

[3] After Kettleman City, the San Luis Canal becomes the property of the State of California.

San Luis & Delta-Mendota Water Authority

SLDMWA was established in 1992 to assume operation and maintenance responsibilities of some of the CVP facilities with a goal of increasing these facilities' reliability and reducing the cost of their operation. SLDMWA consists of 32 member agencies representing both federal and exchange water service contractors. SLDMWA is responsible for the delivery of approximately 3,000,000 AF of water per year to the member agencies with 2,500,000 AF delivered to agricultural water users, 150,000 AF to 200,000 AF to municipal and industrial water users, and 250,000 to 300,000 AF to wildlife refuges. SLDMWA operates and maintains certain portions of the Delta Division, San Luis Unit, and West San Joaquin Divisions of the CVP, including the Tracy Pumping Plant, O'Neill Pumping and Generating Plant, San Luis Drain, Delta Cross Channel, Tracy Fish Facility, Mendota Pool, and Kesterson Reservoir. (SLDMWA 2006)

SLDMWA member agencies include members of the San Felipe Division, described below, along with contractors throughout the Central Valley (see Figure 1-2). The supplies for the CVP agricultural water service contractors have been reduced since 1991 because of the Endangered Species Act listing of winter run salmon (1991) and delta smelt (1992), the Central Valley Project Improvement Act (1992), and Clean Water Act implementation. Water supply deliveries for CVP agricultural water service contractors have decreased from approximately 92 percent in 1992 to approximately 50 percent in 2000 (Nelson 2005).

San Felipe Division

The San Felipe Division of the CVP was authorized in 1960 and currently delivers water from San Luis Reservoir to agriculture and M&I users in Santa Clara Valley in Santa Clara County, and the northern portion of San Benito County (Reclamation Undated b). The agencies that receive water through the San Felipe Division are SCVWD and SBCWD. The Pajaro Valley Water Management Agency (PVMWA) service area was a part of the originally authorized San Felipe Division, but has never entered into the necessary contracts to receive water from the San Felipe Division.

Several conveyance and storage facilities are part of the San Felipe Division and allow for the transport of CVP water from San Luis Reservoir to SBCWD and SCVWD (See Figure 2-2 and Table 2-2). Water from San Luis Reservoir is pumped from the Pacheco Intakes through the Pacheco Tunnel Reaches and on through the Pacheco Conduit. The Pacheco Conduit runs underground southwest until it enters a bifurcation structure that separates water between the Hollister and Santa Clara Conduits. The Santa Clara Tunnel and Conduit, which run through the Diablo Mountains, deliver water to Santa Clara County. Water from the Hollister Conduit serves San Benito County and is delivered to San Justo Dam through a tunnel (Reclamation Undated b).

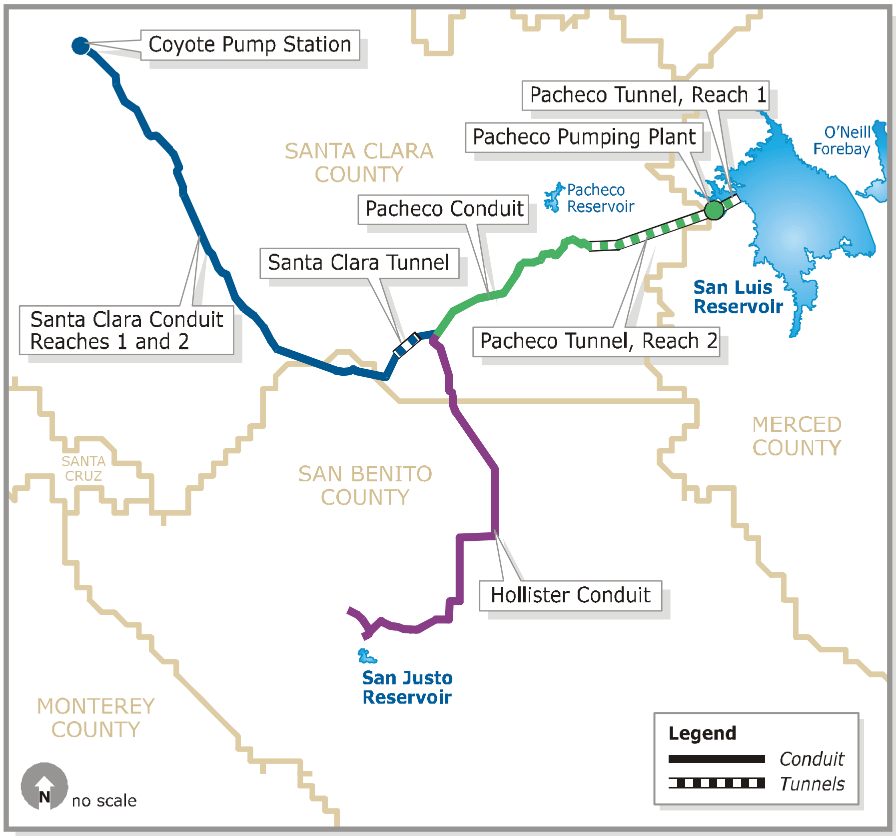


Figure 2-2. San Felipe Division Facilities

Table 2-2. San Felipe Division Facilities

San Felipe Division Facility	Location and Description
San Justo Dam and Reservoir	Stores CVP water from Hollister Conduit.
Pacheco Tunnel	Reaches 1 and 2, along with the Pacheco Pumping Plant, bring water from San Luis Reservoir through the Diablo Mountain Range.
Pacheco Conduit	Extends from the Pacheco Tunnel Reach 2 outlet to the bifurcation of the Santa Clara and Hollister Conduits.
Santa Clara Tunnel and Conduit	Conveys water from the Pacheco Conduit to the Coyote Pumping Plant.
Hollister Conduit	Extends from Pacheco Conduit to San Justo Reservoir.
San Juan Lateral	Conveys water from the Hollister Conduit to the San Juan Valley in San Benito County.
Pacheco Pumping Plant	At the end of Pacheco Tunnel Reach 1.
Coyote Pump Station	End of Santa Clara Conduit near Anderson Dam.

Source: Reclamation Undated b.

As described in Chapter 1, high temperatures and declining water levels create conditions that foster algae growth in San Luis Reservoir. The thickness of the algae blooms vary, but algae cells are typically observed in the water delivered through the Lower Pacheco Intake when the reservoir surface is drawn within 35 feet of the intake, or about 300 TAF of storage. The water quality within the algal blooms can result in water supply issues for the San Felipe Division. The algae-laden water in San Luis Reservoir is often not suitable for agricultural water users with drip irrigation systems in San Benito County or for municipal and industrial water users relying on existing water treatment facilities in Santa Clara County.

Due to the conservative nature of Reclamation’s delivery forecasts, San Luis Reservoir is often predicted to be drawn down to 300 TAF. In response to such forecasts, the San Felipe Division re-operates its water supply and delivery systems at added costs and added risks, to avoid algae-related water issues. The prediction of a low point event, even if the event does not actually occur, forces the San Felipe Division to respond by re-operating its system to avoid potential reductions in water supplies later in the year.

The following discussion covers water supply and infrastructure for the entities that make up the San Felipe Division.

Santa Clara Valley Water District The SCVWD service area has several water supply sources, including imported water (CVP and SWP), natural groundwater, local surface water, conservation, recycled water, water delivered to a portion of the SCVWD service area from the City and County of San Francisco’s Hetch-Hetchy system, and other supplies (surface water rights held by San Jose Water Company and Stanford University) (SCVWD 2003). Table 2-3 shows the SCVWD water supply sources for 2003.

Table 2-3. SCVWD 2003 Water Supply

Type	Percent
CVP	27
SWP	19
Hetch-Hetchy[1]	15
Local Surface Water	13
Natural Groundwater	13
Conservation	8
Other	3
Recycled Water	2

Source: SCVWD 2003
Notes:
[1] A portion of the SCVWD service area is served by deliveries of Hetch-Hetchy supply from the SFPUC. SCVWD does not manage or control this water supply

SCVWD receives imported water from the CVP through the Santa Clara and Pacheco Conduits, and from the SWP through the South Bay Aqueduct. SCVWD has a contract for 100 TAF per year of water from the SWP, although deliveries vary depending on hydrological conditions. SCVWD's CVP contract is for 152.5 TAF per year. Based on a contract negotiated with Reclamation and SLDMWA, SCVWD receives a basic delivery level of no less than 75 percent of the M&I contract amount. As Table 2-3 shows, in 2003, approximately 27 percent of SCVWD's water came from the CVP. SWP supplies made up 19 percent of total supply, while water from Hetch-Hetchy, local surface water, and groundwater made up 15 percent, 13 percent, and 13 percent, respectively.

Groundwater is an important water supply source for Santa Clara County and in average years, groundwater pumping accounts for a significant portion of the County's water supply, including groundwater from natural recharge and the managed recharge of imported and local surface supplies (SCVWD 2003; 2005). SCVWD manages three main groundwater subbasins: Santa Clara Valley, Coyote Valley, and Llagas. Natural recharge of the subbasins is insufficient to off-set groundwater pumping, and therefore SCVWD implements managed recharge using natural and imported surface water. Recharge facilities managed by SCVWD include over 300 acres of off-stream ponds and over 30 local creeks (SCVWD 2005). In an average year, natural recharge accounts for approximately 53.6 TAF, while managed recharge accounts for 116 TAF (SCVWD 2005). Managed recharge also helps to prevent overdraft and land subsidence and allows for carryover of surplus water from wet years to dry years (SCVWD 2003).

SCVWD has a long-term agreement with Semitropic Water Storage District to bank or store SWP water for future use. The agreement does not provide additional water supply for SCVWD, but it does allow excess water to be stored in wet years for later use during multiple dry years. SCVWD currently has 350 TAF of storage capacity at the Semitropic Groundwater Storage Bank. SCVWD uses storage in the Semitropic Groundwater Storage Bank as an in-lieu supply. SCVWD does not withdraw water from Semitropic's groundwater basin, but instead takes a portion of Semitropic's SWP water allocation from the Delta through the South Bay Aqueduct. However, Semitropic Water Storage District's allocation, like that of other south-of-Delta contractors, is proportional to SWP percentage allocation for the year and can therefore limit the amount of water available to SCVWD.

SCVWD also participates in transfers and exchanges. SCVWD has exchanged portions of its CVP allocations with SBCWD and partners in the San Joaquin Valley who are CVP contractors. A total of 7 TAF was exchanged in 2004 (SCVWD 2005). In 1998, SCVWD and two other agencies (PVWMA and Westlands Water District) entered in to an agreement for the permanent assignment of 6.26 TAF per year from Mercy Springs Water District, an agricultural CVP contractor. The agreement provides SCVWD an option for dry-year supplies totaling 20 TAF over 20 years (SCVWD 2005).

In Santa Clara County, additional water sources that are not under the jurisdiction of SCVWD are available, and their use helps to reduce reliance on SCVWD supplies. Several municipalities in Santa Clara County have agreements with the City and County of San Francisco for water from the Hetch-Hetchy system. The San Jose Water Company and Stanford University have surface water rights that they exercise to meet their demands. SCVWD used approximately 9.48 TAF of recycled water in 2004 from four existing wastewater treatment plants and is working towards a goal of 16 TAF per year by 2010 (SCVWD 2003, SCVWD 2005).

SCVWD manages water resources and sells treated water wholesale to retailers in Santa Clara County. Water infrastructure operated by SCVWD includes raw water conveyance, storage, water treatment, and treated water distribution. Raw water is treated at three SCVWD water treatment plants (Santa Teresa, Penitencia, and Rinconada) and then distributed, or used for groundwater recharge. Ten reservoirs managed by SCVWD capture local runoff and store it for use or for groundwater recharge (SCVWD 2005). The total storage capacity of all ten reservoirs is approximately 168.9 TAF (SCVWD 2005).

San Benito County Water District SBCWD's management area encompasses all of San Benito County and includes two incorporated cities; Hollister and San Juan Bautista (SBCWD 2002). The northern portion of San Benito County includes the CVP contractor service area. SBCWD operates the Hollister Conduit, San Juan Lateral, and San Justo Reservoir, which are San Felipe Division facilities; the San Felipe Division Distribution System, which consists of four pumping stations, subsystem and percolation valve and control structures; and San Felipe subsystem pipelines in San Benito County (SBCWD 2007a).

Current SBCWD water supplies include imported CVP water, local surface water collected from runoff, and groundwater. SBCWD's supplies also include water obtained from transfers and CVP water percolated for groundwater recharge. Table 2-4 shows a breakdown of the sources of SBCWD water in 2002.

Table 2-4. SBCWD 2002 Water Supply

Type	Percent
CVP M&I Water	7
CVP Agricultural Water	59
Local Surface Water	27
Transferred Water	3
Other – Percolated Water	4

Source: SBCWD 2002

The increasing use of CVP water has helped to increase groundwater levels and reduce overdraft in the basin. SBCWD has recently seen a shift in water use. From 1993 to 2004, groundwater pumping exceeded imported CVP imported water, but since 2004, imported CVP water has accounted for the majority of water use in the County (SBCWD 2007).

The Gilroy-Hollister Valley groundwater basin is the main source of groundwater for the SBCWD CVP Contractor Service Area. SBCWD does not pump groundwater into its distribution system; users access groundwater with their own wells. The SBCWD does not have any groundwater recharge facilities; stored surface water is released to natural streams and waterways to allow for percolation and recharge of the groundwater basin.

SBCWD manages three reservoirs: San Justo, Hernandez, and Paicines. San Justo Reservoir is managed by the SBCWD through a contract with Reclamation and is used solely to store CVP water from San Luis Reservoir. San Justo Reservoir has a storage capacity of 7 TAF[4] (SBCWD 2007). SBCWD's CVP contract with Reclamation includes 8.25 TAF of water for M&I uses, and 35.55 TAF for agriculture. SBCWD stores imported CVP water in local reservoirs or delivers it to customers through pressurized pipelines. A portion of M&I water is treated at the Lessalt water treatment plant for direct municipal use by Sunnyslope County Water District and the City of Hollister. (SBCWD 2007). Approximately 1.719 TAF of CVP water was treated for use in 2007 (SBCWD 2007).

In 2002, SBCWD used 22.883 TAF of imported CVP water. Of the total CVP water imported, 83 percent was used for irrigation, 6 percent was used for M&I, 5 percent was percolated for groundwater recharge along existing streams, and 6 percent was lost to evaporation and seepage from San Justo Reservoir (SBCWD 2002). In water year 2007, a total of 23.834 TAF of imported CVP water was used, including 18.865 TAF delivered to agricultural customers and 4.969 TAF delivered to M&I customers (SBCWD 2007).

SBCWD owns and operates two of its reservoirs for the purpose of groundwater recharge: Hernandez Reservoir with a capacity of 17.2 TAF; and Paicines Reservoir, with a capacity of 2.87 TAF. These reservoirs capture runoff and release water to Tres Pinos Creek and the San Benito River to augment groundwater recharge during the dry season (SBCWD 2007).

In 1998, SBCWD began participating in transfers and exchanges (including water-banking arrangements) with CVP south-of-Delta contractors and SWP contractors. In 2002, 1 TAF was purchased directly from the San Joaquin River Exchange Contractors Water Authority, while 1.34 TAF was purchased from Reclamation for critical needs and another 0.421 TAF was purchased as part of

4 Reclamation reduced the operating capacity of San Justo Reservoir in 2006 from 10.5 TAF to 7 TAF because of slope stability issues (SBCWD 2007).

a one-time opportunity. SBCWD also participated in exchanges with SCVWD (2 TAF), Kern County Water Agency through the SLDMWA (5.5 TAF), and Alameda Zone 7 (4 TAF) for future water deliveries (SBCWD 2004). SBCWD did not participate in groundwater banking or exchanges in 2007 (SBCWD 2007).

Pajaro Valley Water Management Agency PVWMA has a contract for 6.26 TAF of water for agricultural purposes that was a partial assignment of water from Mercy Springs Water District. PVWMA also has a contract reservation for an additional 19.9 TAF per year of CVP water for agricultural uses that will not be under contract until provisions of the CVPIA are fulfilled. PVWMA currently does not have infrastructure in place to receive any water from the CVP. To deliver its allocation of CVP water to its service area, PVWMA plans to construct a pipeline that will connect to the Santa Clara Conduit (SBCWD, PVMWA, & SCVWD 2007). Although the pipeline project is discussed in the PVWMA long term planning documents, no funds have been secured for this project and no schedule is available.

PVWMA has an agreement with SCVWD and Westlands Water District that allows the two districts to utilize the 6.26 TAF/year of water from Mercy Springs Water District until PVMWA develops the necessary conveyance infrastructure to access the CVP water from the Delta Division. If the infrastructure is not developed by 2022, the water will be permanently assigned to SCVWD and Westlands Water District.

2.1.2 Water Quality

San Luis Reservoir

Water is delivered to San Luis Reservoir from both the California Aqueduct and the Delta-Mendota Canal and as a result, both sources influence water quality in the reservoir. Other factors that influence water quality include the shallow depth of the reservoir and the drawdown and refill cycle that occurs each season. Water quality concerns in San Luis Reservoir include:

- High turbidity and total dissolved solids (TDS) coming in with Delta water;
- Algal blooms and taste and odor issues;
- High total organic carbon (TOC) and bromide concentrations coming in with Delta water;
- MTBE from recreation watercraft;
- Pathogen contamination from livestock grazing around the reservoir.

Table 2-5 and 2-6 present 2002 and 2003 water quality data for San Luis Reservoir at Pacheco Pumping plant from the *Water Quality in the State Water Project, 2002, and 2003* (DWR 2007). Maximum Contaminant Levels for sulfate, chloride, and nitrate in treated drinking water were not exceeded (DWR 2007). TOC and bromide concentrations often exceed target drinking water standards in San Luis Reservoir and at SCVWD's Santa Teresa water treatment plant, which receives San Luis Reservoir water for treatment (DWR 2007). The Delta is considered a major source of the turbidity, TOC, and bromide detected in San Luis Reservoir (SCVWD 2005, SWRCB 2001).

Table 2-5. Major Minerals and Conventional Parameters in San Luis Reservoir at Pacheco Pumping Plant, 2002 and 2003

Major Minerals	Unit	Median	Low	High	Sample Size
Alkalinity	mg/L as CaCO3	87	77	92	24
Calcium	mg/L	22	19	24	24
Chloride	mg/L	79	72	98	24
Magnesium	mg/L	14	13	15	24
Nitrate	mg/L as NO3	3.4	1.6	4.5	24
Sodium	mg/L	56	49	63	24
Sulfate	mg/L	44	39	49	24
Conventional Parameters	**Unit**	**Median**	**Low**	**High**	**Sample Size**
Conductivity	μs/cm	527	475	577	24
Hardness	mg/L as CaCO3	113	98	119	24
pH	pH units	7.0	6.2	8.2	24
TDS	mg/L	310	267	361	24
TSS	mg/L	--	<1	<1	1
Turbidity	NTU	3	1	6	21
VSS	mg/L	--	<1	<1	1

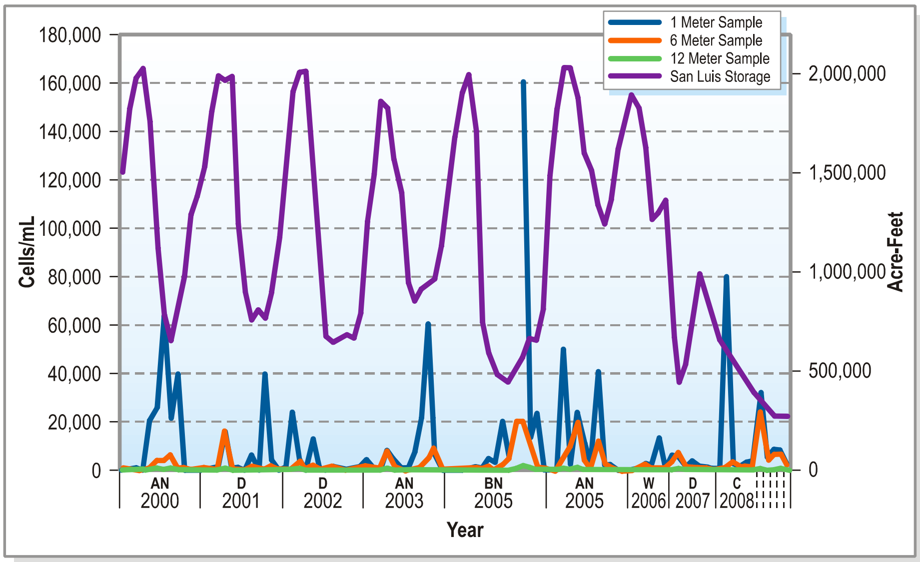
TDS – total dissolved solids
TSS – total suspended solids
VSS – volatile suspended solids
mg/L – milligrams per liter
NTU – nephelometric turbidity unit
μs/cm – microseimens per centimeter
Ca – calcium
CO3 – carbonate
Source: DWR 2007

Table 2-6. Bromide and Total and Dissolved Organic Carbon in San Luis Reservoir at Pacheco Pumping Plant, 2002 and 2003

Major Minerals	Unit	Median	Low	High	Sample Size
Bromide	mg/L	0.24	0.22	0.31	15
DOC	mg/L as C	3.4	2.9	3.9	7
TOC	mg/L as C	3.4	2.8	3.8	8

DOC – dissolved organic carbon
mg/L – milligrams per liter
TOC – total organic carbon
C - carbon
Source: DWR 2007

High nutrient concentrations, ambient temperatures, light, and thermocline development all contribute to algae growth in San Luis Reservoir. Water quality data obtained from three sampling locations (Sisk Dam, Gianelli Intake, and Pacheco Intake) from 2006 through 2007 show that chlorophyll concentrations, an indication of plant growth, generally start to increase in May, peak around July and August, and then decrease through November. The thickness of algae blooms vary annually, but algae cells are typically observed in the water supply delivered through the Lower San Felipe Intake when reservoir surface elevations reach 35 feet above the intake. Figure 2-3 shows the fluctuations in algae count data from 2000-2008 with San Luis Reservoir storage.



Source: DWR CDEC 2008 and SCVWD 2008

Figure 2-3. Algae Counts at Pacheco Pumping Plant

San Luis & Delta-Mendota Water Authority

The service areas of the SLDMWA's member agencies fall within the Delta Division, San Luis Unit and West San Joaquin Divisions of the CVP. The San Felipe Division of the CVP was authorized as an amendment to the San Luis Unit authorization and both SCVWD and SBCWD are SLDMWA member agencies. Water quality in the San Felipe Division is described later in this section. The water quality information presented here is specific to the member agencies that fall within the San Joaquin Valley.

The SLDMWA member agencies in the San Joaquin Valley have service areas that overlie the Tracy, Delta-Mendota, Westside, Kings and Pleasant Valley subbasins of the San Joaquin Valley groundwater basin. These subbasins are characterized by high calcium, magnesium, and sodium levels. The Tracy subbasin groundwater is primarily bicarbonate with increasing predominance of sulfate, sodium chloride, and sodium sulfate groundwater types in the southern subbasins. Observed TDS levels range in the subbasins from a low of 50 mg/L in the Tracy subbasin to the highest observed level of 3,000 mg/L in the Pleasant Valley subbasin. The TDS levels in the Pleasant Valley subbasin and the TDS, selenium and boron levels in some areas of the Westside subbasin can limit the groundwater's usability. (DWR 2004)

Most of the SLDMWA agricultural areas in the San Joaquin Valley drain to the San Joaquin River, which is impaired for boron, DDT, salinity, pesticides, mercury, selenium, and unknown toxicity (SWRCB 2006). The Central Valley Regional Water Quality Control Board (RWQCB) identified selenium and electrical conductivity as the highest priorities for improvement. Selenium is a naturally-occurring trace element that is toxic to waterfowl, and is found throughout the San Joaquin Valley. Shallow groundwater in the Grasslands watershed has elevated levels of selenium, and agricultural drainage from this area are the major source of selenium in the river (RWQCB 2001). The RWQCB has identified water development as a primary cause for elevated salinity in the San Joaquin River (RWQCB 2004). Diversion of natural runoff at Friant Dam and replacement with Delta water, which has higher levels of salinity, has elevated salinity in the basin. Surface and subsurface irrigation discharge are a main source of salinity for the river because the irrigation supplies have high levels of salinity that are increased through contact with marine soils (RWQCB 2004).

Pacheco Reservoir

No water quality data is available for Pacheco Reservoir or Pacheco Creek.

San Felipe Division

The San Felipe Division relies on the Upper and Lower Pacheco Intakes for all of its CVP water supplies, and is therefore vulnerable to water quality issues associated with algae. When algae reach the San Felipe Division intakes, algae-laden water is then conveyed to the San Felipe Division. Algae pose multiple problems for the San Felipe Division because they can disrupt clarification processes, clog filters, and contribute to additional oxidant demand requiring higher disinfectant doses. Algae cause taste and odor issues because they release metabolic byproducts including methylisoborneol (MIB) and geosmin (SCVWD 2003). Algae can also clog irrigation filters and drip lines. Costly treatment processes are required to remove algae and address the water quality issues they cause. When San Luis Reservoir reaches approximately 300 TAF, poor water quality forces the San Felipe Division to rely on alternative water supplies, resulting in re-operation of its water supply and delivery systems.

Santa Clara Valley Water District According to the SCVWD 2005 Urban Water Management Plan, groundwater in SCVWD is considered very good and groundwater quality objectives are achieved at almost all wells. Nitrate and perchlorate concentrations are two water quality issues in the southern portion of Santa Clara County. For information on the quality of CVP water delivered to SCVWD via the San Felipe Division facilities, see the water quality description under San Luis Reservoir.

San Benito County Water District SBCWD has several groundwater quality issues and therefore imported water is often preferred for agricultural uses (SCBWD 2002). The *2007 Annual Groundwater Report* for SBCWD characterizes the groundwater quality in the Gilroy-Hollister Groundwater Basin as highly mineralized and of marginal quality. The northern portion of the basin tends to have water of higher quality than the southern portion. A large area of naturally-occurring boron affects a part of the northern portion of the basin. Groundwater in the region is very hard and has a high level of salts. Other constituents that cause concern include chloride, hardness, metals, nitrate, sulfate, potassium, and total dissolved solids (TDS). Some portions of the basin do not meet the necessary water quality objectives to support beneficial uses (SBCWD 2007). For information on the quality of CVP water delivered to SBCWD via the San Felipe Division facilities, see the water quality description under San Luis Reservoir.

2.2 Future Conditions

This section describes the most likely future conditions in the study area if no SLLPIP actions are implemented to address the low point issue. This section focuses on water supply and water quality.

2.2.1 Water Supply

San Luis Reservoir

In the future, if no changes occur, storage levels in San Luis Reservoir could fall below 300 TAF more often than under existing conditions. Reclamation's forecasts for the CVP may also predict a low point occurrence more often in the future. Future actions that may contribute to an increase in frequency of the low point event or an increase in the prediction of the low point include population growth and increasing water demands, drought, climate change, pumping restrictions in the Delta to address endangered species, and less carryover storage in San Luis Reservoir. Any increase in frequency of reservoir drawdown to storage levels below 300 TAF could reduce the CVP's certainty to meet delivery schedules and could result in a decrease in reliability of CVP water supplies for the San Felipe Division. Even an increase in the frequency of low point event forecasts would affect the San Felipe Division, especially SCVWD.

San Luis & Delta-Mendota Water Authority

As was noted above, if no changes occur in the future, storage levels in San Luis Reservoir could fall below 300 TAF more often than under existing conditions. Reclamation's forecasts for the CVP may also predict a low point occurrence more often in the future. As was presented in Chapter 1, the drawdown of San Luis Reservoir below 300 TAF has the potential to generate scheduling constraints in years with Delta pumping limitations from court-ordered fishery protections. In years when San Luis Reservoir storage levels are down and Delta exports are constrained, Reclamation can require limits on total allocations and total delivery volumes to SLDMWA member agencies in the San Joaquin Valley. Deliveries to SLDMWA member agencies in the San Joaquin Valley could potentially be limited if Reclamation maintains water levels in San Luis Reservoir in order to avoid supply interruptions to the San Felipe Division.

Pacheco Reservoir

No changes in storage are expected for Pacheco Reservoir.

San Felipe Division

Santa Clara Valley Water District The San Felipe Division performs operations planning throughout the year to manage uses and sources of imported and local water supplies. Operational plans must evolve in response to real-time changes in water supply conditions in order to meet water demands. Changes in the reliability of CVP supplies could result from algal blooms and associated supply interruptions, and could have both short-term and long-term effects on San Felipe Division water supplies. Even an increase in the prediction of a low point event would require reductions in water use and reliance on alternative supplies in anticipation of the event. Potential effects discussed below are based on current SCVWD water operations and modeled future operations. While SCVWD has already experienced some of these effects, the future conditions would likely increase the frequency of low point events and would exacerbate the problems.

Treated Water If CVP supplies from San Luis Reservoir became unavailable, water supplies for SCVWD would only be available from the SWP through the South Bay Aqueduct (for the northern portion of Santa Clara County) and local surface storage. This could result in up to a 20 to 35 percent[5] reduction in treated water, depending on how much of the remaining surface storage supply would be required to meet existing environmental flows downstream of local surface storage facilities. The reduction quantities assume that full SWP deliveries would occur. If the SWP delivery quantity was also reduced, additional shortages would result. Water users would either have to re-operate their systems to make up for the shortages or impose mandatory reductions. Water users with limited access to additional water supplies would experience the greatest challenges.

The location, capacity, and treatment capabilities of existing water treatment plants could further reduce treated water supplies during a low point event. SCVWD owns three water treatment plants: Penitencia, Rinconada, and Santa Teresa. In the event of a low point, the Penitencia water treatment plant would likely be run at full capacity because of its proximity to the South Bay

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5 Based on the Water Evaluation and Planning System (WEAP) model run by SCVWD using August as an example month.

Aqueduct. The water shortage would then be allocated to either the Santa Teresa or Rinconada water treatment plants. SCVWD often prioritizes treated water deliveries from the Rinconada treatment plant. However, the Rinconada water treatment plant is the least capable of handling the taste and odor issues from Delta water supplies in the summer and early fall. As a result, retailers supplied by Rinconada, including San Jose Water Company, the City of Santa Clara, Cal-Water, the City of Sunnyvale, and the City of Mountain View, may experience shortages during a low point event.

Surface Water Whether or not a low point actually occurred, existing SCVWD surface water supply operations would have to be altered in the anticipation of a low point event. Local reservoir releases would likely be decreased and deliveries would be reduced to maintain surface water supplies during the low point event. To make up the difference, SCVWD would likely shift to CVP supplies before the low point event to reduce demands on local reservoirs and potentially deliver CVP supplies to Anderson Reservoir for later use during potential supply interruptions. Delivery of CVP supplies would be restricted by the minimum San Luis Reservoir drawdown rate of 2 feet per day, and could limit the quantity of water available. If water was retained in SCVWD reservoirs for longer periods of time, it would increase the chance for carryover spills and water lost to meet flood storage requirements. It would also reduce the potential for managed groundwater recharge.

Additionally, if invasive species such as Zebra or Quagga mussels were present in the local supplies, the potential damage to conveyance and treatment facilities might prevent the local supply water from being treated. This shift in supplies and re-operation of reservoirs would increase costs and permanently reduce short- and long term water supply reliability for SCVWD customers.

Groundwater During a low point event, CVP water would be unavailable and alternate water supplies would be required to meet demands. Water users with access to groundwater would likely increase groundwater pumping to make up for treated water shortages. Because all water sources in the County are already allocated for current and future needs (including short- and long-term drought, emergency use, and maintenance), any increase in groundwater use would reduce overall short-term and long-term water reliability. Additionally, this pumping would come at a time when groundwater recharge would likely be decreased and the need to conserve surface storage supplies that would have been used for recharge to provide a supply when CVP water is unavailable. The combination of increased groundwater pumping and decreased recharge would further deplete groundwater supplies.

In summary, the future conditions for SCVWD would result in short- and long-term water supply effects. Groundwater resources would be depleted at a faster rate during a low point event, because less water would be available for managed recharge and more users would be forced to rely on groundwater to make up for lost surface water supplies. Users would have less treated water available due to treatment plant capacities, locations and treatment capabilities. Reservoirs would be re-operated to reduce releases in order conserve local surface water supplies. All these changes would result in increased operating costs for SCVWD and would reduce the amount of water available for use during maintenance, emergencies, and drought.

San Benito County Water District As described above for existing conditions, SBCWD also experiences issues associated with the low point. An increase in frequency of the low point (or of low point forecasts) would decrease water supply reliability and would increase operating costs. If a low point were anticipated, SBCWD would reserve storage in San Justo Reservoir to ensure deliveries could be made during late summer. This would result in decreased deliveries earlier in the year to maintain sufficient storage (SBCWD 2004 WMP). Alternative water supplies such as groundwater would likely be used to make up for reduced deliveries, but this could increase SBCWD’s vulnerability to drought and other emergencies as groundwater supplies would be depleted. It may also contribute to overdraft in the groundwater basin.

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Chapter 3
Development of Management Measures and Initial Alternatives

The purpose of this chapter is to review the alternative formulation and screening process that was presented in the SLLPIP IAIR, and to describe additional alternative screening that was completed by the Study team in preparation for the Plan Formulation Phase of the SLLPIP Feasibility Study. The Study team is composed of representatives from Reclamation, SCVWD, and SLDMWA.

3.1 Management Measures

The first step in the development of the initial alternatives described in the IAIR was the identification of potential management measures, which could include programs, projects, or policies that would help achieve the objectives. These management measures were screened according to their technical and institutional viability and the degree to which their implementation would achieve the project objectives. This section describes the identification and screening of these management measures.

3.1.1 Management Measure Development

Management measures need not be complete alternatives capable of meeting all project objectives, and may satisfy only some of the Study objectives. The team identified management measures based on SCVWD's past work on the project, other water resources studies, and the team's technical understanding of the project's problems, opportunities, and objectives. SCVWD's previous efforts included an extensive public outreach effort, which resulted in the inclusion of management measures suggested by the project stakeholders and the general public. The initial list of management measures in the IAIR was not constrained in any way.

The 87 management measures identified in the IAIR were grouped into six categories: Institutional Agreements, Source Water Quality Control, Water Treatment, Conveyance, Local Reservoir Storage, and Alternate Water Supplies. The 87 management measures are presented in Figure 3-1.

Institutional Agreements	Source Water Quality Control	Water Treatment	Conveyance	Local Reservoir Storage: More Storage at Existing Dam and Reservoir Sites	Local Reservoir Storage: New Dams and Reservoir Sites	Alternate Water Supplies
Banking	Algae Harvesting	Dissolved Air Flotation (DAF) near San Felipe Intake	Highway 152 Pipeline/ Tunnel	Almaden	Ausaymas	Demand Side Management in SCVWD
Exchanges	Algaecides/Herbicides (for algae or macrophytes)	DAF at Coyote Pumping Plant (plus San Benito and Pajaro)	Holladay Aqueduct	Anderson	Blue Ridge	Desalination: Monterey Bay
Operating Agreements and Procedures	Barley Straw (to absorb algae and nutrients)	DAF at Santa Teresa and Rinconada (plus San Benito and Pajaro)	Northerly Bypass Corridor	Calero	Cedar Creek	Desalination: San Benito Groundwater Basin
Rescheduling	Coffer Dam Around Intake	Add Ozone to Raw Water as It Enters Water Treatment Facilities	Southerly Bypass Corridor	Chesbro	Clarks Canyon	Desalination: San Francisco Bay
	Dilution/Flushing (local runoff)	Add Potassium Permanganate to Raw Water along the Santa Clara Conduit	Extend/Lower San Felipe Intake to Gianelli Inlet/ Outlet Level	Coyote	Coe	Desalination: San Benito Groundwater Basin, San Francisco Bay, and Monterey Bay
	Dredging		Ranney Collectors in San Luis Reservoir	Guadalupe	Harper	Enlarged SBA/ Los Vaqueros Expansion
	Fish Grazers on Algae or Macrophytes		San Felipe Diversion Conveyance Modifications	Lexington	Los Osos	Los Vaqueros Expansion
	Floating Covers			Lower Pacheco (Pacheco Lake Reservoir)	North Fork Pacheco	More Storage in SCVWD Groundwater Basin
	Intermediate Intake for Pacheco Pumping Plant			Pacheco A	Packwood	Options from SBCWD Basin Management Plan
	Isolate Portion (arm) of San Luis Reservoir			Pacheco B	San Benito Reservoir	Options from PVWMA Basin Management Plan
	Macrophyte (water weed harvesting)			Raise San Luis Reservoir	San Felipe	Re-Operation of Anderson Reservoir
	Managed Stratification (modify Gianelli inlet/outlet works)			Stevens Creek	Smith Creek	Recycling in SCVWD
	Mechanical Destratification and Lake Mixing			Upper Pacheco	Del Puerto Reservoir	SFPUC Expanded Calaveras Reservoir
	Nutrient harvesting from Fish or Other Biota			Uvas	South Fork Pacheco	SFPUC Intertie
	Oxygenation or Aeration			Vasona	Ingram Canyon Reservoir	
	Pathogens of Algae or Mycrophytes				Quinto Creek Reservoir	
	Sediment Sealing (fabric liners, chemical barriers)				Garzas Reservoir	
	Shading (dyes) to Minimize light for Photosynthesis				Little Salado Creek Reservoir	
	Use Calero as Wetland				Los Banos Grandes Reservoir	
	Water Level Fluctuation				Orestimba Reservoir	
	Wetlands Algae Filter				Romero Reservoir	

Figure 3-1 **Management** Measures

3.1.2 Management Measure Screening

Screening Resource Management Measures

The screening process (presented in the IAIR) evaluated management measures based on technical viability, institutional viability, and the ability to meet the project objectives. This screening did not evaluate management measures in detail, but rather looked for fatal flaws that would make a measure nonviable. Further analysis during the Study process could show that a particular management measure that was carried forward is actually nonviable. If management measures did not pass the technical and institutional viability criteria, they were dropped from the analysis immediately. Management measures that passed both technical and institutional viability criteria were then evaluated against the project objectives using defined rating scales.

The technical and institutional viability criteria take into account essential factors that the management measures were required to meet. Technical viability addresses the general engineering viability of the management measures. This criterion asks the question: can the measure be constructed or implemented to address the low point issue effectively? For example, some source water quality control management measures might not be viable because they could not be implemented at the scale required, given the large size of the reservoir. The institutional viability criterion considers the institutional aspects of a measure, including regulatory and environmental compliance and public acceptance. For example, some surface storage management measures that include expansion of existing reservoirs might not be viable given their projected inundation of existing communities adjacent to the reservoirs and the associated public opposition to the measure.

Management Measure Screening Results

Figure 3-2 presents the results of the management measure screening and indicates which management measures were carried forward into initial alternative screening. The Study team evaluated the potentially viable management measures according to the project objectives. Figure 3-2 depicts the evaluation results with circles. In general, a full circle in Figure 3-2 means the measure would perform “well” relative to the objective, a partially full circle means the measure would perform “moderately,” and an empty circle means the measure would not meet the objective at all. The study team presented definitions in the IAIR for the criteria used to rank the alternatives relative to the project objectives.

The Study team carried forward the management measures that were technically and institutionally viable and that received at least one "performs moderately" rating (a partially full circle in Figure 3-2) related to a project objective. These retained management measures could help to meet the objectives, and could be combined with other viable management measures to form preliminary alternatives. Figure 3-2 also notes why the eliminated management measures were not carried forward.

3.2 Initial Alternatives

The Study team developed initial alternatives using the measures that were carried forward after management measure screening. In some cases, the initial alternatives were composed of multiple management measures, in combinations that performed better according to the project objectives than individual measures did. These initial alternatives were screened for how well they would meet the Federal criteria: completeness, effectiveness, acceptability, and efficiency. This section describes the identification and screening of these initial alternatives.

3.2.1 Initial Alternative Formulation

The Study team developed 26 initial alternatives using the retained management measures. Initial alternatives included either one measure or a combination of management measures, to achieve good performance relative to the three project objectives: avoiding supply interruptions; increasing reliability and quantity of deliveries; and announcing higher allocations earlier in the year (See Section 1.4). Each management measure was included in one or more initial alternatives. Figure 3-3 shows the 26 initial alternatives.

3.2.2 Alternative Screening

The Study team screened the initial alternatives based on how well they would meet the Federal criteria (completeness, effectiveness, acceptability, and efficiency) using rating scales to gauge each alternative. The Federal criteria are defined as:

- Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.

- Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

- Efficiency is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

- Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

The performance measures that the Study team applied to screen the initial alternatives according to the Federal criteria are presented in Figure 3-3 along with the ratings for each initial alternative.

The Study team selected at least one alternative from each category to carry forward for analysis, maintaining a reasonable range of alternative types. The Study team selected alternatives that appeared to be able to achieve the most benefits for the least cost relative to the other alternatives within a category. This comparison was qualitative because a full analysis of net benefits (benefits minus costs) had not been completed for the initial alternatives. If at least one alternative did not stand out within a category because of higher benefits or lower costs, then multiple alternatives from that category were retained. Much of the future Study work will center on refinement and quantitative measurement of benefits and costs, to enable selection of a preferred plan consistent with the P&Gs. Table 3-1 presents the 17 initial alternatives that were carried forward from the IAIR.

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SLLPIP Management Measure Screening

Measures	Viability		Ability to Meet Project Objectives			Screening Results	Notes
	Technical	Institutional	Reduces Delivery Schedule Risk	Increases Annual Allocation Reliability	Provides for Earlier Annual Allocation		
Institutional Agreements							
Banking			◒	◒	◒	Retained	
Exchanges			◒	○	○	Retained	
Operating Agreements and Procedures			◒	○	○	Retained	
Rescheduling			○	○	○	Screened Out	*If rescheduled water is not used by April 15th (when VAMP flows begin), the water reverts to CVP water without refund and is not available to address the low point problem.*
Source Water Quality Control							
Algae Harvesting			◒	○	○	Retained	
Algaecides/Herbicides (for algae or macrophytes)			◒	○	○	Retained	
Barley Straw (to absorb algae and nutrients)	Not viable	Not viable				Screened Out	*Because of its large size, San Luis Reservoir would require 500 tons of barley straw, which would be expensive and difficult and likely affect recreation activities at the reservoir.*
Coffer Dam Around Intake	Not viable					Screened Out	*Isolating a portion of water in the reservoir would not improve and could further degrade water quality.*
Dilution/Flushing (Local Runoff)	Not viable					Screened Out	*Supply of local high quality water large enough to dilute San Luis supplies is not available.*
Dredging	Not viable					Screened Out	*Reservoir floor does not contribute significantly to algae growth; Delta exports are the main source of nutrients.*
Fish Grazers on Algae or Macrophytes	Not viable	Not viable				Screened Out	*Fish that graze on algae are not well suited to San Luis because these fish can reduce habitat for game fish species.*
Floating Covers	Not viable	Not viable				Screened Out	*San Luis Reservoir has a 12,520 acre surface area. A floating cover would be infeasible because of the reservoir's size and impact on existing recreational uses.*
Intermediate Intake for Pacheco Pumping Plant			○	○	○	Screened Out	*Developing an intermediate intake for the San Felipe Division would not enable increased diversions; a lower intake would be needed.*
Isolate Portion (Arm) of San Luis Reservoir		Not viable				Screened Out	*Isolating a portion of water in the reservoir would not improve and could further degrade water quality.*
Macrophyte (Water Weed Harvesting)			○	○	○	Screened Out	*Nuisance weeds in San Luis do not contribute significantly to algae growth; Delta exports are the main source of nutrients.*
Managed Stratification (Modify Gianelli Inlet/Outlet Works)			◒	○	○	Retained	
Mechanical Destratification and Lake Mixing	Not viable	Not viable				Screened Out	*Mechanical destratification would not be feasible because of the large reservoir size.*
Nutrient Harvesting from Fish or other Biota	Not viable	Not viable				Screened Out	*Fish and water weeds are not a major contributor to algae growth; Delta exports are the main source of nutrients.*
Oxygenation or Aeration	Not viable					Screened Out	*Oxygenating or aerating San Luis Reservoir would not be feasible because of the large reservoir size.*
Pathogens of Algae or Macrophytes	Not viable					Screened Out	*Blue green algae build up resistance to pathogens, minimizing their effectiveness.*
Sediment Sealing (Fabric liners, chemical barriers)	Not viable					Screened Out	*The reservoir floor does not contribute significantly to algae growth; Delta exports are the main source of nutrients.*
Shading (Dyes) to Minimize Light for Photosynthesis	Not viable	Not viable				Screened Out	*San Luis Reservoir has a 12,520 acre surface and stores 2 million acre-feet of water; limiting algae growth by applying dyes would be infeasible because of reservoir size and the impact on existing recreational uses.*
Use Calero Reservoir as Wetlands	Not viable	Not viable				Screened Out	*The 9,000-acre Calero Reservoir is not large enough for the estimated 25,000 acres of wetland needed to treat the water stored in San Luis Reservoir. Converting an existing water storage reservoir to a water treatment facility would be politically infeasible because of the loss in local surface storage.*
Water Level Fluctuation		Not viable				Screened Out	*Water weeds are not a major contributor to algae growth; Delta exports are the main source of nutrients.*
Wetlands Algae Filter (Off-line wetlands)	Not viable					Screened Out	*Constructing the estimated 25,000 acres of wetland needed to treat the water stored in San Luis would not be technically feasible.*
Water Treatment							
Dissolved Air Flotation (DAF) near San Felipe Intake			◒	◒	◒	Retained	
DAF at Coyote Pumping Plant (plus San Benito and Pajaro)			◒	◒	◒	Retained	
DAF at Santa Teresa and Rinconada (plus San Benito and Pajaro)			◒	◒	◒	Retained	
Add ozone to raw water as it enters water treatment facilities			◒	◒	◒	Retained	
Add potassium permangante to raw water along the Santa Clara Conduit			◒	◒	◒	Retained	

Symbol Key — Not viable (blue): *Not Technically or Institutionally Viable*; ○ *Does Not Meet Project Objective*; ◒ *Partially Meets Project Objective*; ● *Meets Project Objective*; Screened Out (orange): *Measure Screened Out*; Retained (green): *Measure Retained for Level 2 Screening*

Figure 3-2 – SLLPIP Management Measure Screening

SLLPIP Management Measure Screening

Measures	Viability: Technical	Viability: Institutional	Ability to Meet Project Objectives: Reduces Delivery Schedule Risk	Ability to Meet Project Objectives: Increases Annual Allocation Reliability	Ability to Meet Project Objectives: Provides for Earlier Annual Allocation	Screening Results	Notes
Conveyance							
Highway 152 Pipeline/Tunnel	■					Measure Screened Out	*Caltrans would likely not provide pipeline easements.*
Holladay Aqueduct			●	◒	◒	Measure Retained for Level 2 Screening	
Northerly Bypass Corridor			●	◒	◒	Measure Retained for Level 2 Screening	
Southerly Bypass Corridor			●	◒	◒	Measure Retained for Level 2 Screening	
Extend/Lower San Felipe Intake to Gianelli Inlet/Outlet Level			◒	◒	◒	Measure Retained for Level 2 Screening	
Ranney Collectors in San Luis Reservoir	■					Measure Screened Out	*The floor of the reservoir is not geotechnically suited to ranney collectors; therefore, 20-40 miles of infiltration galleries would need to be constructed at the bottom of the reservoir.*
San Felipe Division Conveyance Modifications			●	◒	◒	Measure Retained for Level 2 Screening	
Local Reservoir Storage: More Storage at Existing Dam and Reservoir Sites							
Almaden		■				Measure Screened Out	*Almaden Reservoir would be 3,000 feet upstream from New Almaden (a National Historic Landmark).*
Anderson			●	●	●	Measure Retained for Level 2 Screening	
Calero	■					Measure Retained for Level 2 Screening	*An expanded Calero Reservoir would be in an area with liquefiable soils and would not have acceptable dam materials in the vicinity of construction.*
Chesbro			●	●	●	Measure Retained for Level 2 Screening	
Coyote	■					Measure Screened Out	*An expanded Coyote Reservoir would have an active fault running under its left abutment.*
Guadalupe	■					Measure Screened Out	*An expanded Guadalupe Reservoir would have too high an elevation, and would potentially have active faults running through the expanded site.*
Lexington	■	■				Measure Screened Out	*An expanded Lexington Reservoir would be greater than 5 miles from the nearest conveyance facilities and would require relocation of several miles of Highway 17.*
Lower Pacheco (Pacheco Lake Reservoir)			●	●	●	Measure Retained for Level 2 Screening	
Pacheco A			●	●	●	Measure Retained for Level 2 Screening	
Pacheco B		■				Measure Screened Out	*The Pacheco B Reservoir would inundate a portion of Henry Coe State Park.*
Raise San Luis Reservoir			◒	◒	◒	Measure Retained for Level 2 Screening	
Stevens Creek	■					Measure Screened Out	*An expanded Stevens Creek Reservoir would be greater than 5 miles from the nearest conveyance facilities and would be an inefficient site (large dam size compared to the storage volume).*
Upper Pacheco		■				Measure Screened Out	*The Upper Pacheco Reservoir would inundate a portion of Henry Coe State Park.*
Uvas	■					Measure Screened Out	*An expanded Uvas Reservoir would be greater then 5 miles from the nearest conveyance facilities.*
Vasona	■	■				Measure Screened Out	*An expanded Vasona Reservoir would be greater than 5 miles from the nearest conveyance facilities and would inundate portions of Los Gatos.*
Local Reservoir Storage: New Dams and Reservoir Sites							
Ausaymas	■					Measure Screened Out	*Ausaymas Reservoir would have too high an elevation and would be an inefficient site (large dam size compared to the storage volume).*
Blue Ridge	■					Measure Screened Out	*Blue Ridge Reservoir would inundate a portion of Henry Coe State Park, would have too high an elevation, and would be greater than 5 miles from the nearest conveyance facilities.*
Cedar Creek	■					Measure Screened Out	*Cedar Creek Reservoir would involve a dam and storage facility on liquefiable soils and would not have acceptable dam material in the vicinity for construction.*
Clarks Canyon	■					Measure Screened Out	*Clarks Canyon Reservoir would have too high an elevation and would be an inefficient site (large dam size compared to the storage volume).*
Coe	■	■				Measure Screened Out	*Coe Reservoir would inundate a portion of Henry Coe State Park, would have too high an elevation, and would be greater than 5 miles from the nearest conveyance facilities.*

Symbol Key ■ *Not Technically or Institutionally Viable* ○ *Does Not Meet Project Objective* ◒ *Partially Meets Project Objective* ● *Meets Project Objective* *Measure Screened Out* *Measure Retained for Level 2 Screening*

Figure 3-2 – SLLPIP Management Measure Screening

SLLPIP Management Measure Screening

Measures	Viability		Ability to Meet Project Objectives			Screening Results	Notes
	Technical	Institutional	Reduces Delivery Schedule Risk	Increases Annual Allocation Reliability	Provides for Earlier Annual Allocation		
Local Reservoir Storage: New Dams and Reservoir Sites, continued							
Harper	■					Measure Screened Out	*Harper Reservoir would be an inefficient site (large dam size compared to the storage volume).*
Los Osos		■				Measure Screened Out	*Los Osos Reservoir would inundate portions of Henry Coe State Park.*
North Fork Pacheco	■	■				Measure Screened Out	*North Fork Pacheco Reservoir would have too high an elevation, would be greater than 5 miles from the nearest conveyance facilities, and would be an inefficient site (large dam size compared to the storage volume).*
Packwood	■					Measure Screened Out	*Packwood Reservoir would have too high an elevation.*
San Benito			◒	◒	◒	Measure Retained for Level 2 Screening	
San Felipe	■					Measure Screened Out	*San Felipe Reservoir would have too high an elevation and would be an inefficient site (large dam size compared to the storage volume).*
Smith Creek	■					Measure Screened Out	*Smith Creek Reservoir would have too high an elevation, would be greater than 5 miles from the nearest conveyance facilities, and would be an inefficient site (large dam size compared to the storage volume).*
South Fork Pacheco	■					Measure Screened Out	*South Fork Pacheco Reservoir would have too high an elevation and would be an inefficient site (large dam size compared to the storage volume).*
Del Puerto Reservoir			●	●	●	Measure Retained for Level 2 Screening	
Ingram Canyon Reservoir			●	●	●	Measure Retained for Level 2 Screening	
Quinto Creek Reservoir			●	●	●	Measure Retained for Level 2 Screening	
Garzas Reservoir		■				Measure Screened Out	*A reservoir at Garzas Creek would inundate an area with a permanent conservation easement created for CVP mitigation.*
Little Salado Crow Reservoir	■					Measure Screened Out	*Little Salado Crow Reservoir would not be large enough to meet needs.*
Los Banos Grandes Reservoir		■				Measure Screened Out	*Potential environmental impacts would lead to significant difficulty in implementation.*
Orestimba Reservoir		■				Measure Screened Out	*Orestimba Reservoir would inundate an area with a permanent conservation easement created for CVP mitigation.*
Romero Reservoir	■					Measure Screened Out	*Romero Reservoir would not be large enough to meet needs.*
Alternate Water Supplies							
Demand-Side Management in SCVWD	■					Measure Screened Out	*SCVWD has implemented or is planning to implement most demand-side management measures as part of its baseline water supply.*
Desalination: Monterey Bay			●	●	●	Measure Retained for Level 2 Screening	
Desalination: San Benito Groundwater Basin			●	●	●	Measure Retained for Level 2 Screening	
Desalination: San Francisco Bay			●	●	●	Measure Retained for Level 2 Screening	
Desalination: San Benito Groundwater Basin, San Francisco Bay, and Monterey Bay			●	●	●	Measure Retained for Level 2 Screening	
Enlarged SBA/Los Vaqueros Expansion			◒	○	○	Measure Retained for Level 2 Screening	
Los Vaqueros Expansion			◒	○	○	Measure Retained for Level 2 Screening	
More Storage in SCVWD Groundwater Basin			◒	◒	◒	Measure Retained for Level 2 Screening	
Options from SBCWD Basin Management Plan			◒	◒	◒	Measure Retained for Level 2 Screening	
Options from PVWMA Basin Management Plan			◒	◒	◒	Measure Retained for Level 2 Screening	
Recycling in SCVWD			◒	○	○	Measure Retained for Level 2 Screening	*SCVWD is planning to recycle most dry-season discharge as part of its baseline water supply.*
Re-Operation of Anderson Reservoir			◒	○	○	Measure Retained for Level 2 Screening	
SFPUC Expanded Calaveras Reservoir	■	■				Measure Screened Out	*SFPUC is not planning to expand Calaveras Reservoir as a part of its ongoing dam replacement project.*
SFPUC Intertie			◒	◒	◒	Measure Retained for Level 2 Screening	

Symbol Key ■ *Not Technically or Institutionally Viable* ○ *Does Not Meet Project Objective* ◒ *Partially Meets Project Objective* ● *Meets Project Objective* *Measure Screened Out* *Measure Retained for Level 2 Screening*

Figure 3-2 – SLLPIP Management Measure Screening

SLLPIP Institutional Alternative Screening

Category	Alternatives	Completeness: Potential for supply interruptions	Completeness: Delivery quantities for south-of-Delta contractors	Completeness: Potential to allow more aggressive allocations	Effectiveness: Amount of San Luis storage exercised	Effectiveness: Local **operational flexibility**	Acceptability: Impacts to **biological resources**	Acceptability: Impacts to physical resources	Acceptability: Impacts to social resources	Efficiency: Cost
Institutional	Institutional Alternative	Makes Some Progress	Makes Some Progress	Makes Some Progress	Makes Some Progress	Partially Meets	Partially Meets	Partially Meets	Partially Meets	Fully Meets
Source Water Quality Control	Algae Harvesting Alternative	Partially Meets	Partially Meets	Fully Meets	Makes Some Progress	Partially Meets	Partially Meets	Partially Meets	Makes Some Progress	Makes Some Progress
	Algaecide Alternative	Partially Meets	Partially Meets	Fully Meets	Makes Some Progress	Partially Meets	Makes Some Progress	Makes Some Progress	Makes Some Progress	Fully Meets
	Managed Stratification Alternative	Partially Meets	Partially Meets	Fully Meets	Partially Meets	Partially Meets	Partially Meets	Partially Meets	Partially Meets	Partially Meets
Treatment	Treatment at San Felipe Alternative	Partially Meets	Partially Meets	Fully Meets	Partially Meets	Makes Some Progress	Makes Some Progress	Partially Meets	Partially Meets	Fully Meets
	Treatment at WTPs Alternative	Partially Meets	Partially Meets	Fully Meets	Partially Meets	Makes Some Progress	Makes Some Progress	Partially Meets	Partially Meets	Fully Meets
	Treatment at Pumping Plant Alternative	Partially Meets	Partially Meets	Fully Meets	Partially Meets	Makes Some Progress	Makes Some Progress	Partially Meets	Partially Meets	Fully Meets
Conveyance	Holladay Aqueduct Alternative	Fully Meets	Partially Meets	Fully Meets	Partially Meets	Fully Meets	Partially Meets	Makes Some Progress	Partially Meets	Makes Some Progress
	Northerly Bypass Corridor Alternative	Fully Meets	Partially Meets	Fully Meets	Partially Meets	Fully Meets	Makes Some Progress	Makes Some Progress	Partially Meets	Makes Some Progress
	Southerly Bypass Corridor Alternative	Fully Meets	Partially Meets	Fully Meets	Partially Meets	Fully Meets	Partially Meets	Partially Meets	Partially Meets	Partially Meets
	Lower San Felipe Intake Alternative	Partially Meets	Partially Meets	Fully Meets	Fully Meets	Partially Meets	Makes Some Progress	Partially Meets	Partially Meets	Fully Meets
Storage	Anderson Reservoir Expansion Alternative	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Does Not Meet	Does Not Meet	Does Not Meet	Fully Meets
	Chesbro Reservoir Expansion Alternative	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Does Not Meet	Does Not Meet	Makes Some Progress	
	Lower Pacheco Reservoir Alternative	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Does Not Meet	Does Not Meet	Makes Some Progress	Partially Meets
	Pacheco A Reservoir Alternative	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Fully Meets	Does Not Meet	Does Not Meet	Makes Some Progress	Partially Meets
	San Luis Reservoir Expansion Alternative	Partially Meets	Partially Meets	Fully Meets	Makes Some Progress	Makes Some Progress	Does Not Meet	Does Not Meet	Makes Some Progress	Makes Some Progress
	San Benito Reservoir Alternative	Partially Meets	Partially Meets	Fully Meets	Makes Some Progress	Fully Meets	Does Not Meet	Does Not Meet	Makes Some Progress	
	Del Puerto Canyon Reservoir Alternative	Partially Meets	Partially Meets	Fully Meets	Makes Some Progress	Fully Meets	Does Not Meet	Does Not Meet	Makes Some Progress	
	Ingram Canyon Reservoir Alternative	Partially Meets	Fully Meets	Fully Meets	Makes Some Progress	Fully Meets	Does Not Meet	Does Not Meet	Makes Some Progress	
	Quinto Creek Reservoir Alternative	Partially Meets	Fully Meets	Fully Meets	Makes Some Progress	Fully Meets	Does Not Meet	Does Not Meet	Makes Some Progress	
Alternate Water Supplies	Monterey Bay Desalination Alternative	Fully Meets	Fully Meets	Fully Meets	Partially Meets	Fully Meets	Does Not Meet	Makes Some Progress	Makes Some Progress	Does Not Meet
	San Francisco Bay Desalination Alternative	Fully Meets	Fully Meets	Fully Meets	Partially Meets	Fully Meets	Does Not Meet	Makes Some Progress	Makes Some Progress	Does Not Meet
	Combined Desalination Alternative	Fully Meets	Fully Meets	Fully Meets	Partially Meets	Fully Meets	Does Not Meet	Makes Some Progress	Makes Some Progress	Does Not Meet
	Enlarged SBA/Los Vaqueros Expansion Alternative	Partially Meets	Partially Meets	Fully Meets	Partially Meets	Partially Meets	Makes Some Progress	Makes Some Progress	Makes Some Progress	Partially Meets
	Los Vaqueros Expansion Alternative	Partially Meets	Partially Meets	Fully Meets	Partially Meets	Partially Meets	Makes Some Progress	Makes Some Progress	Makes Some Progress	Fully Meets
Combination	San Felipe Division Combination Alternative	Partially Meets	Partially Meets	Fully Meets	Partially Meets	Partially Meets	Partially Meets	Partially Meets	Partially Meets	Partially Meets

Legend: *Fully Meets Criterion* · *Partially Meets Criterion* · *Makes Some Progress Towards Meeting Criterion* · *Does Not Meet Criterion*

Figure 3-3 – SLLPIP Institutional Alternative Screening

Table 3-1. Initial Alternatives Retained after IAIR Evaluation

Category	Alternative	Included Management Measures
Institutional	Institutional Alternative	Banking, exchanges, and operating agreements and procedures.
Source Water Quality Control	Algaecide Alternative	Algaecides, banking, exchanges, and groundwater storage.
Treatment	Treatment at San Felipe Intake Alternative	DAF at San Felipe Intake, treatment at Rinconada, and exchanges.
	Treatment at Water Treatment Plants Alternative	DAF at Water Treatment Plants, treatment at Rinconada, and exchanges
	Treatment at Pumping Plant Alternative	DAF at Coyote PP, treatment at Rinconada, and exchanges.
Conveyance	Lower San Felipe Intake Alternative	Extend/Lower San Felipe Intake to Gianelli Inlet/Outlet Level and banking.
	Southerly Bypass Corridor Alternative	Southerly Bypass Corridor and exchanges.
Storage	Anderson Reservoir Expansion Alternative	Anderson expansion and exchanges.
	Chesbro Reservoir Expansion Alternative	Chesbro expansion and exchanges.
	Lower Pacheco Reservoir Alternative	Lower Pacheco (Pacheco Lake Reservoir) and exchanges.
	Pacheco A Reservoir Alternative	Pacheco A Reservoir and exchanges.
	San Benito Canyon Reservoir Alternative	San Benito Reservoir and exchanges.
	Del Puerto Canyon Reservoir Alternative	Del Puerto Canyon Reservoir, banking, groundwater storage, and exchanges.
	Ingram Canyon Reservoir Alternative	Ingram Canyon Reservoir.
	Quinto Creek Reservoir Alternative	Quinto Creek Reservoir.
Alternate Water Supplies	Los Vaqueros Expansion Alternative	Los Vaqueros Expansion, Anderson re-operation, SFPUC intertie, San Benito groundwater desalination, and exchanges.
Combination	San Felipe Division Combination Alternative	San Felipe Division conveyance modification, groundwater storage, recycling, and exchanges.

Key: DAF = Dissolved Air Flotation
WTPs = water treatment plants
PP = pumping plant
SBA = South Bay Aqueduct
SFPUC = San Francisco Public Utilities Commission

3.3 Additional Alternatives Screening in Plan Formulation Phase

In the Plan Formulation Phase, alternatives carried forward from the IAIR were re-evaluated for their capacity to meet the four Federal planning criteria: completeness, effectiveness, acceptability, and efficiency. The goal of this re-evaluation was to use updated information and data to identify and screen out alternatives that would not meet the planning criteria prior to development of comprehensive plans in the PFR. As a result of the re-evaluation, summarized in Table 3-2, the Study team screened out 14 alternatives, eliminating them from further consideration in the Study, as described following the figure and tables below.

Table 3-2. Alternatives Eliminated after Re-Evaluation during Plan Formulation

Category	Alternative	Included Management Measures
Institutional	Institutional Alternative	Banking, exchanges, and operating agreements and procedures.
Source Water Quality Control	Algaecide Alternative	Algaecides, banking, exchanges, and groundwater storage.
Treatment	Treatment at San Felipe Intake Alternative	DAF at San Felipe Intake, treatment at Rinconada, and exchanges.
	Treatment at Water Treatment Plants Alternative	DAF at Water Treatment Plants, treatment at Rinconada, and exchanges
	Treatment at Pumping Plant Alternative	DAF at Coyote PP, treatment at Rinconada, and exchanges.
Conveyance	Southerly Bypass Corridor Alternative	Southerly Bypass Corridor and exchanges.
Storage	Anderson Reservoir Expansion Alternative	Anderson expansion and exchanges.
	Chesbro Reservoir Expansion Alternative	Chesbro expansion and exchanges.
	Lower Pacheco Reservoir Alternative	Lower Pacheco (Pacheco Lake Reservoir) and exchanges.
	San Benito Canyon Reservoir Alternative	San Benito Reservoir and exchanges.
	Del Puerto Canyon Reservoir Alternative	Del Puerto Canyon Reservoir, banking, groundwater storage, and exchanges.
	Ingram Canyon Reservoir Alternative	Ingram Canyon Reservoir.
	Quinto Creek Reservoir Alternative	Quinto Creek Reservoir.
Alternate Water Supplies	Los Vaqueros Expansion Alternative	Los Vaqueros Expansion, Anderson re-operation, SFPUC intertie, San Benito groundwater desalination, and exchanges.

Key: DAF = Dissolved Air Filtration
WTPs = water treatment plants
PP = pumping plant
SBA = South Bay Aqueduct
SFPUC = San Francisco Public Utilities Commission

3.3.1 Institutional Alternative

The stand-alone Institutional Alternative was screened from further consideration by the Study team under the completeness criterion because it would not provide a reliable long term water supply to meet the SLLPIP project objective of avoiding supply interruptions. Although the Institutional Alternative was screened as a stand-alone alternative, institutional management measures are included as elements of other alternatives.

The Institutional Alternative developed in the IAIR included non-structural exchanges with CVP agricultural contractors that have access to groundwater supplies and with the Metropolitan Water District, north-of-Delta transfers, groundwater banking, and San Felipe Division re-operation management measures. The Institutional Alternative included reliance on end of month San Luis Reservoir storage levels as triggers for when the alternative would be implemented. The triggers were developed to counter the uncertainty associated with forecasting when a low point supply interruption would occur.

Preliminary estimates of Institutional Alternative operations indicate that exchanges with CVP agricultural contractors would be utilized in 46 of the 81 model years, exchanges with MWD would be utilized in 40 years, transfers from north-of-Delta contractors in 47 years, and withdrawals from a groundwater bank in 27 years. Estimates of north-of-Delta transfers were developed assuming constraints on through delta water deliveries including carriage water costs and the following regulatory requirements: State Water Resources Control Board Decision 1641; section b(2) of the Central Valley Project Improvement Act (CVPIA); and the Bay-Delta Hearings Phase 8 Settlement agreement. These estimates did not include consideration of potential changes in future Delta export limits to support Endangered Species Act (ESA) compliance.

Potential changes in regulatory limits on Delta exports to support ESA compliance related to salmon and delta smelt protection are expected to reduce the Institutional Alternative’s ability to rely on north-of-Delta exchanges and transfers. Export limitations due to fishery protection actions are expected to affect spring export capacity, which would cause the CVP and SWP to increase exports later in the summer to meet contract allocations and likely limit the export capacity available to support this alternative’s reliance on summer transfers. The uncertainty regarding future restrictions on south-of-Delta exports, and their potential to prevent the north-of-Delta transfers needed to hold San Luis Reservoir at the 300 TAF level in all years, limit the degree to which the Institutional Alternative is estimated to be able to achieve the SLLPIP project objectives.

The frequency with which the Institutional Alternative would call on each management measure further reduces the likelihood that the alternative would function as a complete alternative. Some measures, such as groundwater banking, have operational limitations in that water must be recharged before it is withdrawn. These limitations are considered when determining the frequency of use of this measure. In many years, only a few acre-feet would be withdrawn because adequate time has not passed since the last withdrawal to accumulate a substantial amount of water in storage. Other measures, such as exchanges and transfers, would require willing participants. Participants are less likely to be willing to engage in a program that requires them to change their actions (pumping groundwater or idling crops) in about half of the years; finding willing participants would therefore be difficult. These considerations contribute to the finding that this alternative would not function as a complete alternative.

The frequency of use of the measures within the Institutional Alternative creates an increased likelihood that they will not be available; however, using the measures on a less frequent basis as safety nets for allocations would be a better fit. When used as safety nets, these measures are necessary in approximately half as many years as in the Institutional Alternative, thereby increasing the likelihood of finding willing participants and the usefulness of a groundwater bank.

3.3.2 Source Water Quality Control Alternatives

The Algaecide Alternative described in the IAIR proposed the use of boats or helicopters to apply copper-based herbicides to San Luis Reservoir in the early stages of summer algae blooms to thin the algae density and lower the concentration of filter-clogging algae in water delivered from the reservoir. The total water quantity benefit that could be provided by the alternative was unknown when the IAIR was prepared, but was estimated to be approximately 50 TAF based on a previous investigation completed as a part of SCVWD's work on the SLLPIP. The alternative has subsequently been screened from further consideration based on the effectiveness and acceptability criteria.

In the early stages of reservoir algae development, when algaecide application could control growth, the blooms in San Luis Reservoir are widely dispersed. This dispersion, coupled with summer winds at the reservoir, which can rapidly transport blooms to the area near the San Felipe Intakes, makes focused treatment infeasible. The entire reservoir would need to be treated with algaecide to control algae blooms.

Preliminary work completed by SCVWD and DWR in the summer of 2007 determined that the need for reservoir-wide algaecide application would necessitate the application of between 400,000 and 1,500,000 pounds of copper sulfate, depending on the concentration of copper sulfate needed and the depth of reservoir requiring treatment. At that time, preliminary cost estimates for this treatment ranged from between $500,000 and $1,700,000 per application. The highly productive water quality conditions found in San Luis Reservoir during the low point months could require multiple applications each year. Algaecide application at this scale would generate environmental and water quality concerns because San Luis Reservoir supplies drinking water and is used for recreational fishing. SCVWD and DWR did not pursue algaecide application because of the uncertain water supply benefits and the potential environmental concerns associated with applying between 400,000 and 1,500,000 pounds of copper sulfate (Janick 2008). These concerns make the alternative unacceptable.

Additional review of the Algaecide Alternative focused on reducing the uncertainty associated with the expected water supply benefit from algaecide application. The review investigated the algaecide application plan evaluated in the IAIR and determined that the proposed algaecide, Cutrine Plus, was not designed to treat algae blooms at depths greater than four feet. The application plan assumed reservoir-wide application at a depth of 30 feet. The proposed algaecide is also not designed for reservoir-wide application, because as the treated algae decays, it causes oxygen depletion that can have a harmful effect on fish in the reservoir. These limitations on application depth and scope directly affect the alternative’s ability to meet the project objectives and the effectiveness criterion.

Uncertainty about the degree to which the Algaecide Alternative would meet the project objectives and the potential challenges associated with permitting the application of algaecide on a drinking water reservoir at this scale (Bolland 2008) led to the elimination of this alternative from further consideration in the Study based on the effectiveness and acceptability criteria.

3.3.3 Treatment Alternatives

The dissolved air flotation (DAF) treatment alternatives described in the IAIR included three potential layouts for using DAF treatment. DAF treatment would be used to reduce the amount of algae in water delivered from San Luis Reservoir and prevent clogging of filters at SCVWD drinking water treatment plants and in SBCWD and PVMWA irrigation infrastructure. Three DAF alternatives were carried forward from the IAIR based on water supply benefits and cost. Further investigation into the potential use of DAF technology for treatment of algae-laden water from San Luis Reservoir focused on previous investigations by SCVWD into adding DAF to its treatment plants as a part of recent treatment plant upgrades.

The addition of DAF facilities at the SCVWD treatment plants as a part of these recent treatment plant upgrades was investigated and, based on then-current information, abandoned in favor of a treatment process that consists of conventional treatment (chemical coagulation, flocculation, and sedimentation), ozonation, and granular media filtration using granular activated carbon (GAC) and sand. SCVWD determined that retrofitting the newly updated treatment plants with DAF was not a cost effective solution for the low point issue and would likely not be an acceptable project by its rate payers. The alternative has subsequently been screened from further consideration as a stand-alone alternative based on the acceptability criterion. Improvements to water treatment facilities, however, may have some utility when combined with other measures. Water treatment will remain as a potential measure within the Combination Alternative.

3.3.4 Conveyance Alternatives

The Lower San Felipe Intake and Southerly Bypass Corridor Alternatives were carried forward in the IAIR because their costs were similarly low relative to the other conveyance alternatives. The Study team's further review of these two conveyance alternatives under the efficiency criterion determined that construction costs for the Southerly Bypass Corridor would exceed the costs for the Lower San Felipe Intake Alternative because of the additional tunnel, pipeline, and pumping facility construction necessary to connect to the O'Neill Forebay. The potential water supply benefits generated by the alternatives were also determined to be the same. While the Southerly Bypass Corridor has greater costs for similar benefits, it should be retained if it has the potential to reduce environmental impacts compared to the Lower San Felipe Intake Alternative. However, the Southerly Bypass Corridor would require a larger pump station and longer tunneling effort (with more earth moving), and would not have the potential to reduce environmental effects. Because the Southerly Bypass Corridor Alternative would have higher costs than the Lower San Felipe Intake Alternative, which would offer similar benefits, the Southerly Bypass Corridor Alternative has been screened from the further consideration based on the efficiency criterion.

3.3.5 Storage Alternatives

Eight storage alternatives were carried forward from the IAIR because of an insufficient amount of data available to compare them effectively against other storage alternatives considered in the study. The Study team completed further analysis to provide sufficient background data to support a comparative analysis of each storage alternative's capacity to meet the project objectives.

The analysis focused on developing sufficient information on physical, geotechnical, geological, and hydraulic conditions as well as forecasting potential land development issues and social impacts associated with each storage alternative. This information was used to screen out alternatives with significant estimated earthwork costs and/or potentially greater impacts relative to the other storage alternatives. The storage alternative screening effort identified the Pacheco A and B Reservoir Alternatives as the most efficient storage alternatives to be carried forward for review in the PFR. The remaining storage alternatives, therefore, are eliminated from further consideration based on the efficiency criterion.

The screening effort carried forward the Pacheco B Reservoir Alternative, which had been screened out in the IAIR because of institutional viability concerns associated with its potential inundation of Henry Coe State Park. In 2003, the SCVWD board decided that any Pacheco Reservoir expansion project must avoid State Park lands. Further review determined that a slightly smaller footprint may be able to meet project needs while avoiding the State Park. In the next phase of this study, the Study team will delineate a reservoir footprint that would not inundate State Park lands.

Appendix B presents the details of the analysis.

3.3.6 Alternate Water Supplies

The Los Vaqueros Expansion Alternative would utilize additional storage capacity that would be created as a part of the Los Vaqueros Reservoir Expansion Project to store supplies for delivery in lieu of deliveries from San Luis Reservoir. For the IAIR, the Study team assumed that 100 TAF of Delta water supply would be available to store in an expanded Los Vaqueros Reservoir for later delivery during the summer low point months to replace supplies from San Luis Reservoir. The 100 TAF would be delivered via the SBA for use by SCVWD and via the California Aqueduct to San Luis Reservoir to maintain deliveries to the San Felipe Division and contractors east of San Luis Reservoir.

The Los Vaqueros Expansion Project Feasibility Study was under development during preparation of this PFR independent of this Study. The Los Vaqueros Expansion Project Feasibility Study Team has completed a Final EIS/EIR with alternatives designed to achieve the project objectives identified by Reclamation, DWR, and the local sponsor, CCWD. The degree to which the SLLPIP could rely on any changes made to the Los Vaqueros facility as a result of the Los Vaqueros Expansion Project Feasibility Study is uncertain and cannot be relied on as a tool to address the SLLPIP project objectives. This uncertainty has led to its elimination from the study based on the completeness criterion.

Chapter 4
Features and Effects of Comprehensive Plans

4.1 Comprehensive Plan Development

The alternatives that were carried forward from the IAIR and reviewed in the PFR using the four federal planning criteria have been narrowed to the following comprehensive plans, presented in this chapter:

- Lower San Felipe Intake Comprehensive Plan (Section 4.3);
- Pacheco Reservoir Comprehensive Plan (Section 4.4); and
- Combination Comprehensive Plan (Section 4.5).

This chapter presents an overview of each of the comprehensive plans, along with a description of the plan's major components and operation, a summary of environmental effects, a projected implementation schedule, and the results of the economic analysis. An overview of the No-Action Alternative (Section 4.2) is also presented in this chapter to support its use as the basis for measuring the potential benefits of the comprehensive plans.

The Study Team refined the comprehensive plans using results from economic analysis (Section 4.1.1), hydrologic modeling using CalSim II (Section 4.1.2), engineering analysis, and preliminary cost estimation (Section 4.1.3). This refinement effort sought to maximize alternative performance in terms of the potential benefits provided. The comprehensive plans presented here will continue to undergo review and refinement as a part of the Study process to support the identification of a recommended plan.

4.1.1 Modeling Analysis

Water operations modeling for the SLLPIP was performed using the Common Assumptions CalSim II Version 9A model package. CalSim is a hydrologic planning model of California's waterscape with an emphasis on the CVP and SWP systems. CalSim was developed jointly by DWR and Reclamation. The Common Assumptions model has been designed to establish common baseline conditions from which the CALFED surface storage investigations can assess feasibility. It provides generally accepted conditions and assumptions regarding the operation of the major water system components at both an existing and future level of development.

The Common Assumptions version of CalSim covers the Sacramento and San Joaquin River valley floor drainage areas, the upper Trinity River, the San Joaquin Valley, and southern California agricultural and urban areas served by the CVP and SWP.

CalSim is set up to simulate and account for the effects of various regulatory requirements by running multiple “steps.” The CalSim model “steps” simulate the operations of the system under various regulatory requirements and agreements. The model is run for one year for each “step” and end-of-year conditions from the final step become input to start the next year for the first step. Detailed information on the “steps” and how they affect operations in the model is presented in Appendix A. The model is being used to evaluate the existing and future No-Action conditions and to compare the future No-Action water supply deliveries to the deliveries that are estimated with implementation of each of the comprehensive plans.

Three modifications were made to the model to refine the simulation of operations in the CVP San Felipe Division for existing and future No-Action conditions: 1) adjusting San Felipe Division delivery patterns to more closely simulate actual delivery patterns; 2) adding a representation of San Felipe Division M&I delivery interruptions caused by low point; and, 3) adding CVP deliveries resulting from the Bay-Delta Hearings Phase 8 Settlement water supplies. Additional information on the modifications is provided in Appendix A.

The institutional measures added to the comprehensive plans to support more aggressive early allocations are being evaluated using a post-processing tool that layers the operation of each measure onto the water supply estimates for each alternative generated by CalSim. The post-processing tool prioritizes the implementation of the institutional measures based on their relative cost and simulates their implementation on an as-available basis. Results from CalSim and the post processing tool’s evaluation of the comprehensive plans are compared to the CalSim results for the existing and future No-Action conditions to identify the potential water supply benefit associated with each comprehensive plan.

4.1.2 Cost Estimates

Cost estimates for the major components of each comprehensive plan were developed using the approach outlined in the Reclamation Manual (Reclamation Undated (c)) and the Cost Estimating Handbook (Reclamation 1989). The estimates were developed at a planning level based on preliminary layouts and designs for each comprehensive plan. The preliminary layouts present a level of detail sufficient to develop planning-level costs for the approximate quantities of material, equipment, or labor that would be required for the implementation of each component.

For each comprehensive plan, the Study Team estimated planning level costs that include capital costs, contingencies, and annual operation and maintenance costs. The engineering cost estimates used in this analysis are in accordance with Reclamation's cost estimating procedures. For the PFR analysis, plan costs do not include the conveyance, pumping, treatment, and other costs that would be required to deliver water from San Luis Reservoir to the end user. Appendix C presents the comprehensive plans' engineering cost estimates.

Cost estimates are used as a part of this comprehensive plan formulation and economic evaluation process to compare potential costs with potential benefits and maximize each plan's relative feasibility by designing features at the most efficient size relative to the benefit provided. The cost estimates presented in this section are presented in 2008 dollars.

4.1.3 Economic Analysis

The economic analysis estimates the net economic benefits (or costs) of the SLLPIP comprehensive plans. The analysis is consistent with economic methods identified in the P&Gs. For the PFR, the economic benefits analysis focuses on water supply benefits to M&I users in the San Felipe Division and to agricultural users in the SLDMWA service area and the San Felipe Division. The P&Gs identify several other categories of potential benefits, such as recreation, flood protection, and hydropower. During the plan formulation phase, the comprehensive plans are not developed to a level of detail at which recreation, flood protection, hydropower, or other benefits besides water supply can be validated or quantified. Therefore, this PFR focuses on water supply benefits only. This economic analysis calculates the present value of benefits and costs for each alternative using the federal discount rate for fiscal year 2008 of 4.875 percent and a 100-year project life.

The CalSim II model results estimate the water supplies available for M&I and agricultural users under the No-Action Alternative conditions and under each comprehensive plan; the model results are the basis for determining the water supply benefits. Appendix C describes assumptions for the water supply economic benefits analysis.

M&I water supply benefits for the SLLPIP comprehensive plans are estimated using the avoided cost method, which essentially compares the costs for M&I elements of potential comprehensive plans. The avoided cost method assumes that benefits are equal to the costs avoided by not implementing other alternatives, and does not explicitly measure the underlying value of the water supply to water users. The avoided cost method will always lead to one alternative with positive net benefits even if the underlying value of the output to water users is low; therefore, it is necessary to assume the value of the M&I supply provided for at least one of the action alternative is greater than its costs. Also, central to this analysis is the assumption that the comprehensive plans would provide similar water supplies, as CalSim II model results show. The value of benefits for each of the plans is counted as equal to that plan's avoided costs, as follows:

- For the least cost comprehensive plan, the avoided costs (i.e., the "benefits") are equal to the cost of the next lowest cost plan.
- For all plans except the least cost plan, the avoided costs (the benefits) are equal to the costs of the least cost plan.

Using this method, plans with higher costs than the least cost plan show net costs rather than net benefits for the M&I purpose. Another key assumption in this analysis is that only structural component costs are relevant to comparisons involving M&I costs and benefits. The institutional add-ons included in the comprehensive plans would provide agricultural benefits only. Therefore, the costs of institutional add-ons are not used to compute M&I project benefits. Agricultural benefits are estimated differently, as described below.

Agriculture water supply benefits for the comprehensive plans are measured using the Central Valley Production Model (CVPM), which is an optimization model that maximizes farm profit based on cropping decisions and production inputs. CVPM calculates the changes in net farm income associated with the additional surface water supply that would be provided by the comprehensive plans. The model first assumes that farmers would reduce groundwater pumping with additional surface water supply deliveries. If enough water is provided, CVPM assumes that farmers may change the cropping decisions to plant more acreage or higher value crops. These changes in groundwater pumping costs or cropping decisions would translate to an increase in net farm income. This increase in income is considered the National Economic Development (NED) benefit. For the PFR analysis, CVPM calculated average annual economic benefits based on average annual water supplies provided by the CALSIM results. The present value calculation assumes the average annual agricultural benefits would occur each year over the project life.

The economic analysis in the PFR is still at a preliminary level of analysis. Appendix C identifies tasks that will be undertaken in the Feasibility Report Phase to refine the benefit estimates as more information becomes available on comprehensive plans. At the PFR level, comprehensive plans that may not have net benefits can be carried forward into the Feasibility Report Phase, because refinement of comprehensive plans and more detailed economic analysis in the Feasibility Report Phase could change the economic results. In particular, the Feasibility Report analysis of M&I water supply benefits will be based on market data, price elasticities, or other consumer willingness to pay estimates, which could lead to different conclusions than those presented in this PFR concerning the economic justification for some or all comprehensive plans.

4.2 No-Action Alternative

4.2.1 Overview

The No-Action Alternative includes the reasonably foreseeable conditions that would occur if no actions were implemented as a part of the SLLPIP. The comprehensive plans are compared to the No-Action Alternative to allow decision makers to determine the effects of implementing the comprehensive plans with the effects of not implementing the comprehensive plans. The No-Action Alternative would provide no direct remedy to the problems associated with the San Luis Reservoir low point and would allow for the continuation of the supply reliability problems described in detail in Chapter 1 and 2.

CVP and SWP operations of San Luis Reservoir under the No-Action Alternative are uncertain. Reclamation currently plans the operation of San Luis Reservoir to reach a minimum pool of 79 TAF. However, as low point issues become more frequent in the future without the SLLPIP project, Reclamation would likely experience substantial political pressure to reserve some water in San Luis Reservoir to allow continued deliveries to the San Felipe Division and prevent health and safety risks associated with an interruption. Under the No-Action Alternative, Reclamation would likely need to compromise between the San Felipe Division and the other contractors, which would result in not fully exercising San Luis Reservoir. The level of compromise is uncertain; therefore, the No-Action Alternative includes two scenarios in an effort to capture the range of potential operations that could occur. In reality, future San Luis Reservoir operations are expected to occur somewhere in between the two No-Action Alternative scenarios.

The first scenario assumes that Reclamation and DWR would continue to operate San Luis Reservoir to reach the minimum pool of 79 TAF. As previously described in the presentation of problems, an unconstrained No-Action Alternative includes low point-related interruptions in deliveries of M&I water supply from San Luis Reservoir to the San Felipe Division, generating a potential risk to public health and safety. Deliveries to agricultural users would continue during a low point issue, but these deliveries would likely cause problems within irrigation systems, such as clogging drip emitters. This scenario is termed Future No-Action-79 TAF throughout the following analysis.

The second scenario assumes that Reclamation and DWR would avoid reservoir drawdown below 300 TAF in response to political pressure generated by the health and safety risk. The water needed to maintain water levels would decrease the overall CVP water supply. The alternative scenario is termed Future No-Action –300 TAF. The two scenarios bracket the potential range of operating conditions that could occur in the future without implementing the SLLPIP project.

4.2.2 Major Components

The No-Action Alternative would not include the development of any new infrastructure.

4.2.3 Operations

The No-Action Alternative would leave the current operations at San Luis Reservoir unchanged. The San Felipe Division would continue annual operations planning to anticipate curtailment of CVP supply, and would manage its uses and sources of imported and local water supplies. CVP agricultural contractors would continue to rely on the current water supply allocation process.

Table 4-1 presents preliminary estimates of average annual San Felipe Division M&I deliveries for the Future No-Action –79 TAF scenario and the Future No-Action –300 TAF scenario. The table shows estimates of San Felipe Division M&I deliveries both in years without low point supply interruptions and in low point years for the scenarios, and presents the percentage of years in which deliveries to the San Felipe Division would be interrupted. As the table shows, the estimated average reduction in San Felipe Division deliveries generated by a low point-related curtailment is 19 TAF, which would be expected during a two-month period in the late summer, when user demands peak, thus representing a major reduction in deliveries during that period.

Table 4-1. Average Annual San Felipe Division M&I Deliveries under the No-Action Alternative

	San Felipe Division Deliveries in Years Without Low Point (TAF)	San Felipe Division Deliveries in Low Point Years (TAF)	Difference	Percentage of Years Deliveries are Curtailed
Future No-Action–79 TAF	112	93	19	35%
Future No-Action –300 TAF	No M&I curtailment with this scenario			0%

Table 4-2 presents the average annual south-of-Delta deliveries under the two scenarios. South-of-Delta deliveries include total M&I deliveries and agricultural service deliveries. The change in M&I deliveries between the two scenarios is small because the deliveries are averaged for all years in the period of record, but not all years experience a low point issue.

Table 4-2. Average Annual Deliveries to South-of-Delta Agricultural and M&I Contractors under the No-Action Alternative

	South-of-Delta M&I[1] Deliveries (TAF)	South-of-Delta Agricultural Service Deliveries (TAF)	South of Delta Total (TAF)
Future No-Action –79 TAF	137.7	1,150	1,287
Future No-Action –300 TAF	137.8	1,047	1,185

(1) This includes the San Felipe Division, the City of Tracy, and other south-of-Delta CVP M&I contractors.

The San Felipe Division contractors, both of whom serve M&I customers, rely upon a stable supply of CVP surface water as a part of their larger water supply portfolios. For SCVWD, this supply portfolio includes imported surface water supplies from the CVP and SWP, local groundwater, and local surface water supplies. SBCWD's supply portfolio includes imported CVP supplies and local ground and surface water resources. Modifications to the reliability of the CVP supply in the form of low point supply interruptions jeopardize the short and long term reliability of other supplies intended for other uses. For instance, groundwater normally reserved for drought or emergency use, may be relied upon during a low point event. A low point supply interruption—and even the threat of an interruption—can result in the immediate reduction of the amount of treated water available for delivery by the contractors, because it requires the re-operation of contractors' surface and groundwater systems and requires the use of alternative water supplies that would otherwise be dedicated to other uses. The effects resulting from delivery reductions and/or curtailments due to a low point pose a significant threat to the contractors' short and long term water supply reliability.

4.2.4 Environmental Effects

This section describes the potential environmental effects of the No-Action Alternative. Table 4-3 summarizes potential environmental effects, indicating temporary construction impacts (indicated with "T"), permanent long term effects (indicated with "P"), or resource categories for which there is no anticipated effect (indicated with "NE").

4.2.5 Projected Implementation Schedule

The No-Action Alternative would not develop any new components and because of this, an implementation schedule was not developed for the alternative.

4.3 Lower San Felipe Intake Comprehensive Plan

4.3.1 Overview

The Lower San Felipe Intake Comprehensive Plan includes construction of a new, lower San Felipe Intake to allow reservoir drawdown to its minimum operating level without algae reaching the San Felipe Intake. 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 TAF level without creating the potential for a water supply interruption to the San Felipe Division. This comprehensive plan also includes institutional measures (exchanges, transfers, and groundwater banking) to provide a safety net in all years, allowing higher allocations earlier in the year by creating access to an additional stored water supply, available as insurance in the event that San Luis Reservoir storage is insufficient to meet the allocation.

Lower San Felipe Intake

As part of this comprehensive plan, a new intake (see Figure 4-1 for a schematic) would be constructed and connected to the existing San Felipe Division Intake via approximately 20,000 feet of new pipeline or tunnel. The San Felipe Intake is currently at elevation 334 feet, and algae-laden water can reach the intake when reservoir levels reach approximately 369 feet (approximately 300 TAF in storage). Because the Gianelli Intake Facility is at elevation 296 feet (approximately 30 feet lower than the minimum operating pool), algae-laden water does not typically reach the Gianelli Intake. The new intake in this comprehensive plan would be at elevation 296 feet, the same elevation as the Gianelli Intake. The lower intake facility would allow the San Felipe Division to receive water from the lower reservoir levels that do not contain high concentrations of algae. A hypolimnetic aeration facility would also be constructed.

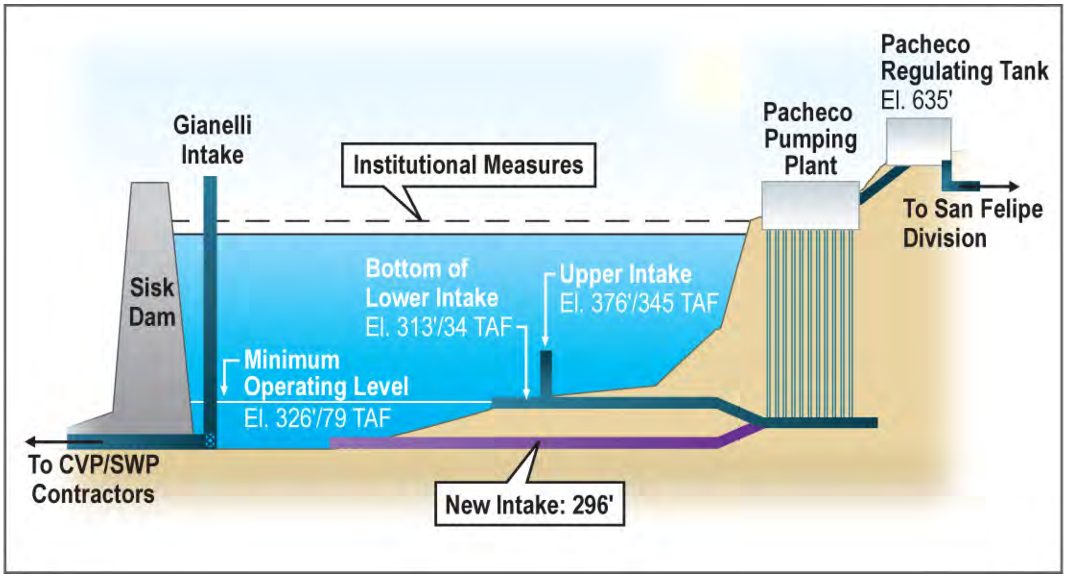

Figure 4-1. Lower San Felipe Intake Alternative

Table 4-3. Environmental Effects –No-Action Alternative

Resource Category	Scenario	Effect Type (T/P/NE)	Notes
Biological Resources	Future No-Action–79 TAF	P	Existing fish populations in San Luis Reservoir could be affected by more frequent drawdown of San Luis Reservoir below 300 TAF as demands on CVP and SWP supplies increase in the future. When the reservoir surface elevation drops during summer months, and algae blooms form, oxygen levels in the reservoirs water column begin to fall as dying algae is broken down by bacteria that consume oxygen in the water. The algae blooms' effect on reservoir oxygenation intensifies as the reservoir is drawn down and algae blooms become more concentrated. The effects of decreased oxygen levels on biological resources are not unique to either scenario but could be more severe under this Future No-Action–79 TAF (unconstrained) scenario than they are under the Future No-Action–300 TAF (constrained) scenario.
	Future No-Action–300 TAF	P	Existing fish populations in San Luis Reservoir could be affected by diminished oxygen in the reservoir created by decaying summer algae blooms. The drops in reservoir oxygen levels under this scenario could be less severe than the alternative unconstrained scenario because it would have less concentrated algae levels at higher water surface elevations. The effect of low oxygen levels on the existing fish populations under the constrained scenario could, however, still generate significant effects on the existing fish population.
Physical Resources	Future No-Action–79 TAF	P	The continued operation of San Luis Reservoir under current operations, with the potential for low point supply interruptions in 35% of the future years as presented in Table 4-1, could generate adverse groundwater and surface water effects in the San Felipe Division. San Felipe Division contractors would be forced to rely on local groundwater and surface water supplies more heavily due to: the increased threat of low point supply interruptions, greater low point supply curtailments, and/or reduced CVP deliveries if reservoir operation is restricted. This increased reliance on local supplies would limit the capacity for San Felipe Division contractors to adequately recharge and refill local groundwater and surface water storage. The resulting condition is that the reliability of both imported surface supplies and local supplies would be diminished. The reduced oxygen levels generated by summer algae blooms in San Luis Reservoir water are an adverse water quality effect. The reduced oxygen levels and decaying algae create taste and odor concerns for M&I water users. The effects of decreased oxygen levels on M&I water users are not unique to either scenario but could be more severe under the Future No-Action–79 TAF scenario than they are under the unconstrained scenario.
	Future No-Action – 300 TAF	P	The continuation of current operational practices at San Luis Reservoir, with a constrained drawdown limit to prevent low point supply interruptions, could generate adverse groundwater and surface water effects in the San Felipe Division. In response to reduced CVP deliveries generated by reservoir operations that prevent drawdown below the 300 TAF level, San Felipe Division contractors would be forced to rely on local groundwater and surface water supplies more heavily. This increased reliance on local supplies would limit the capacity for San Felipe Division contractors to adequately recharge and refill local groundwater and surface water storage. The Future No-Action–300 TAF scenario could have an impact on local groundwater supplies that would be less severe than that of the unconstrained scenario, but could still generate significant long term effects.

Table 4-3. Environmental Effects –No-Action Alternative

Resource Category	Scenario	Effect Type (T/P/NE)	Notes
			The reduced oxygen levels generated by summer algae blooms in San Luis Reservoir water are an adverse water quality effect. The reduced oxygen levels and decaying algae create taste and odor concerns for M&I water users. The drops in reservoir oxygen levels under this constrained scenario could be less severe than those of the unconstrained scenario because of less concentrated algae levels at higher water surface elevations; however, the effect of low oxygen levels on M&I water users could still be significant.
Social Resources	Both Scenarios	NE	No-Action Alternative would not be expected to generate any changes to social resources, given its lack of infrastructure development and lack of changes to any existing facilities.

Key: T = temporary construction related effects, P = permanent long term effects, NE= no effect

Institutional Measures

The Lower San Felipe Intake Comprehensive Plan includes institutional measures to allow more aggressive allocation of water supply to CVP contractors. The institutional measures include the storage of groundwater in a participating bank that will be identified in the Feasibility Study to provide a backstop for making higher allocations earlier in the year. Exchanges and transfers would be negotiated for water and might not be available in the quantity needed or at a price practical for project operations. Exchanges and transfers would rely on existing project facilities to deliver water from potential sellers to the contractors dependent on San Luis Reservoir. No new project facilities would be necessary to support these institutional measures.

4.3.2 Major Components

Lowering the San Felipe Intake would require an extension of the intake for the Pacheco Pumping Plant because the reservoir is higher on the west side than at the site of the Gianelli Intake. The Lower San Felipe Intake Comprehensive Plan would involve the construction of a submerged pipeline along the bottom of the reservoir, or a tunnel underneath the bottom of the reservoir. Figure 4-2 shows the alignment of the pipeline and tunnel. Table 4-4 summarizes the relevant infrastructure for this comprehensive plan.

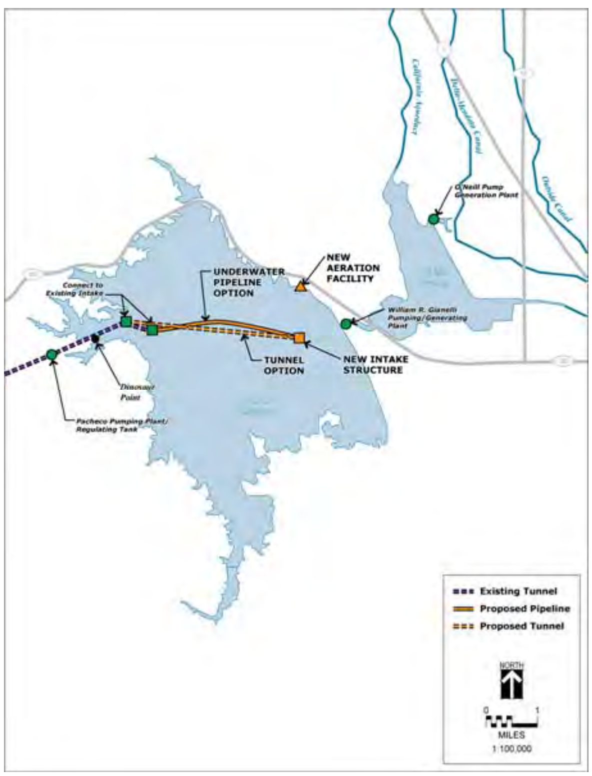

Figure 4-2. Pipeline and Tunnel Alignment for the Lower San Felipe Intake Comprehensive Plan

Table 4-4. Lower San Felipe Intake Comprehensive Plan – Key Design and Project Facilities Information

Parameter	Specification[1]
System Information	
Conveyance Capacity	490 cfs
Pacheco Pump Station Static Lift	80 to 310 feet [2,3]
San Luis Reservoir Minimum Operating Elevation	326 feet (79 TAF minimum pool elevation)
Connection to Existing Intake	
Tunnel option	
New vertical shaft	On Gate Shaft Island
Elevation	330 feet[3]
Diameter	25 to 30 feet
Pipeline Option	
Connection to Existing Intake	Between 334 ft and 376 ft intakes
Intake Extension (Pipeline or Tunnel Option)	
Diameter	13 feet
Length	20,000 feet
Head Loss	6 feet
New Intake Structure	
Elevation (top of structure)	296 feet[3]
Other Facilities	
Hypolimnetic Aeration	
Exchanges and Transfers	Assumes use of existing infrastructure
Groundwater Banking	Assumes use of existing infrastructure

[1] cfs = cubic feet per second ft = feet
[2] Unchanged from existing conditions
[3] feet above mean sea level

Construction of the pipeline option would require a barge to dredge a trench along the reservoir floor and construct the pipeline in segments for later connection by underwater divers. The new dredged trench would deepen the existing 313-foot channel that crosses the reservoir floor from the current San Felipe Intake toward Sisk Dam. Pipeline construction is estimated to generate approximately 10,000 cubic yards of material that would require disposal.

The tunnel option would involve construction of a new vertical shaft on Gate Shaft Island to tie into the existing intake and for construction of the new tunnel with a tunnel boring machine. Tunnel construction would generate an estimated 200,000 cubic yards of spoil material that would require disposal.

4.3.3 Operations

The Lower San Felipe Intake Comprehensive Plan would allow the San Felipe Division to draw water from San Luis Reservoir at the same elevation as the Gianelli Intake, which serves other CVP south-of-Delta contractors, allowing operation of San Luis Reservoir below 300 TAF (and full exercise of San Luis

Reservoir) while avoiding supply interruptions. Institutional measures paired with this comprehensive plan would allow more aggressive, allocations earlier in the spring by accessing exchanges, transfers, and banked groundwater as needed to replace water allocated to agricultural contractors.

This section compares operations for this comprehensive plan with the Future No-Action –79 TAF (unconstrained) and the Future No-Action –300 TAF (constrained) scenarios, as described in Section 4.2. Table 4-5 compares the M&I deliveries for the Lower San Felipe Intake Comprehensive Plan with deliveries that would occur under the two No-Action Alternative scenarios. The table shows deliveries in low point years for this comprehensive plan and the scenarios, and presents the percentage of years in which deliveries to the San Felipe Division would be interrupted. San Felipe Division M&I deliveries in low point years under the Lower San Felipe Intake Comprehensive Plan would be 20 TAF greater than under the Future No-Action -79 TAF, and would have no years where deliveries are curtailed, compared to 35 percent of years where deliveries are curtailed under the Future No-Action -79 TAF. No M&I curtailment would occur under the Future No-Action -300 TAF scenario.

Table 4-5. Average Annual San Felipe Division M&I Deliveries under the Lower San Felipe Intake Comprehensive Plan

	San Felipe Division M&I Deliveries in Low Point Years (TAF)	Percentage of Years M&I Deliveries are Curtailed
Lower San Felipe Intake Comprehensive Plan	113	0%
Future No-Action–79 TAF	93	35%
Difference(1)	20	-35%
Future No-Action –300 TAF	No M&I curtailment with this scenario	0%
Difference		0%

(1) The comprehensive plan provides supply in peak summer months that would have been curtailed under the Future No-Action-79 TAF scenario. The difference depends on how many months experience a low point issue in the model. Differences range from an average of 12 TAF (in years with a one-month low point issue) to 37 TAF (in years with a three-month low point issue).

Table 4-6 presents the average annual south-of-Delta deliveries under the Lower San Felipe Intake Comprehensive Plan. South-of-Delta deliveries include total M&I deliveries and agricultural service deliveries. The Lower San Felipe Intake Comprehensive Plan would increase average annual deliveries by 29–131 TAF over the No-Action Alternative.

Table 4-6. Average Annual Deliveries to South-of-Delta Agricultural and M&I Contractors under the Lower San Felipe Intake Comprehensive Plan

	South-of-Delta M&I[(1)] Deliveries (TAF)	South-of-Delta Agricultural Service Deliveries (TAF)	South of Delta Total (TAF)
Lower San Felipe Intake Comprehensive Plan	145	1172	1316
Future No-Action–79 TAF	138	1150	1287
Difference	**7**	**22**	**29**
Lower San Felipe Intake Comprehensive Plan	145	1172	1316
Future No-Action –300 TAF	138	1047	1185
Difference	**7**	**124**	**131**

[(1)] This includes the San Felipe Division, the City of Tracy, and other south-of-Delta CVP M&I contractors.

The Lower San Felipe Intake Comprehensive Plan includes institutional measures that could be used to increase spring allocations for south-of-Delta agricultural contractors by 5 percent in years when springl allocations would be 60 percent or lower. This 5 percent increase in allocations would correspond to a maximum increase of 100 TAF in south-of-Delta agricultural service deliveries in years that the institutional measures were available. The institutional measures would not be available for implementation in all years when the spring allocations would be 60 percent or lower as is indicated in Table 4-7. Implementation of institutional measures would depend on their availability and the availability of conveyance capacity in the system.

Table 4-7 presents the number of years over the 81 year study period[1] in which institutional measures are predicted to be implemented as a part of the Lower San Felipe Intake Comprehensive Plan and shows the water supply benefit that would be generated by these measures. The water supply benefit is shown as the increase in average agricultural deliveries, and in the number of years that implementation of the institutional measures would result in an increase in spring allocations.

Table 4-7 also presents the number of years when October CVP storage in San Luis Reservoir would be lower as a result of making more aggressive allocations. If San Luis Reservoir did not completely refill prior to April in the following year as a result of institutional measure implementation, there would be an increased risk of lower allocations in subsequent years. Table 4-7 also includes the number of years when the following March CVP storage in San

[1] The 81-years study period from water year 1922 through 2002 and includes wet, above normal, below normal, dry and critical water years. Appendix C contains additional information on the 81-year study period used for modeling.

Luis Reservoir would be lower as a result of making more aggressive allocations. In these years, allocations would likely be lower because San Luis Reservoir did not refill during the winter. The number of years in which October storage would be lower exceeds the number of years in which institutional measures would be implemented because of multiple-year impacts to October storage levels for years in which San Luis Reservoir does not fill completely.

Table 4-7. Early Allocations - Lower San Felipe Intake Comprehensive Plan vs. Baseline Conditions

	Number of Years when Spring Allocation is below 60%	Number of Years when Institutional Measures are Implemented	Number of Years when Spring Allocations are Increased	Average Annual Increase in Agricultural Deliveries over Study Period (TAF)	Number of Years October Storage is Lower Due to More Aggressive Allocations	Number of Years March Storage is Lower Due to More Aggressive Allocations
Lower San Felipe Intake Comprehensive Plan	29	28	19	23	38	22

4.3.4 Environmental Effects

This section describes the potential environmental effects of the Lower San Felipe Intake Comprehensive Plan. Table 4-8 summarizes potential environmental effects, indicating temporary construction impacts (indicated with “T”), permanent long term effects (indicated with “P”), or resource categories for which there is no anticipated effect (indicated with “NE”).

4.3.5 Projected Implementation Schedule

Preliminary estimates of a project implementation schedule for developing the Lower San Felipe Intake Comprehensive Plan tunnel and pipeline options are outlined in Table 4-9.

Table 4-8. Environmental Effects – Lower San Felipe Intake Comprehensive Plan

Resource Category	Resource	Effect Type (T/P/NE)	Notes
Biological Resources	Vegetation and Wildlife	T	Use of construction staging areas might result in some vegetation loss but would likely occur in already disturbed areas. Dredging or tunneling could result in impacts to wildlife and vegetation.
	Fisheries	T	There is no natural fishery at San Luis Reservoir; however, fish species that have been introduced or transported to the reservoir could be affected during dredging activities.
Physical Resources	Hydrology, Water Quality, Groundwater	T	Water quality impacts from operation of barges, in-reservoir dredging for the new trench, or tunneling for the new vertical shaft could result in mobilization of sediment and pollutants into the water column of the reservoir.
	Geology, Soils, Seismicity	T	Construction staging and use of equipment could result in soil erosion. The new intake and pipeline alignment would be near the Ortigalita fault and in an area with the potential for strong seismic activity (ground shaking). These facilities could be damaged during seismic activity.
	Air Quality	T	Operation of barges or a tunnel boring machine and the transportation and disposal of up to 200,000 cubic yards of excess material offsite could result in air quality impacts from vehicle and equipment emissions.
	Land Use	NE	The majority of construction would occur in and directly adjacent to San Luis Reservoir and is not expected to affect any existing land uses.
	Agricultural Resources	NE	No construction actions would occur on agricultural lands, so no agricultural impacts are anticipated.
		T	Temporary noise impacts would occur from construction equipment and vehicles, barges, or a tunnel boring machine.
	Traffic	T	Two existing intersections might require improvement to accommodate construction traffic. Construction equipment and vehicles would be used mainly on-site and would not be expected to greatly affect traffic outside Federal property.
Noise	Population and Housing	NE	This comprehensive plan would not result in the displacement of any people or houses.
	Hydropower	T	This comprehensive plan would not change reservoir operations and would not be expected to adversely affect existing hydropower production over the long-term. Short-term reservoir draw down to support construction could affect hydropower production.
	Visual and Aesthetic Resources	T	Temporary visual impacts include the use of barges on the reservoir and tunneling equipment for the vertical shaft. The new pipeline and intake would not be visible because they would be submerged.
	Public Services and Utilities	T/P	Some construction equipment could require electricity to operate. The new intake and pipeline would use an existing pump station but could increase the use of electricity.

Table 4-8. Environmental Effects – Lower San Felipe Intake Comprehensive Plan

Resource Category	Resource	Effect Type (T/P/NE)	Notes
Physical Resources	Hazards and Hazardous Materials	T	Construction would require the temporary use and storage of hazardous materials. Dredging and other in-reservoir activities could introduce hazardous materials into the reservoir. Unknown hazards might be encountered during dredging or tunneling activities that could pose a health risk to workers and the public.
	Recreation	T/P	Water and land recreation might be temporarily restricted at San Luis Reservoir during the operation of barges and other construction equipment. Under this comprehensive plan, San Luis Reservoir would be drawn down more often, which could affect the use of boat launches.
Social Resources	Cultural Resources	P	Unknown cultural resources could be damaged during dredging or tunneling.
	Environmental Justice	NE	All work would occur on Federal property and no environmental justice impacts would be expected.
	Indian Trust Assets	NE	All work would occur on Federal property, so no impacts Indian Trust Assets would be expected.

Key: T = temporary construction related effects, P = permanent long term effects, NE= no effect

Table 4-9. Lower San Felipe Intake Comprehensive Plan Implementation Schedule

Lower San Felipe Intake Comprehensive Plan	Implementation Time Frame		Expenditures During Construction		
	Design/ Permitting	Construction	Year 1 (0-12 Mon)	Year 2 (13-24 Mon)	Year 3 (25-36 Mon)
Tunnel Option	3.5 years (42 months)	2.3 years (28 Months)	50%	40%	10%
Pipeline Option	3.5 yrs	28 Months	45%	45%	10%

4.3.6 Economic Analysis

Tunnel Option

For this PFR analysis, the M&I benefits are estimated by the avoided costs of the most likely alternative plan and agricultural benefits are estimated with the CVPM. Section 4.1.3 and Appendix C further describe the methods and tools used to estimate economic benefits. The San Felipe Intake comprehensive plan would provide economic benefits to the San Felipe Division by increasing water supplies and preventing potential economic losses of a water shortage. The M&I water supply benefits of the San Felipe Intake Tunnel Option plan would be the avoided costs of the least cost plan, which is the San Felipe Intake Pipeline Option, or $314.1 million in present value.[2] The plan would provide agricultural water supply benefits by increasing net farm income through decreased groundwater pumping costs or changes in cropping patterns. Present value of agricultural water supply benefits would be $64.4 million relative to the Future No-Action -79 TAF and $287.2 million relative to the Future No-Action -300 TAF.

The San Felipe Intake Tunnel Option has capital costs of $399.7 million and annual O&M costs of $1.1 million. The annual costs for implementing institutional measures are $2.5 million. The total present value costs for the Tunnel Option, including institutional measures, are $392.8 million, based on the construction schedule identified in Table 4-9, a 4.875 percent discount rate, and a 100-year period of analysis.[3]

Pipeline Option

The San Felipe Intake Pipeline Option is the least costly plan of the proposed comprehensive plans. The M&I water supply benefits of the Pipeline Option would be the avoided costs of the next costly comprehensive plan, which is the San Felipe Intake Tunnel Option, or $339.0 million. Agricultural water supply benefits of the Pipeline Option would be the same as the Tunnel Option, $64.4 million to $287.2 million in present value.

The San Felipe Intake Pipeline Option, including institutional measures, has capital costs of $374.9 million and annual O&M costs of $0.88 million. The annual costs for implementing institutional measures are $2.5 million. The total present value costs for the Pipeline Option are $367.9 million.

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[2] The avoided costs represent the present value costs, capital and annual O&M costs, of the structural elements of the comprehensive plans. Institutional measures are not included in the avoided costs estimate.

[3] The capital costs reflect today's costs for constructing the San Felipe Intake; however, capital costs would not all occur in a single year. The present value is the value of future costs discounted to reflect the time value of money. The present value costs are less than the capital costs because costs are incurred in the future, not in the current year. The same is true for all comprehensive plans in this chapter.

Net Benefits Summary

Table 4-10 summarizes the present value benefits, costs, and net benefits (or costs) for the San Felipe Intake Tunnel and Pipeline Options comprehensive plan.

Table 4-10. Lower San Felipe Intake Comprehensive Plan Net Benefits Summary: Present Value Benefits, Costs, and Net Benefits (Costs) (Million $)

	Tunnel Option		Pipeline Option	
	FNA–79 TAF	FNA–300 TAF	FNA–79 TAF	FNA–300 TAF
M&I Supply Benefits	314.1	314.1	339.0	339.0
Agricultural Supply Benefits	64.4	287.2	64.4	287.2
Total Benefits	378.5	601.3	403.4	626.2
Total Costs	392.8	392.8	367.9	367.9
Net Benefits (Costs)	(14.3)	208.5	35.5	258.3
Benefit Cost Ratio (B/C)	0.96	1.53	1.10	1.70

4.4 Pacheco Reservoir Comprehensive Plan

4.4.1 Overview

This comprehensive plan includes expansion of the existing Pacheco Reservoir to provide storage for San Felipe Division contractors. This reservoir would function as an expansion of the CVP share of San Luis Reservoir, increasing supplies to all CVP users. During low point months, San Felipe Division contractors would receive deliveries from Pacheco Reservoir. This comprehensive plan would allow drawdown of San Luis Reservoir to its minimum operating level without interrupting deliveries to the San Felipe Division.

The Pacheco Reservoir Comprehensive Plan also includes implementation of institutional measures (exchanges, transfers, and groundwater banking) to provide a safety net in all years, allowing higher allocations earlier in the year by creating access to a supplemental water supply, available as insurance in the event that San Luis Reservoir storage is insufficient to meet the allocation.

Expand Pacheco Reservoir

As part of this comprehensive plan, a new dam and reservoir would be constructed on Pacheco Creek. A new pump station and pipeline would connect the new reservoir to the Pacheco Conduit, downstream of the Pacheco Pumping Plant. The new dam and reservoir would inundate the existing 6,000 acre-foot Pacheco Reservoir, which is owned and operated by the Pacheco Pass Water

District. The new reservoir would include a reservation for storage for Pacheco Pass Water District and for flood control. Two alternative sizes are being considered in this phase of the Study:

- **80 TAF Pacheco Reservoir Comprehensive Plan:** The new reservoir would include 55 TAF of storage for San Felipe Division contractors and a 25 TAF reservation for Pacheco Pass Water District, flood control, instream releases and dead storage.

- **130 TAF Pacheco Reservoir Comprehensive Plan:** The new reservoir would include 100 TAF of storage for San Felipe Division contractors and a 30 TAF reservation for Pacheco Pass Water District, flood control, instream releases, and dead storage.

Institutional Measures

The Pacheco Reservoir Comprehensive Plan includes institutional measures to allow more aggressive allocation of water supply to CVP contractors. The institutional measures include the storage of groundwater in a participating bank that will be identified in the Feasibility Study to provide a backstop for making higher allocations earlier in the year. Exchanges and transfers would be negotiated for water and might not be available in the quantity needed or at a price practical for project operations. Exchanges and transfers would rely on existing project facilities to deliver water from potential sellers to the contractors dependent on San Luis Reservoir. No new project facilities would be necessary to support these institutional measures.

4.4.2 Major Components

The Expand Pacheco Reservoir Comprehensive Plan includes a dam and reservoir located on Pacheco Creek, and a new pipeline and pump station that would connect the reservoir to the Pacheco Conduit. Figures 4-3 and 4-4 show the locations of key facilities for the two potential reservoir sizes. Table 4-11 summarizes key design parameters and relevant infrastructure for the two alternative sizes.

The location of the dam would be on lower Pacheco Creek. As discussed in Section 3.3, two sites identified in previous studies were re-evaluated in this study. The lower site, previously termed Pacheco A Reservoir, was found to have potentially extensive landslides and weak foundation materials in the area of the proposed dam. The upper site, previously termed Pacheco B Reservoir, could inundate a small portion of Henry Coe State Park. In 2003, the SCVWD board decided that a Pacheco Reservoir expansion project must avoid State Park lands.

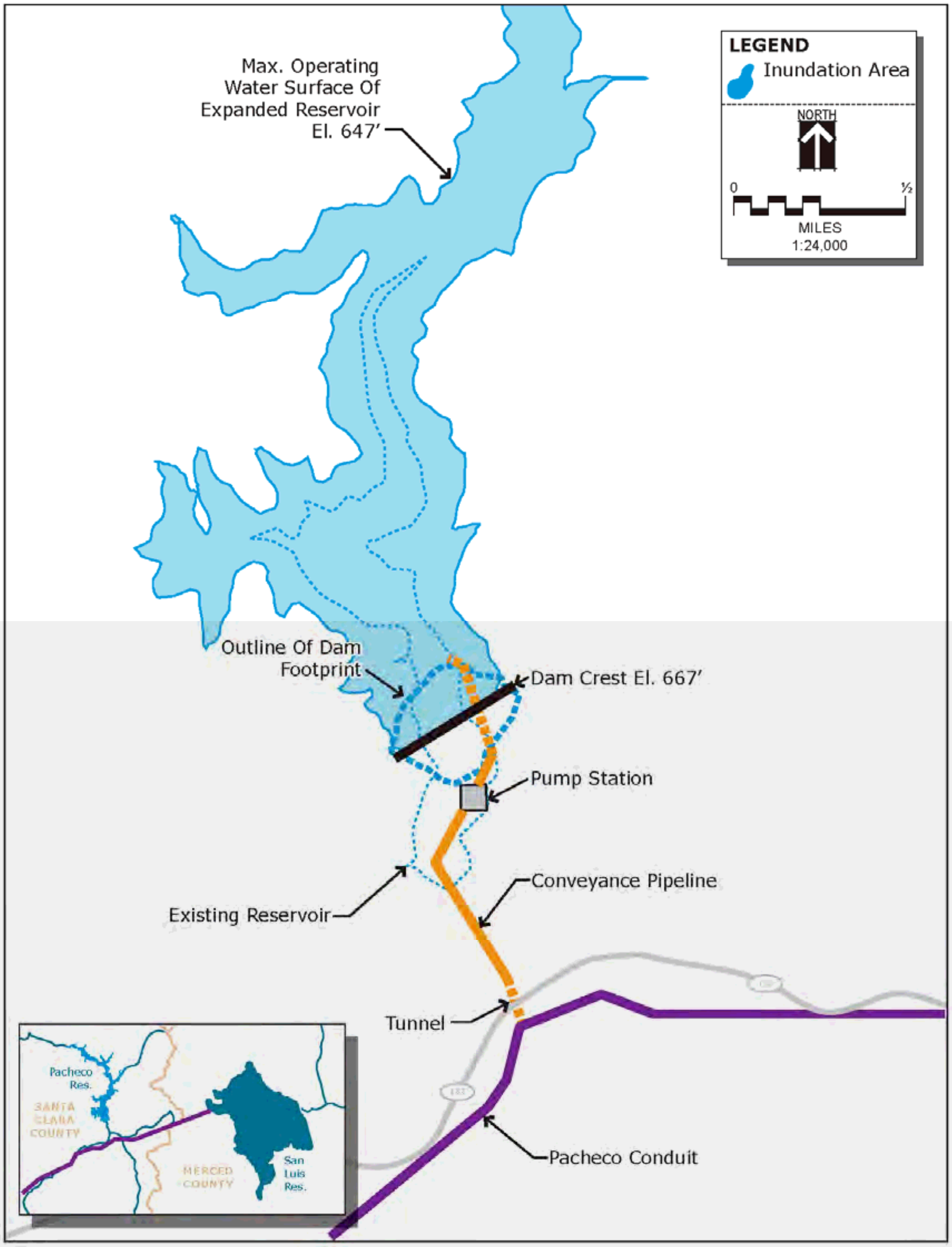

Figure 4-3. 80 TAF Pacheco Reservoir

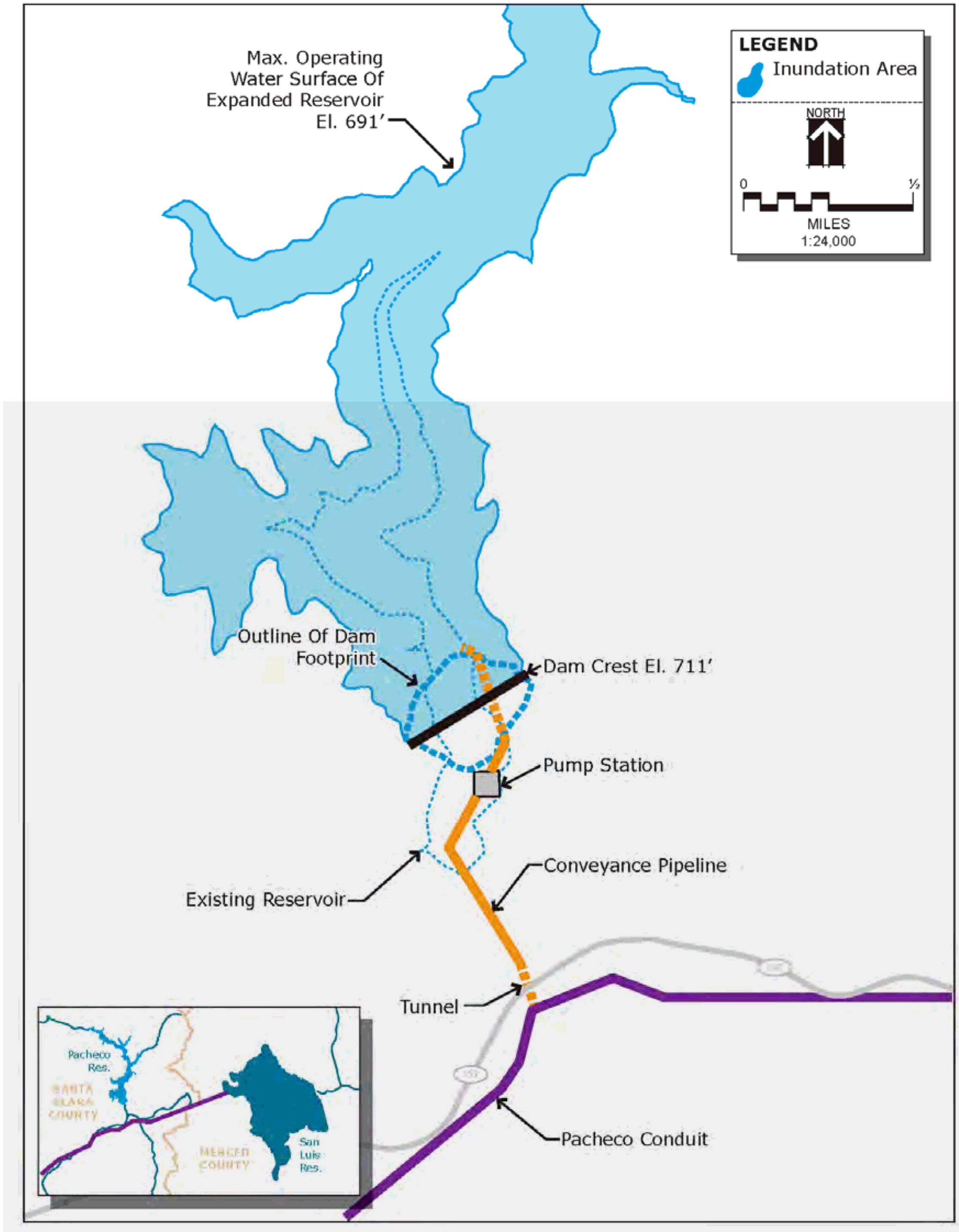

Figure 4-4. 130 TAF Pacheco Reservoir

Table 4-11. Expand Pacheco Reservoir Comprehensive Plan– Key Design Parameters and Project Facilities

Parameter	Specification[1]	
System Information		
Conveyance Capacity	490 cfs	
San Luis Reservoir Minimum Operating Elevation	326 feet (79 TAF minimum pool elevation)	
New Dam and Reservoir		
	80,000 AF Pacheco Reservoir	130,000 AF Pacheco Reservoir
Storage Volume:	80 TAF	130 TAF
Inundation Area:	965 acres	1,315 acres
Potential Number of Affected Parcels:	14	16
Dam Crest Height and Elevation:	667 feet	711 feet
Dam Crest Length:	2,800 feet	2,915 feet
Dam Embankment Volume:	22.0 MCY	29.0 MCY
Potential Landslide Remediation Volume:	14.1 MCY	13.0 MCY
New Pump Station		
Pump Station Capacity	490 cfs	
Pump Station Dynamic Lift	135 ft	180 ft
Pump Station Total Horsepower	11,000 HP	13,750 HP
Pipeline		
Diameter	9–11 foot diameter	
Length	3,850 feet of 9-foot-diameter pipeline and 500 feet of 11-foot-diameter pipeline	
Pacheco Pumping Plant		
New Regulating Tank		
Capacity	3 million gallons	
Diameter	150 feet	
Other Facilities		
Hypolimnetic Aeration		
Exchanges and Transfers	Assumes use of existing infrastructure	
Groundwater Banking	Assumes use of existing infrastructure	

[1] cfs = cubic feet per second MCY = million cubic yards ft = feet HP = horse power

In the next phase of this study, a suitable dam site location between the Pacheco A and Pacheco B sites will be identified, based on further geotechnical investigations. For purposes of analysis and costing in this PFR, the Pacheco A site was used, with costs estimated for development both with and without landslide remediation.

This PFR assumes that all properties within the watershed extending to the dam crest elevation would need to be acquired. The 80 TAF Pacheco Reservoir would affect an estimated 14 parcels; and the 130 TAF Pacheco Reservoir would affect an estimated 16 parcels.

The new dam at Pacheco Reservoir would have an estimated embankment volume of 22 million cubic yards for the 80 TAF reservoir and 29 million cubic yards for the 130 TAF reservoir. The dam would be an earthfill dam with an impervious core. The construction would use material from the dam excavation and on-site borrow areas, except for the dam filter, drain and rip-rap, which would need to be imported materials. Construction of the embankment would include excavating, loading, hauling, placing, and compacting the core and embankment materials. A cofferdam would be constructed for temporary diversion of stream flows.

Construction of the new pipelines to connect the dam to the Pacheco Conduit would be conventional trench and backfill, except under Highway 152, where jack and bore construction would be required.

4.4.3 Operations

The Pacheco Reservoir Comprehensive Plan would allow the San Felipe Division to draw water from the San Luis Reservoir via Pacheco Pumping Plant and Conduit during October through December, for subsequent storage in the new reservoir and use during low point months, typically August and September. Delivering San Felipe Division supplies early to the new reservoir would allow San Luis Reservoir to be drawn down to its minimum pool. The new reservoir would permit full exercise of San Luis Reservoir while avoiding supply interruptions. The new reservoir would function in a way that would increase CVP storage south-of-Delta, which has the potential to increase CVP supplies beyond only addressing the low point issue. Institutional measures paired with this comprehensive plan would allow more aggressive, earlier allocations in the spring by accessing exchanges, transfers, and banked groundwater as needed to replace water allocated to agricultural contractors.

This section compares operations for this comprehensive plan with the Future No-Action–79 TAF (unconstrained) and the Future No-Action –300 TAF (constrained) scenarios, as described in Section 4.2. Table 4-12 compares the M&I deliveries for this comprehensive plan to deliveries for the scenarios. The table shows deliveries in low point years for this comprehensive plan and the scenarios, and presents the percentage of years in which deliveries to the San Felipe Division would be interrupted.

Table 4-13 presents the average annual south-of-Delta deliveries under the Pacheco Reservoir Comprehensive Plan. South-of-Delta deliveries include total M&I deliveries and agricultural service deliveries. The Pacheco Reservoir Comprehensive Plan would increase average annual deliveries by 60–190 TAF over the No-Action Alternative scenarios.

Table 4-12. Average Annual San Felipe Division M&I Deliveries under the Pacheco Reservoir Comprehensive Plan

	San Felipe Division M&I Deliveries in Low Point Years (TAF)	Percentage of Years M&I Deliveries are Curtailed
80 TAF Pacheco Reservoir Comprehensive Plan	114	0%
Future No-Action–79 TAF	93	35%
Difference[1]	21	-35%
Future No-Action –300 TAF	No M&I curtailment with this scenario	0%
Difference		0%
130 TAF Pacheco Reservoir Comprehensive Plan	114	0%
Future No-Action –79 TAF	93	35%
Difference[1]	21	-35%
Future No-Action –300 TAF	No M&I curtailment with this scenario	0%
Difference		0%

[1] The comprehensive plan provides supply in peak summer months that would have been curtailed under the Future No-Action-79 TAF scenario. The difference depends on how many months experience a low point issue in the model. Differences range from an average of 12 TAF (in years with a one-month low point issue) to 37 TAF (in years with a three-month low point issue).

Table 4-13. Average Annual Deliveries to South-of-Delta Agricultural and M&I Contractors (TAF) under the Pacheco Reservoir Comprehensive Plan

	South-of-Delta M&I[1] Deliveries (TAF)	South-of-Delta Agricultural Service Deliveries (TAF)	South of Delta Total (TAF)
80 TAF Pacheco Reservoir Comprehensive Plan	146	1201	1347
Future No-Action–79 TAF	138	1150	1287
Difference	**8**	**51**	**60**
80 TAF Pacheco Reservoir Comprehensive Plan	146	1201	1347
Future No-Action –300 TAF	138	1047	1185
Difference	**8**	**154**	**162**
130 TAF Pacheco Reservoir Comprehensive Plan	147	1228	1375
Future No-Action –79 TAF	138	1150	1287
Difference	**9**	**78**	**88**
130 TAF Pacheco Reservoir Comprehensive Plan	147	1228	1375
Future No-Action –300 TAF	138	1047	1185
Difference	**9**	**181**	**190**

[1] This includes the San Felipe Division, the City of Tracy, and other south-of-Delta CVP M&I contractors.

The Pacheco Reservoir Comprehensive Plan includes institutional measures that could be used to increase spring allocations for south-of-Delta agricultural contractors by 5 percent in years when spring allocations would be 60 percent or lower. This 5 percent increase in allocations would correspond to a maximum increase of 100 TAF in south-of-Delta agricultural service deliveries in years when institutional measures are available for implementation. Implementation of the institutional measures would not result in an increase in allocations in every year that the spring allocations would be 60 percent or lower. Implementation of institutional measures would depend on the availability of the institutional measures and the availability of conveyance capacity in the system.

Table 4-14 presents the number of years over the 81 year study period in which institutional measures are predicted to be implemented as a part of the Pacheco Reservoir Comprehensive Plan and shows the water supply benefit that would be generated by the institutional measures. The water supply benefit is shown as the increase in average agricultural deliveries, and in the number of years that implementation of the institutional measures would result in an increase in spring allocations.

Table 4-14 also presents the number of years in which October CVP storage in San Luis Reservoir would be lower as a result of making more aggressive allocations. If San Luis Reservoir did not completely refill prior to April in the following year as a result of institutional measure implementation, there would be an increased risk of lower allocations in subsequent years. When available, the institutional measures would be implemented in the subsequent years to refill the Federal share of San Luis Reservoir drawn down by the increased allocations. This action could cause institutional measures to be implemented in years when the allocations were greater than 60 percent (as shown in Table 4-14). These measures are not contributing to higher allocations in the same year, but refilling storage that may be lower because of increased allocations in prior years.

Table 4-14 also includes the number of years when the following March CVP storage in San Luis Reservoir would be lower as a result of making more aggressive allocations. In years where March CVP storage in San Luis Reservoir is lower after implementing institutional measures the prior year, allocations would likely be lower because San Luis Reservoir did not refill during the winter. The number of years in which October storage would be lower exceeds the number of years in which institutional measures would be implemented because of multiple-year impacts to October storage levels for years in which San Luis Reservoir does not fill completely.

Table 4-14. Early Allocations Pacheco Reservoir Comprehensive Plan vs. Baseline Conditions

	Number of Years when Spring Allocation is below 60%	Number of Years when Institutional Measures are Implemented	Number of Years when Spring Allocations are Increased	Average Annual Increase in Agricultural Deliveries over Study Period (TAF)	Number of Years October Storage is Lower Due to More Aggressive Allocations	Number of Years March Storage is Lower Due to More Aggressive Allocations
80 TAF Pacheco Reservoir Comprehensive Plan	28	29	18	22	35	22
130 TAF Pacheco Reservoir Comprehensive Plan	28	28	16	20	37	26

4.4.4 Environmental Effects

This section describes the potential environmental effects of the Pacheco Reservoir Comprehensive Plan. Table 4-15 summarizes potential environmental effects, indicating temporary construction impacts (indicated with “T”), permanent long term effects (indicated with “P”), or resource categories for which there is no anticipated effect (indicated with “NE”).

4.4.5 Projected Implementation Schedule

Preliminary estimates of a project implementation schedule for developing the Pacheco Reservoir Comprehensive Plan are outlined in Table 4-16.

4.4.6 Economic Analysis

80 TAF Pacheco Reservoir Comprehensive Plan

For this PFR analysis, the M&I benefits are estimated by the avoided costs of the most likely alternative plan and agricultural benefits are estimated with the CVPM. Section 4.1.3 and Appendix C further describe the methods and tools used to estimate economic benefits. The M&I water supply benefits of the 80 TAF Pacheco Reservoir would be the avoided costs of the least cost plan, which is the San Felipe Intake Pipeline Option, or $314.1 million in present value.[4] Present value of agricultural water supply benefits would be $120.3 million relative to the Future No-Action -79 TAF and $348.7 million relative to the Future No-Action -300 TAF.

[4] The avoided costs represent the present value costs, capital and annual O&M costs, of the structural elements of the comprehensive plans. Institutional measures are not included in the avoided costs estimate.

Table 4-15. Environmental Effects – Pacheco Reservoir Comprehensive Plan

Resource Category	Resource	Effect Type (T/P/NE)	Notes
Biological Resources	Vegetation and Wildlife	T/P	Clearing and grading for construction sites and borrow areas could result in impacts to vegetation and wildlife, including special-status species. Expansion of the reservoir would result in the permanent loss of habitat.
	Fisheries	T/P	General construction activities could have water quality impacts that could adversely affect steelhead and steelhead habitat in Pacheco Creek. Drawdown of Pacheco Reservoir during construction and any potential changes in releases from Pacheco Reservoir could affect steelhead migration.
Physical Resources	Hydrology, Water Quality, Groundwater	T/P	Drawdown of the existing Pacheco reservoir, construction and use of a cofferdam, diversion of existing stream flows around the site to construct the new embankments, and operation of construction vehicles and equipment could result in adverse water quality impacts within the reservoir. This comprehensive plan would permanently alter existing hydrology by expanding the existing reservoir and changing the location of releases to Pacheco Creek. Any changes in releases from Pacheco Reservoir during construction would have the potential to affect groundwater recharge.
	Geology, Soils, Seismicity	T	Use of construction staging, stockpiling, and borrow areas would increase the potential for soil erosion. The area around the existing Pacheco Reservoir is prone to landslides, which may affect construction.
	Air Quality	T/P	Operation of a new pump station would introduce a permanent source of air pollutant emissions. Excavation and transportation of materials for new embankments and for pipeline construction would cause temporary air quality impacts. Materials delivered from off-site sources would also cause temporary air quality impacts.
	Land Use	P	This comprehensive plan would require the acquisition of several private properties.
	Agricultural Resources	P	Expansion of the reservoir could result in the conversion of agricultural lands to non-agricultural uses.
	Noise	T/P	Temporary noise impacts would occur during excavation of materials, blasting, and operation of construction vehicles and equipment around Pacheco Reservoir. The pump station would create a new and permanent noise source.
	Traffic	T	Upgrades to existing roads and construction of new roads would be required to obtain borrow materials and to construct the new embankments, pipeline, and pump station. The delivery of materials (e.g., filters, rip rap) from off-site sources would increase traffic on existing roadways.
	Population and Housing	P	Several private properties with structures would need to be acquired to allow for the expansion of Pacheco Reservoir.
	Hydropower	NE	No hydropower facilities exist at Pacheco Reservoir; so no hydropower impacts are anticipated.
	Visual and Aesthetic Resources	T/P	Permanent visual impacts would result from the construction of a new pump station, the excavation of borrow areas, the construction of new embankments, and inundation of a larger area for the reservoir. Temporary visual impacts would include construction equipment, vehicles, and stockpiling of materials around Pacheco Reservoir.

Table 4-15. Environmental Effects – Pacheco Reservoir Comprehensive Plan

Resource Category	Resource	Effect Type (T/P/NE)	Notes
	Public Services and Utilities	T/P	Temporary waste would be created during construction to expand Pacheco Reservoir. The new pump station required for this comprehensive plan could need a new substation and upgrades to existing power lines, transmission lines, and transmission towers.
	Hazards and Hazardous Materials	T	Construction would require the use and storage of hazardous materials. The new pump station could require the permanent storage of fuel and other hazardous materials for operation and maintenance. Unknown hazards might be encountered during borrow activities that could pose a health risk to workers. Blasting might be required to obtain borrow materials for embankments.
Physical Resources	Recreation	P	There are no formal recreation facilities at Pacheco Reservoir, so there would be no recreation impacts. Under this comprehensive plan, San Luis Reservoir would be drawn down more often, which could affect the use of boat launches.
Social Resources	Cultural Resources	P	Unknown cultural resources might be damaged during excavation of borrow areas, expansion of the reservoir area of inundation, and construction of the pipeline and pump station.
	Environmental Justice	NE	Preliminary analyses show no low income or minority populations within the area. No environmental justice impacts are expected.
	Indian Trust Assets	NE	No Indian Trust Assets have been identified in the affected area around Pacheco Reservoir in Santa Clara County (BIA 2000).

Key: T = temporary construction related effects, P = permanent long term effects, NE= no effect

Table 4-16. Pacheco Reservoir Comprehensive Plan Implementation Schedule

	Implementation Time Frame		Expenditures During Construction				
	Design/ Permitting	Construction	Year 1 (0-12 Mon)	Year 2 (13-24 Mon)	Year 3 (25-36 Mon)	Year 4 (37-48 Mon)	Year 5 (49-60 Mon)
Pacheco Reservoir Comprehensive Plan	4 years	5 years	20%	25%	25%	20%	10%

The 80 TAF Pacheco Reservoir has capital costs of $723.8 million without landslide remediation, and annual O&M costs would be $3.4 million The annual costs for implementing institutional measures would be $2.4 million. The total present value costs for the 80 TAF Pacheco Reservoir without landslide remediation, including institutional measures, would be $650.4 million, based on the construction schedule identified in Table 4-16, a 4.875 percent discount rate, and a 100-year period of analysis. If landslide remediation is necessary to construct the reservoir, capital costs would be $956.3 million and O&M costs would be $3.6 million. The total present value costs of the 80 TAF Pacheco Reservoir with landslide remediation would be $830.7 million.[5]

130 TAF Pacheco Reservoir Comprehensive Plan

The M&I water supply benefits of the 130 TAF Pacheco Reservoir would be the avoided costs of the least cost plan, which is the San Felipe Intake Pipeline Option, or $314.1 million in present value. Present value of agricultural water supply benefits would be $166.7 million relative to the Future No-Action -79 TAF and $402.2 million relative to the Future No-Action -300 TAF.

The 130 TAF Pacheco Reservoir has capital costs of $880.7 million without landslide remediation and annual O&M costs would be $3.6 million. The annual costs for implementing institutional measures would be $2.3 million. The total present value costs for the 130 TAF Pacheco Reservoir without landslide, including institutional measures, would be $770.9 million. If landslide remediation is necessary to construct the reservoir, capital costs would increase to $1,094.1 million and O&M costs would be $3.8 million. The total present value costs of the 130 TAF Pacheco Reservoir with landslide remediation, including institutional measures, would be $935.7 million.

Net Benefits Summary

Table 4-17 summarizes the present value benefits, costs, and net benefits (or costs) for the Pacheco Reservoir Comprehensive Plan 80 TAF and 130 TAF reservoirs, with and without landslide remediation.

[5] The capital costs reflect today's costs for constructing the San Felipe Intake; however, capital costs would not all occur in a single year. The present value is the value of future costs discounted to reflect the time value of money. The present value costs are less than the capital costs because costs are incurred in the future, not in the current year. The same is true for all comprehensive plans in this chapter.

Table 4-17 Pacheco Reservoir Comprehensive Plan Net Benefits Summary: Present Value Benefits, Costs, and Net Benefits (Costs) (Million $)

	Without Landslide Remediation		With Landslide Remediation	
	FNA–79 TAF	FNA–300 TAF	FNA–79 TAF	FNA–300 TAF
80 TAF Pacheco Reservoir				
M&I Supply Benefits	314.1	314.1	314.1	314.1
Agricultural Supply Benefits	120.3	348.7	120.3	348.7
Total Benefits	434.4	662.8	434.4	662.8
Total Costs	650.4	650.4	830.7	830.7
Net Benefits (Costs)	(216.0)	12.4	(396.3)	(167.9)
Benefit Cost Ratio (B/C)	0.67	1.02	0.52	0.80
130 TAF Pacheco Reservoir				
M&I Supply Benefits	314.1	314.1	314.1	314.1
Agricultural Supply Benefits	166.7	402.2	166.7	402.2
Total Benefits	480.8	716.3	480.8	716.3
Total Costs	770.8	770.8	935.7	935.7
Net Benefits (Costs)	(290.0)	(54.5)	(454.9)	(219.4)
Benefit Cost Ratio (B/C)	0.62	0.93	0.51	0.77

4.5 Combination Comprehensive Plan

4.5.1 Overview

The Combination Comprehensive Plan includes multiple structural components and management measures to maximize operational flexibility and supply reliability in the San Felipe Division to address water supply curtailments or reductions generated by the low point issue. The Combination Comprehensive Plan would include increased groundwater aquifer recharge and recovery capacity, desalination, institutional measures, and the re-operation of the SCVWD raw and treated water systems. Elements not currently included in the Combination Comprehensive Plan that could be added or replace existing components, if found to be feasible and with equivalent or better cost structures, include drinking water treatment improvements, shallow groundwater pumping, and indirect potable reuse.

4.5.2 Major Components

The Combination Comprehensive Plan includes the development of new well fields, groundwater recharge facilities, participation in the development of a regional desalination facility, institutional measures, and local re-operation in the San Felipe Division. Figure 4-5 indicates the general locations of key facilities for the Combination Comprehensive Plan. Table 4-18 summarizes key design parameters and relevant infrastructure for the comprehensive plan.

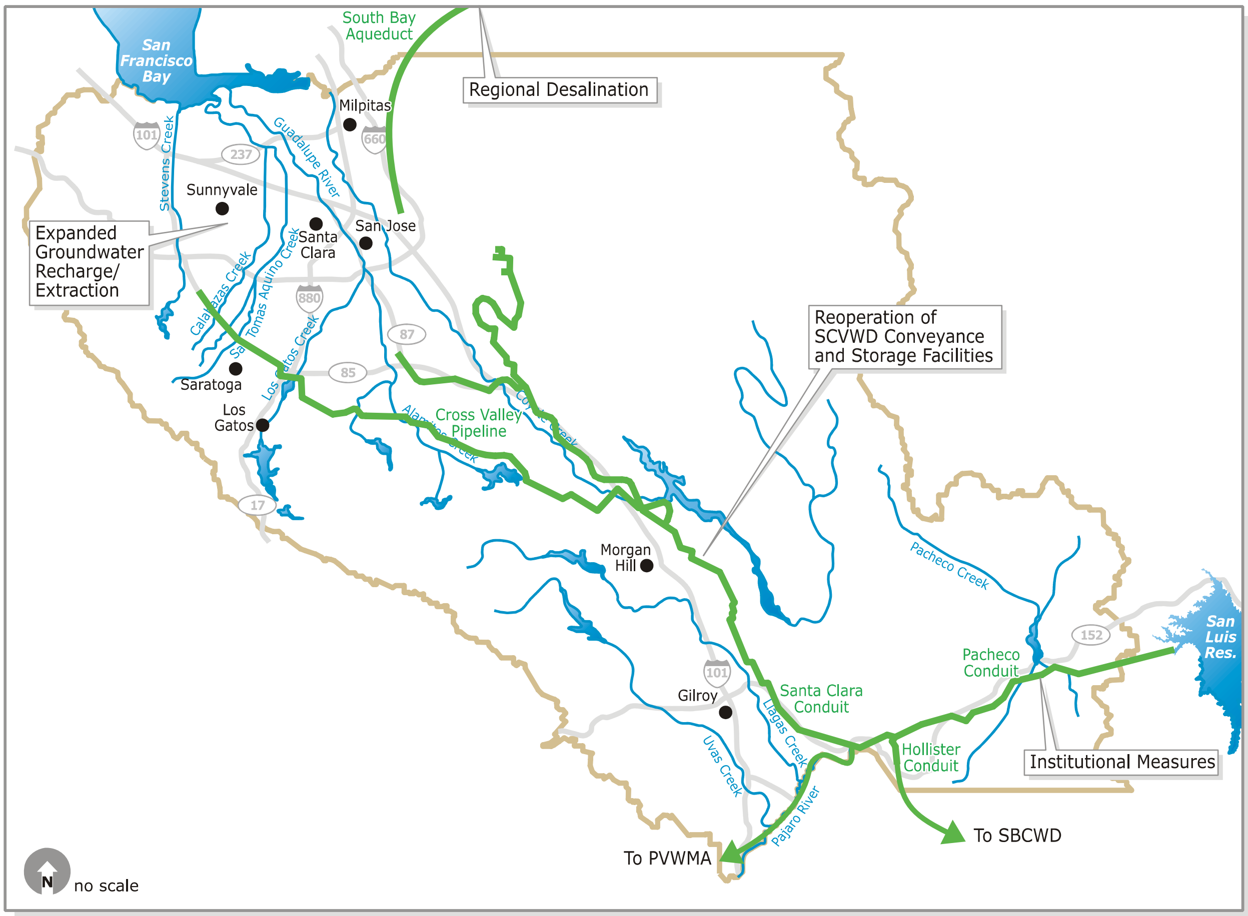

Figure 4-5. Combination Alternative

Table 4-18. Combination Comprehensive Plan – Key Design Parameters and Project Facilities

Parameter	Specification
System Information	
Conveyance Capacity	
San Luis Reservoir Minimum Operating Elevation	326 feet (79 TAF minimum pool elevation)
Well Fields	
West Side and East Side Well Fields	70 new wells with extraction and recharge capacity at each well field
	1,500 gpm pumping capacity per well
Recharge Facilities	
Active Recharge Ponds	44 to 88 acres of active recharge facilities (75% of area used for recharge, 25% of area required for support facilities)
Regional Desalination	
Bay Area Regional Desalination Project	71 mgd desalination facility – SCVWD participation at 10 mgd
Pump Station to deliver supplies to EBMUD Mokelumne Aqueducts	Pump station with 500 foot lift
	3-mile-long, 4 foot-diameter-pipeline
Local Reoperation	
Changes to operation of surface water reservoirs and groundwater supplies	Assumes use of existing infrastructure
Other Facilities	
Exchanges and Transfers	Assumes use of existing infrastructure
Groundwater Banking	Assumes use of existing infrastructure

Well Fields

This component of the Combination Comprehensive Plan consists of new groundwater wells and connections on the east and west side of the SCVWD's treated water system. These wells would be used to fill the gaps in treated water supplies that result during the low point event. SCVWD's groundwater basin can be used in the short term with a reasonable level of reliability (provided that supplies and recharge capacity are available to make up for the increased level of groundwater pumping), until supplies from San Luis Reservoir are restored.

The west side of the SCVWD's service area is served by the Rinconada Water Treatment Plant and the east side is served by Penitencia Water Treatment Plant and Santa Teresa Water Treatment Plant. The East Side Well Fields and West Side Well Fields projects will provide the SCVWD and its retailers with a self-sufficient, local supply for low point events and emergencies and the potential to recharge the groundwater basin through groundwater injection. Under these projects, 70 new wells, each with a capacity of 1,500 gallons per minute, would be constructed to supply the treated water transmission lines.

Recharge Facilities

The well fields described above have the potential to be used for both supply and for recharge. This type of operation is known as aquifer storage and recovery (ASR). Recharge not obtained through ASR, or needed in other locations to prevent localized impacts of increased groundwater pumping, would be satisfied through the construction of new recharge ponds. Preliminary estimates indicate that 44–88 acres of active recharge would be required in order to replace the peak recharge lost during the low point. The size of the recharge area could be reduced through the use of ASR wells.

Desalination

Four Bay Area water agencies—the Contra Costa Water District, the East Bay Municipal Utility District (EBMUD), the San Francisco Public Utilities Commission, and SCVWD—are jointly exploring a regional desalination project that would provide an additional water source, diversify the area's water supply, and foster long term regional sustainability. The Bay Area Regional Desalination Project could consist of one or more desalination facilities with an ultimate total capacity of up to 71 million gallons per day. The four partner agencies are focusing on optimizing technologies that minimize power requirements and environmental effects. For purposes of the PFR facilities sizing, and economic and environmental analyses, a new East Contra Costa County desalination plant, co-located with the Mirant Power Plant in Pittsburg, is assumed. Water from this site would be delivered to SCVWD via wheeling and/or exchanges with EBMUD and San Francisco Public Utilities Commission retail customers.

This component of the Combination Comprehensive Plan would provide supplies to treated water customers during the low point, and provide a supplemental water supply source throughout the remainder of the year to make up for supplies lost during the low point event.

Any desalination plant constructed for the Bay Area Regional Desalination Project would require raw water supply facilities, concentrate disposal facilities, and product water delivery pipelines and pump stations. The following assumptions were made about facilities needed for the East Contra Costa site: raw water would be obtained from the power plant's cooling water system; concentrated brine disposal would take place via the power plant's cooling water return line to the river; and product water delivery to EBMUD's Mokelumne Aqueduct would require a pump station (with a 500-foot lift) and a 3-mile-long, 4-foot-diameter pipeline for a 40-mgd plant.

Institutional Measures

The institutional measures in the Combination Comprehensive Plan would allow the SCVWD to take CVP supplies through the SBA (provided that supplies and conveyance capacity are available) in order to minimize treated water shortages. In addition, a portion of the SCVWD's CVP-allocated supplies would be stored in the Semitropic Groundwater Storage Bank to avoid the potential loss of carryover CVP supplies. SWP and CVP scheduling flexibility would also be required to minimize the overall impacts of the low point event, thus reducing the amount of additional local storage, groundwater recharge, and groundwater pumping needed.

Local Re-operation

Under the Combination Comprehensive Plan, the SCVWD would need to operate differently than under current conditions in order to meet treated water demands without negatively affecting its groundwater basin, local surface storage, and banked storage.

4.5.3 Operations

The Combination Comprehensive Plan would allow San Luis Reservoir to be drawn down to its minimum operating level while San Felipe Division contractors would suspend delivery as algae reached the San Felipe Intake. While the Combination Comprehensive Plan would allow operation of San Luis Reservoir below the 300 TAF level, the potential for a water supply interruption to the San Felipe Division would not be alleviated. Instead, San Felipe Division contractors would rely on locally-stored reserves obtained before and after the low point.

This section compares operations for this comprehensive plan with the Future No-Action–79 TAF (unconstrained) and the Future No-Action – 300 TAF (constrained) scenarios, as described in Section 4.2. Table 4-19 compares the M&I deliveries for this comprehensive plan to deliveries for the scenarios. The table shows deliveries in low point years for this comprehensive plan and the scenarios, and presents the percentage of years in which deliveries to the San Felipe Division would be interrupted.

Table 4-19. Average Annual San Felipe Division M&I Deliveries under the Combination Comprehensive Plan

	San Felipe Division M&I Deliveries in Low Point Years (TAF)	Percentage of Years M&I Deliveries are Curtailed
Combination Comprehensive Plan	114	0%
Future No-Action–79 TAF	93	35%
Difference[(1)]	21	-35%
Future No-Action –300 TAF	No M&I curtailment with this scenario	0%
Difference		0%

[(1)] The comprehensive plan provides supply in peak summer months that would have been curtailed under the Future No-Action-79 TAF scenario. The difference depends on how many months experience a low point issue in the model. Differences range from an average of 12 TAF (in years with a one-month low point issue) to 37 TAF (in years with a three-month low point issue).

Table 4-20 presents the average annual south-of-Delta deliveries under the Combination Comprehensive Plan. South-of-Delta deliveries include total M&I deliveries and agricultural service deliveries.

Table 4-20. Average Annual Deliveries to South-of-Delta Agricultural and M&I Contractors (TAF) under the Combination Comprehensive Plan

	South-of-Delta M&I[1] Deliveries (TAF)	South-of-Delta Agricultural Service Deliveries (TAF)	South-of-Delta Total (TAF)
Combination Comprehensive Plan	145	1,171	1,316
Future No-Action–79 TAF	138	1,150	1,287
Difference	**7**	**21**	**29**
Combination Comprehensive Plan	145	1,171	1,316
Future No-Action–300 TAF	138	1,047	1,185
Difference	**7**	**124**	**131**

[1]This includes the San Felipe Division, the City of Tracy, and Other south-of Delta CVP M&I Contractors.

The Combination Comprehensive Plan includes institutional measures that could be used to increase spring allocations for south-of-Delta agricultural contractors by 5 percent in years when spring allocations would be 60 percent or lower. This 5 percent increase in allocations would correspond to a maximum increase of 100 TAF in south-of-Delta agricultural service deliveries when institutional measures are available. The institutional measures would not be available for implementation in all years when the spring allocations would be 60 percent or lower. Implementation of institutional measures would depend on their availability and the availability of conveyance capacity in the system.

Table 4-21 presents the number of years over the 81 year study period in which institutional measures are predicted to be implemented as a part of the Combination Comprehensive Plan and shows the water supply benefit that would be generated by these measures. The water supply benefit is shown as the increase in average agricultural deliveries, and in the number of years that implementation of the institutional measures would result in an increase in spring allocations.

Table 4-21 also presents the number of years in which October CVP storage in San Luis Reservoir would be lower as a result of making more aggressive allocations. If San Luis Reservoir did not completely refill prior to April in the following year as a result of institutional measure implementation, there would be an increased risk of lower allocations in subsequent years. Table 4-21 also includes the number of years when the following March CVP storage in San

Luis Reservoir would be lower as a result of making more aggressive allocations. In these years, allocations would likely be lower because San Luis Reservoir did not refill during the winter. The number of years in which October storage would be lower exceeds the number of years in which institutional measures would be implemented because of multiple-year impacts to October storage levels for years in which San Luis Reservoir does not fill completely.

Table 4-21. Early Allocations – Combination Comprehensive Plan vs. Baseline Conditions

	Number of Years when Spring Allocation is below 60%	Number of Years when Institutional Measures are Implemented	Number of Years when Spring Allocations are Increased	Average Annual Increase in Agricultural Deliveries over Study Period (TAF)	Number of Years October Storage is Lower Due to More Aggressive Allocations	Number of Years March Storage is Lower Due to More Aggressive Allocations
Combination Comprehensive Plan	29	28	19	23	38	22

4.5.4 Environmental Effects

This section describes the potential environmental effects of the Combination Comprehensive Plan. Table 4-22 summarizes potential environmental effects, indicating temporary construction impacts (indicated with “T”), permanent long term effects (indicated with “P”), or resource categories for which there is no anticipated effect (indicated with “NE”).

Table 4-22. Environmental Effects – Combination Comprehensive Plan

Resource Category	Resource	Effect Type (T/P/NE)	Notes
Biological Resources	Vegetation and Wildlife	T/P	Construction of new recharge ponds has the potential to result in loss of wildlife habitat, but could also create new types of habitat. Both the well fields and the desalination facility would require new pipelines and new pumping plants to convey water. Construction of pipelines and pumping plants has the potential to adversely affect vegetation and wildlife species.
	Fisheries	P	Because San Luis Reservoir could be drawn down to the minimum operating pool more frequently, fish in the reservoir might be affected by low oxygen levels. Concentrate disposal from the desalination facility could result in adverse effects to aquatic vegetation and wildlife species.
Physical Resources	Hydrology, Water Quality, Groundwater	T/P	Construction staging and use of equipment could increase the potential for soil erosion and cause related short term water quality effects. Drilling for the well fields and pipeline construction would likely result in the displacement and potential erosion of soil. Concentrated brine disposal from a desalination facility could have adverse water quality effects. Use of the well fields for additional water supply would increase the drawdown rate of existing groundwater aquifers and could result in land subsidence. This comprehensive plan would allow San Luis Reservoir to be drawn down to the minimum operating pool more frequently, which could result in anaerobic conditions in the reservoir that could cause taste and odor issues.
	Geology, Soils, Seismicity	T	Construction staging and use of equipment could increase the potential for soil erosion. Drilling for the well fields and pipeline construction would likely result in the displacement of soil.
	Air Quality	T/P	New pumping plants and the new desalination facility would create a permanent new source of emissions. Construction for the aquifer recovery and recharge system and the desalination facility would result in temporary air pollutant emissions.
	Land Use	P	Up to 88 acres of land could be required for the groundwater recharge facilities. The desalination facility would likely be co-located with an existing power plant. Easements would likely be required for the new pipelines.
	Agricultural Resources	P	Some agricultural and/or undeveloped lands might be affected by construction of recharge ponds for the aquifer storage and recovery program.
	Noise	T/P	Temporary noise impacts would occur from construction equipment and vehicles. The new pump stations would create a new source of permanent noise.
	Traffic	T	Temporary traffic impacts would occur associated with construction vehicles and earth-moving equipment for wells and recharge facilities.
	Population and Housing	NE	Preliminary review of the comprehensive plan indicates that it would not result in the displacement of any people or houses. A detailed investigation of the final comprehensive plan's layout and the potential for it to displace any people or houses will be completed in the EIS/EIR.
	Hydropower	NE	This comprehensive plan would not be expected to adversely affect existing hydropower production.
	Visual and Aesthetic Resources	T/P	The well fields and recharge ponds for the aquifer storage and recovery program and the new desalination facility would create new permanent features that would have some visual impacts.
	Public Services and	T/P	The new desalination facility would require power and would be co-located with a power plant to obtain

Table 4-22. Environmental Effects – Combination Comprehensive Plan

Resource Category	Resource	Effect Type (T/P/NE)	Notes
	Utilities		electricity more efficiently. New pumping stations would also require electricity to operate. New water conveyance infrastructure would be required to convey water from the well fields to the water treatment plants, and from the regional desalination facility to SCVWD.
	Hazards and Hazardous Materials	T	Construction would require the temporary use and storage of hazardous materials. Operation and maintenance of the desalination facility would require the use and storage of hazardous materials. Hazardous materials would be transported to the facility on a routine basis. Maintenance of well fields, associated pumping stations, and pipelines could necessitate the use and storage of small quantities of hazardous materials.
Physical Resources	Recreation	P	Under this comprehensive plan, San Luis Reservoir would be drawn down more often, which could affect the use of boat launches.
Social Resources	Cultural Resources	P	Unknown cultural resources might be damaged during drilling of wells for the well fields, and during excavation or trenching for pipelines.
	Environmental Justice	NE	New facilities would be sited on currently vacant land and would not displace any low-income or minority communities.
	Indian Trust Assets	NE	The areas with new facilities do not include Indian Trust Assets.

Key: T = temporary construction related effects, P = permanent long term effects, NE= no effect

4.5.5 Projected Implementation Schedule

Preliminary estimates of a project implementation schedule for developing the Combination Comprehensive Plan are outlined in Table 4-23. The implementation schedule assumes the recharge facilities and extraction wells would be completed in Year 1 of construction. The schedule also assumes about 20 percent of the desalination facility would be completed in Year 1 and 40 percent in Years 2 and 3. Expenditures during construction in Table 4-23 are based on all components.

Table 4-23. Combination Comprehensive Plan Implementation Schedule

	Implementation Time Frame		Expenditures During Construction		
	Design/ Permitting	Construction	Year 1 (0-12 Mon)	Year 2 (13-24 Mon)	Year 3 (25-36 Mon)
Combination Comprehensive Plan	3.5 years (42 months)	3 years (36 months)	88%	6%	6%

4.5.6 Economic Analysis

For this PFR analysis, the M&I benefits are estimated by the avoided costs of the most likely alternative plan. Section 4.1.3 and Appendix C further describe the methods and tools used to estimate economic benefits. The M&I water supply benefits of the Combination plan would be the avoided costs of the least cost plan, which is the San Felipe Intake Pipeline Option, or $314.1 million in present value.[6] The agricultural benefits of the Combination plan are assumed to be the same as the San Felipe Intake plan because the institutional measures implemented and agricultural deliveries would be similar. Present value of agricultural water supply benefits would be $64.4 million relative to the Future No-Action -79 TAF and $287.2 million relative to the Future No-Action -300 TAF.

The Combination plan has capital costs of $478.0 million and annual O&M costs of $11.0 million. The annual costs for implementing institutional measures are $2.5 million. The total present value costs for the Combination plan are $613.4 million, based on the construction schedule identified in Table 4-23, a 4.875 percent discount rate, and a 100-year period of analysis. [7]

[6] The avoided costs represent the present value costs, capital and annual O&M costs, of the structural elements of the comprehensive plans. Institutional measures are not included in the avoided costs estimate.

[7] The capital costs reflect today's costs for constructing the San Felipe Intake; however, capital costs would not all occur in a single year. The present value is the value of future costs discounted to reflect the time value of money.

Table 4-24 summarizes the present value benefits, costs, and net benefits (costs) for the Combination plan.

Table 4- 24 Combination Comprehensive Plan Net Benefits Summary: Present Value Benefits, Costs, and Net Benefits (Costs) (Million $)

	FNA– 79 TAF	FNA–300 TAF
M&I Supply Benefits	314.1	314.1
Agricultural Supply Benefits	64.4	287.2
Total Benefits	378.5	601.3
Total Costs	613.4	613.4
Net Benefits (Costs)	(234.9)	(12.1)
Benefit Cost Ratio (B/C)	0.62	0.98

The present value costs are less than the capital costs because costs are incurred in the future, not in the current year. The same is true for all comprehensive plans in this chapter.

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Chapter 5
Evaluation and Comparison of Comprehensive Plans

5.1 Comprehensive Plan Evaluation and Comparison

Consistent with the standards for formulating and evaluating alternatives for planning and water resource-related projects outlined in the P&Gs, the evaluation and comparison of comprehensive plans in this PFR relies on the Federal criteria of completeness, effectiveness, acceptability, and efficiency to present the relative performance of the comprehensive plans as they are defined in this stage of the Feasibility Study process. The comprehensive plans will continue to be evaluated under these criteria in future phases as they are further refined through the completion of engineering, environmental, and economic evaluations. This section further describes the Federal criteria and their application in the evaluation and comparison process, and the preliminary results of this comparison.

Figure 5-1 presents the criteria, performance measures, and the rating scales used for the comparison of the comprehensive plans. Each scale has four levels with the exception of physical implementability, which has three levels. To facilitate visual review of a comparison summary, levels are depicted with colors. In all cases, a dark green rating indicates that the comprehensive plan would meet the criterion fully and a purple rating indicates that the comprehensive plan would not meet the criterion.

5.1.1 Completeness

The completeness criterion addresses whether the comprehensive plan would account for all investments or other actions necessary to realize the planned effects. This criterion considers how well the comprehensive plan would achieve the planning objectives. The Study team developed three performance measures for the completeness criterion to characterize the degree to which each comprehensive plan would provide for the realization of the SLLPIP’s planned effects.

Screening Criteria

Planning Criterion	Performance Measures	Rating Scales
Completeness	Full spectrum of objectives	*Fully meets the project objectives*
		Fully meets two project objectives, and partially meets the others
		Fully meets one project objective, and partially meets the others
		Partially meets the project objectives
	Reliability	*Provides long-term reliability improvements without major increases in operations and maintenance*
		Provides long-term reliability improvements with increases to operations and maintenance
		Provides reliability improvements without increasing operations and maintenance
		Provides reliability improvements with increases to operations and maintenance
	Physical implementability	*Requires little new construction*
		Requires new construction with non-complex construction techniques
		Requires new construction with complex construction techniques
Effectiveness	Decreased supply interruptions to San Felipe contractors	*Fully eliminates interruptions and provides a large increase in supply*
		Fully eliminates interruptions and provides a small increase in supply
		Fully eliminates interruptions
		Does not fully eliminate interruptions
	Increased delivery quantities for south-of-Delta CVP contractors	*Provides large increases in CVP agricultural deliveries*
		Increases in CVP agricultural deliveries
		Is neutral or provides small increases in CVP agricultural deliveries
		Decreases CVP agricultural deliveries
	More aggressive allocations	*Provides large increases in allocations and deliveries*
		Provides small increases in allocations and deliveries
		Provides no change to deliveries associated with allocations
		Decreases deliveries associated with allocations
	Full exercise of San Luis storage	*Increases use of full storage in San Luis Reservoir*
		Allows full exercise of the reservoir without affecting the San Felipe Division supplies
		Is neutral with regards to San Luis storage
		Does not allow the reservoir to fall below 300 TAF
Acceptability	Biological resource impacts	*Benefits biological resource*
		Creates no impact or temporary or minor, but mitigable, adverse impacts to biological resources
		Creates moderate, but mitigable, impacts to biological resources
		Creates unmitigable impacts to biological resources
	Physical resource impacts	*Benefits physical resource*
		Creates no impact or temporary or minor, but mitigable, adverse impacts to physical resources
		Creates moderate, but mitigable impacts to physical resources
		Creates unmitigable impacts to physical resources
	Social resource impacts	*Benefits social resource*
		Creates no impact or temporary or minor, but mitigable, adverse impacts to social resources
		Creates moderate, but mitigable, impacts to social resources
		Creates unmitigable impacts to social resources
Efficiency	Net benefit	*Provides net benefit*
		Has benefits generally equal to costs
		Net benefits close to positive
		Not enough benefits to move forward

Figure 5-1 Screening Criteria

Full Spectrum of Objectives

This performance measure indicates each comprehensive plan's capacity to satisfy the three planning objectives by the degree to which implementation of each plan would:

- Result in avoidance of supply interruptions;
- Increase deliveries; and
- Allow more aggressive, early allocations.

The rating scales correspond to the number of project objectives that the plan would fully meet. A comprehensive plan scoring a dark green rating would fully satisfy all three objectives. Plans scoring light green would fully satisfy two objectives and a plan scoring yellow would fully satisfy one objective with partial satisfaction of the others. A plan scoring a purple ranking would only partially satisfy the three project objectives. Table 5-1 shows the rating for each comprehensive plan with a brief explanation. The comprehensive plans all scored dark green ratings for this performance measure, because they would all fully satisfy the project objectives.

Table 5-1. Comprehensive Plan Ratings for Meeting the Project Objectives

Comprehensive Plan	Layout	Rating	Explanation
Lower San Felipe Intake	Pipeline	Dark Green	Lowering the San Felipe Intake, coupled with institutional measures, would: eliminate water low point related supply delivery interruptions by avoiding the summer algae blooms; increase deliveries by supporting the full exercise of San Luis Reservoir; and would support aggressive, early allocations.
	Tunnel	Dark Green	
Pacheco Reservoir	80 TAF	Dark Green	A new storage facility on the west side of San Luis Reservoir on Pacheco Creek, coupled with institutional measures, would: eliminate low point related water supply delivery interruptions by allowing delivery of San Felipe Division supply prior to summer algae growth; increase deliveries by supporting the full exercise of San Luis Reservoir; and would support aggressive, early allocations.
	130 TAF	Dark Green	
Combination		Dark Green	Development of additional groundwater recharge and recovery capacity and conveyance system expansion within the San Felipe Division would eliminate low point related water supply delivery interruptions by facilitating deliveries from San Luis Reservoir prior to summer low point months, and would provide greater flexibility for operations within the San Felipe Division to supplement supplies made unavailable during low point delivery interruptions. Institutional measures would support aggressive, early allocations.

Reliability

This performance measure indicates each comprehensive plan's capacity to provide long term water supply reliability improvements and the degree to which they generate new operations and maintenance responsibilities for the project partners.

The rating scales correspond to the long term improvement in water supply reliability and the level of new operations and maintenance responsibility that would be generated by implementation of the plan. A comprehensive plan scoring a dark green rating would provide long term reliability improvements without increasing operations and maintenance requirements. Plans scoring light green would provide long term reliability improvements with increases to operations and maintenance requirements and a plan scoring yellow would provide short-term reliability improvements without increasing operations and maintenance requirements. A plan scoring a purple ranking would provide short-term reliability improvements and would result in increases in operations and maintenance responsibilities. Table 5-2 shows the rating for each comprehensive plan with a brief explanation. The Lower San Felipe Intake Comprehensive Plan would extend the existing intake infrastructure to a lower elevation in the reservoir but would not be expected to develop major new operations and maintenance responsibilities as compared to the Pacheco Reservoir and Combination Comprehensive Plans, which would both develop new stand alone infrastructure and be expected to generate new operations and maintenance responsibilities where none currently exist.

Table 5-2. Comprehensive Plan Ratings for Providing Reliability Benefits

Comprehensive Plan	Layout	Rating	Explanation
Lower San Felipe Intake	Pipeline	Dark Green	Lowering the San Felipe Intake, coupled with institutional measures, would provide improved water supply reliability and would not generate a major increase in operations and maintenance responsibilities because of the new infrastructure's direct interface with the existing system.
	Tunnel	Dark Green	
Pacheco Reservoir	80 TAF	Light Green	Developing a new reservoir on Pacheco Creek, coupled with institutional measures, would provide improved water supply reliability, but would increase operations and maintenance responsibilities by creating new conveyance and dam infrastructure.
	130 TAF	Light Green	
Combination		Light Green	The Combination Comprehensive Plan would provide improved water supply reliability, but would increase operations and maintenance responsibilities by creating new groundwater recharge and extraction infrastructure, modifications to existing conveyance facilities, and new water treatment facilities.

Physical Implementability

This performance measure indicates the relative complexity associated with designing and constructing each comprehensive plan.

The rating scales correspond to the amount of new construction that would be required and the relative complexity of necessary design and construction. A comprehensive plan scoring a dark green rating would require little new construction and would instead rely on changes in the operations of existing facilities. Comprehensive plans that score light green would require new construction with non-complex design and construction techniques. Plans scoring a purple rating would require new construction with complex design and construction techniques. For the purpose of this evaluation, non-complex design and construction techniques were considered to be those that would utilize proven technologies and approaches for which there is a proven track record at the scale proposed by each comprehensive plan. Table 5-3 shows the rating for each comprehensive plan with a brief explanation. The comprehensive plans would all require new construction utilizing non-complex design and construction techniques with an established existing record of project completion at the scale required for the SLLPIP.

Table 5-3. Comprehensive Plan Ratings for Physical Implementability

Comprehensive Plan	Layout	Rating	Explanation
Lower San Felipe Intake	Pipeline	Light Green	Lowering the San Felipe Intake would require new construction to extend and lower the existing San Felipe Division Intake in San Luis Reservoir. The design and construction approaches that would be utilized are well proven at the scale proposed for this plan.
	Tunnel	Light Green	
Pacheco Reservoir	80 TAF	Light Green	The Pacheco Reservoir Comprehensive Plan would require new construction to develop the dam as well as conveyance infrastructure to connect to the Pacheco Conduit. The design and construction approaches that would be utilized are well proven at the scale proposed for this plan.
	130 TAF	Light Green	
Combination		Light Green	The Combination Comprehensive Plan would develop new groundwater recharge and extraction infrastructure, make modifications to existing conveyance facilities, and develop new water treatment facilities. The design and construction approaches that would be utilized to make these modifications and develop these new facilities are well proven at the scale proposed for this plan.

5.1.2 Effectiveness

The effectiveness criterion addresses how well a comprehensive plan would alleviate problems and achieve opportunities. Four performance measures were developed for this criterion to compare the extent to which each plan satisfies this criterion.

Decreased Supply Interruptions to San Felipe CVP Contractors

This performance measure indicates each comprehensive plan's capacity to prevent San Luis Reservoir summer algae blooms from generating water supply interruptions, and the potential for generating an increase in south-of-Delta M&I water supply.

The rating scales examine how well the comprehensive plans would prevent future low point supply interruptions by avoiding summer algae blooms and consider the size of any potential increase in M&I water supply provided by the plans beyond that associated with eliminating supply interruptions. A plan scoring a dark green rating would fully eliminate water supply interruptions and would provide a large increase in M&I water supply. Plans scoring light green would fully eliminate water supply interruptions and would provide a small increase in M&I water supply, and a plan scoring yellow would fully eliminate interruptions but would not provide any increased M&I supply. A plan scoring a purple rating would not eliminate water supply interruptions and would not provide any increase in M&I water supply. Table 5-4 shows the rating for each comprehensive plan with a brief explanation. The comprehensive plans would all fully eliminate water supply interruptions and would provide small increases in M&I water supplies.

Table 5-4. Comprehensive Plan Ratings for San Felipe Division Supply Interruptions

Comprehensive Plan	Layout	Rating	Explanation
Lower San Felipe Intake	Pipeline	Yellow	Lowering the San Felipe Intake would fully eliminate supply interruptions by lowering the San Felipe Intake to the same level as the Gianelli Intake.
	Tunnel	Yellow	
Pacheco Reservoir	80 TAF	Light Green	The Pacheco Reservoir Comprehensive Plan would fully eliminate supply interruptions by allowing for San Felipe Division deliveries prior to summer low point months for storage in Pacheco Reservoir. A new reservoir on Pacheco Creek would provide a small increase in supply.
	130 TAF	Light Green	
Combination		Light Green	The Combination Comprehensive Plan would develop new and expanded groundwater recharge and extraction capacity and brackish water desalination, providing alternate supplies for the San Felipe Division during low point events and additional supplies during years without a low point issue.

Increased Delivery Quantities for south-of-Delta CVP Contractors

This performance measure indicates each comprehensive plan's capacity to increase deliveries to south-of-Delta CVP agricultural contractors.

The rating scales examine to what degree the comprehensive plans could increase the quantity of water delivered to south-of-Delta CVP agricultural contractors. A plan scoring a dark green rating would provide large increases in CVP agricultural deliveries. Plans scoring light green would provide moderate increases in CVP agricultural deliveries and plans scoring yellow would have no affect on deliveries or provide small increases in CVP agricultural deliveries. A plan scoring a purple rating would generate a decrease in deliveries to south-of-Delta CVP agricultural contractors. Table 5-5 shows the rating for each comprehensive plan with a brief explanation. The Pacheco Reservoir Comprehensive Plan would, by developing additional south-of-Delta storage capacity, allow for the large increases in deliveries to south-of-Delta CVP agricultural contractors, while maintaining deliveries to the San Felipe Division. The other comprehensive plans would provide increases in these deliveries but in smaller quantities than the Pacheco Reservoir Comprehensive Plan. (Chapter 4 presents the estimation of increases in deliveries.

Table 5-5. Comprehensive Plan Ratings for Increased Delivery Quantities for South-of-Delta CVP Contractors

Comprehensive Plan	Layout	Rating	Explanation
Lower San Felipe Intake	Pipeline	Light Green	Lowering the San Felipe Intake would allow for the full exercise of San Luis Reservoir without generating water supply delivery interruptions. Full exercise of the reservoir, coupled with institutional measures, would provide an increase in deliveries to south-of-Delta CVP agricultural contractors.
	Tunnel	Light Green	
Pacheco Reservoir	80 TAF	Dark Green	The Pacheco Reservoir Comprehensive Plan would provide larger increases in deliveries to south-of-Delta CVP agricultural contractors than the other plans because it would include development of additional capacity to store Delta surplus for later delivery to CVP agricultural contractors.
	130 TAF	Dark Green	
Combination		Light Green	The Combination Comprehensive Plan would allow for the full exercise of San Luis Reservoir without generating water supply delivery interruptions. Full exercise of the reservoir, coupled with institutional measures and increases in groundwater storage capacity within the San Felipe Division, would provide an increase in deliveries to south-of-Delta CVP agricultural contractors.

More Aggressive Allocations

This performance measure indicates each comprehensive plan's capacity to increase early season allocations to support planting decisions.

The rating scales examine how well the comprehensive plans would increase early season allocations by ranking each comprehensive plan's ability to utilize available institutional measures to increase early season allocations and the associated deliveries. A plan scoring a dark green rating would provide large increases in allocations and deliveries. A plan scoring a light green rating would provide small increases in allocations and deliveries and a plan scoring a yellow rating would provide no change in deliveries associated with allocations. A plan scoring a purple rating would decrease deliveries associated with allocations. Table 5-6 shows the rating for each comprehensive plan with a brief explanation. The institutional measures are utilized by all of the comprehensive plans and preliminary estimates of the potential benefits generated by each plan indicate that implementation of any of the plans would allow for small increases in early season allocations and deliveries.

Table 5-6. Comprehensive Plan Ratings for More Aggressive Allocations

Comprehensive Plan	Layout	Rating	Explanation
Lower San Felipe Intake	Pipeline	Light Green	Lowering the San Felipe Intake would provide small increases in allocations and deliveries.
	Tunnel	Light Green	
Pacheco Reservoir	80 TAF	Light Green	The Pacheco Reservoir Comprehensive Plan would provide small increases in allocations and deliveries.
	130 TAF	Light Green	
Combination		Light Green	The Combination Comprehensive Plan would provide small increases in allocations and deliveries.

Full Exercise of San Luis Reservoir

This performance measure indicates each comprehensive plan's capacity to increase the use of full storage in San Luis Reservoir.

The rating scales examine how well implementation of the comprehensive plans would increase full use of San Luis Reservoir storage by comparing the number of years that the reservoir would be expected to fall below 300 TAF (full exercise) without affecting San Felipe Division deliveries. A plan scoring a dark green rating would increase the number of years that San Luis Reservoir elevations would be expected to fall below 300 TAF (i.e., full exercise of the reservoir would be more frequent than under the No-Action Alternative) without affecting San Felipe Division deliveries. A plan scoring a light green rating would allow full exercise of San Luis Reservoir without increasing the frequency that storage falls below 300 TAF and without affecting San Felipe

Division deliveries and a plan scoring a yellow rating would not affect San Luis storage. A plan scoring a purple rating would not allow the reservoir to be drawn below 300 TAF without creating San Felipe Division supply interruptions. Table 5-7 shows the rating for each comprehensive plan with a brief explanation. The comprehensive plans would all support the full exercise of San Luis Reservoir storage.

Table 5-7. Comprehensive Plan Ratings for the Full Exercise of San Luis Storage

Comprehensive Plan	Layout	Rating	Explanation
Lower San Felipe Intake	Pipeline	Light Green	Lowering the San Felipe Intake would support the drawdown of San Luis Reservoir below 300 TAF while maintaining deliveries to the San Felipe Division.
	Tunnel	Light Green	
Pacheco Reservoir	80 TAF	Light Green	The Pacheco Reservoir Comprehensive Plan would support the drawdown of San Luis Reservoir below 300 TAF while maintaining deliveries to the San Felipe Division.
	130 TAF	Light Green	
Combination		Light Green	The Combination Comprehensive Plan would support the drawdown of San Luis Reservoir below 300 TAF while maintaining deliveries to the San Felipe Division.

5.1.3 Acceptability

The acceptability criterion addresses the viability of a comprehensive plan with respect to acceptance by State and local entities and compatibility with existing laws. The performance measures for the acceptability criterion focus on potential environmental effects, which will be described further through the analyses performed as part of compliance with California Environmental Quality Act and National Environmental Protection Act. The performance measures for this criterion consider the comprehensive plans' potential environmental impacts to biological, physical, and social resources in the Study area.

The acceptability planning criterion has three performance measures: impacts to biological resources, impacts to physical resources, and impacts to social resources. The rating scales measure the severity of these impacts and whether they are mitigable. A plan scoring a dark green rating would be expected to provide benefits related to the resource. A plan scoring a light green rating would create no impact or would create temporary or minor mitigable impacts. A plan scoring a yellow rating would create a moderate but mitigable impact, and a plan scoring a purple rating would create unmitigable impacts. Table 5-8 shows the rating for each comprehensive plan with a brief explanation.

Anticipated effects associated with the lower San Felipe Intake Comprehensive Plan would be temporary, construction-related impacts, because its new components would be within the already-developed footprint of the San Luis Reservoir. The Pacheco Reservoir Comprehensive Plan would be expected to generate a moderate level of impacts because its new components would be along Pacheco Creek and land that is currently undeveloped and is used for livestock grazing would be inundated. The explanations in Table 5-8 highlight the anticipated effects of each Comprehensive Plan.

Table 5-8. Comprehensive Plan Ratings for Acceptability

Comprehensive Plan	Layout	Biological Impacts	Physical Impacts	Social Impacts	Explanation
Lower San Felipe Intake	Pipeline	Light Green	Yellow	Light Green	Dredging to extend and lower the San Felipe Intake would have temporary recreation, noise, and air quality effects, and could affect aquatic species in the reservoir. Water quality impacts might be greater than the tunnel option due to the disturbance and introduction of sediments in the water column and potential discharges of pollutants from vehicles and equipment working in the reservoir.
	Tunnel	Light Green	Light Green	Light Green	Tunneling to construct a new intake would have temporary noise, air quality, recreation, and traffic effects. Water quality impacts, such as increase in turbidity, could occur.
Pacheco Reservoir	80 TAF	Yellow	Yellow	Light Green	The Pacheco Reservoir Comprehensive Plan would result in substantial impacts to biological resources from habitat inundation. Cultural resources and private property could also be inundated. A large amount of material would be required for embankments and the construction activities associated with obtaining and placing this material would cause air quality, traffic, and noise impacts.
	130 TAF	Yellow	Yellow	Light Green	
Combination		Light Green	Light Green	Light Green	The Combination Comprehensive Plan would include increases in groundwater recharge and extraction capacity with construction of new well fields and recharge facilities and the potential associated short term impacts, a new regional desalination plant that could generate brine disposal impacts, reoperation of District conveyance facilities and the implementation of institutional measures. These facilities would be expected to generate minor mitigable impacts.

5.1.4 Efficiency

The efficiency criterion addresses how well a comprehensive plan would deliver economic benefits from a project cost standpoint, in comparison to the performance measures associated with the completeness and effectiveness criteria, which address each plan's benefits qualitatively. The Study team defined the performance measure for the efficiency criterion as the comprehensive plans' net benefits.

Net Benefits

This performance measure compares each comprehensive plan's benefits to its costs to quantify the efficiency of each plan at securing benefits. The estimates of benefits and the costs used for this evaluation are preliminary and are subject to revision in the Feasibility Report as new benefits associated with the plans are identified and the cost estimates are refined as more detailed designs are developed for the each plan's features.

A plan scoring a dark green rating would provide net benefits based on preliminary benefit and cost estimates. Plans scoring light green ratings would be expected to generate benefits generally equal to costs, and a plan scoring a yellow rating would generate benefit values that may be nearly equal to, but lower than costs. The Study team anticipates that as a part of future review, the identification of new or increased benefits not evaluated as a part of preliminary estimates will shift the net benefits of the yellow-rated comprehensive plans to positive. A plan scoring a purple rating would provide so little benefit that it would be screened from further review in the Feasibility Study. Table 5-9 shows the rating for each comprehensive plan with a brief explanation, a detailed economic analysis of the comprehensive plans is presented in Appendix C.

Table 5-9. Comprehensive Plan Ratings for Efficiency

Comprehensive Plan	Layout	Rating	Explanation
Lower San Felipe Intake	Pipeline	Dark Green	The Lower San Felipe Intake Comprehensive Plan pipeline layout option would generate the same water supply benefit as the tunnel option with lower construction costs. Feasibility-level engineering will further refine the cost estimates to verify that the pipeline option performs better than the tunnel option under the efficiency criterion.
	Tunnel	Light Green	

Table 5-9. Comprehensive Plan Ratings for Efficiency

Comprehensive Plan	Layout	Rating	Explanation
Pacheco Reservoir	80 TAF	Yellow	The Pacheco Reservoir Comprehensive Plan options would have similar water supply benefits and similar estimated construction costs. Feasibility level benefit analysis is expected to increase the net benefits for Pacheco Reservoir, and additional investigation of landslide issues along Pacheco Creek is expected to support the narrowing of the plan to one layout option for review in the Feasibility Report.
	130 TAF	Yellow	
Combination		Yellow	The Combination Comprehensive Plan would generate similar benefits as the Lower San Felipe Intake Tunnel Option. Feasibility level analysis will further define components of the plan to increase benefits and refine cost estimates.

5.2 Summary of Comparisons

Figure 5-2 shows a summary of the comprehensive plan comparison and evaluation. As Figure 5-2 shows, none of the comprehensive plans received a purple rating (for not meeting a criterion) and all three plans will be carried forward into the Feasibility Report for additional review and consideration. This section provides descriptions of potential issues associated with each plan, identified as a part of the evaluation and comparison that will require investigation as the Feasibility Study proceeds. This comparison and evaluation effort did not identify a preliminary NED plan, given the narrow range of benefits and costs identified as a part of this preliminary investigation. Feasibility level analysis will focus on refining both the benefit and cost estimates to support the identification of a NED plan. Table 5-10 lists the comprehensive plans being carried forward to the Feasibility Report; a No-Action/No-Project Comprehensive Plan will also be retained for comparison and further analysis in the draft EIS/EIR.

Table 5-10. Comprehensive Plans Being Carried Forward to the Feasibility Report

Comprehensive Plan	Features Included
Lower San Felipe Intake	Lowered San Felipe Intake and institutional measures
Pacheco Reservoir	Pacheco Reservoir and institutional measures
Combination Comprehensive Plan	Groundwater recharge and recovery, desalination, institutional measures, and SCVWD system reoperation

Comprehensive Plan Screening

Screening Criteria: Planning Criterion	Screening Criteria: Performance Measure	Lower San Felipe Intake Comprehensive Plan: *Pipeline*	Lower San Felipe Intake Comprehensive Plan: *Tunnel*	Pacheco Reservoir Comprehensive Plan: *80 TAF Pacheco Reservoir*	Pacheco Reservoir Comprehensive Plan: *130TAF Pacheco Reservoir*	Combination Comprehensive Plan: *Impacts to biological resources*
Completeness	Full spectrum of alternatives					
	Reliability					
	Physical implementability					
Effectiveness	Decreased supply interruptions to San Felipe CVP contractors					
	Increased delivery quantities for south-of-Delta contractors					
	More aggressive allocations					
	Full exercise of San Luis storage					
Acceptability	Biological resource impacts					
	Physical resource impacts					
	Social resource impacts					
Efficiency	**Net benefits***					

Footnote

** Net benefits are preliminary and will likely increase for all alternatives because current estimates do not capture all potential benefits, and feasibility-level analysis will refine estimates.*

Figure 5-2: Comprehensive Plan Screening

5.2.1 Lower San Felipe Intake Comprehensive Plan

Both Lower San Felipe Intake Comprehensive Plan options are being carried forward for additional analysis in the Feasibility Study. Feasibility-level engineering and environmental review will include detailed analysis of the potential cost differences between the tunnel and pipeline layouts. The environmental effect analysis will include the review of potential for water quality impacts caused by construction of the pipeline across the reservoir floor or by developing the access shaft for the tunneling equipment. The analysis will also review the potential costs and environmental effects associated with implementing the institutional measures common to all of the plans.

5.2.2 Pacheco Reservoir Comprehensive Plan

Both Pacheco Reservoir Comprehensive Plan options are being carried forward for additional analysis in the Feasibility Study. Feasibility-level engineering review will include detailed analysis of the potential cost differences between the two dam layouts, given the uncertainty associated with mapped landslide areas in the proposed embankment locations. The environmental effect analysis will include an investigation of the potential for landslide activity in the proposed embankment areas and the reservoir inundation zones to characterize the potential risk for project related water quality impacts. As noted above, the analysis will also review the potential effects generated by use of the institutional measures common to all of the plans.

5.2.3 Combination Comprehensive Plan

The Combination Comprehensive Plan is being carried forward for additional analysis in the Feasibility Study. The Feasibility-level engineering and environmental review will investigate in greater detail the potential costs associated with developing and operating all of the components in the Combination Comprehensive Plan, including review of the potential costs and water supply benefits associated with the regional desalination facility, and the potential environmental effects associated with its operation.

Chapter 6
Implementation Considerations

6.1 Uncertainties

At this stage in the planning process, several uncertainties remain regarding the comprehensive plans and their implementation. The Feasibility Report Phase of the planning process will focus on reducing these uncertainties by addressing the issues described below.

6.1.1 System Operations

Current CalSim II modeling results for the SLLPIP use the past to predict the future; that is, they assume what has happened in the past is most likely to also occur in the future. Biological and environmental issues in the Delta may result in future CVP and SWP operations that are much different from those of the past. Accurately predicting future CVP and SWP operations has been, and will continue to be a key challenge during the feasibility and EIS/EIR stage of the SLLPIP planning process.

Biological and environmental issues in the Delta affecting future CVP and SWP operations include the Biological Opinions on Long-Term Operations of the CVP and SWP (Section 1.7.6), the Delta Plan under development by the Delta Stewardship Council (Section 1.7.11), and California Bay Delta Conservation Plan (Section 1.7.10).

The Feasibility Report and EIS/EIR will need to use the best available information to address changes in the management of the Delta and future operations of the CVP and SWP. As new information becomes available, this will be incorporated into the SLLPIP analysis.

6.1.2 Comprehensive Plan Refinements

The comprehensive plans in this PFR were developed to a level that would allow them to be compared against each other to determine preliminary benefits and environmental effects. Site-specific details have not been finalized for several of the comprehensive plans because of lack of site-specific information, the need to examine potential landslide issues, and other environmental concerns. As the comprehensive plans are developed further in the Feasibility Study, refinements may occur to address such issues. Refined comprehensive plans will be described in detail in the Feasibility Report and EIS/EIR.

6.1.3 Cost Estimates

Planning-level construction cost estimates were prepared for the PFR, in 2008 dollars. Cost estimates are based on facility layouts prepared for each of the comprehensive plans. As noted in Section 6.1.2., site-specific details have not been finalized for the comprehensive plans. The cost estimates attempt to capture this uncertainty through the use of a contingency factor, to account for items not yet fully detailed in the design. As the comprehensive plans are further developed in the Feasibility Report, costs will be refined.

Uncertainty in the cost estimates exists due to recent changes in materials and labor costs. In recent years, construction costs have significantly outpaced general inflation. While these recent trends have been factored into cost estimates prepared for this analysis, volatility in construction trends could affect construction cost estimates.

6.2 Public Involvement

The SLLPIP is addressing issues of interest and concern to stakeholders engaged in local and regional water resources planning and several Federal and State agencies with regulatory and management responsibilities related to natural resources in the study area.

From the inception of the SLLPIP in 2002, the project team has maintained a very active public and agency involvement program that has included a wide range of activities. A Public Involvement Plan was initiated at the beginning of the SLLPIP that is designed to provide meaningful opportunities for stakeholder participation and to inform the public. Specifically, the Public Involvement Plan is designed to address issues of interest and concern to stakeholders engaged in local and regional water resources planning. The Public Involvement Plan supports Reclamation, SCVWD, and SLDWMA’s efforts to work with all stakeholders to develop a community consensus alternative. The plan has evolved as the SLLPIP has continued. The goals for the Public Involvement Plan are as follows:

- Facilitate an efficient process to meet NEPA/CEQA requirements.
- Inform and educate the public regarding SLLPIP and provide context and linkage to the various parallel processes.
- Actively involve elected officials, stakeholders, interest groups and the general public in the planning and environmental review processes.
- Ensure the public has the opportunity to participate throughout project development.

- Ensure that issues and concerns expressed by the public, stakeholders, and interest groups are addressed in the planning process.
- Present the results of SLLPIP planning activities to the public, stakeholders, interested groups and government agencies in a timely fashion.

The Public Involvement Plan maintains two primary themes: outreach and information. Associated with these themes are procedures that enable the overall SLLPIP to satisfy the public involvement requirements of NEPA and CEQA for development of an EIS/EIR.

The interactive components of the Public Involvement Plan focus on ensuring that stakeholders and the public have the opportunity to effectively participate in the development of the SLLPIP. Stakeholders in the SLLPIP area bring a high level of experience and local knowledge to the process, and provide a variety of recommendations, responses, and reviews that likewise inform the plan formulation process. Outreach components are designed to provide information and materials to a broad group of interested parties. The outreach components disseminate information widely, bring additional stakeholders and interested parties to the process, and enhance coordination with related water resources planning and management groups.

At the center of this public involvement plan are a series of public scoping meetings, formal public hearings, project updates, and website updates to provide timely distribution of project information. All meetings will provide clear objective information on the project, explain the project process, timeline and milestones, and solicit input on project alternatives. The project team will present technical information at these meetings to help participants understand project challenges, constraints, and the opportunities for solutions. They will also allow participants to express their ideas and voice their concerns in a valuable and meaningful way. Meeting formats will be tailored to meet desired objectives of specific meetings.

Informational materials will be prepared and distributed to engage those who do not traditionally attend meetings. A proactive media relations effort will also be established to ensure that timely and accurate information is being distributed to the media.

6.2.1 Public Scoping Meetings

An environmental compliance process consistent with NEPA and CEQA was initiated in September 2008 when Reclamation issued an NOI and SCVWD issued an NOP. During the week of September 15, 2008, Reclamation, SCVWD, and SLDMWA convened a series of public scoping meetings in Sacramento, San Jose, and Los Banos, California, to inform interested groups and individuals about the SLLPIP and to solicit ideas and comments. These meetings were held in areas that represent stakeholders, including (1) Sacramento area (to encourage regulatory agency participations), (2) service are of the West San Joaquin Division of the CVP (Los Banos), and (3) service area of the San Felipe Division of the CVP (San Jose).

The environmental scoping process allows stakeholders and interested parties to suggest potential issues that may require environmental review, reasonable alternatives to consider, and potential mitigation strategies to reduce or avoid substantial adverse environmental impacts. Scoping also allows lead agencies to clearly set the parameters of the environmental compliance process by determining which issues will or will not be addressed, and rationale for those determinations. In addition, scoping provides decision-makers with insight on the analyses that the public believes should be considered as part of the decision-making process.

An Environmental Scoping Report was prepared consistent with Reclamation guidance and in compliance with NEPA requirements, and released in December 2008 (Reclamation 2008b). The report describes the scoping process, comments received during scoping, and how these comments would be addressed as part of the SLLPIP. Input received through stakeholder/public outreach has been, and will continue to be, incorporated into the development of the SLLPIP.

6.2.2 Public Workshops

Several public workshops will be held to inform the public about the SLLPIP status and findings during development of the Feasibility Report and EIS/EIR. It is anticipated that workshops will be held in several locations to make it more convenient for individuals and organizations to participate. The timing of these meetings will be based on feedback from interested parties.

6.2.3 Public Meetings/Hearings

Upon the completion of the Draft Feasibility Report and Draft EIS/EIR, the draft documents will be circulated to the public and to agencies for review and comment. Reclamation, SCVWD, and SLDMWA will hold public hearings to formally solicit public comment on the Draft EIS/EIR. Based on information gained at earlier public meetings, a meeting plan will be developed and implemented to ensure broad participation in the hearings. The public will also be able to provide written comments on the Draft Feasibility Report and Draft EIS/EIR during the comment period.

Upon completion of the final Feasibility Report, an informational meeting will be held to share the results with the public.

6.2.4 Project Webpage Maintenance

Reclamation will maintain a project webpage within the Mid-Pacific Region's website. The webpage would include information such as: background information, reference documents, meeting announcements, meeting summaries, posters, brochures and other related information. The webpage will also provide the public with the ability to submit comments via the webpage during comment periods. The webpage is located at http://www.usbr.gov/mp/sllpp/index.html.

6.2.5 Project Updates

Throughout the Feasibility Study process, the project partners will develop and distribute informational project updates. These project updates will brief interested parties on the progress of the study and provide contacts for more information. The information in the project updates will be written in a way that is accessible to all interested parties, regardless of their participation in past meetings or public involvement activities.

6.2.6 Future Public Involvement Opportunities

Continued public and stakeholder involvement will be a critical component during the final phase of the SLLPIP, which will culminate with release of the Final Feasibility Report and its accompanying EIS/EIR. All activities will be geared to continued compliance with NEPA, Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), and the President's April 29, 1994, memorandum regarding the engagement of federally recognized tribal governments.

The SMT plans to continue outreach activities through distribution of informational materials to interested parties, and coordination of public and stakeholder briefings, meetings and workshops, and media relations. Listed below is a brief overview of planned future outreach activities:

- Public open houses and workshops to collect comments from the public and other interested parties
- Briefings for Federal and State elected officials
- Workshops and one-on-one briefings with CVP and SWP contractors
- Coordination with federally and non-federally recognized Native American tribes
- Coordination with potentially affected power interests
- Distribution of informational materials to support various stages of the SLLPIP meetings or public involvement activities

6.3 Regulatory and Related Requirements for Environmental Compliance

Any comprehensive plan that is selected for implementation would be subject to the requirements of numerous Federal, State, and local laws, policies, and regulations. Reclamation is the lead agency for NEPA compliance, and SCVWD is the lead agency for CEQA compliance. Moreover, Reclamation would need to obtain various permits and meet regulatory requirements before beginning any project construction, and comply with a number of environmental regulatory requirements as part of the NEPA and CEQA compliance process. Table 6-1 lists the major requirements for project implementation. Local requirements that SLLPIP would be required to meet will be better defined once site-specific plans have been developed.

Table 6-1. List of Regulatory Requirements Potentially Affecting Project Implementation

Agency and Associated Permit Action	Recommended Prerequisites for Submittal[1]	Estimated Processing Time[2]
FEDERAL		
USACE Clean Water Act Section 404 Individual Permit Rivers and Harbors Act Section 10 Permit	• Application • ASIP for submittal to USFWS/NMFS/DFG • Section 401 Water Quality Certification permit or application • NEPA documentation (environmental compliance documents) • Section 106 compliance documentation • Wetland delineation • Section 404 (b)(1) evaluation and identification of the Least Environmentally Damaging Practical Alternative • Mitigation and monitoring plan	24 months
USFWS/NMFS Endangered Species Act Section 7 Consultation	• Informal technical consultation regularly • ASIP • Alternative description	12 months
USFWS Fish and Wildlife Coordination Act Report	• Informal technical consultation regularly • ASIP • Alternative description	12 months
SHPO/ACHP National Historic Preservation Act, Section 106	• Cultural Survey Report • Documentation of consultation with Native American representatives	9 months
STATE		
RWQCB Clean Water Act Section 401 Water Quality Certification	• Application • Fish and Game Code Section 1602 Application • CWA Section 404 permit or application • Draft environmental compliance documents • Mitigation and monitoring plan (if needed)	6 months
RWQCB NPDES General Permit for Storm Water Discharges Associated with Construction Activity (General Permit) Water Quality Order 99-08-DWQ	• Application • SWPPP	3 months

Table 6-1. List of Regulatory Requirements Potentially Affecting Project Implementation

Agency and Associated Permit Action	Recommended Prerequisites for Submittal[1]	Estimated Processing Time[2]
DFG California Endangered Species Act Section 2081: Incidental Take Permit or 2080.1 Consistency Determination	• Informal technical consultation • Application, if requesting a 2081 Incidental Take Permit • Biological opinion and incidental take statement, if requesting a consistency determination (preferred approach)	6 months after Biological Opinion issued
DFG Fish and Game Code Section 1602 Streambed Alteration Agreement	• Application • Section 401 Water Quality Certification permit or application • CWA Section 404 permit or application • Draft environmental compliance documents • Mitigation plan	9 months
The Reclamation Board California Code of Regulations, Title 23: Encroachment Permit	• Application	9 months
SWRCB Amended water right	• Application • Draft (possibly final) environmental compliance documents	12 months
State Lands Commission Land Use Lease	• Application • Draft environmental compliance documents	9 months
LOCAL		
BAAQMD, MBUAPCD, & SJVAPCD Dust Control Plan	• Dust Control Plan • Dust Control Training Course • Preapplication meeting (encouraged)	2 months
BAAQMD, MBUAPCD, & SJVAPCD **Authority to Construct and Permit to Operate**	• Application • Preapplication meeting (encouraged)	6 months
Other Agencies Building Permits, Easements, Right-of-Way Crossings, Encroachment Permits, Tree Removal Permits, Design Standards and Specifications, Other Local Permits and Approvals	• Permits/Approvals	Prior to Construction

Notes:
1 All permit applications require detailed project description information. Anticipated processing time is estimated based on initial permit applications submittal to permit issuance.
2 From accepted permit application submittal.

Key: ACHP = Advisory Council on Historic Preservation ASIP = Action-Specific Implementation Plan
BAAQMD = Bay Area Air Quality Management District
CWA = Clean Water Act
DFG = California Department of Fish and Game
MBUAPCD = Monterey Bay Unified Air Pollution Control District
NEPA = National Environmental Policy Act
NMFS = National Marine Fisheries Service
NPDES = National Pollutant Discharge Elimination System
RWQCB = Regional Water Quality Control Board
SHPO = State Historic Preservation Officer
SJVAPCD = San Joaquin Valley Air Pollution Control District
SWPP = Stormwater Pollution Prevention Plan
SWRCB = State Water Resources Control Board
The Reclamation Board = The Reclamation Board of the State of California
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

In addition to the major Federal, State, and local environmental requirements listed in Table 6-1, the alternatives considered may be subject to other laws, policies, or plans. Table 6-2 lists many of the other laws, policies, and plans that may potentially affect the development of any alternative.

Table 6-2. Potential Regulatory Requirements for the SLLPIP

Federal	Method of Compliance[1]	Project Phase
National Environmental Protection Act	EIS/EIR	EIS/EIR
Endangered Species Act	Section 7 Consultation with USFWS and/or NMFS through an ASIP	EIS/EIR
Clean Water Act	401, 404, 402 Permits	EIS/EIR
Magnuson-Stevens Fishery Conservation and Management Act	EIS/EIR	EIS/EIR
Fish and Wildlife Coordination Act	FWCAR	EIS/EIR
Migratory Bird Treaty Act	EIS/EIR, MMRP	EIS/EIR
E.O 12898 Environmental Justice	EIS/EIR	EIS/EIR
Clean Air Act	EIS/EIR, MMRP	EIS/EIR
National Historic Preservation Act Section 106	Section 106 Consultation with SHPO	EIS/EIR
Rivers and Harbors Act Permit	Section 10 Permit	EIS/EIR
E.O 11990 Protection of Wetlands	EIS/EIR, MMRP, 404 Permit	EIS/EIR
Farmland Protection Policy Act	EIS/EIR, MMRP	EIS/EIR
Indian Trust Assets	EIS/EIR	EIS/EIR
State		
California Environmental Quality Act	EIS/EIR	EIS/EIR
California Endangered Species Act	EIS/EIR, ASIP	EIS/EIR
California Fish and Game Code Section 1600 (Streambed Alteration Agreement)	Streambed Alteration Agreement	EIS/EIR
Natural Community Conservation Planning Act	EIS/EIR	EIS/EIR
Porter-Cologne Water Quality Control Act	EIS/EIR	EIS/EIR
San Francisco Bay Conservation and Development Commission	BCDC Permit	EIS/EIR
California Water Code Section 1700 - Petition for Water Rights Change with the SWRCB	Petition for Water Rights Change with SWRCB	Prior to Construction
California Streets and Highways Code Section 660-743	Encroachment Permit	Prior to Construction
Safe Drinking Water Act	EIS/EIR	EIS/EIR
California Department of Public Health Water Supply Permit	Water Supply Permit	Prior to Construction
Native Plant Protection Act; California Fish and Game Code §1900 et seq	EIS/EIR	EIS/EIR
California Fish and Game Code §1800-1802	EIS/EIR	EIS/EIR
California Fish and Game Code §3503	EIS/EIR	EIS/EIR
California Fish and Game Code §3511 and 5050	EIS/EIR	EIS/EIR
California Scenic Highways Program	EIS/EIR	EIS/EIR

Table 6-2. Potential Regulatory Requirements for the SLLPIP

Federal	Method of Compliance[1]	Project Phase
Local		
Building Permits	Permits/Approvals	Prior to Construction
Easements	Permits/Approvals	Prior to Construction
Right-Of-Way Crossings	Permits/Approvals	Prior to Construction
Encroachment Permits	Permits/Approvals	Prior to Construction
Tree Removal Permits	Permits/Approvals	Prior to Construction
Design Standards and Specifications	Permits/Approvals	Prior to Construction
Other Local Permits and Approvals	Permits/Approvals	Prior to Construction

1. FWCAR = Fish and Wildlife Coordination Act Report; MMRP = Mitigation Monitoring Reporting Program SHPO = State Historic Preservation Officer; BCDC = Bay Conservation and Development Commission

Environmental compliance is generally integrated into NEPA and CEQA compliance and is typically addressed through environmental documentation, mitigation, permitting and/or approvals, and agency consultation. Additionally, the CALFED Program has developed a comprehensive strategy to address several of the Federal and State regulations that pertain to vegetation and wildlife. The Multi-Species Conservation Strategy is an appendix of the CALFED Bay-Delta Program Programmatic EIS/EIR (PEIS/EIR) and describes how CALFED Program actions will comply with the Federal ESA, California Endangered Species Act (CESA), and the California Natural Community Conservation Planning Act (NCCPA) requirements. For the CALFED Program project actions identified in the PEIS/EIR and ROD, an Action Specific Implementation Plan (ASIP) is developed to address the ESA, CESA, and NCCPA consultation requirements of Federal and State agencies. The SLLPIP is an approved CALFED Program action and will therefore require completion of an ASIP to address these requirements.

Several important environmental issues, discussed below, must be considered in the next stages of the SLLPIP planning process. Early agency consultation and consideration of these issues during refinement of the comprehensive plans will help to minimize potential environmental effects and avoid lengthy delays during the permitting and approval process.

Easements

Several of the comprehensive plans may require the installation of pipelines under a State highway or construction activities within a State highway right-of-way. These actions typically require approval by Caltrans in the form of an easement and/or encroachment permit. Consultation with Caltrans prior to the feasibility study and EIS/EIR is necessary to ensure that preliminary alternative plans are feasible. The need for additional easements and/or encroachment permits will be evaluated as the comprehensive plans are further refined in the Feasibility Report and EIS/EIR.

Endangered Species

All comprehensive plans have the potential to affect Federal or State species listed as endangered or threatened. Informal consultation with DFG, USFWS, and NMFS is often conducted in the initial stages of the SLLPIP to ensure that comprehensive plans will not conflict with listed species or habitat to such an extent as to render a comprehensive plan infeasible. Early consultation may also allow comprehensive plans to be revised to avoid or reduce potential impacts.

Wetlands

All types of comprehensive plans that require construction have the potential to affect Federal wetlands. Impacts to Federal wetlands from proposed improvements/activities that do not qualify for a general permit (i.e., do not meet the criteria for a Nationwide Permit) would require an individual permit. A Section 404(b)(1) alternatives analysis is required for an individual permit and must demonstrate that there are no practicable alternatives to the proposed activity. In evaluating the initial feasibility of potential alternatives for the project, it is important to carefully consider those that may have significant impacts to wetlands and anticipate the likelihood of being able to successfully demonstrate that there are no practicable alternatives.

General Conformity

Under the Federal Clean Air Act (CAA, 42 U.S.C. Section 7410 et seq.), States must submit a SIP for areas that have pollutant concentrations above the NAAQS. Such areas are often referred to as "nonattainment" areas and an SIP delineates the programs, measures, and timeframes for bringing such areas back into attainment with NAAQS. In order to ensure that Federal activities do not hamper local efforts to control air pollution, Section 176(c) of CAA prohibits Federal agencies from approving any action which does not conform to an approved SIP or Federal implementation plan.

The requirements related to a CAA general conformity determination must be satisfied before Reclamation can implement the proposed project. The first step in the process is to determine whether the air pollutant emissions exceed the *de minimis* thresholds. If so, the project proponent must demonstrate that those emissions will not conflict with, or otherwise impede the successful implementation of, the SIP. As noted above, that latter step can require a substantial amount of work, and could pose a major problem if conformity cannot be fully demonstrated. In evaluating the initial feasibility of potential comprehensive plans for the project, it is important to carefully consider those that would result in emissions that exceed the *de minimus* thresholds, especially those alternatives, if any, that would result in emissions that far exceed the thresholds.

6.4 Implementation Responsibilities

The next step in the planning process will involve determining roles and responsibilities.

6.4.1 Cost Sharing

Because no preferred comprehensive plan has been selected in this PFR and estimation of benefits is incomplete, no plan for sharing of project costs between the Federal government and the various project beneficiaries has been developed. Project cost sharing will be addressed in the Study once a preferred comprehensive plan is selected, benefit estimation is completed, and detailed cost estimates for that comprehensive plan have been prepared. The following discussion describes cost sharing considerations and identifies several possible cost sharing approaches that could be considered in the Feasibility Report Phase. The cost sharing process typically involves determination of costs to be shared, a cost allocation, and assignment of costs to individual project beneficiaries. The current CVP cost sharing approach and the Separable Cost-Remaining Benefit (SCRB) cost allocation, either which may serve as the basis for cost sharing of SLLPIP, are described briefly. These are two examples for allocating costs of a project and do not necessarily reflect the final approach that will be used for the SLLPIP.

Costs to Be Shared

The first step in developing a cost sharing plan is to identify the project costs. Cost sharing is a financial exercise, rather than an economic evaluation, and project costs may be presented differently between the two. For example, construction costs and operations, maintenance and repair (OM&R) costs can be expressed in present worth terms in the economic analysis, but are typically expressed on a single, current-year basis in the financial analysis. In addition, a financial analysis may involve inclusion of already-expended costs (known as “sunk” costs) which are not appropriately included in an NED economic analysis. Also, the financial analysis will typically identify interest which accrues during the construction period, and also can include interest on investment which accrues after construction is complete.

Cost sharing usually addresses both funding of project costs and, if applicable, repayment of those costs. For example, the Federal government may fund the entire construction of a project, and cost sharing by project beneficiaries occurs when they repay those costs over time. On the other extreme, the Federal government and project beneficiaries may jointly fund project construction as required, in which case no repayment occurs. Similarly, annual OM&R costs may be wholly or partly funded by the Federal government and reimbursed by project beneficiaries, or they can be entirely funded by project beneficiaries without Federal appropriation.

Cost Allocation

Cost allocations are typically performed on projects involving Federal funding of construction and/or OM&R. A cost allocation divides costs among project purposes on some equitable basis. The primary purpose of SLLPIP is water supply (M&I and irrigation), but more in-depth analysis in the Feasibility Report Phase could show some additional recreation or fish and wildlife enhancement benefits, depending on which comprehensive plan is selected as the preferred comprehensive plan. There are a variety of methods used to allocate costs among purposes, but those methods are generally based on either consideration of proportionate economic benefits or proportionate water supply. It is important to allocate costs between M&I and irrigation because, on Federally-funded projects, M&I users pay interest during construction and interest on investment, while irrigators usually do not. The cost allocation may serve as the basis for determining the relative share of construction funding between beneficiaries and the Federal government, or if funding is wholly provided by the Federal government, it will serve as the basis for repayment of costs.

Assignment of Costs to Project Beneficiaries

The cost allocation divides costs among purposes, but costs must be further subdivided if there are multiple beneficiaries included in each purpose. For example, an allocation of SLLPIP costs would include an allocation to the irrigation purpose, but there are many affected CVP districts. Like the cost allocation, assignment of allocated costs to individual water users is typically accomplished using proportionate benefits or water supply. The following sections include two example methods to allocate costs of a project and do not necessarily reflect the final approach that will be used for the SLLPIP.

The cost allocation divides costs among purposes, but costs must be further subdivided if there are multiple beneficiaries included in each purpose. For example, an allocation of SLLPIP costs would include an allocation to the irrigation purpose, but there are many affected CVP districts. Like the cost allocation, assignment of allocated costs to individual water users is typically accomplished using proportionate benefits or water supply. The following sections include two example methods to allocate costs of a project and do not necessarily reflect the final approach that will be used for the SLLPIP.

Existing Cost Sharing in the CVP Cost Allocation

When cost sharing is addressed during the Feasibility Report Phase, it is likely that one approach considered will be to allocate and assign SLLPIP costs in the same manner that existing CVP costs are allocated. This approach presumes that SLLPIP will benefit purposes in a manner similar to what is being currently served.

San Felipe Division costs are considered "out of basin" costs and are paid by only those benefiting from those facilities rather than being spread across all CVP water users. Currently, about 67 percent of San Felipe costs are allocated to M&I contractors (primarily SCVWD), 23 percent to irrigation (primarily SBCWD), and 10 percent to recreation and fish and wildlife enhancement purposes. The allocation and assignment of OM&R costs are handled in a similar manner. These cost allocations are based on the feasibility report for construction of the San Felipe Division and contractor negotiation.

SCRB Sample Cost Allocation

This section presents a second cost allocation approach for the SLLPIP. The SCRB cost allocation method uses economic benefits and single-purpose alternative costs to allocate project costs and is appropriate when a project has multiple purposes. The lesser of the value of benefits and the cost of a single-purpose alternative that provides the same level of benefits is called the justifiable expenditure; it is the maximum amount that is justified to spend on obtaining the benefits. The cost of the project with a purpose in question removed is known as the separable cost and is also equal to the cost of adding the purpose back to the project. This represents the minimum cost allocation to a purpose. The separable cost for each purpose is subtracted from its justifiable expenditure, and the remainder is called remaining benefits. Remaining benefits are totaled, and the percentage distribution among projects purposes is calculated. The costs of the project that remain after all separable costs have been deducted are known as remaining joint costs and are spread among project purposes using the remaining benefits percentages. Separable costs and remaining joint costs for each purpose are added to give the total cost allocation to that purpose.

In the event that SLLPIP only serves water supply, total project cost would be allocated to water supply and then suballocated among uses based on volume of use.

Under both existing CVP repayment procedures and laws governing Reclamation-wide repayment, Federal capital and O&M costs allocated to irrigation and M&I water supply are fully reimbursable. Consideration of cost allocation and cost allocation methodology will be more thoroughly examined during the Feasibility Report Phase, as alternatives are refined.

6.4.2 NEPA and CEQA Leads

In order to meet the requirements of NEPA and CEQA, the SLLPIP Study team must determine a Federal NEPA Lead Agency and a State or local CEQA Lead

Agency. Reclamation will act as the NEPA Lead Agency and SCVWD will act as the CEQA Lead Agency for the EIS/EIR.

6.4.3 Environmental Compliance

Reclamation will be responsible for compliance with NEPA and will obtain the appropriate Federal approvals and permits. Reclamation will also be responsible for Section 7 Consultation with USFWS and NMFS, as well as consultation with the SHPO as required by Section 106 of the National Historic Preservation Act.

SCVWD will be responsible for compliance with CEQA and will coordinate with DFG. SCVWD will also be responsible for obtaining all necessary State approvals and permits.

6.4.4 Feasibility Report and EIS/EIR

Reclamation will complete the Feasibility Report. Reclamation and SCVWD will be responsible for completing the EIS/EIR.

Chapter 7
Findings and Future Actions

This chapter summarizes major findings regarding alternative selection, Federal and State interest, and uncertainties and refinements. Future actions and the schedule for the Investigation are also summarized in this chapter.

7.1 Findings

There is a need to develop solutions that address the low point issue associated with San Luis Reservoir. Delivery interruptions, conservative early allocation estimates, and reduced supplies are affecting south-of-Delta contractors, especially in the San Felipe Division. Increasing water demands, additional restrictions on pumping in the Delta, and decreasing carryover storage are expected to reduce the potential to fill San Luis Reservoir each year. Climatological conditions and the health of the Delta will also contribute to greater water supply uncertainty in the future for south-of-Delta contractors dependent on San Luis Reservoir. Developing an innovative solution to the low point issue is a key step in increasing supply reliability for south-of-Delta contractors, who provide irrigation water for over one million acres of highly productive agricultural land and meet the water needs of almost 2 million people.

In this Plan Formulation Phase, the Study team refined and further screened the alternatives using the Federal criteria. Three comprehensive plans and the No-Action Alternative have been carried forward for further analysis:

- No-Action Alternative – No Federal action would be taken to resolve the low point issue.
- Lower San Felipe Intake Comprehensive Plan – Construct a new, lower San Felipe Intake to allow reservoir drawdown to minimum operating pool.
- Pacheco Reservoir Comprehensive Plan– Expand existing Pacheco Reservoir to 80 TAF to provide storage for San Felipe Division contractors. Pacheco Reservoir (Alternative 4B) – Expand existing Pacheco Reservoir to 130 TAF to provide storage for San Felipe Division contractors.
- Combination Comprehensive Plan - Construct and implement multiple structural components and management measures, including increased groundwater aquifer recharge and recovery capacity, desalination,

institutional measures, and the re-operation of the SCVWD raw and treated water systems.

This stage in the planning process has identified the following major findings:

- Preliminary water supply benefit modeling indicates that benefits are similar for all comprehensive plans currently under consideration. The benefit analysis is expected to change as water supply modeling is further refined and a higher level of detail is developed for facilities proposed in the alternative plans.
- All comprehensive plans satisfy the project planning objectives.
- All comprehensive plans have the potential for environmental effects, all of which are considered mitigable. Future studies and environmental analysis may identify additional effects that are not considered mitigable.
- Refined water supply benefit modeling and future economic analyses are expected to support the identification of a recommended plan.
- Alternative plans have been identified that result in positive net NED benefits and significant positive regional economic effects. To date, there has been strong interest at the local, regional, State, and Federal levels in a potential project to address the identified planning objectives and opportunities. This PFR concludes there is a Federal interest in continuing the Study to determine the feasibility of a project to meet the study objectives associated with supply reliability, scheduling certainty, and forecasting supplies. The degree and magnitude of the Federal interest in a potential project will be refined and quantified in the Feasibility Report, EIS/EIR, and supporting documentation.

7.2 Uncertanties

Further definition and resolution of concerns and uncertainties will be a substantial effort in upcoming studies for the Feasibility Report. Certain assumptions were made for aspects of this report based on engineering and scientific judgment. Various uncertainties associated with the Study are discussed below. Uncertainties will be addressed further in the feasibility phase of the Study, to the extent practicable, as evaluations are refined.

7.2.1 Hydrology and Climate Change

The potential for climate change poses a major hydrologic uncertainty, which could possibly produce conditions that are different from those for which current water management operations were designed. The potential for, and magnitude of, climate change is widely debated. Climate change could cause warmer winters with less snow and more rain, resulting in more late winter and early spring runoff but less late spring and early summer runoff. This change in precipitation timing, frequency, and magnitude may require changes in reservoir operation and evacuation of storage to maintain the flood storage space. Less summer moisture available for crops would increase the need for more irrigation water during the growing season, and additional water deliveries may be required to support agriculture. Climate change is also expected to raise sea levels, which would increase Bay-Delta vulnerability to sea water intrusion, impact water quality and deliveries, and increase levee failure and flooding risk.

The State is investing substantial resources in studying how global climate changes could affect the way California receives and stores water. Results indicate that climate changes in the State could affect hydrology, water temperatures for fish, and future operations for both flood damage reduction and water supply deliveries. The effects of climate change on the SLLPIP will be considered in the feasibility phase as data sets for climate change sensitivity analyses become available.

7.2.2 System Operations

Water operations modeling performed for this PFR was completed assuming that current system facilities and operational constraints would not change for the without-project conditions. Federal planning guidance was used to make assumptions about which future projects and plans may or may not be implemented; these projects were correspondingly included or excluded from these models and evaluations. Assumptions made for the PFR evaluations may change during feasibility evaluations, and may affect the findings. The most up-to-date information and assumptions is used for the operations modeling at each phase of the SLLPIP.

Some key areas of uncertainty potentially affecting operational analyses for the SLLPIP include implementation of the SJRRP on the operations of Friant Dam and the San Joaquin River, and changes in Delta export regulations or policies resulting from biological opinions, new ESA listings, or implementation of measures associated with various planning processes for the Delta, including the BDCP and the Delta Plan.

As uncertainties regarding some of these plans and policies are resolved, operational assumptions will be refined, which may change the basis of comparison for or magnitude of the accomplishments of the alternative plans. The timing for potential resolution of any of these uncertainties relative to the SLLPIP schedule is unknown. The biological opinions governing Delta operations have been challenged in court, and it is unclear how the findings will change operations in the future. For the SJRRP, the Stipulation of Settlement indicates that full Restoration Flows will begin in 2014, and river facility construction will be completed by 2016. A program of Interim Flows started on October 1, 2009, and is scheduled to continue until full Restoration Flows begin. The SLLPIP will make refinements to relevant planning assumptions as new information becomes available during the feasibility phase.

7.2.3 Cost Estimates

Cost estimates developed for alternative plans included in this report are based on 2007 price levels. Varying uncertainties are associated with the material and unit costs used to develop the estimates, including the price of construction materials, the proximity of materials to the project site, and labor costs. Trends from the past few years were used to try to reliably estimate the cost of materials, but outside factors could further influence price changes. Cost estimates will be reevaluated and updated in the feasibility phase.

7.2.4 Alternative Refinements

Plan formulation is an iterative process with the intent to lead to identification of a recommended plan for Federal and/or State consideration. As mentioned, the alternative plans described in this report are likely to evolve as the SLLPIP progresses toward completion. In addition to some of the other areas of uncertainty described herein, potential adjustments in the alternatives could result from assumptions and estimates concerning project scope, magnitude of accomplishments and benefits, environmental impacts, types and extent of potential mitigation, necessary physical features, and external projects and programs. This iterative process is important in refining alternatives to ensure that the plan ultimately chosen as the recommended plan best addresses the planning objectives and Federal criteria.

7.3 Future Actions

The next steps will focus on continuation of the Feasibility Study (e.g., planning, engineering, environmental, social and economic, and financial analyses). The analyses will be coordinated with partnering agencies and concerned stakeholders, agencies, public, and tribes, which will culminate in preparation and processing of a Feasibility Report and companion EIS/EIR to address the potential effects of a recommended plan and alternatives. The engineering evaluation will refine the design, layout, and construction methods for each alternative. The economic analysis will update costs and re-evaluate benefits for all comprehensive plans. The environmental analysis will identify potential beneficial and adverse impacts of each alternative according to NEPA and CEQA processes and procedures, and other pertinent environmental laws, regulations, guidelines, and policies. The draft and final Feasibility Report and EIS/EIR will be available for public review and comment, in support of decision making by Reclamation, Department of Interior, the U.S. Congress, and non-Federal partners.

7.3.1 Refinement of Comprehensive Plans

The next stages in the planning process will involve the refinement of the comprehensive plans to assist in the development of the NED plan and the identification of the recommended plan. As site-specific details are developed for the facilities proposed in the plans, the elements in each plan could potentially be modified based on the engineering, economic, and environmental analyses. The detailed comprehensive plans will then be evaluated in the Feasibility Study and EIS/EIR, as required by NEPA and CEQA. The recommended plan should be consistent with the requirements to identify the NED Plan (per P&G), Proposed Action and Preferred alternative (per NEPA), Proposed Project and Environmentally Superior Alternative (per CEQA), and the Least Environmentally Damaging Practicable Alternative (per Clean Water Act, Section 404).

7.3.2 Analysis of Economic Benefits

M&I Water Supply Benefits

The economic analysis in the Feasibility Report will determine “willingness-to-pay” by focusing on incremental water supplies provided by each of the SLLPIP plans to the end users.

Under the No-Action Alternative, end users would experience a water shortage during the low point months. SLLPIP comprehensive plans would provide water supplies to avoid these shortages, and depending on the plan, provide additional water supplies to CVP M&I users. End users are willing to pay a certain amount to avoid water shortages. This “willingness to pay” is an estimate of the value of water to the customer, or the benefit value of water supply.

There are several technically acceptable methods to estimate willingness to pay for M&I water that will be considered in the Feasibility Report Phase. One method is to use existing price elasticity measurements to develop a demand curve for M&I water supply.[1]

If price elasticity, current price, and quantity demanded are known, then a demand curve can be specified to estimate changes in residential willingness to pay (benefits) to avoid potential water shortages. These benefits can then be compared to the costs to avoid the shortages that would be associated with various plans, to determine whether the plans are economically justified.

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1 Price elasticity of demand is defined as the percentage change in quantity demanded of a good divided by the percentage change in price.

Agricultural Water Supply Benefits

For the Feasibility Report, the economic analysis of agricultural water supply benefits will further assess the effect earlier allocations would have on farming decisions. For this PFR, CVPM estimates the additional water supplies primarily result in changes in groundwater pumping costs. However, more aggressive, early allocations could result in the suspension of planned water transfers that would have been secured absent the higher allocation or cropping pattern changes. These options will be further analyzed and, if applicable, quantified in the Feasibility Report.

The current CVPM benefits reflect only a single model run using the average water supply change over the CALSIM period of record. This approach does not likely provide adequate resolution on year-to-year benefits, since the average includes many “zero effect” years. Representative years may be modeled in CVPM for the Feasibility Report.

In the Feasibility Report, CVPM will be used to estimate benefits within the San Felipe Division, rather than grouping them with Regions 10 and 14[2] benefits. This will give a more accurate estimate of agricultural water supply benefits to SCVWD and SBCWD than previous analyses. The economic analysis in the Feasibility Report will also address the potential costs to San Felipe Division irrigators caused by poor quality reservoir water clogging irrigation sprinklers. This would be an avoided cost, or benefit, under the SLLPIP comprehensive plans.

Cost-Sharing and Financial Feasibility Analysis

The cost sharing analysis in Feasibility Report will be updated as the comprehensive plans are further refined and a recommended plan is selected. The cost sharing process typically involves determination of costs to be shared, a cost allocation, and assignment of costs to individual project beneficiaries. SLLPIP primary purposes include M&I water supply and irrigation water supply, but more in-depth analysis in the Feasibility Report Phase could show some additional recreation or fish and wildlife benefits, depending on which comprehensive plan is selected as the recommended plan. The PFR identified various approaches to assign costs to project beneficiaries. The approaches will be more thoroughly examined during the Feasibility Report Phase. The Feasibility Report will also include a financial feasibility analysis to evaluate the financial capability of each beneficiary to pay for its share of the project.

7.3.3 Agency Coordination and Stakeholder Involvement

The SLLPIP Study Team will continue to coordinate with interested Federal, State, and local agencies as they further refine the SLLPIP comprehensive

2 For modeling purposes, the CVPM divides the Central Valley into 21 different crop production regions. The regions in the SLLPIP study area include Region 10 – Delta-Mendota Canal CVP users and Region 14 – Westlands Water District.

plans. The Study Team will also complete public involvement activities required by NEPA and CEQA as well as additional activities designed to keep stakeholders up-to-date on project progress.

7.4 Schedule and Status of Feasibility Report

The draft Feasibility Report and EIS/EIR are expected for public release in the summer of 2011, with the Final Feasibility Report and EIS/EIR anticipated in the winter of 2011. A decision is anticipated in early 2012, as listed below.

Draft Feasibility Report and EIS/EIR	Summer 2011
Final Feasibility Report and EIS/EIR	Winter 2011
Washington D.C. Review	Winter 2011
Record of Decision/Findings	Spring 2012

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Appendix A
Water Operations Modeling

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Water Operations Modeling

A.1 Introduction and Background

The purpose of the San Luis Low Point Improvement Project (SLLPIP) is to address the delivery schedule uncertainty and water supply reliability problems that occur when San Luis Reservoir water storage levels drop below 369 feet above mean sea level or 300 thousand acre-feet (TAF).

Conditions in San Luis Reservoir promote the growth of reservoir-wide algae during summer months. The water quality within the algae blooms is not suitable for agricultural water users with drip irrigation systems in San Benito County and for municipal and industrial (M&I) water users and existing water treatment facilities in Santa Clara County.

As water levels decline to the point that the algae is near the Upper Pacheco Intake, that intake is no longer used. Low point conditions occur when the water levels decline to the point that the algae blooms are near the Lower Pacheco Intake. Typically, this point occurs when water levels reach an elevation of 369 feet above mean sea level or 300 thousand acre-feet (TAF), when the water is approximately 35 feet above the top of the Lower Pacheco Intake (334 feet above mean sea level or 110 TAF).

The SLLPIP Feasibility Study (Study) is investigating alternatives to optimize the water supply benefits of San Luis Reservoir and accomplish the following objectives.

- Avoiding supply interruptions when water is needed by increasing the certainty of meeting the requested delivery schedule throughout the year to south-of-Delta contractors dependent on San Luis Reservoir.
- Increasing the reliability and quantity of yearly allocations to south-of-Delta contractors dependent on San Luis Reservoir.
- Announcing higher allocations earlier in the season to south-of-Delta contractors dependent on San Luis Reservoir without sacrificing accuracy of the allocation forecasts.

This technical appendix to the Plan Formulation Report (PFR) describes the modeling tools and assumptions used in analyses that support the PFR. The PFR evaluated several alternatives for their ability to satisfy the above objectives. Simulations of CVP and State Water Project (SWP) operations were performed to determine the alternatives' effects on water supply reliability, San Luis Reservoir storage levels, and CVP allocations to south-of-Delta (SOD) contractors. To quantify the results, operation of the CVP/SWP system with each project alternative is compared to operations under an assumed Future No Action (FNA) condition.

This technical appendix begins with a description of the key components of the physical system relative to San Luis Reservoir operations (Section A.2). Section A.2 describes CalSim, the system operations planning model used for most water operations analyses conducted in support of the PFR. Descriptions of the FNA conditions for San Luis Reservoir and San Felipe Division deliveries (Sections A.3 through Section A.4) are followed by discussion of key assumptions and results of limited sensitivity analysis conducted for those key assumptions (Section A.6). Sections A.7 through A.9 describe the evaluation of each alternative and describe the models and assumptions used in the analysis. Key results, primarily focused on water deliveries, are provided for each comprehensive plan.

A.2 Physical System

The following paragraphs describe the physical system and facilities that are most likely to be affected by the operation of the SLLPIP alternatives, and which have been considered in the technical analysis. The system and facilities as described below make up the assumed existing baseline. Subsequent sections describe assumptions regarding how these facilities would be modified or operated under an FNA scenario.

A.2.1 San Luis Reservoir

San Luis Reservoir is a jointly operated Federal and State of California facility and part of the San Luis Unit of the CVP. San Luis Reservoir was formed in 1967 by the construction of Sisk Dam. The reservoir stores water available from the CVP's Delta-Mendota Canal (DMC) and the SWP's California Aqueduct during the non-irrigation wet season (October through March) and delivers water during the dry season (April through September) when irrigation occurs. The reservoir's capacity is approximately 2.028 million acre-feet (MAF). Reclamation manages 47.6% or 965 TAF of the capacity; the remainder is owned and operated by the SWP.

Water is delivered from San Luis Reservoir through the William R. Gianelli Pumping-Generating Plant and O'Neill Forebay to CVP and SWP contractors via the DMC and the California Aqueduct. These facilities are located on the east side of San Luis Reservoir. Water is also delivered from the west side of San Luis Reservoir to contractors in the San Felipe Division of the CVP. The San Felipe Division includes Santa Clara Valley Water District (SCVWD) and the San Benito County Water District (SBCWD. Water is delivered to these contractors through the Pacheco Pumping Plant, Tunnel, and Conduit.

San Luis Reservoir is the major SOD storage facility for both the CVP and SWP (the Projects). The Projects use San Luis Reservoir to store water exported from the Sacramento-San Joaquin River Delta (Delta). The Projects export Delta flows that are in excess of flows needed to meet in-Delta demands, water quality, and flow requirements. These excess flows may be a result of uncontrolled Delta inflow or water released from North-of-Delta (NOD) reservoirs. When the ability to export excess flow exceeds SOD demands, the Projects store water in San Luis Reservoir. When SOD demands exceed the ability of the Projects to export water from the Delta water is released from San Luis Reservoir. SOD demands are typically less than Delta export capacity during October through March, allowing the Projects to store exports in San Luis Reservoir until needed. San Luis Reservoir typically reaches maximum annual storage levels in April as demands begin to exceed Delta export capacity. Typically, beginning in mid-April the Projects draw on San Luis Reservoir to supplement Delta exports and meet SOD demands. San Luis Reservoir typically reaches its lowest annual storage level in late August or September.

A.2.2 CVP South of Delta Contractors

The CVP provides water to numerous SOD contractors under different contract types and arrangements. These contractors include the San Joaquin River Exchange Contractors, CVP Wildlife Management Areas, agricultural service contractors, and M&I service contractors. Contractors take delivery of CVP water from the upper and lower DMC, Mendota Pool, and the Joint Reach of the California Aqueduct on the east side of San Luis Reservoir and the Pacheco Pumping Plant, Tunnel, and Conduit on the west side of the reservoir.

On each side of the reservoir, the primary contractors of interest for the SLLPIP are agricultural and M&I service contractors. Service contractors that take delivery from the east side of San Luis Reservoir hold contracts for approximately 1.86 MAF of water. Most of these contractors are member agencies of the San Luis and Delta-Mendota Water Authority (SLDMWA). The SLDMWA assumes responsibility for the operations and maintenance of certain CVP facilities that deliver water to its member agencies. The majority of these contracts are for agricultural water with smaller M&I contracts for the Cities of Tracy, Avenal, Coalinga, and Huron. M&I service contracts supplied from the east side of the reservoir total 36.5 TAF.

Service contractors supplied through the Pacheco Pumping Plant make up the San Felipe Division of the CVP and include SCVWD and SBCWD. The Service contracts provide for a maximum total quantity of CVP water to be made available annually to the Contractor (subject to shortages) for irrigation and M&I purposes. The scheduling of the total contract supplies available between irrigation and M&I use is flexible. For modeling purposes, maximum deliveries of irrigation water and M&I supplies assumed are in Table A-1, in TAF per year, for each agency in the San Felipe Division. The quantities listed in the "Agency Total" column constitute total contract amounts. The agency totals are not assumed to change under future assumptions. Pajaro Valley Water Management Agency (PVWMA) does not have a contract to receive water through the San Felipe Division, but it has received a partial assignment of CVP water from Mercy Springs Water District. Because PVWMA cannot currently take the water, it entered into an agreement with Westlands Water District and SCVWD allowing them to use the water until PVWMA is ready to take delivery of the water. CalSim includes the 6.3 TAF from this assignment as PVWMA water. This water demand was maintained in CalSim because some of this water is now going to SCVWD and it may all go to PVWMA in the future.

Table A-1. Assumed CVP San Felipe Division Annual Water Use Quantities in CalSim (TAF)

Agency	Irrigation	M&I	Agency Total
Santa Clara Valley Water District	33.1	119.4	152.5
San Benito County Water District	35.6	8.3	43.9
Pajaro Valley Water Management Agency[1]	6.3	0.0	6.3
Total by Contract Type	**75**	**127.7**	**202.7**

Notes:
[1] The PVWMA service area was part of the authorized San Felipe Division, but they have never entered into the necessary contracts to receive water from the San Felipe Division or to repay the costs of constructing the San Felipe Division. CalSim, however, includes PVWMA as part of the San Felipe Division.

Forecasted and actual low point events can interrupt the ability of contractors in the San Felipe Division to divert water from the reservoir. M&I deliveries can be interrupted when the total storage in San Luis Reservoir drops below 300 TAF. Agricultural contractors on the west side of the reservoir may also have deliveries interrupted due to degraded water quality.

A.2.3 CVP Allocation Process

Reclamation's Central Valley Operations Office (CVOO) is responsible for operating CVP reservoirs and making annual allocations to CVP contractors. Annual water delivery allocations are the portion of full contract supply the CVP can commit to deliver. Allocations are made as a percentage of full contract supply and range from 0 to 100%. Separate allocations are made for areas north and south of the Delta, and for M&I and agricultural contracts. M&I allocations are always greater than or equal to agricultural contract allocations and specific criteria exist for how each type of contract is reduced when the CVP cannot commit to provide full contract supply.

CVOO typically makes a preliminary allocation in January and the initial allocation in February. Allocations are refined and adjusted throughout the year based on improved information on water supplies and demands. CVOO determines allocations by considering available water supplies, based on current storage levels in CVP reservoirs and forecasts of reservoir inflows at the ninetieth percentile (inflow that is expected to be equaled or exceeded 90% of the time). CVOO balances available supply estimates with water demands. Water demands include demands from CVP contractors, minimum in-stream flow requirements, downstream temperature requirements, and Delta flow and water quality requirements. Forecasts of Delta conditions and flow requirements combined with the experience of CVP operators enable CVOO to forecast the capacity to move water through the Delta for delivery to SOD contractors. CVOO uses a monthly spreadsheet model that balances supply and demand forecasts and simulates future reservoir levels in order to make allocations.

The uncertainty in both supply and demand forecasts typically results in adjustments to allocations as the CVP contract year progresses. Later in the year, CVOO has more information regarding reservoir inflows, Delta conditions, and contractor and environmental demands. More certainty regarding both water supply and demand often allows CVOO to increase allocations. The value of increased allocations to CVP contractors can depend on when the increase occurs. For agricultural contractors, allocation increases made after approximately April 15th are less valuable than those made earlier because, by then, farmers have already decided what crops to plant and how many acres to put into production.

A.2.4 SWP South of Delta Operations

The San Luis Reservoir low point is also influenced by SWP SOD operations. Variations in SWP exports, demands, deliveries, and carryover have a significant influence on the total storage in San Luis Reservoir. SWP contractors hold contracts for over 4 MAF of water SOD. These contracts include approximately 1 MAF of agricultural water and 3 MAF of M&I water. The SWP exports water from the Delta at the Banks Pumping Plants and transports it south through the California Aqueduct. The South Bay and Coastal Aqueducts move water west from the California Aqueduct. The California Aqueduct splits into an east and west branch after going over and through the Tehachapi Mountains in Southern California. Four terminal reservoirs regulate flow near the end of the east and west branch and provide emergency supplies for M&I demands in Southern California.

SWP operations are not expected to change significantly under most of the SLLPIP comprehensive plans. However, SWP operations can and do have a significant influence on the frequency, magnitude, and duration of low point condition. Assumptions regarding SWP operations for existing and FNA conditions are provided in subsequent sections.

A.2.5 Delta Facilities

Major CVP facilities in the Delta include the Delta Cross Channel, Contra Costa Canal, C.W. “Bill” Jones Pumping Plant (Jones Pumping Plant), and the DMC. The Delta Cross Channel is a diversion channel between the Sacramento River and Snodgrass Slough near Walnut Grove. The Delta Cross Channel is used to draw fresh water supplies from the Sacramento River to the interior of the Delta and the export facilities to improve water quality. The Contra Costa Canal delivers water diverted from the lower San Joaquin River near Oakley to Contra Costa County and communities in the East Bay.

The Jones Pumping Plant consists of six pumps with a combined capacity of approximately 4,600 cubic feet per second (cfs). The pumping plant lifts water into the DMC from a canal near the junction of Old River and Grant Line Canal in the south Delta. The DMC transports water from the Jones Pumping Plant 117 miles along the west side of the San Joaquin Valley to the Mendota Pool, west of Fresno. The DMC also supplies water to the O’Neill Forebay, from where it is pumped into storage in the CVP portion of San Luis Reservoir or delivered to CVP contractors off of the San Luis Aqueduct.

The SWP also has significant infrastructure in the Delta, including the Banks Pumping Plant and the California Aqueduct. The Banks Pumping Plant is west of Jones Pumping Plant and connected to the Clifton Court Forebay. The Banks Pumping Plant has a capacity of 10,350 cfs; however, the 1981 “Four Pumps Agreement” issued by the U.S. Army Corps of Engineers constrains its capacity to 6,680 cfs from March 16th through December 14th. Outside of this period, pumping is limited to 6,680 cfs plus one-third of the total flow of the San Joaquin River at Vernalis when flow exceeds 1,000 cfs. When flow of the San Joaquin River at Vernalis is less than 1,000 cfs, pumping at Banks Pumping Plant is limited to 6,680 cfs. The Banks Pumping Plant lifts water into the California Aqueduct for delivery to SWP contractors in the Central Valley and Southern California. Water is diverted directly from the California Aqueduct and delivered to O’Neill Forebay for storage in the State of California’s portion of San Luis Reservoir.

Operational changes in either the CVP or SWP Delta facilities can affect storage in San Luis Reservoir. Delta exports at Jones and Banks Pumping Plants typically have the largest effects, but other changes may also affect the reservoir and low point issues. Analysis of the SLLPIP comprehensive plans must incorporate operations of both CVP and SWP Delta facilities, because implementation of the comprehensive plans may cause changes in how Delta facilities are utilized.

A.2.6 North of Delta Facilities

The Sacramento Valley encompasses about six million acres of developed agricultural and urban areas and undeveloped native areas. The Sacramento River system, from which the CVP acquires water, includes the Sacramento River and its major tributaries: the Feather, Yuba, Bear, and American Rivers and their tributaries. The CVP also imports Trinity River water through facilities on the Trinity River and Clear Creek. Most major streams and rivers in the Sacramento Valley are regulated by reservoirs of various sizes to provide flood control, water supply, hydropower, and other benefits.

Major reservoirs in the Sacramento Valley include those in the CVP: Lake Shasta (4.55 MAF) and Folsom Lake (975 TAF), and the SWP's Oroville Reservoir (3.56 MAF). The most significant effects that would occur with implementation of the SLLPIP comprehensive plans would likely be in CVP reservoirs, with smaller effects through the remainder of the upstream system. Changes in Delta exports can create changes in flows required to meet water quality requirements, both in the models and in actual operations. These changes can affect the operations at upstream reservoirs for both the CVP and SWP.

A.3 System Model

Water operations modeling was performed using Version 9A (V9A) of the California Simulation Model (CalSim). CalSim is a hydrologic planning model of California's waterscape with an emphasis on the CVP and SWP systems. CalSim was developed jointly by the U.S. Bureau of Reclamation (Reclamation) and the Department of Water Resources (DWR). CalSim utilizes a mixed integer linear programming solver to determine the optimal set of decisions based on a set of weights and constraints. The weights and constraints were developed to simulate reservoir and Delta operations under various regulatory and physical frameworks.

CalSim V9A has been expanded and refined through the Common Assumptions process for the CALFED surface storage investigations. The Common Assumptions effort is designed to establish common baseline conditions as starting points for analysis of individual projects by providing commonly accepted conditions and assumptions regarding the operation of the major water system components at existing and future levels of development. The Common Assumptions process made significant improvements to the CalSim model in order to provide a common representation of both the existing and future level conditions for use in all CALFED surface storage investigations.

The Common Assumptions version of CalSim covers the Sacramento and San Joaquin River valley floor drainage areas, the upper Trinity River, the San

Joaquin Valley, and southern California agricultural and urban areas served by the CVP and SWP.

CalSim is set up to simulate and account for the effects of various regulatory requirements by running multiple “steps.” CalSim model “steps” simulate system operations under various regulatory requirements and agreements. The model is run for one year for each “step” and end-of-year conditions from the final step are then input to start model simulation of the first step in the next year. The Common Assumptions V9A CalSim model contains the following five steps:

D-1641 The regulatory requirements provided in State Water Resources Control Board (SWRCB) Decision 1641 (D-1641). D-1641 was issued in 1999 and revised in 2000. D-1641 specifies how the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, adopted May 22, 1995 (1995 Water Quality Control Plan) and revised December 13, 2006, is to be implemented. D-1641 provides both flow and water quality requirements at several locations in the Delta. D-1641 is the current basis for most regulatory requirements governing the Delta and affects how the CVP and SWP operate upstream reservoirs and Delta export pumps. CalSim simulates the system under these regulations and stores the resulting operations for comparison and use with other steps.

D-1485 The regulatory requirements provided in SWRCB Decision 1485 (D-1485). D-1485 was replaced by D-1641 and is no longer used for Delta standards or for operation of the CVP or SWP; however, a D-1485 simulation is necessary for water accounting purposes. Section b(2) of the Central Valley Project Improvement Act (CVPIA) dedicated 800 TAF of water to be made available for environmental purposes. This “b(2)” water is split into two separate accounts: non-discretionary and discretionary. Non-discretionary b(2) water, all or part of the 800 TAF, is the difference in water amounts (either additional releases from upstream reservoirs or water available but not exported from the Delta) to meet the more stringent requirements of D-1641 instead of the previous requirements of D-1485. Therefore, CalSim simulates the operations of the system under both D-1641 and D-1485 to determine this difference in water amounts.

CVPIA b(2) As described above, CVPIA b(2) dedicated 800 TAF of water annually to environmental purposes. The b(2) step compares the operations of the system under both D-1641 and D-1485 to determine the non-discretionary portion of b(2) water. The use of the remaining volume of water, the discretionary account, is simulated in the b(2) step. Discretionary b(2) water may include additional winter releases from upstream reservoirs or export reductions in the weeks before and after the reductions that occur as part of the Vernalis Adaptive Management Plan (VAMP). CalSim results at the end of the b(2) step depict the operation of the system under D-1641 and CVPIA b(2).

Under FNA conditions, the operation of the California Aqueduct-DMC Intertie is simulated in the b(2) step. These results are used as the basis for simulation of additional operations in the following steps.

Conveyance The conveyance and transfer steps of CalSim are primarily used to simulate specific aspects of Project operations, rather than regulatory requirements, as in the preceding steps. CVPIA b(2) actions and costs are "fixed" to those simulated in the b(2) step. For FNA conditions, the conveyance step simulates Stage 1 water transfers. Stage 1 transfers are included in CVP and SWP allocations, and include transfers associated with the Bay-Delta Hearings Phase 8 Settlement (Phase 8) and the Lower Yuba River Accord.

Transfer The transfer step layers Stage 2 water transfers onto operations from the conveyance step and simulates Joint Point of Diversion operations for the CVP and SWP (Joint-Point). Stage 2 water transfers are region-specific acquisitions made by M&I water users to supplement project water supplies. Stage 2 transfers are private party transfers moved through the Delta as a last priority for export capacity. Joint-Point operations increase the flexibility of CVP and SWP exports by allowing both of the Projects to utilize available export capacity at the other Project's pumps. The CVP tends to derive greater benefit from Joint-Point operations because its operations are more often constrained by export capacity. The transfer step also includes the wheeling of CVP water for Cross Valley Canal contractors at the Banks pumping plant.

The five-step simulation was used to evaluate the baseline, the FNA baselines and all SLLPIP comprehensive plans because it simulates actions that affect San Luis Reservoir and available Delta export capacity.

The Common Assumptions process developed an additional model step to simulate the operations of the Environmental Water Account (EWA) Program. The EWA is an agreement between U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, Reclamation, and DWR. The purpose of the EWA is to protect fisheries (primarily winter and spring run Chinook salmon, Delta smelt, and steelhead) by reducing Delta pumping during critical times of the year, and recovering water lost due to pumping reductions with water transfers, purchases, and increased pumping at other times of the year. The timing and volume of pumping reductions varies with hydrology and fish behavior, making forecasting EWA actions difficult. EWA fish actions typically reduce exports in the winter and spring period, with the largest curtailments during the VAMP pulse period in April and May. During the pumping reductions, San Luis Reservoir storage is drawn down to make deliveries that otherwise would have been made directly from the export pumps, creating a "debt" to San Luis Reservoir—a storage deficit; the largest deficit typically occurs in June. EWA deficits in San Luis Reservoir storage are typically replaced over the summer with water transfers, purchases, and increased pumping. As part of the EWA Program, the export to inflow (EI) ratio can be relaxed to recover water lost during pumping reductions. The EWA has 500 cfs of dedicated pumping capacity from July through September to facilitate cross-Delta transfers and assist in the recovery of water lost due to EWA actions. The EWA is not currently included in Common Assumptions for either existing or FNA conditions. The current CalSim representation of EWA is still undergoing quality control. The changing nature of EWA and its implementation make it difficult to simulate.

A.3.1 Model Assumptions

Table A-2 is reproduced from the Common Assumptions CalSim documentation. The table provides a general description of the regulations and agreements that are simulated. The existing and supplemental future conditions shown in Table A-2 were not used in analyses conducted for the PFR.

Modifications to Common Assumptions CalSim for SLLPIP

Several modifications were made to the Common Assumptions CalSim V9A model to develop a representation of the FNA conditions. These changes help refine simulations of CVP San Felipe Division operations and correct minor issues in the model. Some of the changes made for this project will be included in the next release of the Common Assumptions package.

San Felipe Division Delivery Pattern San Felipe Division delivery patterns in CalSim were reviewed prior to performing any modeling. Because the delivery patterns in the Common Assumptions model were not representative of actual San Felipe Division deliveries, the delivery patterns were adjusted for use in simulations of FNA conditions. Delivery patterns in the Common Assumptions model were based on historical water charges from Reclamation's accounting database. These patterns were heavily influenced by a few months when water charges did not represent actual water deliveries. Figure A-1 illustrates the delivery patterns in the Common Assumptions model. CalSim delivery patterns are represented as a percentage of contract year demand taken each month. CVP SOD delivery patterns, including San Felipe Division, do not vary from year to year in CalSim.

Table A-2. Common Assumptions CalSim Inputs Assumptions: Common Model Package (Version 9A)

	Existing Condition Assumption	Future No Action Condition Assumption	Supplemental Future Condition (#1) Assumption
Planning horizon	2004[a]	2030[a]	Same
Demarcation date	June 1, 2004[a]	Same	Same
Period of simulation	82 years (1922–2003)	Same	Same
HYDROLOGY			
Level of development	2005 level[b]	2030 level[c]	Same
Sacramento Valley (excluding American River)			
CVP	Land-use based, limited by contract amounts[d]	Same	Same
SWP (FRSA)	Land-use based, limited by contract amounts[e]	Same	Same
Nonproject	Land-use based	Same	Same
Federal refuges	Recent historical Level 2 deliveries[f]	Firm Level 2 water needs[f]	Same
American River			
Water rights	2004[g]	Sacramento Area Water Forum[g,h]	Same
CVP	2004[g]	Sacramento Area Water Forum (PCWA modified)[g,h]	Same
PCWA	No CVP contract water supply	35,000 AF CVP contract supply diverted at the new American River PCWA Pump Station	Same
San Joaquin River[i]			
Friant Unit	Limited by contract amounts, based on current allocation policy	Same	Same
Lower Basin	Land-use based, based on district-level operations and constraints	Same	Same
Stanislaus River	Land-use based, based on New Melones IOP[j]	Same	Same
South of Delta (CVP/SWP project facilities)			
CVP	Demand based on contracts amounts[d]	Same	Same
Contra Costa Water District	124,000 AF CVP contract supply and water rights[k]	195,000 AF CVP contract supply and water rights[k]	Same
SWP	Demand varies based pattern used for 2004 OCAP Today studies; Table A transfers that occurred in 2005 and 2006 are not included	Demand based on full Table A amounts[e,l]	Same
Article 56	Based on 2002–2006 contractor requests	Same	Same
Article 21	MWD demand up to 100,000 AF/month from December to March, total of other demands up to 84,000 AF/month in all months[e,l]	MWD demand unlimited but subject to capacity to convey and deliver; KCWA demand of up to 2,555 cfs; others same as existing	Same
Federal refuges	Recent historical Level 2 deliveries[f]	Firm Level 2 water needs[f]	Same
FACILITIES			
Systemwide	Existing facilities[a]	Same	Same
Sacramento Valley			
Shasta Lake	Existing, 4,552,000 AF capacity	Same	Same
Colusa Basin	Existing conveyance and storage facilities	Same	Same
Upper American River	PCWA American River pump station not included	PCWA American River pump station included	Same
Lower Sacramento River	Freeport Regional Water Project not included	Freeport Regional Water Project included	Same

Table A-2. Common Assumptions CalSim Inputs Assumptions: Common Model Package (Version 9A)

	Existing Condition Assumption	Future No Action Condition Assumption	Supplemental Future Condition (#1) Assumption
Delta Region			
SWP Banks Pumping Plant	6,680 cfs capacity[a]	Same	8,500 cfs capacity[a]
CVP C.W. "Bill" Jones Pumping Plant	4,200 cfs plus diversions upstream of DMC constriction	4,600 cfs capacity in all months (allowed for by the Delta-Mendota Canal–California Aqueduct Intertie)	Same
Los Vaqueros Reservoir	Existing storage capacity, 100,000 AF, (Alternative Intake Project not included)	Existing storage capacity, 100,000 AF; Alternate Intake Project included[o]	Same
San Joaquin River			
Millerton Lake (Friant Dam)	Existing, 520,000 AF capacity	Same	Same
South of Delta (CVP/SWP project facilities)			
South Bay Aqueduct Enlargement	None	430 cfs capacity from junction with California Aqueduct to Alameda County FC&WSD Zone 7 diversion point	Same
California Aqueduct East Branch Enlargement	None	None	Same
WATER MANAGEMENT ACTIONS (CALFED)			
Water Transfer Supplies (available long term program)			
Phase 8[n]	None	Supplies up to 185,000 AF/yr from new groundwater substitution, with 60% going to SWP and 40% to CVP[p]	Same
Lower Yuba River Accord	Not included	Not included	Same
REGULATORY STANDARDS			
Trinity River			
Minimum flow below Lewiston Dam	Trinity EIS Preferred Alternative (369,000–815,000 TF/year)	Same	Same
Trinity Reservoir end-of-September minimum storage	Trinity EIS Preferred Alternative (600,000 AF as able)	Same	Same
Clear Creek			
Minimum flow below Whiskeytown Dam	Downstream water rights, 1963 Reclamation Proposal to USFWS and National Park Service, and USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
Upper Sacramento River			
Shasta Lake end-of-September minimum storage	SWRCB WR 1993 Winter-Run Biological Opinion (1,900,000 AF)	Same	Same
Minimum flow below Keswick Dam	Flows for SWRCB WR 90-5 and USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
Feather River			
Minimum flow below Thermalito Diversion Dam	1983 DWR–CDFG Agreement (600 cfs)	Same	Same
Minimum flow below Thermalito Afterbay outlet	1983 DWR–CDFG Agreement (750-1,700 cfs)	Same	Same
Yuba River			
Minimum flow below Daguerre Point Dam	Interim D-1644 Operations[q]	Same	Same
American River			
Minimum flow below Nimbus Dam	SWRCB D-893[r] (see accompanying Operations Criteria), and USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
Minimum Flow at H Street Bridge	SWRCB D-893	Same	Same
Lower Sacramento River			
Minimum flow near Rio Vista	SWRCB D-1641	Same	Same

Table A-2. Common Assumptions CalSim Inputs Assumptions: Common Model Package (Version 9A)

	Existing Condition Assumption	Future No Action Condition Assumption	Supplemental Future Condition (#1) Assumption
Mokelumne River			
Minimum flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (100-325 cfs)	Same	Same
Minimum flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (25-300 cfs)	Same	Same
Stanislaus River			
Minimum flow below Goodwin Dam	1987 Reclamation–CDFG agreement, and USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
Minimum dissolved oxygen	SWRCB D-1422	Same	Same
Merced River			
Minimum flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180-220 cfs, Nov-Mar), Cowell Agreement, and FERC 2179 (25-100 cfs)	Same	Same
Tuolumne River			
Minimum flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94,000–301,000 AF/year)	Same	Same
San Joaquin River			
San Joaquin River below Friant Dam/Mendota Pool	None	None	None
Maximum salinity near Vernalis	SWRCB D-1641	Same	Same
Minimum flow near Vernalis	SWRCB D-1641, and VAMP per SJRA	Same[s]	Same[s]
Sacramento River–San Joaquin River Delta			
Delta Outflow Index (Flow and Salinity)	SWRCB D-1641	Same	Same
Delta Cross Channel gate operation	SWRCB D-1641	Same	Same
Delta exports	SWRCB D-1641, USFWS discretionary use of CVPIA 3406(b)(2)	Same	Same
OPERATIONS CRITERIA: RIVER-SPECIFIC			
Upper Sacramento River			
Flow objective for navigation (Wilkins Slough)	3,500–5,000 cfs based on CVP water supply condition	Same	Same
American River			
Folsom Dam flood control	Variable 400/670 flood control diagram (without outlet modifications)	Same	Same
Flow below Nimbus Dam	Discretionary operations criteria corresponding to SWRCB D-893 required minimum flow	Same	Same
Sacramento Area Water Forum Mitigation Water	None	Up to 47,000 AF in dry years	Same
Feather River			
Flow at Mouth of Feather River (above Verona)	Maintain CDFG/DWR flow target of 2,800 cfs for Apr-Sep dependent on Oroville inflow and FRSA allocation	Same	Same
Stanislaus River			
Flow below Goodwin Dam	1997 New Melones IOP	Same	Same
San Joaquin River			
Salinity at Vernalis	D-1641	San Joaquin River Salinity Management Plan[t]	Same

Table A-2. Common Assumptions CalSim Inputs Assumptions: Common Model Package (Version 9A)

	Existing Condition Assumption	Future No Action Condition Assumption	Supplemental Future Condition (#1) Assumption
OPERATIONS CRITERIA: SYSTEMWIDE			
CVP water allocation			
CVP Settlement and Exchange	100% (75% in Shasta critical years)	Same	Same
CVP refuges	100% (75% in Shasta critical years)	Same	Same
CVP agriculture	100%-0% based on supply (SOD allocations are reduced due to D-1641 and 3406(b)(2) allocation-related export restrictions)	Same	Same
CVP municipal & industrial	100%-50% based on supply (SOD allocations are reduced due to D-1641 and 3406(b)(2) allocation-related export restrictions)	Same	Same
SWP water allocation			
North of Delta (FRSA)	Contract-specific	Same	Same
South of Delta (including North Bay Aqueduct)	Based on supply; equal prioritization between agriculture and municipal and industrial based on Monterey Agreement	Same	Same
CVP-SWP coordinated operations			
Sharing of responsibility for in-basin use	1986 Coordinated Operations Agreement (2/3 of the North Bay Aqueduct diversions are considered as Delta Export, 1/3 of the North Bay Aqueduct diversion is considered as in-basin use)	1986 Coordinated Operations Agreement (FRWP EBMUD and 2/3 of the North Bay Aqueduct diversions are considered as Delta Export, 1/3 of the North Bay Aqueduct diversion is considered as in-basin use)	Same
Sharing of surplus flows	1986 Coordinated Operations Agreement	Same	Same
Sharing of restricted export capacity for project-specific priority pumping	Equal sharing of export capacity under SWRCB D-1641; use of CVPIA 3406(b)(2) restricts only CVP exports	Same	Same
Dedicated CVP conveyance at BPP	None	SWP to convey 50,000 AF/year of Level 2 refuge water supplies at BPP (July and August)	SWP to convey 100,000 AF/year of Level 2 refuge water supplies at BPP (July and August)
North-of-Delta accounting adjustments	None	CVP to provide the SWP a maximum of 375,000 AF/year of water to meet in-basin requirements through adjustments in 1986 Coordinated Operations Agreement accounting (released from Shasta)	CVP to provide the SWP a maximum of 75,000 AF/year of water to meet in-basin requirements through adjustments in 1986 Coordinated Operations Agreement accounting (released from Shasta)
Sharing of export capacity for lesser priority and wheeling-related pumping	Cross Valley Canal wheeling (maximum of 128,000 AF/year), CALFED ROD defined Joint Point of Diversion	Same	Same
San Luis Low Point	San Luis Reservoir is allowed to operate to a minimum storage of 100,000 AF	Same	Same
CVPIA 3406(b)(2)			
Policy Decision	Per May 2003 Dept. of Interior Decision:	Same	Same
Allocation	800,000 AF, 700,000 AF in 40-30-30 dry years, and 600,000 AF in 40-30-30 critical years	Same	Same

Table A-2. Common Assumptions CalSim Inputs Assumptions: Common Model Package (Version 9A)

	Existing Condition Assumption	Future No Action Condition Assumption	Supplemental Future Condition (#1) Assumption
CVPIA 3406(b)(2) (continued)			
Actions	1995 WQCP, Upstream fish flow objectives (Oct-Jan), VAMP (Apr 15-May 15) CVP export restriction, 3,000 cfs CVP export limit in May and June (D-1485 striped bass cont.), Post-VAMP (May 16-31) CVP export restriction, Ramping of CVP export (June), Upstream Releases (Feb-Sep)	Same	Same
Accounting adjustments	Per May 2003 Interior Decision, no limit on responsibility for nondiscretionary D-1641 requirements with 500,000 AF target, no reset with the storage metric and no offset with the release and export metrics, 200,000 AF target on costs from Oct-Jan	Same	Same

Notes:

[a] A detailed description of the assumptions selection criteria and policy basis used is included in the Policy section of this CACMP report.

[b] The Sacramento Valley hydrology used in the Existing Conditions CalSim model reflects nominal 2005 land-use assumptions. The nominal 2005 land-use was determined by interpolation between the 1995 and projected 2020 land-use assumptions associated with Bulletin 160-98. The San Joaquin Valley hydrology reflects 2005 land-use assumptions developed by Reclamation to support Reclamation studies.

[c] The Sacramento Valley hydrology used in the Future No Action CalSim model reflects 2020 land-use assumptions associated with Bulletin 160-98. The San Joaquin Valley hydrology reflects draft 2030 land-use assumptions developed by Reclamation to support Reclamation studies.

[d] CVP contract amounts have been reviewed and updated according to existing and amended contracts as appropriate. Assumptions regarding CVP agricultural and municipal and industrial service contracts and Settlement Contract amounts are documented in Table 4 (North of Delta) and 6 (South of Delta) of Appendix B: CACMP Delivery Specifications.

[e] SWP contract amounts have been reviewed and updated as appropriate. Assumptions regarding SWP agricultural and municipal and industrial contract amounts are documented in Table 2 (North of Delta) and Table 3 (South of Delta) of Appendix B: CACMP Delivery Specifications.

[f] Water needs for federal refuges have been reviewed and updated as appropriate. Assumptions regarding firm Level 2 refuge water needs are documented in Table 4 (North of Delta) and 6 (South of Delta) of Appendix B: CACMP Delivery Specifications. As part of the Water Transfers technical memorandum (Appendix A: Characterization and Quantification), incremental Level 4 refuge water needs have been documented as part of the assumptions of future water transfers.

[g] Assumptions regarding American River water rights and CVP contracts are documented in Table 5 of Appendix B: CACMP Delivery Specifications.

[h] Sacramento Area Water Forum 2025 assumptions are defined in Sacramento Water Forum's EIR. PCWA CVP contract supply is modified to be diverted at the PCWA pump station. Assumptions regarding American River water rights and CVP contracts are documented in Table 4 of Appendix B: PFCMP Delivery Specifications.

[i] The new CalSim representation of the SJR has been included in this model package (CalSim San Joaquin River Model, [Reclamation 2005]). Updates to the SJR have been included since the preliminary model release in August 2005. In addition, a dynamic groundwater simulation is currently being developed for SJR valley, but is not yet implemented. Groundwater extraction/recharge and stream-groundwater interaction are static assumptions and may not accurately reflect a response to simulated actions. These limitations should be considered in the analysis of results.

[j] The CACMP CalSim model representation for the Stanislaus River does not necessarily represent Reclamation's current or future operational policies.

[k] The Existing CVP contract is 140,000 AF. The actual amount diverted is reduced due to supplies from the Los Vaqueros project. The existing Los Vaqueros storage capacity is 100,000 AF. Associated water rights for Delta excess flows are included.

[l] Table A and Article 21 deliveries into the San Francisco Bay Area Region–South and South Coast Region in the CACMP are a result of interaction between CalSim and LCPSIM. More information regarding LCPSIM is included in the following subsection of this document and the CalSim-LCPSIM Integration technical memorandum (see Appendix C: Analytical Framework).

[m] PCWA American River pumping facility upstream of Folsom Lake is under construction. A Sacramento River diversion for PCWA is not included in the PFCMP. This assumption will be revisited as part of the development of the FSCMP.

[n] Mokelumne River flows reflect EBMUD supplies associated with the Freeport Regional Water Project.

[o] The Contra Costa Water District Alternate Intake Project is a new intake at Victoria Canal to operate as an alternate intake for Los Vaqueros Reservoir. This assumption is consistent with the future no-project condition defined by the Los Vaqueros Enlargement study team.

[p] This Phase 8 requirement is assumed to be met through Sacramento Valley Water Management Agreement Implementation.

[q] Interim D-1644 is assumed to be implemented

[r] Sacramento Area Water Forum Lower American River Flow Management Standard is not included in the CACMP. Reclamation has agreed in principle to the Flow Management Standard, but flow specifications are not yet available for modeling purposes.

[s] It is assumed that either VAMP, a functional equivalent, or D-1641 requirements would be in place in 2030.

[t] The CACMP CalSim model representation for the SJR does not explicitly implement the CALFED Salinity Management Plan.

CACMP = Common Assumptions Common Models Package
FC&WSD = Flood Control and Water Supply District
FRSA = Feather River Service Area
FRWP = Freeport Regional Water Authority
FSCMP = Feasibility Study Common Models Package
KCWA = Kern County Water Authority
LCPSIM = Least Cost Pricing Simulation Model
MWD = Metropolitan Water District of Southern California
OCAP = Operations Criteria and Plan
PCWA = Placer County Water Authority
PFCMP = Plan Formulation Report Common Models Package

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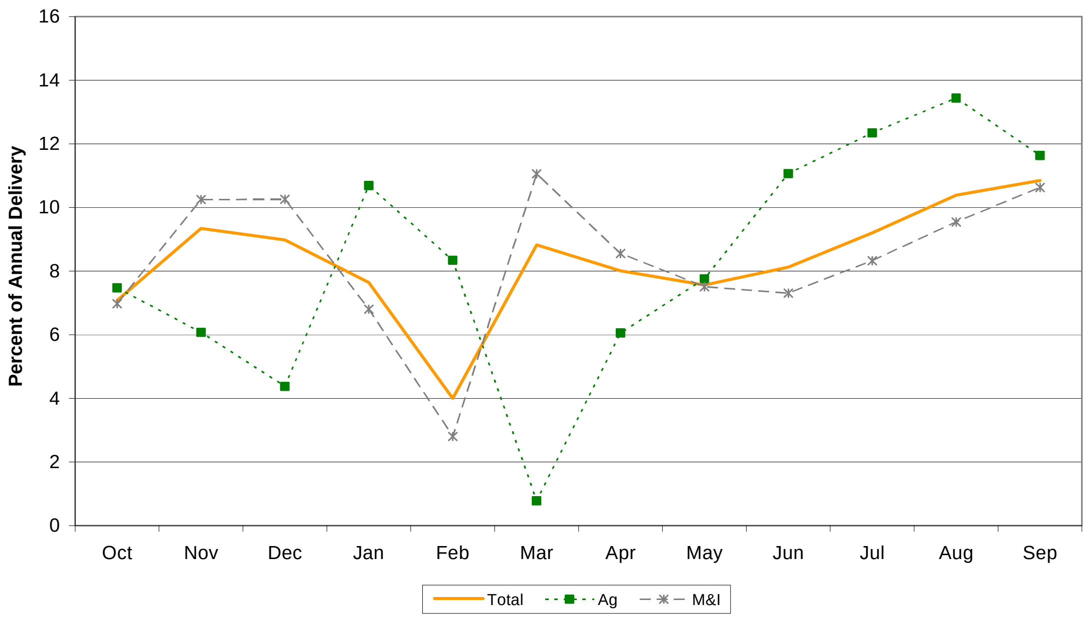


Note: Revised delivery patterns were developed from historical agricultural diversion patterns and M&I water usage as reported by water purveyors in Santa Clara County for the period of 1994 through 2005. M&I water use data were available from DWR Division of Planning and Local Assistance.

Figure A-1. Common Assumptions CalSim San Felipe Division Delivery Patterns

Figure A-2 illustrates the revised agricultural, M&I, and total delivery pattern used in analyses for the SLLPIP.

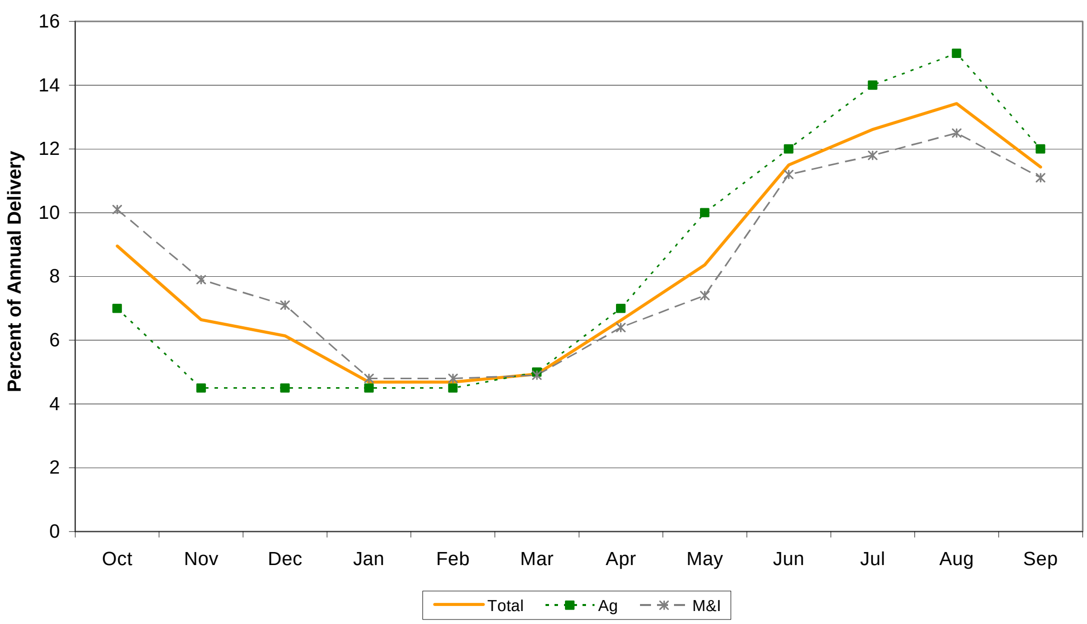


Figure A-2. SLLPIP San Felipe Division Delivery Patterns

The total revised delivery pattern was compared with historical Pacheco Pumping Plant data for the period from 1997 through 2006 to ensure it is representative of current patterns of use within the San Felipe Division. Figure A-3 presents this comparison.

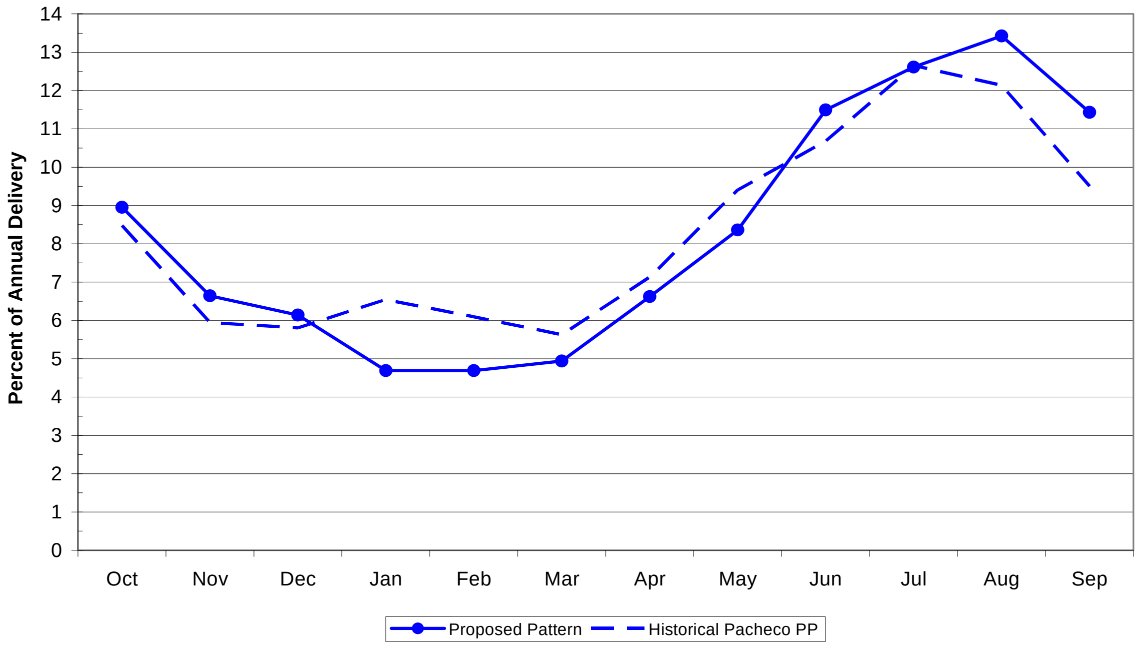


Figure A-3. SLLPIP San Felipe Division Delivery Pattern and Historical Pacheco Pumping Plant Operation

San Felipe Division M&I Delivery Interruptions The Common Assumptions CalSim model does not consider the potential interruptions to San Felipe Division deliveries caused by San Luis Reservoir low point issues. Deliveries are made to both San Felipe Division agricultural and M&I contractors regardless of storage levels and potential water quality concerns in San Luis Reservoir. A modification was made to CalSim used for the SLLPIP such that San Felipe Division M&I contract water would not be delivered when the previous end-of-month combined CVP and SWP storage in San Luis Reservoir was less than 300 TAF. In the model, San Felipe Division agricultural contract water is delivered regardless of the storage level in San Luis Reservoir, although it is recognized that this water may also cause problems for agricultural contractors. San Felipe Division M&I contract water not delivered in any month due to San Luis Reservoir low point issues is not assumed to be rescheduled or delivered in later months. This water is left in San Luis Reservoir and is available for allocation during the following year. Interrupted San Felipe Division M&I deliveries are quantified and presented in subsequent sections.

Bay-Delta Hearings Phase 8 Settlement Implementation The Phase 8 Settlement is an agreement by Sacramento Valley water users to make a specified volume of water available under defined hydrologic conditions to meet requirements of the 1995 Water Quality Control Plan. The agreement specifies that up to 185 TAF of water will be made available in the Sacramento Valley through a variety of programs (such as groundwater banking) in all but "wet" years, as classified by the Sacramento Valley Water Year Type Index (Sacramento Valley Index). This water offsets a similar volume of water that would otherwise be released by the CVP and SWP to meet the requirements of the 1995 Water Quality Control Plan. The 185 TAF requirement is split: 40% to the CVP and 60% to the SWP. The actual implementation of the Phase 8 agreement is still being determined.

The Common Assumptions CalSim V9A FNA model did not correctly simulate delivery of water made available to the CVP through Phase 8. Phase 8 is simulated in CalSim as an additional water supply, made available on an agricultural demand pattern from river basins within the Sacramento Valley. This water is considered in the allocation logic for both the CVP and SWP and may increase allocations when it is available. This assumption is made solely for modeling the effects of Phase 8 and may not depict how the program is operated when implemented.

The CalSim simulation of FNA conditions used for the SLLPIP includes a change to CVP allocation logic for SOD to include the CVP portion of Phase 8 water. This change ensures that Phase 8 water is considered and simulated as being delivered to SOD contractors. Phase 8, as currently simulated, has an influence on the frequency, duration, and magnitude, of simulated low point issues. The reason for this and the model sensitivity to Phase 8 assumptions are presented in Section A.6.

A.3.2 Future No Action Baselines

It is likely that the operation of San Luis Reservoir under FNA conditions would be similar to current operations. For the PFR analysis, two potential FNA baselines were described. Under the "unconstrained" FNA condition, CVP and SWP operators would allocate water such that San Luis Reservoir has the potential to be drawn down to dead storage, 79 TAF, every summer. This appendix refers to the unconstrained FNA baseline as FNA–79. Under the "constrained" FNA baseline, CVP operations would ensure that the reservoir remains at 300 TAF of storage to prevent delivery interruptions to San Felipe Division contractors. This appendix refers to the constrained FNA baseline as FNA–300. Section A.3.3 describes the assumptions for this alternative FNA baseline.

The following plots summarize simulated San Luis Reservoir low point for FNA–79. Figure A-4 presents the probability of exceedance for annual minimum storage level in San Luis Reservoir. Figure A-5 illustrates the annual minimum storage levels. Results showing changes in deliveries to CVP contractors are summarized by CVP contract year, typically from March through the following February. There are 81 full CVP contract years in the period from October 1921 through September 2003. Therefore, results presented in these figures and the following sections are summarized for the 81-year period from 1922 through 2002.

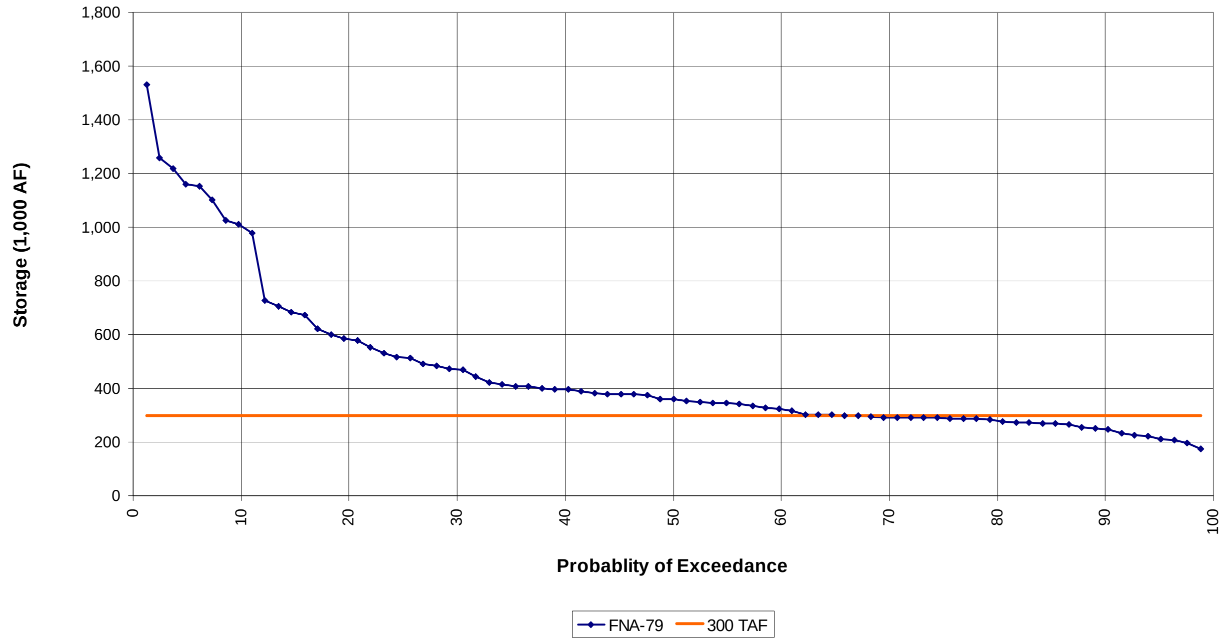


Figure A-4. Probability of Exceedance for San Luis Reservoir annual Minimum Storage Level: Future No Action Conditions

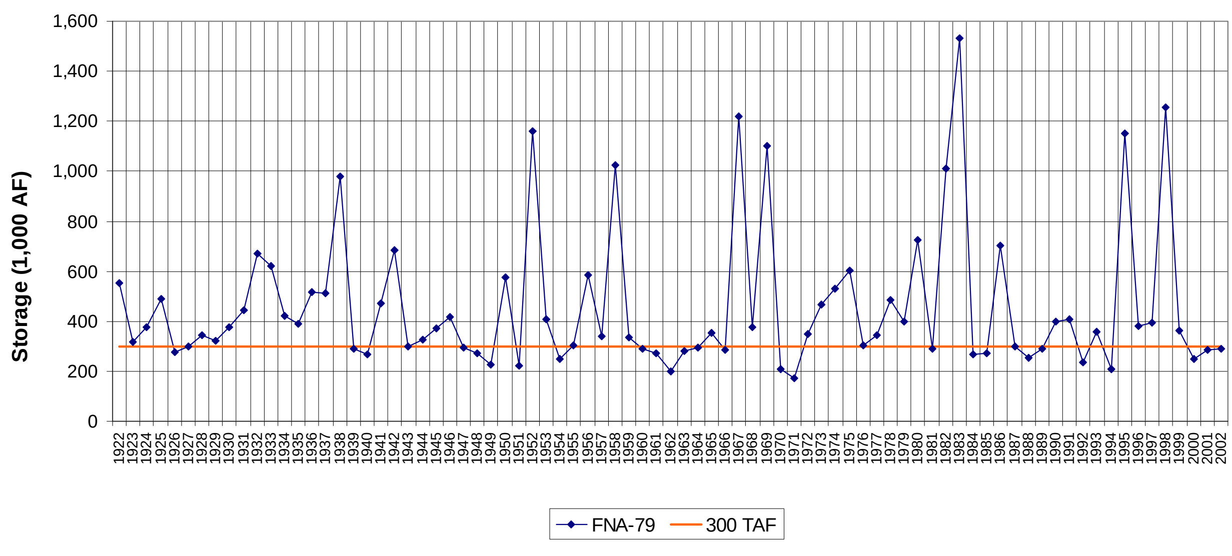


Figure A-5. Time-Series of San Luis Reservoir Annual Lowest Storage Levels: Future No Action Conditions

Under FNA–79 conditions, storage is predicted to fall below 300 TAF in 28 of 81 years (35 % of the years). Additionally, the maximum storage deficit below 300 TAF in those years ranges from 1 TAF to 126 TAF.

A.3.3 Alternative Future No Action Baseline

As noted above, FNA–300 was developed to depict operations if Reclamation were to operate to ensure that San Luis Reservoir storage levels did not go below 300 TAF. Operations in FNA–300 prevent San Felipe Division M&I delivery interruptions.

In order to simulate the effects of this operation in CalSim, CVP dead storage in San Luis Reservoir was increased from 45 TAF to 245 TAF and SWP dead storage is simulated in CalSim as 55 TAF; therefore, the 300 TAF minimum is maintained in all years. The assumption for this analysis is that the CVP is solely responsible for maintaining adequate storage to ensure deliveries to San Felipe Division M&I contractors, and that CVP San Luis Reservoir operations would not depend on the SWP maintaining some volume of water in storage above dead pool at low point. Under these conditions the CVP would need to plan to maintain the entire difference between 300 TAF and SWP dead pool when making allocations and would need to balance storage between reservoirs north and south of the Delta.

This assumption has significant effects on CVP operations and deliveries and it influences SWP operations. FNA–300 has been defined for the PFR as a "bookend" for the potential range of future operations. Both FNA–79 and FNA–300 are compared with each SLLPIP comprehensive plan to understand the range of potential project benefits. The following figures compare the San Luis Reservoir annual lowest storage levels that would occur under FNA–79 and FNA–300.

Figure A-6 and Figure A-7 illustrate that a requirement to maintain 300 TAF of storage in San Luis Reservoir would affect the lowest annual storage level in all years, not only those years that storage previously went below 300 TAF. The result is that CVP SOD deliveries to both agricultural and M&I contractors would be lower with the FNA–300 operations than they would be with FNA–79.

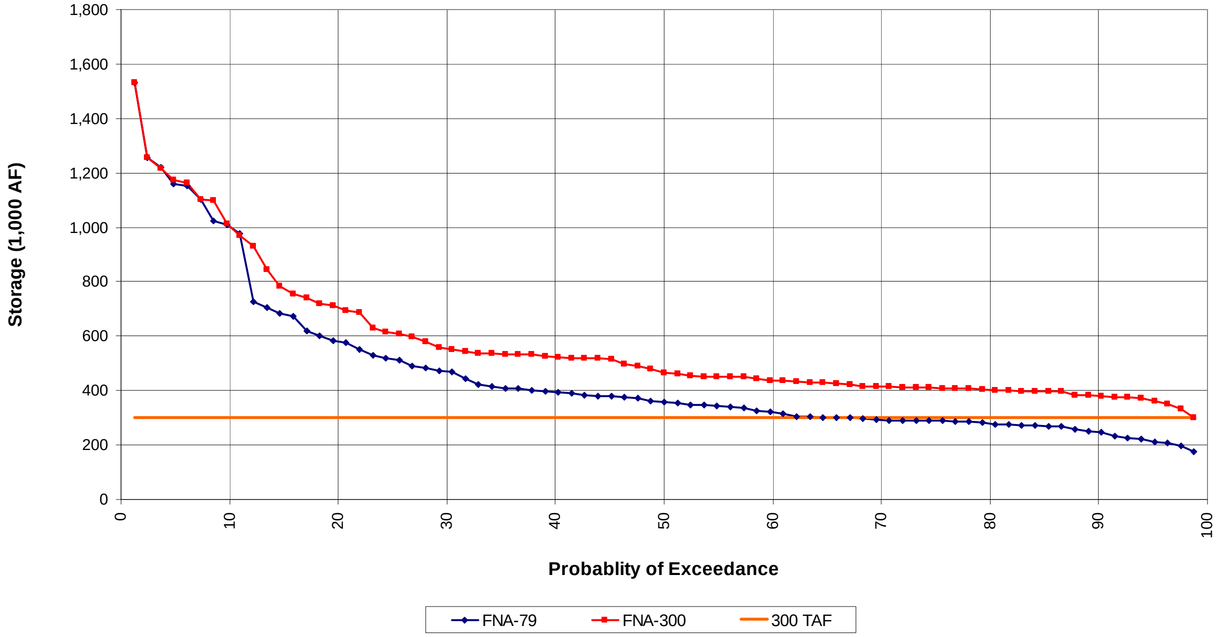


Figure A-6. Probability of Exceedance for San Luis Reservoir Annual Minimum Storage Level: FNA–79 and FNA–300

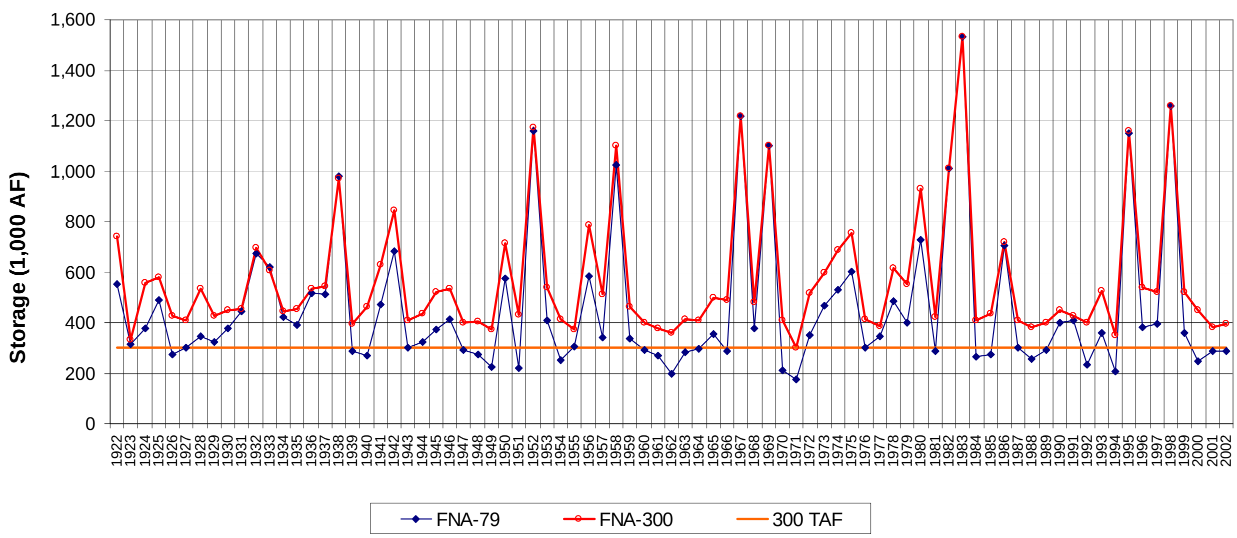


Figure A-7. Time-Series of San Luis Reservoir Annual Minimum Storage Levels: FNA–79 and FNA–300

A.3.4 Interrupted San Felipe M&I Deliveries

Low point conditions are assumed to occur, and San Felipe Division M&I deliveries are assumed to be interrupted, when San Luis Reservoir storage is less than 300 TAF. Figure A-8 illustrates annual interrupted deliveries for FNA–79. There would be no interrupted San Felipe Division M&I deliveries under FNA–300 because San Luis Reservoir storage is maintained at or above

300 TAF at all times. San Felipe Division contractors are not assumed to take delivery of these interrupted deliveries in future months within the same contract year. These deliveries would remain in San Luis Reservoir to be allocated in subsequent years.

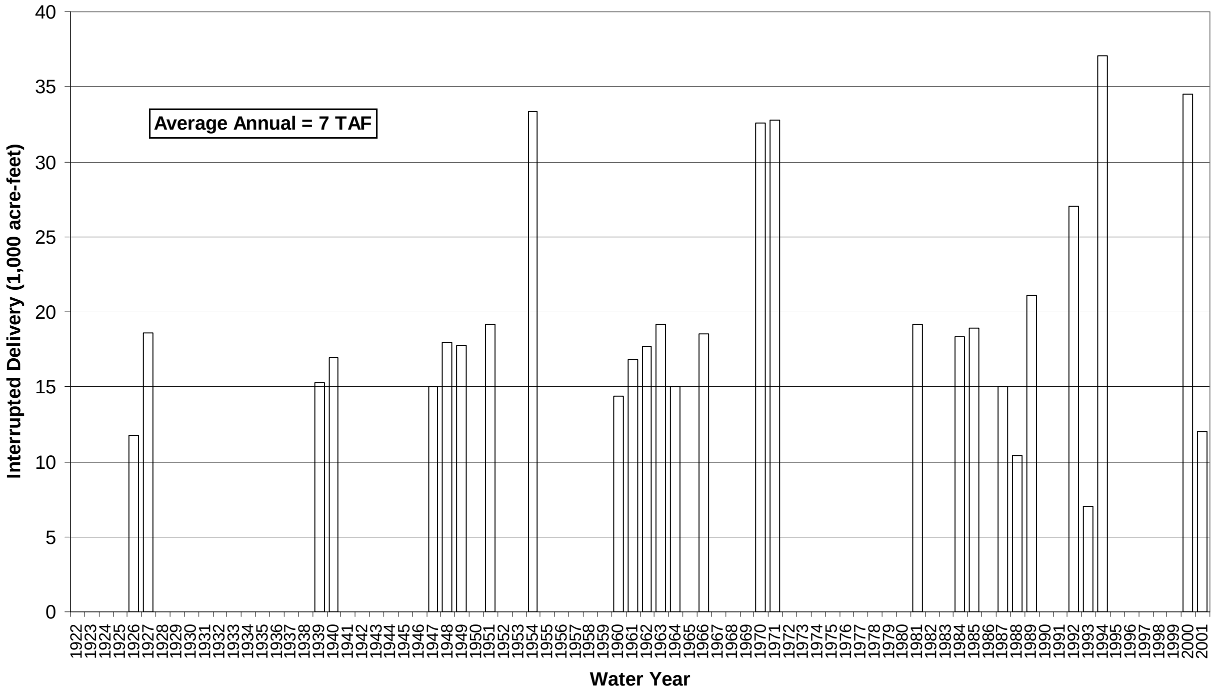


Figure A-8 – Time-series of Annual Interrupted San Felipe M&I Deliveries, FNA–79

A.4 CalSim Depiction of San Luis Reservoir

CalSim simulates the integrated operations of the CVP and SWP both north and south of the Delta; therefore, it is relied upon as the foundation for the SLLPIP and other CalFed studies. However, CalSim was developed primarily to simulate reservoir operations upstream from the Delta and to simulate Delta conditions and operations. CalSim does not account for many of the variables that affect San Luis Reservoir storage. An understanding of the limitations of CalSim for the analysis of SLLPIP alternatives is necessary to characterize results properly.

A.4.1 CalSim and Historical Comparison

Figure A-9 is a comparison of historical San Luis Reservoir storage and simulated storage from the Common Assumptions CalSim V9A existing conditions simulation.

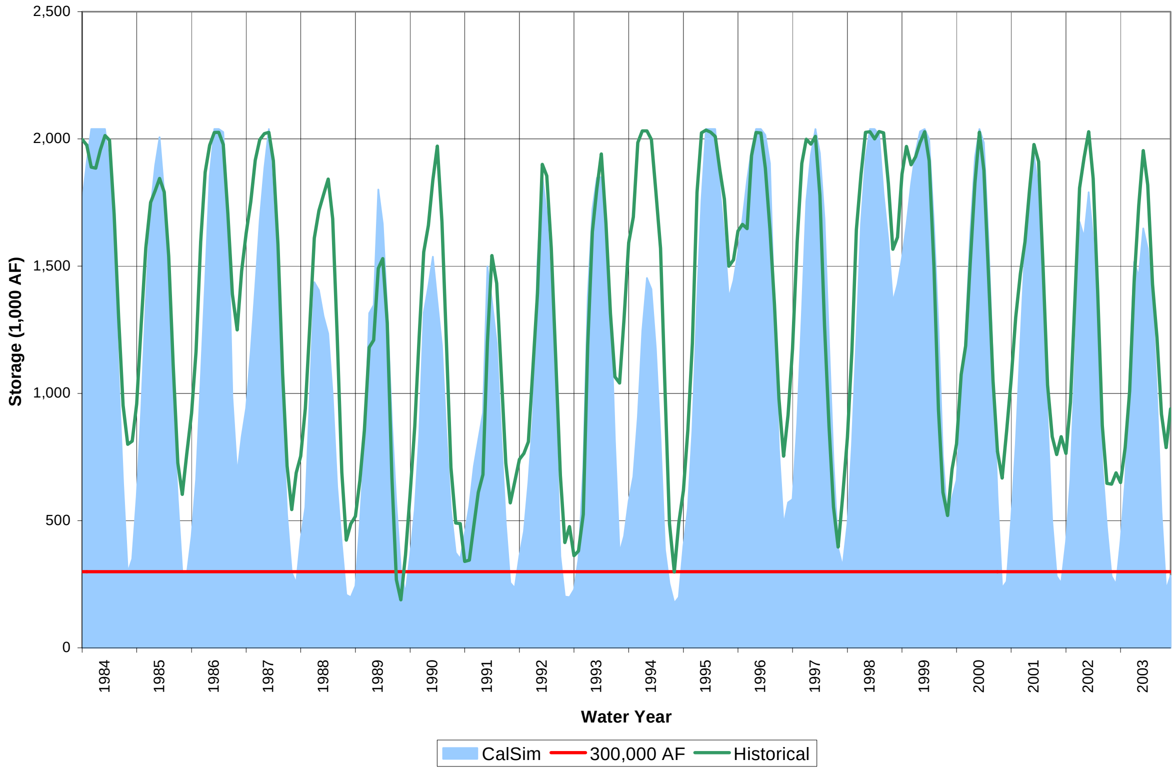


Figure A-9. Historical and Simulated End-of-Month San Luis Reservoir Storage

Figure A-9 illustrates that CalSim simulates more frequent and more severe occurrences of San Luis Reservoir low point issues than what has occurred in the recent past. CalSim simulation of maximum annual San Luis Reservoir storage is closer to what has occurred historically.

There are many reasons for the differences between historical and simulated San Luis Reservoir lowest annual storage levels. San Luis Reservoir is a key component of both the CVP and SWP. Changes in operations in nearly any area of either project result in some change in San Luis Reservoir storage. The location of San Luis Reservoir, downstream from most project facilities, makes modeling the reservoir extremely difficult. Additionally, the Common Assumptions CalSim development efforts have not been focused on San Luis Reservoir. While the reservoir is an important operational component for both the CVP and SWP, modeling efforts were more focused on representation of the Delta and upstream areas. Differences in SOD demand patterns, rescheduling of CVP water, and numerous other factors that influence San Luis Reservoir storage have not been refined.

An understanding of the limitations of CalSim's representation of San Luis Reservoir low point is important when interpreting results and understanding how actual operations of SLLPIP alternatives may differ from simulations performed in support of the PFR. To the extent that CalSim over- or underestimates the frequency, duration, and magnitude of low point issues, the model may also lead to over- or underestimation of the benefits of the comprehensive plans. While CalSim simulation of existing conditions is overestimating the frequency of low point issues compared to historical data, the model does not consider years when SCVWD and other contractors in the San Felipe Division alter operations due to potential or forecasted low point issues. In this way, CalSim may not be capturing all effects of potential low point issues. Additionally, the primary focus of the PFR is to compare the operations and results of different comprehensive plans. While CalSim may be over- or underestimating the frequency of low point issues, the model does so consistently across all the comprehensive plans. Results can therefore be used with a higher degree of confidence for a comparative analysis between comprehensive plans than for an absolute analysis of the benefits of a single plan.

A.4.2 Supplemental Support for Modeling Results

As discussed in previous sections, CalSim is a useful tool for evaluating project alternatives and their resulting affect on water supplies in a comparative sense because of the myriad factors that affect San Luis operations.

When evaluating project benefits, CalSim results must be used in more of an absolute sense. For example, if CalSim is underestimating the occurrence of low point conditions in FNA scenarios, it will also underestimate San Felipe Division M&I delivery interruptions. Project alternatives that prevent delivery interruptions will show fewer benefits than may actually occur because one measure of project benefits is the delivery of water that would otherwise be interrupted. CalSim simulation of any future condition represents only one of many possible future conditions.

The study team assessed historical hydrology and CVP SOD operations to identify hydrology-related conditions and factors that contribute to, or help prevent the occurrence of low point issues. The frequency of occurrence for those contributing and preventing factors can help identify years when low point issues would be more and less likely. This analysis reviewed the frequency of occurrence of factors or combinations of factors to define a minimum and maximum number of years when low point issues would be more likely to occur, as discussed below. This information provides a model-independent estimate of the range of potential low point occurrences and helps support CalSim model results.

CVP operators currently target drawdown of the CVP portion of San Luis Reservoir to minimum pool each year when making allocations. The reasons why CVP storage stays above or dips below minimum pool can be characterized as either supply or demand factors. Supply factors include reservoir inflows north and south of the Delta, the availability of local supplies or surplus flows south of the Delta, unforeseen increases or reductions in Delta exports, water year types, water supply forecasts, and spills into Mendota Pool. Demand factors include meteorological conditions such as temperature, wind, and precipitation, which drive evapotranspiration (ET) from crops and changes in cropping patterns, which influence the timing of demand for water from San Luis Reservoir.

Reclamation currently uses conservative forecasts for both supply (90% exceedance for reservoir inflows) and demand. The use of conservative forecasts reduces the number of times actual inflow is less than forecasted or actual demands exceed forecasts. Low point issues are more likely to occur when actual demands are at or above forecasted demands and/or supplies are at or below forecasted supplies. Data for most of the supply and demand factors was collected and analyzed previously to determine the feasibility of predicting potential low point conditions.

This analysis included a review of the historical hydrology and data to estimate how frequently the actual factors that influence supply and demand are more likely to be significantly different from forecasted values.

This analysis attempts to estimate a range of the number of years when low point issues are more likely to occur. A worst-case scenario would result in a low point condition occurring every year, whereas low point conditions would never occur in a best-case scenario. CalSim simulations provide one possible set of San Luis Reservoir storage conditions with a finite number of predicted low point occurrences. There is considerable uncertainty surrounding future conditions that would affect the operation of San Luis Reservoir and the potential for low point issues. This analysis provides one alternative method for estimating the range of potential low point issues and the conditions that may lead to development of low point issues.

Sacramento and San Joaquin Valley Water Year Indices can be used to evaluate factors that might increase or decrease San Luis Reservoir storage conditions.

- The Sacramento River, which carries water released from upstream CVP and SWP reservoirs, is the largest river flowing into the Delta; water stored in San Luis Reservoir is exported from the Delta. The Sacramento Valley Index is an indicator of overall water supply conditions in the Sacramento Valley.

- The San Joaquin Valley Water Year Index (SJR Index) can be an indicator of conditions in much of the area supplied by San Luis Reservoir, including other rivers and creeks that serve as local supplies to areas served by San Luis Reservoir. The SJR Index can be an indicator of flow from the Kings River through James Bypass to Mendota Pool and spills from Friant Dam down the San Joaquin River to Mendota Pool. (Spills into Mendota Pool during the April through September irrigation season reduce the need for deliveries from San Luis Reservoir and decrease the likelihood of low point issues.) Figure A-10 shows the frequency of such spills and the SJR Index in years when spills occur.

Figure A-10 shows that historically, large volumes of water have spilled into Mendota Pool when the SJR Index is wet. While there can be differences between conditions in the northern and southern San Joaquin Valley, or the east and west sides of the San Joaquin River, the SJR Index generally indicates the availability of local water supplies. When the SJR Index is wet or above normal, there is typically more local supply available and less demand for water from San Luis Reservoir and vice versa. In this way, the SJR Index can be an indicator of demand for water from San Luis Reservoir. In wet and above normal years when spill occurs to Mendota Pool, there would be less likelihood of a low point occurrence.

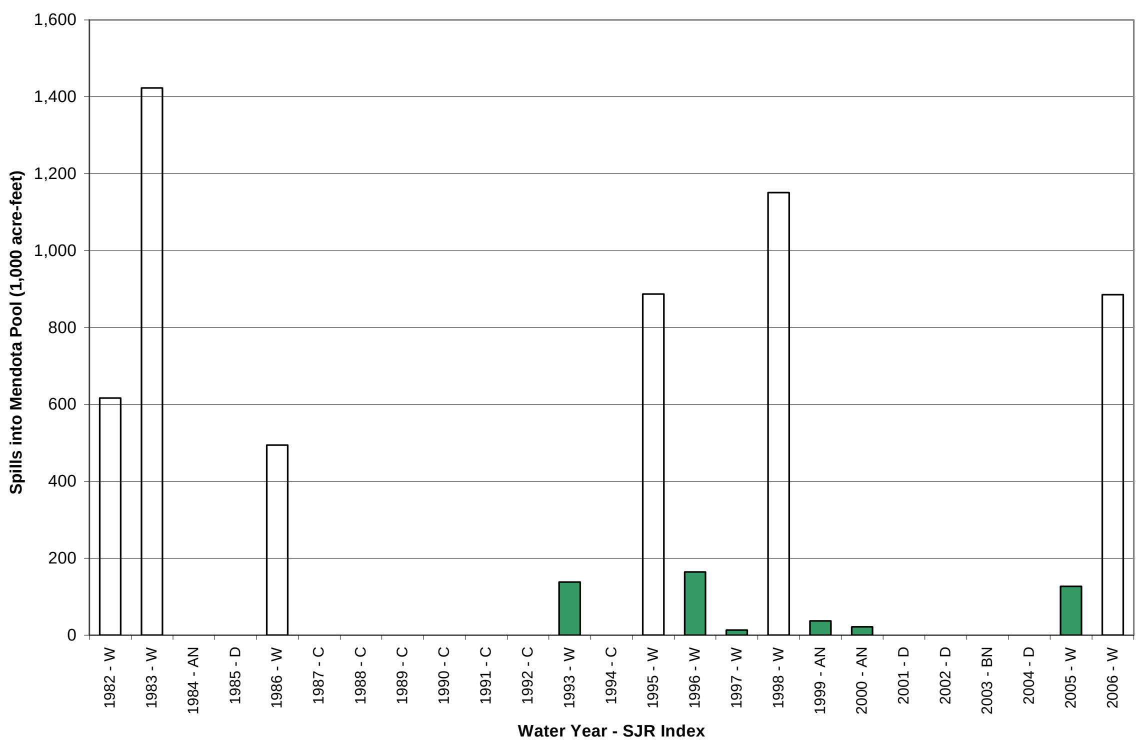


Figure A-10. Total April through September Spills into Mendota Pool

Another indicator of demand may be obtained through analysis of historical temperature data. While numerous factors contribute to crop ET and from that, water requirements, temperature is a primary ET factor and long-term data records of temperature are readily available. Daily temperature records for five locations throughout the San Joaquin Valley were reviewed and analyzed to identify years that were significantly above or below long-term average temperatures from April through September. Long-term average monthly temperatures were calculated for each station based on the available record. The difference between recorded daily temperature and average monthly temperature were summed for the April through September period each year. These degree-day differences for each station were analyzed to determine years when the five stations were consistently above or below the average monthly temperature for the entire season. These results are summarized by SJR Index in Figure A-11.

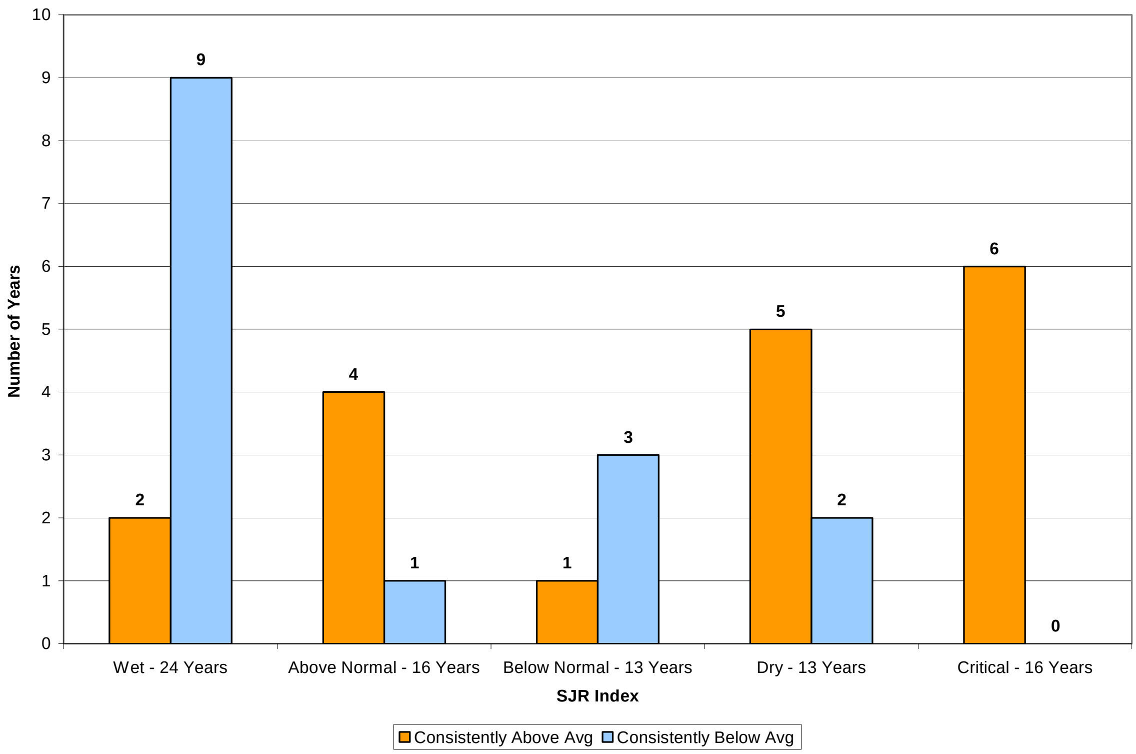


Figure A-11. Years with Temperatures Consistently Different from Long-Term Averages throughout CVP SOD Service Area

Figure A-11 illustrates for the 81-year analysis period that, in 18 years the majority of the analyzed stations had consistently above average temperatures, with 11 of those years being classified as dry or critical (5 dry years and 6 critical years) according to the SJR Index. Conversely, 15 years show consistently below average temperatures with 10 of those years being classified as wet or above normal (9 wet years and 1 above normal year) according to the SJR Index. The combination of dry conditions and higher temperatures, (which prompt higher demands than in other years) is more likely to result in low point conditions.

The drawdown of San Luis Reservoir to its low point is also highly dependent on human decision-making, including allocations made by CVP operators and water users' responses to storage conditions in San Luis Reservoir. Low point conditions will tend to occur when supplies are less than forecasted and/or demands are greater than forecasted. Low point conditions might not occur only in dry or critical years, or in every dry or critical year. Dry and critical years, when demands are typically higher than forecasted (and supplies are lower), are simply more likely to lead to low point conditions than wet years, when demands are typically lower than forecasted.

Based on Figure A-10 and Figure A-11, it is possible to estimate the number of years when low point conditions are most and least likely.

Table A-3 shows that in the 81-years PFR analysis period, there would be 16 years when low point conditions are more likely and 10 years when low point years would be less likely to occur. Therefore, the maximum number of years when low point issues might occur is 71: 81 minus 10 years when low point is less likely. The minimum number of years when low point might occur could be as high as 16, assuming low point issues occur in every year that is defined as “more likely” in Table A-3. Under FNA–79 conditions, low point issues are predicted to occur in 28 years. Based on the analysis of historical hydrology and temperature, these CalSim results are within the range of a model-independent analysis of potential low point occurrence.

Table A-3. Number of Years in Period of Analysis when Low Point Issues are More and Less Likely

Water Year Index	Sacramento Valley Index Years	SJR Index Years	Above Average Temperature	Below Average Temperature	Low Point More Likely[1]	Low Point Less Likely[2]
Wet	26	24	2	9	-	9
Above Normal	11	16	4	1	4	1
Below Normal	14	12	1	3	1	-
Dry	18	13	5	2	5	-
Critical	12	16	6	0	6	-
Total	**81**	**81**	**18**	**15**	**16**	**10**

1 Assumes above average temperatures in any year-type except wet increase the likelihood of low point issues.
2 Assumes wet or above normal years, when spills into Mendota Pool would occur, combined with below average temperatures decrease the likelihood of low point issues.

A.5 Earlier CVP SOD Allocations

One of the objectives of the SLLPIP is to announce higher allocations to CVP SOD agricultural service contractors earlier in the season without sacrificing accuracy of the allocation forecasts. The purpose of this objective is to obtain the highest possible allocation as early in the season as possible when decisions regarding types of crops and amount of acreage to plant are being made. Analysis for the PFR has focused on simulating the ability to increase allocations earlier while using institutional measures such as groundwater banking, exchanges, and water transfers as a backstop for over-allocations. This section describes operations, assumptions, and modeling tools for this analysis. The section provides background on the CVP allocation process, recent historical allocations, and a description of the allocation process in CalSim.

A.5.1 Background on CVP Allocations

The CVP typically makes a preliminary allocation in January and the initial allocation in February. Allocations are typically assessed and updated as more information on water supply and export operations becomes available. Reclamation considers many factors when making SOD allocations, including CVP San Luis Reservoir storage, NOD reservoir storage, reservoir inflow forecasts, estimated export capacity, and contractor demands. Reclamation targets its drawdown of CVP San Luis Reservoir storage to dead pool (45 TAF) each year. The volume of water that can be delivered prior to reaching the annual minimum storage level typically constrains the allocation process. This operation is meant to deliver as much water as possible without dedicated carryover storage for future years. The carryover storage operation begins after the annual minimum storage level is reached, when San Luis Reservoir begins to refill. Historically, Reclamation has been conservative in making allocations early in the year to avoid having to reduce allocations in subsequent months. In later months, when water supply and export capacity forecasts are more accurate, Reclamation has increased allocations to allow contractors access to available water.

While Reclamation is forecasting water supply and Delta export operations to arrive at initial allocations, CVP SOD agricultural service contractors are making decisions regarding which crops and how many acres to plant based on market conditions and available water supplies. Planting decisions are typically finalized and fields planted by the middle of April, based partially on water allocations at that time. When allocations are below a certain percentage, contractors may plant less acreage than they would if allocations were higher. Given the way planting decisions are made in the CVP service area, increases in allocations after planting are less valuable than they would be if they were made prior to planting.

In recent years, Reclamation has increased allocations after April several times. Table A-4 shows historical allocations for the past eight years with increases after April highlighted. In some years, allocations were increased by more than 10% in the May-through-July period.

Table A-4. Historical CVP South-of-Delta Ag Service Allocations (% of full contract supply)

Month	2000	2001	2002	2003	2004	2005	2006	2007
Jan	40	35	45	50	60	60	65	60
Feb	40	15	55	60	65	60	65	50
Mar	60	40	55	60	65	60	65	50
Apr	60	40	55	65	65	75	65	50
May	60	**45**	**60**	**70**	65	**85**	**100**	50
Jun	60	45	**65**	70	65	85	100	50
Jul	**65**	45	65	**75**	65	**90**	100	50

Historical data on system conditions, water supply forecasts, demands, deliveries, and reservoir levels were analyzed to determine possible reasons why allocations were increased in these years. Based on this analysis it appears Reclamation tends to increase allocations when CVP San Luis Reservoir storage is higher than expected in the months prior to the annual minimum storage level.

Figure A-12 illustrates that allocations increased when CVP San Luis Reservoir storage was higher in May and July.

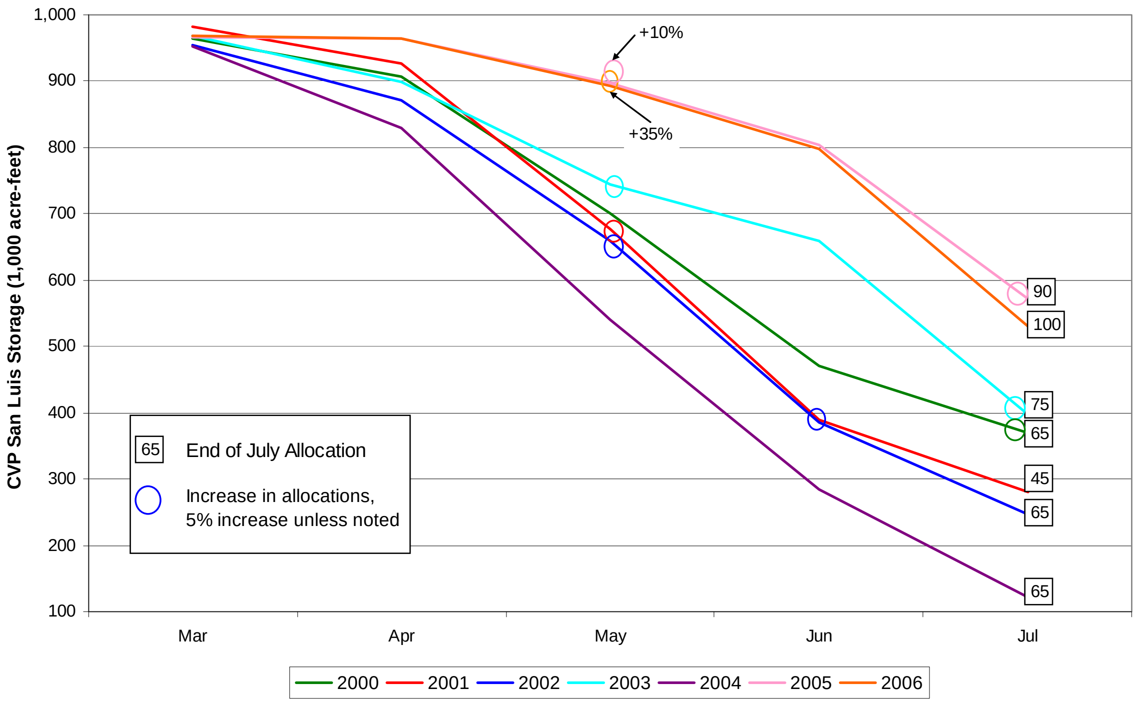


Figure A-12. Recent CVP San Luis Reservoir Storage and Allocation Increases

Compared to water that must be exported from the Delta, water stored in CVP San Luis Reservoir is a firm supply; therefore, Reclamation can allocate it with less risk of over-allocation. Further analysis considered possible reasons why CVP San Luis Reservoir storage remained higher than expected in some years, prompting increases in allocation. San Luis Reservoir storage levels fluctuate based on variations in Delta exports and contractor demands. Jones Pumping Plant pumping patterns were similar for most of the years shown in Figure A-12 and tended to vary proportionally in volume with allocations. An estimate of contractor demands was made by analyzing crop ET and precipitation data available from California Irrigation Management Information System stations throughout the CVP service area. ET is the loss or use of water by crops and includes both transpiration and evaporation from crops and the soil surface. A portion of total ET is met from precipitation and the remainder must be met from applied water. Therefore, contractor demands for applied water tend to follow the same patterns and trends as the evapotranspiration of applied water (ETAW). California Irrigation Management Information System data was used to estimate the cumulative ETAW for the years and months presented in Figure A-12.

Figure A-13 illustrates that CVP San Luis Reservoir storage levels are related to the cumulative ETAW each year. Relative to other years, higher cumulative ETAW results in lower CVP San Luis Reservoir storage (as in 2004), and in years when cumulative ETAW is lower, CVP San Luis Reservoir storage tends to remain higher (as in 2006). If ETAW and demands are lower than the forecast, CVP San Luis Reservoir storage will likely remain higher than the forecast and result in an allocation increase later in the year. Unfortunately, it is not possible to forecast ETAW and contractor demands accurately to increase allocations earlier and improve low point forecasts. The inability to accurately forecast demands results in the use of more conservative demand estimates to avoid over-allocating water.

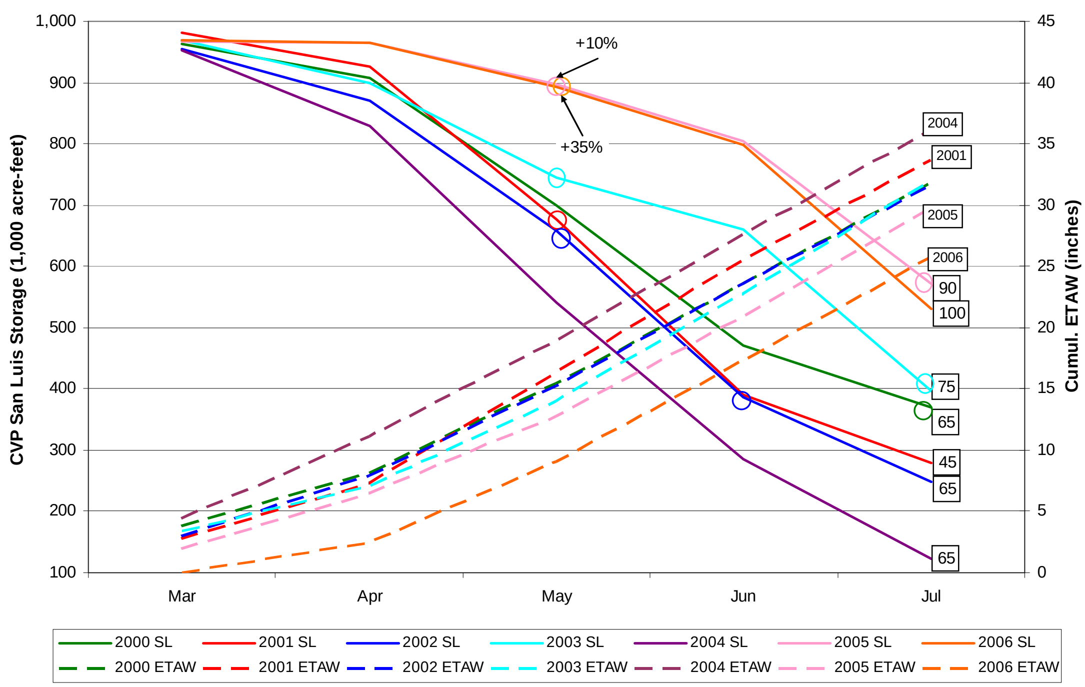


Figure A-13. Recent CVP San Luis Reservoir Storage, Allocation, and Cumulative ETAW

A.5.2 CalSim Depiction of CVP Allocations

CalSim results were also used to develop methods for providing higher early allocations to CVP SOD contractors—an SLLPIP objective. The Study team developed and applied a spreadsheet tool that post-processes CalSim results to determine how this objective could be achieved. (See Section A.7).

Understanding how CalSim allocation logic differs from that used by CVOO allows for an evaluation of the tool that was were used to perform analyses related to this objective. CalSim CVP SOD allocation logic considers current system conditions, including CVP storage levels north and south of the Delta, forecasts of Delta inflow and inflow to Mendota Pool, and estimates for available export capacity. This information is used to develop SOD allocations, which are compared with system wide allocations developed from theoretical delivery curves based on systemwide available water supply. In years when allocations are less than 100%, agricultural and M&I contracts are cut by tiers, with agricultural contractors reduced first and more severely than M&I contractors.

Unlike actual operations, in which the CVOO staff continually monitors system conditions and may alter allocations at any time, CalSim makes initial allocations in March based on end-of-February conditions and forecasts. The model updates these allocations in April and May. The May CalSim allocations are then used for the remainder of the CVP contract year.

Figure A-14 is a comparison of historical and simulated May CVP SOD allocations to agricultural service contractors. This figure shows that CalSim provides a reasonable approximation of recent CVP allocations. Comparisons prior to1995, the first year when regulatory provisions of the CVPIA were implemented, are not appropriate.

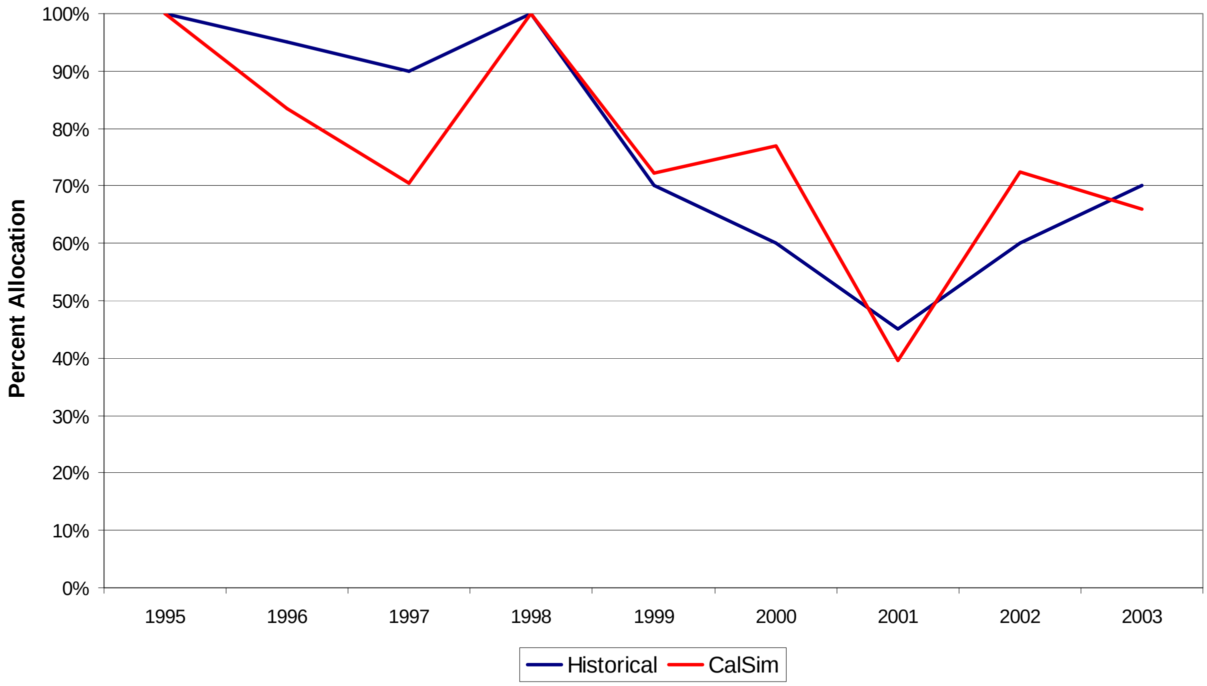


Figure A-14. Historical and Simulated CVP SOD Ag Allocation

A.6 Model Sensitivity to Select Assumptions

Accurate simulation of San Luis Reservoir low point conditions is difficult because the reservoir is near the end of the CVP/SWP system and changes in other areas of the CVP and SWP affect San Luis Reservoir. This is also true in actual operations, in that changes in other areas of the CVP and SWP (such as upstream reservoirs and Delta conditions) and SOD demands affect San Luis Reservoir storage. The challenges of simulating the reservoir are compounded when forecasting low point conditions at a future level of development. There is significant uncertainty surrounding numerous assumptions for future conditions, regulations, demands, and supplies. All of these assumptions will likely affect San Luis Reservoir. The FNA–79 and FNA–300 conditions described above cover a portion of the range of all possible scenarios and resulting San Luis Reservoir storage conditions.

Uncertainties are associated with many of the assumptions regarding future conditions. The Study team identified key assumptions and tested the sensitivity of simulated low point conditions to changes in those assumptions. Key assumptions identified for the PFR were operations without Phase 8, operations without Article 56 for SWP contractors, and Judge Wanger order for the protection of delta smelt. The Study team conducted a sensitivity analysis using FNA–79 for Article 56 and Phase 8 because FNA–300 prevents the occurrence of low point issues. Sensitivity to the order was conducted at an existing level of development using an approximate implementation of the order in CalSim. The magnitude of change seen at the existing level of development is likely to be similar for FNA–79. The Feasibility Report Phase will include additional analysis for the sensitivity of order assumptions using a more refined implementation under FNA conditions and with SLLPIP comprehensive plans.

A.6.1 Simulated Phase 8 Settlement

Historically, the CVP and SWP have shared responsibility for making a specified volume of water (Phase 8 water) available in certain hydrologic year types to meet the requirements of the 1995 Water Quality Control Plan. The Phase 8 Hearing was to determine the responsibilities of upstream water users in the Sacramento Valley toward meeting the requirements. In 2002, upstream water users and the Projects reached a settlement agreement, which is being implemented.

The primary cause of the differences in the CalSim representation of the low point between the existing and FNA conditions is the inclusion of Phase 8 in the FNA condition. The timing of when Phase 8 water is made available, moved through the Delta, and delivered to contractors has a significant influence on San Luis Reservoir storage.

In CalSim, Phase 8 water is made available in years not classified as “wet” by the Sacramento Valley Index. Phase 8 water is made available when agricultural water users in the Sacramento Valley substitute groundwater pumping for surface water diversions or release water from privately owned reservoirs. This water is then made available to the CVP and SWP. Groundwater substitution programs are simulated to occur later in the summer when there is typically storage capacity available in project reservoirs, available export capacity at Delta pumping plants, or both. Figure A-15 illustrates the monthly volumes of water that the model assumed would be made available from each source in the Sacramento Valley.

As shown in Figure A-15, Phase 8 water is made available in the model from May through September. Phase 8 water is either exported from the Delta in the same month when made available or stored in NOD project reservoirs for future release and export. Figure A-16 illustrates the months in which Phase 8 water is typically moved SOD. This shows that the majority of the water is moved from July through September and on average approximately 110 TAF is exported each year.

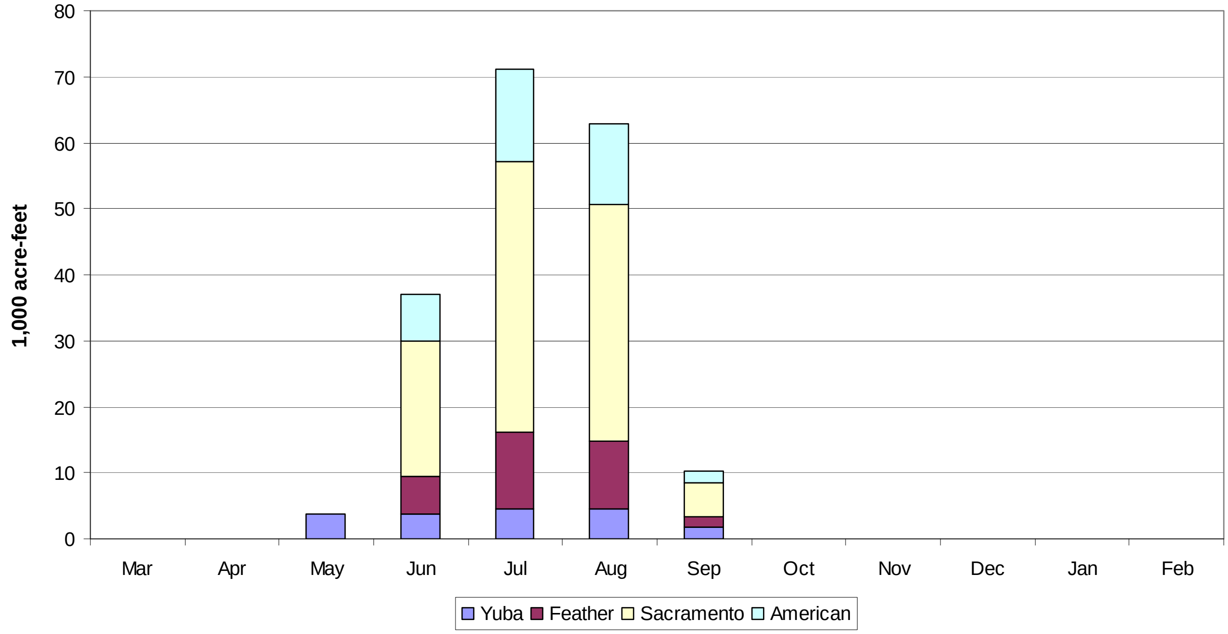


Figure A-15. Simulated Timing, Quantity, and Source of Water made Available from Phase 8

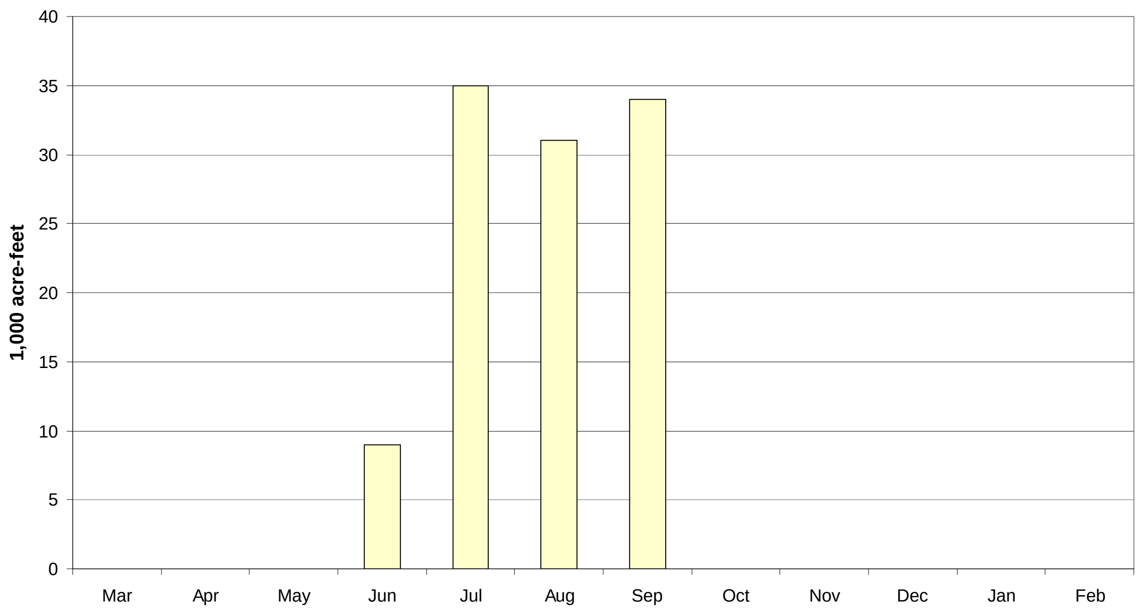


Figure A-16. Simulated Average Monthly Delta Export of Phase 8 Water

As Figure A-16 shows, this water is typically exported in the months immediately preceding and during the period of lowest storage in San Luis Reservoir. Delivery of Phase 8 water for both the CVP and SWP occurs throughout the contract year because the water is simulated to increase allocations within each project. The increase in allocations creates a slight increase in deliveries prior to when the water is moved. This increase in deliveries may drawdown San Luis Reservoir further than it would without the increase in allocation. However, the total volume of Phase 8 water must cover not only the increased drawdown that has occurred, but also the increased delivery throughout the remainder of the contract year. The overall effect of Phase 8 can be seen in Figure A-17 which compares simulated average monthly San Luis Reservoir storage with and without Phase 8.

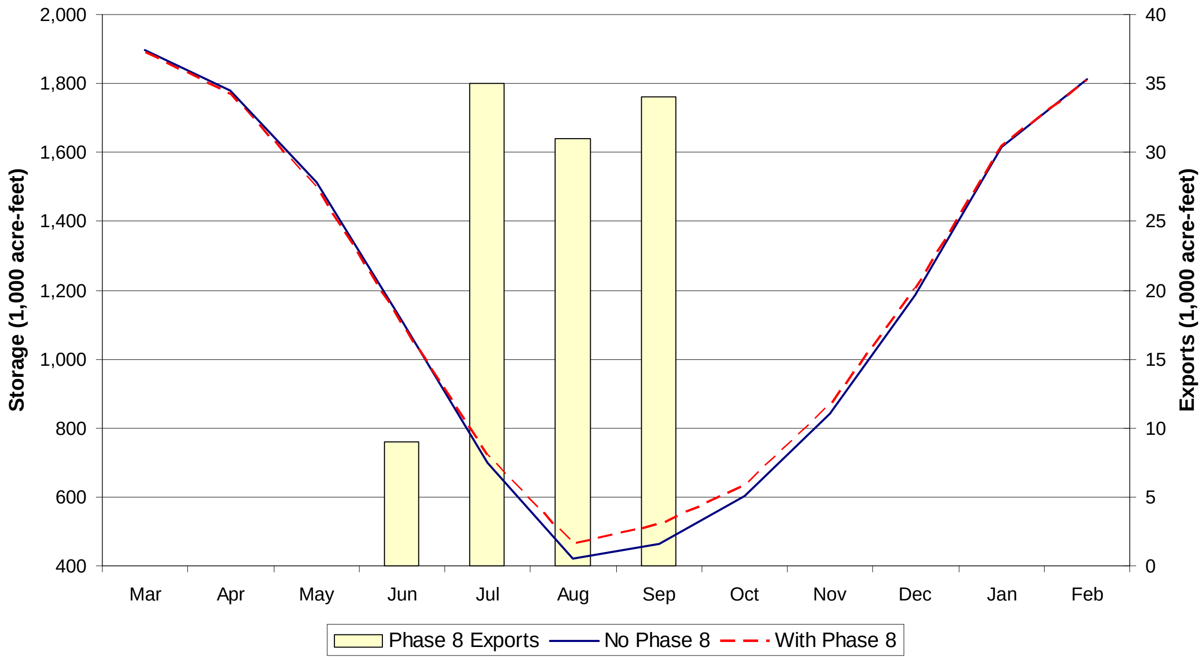


Figure A-17. Simulated Average End-of-Month San Luis Reservoir Storage and Phase 8 Exports

Figure A-17 shows a slight decrease in average San Luis Reservoir storage before Phase 8 water is exported from the Delta. The Phase 8 water then increases average storage during low point months of August and September. Over the remainder of the CVP contract year, storage values between the two scenarios converge as the additional Phase 8 water is delivered from storage to SOD contractors. Based on discussions with personnel at Reclamation and DWR, this representation of Phase 8 and resulting effect on San Luis Reservoir storage is reasonable for the purpose of the SLLPIP.

The environmental documentation for the 2002 Phase 8 Settlement Agreement is not yet complete and there is considerable uncertainty regarding how and when Phase 8 will actually be implemented. Therefore, simulations of FNA conditions without Phase 8 were made to understand its potential effects on the frequency and magnitude of future low point conditions. Figure A-18 compares the annual low point probability without Phase 8 to probability under FNA–79 conditions, which include Phase 8.

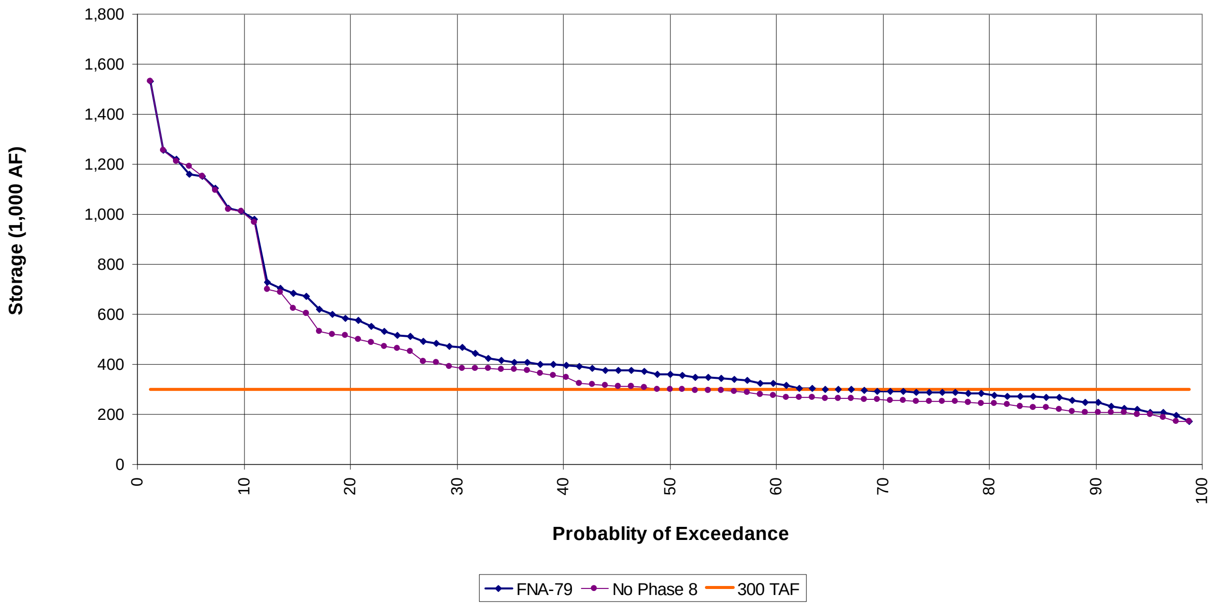


Figure A-18. Probability of Exceedance for Annual San Luis Reservoir Low Point with and without Phase 8

Figure A-18 shows that the absence of a Phase 8 program (as currently implemented and simulated in CalSim) lowers the annual minimum storage level in San Luis Reservoir in approximately 85% of years. Absent the Phase 8 program, the simulated San Luis Reservoir annual minimum storage level drops below 300 TAF in approximately 50% of the years, compared to 35% under FNA–79 conditions. Phase 8 water is moved into San Luis Reservoir in the months immediately preceding low point or during low point months, thereby increasing storage at low point.

An increase in the frequency and magnitude of low point conditions would result in an increase in interrupted San Felipe Division M&I deliveries. Table A-5 summarizes the change in interrupted deliveries for the Phase 8 and Article 56 (See Section A.6.2) sensitivity analyses.

Table A-5. Sensitivity of Average Annual San Felipe Division M&I Delivery Interruptions to Phase 8 and Article 56 Assumptions (TAF)

Sacramento Valley Index	FNA – 79	FNA–79 without Phase 8	FNA–79 without Article 56
Wet	5	5	5
Above Normal	9	15	9
Below Normal	4	13	4
Dry	11	22	13
Critical	7	14	8
All Years	**7**	**13**	**8**

A.6.2 Article 56

Article 56, which is part of the Monterey Agreement between DWR and State Water Project contractors, allows SWP contractors to carry over a portion of the current year's Table A allocation in San Luis Reservoir for delivery in subsequent years. The operation of Article 56 is simulated in CalSim as part of FNA–79 and FNA–300. Article 56 has the potential to increase storage levels in the SWP portion of San Luis Reservoir and affect the San Luis Reservoir low point. Therefore, the Study team simulated FNA conditions without Article 56 for comparison with FNA–79, to understand the potential change in San Luis Reservoir storage. Figure A-19 compares the annual low point probability without Article 56 to FNA–79, which includes Article 56 operations.

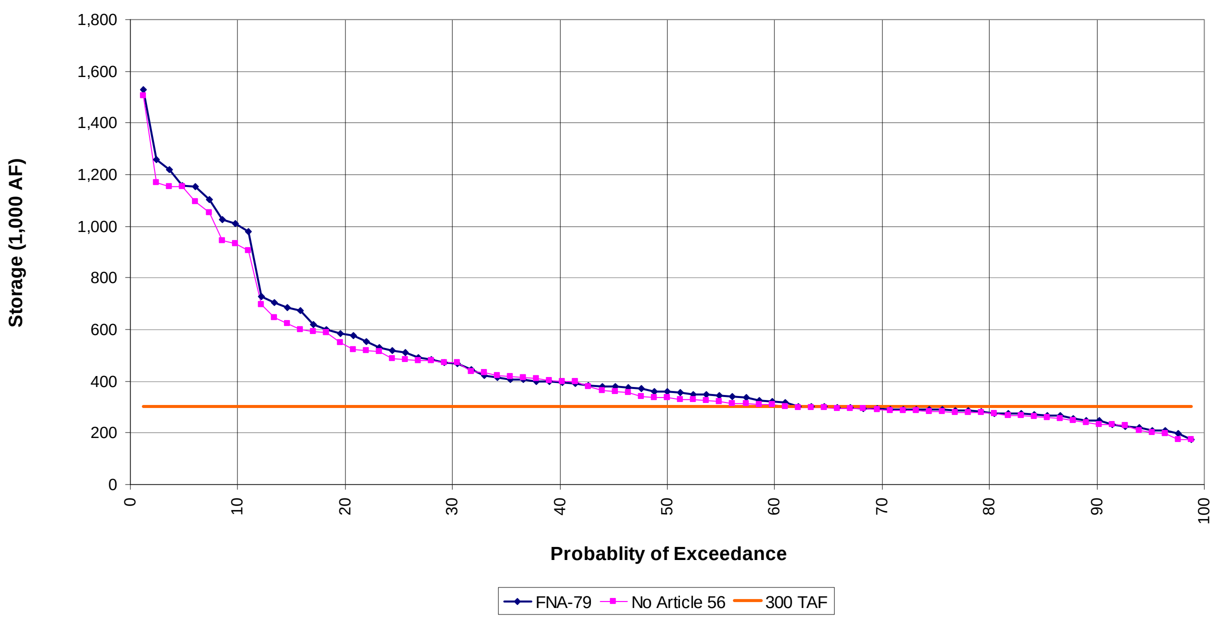


Figure A-19. Probability of Exceedance for Annual San Luis Reservoir Annual Minimum Storage Level with and without Article 56

As Figure A-19 shows, there would be little difference in annual minimum storage levels in San Luis Reservoir under FNA–79 conditions with and without

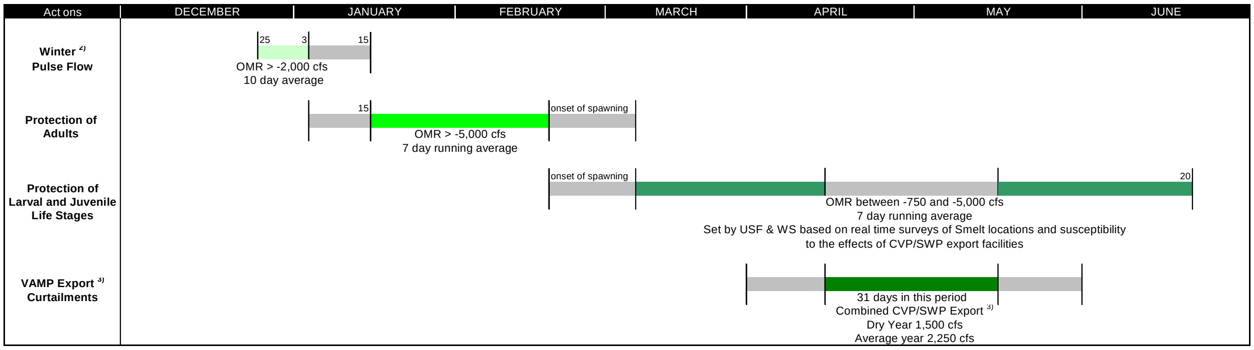
Article 56. The reason for the small change in the magnitude of annual minimum storage levels is that water carried over from one year to the next under Article 56 is typically stored in Oroville Reservoir until after the annual minimum storage level each year. The water is then moved into San Luis Reservoir in the fall and winter months for delivery in the next contract year. Water carried over under Article 56 will not be delivered prior to the annual minimum storage level and is not required to be in San Luis Reservoir at the time when the annual minimum storage level occurs.

Changes in the frequency, magnitude, and duration of low point conditions result in changes in interrupted San Felipe Division M&I deliveries. Table A-5 summarizes changes for the Article 56 sensitivity analysis.

A.6.3 Remedy Order for Delta Smelt

In December 2007, Judge Oliver Wanger issued an order for the protection of delta smelt (*Natural Resources Defense Council, et al. v. Kempthorne, et al.* 2007). The order includes flow criteria for Old and Middle River (OMR) in the Delta, monitoring requirements, and instruction on the installation and operation of barriers in the south Delta. Absent the operation of CVP and SWP export pumps, flow in OMR north of Clifton Court Forebay and Victoria Canal is tidally influenced with a net flow that goes north toward Frank's Tract. During operation of CVP and SWP export pumps, net flow in OMR can be reversed (indicated by negative flows) to flow south toward the export pumps. These reverse flows may affect delta smelt. The order limits negative flow in OMR during certain times of the year, which may limit CVP and SWP exports.

In the order, OMR flow criteria were specified for the period from around the end of December through mid June, depending on various triggers determined from real-time monitoring. From March through June, the order specifies a range of OMR flows, specified as a 7-day running average. Actual flow requirements are to be determined by fisheries agencies based on real-time monitoring and surveys. OMR flow criteria range from -750 cfs to -5,000 cfs. Because export pumping tends to increase negative flow in OMR, the less negative the number, the more restrictive the criteria are on export pumping. Figure A-20 summarizes order actions that affect water supply.



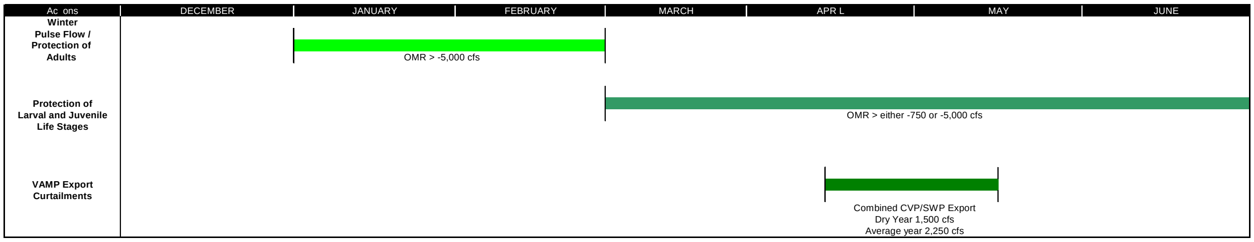
1) This table only shows the parts of the December 14th Order that affects water supplies. The Order also includes monitoring requirements, prohibition of the installation of the Head of Old River Barrier in the Spring, and limited operations of the temporary agricultural Barriers in the South Delta.
2) Triggered only if turbidity exceeds 12 NTU at any of 3 specific Delta Stations. Action lasts for 10 days once triggered.
3) The Vernalis Adaptive Management Plan includes San Joaquin River flow enhancements and curtailed CVP/SWP pumping.

Figure A-20. Summary of Order Actions Affecting Water Supply(1)

The actions in Judge Wanger's order were only in effect until USFWS completed the new biological opinion on the proposed coordinated operations of the CVP and SWP. This biological opinion was completed in December 2008. The sensitivity studies were completed before the biological opinion was available, and while the order is no longer in effect, the sensitivity study on the order provides some helpful information. Some of the restrictions in the biological opinion, particularly those in the spring, are similar to those in the order. Additionally, the sensitivity study provides insight into how environmental restrictions could affect the utility of SLLPIP alternatives.

OMR flow criteria contained in the order are highly variable and based on conditions that are not easy to forecast or model, such as the location of smelt in the Delta. The sensitivity analysis for the PFR effectively brackets the range of flow criteria and the likely effects of the order on Delta export operations and SOD water supply by performing two simulations, in which the values at either end of the range are used for the entire period when criteria may be in place. This approach helps to address the uncertainty regarding what the OMR flow criteria will be each year.

A coarse approximation of the order was implemented in CalSim by making several simplifying assumptions. OMR flow is not simulated in CalSim and was approximated based on statistical relationships between flow in OMR, the San Joaquin River at Vernalis, and South Delta diversions. South Delta diversions include diversions into Clifton Court Forebay, CVP Jones pumping, Contra Costa Water District (CCWD) diversions, and net channel depletions in the South Delta. Delta exports, diversions, and San Joaquin River flow are calculated in CalSim and used to estimate OMR flow. Delta export pumping was adjusted to ensure OMR flow did not violate order flow criteria. Figure A-21 illustrates the CalSim implementation of order actions.



1) The 10-day turbidity action is ignored.
2) Assumed an OMR restriction of -5,000 cfs applied the entire months of January and February for adult smelt. The restriction actually begins January 15, unless the 10-day winter pulse flow action is triggered. If triggered, the -5,000 cfs restriction begins immediately after the 10-day winter pulse flow action.
3) Assumed a discretionary OMR restriction of -750 cfs or -5,000 cfs applied to the entire months of March through June for larvae and juvenile smelt. The restriction actually begins immediately following the previous adult smelt action and ends no later than June 20, but can end earlier based on the location of smelt in the Delta.
4) Assumed that temporary fish and agricultural barriers are not installed during the Wanger period, i.e. through June. The final order allows for temporary agricultural barrier installation.

Figure A-21. CalSim Order Assumptions

The Study team used two separate CalSim simulations to estimate a range of potential order effects. Both simulations assume a limit of -5,000 cfs in OMR for January and February. OMR flow criteria of -750 cfs was assumed from March through June for the more export-restricted scenario (-750 OMR) and -5,000 cfs from March through June for the less restrictive simulation (-5,000 OMR). For the PFR, sensitivity analysis for the order was conducted at an existing level of development. The following figures and tables compare results of both order simulations to a baseline simulation.

Figure A-22 shows that in both order simulations, the probability of low point issues occurring is increased and storage is reduced relative to the baseline in most years. Similar results are expected for a future level of development. Increases in the frequency, magnitude, and duration of low point issues would result in increases in delivery interruptions to San Felipe Division M&I Contractors, summarized below in Table A-6.

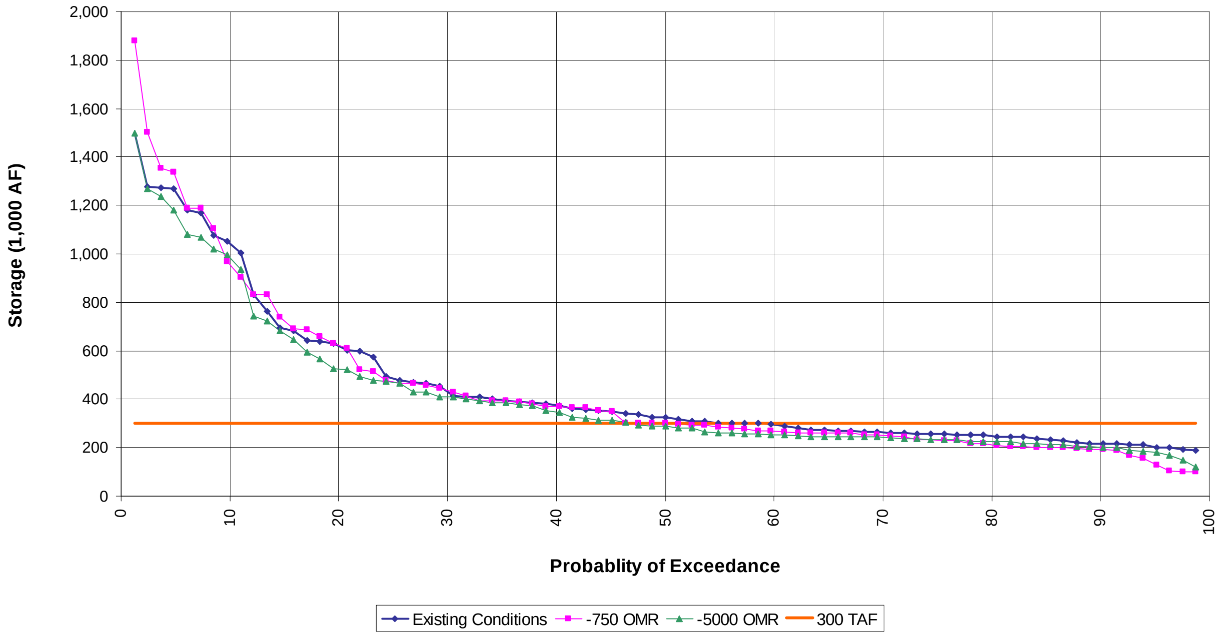


Figure A-22. Probability of Exceedance for Annual San Luis Reservoir Low Point with Order OMR Flow Criteria

Table A-6. Sensitivity Analysis: San Felipe Division M&I Delivery Interruptions with Order OMR Flow Criteria (TAF)

Sacramento Valley Water Year Index	Existing Conditions	-750 cfs OMR Flow Criteria	-5,000 cfs OMR Flow Criteria
Wet	3	3	5
Above Normal	14	12	20
Below Normal	9	17	13
Dry	17	33	22
Critical	18	26	19
All Years	**11**	**17**	**14**

Table A-6 illustrates that OMR flow criteria could increase San Felipe Division M&I delivery interruptions and reduce San Felipe Division M&I deliveries by an additional 3 to 6 TAF relative to the baseline. In addition to increasing delivery interruptions, OMR flow criteria would decrease allocations to all SOD contractors such that total average annual deliveries to the San Felipe Division would decrease by more than 3 to 6 TAF with OMR flow criteria. Additionally, the benefits of the project alternatives (see discussion of the comprehensive plan evaluations, below) that are reliant on moving more water through the Delta, such as the Institutional Alternative, could be decreased when evaluated with OMR flow criteria.

A.7 Institutional Measures Used for Comprehensive Plans

The stand-alone Institutional Alternative was screened from further consideration by the Study team under the completeness criterion because it would not provide a reliable long term water supply to meet the SLLPIP project objective of avoiding supply interruptions. Although the Institutional Alternative was screened as a stand-alone alternative, the institutional management measures included in the alternative are being considered as components of the comprehensive plans under consideration in the PFR. This section reviews institutional measures included in comprehensive plans and how they were evaluated.

A.7.1 Exchanges and Transfers

The institutional management measures include exchanges and transfers to support the higher early allocation of water supply to CVP contractors. Long-term agreements to transfer or exchange water would need to be negotiated and in place when called upon to maintain storage in San Luis Reservoir. Both exchanges and transfers would rely on existing project facilities to deliver water from potential sellers to the contractors dependent on San Luis Reservoir. It is assumed that water transfers would be negotiated for sources north of the Delta. Transferred water would therefore represent a "new" supply for the SOD service areas reliant on San Luis Reservoir. Water transferred would meet a portion of the demand normally met from San Luis Reservoir, thereby decreasing the required release from San Luis Reservoir and helping to maintain storage levels. Water exchanges would likely be similar to the existing "source-shifting" agreements utilized by the EWA. Source-shifting agreements would compensate the CVP or SWP contractors that have access to San Luis Reservoir and other water sources south of the Delta. Potential source-shifting partners evaluated for the PFR include CVP contractors that have access to groundwater supplies and Metropolitan Water District (MWD), which has supplies in Castaic Lake. No new project facilities would be necessary to support these measures.

A.7.2 Groundwater Banking

The actual groundwater bank that would be used as one of the institutional management measures has not been identified. For the purposes of the PFR, the Semitropic Water Storage District (Semitropic) groundwater bank in Kern County is assumed to be representative of the type of groundwater bank available for the project. A groundwater bank with the existing infrastructure and capacity needed to support project operations will be identified as a part of the Feasibility Study to support additional analysis of the comprehensive plans.

The Study team made assumptions regarding groundwater banking operations using the Semitropic Water Storage District's existing participation rules for storing and extracting water supplies from its bank. Participation in the Semitropic groundwater bank is initiated through purchase of shares in the bank itself. These shares create access rights for groundwater storage and extraction based upon contractual limitations. Revenue from the sale of shares is used by Semitropic for development of facilities necessary for operation of the groundwater bank. In addition to the share cost, groundwater bank participants are responsible for Semitropic operation and maintenance fees that include a flat per-share fee for depositing and extracting groundwater, electricity costs for pumping groundwater, and a general management fee.

A.7.3 Modeling Methodology

The institutional management measures were evaluated by layering the operation of each institutional measure onto the results of the structural alternatives that they were paired with. The implementation of institutional measures was prioritized in the analysis based on estimated costs for each measure. The institutional measures were ranked from least to most expensive as water transfers, source shifting, and groundwater banking.

Operation of Water Transfers

Modeling for the institutional management measures assumed that water transfers would originate from NOD sources and would be transferred through the Delta and exported at either Jones or Banks Pumping Plants. Transfer water was assumed to be delivered directly from either the DMC or California Aqueduct to CVP contractors who, absent the transfer, would take delivery of an equal volume of water from San Luis Reservoir. A volume of water equal to the transfer volume is kept in San Luis Reservoir.

Modeling for the institutional management measures assumed that a long-term agreement to call on a maximum volume of water each month and each season would be in place. Analysis conducted for the PFR assumed a maximum of 30 TAF available each month from June through September for a maximum annual transfer of 120 TAF each summer. This volume of water was assumed to be available every year.

The Study team used post-processing of CalSim simulation results for the Delta and CVP and SWP exports to estimate constraints on moving water through the Delta for delivery to SOD contractors. These constraints on the ability to transfer water through the Delta include:

Available pumping capacity at Project pumping plants and canals, considering regulatory requirements and Delta conditions; “Balanced” or “surplus” Delta conditions; and Carriage water costs associated with exporting additional water while meeting Delta water quality standards.

The post-processing tool analyses CalSim results to determine what is governing Delta operations each month. This information can be used to determine when the Delta is in “balanced” or “surplus” conditions. “Balanced” conditions occur when releases from upstream CVP and SWP reservoirs plus unregulated flow is approximately equal to Sacramento Valley in-basin uses, water required to meet Delta outflow and water quality requirements, and Delta exports. Under balanced conditions, it may be possible to make additional water available from NOD sources and export all or a portion of this water. “Surplus” conditions occur when releases from upstream CVP and SWP reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses, water required to meet Delta outflow and water quality requirements, and exports. Surplus conditions indicate that the CVP and SWP are not capable of controlling the water entering and leaving the Delta and are therefore not capable of controlling any additional water made available from north of Delta sources. Through-Delta transfers cannot occur when the Delta is in surplus conditions. Under balanced conditions, carriage water costs are the portion of any additional Sacramento River inflow to the Delta required to meet Delta water quality standards. Carriage water costs typically range from 0 to 55 % of additional Sacramento River flow in the June through September period.

The institutional management measures were evaluated using CalSim results for a simulation that did not include OMR flow criteria. OMR flow criteria and the resulting shift in CVP and SWP operations reduce export capacity available for water transfers as part of the institutional management measures.

Water transferred into San Luis Reservoir from NOD sources is “new” water in the SOD service area. After San Luis Reservoir storage reaches its annual minimum level, it is possible to either leave the water in San Luis Reservoir or provide the water as an additional supply to contractors. Water left in San Luis Reservoir would tend to either increase the availability of Section 215 water, unstorable water made available to CVP contractors, in the following winter or spring months in the event that CVP storage fills, or be allocated for delivery to all contractors in the following spring if CVP storage does not refill. In either instance, the additional water would eventually be delivered to CVP contractors. Therefore, for the PFR analysis it was assumed this water is delivered in the fall and early winter months and this increase in deliveries is considered a benefit of the institutional management measures.

Operation of Water Exchanges

Water exchanges through source-shifting agreements help maintain San Luis Reservoir storage by compensating contractors to utilize other available water supplies in-lieu of taking delivery from San Luis Reservoir. Two such contractors were evaluated for the PFR analysis of the institutional management measures: CVP contractors with access to groundwater and MWD, with its Castaic Lake supplies. Source-shifting agreements temporarily shift delivery of water from San Luis Reservoir to an alternative supply.

Assumptions for source-shifting agreements were developed from discussions with CVP contractors and MWD. CVP contractors with access to groundwater may be willing to pump groundwater instead of taking delivery of contract supplies from San Luis Reservoir. These contractors have limited groundwater pumping and distribution capacity that may not be available in all years. It was assumed that the capacity available for source shifting was a function of available CVP contract water. In years when the CVP cannot deliver full contract supply, all or a portion of groundwater pumping capacity would be used to augment CVP supplies and would not available for source-shifting operations. It is assumed that any volume of water source-shifted by CVP contractors will be delivered after low point, as opposed to being rescheduled for delivery in the following year.

MWD has some degree of flexibility to meet demands temporarily along the West Branch of the California Aqueduct using water stored in Castaic Lake instead of delivery from San Luis Reservoir. This flexibility could be used in a source-shifting agreement to maintain storage in San Luis Reservoir until low point concerns have past. In recent years MWD has participated in source-shifting agreements as part of the EWA Program. Under actual operations, there may be competition for source-shifting capacity between different programs. Conservative estimates of the volume of water available for source shifting each year were made for the PFR analysis. It is assumed that any volume of water source-shifted by MWD would be delivered after low point, in addition to current deliveries and subject to potential capacity limitations, to refill Castaic Lake. Table A-7 summarizes the monthly volumes of water assumed to be available for a source-shifting operation under various conditions.

Table A-7. Assumptions for Source Shifting (TAF)

CVP Agricultural Service Contractors			
CVP Allocation (%)	**July**	**August**	**September**
90-100	10	10	10
60-90	7	7	7
25-60	5	5	5
<25	0	0	0
CVP San Joaquin River Exchange Contractors			
Conditions	**July**	**August**	**September**
Non Shasta Critical	7	7	7
Shasta Critical	0	0	0
MWD Castaic Lake Supplies			
Conditions	**July**	**August**	**September**
All Years	25	25	25*

*Subject to an annual maximum of 50 TAF.

Groundwater Banking Operations

Groundwater banking operations are estimated to be the most expensive institutional measure and therefore would be the last utilized to maintain storage above 300 TAF. The PFR analysis assumed that a groundwater bank utilized for the SLLPIP would be a CVP asset. This would likely involve the CVP purchasing storage space or shares in an existing Central Valley groundwater bank. Assumptions regarding the operation of the bank were made based on information on Semitropic Water Storage District's groundwater banking operation. Assumptions regarding how water is moved into (puts) and out of (takes) the bank are described in the following sections.

Water Supplies and Puts to Groundwater Bank The water supply available to a CVP groundwater bank is water surplus to the existing operation of the CVP. Current CVP operations control water in NOD reservoirs and through Delta exports for allocation and delivery throughout the CVP. These operations are simulated in CalSim and they provide the basis for layering on groundwater banking operations. Section 215 water is made available to contractors for immediate delivery when it is available and is the water supply assumed to be available for storage in a CVP groundwater bank. The CVP declares the availability of SOD Section 215 water when the following conditions occur.

1. Surplus water in the Delta;

2. Available CVP export and canal capacity to deliver the water; and

3. No available storage capacity in the CVP portion of San Luis Reservoir.

Additionally, under Joint-Point operations it may be possible to move water for storage in a groundwater bank with available capacity at SWP export facilities. Joint-Point operations are assumed under the FNA conditions.

Section 215 water is typically only available in the December through March period. The post-processing tool used to evaluate the institutional management measures estimated the availability of Section 215 water and the storage of this water in a groundwater bank subject to constraints on banking operations.

Central Valley groundwater banking operations primarily use two methods to "bank" water in the ground: direct and in-lieu recharge. Direct recharge is typically done by flooding recharge ponds and allowing water to percolate through the soil column and into the underlying aquifer. The volume of water that may be recharged is limited by the area of the pond and soil properties that govern how quickly water percolates. Under wet conditions, it may not be possible to conduct direct recharge because soils and ponds may already be saturated. In-lieu recharge involves the delivery of surface water to meet demands that would otherwise be met from groundwater supplies. The water that would have been pumped from the aquifer, absent the delivery of surface water, is then considered "banked" for future use. To conduct in-lieu recharge surface water must be delivered during periods when there are demands for groundwater that can be offset by surface water deliveries.

Groundwater banking operations for the SLLPIP would use both direct and in-lieu recharge. Direct recharge capacity is assumed to be a function of hydrologic conditions in the Central Valley. The SJR Index is used as an estimate of these conditions. Monthly limits were assumed based on year type, with less recharge capacity in wetter years and winter months and higher capacities in drier years and summer months. In-lieu recharge capacities were developed as a function of SWP allocations each year under the assumption that as allocations decrease, groundwater pumping increases, providing more opportunities for in-lieu recharge. Estimates of annual groundwater pumping that may be offset by surface water deliveries were distributed using a monthly irrigation pattern. Table A-8 is a summary of the assumptions for the monthly capacities for putting water into a groundwater bank.

Table A-8 shows that the highest available capacity for putting water into a groundwater bank occurs in the summer months of dry years. These constraints limit the usefulness of banking operations for the SLLPIP for two reasons. First, this schedule is opposite the times when water is available to be put into the bank. Second, the highest available capacity for putting water into a groundwater bank occurs during the same months when water may be extracted in order to maintain San Luis Reservoir storage.

Table A-8. Monthly Recharge Capacities for Groundwater Banking (TAF)

Direct Recharge												
SJR Index	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Wet	0.6	0	0	0	0	0	0	0.6	0.6	0.6	0.6	0.6
Above Norm	1.2	1.2	0	0	0	0	1.2	1.2	1.2	1.2	1.2	1.2
Below Norm	1.2	1.2	1.2	0	0	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Dry	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Crit	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
In-Lieu Recharge												
SWP Alloc.	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
100	0.2	0.1	0.1	0.0	0.1	0.2	0.4	1.0	2.3	2.8	2.1	0.6
75	0.5	0.2	0.2	0.1	0.3	0.5	0.8	1.9	4.6	5.5	4.3	1.2
50	0.7	0.4	0.3	0.1	0.4	0.7	1.2	2.9	6.9	8.3	6.4	1.7
Maximum	**1.9**	**1.6**	**1.5**	**1.3**	**1.6**	**1.9**	**2.4**	**4.1**	**8.1**	**9.5**	**7.6**	**2.9**
Minimum	**0.8**	**0.1**	**0.1**	**0.0**	**0.1**	**0.2**	**0.4**	**1.6**	**2.9**	**3.4**	**2.7**	**1.2**

Groundwater banking operations typically assume a loss factor for surface water delivered to the bank such that 100% of delivered surface water is not considered banked. Losses can include delivery system losses, evaporation from recharge ponds, and movement of water within the aquifer. A 10% loss rate was assumed for all surface water delivered to the groundwater bank.

Take from Groundwater Bank to San Luis Reservoir Additional agreements may be required to recover water from a Central Valley groundwater bank and back an equivalent volume of water into San Luis Reservoir. The simplest scenario would involve pumping water out of the bank for direct delivery to a bank owner with an existing SWP or CVP contract. This delivery of groundwater pumped from the bank would offset delivery of SWP or CVP contract supplies from San Luis Reservoir, and an equivalent volume of water would remain in San Luis Reservoir to protect against low point issues. This may be representative of potential banking operations with a member of the Kern Water Bank, which is also an SWP contractor. Alternatively, a groundwater bank may have the ability to pump groundwater back into the California Aqueduct for delivery to an SWP or CVP contractor further south in lieu of delivery from San Luis Reservoir.

Limitations exist for both direct delivery and pump-back operations. The volume of water that can be delivered directly to an SWP or CVP contractor overlying or nearby the bank is likely a function of contract allocations. For the PFR analysis, it was assumed that direct delivery would occur to an SWP contractor and would be a function of SWP allocations. Higher allocations increase the ability of those contracts to reduce delivery from San Luis Reservoir and take delivery of pumped groundwater. When allocations are lower, contractors are not taking as much water from San Luis Reservoir and have less ability to reduce those deliveries. The volume of water that can be pumped out of the ground and into the California Aqueduct is limited by available pumping and conveyance capacity. Pumping capacity estimates were developed from discussions with Semitropic. Table A-9 is a summary of the monthly constraints in TAF on recovering water from a CVP groundwater bank.

Table A-9. Monthly Recovery Capacities for Groundwater Banking (TAF)

Direct Delivery												
SWP Alloc.	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
100	0.7	0.4	0.3	0.1	0.4	0.7	1.2	2.9	6.9	8.3	6.4	1.7
75	0.5	0.2	0.2	0.1	0.3	0.5	0.8	1.9	4.6	5.5	4.3	1.2
50	0.2	0.1	0.1	0.0	0.1	0.2	0.4	1.0	2.3	2.8	2.1	0.6
Pump-Back to California Aqueduct												
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Capacity	5	5	5	5	5	5	5	5	5	5	5	5
Maximum	**5.7**	**5.4**	**5.3**	**5.1**	**5.4**	**5.7**	**6.2**	**7.9**	**11.9**	**13.3**	**11.4**	**6.7**
Minimum	**5.2**	**5.1**	**5.1**	**5.0**	**5.1**	**5.2**	**5.4**	**6.0**	**7.3**	**7.8**	**7.1**	**5.6**

Like water transferred from north of the Delta, water recovered from a groundwater bank and stored in San Luis Reservoir is also a new source of water in the SOD service area. It was assumed that this water also would be delivered in the fall and early winter months to CVP contractors, and this increase in deliveries is considered a benefit of the institutional management measures.

Another option that was evaluated for water transferred from NOD and water recovered from a groundwater bank was the return from San Luis Reservoir to the groundwater bank to be restored. This allows some additional flexibility to move water into a groundwater bank when there is available recharge capacity. However, this operation provided a minimal increase in the usefulness of groundwater banking, and this operation was not included in the analysis for the PFR.

A.8 Lower San Felipe Intake Comprehensive Plan

This comprehensive plan includes construction of a new lower San Felipe Intake to allow reservoir drawdown to its minimum operating level without algae reaching the San Felipe Intake. Moving the San Felipe Intake to an elevation equal to the Gianelli Intake would allow operation of San Luis Reservoir below the 300 TAF level without creating the potential for a water supply interruption to the San Felipe Division. The comprehensive plan also includes institutional measures (groundwater banking, exchanges, and transfers) to provide a safety net in all years, allowing higher allocations earlier in the year by creating access to an additional water supply, available as insurance in the event that San Luis Reservoir storage is insufficient to meet the allocation.

A.8.1 Lower San Felipe Intake

As part of this comprehensive plan, a new intake would be constructed and connected to the existing San Felipe Division Intake via approximately 20,000 feet of new pipeline or tunnel. The San Felipe Intake is currently at elevation 334 feet, and algae-laden water can reach the intake when reservoir levels reach approximately 369 feet (approximately 300 TAF in storage). Because the Gianelli Intake Facility is at elevation 296 feet (approximately 30 feet lower than the minimum operating pool), algae-laden water does not typically reach the Gianelli Intake. The new intake in this alternative would be at elevation 296 feet, the same elevation as the Gianelli Intake. The lower intake facility would allow the San Felipe Division to receive water from the lower reservoir levels that do not contain high concentrations of algae. A hypolimnetic aeration facility would also be constructed.

A.8.2 Institutional Measures

The Lower San Felipe Intake Comprehensive Plan includes the institutional measures to allow higher early allocation of water supply to CVP contractors. Through groundwater banking, wet season water would be stored in the participating groundwater bank, and this water would provide a backstop for making higher allocations earlier in the year. Exchanges and transfers would be negotiated on the open spot market and might not be available in the quantity needed or at a price practical for project operations. Exchanges and transfers would rely on existing project facilities to deliver water from potential sellers to the contractors dependent on San Luis Reservoir. No new project facilities would be necessary to support these institutional measures.

A.8.3 Modeling Approach and Assumptions

Implementation of the Lower San Felipe Intake Comprehensive Plan would allow delivery to San Felipe Division M&I contractors as long as San Luis Reservoir storage were maintained above dead pool. This operation was simulated in CalSim by removing the constraint requiring San Luis Reservoir storage to be greater than 300 TAF for delivery to San Felipe Division M&I

contractors. CalSim does not explicitly simulate operations under the Lower San Felipe Intake Comprehensive Plan, but implicitly captures the operation and the resulting effects on the CVP and SWP system.

Results of this CalSim simulation are the basis for analysis of the ability of institutional measures to support higher early CVP allocations. Simulation of the institutional measures was evaluated by layering the operation of each institutional measure onto the CalSim results for the system operation with the Lower San Felipe Intake Comprehensive Plan. This analysis allowed the simulation of each institutional measure individually and in combination with other measures. The implementation of institutional measures was prioritized in the analysis based on estimated costs for each measure. The institutional measures were ranked from least to most expensive as water transfers, source shifting, and groundwater banking.

Simulation results for the Lower San Felipe Intake Comprehensive Plan with higher early CVP allocations are compared to both FNA–79 and FNA–300. Comparison with FNA–79 shows the effect of making deliveries to San Felipe Division M&I contractors when San Luis Reservoir storage is between 300 TAF and dead pool and the effect of delivery increases due to higher early allocations. Comparison with the FNA–300 baseline provides a likely upper bound to the range of benefits that would be provided by the Lower San Felipe Intake Comprehensive Plan to CVP SOD contractors.

Modeling Earlier Allocations and Institutional Measures

The objective of earlier allocations is to make the April allocation closer to the final July allocation in years when allocations are less than a certain threshold. The Study team estimated that it is most important that April allocations be as close as possible to final allocations when CVP SOD agricultural service contract allocations are less than 60% because in these years, cropping decisions are more dependent on allocations than when allocations are higher. The early allocation tool uses 60% as the threshold to identify target years for increasing allocations. Increasing allocations earlier in the year increases the risk of over-allocating water if actual demands exceed forecasted demands and/or actual supplies are less than forecasted supplies. In these instances, institutional measures are implemented to prevent delivery or allocation reductions. A post-processing tool was developed to layer this analysis on CalSim results for the Lower San Felipe Intake and Expand Pacheco Reservoir Comprehensive Plans.

The early allocation tool applies the same institutional measures as described for the Institutional Alternative; however, the measures are implemented to prevent CVP San Luis Reservoir storage from reaching dead pool instead of to maintain San Luis Reservoir storage above 300 TAF. Assumptions regarding the operation of groundwater banks, transfers, and exchanges are the same as described above for the Institutional Alternative.

For years when allocations are less than 60%, the early allocation tool estimates the volume of water available through institutional measures, to determine if they would provide an adequate backstop for earlier allocations. The volume of water available from institutional measures is the sum of estimated available water transfers, available source-shifting assets, and water previously stored in a groundwater bank. The volume of backstop required is dependent on the percent increase in early allocations. The early allocation tool targets a 5% increase in allocation in years when allocations are less than 60%. A 5% increase in CVP SOD allocations is approximately 100 TAF of additional contract delivery. These deliveries are made according to an irrigation demand pattern that results in 75 TAF of additional delivery prior to CVP San Luis Reservoir storage reaching its annual minimum storage level. Thus, the volume of institutional measures required as a backstop to prevent CVP San Luis Reservoir storage from reaching dead storage is 75 TAF. In any given year, if CalSim allocations are less than 60% and available institutional measures equal or exceed 75 TAF, the simulation increases allocations.

The early allocation tool simulates the additional delivery and drawdown of CVP San Luis Reservoir storage associated with increases in allocations. For some years, CalSim results show that CVP San Luis Reservoir storage would be adequate to make additional deliveries without the need to call on institutional measures. As in simulations of the Institutional Alternative, storage “triggers levels” were developed in order to simulate when the institutional measures may be called upon. Trigger levels were developed based on a review of actual and simulated storage levels and an understanding of the variability in SOD demands and deliveries. Trigger levels are intended to be representative of the storage conditions in the reservoir that would cause CVP operators to be concerned that storage in future months would reach dead storage. Trigger levels act as surrogates for the actual decision-making process of operators who consider many factors in forecasting future storage conditions. Table A-10 presents the storage trigger levels used in the PFR analysis for the Lower San Felipe Intake Comprehensive Plan.

Table A-10. End-of-month CVP San Luis Reservoir Storage Trigger Levels for the Lower San Felipe Intake Comprehensive Plan (TAF)

Month	July	August	September	October
Storage Trigger Level	350	160	45	45

Trigger levels are used to determine when to implement institutional measures and the volume of water to be made available. End-of-month simulated storage is compared to trigger levels to determine the volume of water needed to bring the simulated storage up to the trigger level, not necessarily back to levels simulated in CalSim.

The early allocation tool simulates the additional deliveries that would result from earlier allocations. These additional deliveries are simulated from May through October. For years when earlier allocations are made, CVP San Luis Reservoir end-of-October storage levels in the early allocation tool are lower than in the CalSim simulation results. This results in a deficit in San Luis Reservoir, relative to the CalSim simulation. The early allocation tool estimates the availability of water and export capacity to refill this deficit during the following winter and spring. In some instances, the deficit is refilled and CVP San Luis Reservoir storage returns to the levels simulated in CalSim. In other instances, the deficit does not refill and may persist for several years. When a deficit is carried over until the following spring, the early allocation tool does not allow further increases in allocation in that year. In actual operations, deficits carried over from one year to the next would likely tend to reduce allocations in subsequent years.

The early allocation tool is not meant to exactly replicate Reclamation's potential operations when using institutional measures as a backstop against over-allocation. The early allocation tool layers the incremental operations onto CalSim results to provide information on the potential delivery increase, the need to implement institutional measures, and the risk to future allocations (carried over storage deficits). These results are meant to demonstrate the potential benefits and risks of Reclamation making higher early allocations and using institutional measures as backstops against over-allocation.

A.8.4 Water Operations Modeling Results

The Lower San Felipe Intake Comprehensive Plan was analyzed for an 81-year period to estimate the potential changes in CVP deliveries that would be due to both the physical change to the intake and the availability of institutional measures to support earlier allocations. The following sections summarize the effects that the comprehensive plan would have on CVP SOD M&I and agricultural service contract deliveries.

CVP Deliveries

Implementation of the Lower San Felipe Intake Comprehensive Plan would increase CVP SOD contract deliveries to both M&I and agricultural contractors when compared to both the FNA–79 and FNA–300 scenarios. Compared to FNA–79, M&I deliveries would increase because the San Felipe Division could take delivery of water when San Luis Reservoir is below 300 TAF. In comparison, these deliveries are defined as Interrupted San Felipe Deliveries in FNA–79. Compared to FNA–300, M&I deliveries increase because the lower San Felipe intake would allow the CVP to draw San Luis Reservoir storage down below 300 TAF and could allocate additional water to both M&I and agricultural service contractors. Compared to both FNA conditions, agricultural deliveries under the Lower San Felipe Intake Comprehensive Plan would increase due to higher earlier allocations. The following tables summarize deliveries to CVP contractors under the Lower San Felipe Intake Comprehensive Plan.

Table A-11 shows an average annual increase in CVP SOD M&I deliveries of 7 TAF under the Lower San Felipe Intake Comprehensive Plan compared to both FNA scenarios. Compared to FNA–79, increases associated with the Lower San Felipe Intake Comprehensive Plan would occur within the San Felipe Division, because water could be delivered even when San Luis Reservoir storage is below 300 TAF. In contrast to the operations in FNA–300, in which 300 TAF of storage must be maintained in San Luis Reservoir, the lower intake would allow Reclamation to utilize CVP San Luis Reservoir storage fully and increases associated with the Lower San Felipe Intake Comprehensive Plan would occur for all CVP SOD M&I service contractors relative to FNA–300. Compared to FNA–79, the Lower San Felipe Intake Comprehensive Plan would provide more dry year water to San Felipe Division, and compared to FNA–300 the Lower San Felipe Intake Comprehensive Plan would provide more wet year water to all CVP SOD M&I contractors.

Table A-11. CVP SOD M&I Deliveries with Lower San Felipe Intake Comprehensive Plan (TAF)

Sacramento Valley Index	FNA–79	FNA–300	Lower San Felipe Intake	Change from FNA–79	Change from FNA–300
Wet	156	152	161	5	9
Above Normal	150	149	160	10	11
Below Normal	143	136	147	4	11
Dry	123	131	134	11	3
Critical	102	109	109	7	0
All Years	**138**	**138**	**145**	**7**	**7**

Table A-12 shows an average annual increase (relative to the FNA condition) in CVP SOD agricultural service contract deliveries of between 22 and 124 TAF under the Lower San Felipe Intake Comprehensive Plan. Compared to FNA–79, all delivery increases under the Lower San Felipe Intake Comprehensive Plan would be a result of earlier allocations. Comparing FNA–79 and the CalSim simulation of only the lower intake shows a slight decrease in deliveries. The decrease in CalSim simulated deliveries occurs in the model because, under FNA–79, interrupted San Felipe Division M&I deliveries remain in the reservoir and are allocated to agricultural service contractors in subsequent years. When these deliveries are made to San Felipe Division in the CalSim simulation of the Lower San Felipe Intake Comprehensive Plan, it results in slightly lower agricultural deliveries. Compared to FNA–300, increases under the Lower San Felipe Intake Comprehensive Plan would occur because of earlier allocations and because the lower intake would allow Reclamation to fully utilize CVP San Luis Reservoir storage. Full utilization of San Luis Reservoir tends to increase deliveries more in wet, above normal, and below normal year types while increases in dry and critical years would be due mostly to earlier allocations.

Table A-12. CVP SOD Agricultural Deliveries with Lower San Felipe Intake Comprehensive Plan (TAF)

Sacramento Valley Index	FNA–79	FNA–300	Lower San Felipe Intake			Change from FNA–79	Change from FNA–300
			CalSim	Early Alloc. Tool Increase	Total		
Wet	1,563	1,421	1,562	4	1,566	3	145
Above Normal	1,424	1,219	1,422	0	1,422	-3	203
Below Normal	1,147	1,011	1,147	21	1,168	21	158
Dry	899	896	896	50	946	48	51
Critical	383	351	379	50	429	47	78
All Years	**1,150**	**1,047**	**1,148**	**23**	**1,171**	**22**	**124**

Institutional Measures

Under the Lower San Felipe Intake Comprehensive Plan, institutional measures would be implemented to support earlier allocations. Table A-13 summarizes the results of the early allocation tool for the Lower San Felipe Intake Comprehensive Plan.

Table A-13. Annual Operation of Early Allocation Tool with Lower San Felipe Intake Comprehensive Plan

	CVP Allocations less than 60%	Allocations Increased Earlier	Institutional Measures Implemented	October Storage is Lower	March Storage is Lower
Number of Years	29	19	28	38	22

Table A-13 shows that in 19 of the 29 years that CalSim predicts allocations to CVP SOD agricultural service contractors of less than 60%, it might be possible to make a higher allocation earlier in the year. However, increasing allocations in these years might result in lower March storage in 22 years, potentially resulting in lower allocations in those years. October and March storage is predicted to be lower in more years than number of years in which allocations are increased because carryover deficits in CVP San Luis Reservoir can persist for several years. The following figure illustrates this effect.

Figure A-23 presents the annual maximum storage in the CVP portion of San Luis Reservoir in the CalSim simulation of a lower San Felipe Intake , compared with the annual maximum storage with early allocations. Differences between the annual maximum storage and the CVP storage capacity would occur in years when storage deficits persist in the reservoir; these differences could affect subsequent allocations. Also shown are years when early allocation increases provide 100 TAF of additional contract delivery. Figure A-23 illustrates that in years such as 1990, when early allocations would result in an additional 100 TAF of contract delivery, a deficit might be carried over for several years.

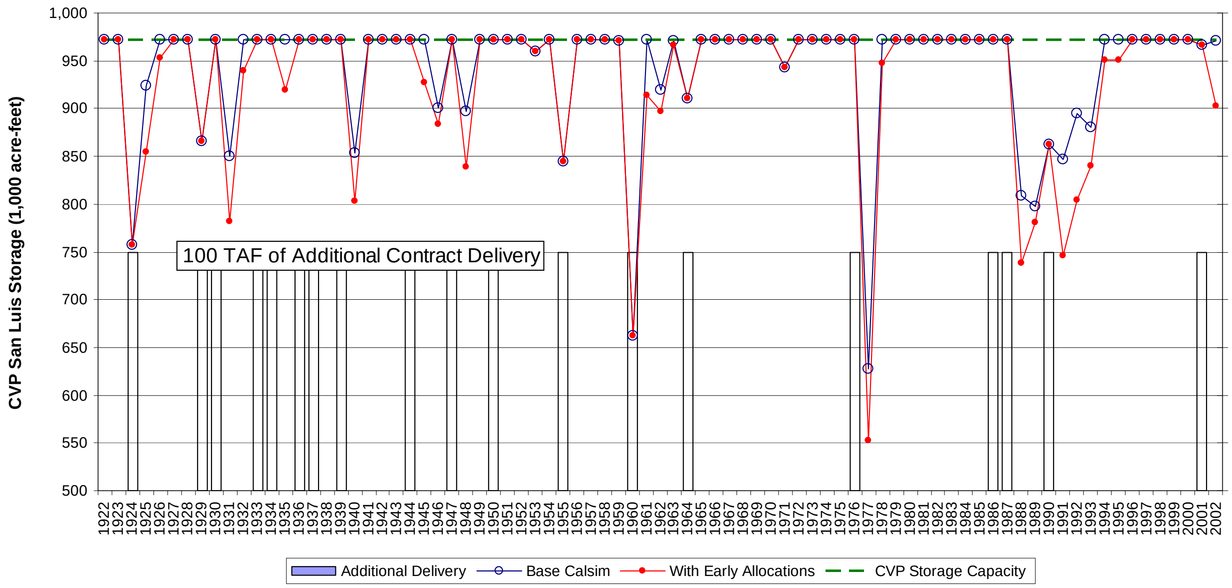


Figure A-23. Annual CVP San Luis Reservoir Maximum Storage with Additional Deliveries through Early Allocations

Carryover of storage deficits is also a reason why institutional measures are implemented in more years than allocations are increased. In the model, institutional measures are implemented based on the storage trigger levels presented in Table A-10 to reduce or eliminate any carryover debt. When carryover deficits persist for several years, institutional measures may be implemented in each year to maintain storage at the trigger levels. The following figure illustrates that after an increase in allocations and delivery, such as in 1990, various institutional measures were simulated to occur in each of the next four years to maintain storage at the trigger levels.

The implementation of institutional measures illustrated in Figure A-24 is summarized in Table A-14 by Sacramento Valley Index. This information can be used to help estimate the cost of implementing the institutional measures in conjunction with the Lower San Felipe Intake Comprehensive Plan.

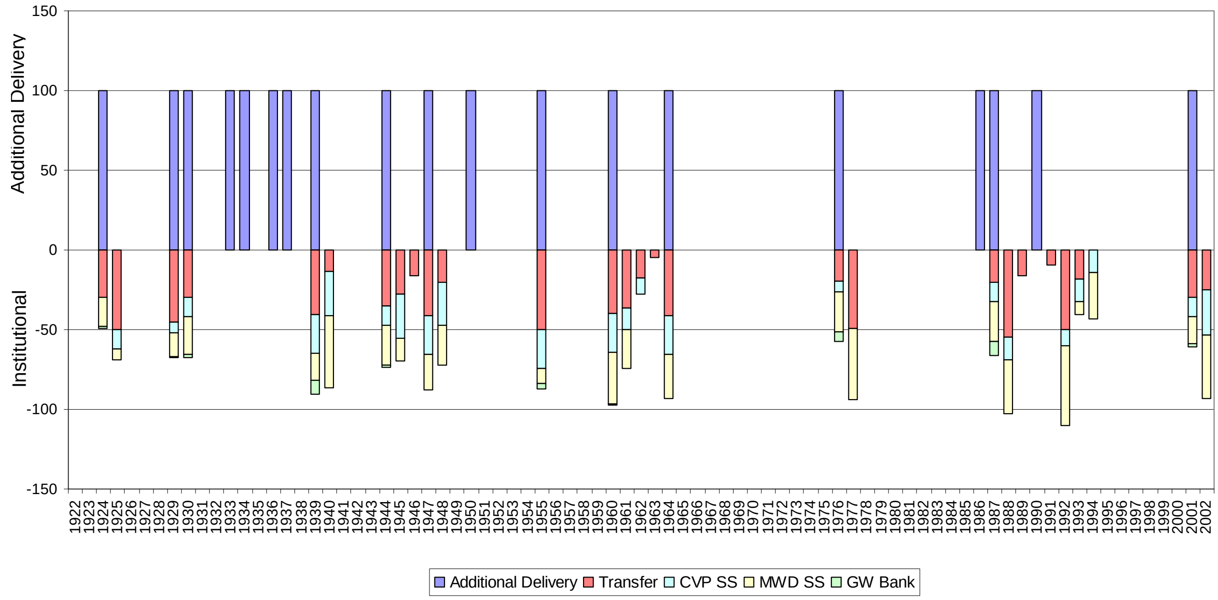


Figure A-24. Additional Deliveries and Implemented Institutional Measures under the Lower San Felipe Intake Comprehensive Plan

Table A-14. Average Annual Implemented Institutional Measures as Backstops for Earlier Allocations with Lower San Felipe Intake Comprehensive Plan (TAF)

Sacramento Valley Index	Water Purchased for Transfer	Transfer Water in San Luis Reservoir[1]	CVP Source Shifting	MWD Source Shifting	Groundwater Bank Deposit	Groundwater Bank Withdrawal
Wet	0	0	0	0	0	0
Above Normal	5	3	4	5	0	0
Below Normal	9	6	5	3	1	0
Dry	34	25	12	15	1	2
Critical	26	22	4	18	0	1
All Years	**14**	**10**	**5**	**7**	**0**	**0**
Number of Years[2]	**27**	**27**	**22**	**23**	**48**	**11**

[1]The differences between water purchased and water moved into San Luis Reservoir are from the estimated carriage water costs for moving water through the Delta.
[2]Out of 81 years analyzed.

A.9 Pacheco Reservoir Comprehensive Plans

Implementation of the Pacheco Reservoir Comprehensive Plan would include expansion of the existing Pacheco Reservoir to provide storage for San Felipe Division contractors. During low point months, San Felipe Division contractors would receive deliveries from Pacheco Reservoir. This alternative would allow operation of San Luis Reservoir to its minimum operating level without interrupting deliveries to the San Felipe Division. Depending on reservoir operation and size, it could also improve supply reliability to CVP contractors.

The Pacheco Reservoir Comprehensive Plan would also include groundwater banking, exchanges, and transfers to provide a safety net in all years, allowing higher allocations earlier in the year by creating access to a supplemental water supply, available as insurance in the event that San Luis Reservoir storage is insufficient to meet the allocation.

A.9.1 Expand Pacheco Reservoir

As part of the Pacheco Reservoir Comprehensive Plan, a new dam and reservoir would be constructed on Pacheco Creek. A new pump station and pipeline would connect the new reservoir to the Pacheco Conduit, downstream of the Pacheco Pumping Plant. The new dam and reservoir would inundate the existing 6,000 acre-foot Pacheco Reservoir, which is owned and operated by the Pacheco Pass Water District. The new reservoir would include a reservation for storage for Pacheco Pass Water District and for flood control. Two alternative sizes are being considered in this phase of the San Luis Low Point Feasibility Study:

- 80 TAF Pacheco Reservoir Comprehensive Plan: The new reservoir would include 55 TAF of storage for San Felipe Division contractors and a 25 TAF reservation for Pacheco Pass Water District, flood control, in-stream releases, and dead storage.

- 130 TAF Pacheco Reservoir Comprehensive Plan: The new reservoir would include 100 TAF of storage for San Felipe Division contractors and a 30 TAF reservation for Pacheco Pass Water District, flood control, in-stream releases, and dead storage.

A.9.2 Institutional Measures

The Pacheco Reservoir Comprehensive Plan includes institutional measures to allow higher early allocation of water supply to CVP contractors. As part of the groundwater banking measure, wet season water would be stored in the participating groundwater bank, and this water would provide a backstop for making higher allocations earlier in the year. Exchanges and transfers would be negotiated on the open spot market and might not be available in the quantity needed or at a price practical for project operations. Exchanges and transfers would rely on existing project facilities to deliver water from potential sellers to the contractors dependent on San Luis Reservoir. No new project facilities would be necessary to support these measures.

A.9.3 Modeling Approach and Assumptions

The Expand Pacheco Reservoir Comprehensive Plan was modeled in two phases, like the Lower San Felipe Intake Comprehensive Plan. In the first phase, the operation of an expanded reservoir on Pacheco Creek integrated with CVP operations was simulated in CalSim. CalSim simulated the operation by balancing storage levels between Pacheco and San Luis Reservoir differently throughout the year, to store water in Pacheco starting in October until needed during the following year's minimum storage months of August and September. Water stored in Pacheco Reservoir each spring is included in CVP SOD allocation logic and can increase allocations to all CVP SOD contractors. In the second phase, CalSim results from the first phase were post-processed using the early allocation tool to simulate higher early allocations to CVP agricultural service contractors.

Pacheco Reservoir Operations

In analyses conducted for the PFR, an expanded Pacheco Reservoir was assumed to operate on an annual cycle. The reservoir would be filled each year starting in October by diverting water from San Luis Reservoir, up to the full capacity of the Pacheco Pumping Plant. For this analysis, it was assumed that the Pacheco Pumping Plant capacity is 480 cfs regardless of the storage level in San Luis Reservoir. Assuming this capacity, the larger Pacheco Reservoir would typically fill by January. If the Pacheco Pumping Plant capacity were less than 480 cfs, there would still be adequate time in the months of February and March to fill an Expanded Pacheco Reservoir prior to the start of the CVP contract year and Delta export restrictions in April. Therefore, results presented below are not expected to change significantly, even if Pacheco Pumping Plant capacity is slightly less than 480 cfs. Diversions to the expanded Pacheco Reservoir would be greater than normal San Felipe Division deliveries for the October through March, but would not exceed the San Felipe Division's annual allocation.

In the modeling performed for this analysis, the San Felipe Divisions CVP allocation is stored in Pacheco Reservoir each year from October through March. In the CalSim model, CVP SOD allocations are simulated to include water stored in Pacheco Reservoir and the CVP portion of San Luis Reservoir. This water is released from Pacheco Reservoir to San Felipe Division Contractors Operations under the 80 TAF Pacheco Reservoir Comprehensive Plan would include releases from Pacheco Reservoir to San Felipe Division Contractors from June through September. These are the most likely months for San Luis Reservoir low point issues that would interrupt deliveries to M&I contractors. The 80 TAF Pacheco Reservoir Comprehensive Plan would reserve the entire CVP portion of Pacheco Reservoir storage (55 TAF) for release to both agricultural and M&I contractors during these two months. This volume is approximately equivalent to the total simulated diversion of San Felipe agricultural and M&I contractors at 100% allocation. It is assumed that if low point conditions persisted for longer than two months, they would most likely occur in years with less than 100% allocation for both M&I and agricultural service contractors. Diversions would decrease with lower allocations and would allow for delivery from Pacheco Reservoir for a longer period. Additionally, it might be possible for M&I contractors to take delivery of water from Pacheco Reservoir while agricultural contractors take delivery from San Luis Reservoir during periods of persistent low point issues.

Operations under the 130 TAF Pacheco Reservoir Comprehensive Plan would include deliveries from Pacheco Reservoir to San Felipe Division contractors starting in April, but would reserve 55 TAF for delivery during low point months. Supplying San Felipe contractors from Pacheco Reservoir for more months would keep more water in CVP San Luis Reservoir for delivery to other SOD contractors. Figure A-25 illustrates typical Pacheco Reservoir operations for both Pacheco Reservoir Comprehensive Plans.

Annual operations for Pacheco Reservoir were designed to maximize the total water supply that could be developed under the comprehensive plan, while ensuring sufficient storage to meet San Felipe Division deliveries during potential low point months. Alternative operations could be developed for future analyses to increase water supply reliability in certain year types and increase flexibility to manage other issues, including San Luis Reservoir drawdown restrictions or Delta export outages.

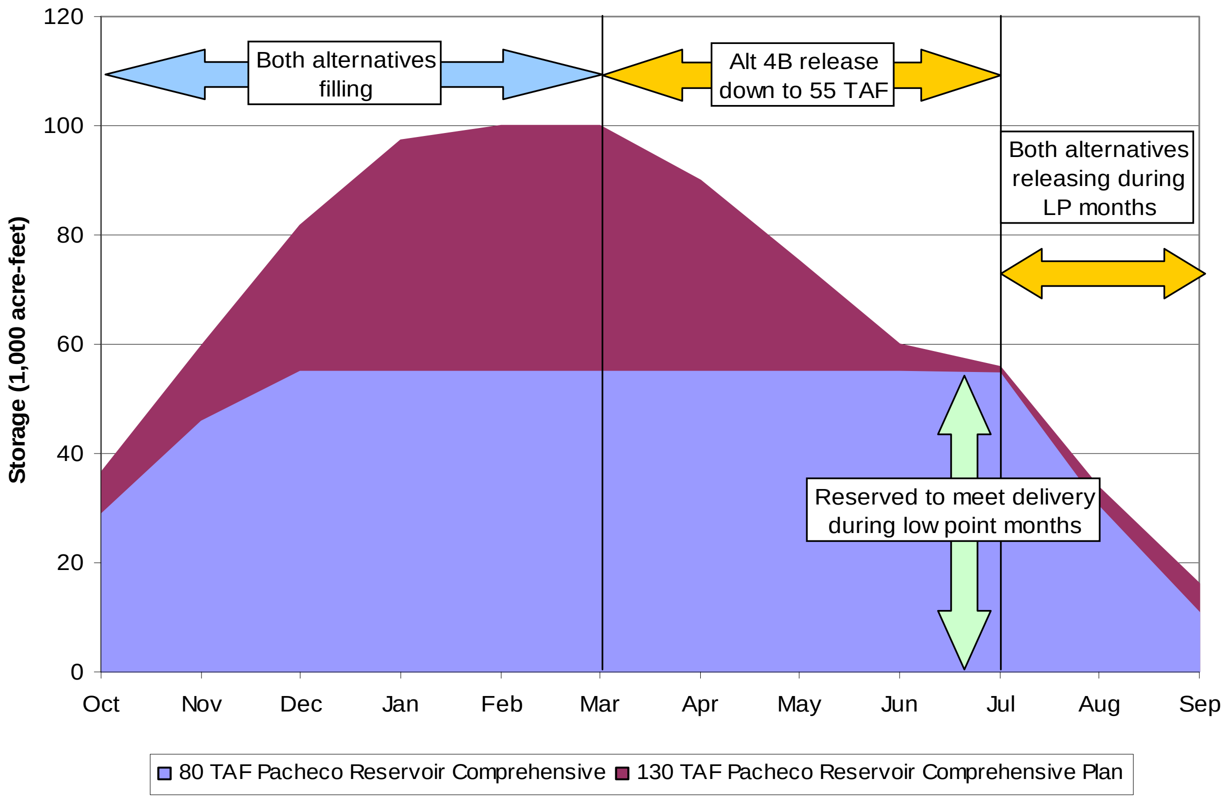


Figure A-25. Typical Pacheco Reservoir Operations

Early Allocations and Institutional Measures

Operation of the early allocation tool for the Pacheco Reservoir Comprehensive Plan was the same as described for the Lower San Felipe Intake Comprehensive Plan. For the Pacheco Reservoir Comprehensive Plan, the analysis was based on CalSim results for both the 80 TAF and 130 TAF reservoirs. Assumptions for the individual institutional measures were the same as described for the Institutional Alternative.

A.9.4 Water Operations Modeling Results

The Pacheco Reservoir Comprehensive Plan was analyzed for an 81-year period to estimate the potential changes in CVP deliveries from both the reservoir expansion and the availability of institutional measures to support earlier allocations. The following sections summarize the effects that the comprehensive plan would have on CVP SOD storage and CVP SOD M&I and agricultural service contract deliveries.

CVP South of Delta Storage

An expanded Pacheco Reservoir increases the total CVP SOD storage in most years of the simulation. In years when Pacheco Reservoir and CVP San Luis are able to store more water SOD than CVP San Luis, the increase in storage can increase allocations and deliveries. The following tables summarize the increase in CVP SOD storage (San Luis Reservoir plus Pacheco Reservoir) under both Pacheco Reservoir options, by year type.

Table A-15 and Table A-16 show that both Pacheco Reservoir Comprehensive Plans would increase CVP storage south of the Delta. This increase in storage typically results in higher allocations and deliveries.

Table A-15. Maximum CVP SOD Storage with 80 TAF Pacheco Reservoir Comprehensive Plan (TAF)

Sacramento Valley Index	FNA–79	FNA–300	Pacheco Alternative 4A	Change from FNA–79	Change from FNA–300
Wet	970	972	1,024	54	52
Above Normal	955	966	1,002	46	35
Below Normal	958	964	1,009	52	46
Dry	935	961	974	39	13
Critical	867	905	916	49	11
All Years	**943**	**957**	**991**	**48**	**34**

Table A-16. Maximum CVP SOD Storage with 130 TAF Pacheco Reservoir Comprehensive Plan (TAF)

Sacramento Valley Index	FNA–79	FNA–300	Pacheco Alternative 4B	Change from FNA–79	Change from FNA–300
Wet	970	972	1,068	97	96
Above Normal	955	966	1,037	82	71
Below Normal	958	964	1,047	89	83
Dry	935	961	1,010	76	49
Critical	867	905	960	93	55
All Years	**943**	**957**	**1,031**	**88**	**74**

CVP Deliveries

The Pacheco Reservoir Comprehensive Plans would increase CVP SOD deliveries to both M&I and agricultural service contractors. The following tables summarize the increases for both comprehensive plans by year type.

Table A-17 shows an average annual increase in CVP SOD M&I deliveries of 8 TAF under the 80 TAF Pacheco Reservoir Comprehensive Plan, compared to both FNA conditions. Compared to FNA–79, the increase with the Pacheco Reservoir Comprehensive Plan would occur primarily within the San Felipe Division, because water could be delivered even when San Luis Reservoir storage was below 300 TAF. The majority of the additional deliveries (7 TAF) were defined as Interrupted San Felipe Division Deliveries in FNA-79. The remainder of the delivery increase (1 TAF) would occur because of the additional storage in Pacheco Reservoir and would provide a small delivery increase to all CVP SOD M&I service contractors. In contrast to the operations in FNA–300, in which 300 TAF of storage must be maintained in San Luis Reservoir, the expansion of Pacheco Reservoir would allow Reclamation to utilize CVP San Luis Reservoir fully, providing increases in deliveries for all CVP SOD M&I service contractors relative to FNA–300. A small increase in deliveries would also occur because of the additional storage in Pacheco Reservoir. Compared to FNA–79, the Pacheco Reservoir Comprehensive Plan would provide more dry year water to the San Felipe Division, and compared to FNA–300 the Pacheco Reservoir Comprehensive Plan would provides more wet year water to all CVP SOD M&I contractors.

Table A-17. CVP SOD M&I Deliveries with 80 TAF Pacheco Reservoir Comprehensive Plan (TAF)

Sacramento Valley Index	FNA–79	FNA–300	Pacheco Alternative 4A	Change from FNA–79	Change from FNA–300
Wet	156	152	162	6	10
Above Normal	150	149	161	11	12
Below Normal	143	136	151	8	15
Dry	123	131	135	12	4
Critical	102	109	109	7	0
All Years	**138**	**138**	**146**	**8**	**8**

The 130 TAF Pacheco Reservoir Comprehensive Plan would provide similar, though slightly larger benefits than the 80 TAF Pacheco Reservoir Comprehensive Plan. Differences in the change from each FNA scenario occur for the same reasons as described previously for Table A-18, though there is a larger increase from the additional storage in Pacheco Reservoir for the 130 TAF Pacheco Reservoir Comprehensive Plan.

Table A-18. CVP SOD M&I Deliveries with 130 TAF Pacheco Reservoir Comprehensive Plan (TAF)

Sacramento Valley Index	FNA–79	FNA–300	Pacheco Alternative 4B	Change from FNA–79	Change from FNA–300
Wet	156	152	163	7	11
Above Normal	150	149	162	12	13
Below Normal	143	136	151	8	15
Dry	123	131	136	13	4
Critical	102	109	109	7	0
All Years	**138**	**138**	**147**	**9**	**9**

Table A-19 shows an average annual increase (relative to the FNA condition) in CVP SOD agricultural service contract deliveries of between 51 and 154 TAF for the 80 TAF Pacheco Reservoir Comprehensive Plan. Compared to FNA–79, delivery increases would be a result of additional storage in Pacheco Reservoir (29 TAF) and earlier allocations (22 TAF). Compared to FNA–300, increases would occur because of additional storage in Pacheco Reservoir, from earlier allocations, and because Pacheco Reservoir would allow Reclamation to utilize CVP San Luis Reservoir storage fully.

Table A-19. CVP SOD Agricultural Service Contract Deliveries with 130 TAF Pacheco Reservoir Comprehensive Plan (TAF)

Sacramento Valley Index	FNA–79	FNA–300	Pacheco Alternative 4A			Change from FNA–79	Change from FNA–300
			CalSim	Early Alloc. Tool	Total		
Wet	1,563	1,421	1,608	0	1,608	45	187
Above Normal	1,424	1,219	1,471	0	1,471	47	252
Below Normal	1,147	1,011	1,186	21	1,207	60	197
Dry	899	896	904	50	954	55	58
Critical	383	351	385	50	435	52	84
All Years	**1,150**	**1,047**	**1,179**	**22**	**1,201**	**51**	**154**

Table A-20 presents similar results for the 130 TAF Pacheco Reservoir Comprehensive Plan. Comparison of the results presented in Table A-19 and Table A-20 illuminate the additional deliveries that would result from the difference in Pacheco Reservoir capacity between the 80 and 130 TAF options. The larger Pacheco Reservoir would add 45 TAF of storage and would provide approximately 25 TAF of additional delivery.

Table A-20. CVP SOD Agricultural Service Contract Deliveries with 80 TAF Pacheco Reservoir Alternative (TAF)

Sacramento Valley Index	FNA–79	FNA–300	Pacheco Alternative 4B			Change from FNA–79	Change from FNA–300
			CalSim	Early Alloc. Tool Increase	Total		
Wet	1,563	1,421	1,648	0	1,648	85	227
Above Normal	1,424	1,219	1,511	0	1,511	87	292
Below Normal	1,147	1,011	1,215	21	1,237	89	226
Dry	899	896	926	44	970	72	75
Critical	383	351	391	42	433	50	82
All Years	**1,150**	**1,047**	**1,208**	**20**	**1,228**	**78**	**180**

Institutional Measures

The early allocation tool was utilized to analyze the effect of increasing allocations in the years when CalSim simulated allocations are less than 60%. The early allocation tool was based on CalSim simulations of the 80 and 130 TAF Pacheco Reservoir Comprehensive Plans. Additional description of the early allocation tool, assumptions, and operations can be found in the sections describing the Lower San Felipe Intake Comprehensive Plan and Institutional Alternative. The following two tables summarize the results for the 80 TAF Pacheco Reservoir Comprehensive Plan.

Table A-21 shows that in 18 of the 28 years that the CalSim predicts allocations to be less than 60%, it might be possible to make a higher allocation earlier in the year. However, increasing allocations in these years might result in lower March storage in 22 years, potentially resulting in lower allocations in those years. Institutional measures would be implemented in 29 years to maintain CVP San Luis Reservoir storage.

Table A-21. Annual Operation of Early Allocation Tool under the 80 TAF Pacheco Reservoir Comprehensive Plan

	CVP Allocations less than 60%	Allocations Increased Earlier	Institutional Measures Implemented	October Storage is Lower	March Storage is Lower
Number of Years	28	18	29	35	22

Table A-22 summarizes the average annual volumes and number of years when each institutional measure would be implemented.

Table A-22. Average Annual Implemented Institutional Measures as Backstops for Earlier Allocations for Pacheco Alternative 4A (TAF)

Sacramento Valley Index	Water Purchased for Transfer	Transfer Water in San Luis[1]	CVP Source Shifting	MWD Source Shifting	Groundwater Bank Deposit	Groundwater Bank Withdrawal
Wet	3	2	1	0	0	0
Above Normal	6	3	4	5	0	0
Below Normal	7	4	6	5	1	0
Dry	32	24	9	10	0	1
Critical	29	25	4	15	0	1
All Years	**14**	**11**	**4**	**6**	**0**	**0**
Number of Years[2]	**28**	**28**	**23**	**22**	**45**	**11**

[1]The differences between water purchased and water moved into San Luis Reservoir are from the estimated carriage water costs for moving water through the Delta.
[2]Out of 81 years analyzed.

The next two tables summarize early allocation tool results for the 130 TAF Pacheco Reservoir Comprehensive Plan.

The data in Table A-23 illustrates the potential tradeoff associated with increasing allocations in one year—possibly decreasing storage and allocations in the subsequent years.

Table A-23. Annual Operation of Early Allocation Tool with the 130 TAF Pacheco Reservoir Comprehensive Plan

	CVP Allocations less than 60%	Allocations Increased Earlier	Institutional Measures Implemented	October Storage is Lower	March Storage is Lower
Number of Years	28	16	28	37	26

Table A-24 provides the average annual volume of water needed for each institutional measure to provide a backstop against over-allocating water south of the Delta.

Table A-24. Average Annual Implemented Institutional Measures as Backstops for Earlier Allocations for the 130 TAF Pacheco Reservoir Comprehensive Plan (TAF)

Sacramento Valley Index	Water Purchased for Transfer	Transfer Water in San Luis Reservoir[1]	CVP Source Shifting	MWD Source Shifting	Groundwater Bank Deposit	Groundwater Bank Withdrawal
Wet	5	3	1	0	0	0
Above Normal	5	3	4	6	0	0
Below Normal	9	5	5	3	1	0
Dry	31	24	9	10	0	1
Critical	23	19	5	16	0	0
All Years	**14**	**10**	**4**	**6**	**0**	**0**
Number of Years[2]	**27**	**27**	**24**	**21**	**38**	**11**

[1]The differences between water purchased and water moved into San Luis Reservoir are from the estimated carriage water costs for moving water through the Delta.
[2]Out of 81 years analyzed.

A.10 Combination Comprehensive Plan

The Combination Comprehensive Plan includes multiple structural components and management measures to maximize operational flexibility and supply reliability in the San Felipe Division to address water supply curtailments or reductions generated by low point issues. The Combination Comprehensive Plan would include reoperation of local surface water reservoirs, the ability to either take CVP supplies through the South Bay Aqueduct or reschedule SWP supplies, increased groundwater recharge and extraction capacity, and desalination. These changes would require reoperation of the SCVWD raw and treated water systems.

A.10.1 Anderson Reservoir Reoperation

Anderson Reservoir is the largest surface water storage facility in SCVWD. The reservoir has a maximum capacity of approximately 90 TAF. SCVWD operates the reservoir primarily to capture local runoff and release it for groundwater recharge through the downstream creeks. Anderson Reservoir is operated in conjunction with Coyote Reservoir located directly upstream of Anderson on Coyote Creek. Coyote Reservoir has a maximum capacity of approximately 23 TAF, but is only filled to half capacity due to seismic concerns. A recent, preliminary study of Anderson Dam raised potential seismic concerns for Anderson Reservoir. SCVWD is in the process of performing a more detailed seismic study.

Anderson Reservoir can be used in the Combination Comprehensive Plan to store CVP water prior to low point issues in San Luis Reservoir for delivery during low point issues. It is possible to put CVP water into Anderson Reservoir by either; reducing Anderson release and routing an equivalent volume of water from the Santa Clara Conduit down creeks below Anderson, or by directly pumping CVP water into Anderson at the Coyote Pump Station.

A.10.2 CVP Supplies through South Bay Aqueduct

An institutional arrangement to allow SCVWD to take a portion of their CVP supply through the South Bay Aqueduct (SBA) would provide additional operational flexibility during low point issues. During low point issues, SCVWD would take delivery of all or a portion of the water they would otherwise take through the Pacheco Pumping Plant through the SBA. This operation could be balanced by exchange of an equivalent volume of CVP and SWP water in San Luis Reservoir.

Alternatively, SCVWD may take delivery of a larger volume of their SWP contract water during low point issues. An equivalent volume of CVP water would then be rescheduled in San Luis Reservoir for delivery after low point issues. During these months after low point SWP deliveries would be reduced by the same volume CVP deliveries are increased.

A.10.3 Groundwater Banking and Extraction

Increased groundwater banking and extraction capacity, including new recharge ponds and/or injection wells and new extraction wells operated by SCVWD would provide additional operational flexibility during low point issues. Additional groundwater banking capacity could be used to recharge water made available from a desalination plant or to recharge CVP supplies prior to and after low point issues. Groundwater extraction capacity is needed for SCVWD to access local groundwater supplies during low point issues in lieu of taking delivery from San Luis Reservoir.

A.10.4 Desalination

SCVWD has investigated participation in a regional desalination plant in the Delta. Preliminary estimates of the total plant capacity are approximately 70 million gallons per day (MGD). SCVWD has expressed an interest in having access to approximately 10 MGD of that capacity. Water from the desalination plant would be delivered through the SCVWD system and would permit an equivalent volume of CVP water to recharge local aquifers.

Desalination could be used to increase operational flexibility during low point issues by directly delivering water from desalination to replace CVP supplies interrupted by low point issues. During other times of the year desalination water could be banked in local aquifers for use during future occurrences of low point issues.

A.10.5 Simulation of the Combination Comprehensive Plan

Operations of the four components described above were simulated in a spreadsheet model of the Combination Comprehensive Plan. The model was built upon the FNA-79 CalSim simulation of CVP and SWP operations. Operation of each component was layered onto system wide results to simulate how each component may be used by SCVWD to operate during low point issues. There would be no operation of the Combination Comprehensive Plan for the FNA-300 Alternative because there are no low point issues under that alternative.

Modeling of the Combination Comprehensive Plan completed for the PFR relied on several assumptions regarding how each component of the plan may operate. The objective of modeling for the PFR was to prove whether or not combining these components into a single plan would provide a complete and reasonable plan for addressing low point issues and for comparison with other plans. Assumptions for how each component operates are coarse and will be refined for the Feasibility Study.

Modeling of the Combination Comprehensive Plan assumed a priority for implementing each component in response to low point issues. Components were prioritized based on assumed implementation costs. Reoperation of Anderson Reservoir and taking CVP supplies through the SBA are management measures that do not require additional infrastructure and were prioritized first and second, respectively. Groundwater recharge and extraction and desalination require additional infrastructure and were prioritized third and fourth, respectively.

The Combination Comprehensive Plan also includes institutional measures to allow earlier, more aggressive CVP SOD allocations. The early allocation tool was used to simulate the additional deliveries possible with the Combination Comprehensive Plan. CVP and SWP operations of upstream reservoirs, allocations, Delta pumping, and San Luis Reservoir will not change significantly under the Combination Comprehensive Plan, relative to the FNA-79 or Lower Intake Comprehensive Plan. CVP and SWP operations with the Combination Comprehensive Plan would be very similar to operation of the Lower Intake Comprehensive Plan, except for minor changes in the timing of delivery of San Felipe M&I supplies. Therefore, CalSim simulation results of CVP and SWP operations with the Lower Intake Comprehensive Plan were used in the early allocation tool for the Combination Comprehensive Plan.

Reoperation of Anderson Reservoir

Anderson Reservoir would be used to store CVP supplies prior to San Luis low point in years when low point issues are forecasted to occur. CVP water stored in Anderson would be used during low point issues in lieu of delivery from San Luis Reservoir. Simulated storage levels in San Luis Reservoir were used as triggers to forecast when low point issues may occur and initiate storage of CVP water in Anderson Reservoir. Storage of CVP water in Anderson began as early as May depending on San Luis Reservoir storage. Table A-25 presents the triggers used in the model. Triggers in Table A-25 are based on review of

CalSim simulated San Luis Reservoir storage for years when low point issues are simulated to occur. Triggers for actual operations would likely be different and consider additional information such as SWP and CVP SOD allocations.

Table A-25: Total San Luis Reservoir Storage Triggers for Storing CVP Supplies in Anderson Reservoir

	May	June	July	August
Total San Luis Storage (TAF)	1,700	1,200	800	450

The ability to move CVP water into Anderson Reservoir is constrained by available storage capacity in Anderson, the ability to offset Anderson releases with CVP supplies, and the capacity to pump CVP water directly into Anderson.

Available storage capacity in Anderson was calculated using historical Anderson storage from WY 1956 through 2003, the period after construction of Anderson Reservoir. Maximum storage capacity in Anderson Reservoir was assumed to be 85 TAF. The difference between the maximum and historical storage was the available capacity. For the period prior to the construction of Anderson estimates of Anderson storage levels were made based on the San Joaquin River 60-20-20 Index. These estimates were conservative and assumed high storage levels in Anderson compared to historical storage levels in similar year types.

The ability to store CVP water in Anderson was estimated based on review of the historical change in Anderson storage. Change in storage was used to estimate reservoir release. Actual reservoir release was likely higher as change in storage also includes effects of inflow from Coyote Reservoir upstream. An additional 15 cfs (1 AF) of direct pumping capacity was also assumed. Table A-26 presents the total assumed capacity to move CVP water into Anderson.

Table A-26: Capacity to Move CVP Supplies into Anderson Reservoir

CVP to Anderson	May	June	July	Aug.	Sep.	Oct.
Capacity (TAF)	3.5	4.0	4.0	4.0	3.0	2.0

The ability to deliver CVP water stored in Anderson during low point issues in San Luis Reservoir is constrained by current reservoir drawdown criteria. Maximum monthly drawdown in Anderson Reservoir is 6 TAF. Anderson Reservoir can release additional water, above 6 TAF, if water can be released from Coyote Reservoir such that storage in Anderson does not change by more than 6 TAF. It was assumed that maximum drawdown in Coyote Reservoir for refilling Anderson was 2 TAF with a maximum seasonal drawdown of 6 TAF total for Coyote Reservoir.

All or a portion of the allowable drawdown in Anderson may be used by existing operations. The ability to deliver CVP water stored in Anderson during low point issues is the drawdown limit minus historical drawdown calculated from the change in storage. Limited sensitivity analysis to Combination Comprehensive Plan assumptions showed Anderson drawdown limits constrain the ability of Anderson Reservoir reoperation to assist in operating around low point issues.

CVP Delivery through SBA

The ability of SCVWD to either take delivery of CVP supplies through the SBA or to reschedule SWP supplies in response to low point issues was simulated as the second option in the Combination Comprehensive Plan. The ability to deliver additional water through the SBA may be constrained by an institutional or operational limit and available capacity in the SBA. A maximum volume of 10 TAF/month of CVP or rescheduled SWP delivery was assumed each month as an institutional/operational limit. Available SBA capacity was estimated as 182 cfs (SBA capacity at SCVWD turnout) minus simulated SWP delivery to SCVWD from CalSim. Available SBA aqueduct capacity typically constrains the ability to take delivery of additional supplies during the occurrence of low point issues.

Groundwater Banking and Extraction

Operation of additional groundwater banking and extraction facilities was simulated in the Combination Comprehensive Plan model. Groundwater recharge capacity was assumed to be 66 acre-feet/day based on a preliminary analysis of potential recharge pond locations. Groundwater extraction capacity was initially assumed to be 264 acre-feet/day based on a preliminary well field design. During simulation of the Combination Comprehensive Plan it was determined that additional groundwater extraction capacity was necessary to completely operate around low point issues and extraction capacity was increased to 450 acre-feet/day.

Infrastructure for groundwater operations was assumed to be new and the full capacity available during low point issues. There may be some limited groundwater recharge and extraction capacity available within delivery systems of SCVWD customers that could be available during low point events. This option will be investigated during the Feasibility Study.

Desalination

Additional water made available from a regional desalination plant was simulated to be directly delivered, allowing an equivalent volume of CVP supply to be banked in local aquifers. During low point issues the direct delivery of desalinated water offsets a portion of the interrupted San Felipe M&I deliveries. Water previously banked in local aquifers through the desalination project is assumed to be the water pumped at new groundwater extraction facilities. The Combination Comprehensive Plan tool simulates 10 MGD (1 TAF/month) of water available from desalination for either direct delivery or groundwater banking in all but critical years, as defined by the San Joaquin River 60-20-20 Index.

A.10.6 Water Operations Modeling Results

The Combination Comprehensive Plan was analyzed for an 81-year period to estimate the potential changes in CVP deliveries that would be due to both management measures and structural components within SCVWD to operate around low point issues, and availability of institutional measures to support earlier allocations. The following sections summarize Combination Comprehensive Plan effects on CVP SOD M&I and agricultural service contract deliveries.

CVP Deliveries

Implementation of the Combination Comprehensive Plan would increase CVP SOD contract deliveries to both M&I and agricultural contractors when compared to both the FNA-79 and FNA-300 scenarios. Compared to FNA-79, M&I deliveries would increase because SCVWD could take delivery at other times of the interrupted deliveries due to low point issues when San Luis Reservoir storage is below 300 TAF. Compared to FNA-300, M&I deliveries increase because the Combination Comprehensive Plan allows the CVP to draw San Luis Reservoir storage below 300 TAF and to allocate additional water to both M&I and agricultural service contractors. Compared to both FNA conditions, agricultural deliveries under the Combination Comprehensive Plan increase due to higher earlier allocations. The following tables summarize deliveries to CVP contractors under the Combination Comprehensive Plan.

Table A-27 shows an average annual increase in CVP SOD M&I deliveries of 7 TAF under the Combination Comprehensive Plan compared to both FNA scenarios. Compared to FNA–79, increases associated with the Combination Comprehensive Plan would occur within the San Felipe Division, because water could be delivered even when San Luis Reservoir storage is below 300 TAF. These are the same deliveries defined as interrupted San Felipe M&I deliveries in the FNA-79 scenario. In contrast to the operations in FNA–300, in which 300 TAF of storage must be maintained in San Luis Reservoir, the Combination Comprehensive Plan would allow Reclamation to fully utilize CVP San Luis Reservoir storage. Delivery increases associated with the Combination Comprehensive Plan would occur for all CVP SOD M&I service contractors relative to FNA–300. Compared to FNA–79, the Combination Comprehensive Plan would provide more dry year water to San Felipe Division, and compared to FNA–300 the Combination Comprehensive Plan would provide more wet year water to all CVP SOD M&I contractors.

Table A-27: CVP SOD M&I Deliveries with Combination Comprehensive Plan (TAF)

Sacramento Valley Index	FNA-79	FNA-300	Combination Comprehensive Plan	Change from FNA-79	Change from FNA-300
Wet	156	152	161	5	9
Above Normal	150	149	160	10	11
Below Normal	143	136	147	4	11
Dry	123	131	134	11	3
Critical	102	109	109	7	0
All Years	**138**	**138**	**145**	**7**	**7**

Table A-28 shows an average annual increase (relative to the FNA condition) in CVP SOD agricultural service contract deliveries of between 22 and 124 TAF under the Combination Comprehensive Plan. Compared to FNA–79, all delivery increases under the Combination Comprehensive Plan would be a result of earlier allocations. Comparing FNA–79 and only the CalSim simulation shows a slight decrease in deliveries. The decrease in CalSim simulated deliveries occurs in the model because, under FNA–79, interrupted San Felipe Division M&I deliveries remain in the reservoir and are allocated to agricultural service contractors in subsequent years. When these deliveries are made to San Felipe Division in the CalSim simulation, it results in slightly lower agricultural deliveries. Compared to FNA–300, increases under the Combination Comprehensive Plan would occur because of earlier allocations and because the lower intake would allow Reclamation to fully utilize CVP San Luis Reservoir storage. Full utilization of San Luis Reservoir tends to increase deliveries more in wet, above normal, and below normal year types while increases in dry and critical years would be due mostly to earlier allocations.

Table A-28: CVP SOD Agricultural Service Contract Deliveries with Institutional Alternative (TAF)

Sacramento Valley Index	FNA-79	FNA-300	Combination Comprehensive Plan			Change from FNA-79	Change from FNA-300
			CalSim	Early Alloc. Tool Increase	Total		
Wet	1,563	1,421	1,562	4	1,566	3	145
Above Normal	1,424	1,219	1,422	0	1,422	-3	203
Below Normal	1,147	1,011	1,147	21	1,168	21	158
Dry	899	896	896	50	946	48	51
Critical	383	351	379	50	429	47	78
All Years	**1,150**	**1,047**	**1,148**	**23**	**1,171**	**22**	**124**

Implementation of Combination Comprehensive Plan Components

Results from the Combination Comprehensive Plan model are used to understand the frequency for implementing each component and the volume of water each component provides toward operating around low point issues. Figure A-26 illustrates the annual operation of each component in response to low point issues. Red diamonds represent the annual volume of San Felipe

M&I delivery interruptions due to low point issues. Stacked bars below the diamonds quantify the contribution of each component toward restoring the interrupted deliveries.

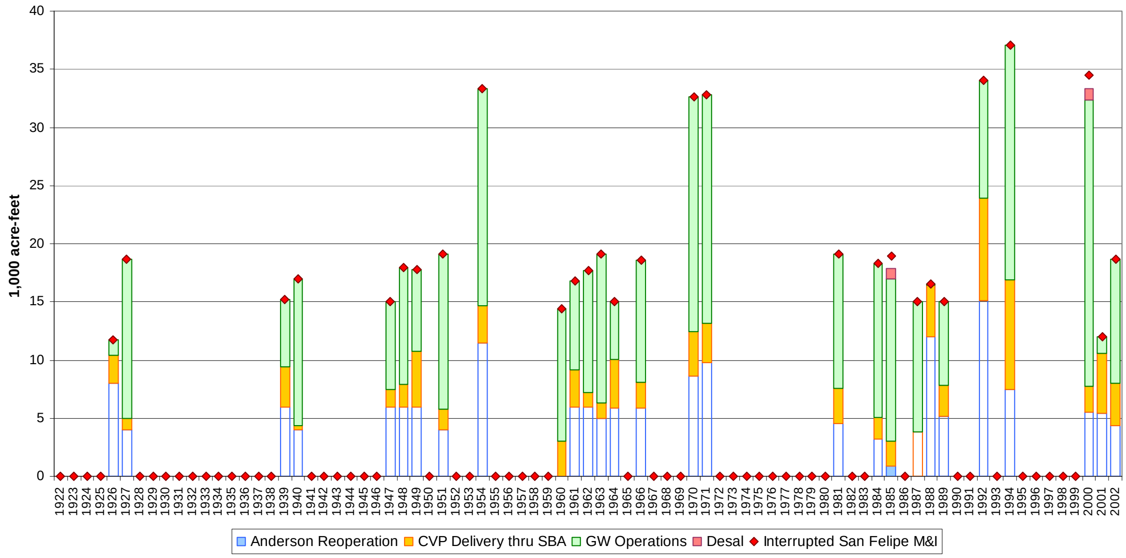


Figure A-26: Annual Operation of Each Component of the Combination Comprehensive Plan

Figure A-26 illustrates that groundwater operations contribute the largest volume of water toward operating around low point issues. Reoperation of Anderson Reservoir is the second largest component, followed by delivery of CVP supplies through the SBA. Delivery of desalination water contributes a small amount of water in a few years because it is considered the last option for operating around low point issues. However, desalination allows for additional groundwater recharge to local aquifers and this recharged water allows groundwater pumping operations during low point issues without creating a deficit in local groundwater storage. Table A-29 summarizes the average annual volume of water from each component and the number of years each component is utilized.

Table A-29: Annual Summary of Components of the Combination Comprehensive Plan

	Interrupted San Felipe M&I Delivery	Anderson Reservoir	CVP Delivery thru SBA	Ground-water Operation	Desalination	
					Direct Delivery	Recharge
Avg. Annual (TAF)	7	2	1	4	0	9
Number of Years[1]	28	70	28	27	2	72

[1]Out of 81 years analyzed.

CVP delivery through the SBA and groundwater operations are implemented in response to low point issues and are only implemented in years with interrupted San Felipe M&I delivery. Reoperation of Anderson Reservoir occurs in anticipation of forecasted low point issues and can occur in years when low point issues to not materialize. San Luis Reservoir storage trigger levels in Table A-25, used to initiate reoperation of Anderson Reservoir, are determined based on CalSim simulation of San Luis Reservoir. CalSim simulations show large fluctuations in San Luis Reservoir storage and trigger levels must be set high to account for these fluctuations. High trigger levels result in more frequent reoperation of Anderson Reservoir in the Combination Comprehensive Plan model. Figure A-27 presents the annual volumes of water moved into and out of Anderson Reservoir based on San Luis Reservoir storage trigger levels.

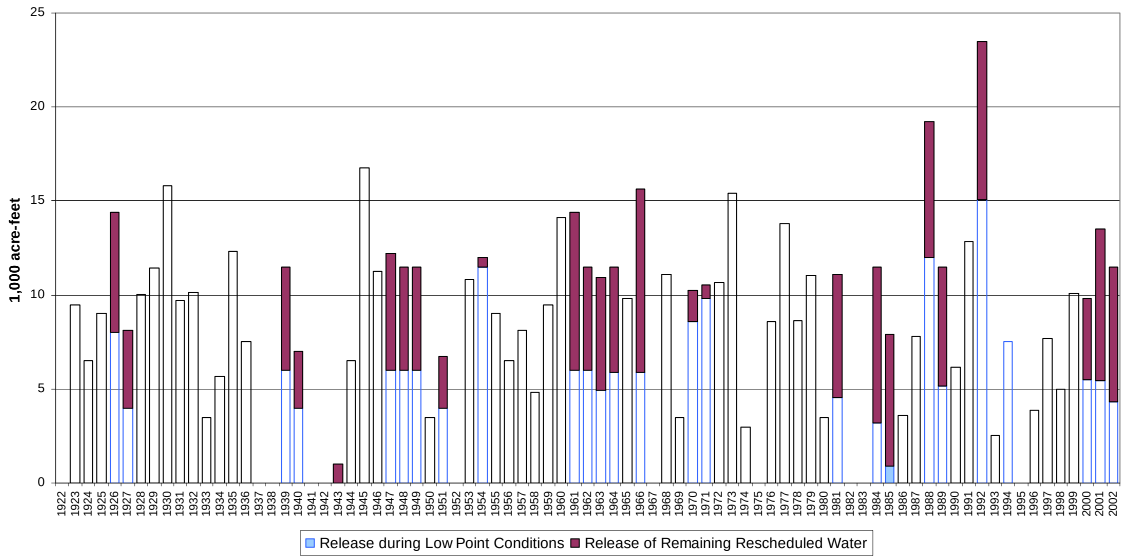


Figure A-27: Annual Reoperation of Anderson Reservoir in Response to Forecasted San Luis Reservoir Low Point Issues

Figure A-27 illustrates annual CVP water released from Anderson. Blue bars represent water released during low point issues to replace interrupted San Felipe M&I deliveries. Purple bars represent CVP water moved into Anderson in anticipation of future low point issues and released after low point because it was not needed. In actual operations it would be possible to improve the forecast of future low point issues compared to what has been done based on CalSim results. Actual low point forecasts may include current San Luis Reservoir storage, SWP and CVP allocations, upstream reservoir storage, Delta export forecasts, and other inputs. The Anderson Reservoir operation illustrated in Figure A-27 likely overestimates the frequency of moving CVP supplies into and out of Anderson.

Institutional Measures

Under the Combination Comprehensive Plan, institutional measures would be implemented to support earlier allocations. Table A-30 summarizes the results of the early allocation tool for the Combination Comprehensive Plan.

Table A-30: Annual Operation of Early Allocation Tool with Combination Comprehensive Plan

	CVP Allocations less than 60%	Allocations Increased Earlier	Institutional Measures Implemented	October Storage is Lower	March Storage is Lower
Number of Years	29	19	28	38	22

Table A-30 shows that in 19 of the 29 years that CalSim predicts allocations to CVP SOD agricultural service contractors of less than 60%, it might be possible to make a higher allocation earlier in the year. However, increasing allocations in these years might result in lower March storage in 22 years, potentially resulting in lower allocations in those years. October and March storage is predicted to be lower in more years than the number of years in which allocations are increased because carryover deficits in CVP San Luis Reservoir can persist for several years. The following figure illustrates this effect.

Figure A-28 presents the annual maximum storage in the CVP portion of San Luis Reservoir in the CalSim simulation used to approximate the operation of the Combination Comprehensive Plan, compared with the annual maximum storage with early allocations. Differences between the annual maximum storage and the CVP storage capacity would occur in years when storage deficits persist in the reservoir; these differences could affect subsequent allocations. Also shown are years when early allocation increases provide 100 TAF of additional contract delivery. Figure A-28 illustrates that in years such as 1990, when early allocations would result in an additional 100 TAF of contract delivery, a deficit might be carried over for several years.

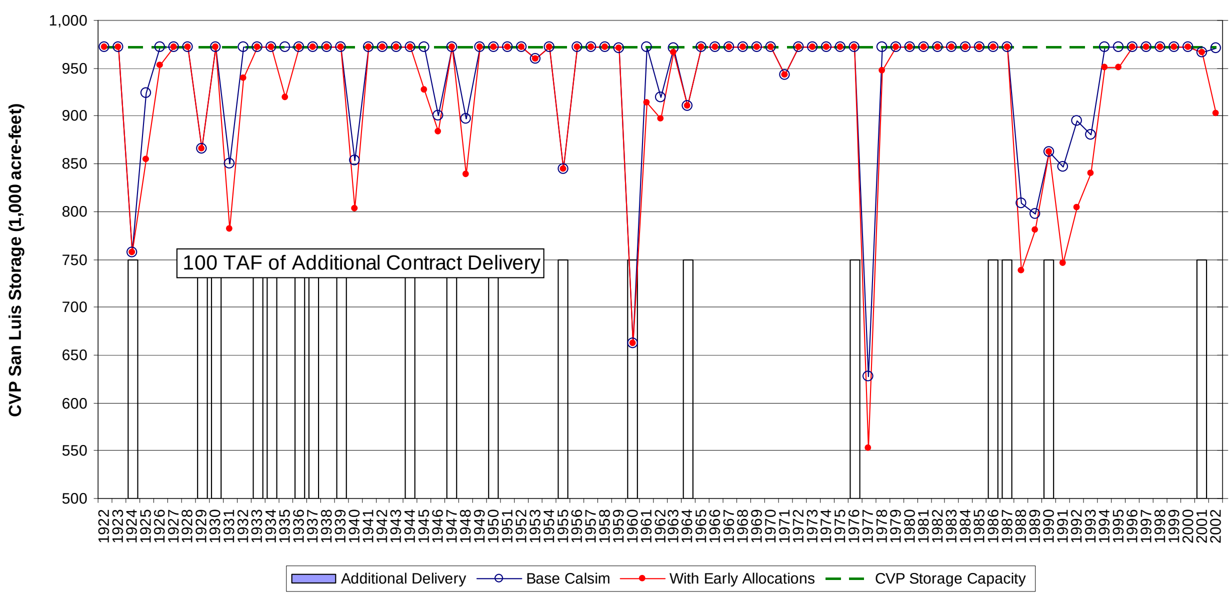


Figure A-28: Annual CVP San Luis Reservoir Maximum Storage with Additional Deliveries through Early Allocations

Carryover of storage deficits is also a reason why institutional measures are implemented in more years than allocations are increased. In the model, institutional measures are implemented based on the storage trigger levels presented in Table A-31 to reduce or eliminate any carryover debt. When carryover deficits persist for several years, institutional measures may be implemented in each year to maintain storage at the trigger levels. The following figure illustrates that after an increase in allocations and delivery, such as in 1990, various institutional measures were simulated to occur in each of the next four years to maintain storage at the trigger levels.

Table A-31: Average Annual Implemented Institutional Measures as Backstops for Earlier Allocations with Combination Comprehensive Plan (TAF)

Sacramento Valley Index	Water Purchased for Transfer	Transfer Water in San Luis Reservoir[1]	CVP Source Shifting	MWD Source Shifting	Groundwater Bank Deposit	Groundwater Bank Withdrawal
Wet	0	0	0	0	0	0
Above Normal	5	3	4	5	0	0
Below Normal	9	6	5	3	1	0
Dry	34	25	12	15	1	2
Critical	26	22	4	18	0	1
All Years	**14**	**10**	**5**	**7**	**0**	**0**
Number of Years[2]	**27**	**27**	**22**	**23**	**48**	**11**

[1]The differences between water purchased and water moved into San Luis Reservoir are from the estimated carriage water costs for moving water through the Delta.
[2]Out of 81 years analyzed.

The implementation of institutional measures illustrated in Figure A-29 is summarized below by Sacramento Valley Index. This information can be used to help estimate the cost of implementing the institutional measures in conjunction with the Combination Comprehensive Plan.

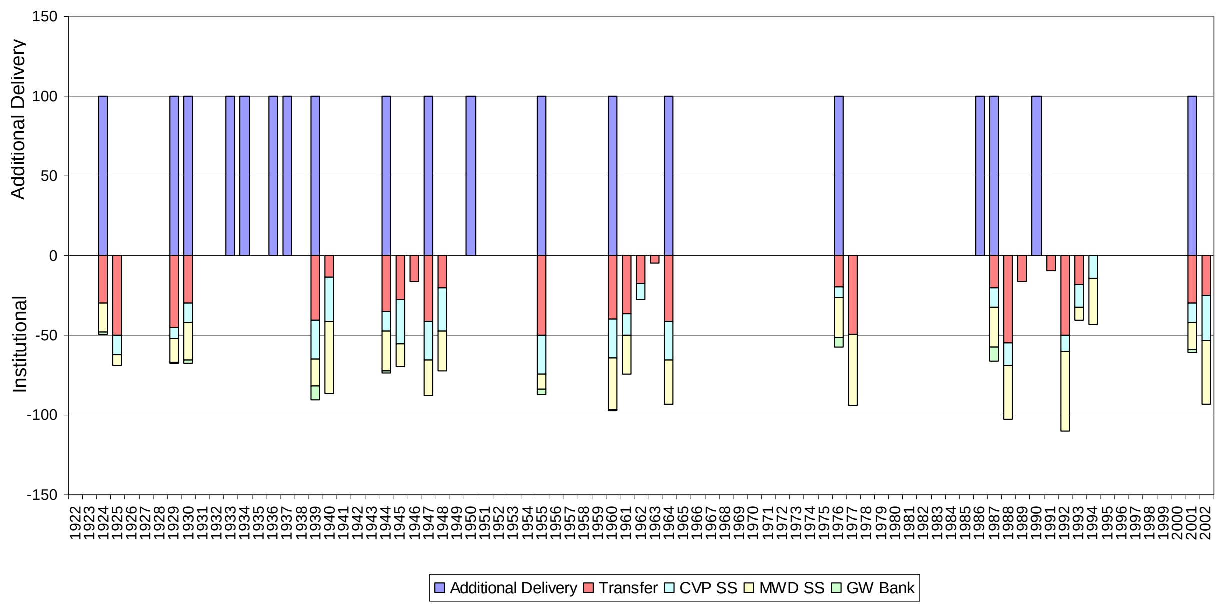


Figure A-29: Additional Deliveries and Implemented Institutional Measures under the Combination Comprehensive Plan

Appendix B
SLLPIP Storage Alternatives Preliminary Screening Report

Appendix B
Storage Alternative Screening

B.1 Introduction

In May 2007, the Bureau of Reclamation (Reclamation), in cooperation with Santa Clara Valley Water District (SCVWD) and San Luis & Delta-Mendota Water Authority (SLDMWA), completed an Initial Alternatives Information Report (IAIR) for the San Luis Low Point Improvement Project (low point project). The IAIR identified eight potential alternatives for increasing surface storage capacity in the study area to address the low point project objectives (See Figure B-1 at the end of this report). The purpose of this storage alternative preliminary screening is to evaluate these storage alternatives based on a selected set of screening criteria and recommend storage alternatives that should be carried forward for further evaluation and engineering study in the Plan Formulation Phase of the low point project.

The eight storage alternatives identified in the IAIR for further review include:

- Anderson Reservoir Expansion;
- Chesbro Reservoir Expansion;
- Lower Pacheco Reservoir Expansion;
- Pacheco A Reservoir (new dam);
- San Benito Reservoir (new dam);
- Ingram Canyon Reservoir (new dam);
- Quinto Creek Reservoir (new dam); and
- Del Puerto Canyon Reservoir (new dam).

Preliminary review of the storage alternatives revealed significant challenges with respect to a weak foundation condition at the Lower Pacheco site that precluded the alternative's further consideration. The IAIR screened out the Pacheco B reservoir site because it would not be able to achieve the storage capacity goals without inundating a small portion of Henry Coe State Park; however, this site has been included in this preliminary screening report because of its superior foundation materials.

Appendix B (Surface Storage Level 1 Screening) of the IAIR presents the technical viability factors used to eliminate alternatives deemed the most difficult to design and construct relative to the benefits they would provide. The capacity factor in the IAIR established minimum sizes[1] needed for a reservoir to be carried forward for further consideration in the feasibility study process. The minimum sizes described in the IAIR are: 100 thousand acre-feet (TAF) of additional storage capacity for any reservoir west of San Luis Reservoir that would be expanded, 150 TAF for any new reservoir west of San Luis Reservoir, and 271 TAF for a reservoir east of San Luis Reservoir.

The San Benito Reservoir Alternative would develop a reservoir with a storage capacity of approximately 60 TAF or 90 TAF less than the technical viability factor. During review of the IAIR, San Benito Reservoir was identified by the Study Management Team as a potentially viable alternative in combination with other measures and was therefore carried forward into this preliminary screening to further investigate its viability.

The Chesbro Reservoir Alternative would expand an existing 8 TAF reservoir to create a new 150 TAF reservoir. This new reservoir would develop an additional 42 TAF of storage capacity beyond the 100 TAF required for a reservoir to be deemed technically feasible in the alternative screening completed for the IAIR. The potential for an expanded 150 TAF Chesbro Reservoir was identified in the 2003 San Luis Low Point Improvement Project Draft Alternatives Screening Report (SCVWD 2003). The 150 TAF Chesbro Reservoir is included in this preliminary screening to further investigate its viability.

B.1.2 Regional Setting and Geologic Conditions

Regional Setting

The proposed dam sites are all within the Coast Ranges Province of California. The Coast Ranges Province is a northwest-oriented grain of landscape that extends about 400 miles from the Transverse Ranges Province (to the south) to the Oregon border (Harden 1998). In an east-west direction, it extends approximately 50 miles from the Pacific Ocean to the Great Valley. The San Andreas Fault zone lies just west of the boundary between the southern Coast Ranges and the Central Valley of California. Because of interaction of the strike-slip San Andreas Fault system with the compressional tectonics of the Coast Ranges, the geologic conditions in the areas of the proposed dam construction are structurally complex.

Regionally, the geologic conditions are characterized by hilly terrain dominated by the Upper Jurassic (150 million years old) Franciscan complex and other younger rocks separated by a series of alluvial filled valleys.

[1] Minimum reservoir sizes were developed based on the total amount of water the San Felipe Division would require during the low point months.

Seismicity and Faults

The geology of the region is dominated by tectonic activity associated with the active San Andreas and other active and potentially active fault systems. In accordance with Reclamation guidelines, this report considers faults younger than 100,000 years to be active for the purposes of dam siting. Figure B-2 shows the active or potentially active faults of most concern in the study area; these include the Calaveras, Greenville, Hayward, Ortigalita, Paicines, San Benito, San Andreas, and Sargent Faults. Other less well-defined faults may also affect the proposed sites.

The Calaveras Fault branches off the San Andreas Fault zone near Hollister, California, and extends north to Mt. Diablo for about 100 miles. The fault is considered a right-lateral strike slip. The Calaveras Fault has a creep rate of about 7.5 to 11.5 mm/yr near its southern end while almost no creep has been detected near its northern end (Galehouse 1990). The last earthquake to rupture the Calaveras measured 6.2 on the Richter scale and occurred in 1984 along the Morgan Hill section of the fault. The Maximum Credible Earthquake (MCE) for the Calaveras Fault is estimated to be 7.5 (Mualchin 1996).

The Greenville Fault is the easternmost of the faults that make up the San Andreas Fault system in the San Francisco Bay area. It consists of several strands and extends a distance of about 44 miles from the Diablo Range at the north to the Livermore Valley at the south. It is a right-lateral strike-slip fault. Based on offset stream terraces and paleosols, the Greenville Fault has an estimated slip rate ranging from 0.1 to 0.7 mm/yr (Wright et. al. 1982). The MCE for the Greenville Fault is estimated to be 7.25 (Mualchin 1996).

The Hayward Fault extends for a distance of approximately 100 miles from near San Jose at its southeastern end to San Pablo Bay at its northwestern end. Beneath San Pablo Bay the Hayward Fault steps over to the east and continues along the Rodgers Creek Fault. It is a northwest trending right-lateral strike-slip fault. The Hayward Fault creep rate, to a depth of about 3-miles along its entire length, is approximately 9 mm/yr, and it is considered capable of producing large earthquakes, as evidenced by the October 21, 1868 M6.8 earthquake. Its MCE is estimated to be 7.5 (Mualchin 1996). The Hayward Fault and its northern extension, the Rodgers Creek Fault, are regarded as one of the most hazardous fault systems in the San Francisco Bay Area with a future probability for a M6.7 earthquake of about 27% over the next thirty years (Working Group on California Earthquake Probabilities 1999, 2003).

The approximately 50-mile-long Ortigalita Fault extends between Crow Creek in western Stanislaus County southward to near Panoche in western Fresno County. It is a right-lateral strike-slip fault. The Ortigalita Fault is the tectonic contact between the Franciscan Complex core of the Diablo Range and the Great Valley Sequence at the eastern margin. It consists of two major segments separated at San Luis Reservoir by a 3-mile-wide, right-stepping, pull-apart basin (Anderson and O'Connell 2005). The right-slip movement is estimated to be 0.5 to 1.5 mm/yr (USGS 2006a). The Ortigalita Fault has an estimated MCE of 7.0 (Mualchin 1996).

The 15-mile-long Paicines and 14-mile-long San Benito Faults are immediately east of, and parallel to, the San Andreas Fault zone along the San Benito River Valley at Tres Pinos. These are right-lateral strike-slip faults. The slip rate on the Paicines Fault is high; on the order of 12-17 mm/yr. (Working Group on California Earthquake Probabilities 1999). The slip rate on the San Benito Fault is not known. Although the Paicines Fault shows evidence for movement in Holocene (last 10,000 years) and the San Benito Fault has been active during the Quaternary (last 2,000,000 years), their close proximity to the San Andreas Fault zone indicates that they are probably not independent sources. They are not considered capable of generating large earthquakes themselves, but considered capable of rupturing during large earthquakes on the neighboring San Andreas Fault zone.

The San Andreas Fault is approximately 745 miles long. It begins near the Salton Sea to the south and extends northwards to Point Delgada on the coast. It generally parallels the direction of plate motion between the Pacific and North American plates. It is a right-lateral strike-slip fault. Historic fault creep rates are as high as 34 mm/yr for an 82-mile-long creeping section in central California, with creep rates gradually tapering to zero at the northwestern and southeastern ends of the section (USGS 2006b). To the south, it is essentially a singular fault trace; however, in the site vicinity it branches into the Calaveras and Hayward Faults. Two major surface-rupturing earthquakes have occurred on the San Andreas Fault in historic time: the 1857 Fort Tejon and 1906 San Francisco earthquakes. Additional historic surface rupturing earthquakes include the unnamed 1812 earthquake along the Mojave section and the northern part of the San Bernardino Mountains section, and a large earthquake in the San Francisco Bay area that occurred in 1838. It has an estimated MCE of approximately 8.0.

The Sargent Fault is approximately 32-miles long. It branches from the San Andreas Fault and extends for about 34 miles near Lexington Reservoir in the north to just north of Hollister in the south. The Sargent fault is a reverse fault that dips steeply to the west and is seismically active (Wagner 1990). It has a slip rate of approximately 3 mm/yr (Prescott and Burford 1976 and Working Group on Northern California Earthquake Potential 1996). The Sargent Fault has an MCE of approximately 6.75 (Mualchin 1996).

B.1.3 Screening Criteria

Overview

This preliminary screening includes criteria to help determine which reservoir sites would best meet the project objectives while minimizing project costs. Each criterion is assigned a rating score to allow an overall score to be calculated. These scores are subjective measures. They have been used to provide a basis for elimination of some of the storage alternatives and select those that merit further investigation and engineering evaluation. The following sections and Table B-1 describe the criteria, which are grouped into four categories.

At this stage of the screening process, the evaluation does not include cost estimates. Several of the criteria reflect the difficulty and magnitude of the construction for each site; these criteria allow comparison of costs without completion of detailed cost estimates. In addition, this preliminary screening does not evaluate the impacts to the lands and populations downstream of each dam site from a dam break. The next phase of the Feasibility Study will include this analysis for the dam sites remaining after this preliminary screening.

Physical Conditions

The first set of criteria is related to the physical conditions at each dam site. The most efficient dam sites maximize the amount of storage created while minimizing reservoir footprint and dam embankment size. Three separate physical conditions criteria were considered as presented in Table B-1 and are explained below:

Ratio of Embankment Volume to Storage Capacity (CY per AF): This criterion is derived from the preliminary estimates of new or increased earth embankment volume in relation to new or increased storage capacity. The dams for which this ratio is a smaller number would be more efficient as less earth embankment needs to be constructed for the same amount of water being stored. Typically, values in the range of 30 to 50 are considered very efficient and have been assigned a higher rating score. Values of 100 or more are considered very inefficient and are assigned a lower rating score. Unit costs (i.e. construction cost per amount of water supplied) would be higher for inefficient dams. Embankment volumes are derived assuming a 2.5H:1V slope on both the upstream and downstream sides unless otherwise noted.

- **Ratio of Storage Capacity to Reservoir Area (AF/ Ac):** This criterion is derived from the preliminary estimates of new or increased storage capacity in relation to new or increased inundation area. Typically, values in the range of 100 or more are considered favorable and have been assigned a higher rating score. In comparing two dams that are otherwise similar, the dam for which this ratio is a larger number may have a lesser relative environmental impact, as a lesser inundation area would be needed to store the same amount of water.

Table B-1 - Screening Criteria and Ratings Scores

Rating Score	Physical Conditions				Geotechnical/Geological Conditions					Hydraulic Conditions			Social/Land Development Impacts			
	Embankment Volume CY/ Storage Capacity AF	Storage Capacity AF/ Reservoir Area AC	Dam Raise FT	Meet Capacity Goal	Liquefaction Potential	Nearest Fault Distance	Potential for Landslides	Foundation Treatment Required	On-Site Material Conditions	Conveyance Length MILES	Spillway Construction	Flood Protection Benefits	Inundated Roadways MILES	Additional Inundation Area AC	Developed Areas Impacted	Land Acquisition Issues
1	250 or >	50 or <	501 or >	No	very high	Site in A-P Zone	very high	extensive	materials on site are insufficient and unsuitable, site vicinity is mostly developed, will involve hauling substantial quantities for several miles	> 4.5 miles	extensive	none	> 9.0	< 2,500	extensive	extensive
2	200 - 249	51 - 60	401 - 500			< 1/2 mi				4.1 - 4.5		very little	8.1 - 9.0	< 2,250		
3	150 - 199	61 -70	351 - 400		high	< 1 mi	high	significant	materials on site are insufficient and/or unsuitable, considerable material will need to be hauled a few miles	3.6 - 4.0	significant		7.1 - 8.0	< 2,000	significant	significant
4	100 - 149	71 - 80	301 - 351			< 2.5 mi				3.1 - 3.5		some	6.1 - 7.0	< 1,750		
5	75 - 99	81 - 90	251 - 300	Reduced goal	moderate	< 5 mi	some	moderate	materials on site may be insufficient, what's available is suitable but some material will need to be hauled a few miles	2.6 - 3.0	moderate		5.1 - 6.0	< 1,500	moderate	moderate
6	60 - 74	91 - 100	201 - 250			<7.5 mi				2.1 - 2.5		adequate	4.1 - 5.0	< 1,250		
7	50 - 59	101 - 110	151 - 200		low	< 10 mi	low	some	adequate materials available but suitability is questionable, some material may need to be hauled a few miles	1.6 - 2.0	some		3.1 - 4.0	< 1,000	some	some
8	40 - 49	111 - 120	101 - 150			< 15 mi				1.1 - 1.5		significant	2.1 - 3.0	< 750		
9	30 - 39	121 - 130	51 - 100		very low	< 20 mi	very low	very little	ample material available on site but some may be unsuitable and may require selective grading	0.6 - 1.0	very little		1.1 - 2.0	< 500	very little	very little
10	30 or <	131 or >	50 or <	Yes	none	≥ 20 mi	none	none	ample suitable material is available on-site	≤ 0.5 mi	none	beyond required	< 1.0	< 250	none	none

- **Dam Height (ft)**: This physical condition criterion is included to reflect the potential engineering difficulties and safety concerns associated with taller dams. All other parameters being similar, if an excessive height is required to achieve the same capacity goal, it is considered to be less desirable. In some instances, heights of the order of over 500 feet were required and these have been assigned a lower rating score.

- **Meeting the Capacity Goal:** Meeting the desired capacity goal is a key factor in screening. Sites that meet the goal were assigned a high score. One site (Pacheco B) that could not meet the goal was assigned a low score. One site (San Benito) that was carried forward with the lesser available capacity goal was given an intermediate score. These scores by themselves do not have significance but introducing a score for this factor helps avoid a misleading high score for a site which does not meet the capacity goal but has otherwise favorable characteristics.

Evaluating how well each alternative met the physical conditions criteria required details of dam location, size, and layout. For several reservoir sites, exact dam locations were not available. An optimization of the largest reservoir storage capacity possible given the least amount of earthwork required to raise a dam determined the best location for each dam.

Table B-2 lists the longitude (easting) and latitude (northing) of the dam embankments used for this storage alternative preliminary screening.

Table B-2. Dam Locations

Name	Easting	Northing
Anderson Left	121 37' 46.21" W	37 10' 08.06" N
Anderson[(1)] Center	121 37' 50.07" W	37 10' 00.71" N
Anderson Right	121 37' 35.56" W	37 09' 47.95" N
Chesbro Left	121 41' 58.42" W	37 06' 50.36" N
Chesbro* Center	121 41' 49.58" W	37 06' 54.03" N
Chesbro* Center	121 41' 38.81" W	37 06' 59.09" N
Chesbro Right	121 41' 34.83" W	37 07' 11.76" N
Pacheco A Left	121 17' 40.90" W	37 03' 19.89" N
Pacheco A Right	121 17' 19.04" W	37 03' 31.79" N
Pacheco B Left	121 17' 52.96" W	37 04' 06.75" N
Pacheco B Right	121 17' 36.25" W	37 04' 15.83" N
San Benito Left	121 21' 14.35" W	36 46' 20.00" N
San Benito Right	121 20' 58.39" W	36 46' 38.03" N
Ingram Canyon Left	121 18' 01.71" W	37 31' 44.93" N
Ingram Canyon Right	121 17' 32.17" W	37 31' 28.09" N
Del Puerto Right	121 13' 26.55" W	37 28' 22.68" N
Del Puerto Right	121 13' 26.55" W	37 28' 22.68" N
Quinto Left	121 06' 53.54" W	37 09' 34.96" N
Quinto Right	121 05' 29.81" W	37 10' 39.99" N

[(1)] Anderson and Chesbro Dams have a curved configuration so additional points are provided for bearing purposes.

The source data used to develop topography for the physical condition evaluation included the USGS National Elevation Dataset (NED). This data set provided the most comprehensive and readily available source of information to proceed with the study. Prior to analyzing the locations, both 1 ft and 5 ft contours were generated in California State Plane NAD 83 Zone III. Water surface elevations were used to designate contour closure polygons to create the inundation areas for each location. The inundation polygon area was used with the NED dataset to arrive at volumetric capacity estimates. Analyses were performed in ArcGIS 9.2 with 3D Analyst. Calculations were substantiated using spreadsheet and hand calculations.

In all cases, a crest width of 40 feet was selected for the dam and the top of dam elevation included a 20-foot allowance for freeboard. While actual requirements would vary based on design, these values provide a reasonable basis for comparing alternative sites.

Geotechnical and Geological Conditions

Several geotechnical and geological criteria were selected for evaluation of the storage alternatives. Table B-1 lists these criteria and their rating scores, which can be summarized as follows:

- **Liquefaction Potential:** This criterion relates to the potential for soils beneath and near the dam embankment and abutments to liquefy during earthquake strong ground motion. Liquefiable soils will require removal or improvement during dam construction, increasing construction cost and impact.

- **Distance to Faults:** This criterion relates to the distance of the dam and reservoir from identified active faults. Closer faults increase the potential level of strong ground shaking and associated risk of embankment failure, liquefaction, landslides, lateral spreading, and seiches. Very close faults also imply some risk of fault displacement beneath the embankment or reservoir. The computer program EQFAULT Version 3.00 (Blake 2000) was used to help estimate the maximum earthquake site acceleration at each site. If a site was mapped within an Alquist Priolo Earthquake Fault Zone (A-P zone) that requires an in-depth field fault investigation, it was assigned the lowest rating.

- **Landslides:** This criterion relates to the potential for landslides to occur at the dam abutments and around the margins of the reservoir. Impacts were considered higher for two possible scenarios: Conditions at the dam abutment(s) that are likely to require significant landslide remediation and/or conditions at the shores of the new reservoir that have potential landslides that can be triggered by wetting. Of the second type of risk (reservoir shores), risks were considered higher and hence the assigned scores were lower, if the areas surrounding the reservoir were already developed and landslides had the potential to affect the neighboring uphill properties.

- **Foundation Treatment Required:** This criterion relates to identified requirements for overexcavation and replacement and/or grouting of weak or permeable soils beneath the dam embankment or weak, fractured rock in the dam abutments to control seepage and settlement.

- **On-Site Material Availability:** This criterion relates to the suitability and the availability of earth materials that can be used for the embankment construction. Specific borrow sources were not identified; rather; a subjective evaluation was made based on the quality of materials near the dam and development or topographic limitations on developing borrow sites near the dam. Sites that were estimated to require hauling due to lack of suitable materials on-site, were assigned lower scores. No site visits or field reconnaissance were conducted to make such assessments. Material source conditions were assessed from available geologic maps and are considered preliminary in nature.

Hydraulic Conditions

The hydraulic criteria selected for evaluation of the storage alternatives and their rating scores are shown in Table B-1 and can be summarized as follows:

- **Conveyance Length:** This criterion relates to the estimated distance between the outlet works of a proposed reservoir and the nearest connection of an existing conveyance pipeline.

- **Spillway Construction:** This criterion relates to the potential complexity of the spillway, hydraulic head, and energy dissipation requirements.

- **Flood Protection Benefits:** This criterion relates to anticipated flood protection benefit of the completed storage alternative. No specific evaluation was made; rather, the rating was assigned based on potential benefits previously reported in earlier evaluations and screening.

Land Development and Social Impacts

The land development and social impacts criteria selected for evaluation of the storage alternatives and their rating scores are shown in Table B-1 and can be summarized as follows:

- **Inundated Roadways:** This criterion relates to the length of streets, roads, and highways that would require relocation, as estimated from GIS mapping.

- **Additional Inundation Area:** This criterion relates to the new areas that would be inundated by the storage alternative, irrespective of the nature of the land inundated.
- **Affected Developed Areas:** This criterion relates to the amount of developed area affected by either embankment construction or inundation from the reservoir.
- **Land Acquisition Issues:** This criterion relates to relative social and economic impacts due to relocation of residences and structures from construction and/or newly inundated areas.

B.2 Evaluation of Alternatives

B.2.1 Anderson Reservoir Expansion

Physical Conditions

> ***Anderson Reservoir - Physical Conditions Criteria***
>
> ***Embankment Efficiency*** *– 34 CY/AF*
> ***Storage Utilization*** *– 88 AF/Ac*
> ***Dam Raise*** *– 65 ft*

The Draft Conceptual Alternatives Screening Report (SCVWD 2003) initially conceptualized the expansion of Anderson Reservoir (see Figure B-3). This alternative addresses the San Luis Reservoir Low Point problem by raising the crest of the existing dam to increase storage by 100 TAF to allow for early delivery and storage of water from San Luis Reservoir prior to potential supply interruption caused by a low point issue. The reservoir expansion would be accomplished by extending and raising the downstream face of the earthen dam, which would allow construction without draining the existing reservoir. Extending and raising the downstream face would maintain the dam’s existing 2.5:1 side slope configuration. Table B-2 lists the east and north coordinates of the new crest at the intersections between the new dam axis and the abutments. Table B-3 provides the physical properties of the existing and the upgraded dams. The net increase values and other quantitative measures used in the screening are summarized in Table B-4.

Raising the dam height by 65 feet (reservoir raised by 60 feet) increases the reservoir capacity by 100 TAF to a total capacity of approximately 190 TAF. The additional earthwork required to expand Anderson Reservoir is approximately 3.4 million cubic yards, yielding a ratio of earthwork volume to reservoir capacity of 34 CY per AF (cubic yards per every acre-feet of additional storage gained).

Table B-3. Physical Properties of Alternative Storage Sites

Storage Alternative		Dam						Reservoir		
		Dam Height FT	Dam Volume MCY	Crest Width FT	Crest Length FT	Crest Elevation FT	Freeboard FT	Water Surface Elevation FT	Inundation Area AC	Storage Capacity TAF
Existing	Anderson	235	3.7	40	1,430	640	15	625	1,270	90
	Chesbro	95	0.4	22	690	535	10	525	285	8
Upgraded or New	Anderson	300	7.1	40	2,550	705	20	685	2,410	190
	Chesbro	275	9.8	40	3,400	715	20	695	1,910	150
	Pacheco A	255	8.0	40	2,140	730	20	710	1,475	150
	Pacheco B	285	7.0	40	1,650	760	20	740	1,290	130
	San Benito	160	1.8	40	2,250	575	20	555	1,040	60
	Ingram	540	26.6	40	2,750	1,005	20	985	1,995	271
	Del Puerto	505	67.9	40	6,750	780	20	760	1,900	271
	Quinto Dam	310	45.0	40	12,100	655	20	635	2,480	271

NOTES: Dam heights rounded to nearest 5 ft.

Upgraded crest lengths rounded to nearest 50 ft.

Inundation areas rounded to nearest 5 Ac.

Existing Anderson and Chesbro values reflect recent survey results (SCVWD web page)

Pacheco A and Pacheco B values based on ground El. 475' (MWH report indicates ground El. 400')

San Benito height is approx. 145 ft except at a small local zone where it is 160 ft.

Table B-4 - Quantitative Screening Measures

Storage Alternative	Physical Condition Measures								Geotechnical Measures	Hydraulic Measures	Impact Measures
	Estimated Values						Derived Ratios				
	Additional Dam Height (ft)	Additional Water Height (ft)	Additional Storage Goal (TAF)	Additional Storage Available (TAF)	Additional Inundation Area (Ac)	Additional Dam Volume (MCY)	EMBANKMENT EFFICIENCY [Dam Vol.÷Storage Cap.] (CY/AF) (lower # is better)	STORAGE UTILIZATION [Storage Cap.÷Inund. Area] (AF/Ac) (higher # is better)	Nearest Fault Distance (Miles)	Additional Conveyance Length (Miles)	Inundated Roadways Length (Miles)
Anderson	65	60	100	100	1,140	3.4	34	88	1.8	0.7	3.9
Chesbro	180	170	142	142	1,625	3.4	24	87	7.0	2.7	9.8
Pacheco A	255	235	150	150	1,475	8.0	53	102	8.7	0.5	0.7
Pacheco B	285	265	150	130	1,290	7.0	54	101	8.5	1.7	4.0
San Benito	160	140	60	60	1,040	1.8	30	58	0.0	5.6	4.5
Ingram	540	520	271	271	1,995	26.6	98	136	0.0	2.4	6.6
Del Puerto	505	485	271	271	1,900	67.3	248	143	0.0	2.0	6.9
Quinto Dam	310	290	271	271	2,480	45.0	166	109	0.0	2.8	5.6

NOTES:

Physical condition values for existing dams reflect net increase only (see Table 2.1 for existing and total values)

Storage goals are as established in Appendix B of the SLLPIP (June 2007) and described in Section 1.1 of this report

Pacheco A vaues based on ground el. 475'. If ground El. 400 ft; Dam Ht = 330 ft, Earth Vol = 14.7 MCY, Embankment Efficiency = 98 CY/AF

Pacheco B vaues based on ground el. 475'. If ground El. 400 ft; Dam Ht = 360 ft, Earth Vol = 12.3 MCY, Embankment Efficiency = 95 CY/AF

Dam volumes do not include foundation or abutment overexcavation. Sites in alluvial basins (San Benito, Quinto) are likely to have higher earth volumes due to foundation overexcavation; sites with potential landslides at the abutments (Pacheco A, San Benito) are likely to have higher earth volumes due to abutment overexcavation

Fault distances reported as '0.0' are based on maps or EQFAULT program outputs, whichever is more conservative (maps and program outputs for the same site may differ)

All existing and new sites require new spillway and outlet construction

The additional amount of inundated land is approximately 1,140 acres (Ac), yielding a ratio of additional storage capacity to additional reservoir footprint of 88 AF per Ac (acre-feet of stored water capacity gained per every acre of additional land required).

Geotechnical and Geological Conditions

> ***Anderson Reservoir- Geotechnical and Geological Conditions Criteria***
>
> ***Liquefaction*** *– Low*
> ***Distance to Faults*** *– 1.8 mi*
> ***Landslide Potential*** *– High*
> ***Foundation Treatment*** *– Moderate (existing dam conditions uncertain)*
> ***On-site Material*** *– Some hauling needed*

Geology Figure B-4 (Wagner 1991) depicts local geologic conditions near Anderson Dam. Generally, the dam site is characterized by Jurassic age ultramafic rocks in the abutment areas of the existing dam. These ultramafic rocks, which are gabbroic in part, include peridotite, hornblendite, and are locally serpentinized. According to the geologic map, the majority of the rocks surrounding the reservoir are unconsolidated Holocene age terrace deposits. These Plio-Pleistocene terrace deposits consist of sand, silt, clay, and gravel. The valley floor sediments consist of Quaternary alluvium of unknown thickness. These unconsolidated stream and basin deposits range in size from clay to boulder.

Seismicity As with most areas of California, the site is subject to ground shaking caused by earthquakes. Figure B-4 shows the Calaveras Fault and the Silver Creek Fault to be in close proximity. Available mapping suggests discontinuity of the Silver Creek Fault across the dam embankment area. Further research into the dam construction and its geotechnical studies may provide additional information. At this time, there does not appear to be any fault directly intercepting the dam embankment. The computer program EQFAULT lists the Calaveras Fault as the closest fault at 1.8 miles away. The San Andreas Fault is 12.7 miles away. The maximum earthquake site acceleration is estimated to be 0.39g.

Liquefaction The embankment area is comprised of serpentinized ultramafic rock; therefore, liquefaction susceptibility is low. Records of the original dam construction would need to be evaluated for further assessment.

Landsliding The area around Anderson Lake has had considerable landslide activity as shown in Figure B-5 (Weigers 2006; Delarette 2006). Many of the landslides appear to be deep seated. Of these landslides, some are active or historic slides, which are of more concern. Raising Anderson Dam would inundate the toes of these landslide areas (see Figure B-5). Fluctuations in water levels would make these landslide areas subject to wetting and drying cycles. Earthquake activity may also create increased landslide risk. Under such conditions, active and perhaps even dormant landslides may re-activate.

The southeasterly shore of the existing lake is a developed area. The Draft Conceptual Alternatives Screening Report (SCVWD 2003) estimated that an expanded Anderson Reservoir could inundate approximately 100 homes. This preliminary screening analysis suggests that additional homes upslope of the expanded reservoir could be subject to new landslide activity generated by the expanded reservoir footprint. Extending home acquisitions beyond the inundation footprint buffer could minimize such risks, but would potentially increase the alternative's cost. Further geotechnical studies would be needed to assess landslide risks and to evaluate the added cost impacts. At this time, this alternative is considered to have a relatively high risk in terms of landslides around the inundation perimeter. Remediation of such risks is considered relatively difficult.

Dormant mature landslides are mapped near the existing right abutment and uphill from it. Even though these are mature landslides, at least one slide is directly in line with the proposed embankment expansion. The additional geotechnical studies described above would investigate its potential removal. Based on available mapping, this slide appears of a size that would permit its management through conventional earthwork activities. The additional cost impact is not known. This alternative is considered to have a moderate to high risk in terms of landslides at the dam embankment expansion area. Reduction of such risks is considered reasonable to moderately difficult depending on actual field conditions.

Material Availability Materials within approximately 3 miles of the dam embankment consist of terrace deposits, landslide debris, and serpentinized ultramafic rock. These materials are generally considered suitable for embankment construction, provided they are processed as engineered fill. Serpentinized rock may be harder to process depending on local conditions. Serpentinized rock can also contain naturally occurring asbestos and special health and safety measures may be needed during construction to avoid impacts associated with naturally occurring asbestos, if encountered.

Foundation Treatment Requirements Provided further investigation of the existing dam reveals suitable conditions for the expansion, the need for foundation treatment would not be anticipated. Raising the dam would typically involve keying in to the existing dam and widening on the downstream side. As mentioned earlier, landslide removal could be necessary at the right abutment. Further investigation of existing dam conditions is needed to assess if additional stabilization of the existing embankment will be needed prior to expansion.

In general, the foundation treatment rating for an existing dam would require an evaluation of the previously placed earth materials in addition to the natural site conditions. An existing dam can be considered to be more favorable than a new site with known problems (landslides, faults, etc.), however, less favorable than a new site expected to have stable foundation conditions. Raising a dam that has been previously designed for a certain height may or may not require treatment of the original dam, depending on several factors such as the potential for settlement under additional loads and the verifiable quality of as-built records. Remedial foundation treatment (i.e. stabilization of the existing dam embankment) may become necessary due to less stringent standards which may have been in effect at the time of its original construction (e.g. seismic loads). Also, investigations through existing dams are more complex than those in pristine sites. Increasing a dam height could pose various geotechnical engineering challenges depending on such aforementioned factors, which are not known at this time. At this level of study, an in-depth evaluation of existing dams has not been performed. A rating assignment in the range of moderate to significant is considered to be a reasonable value for existing dams.

Hydraulic Conditions

An expanded Anderson Reservoir would store early deliveries from San Luis Reservoir prior to the summer low point months. The San Felipe Division would receive deliveries of this San Luis supply from Anderson Reservoir when algae conditions prevent the pumping of supplies in San Luis Reservoir.

Anderson Reservoir - Hydraulic Conditions Criteria

***Conveyance Length** – 3,900 ft*
***Spillway** – Significant Upgrade*
***Flood Protection** – Not Significant*

As mentioned in the IAIR, water stored at Anderson Reservoir would have to serve the San Benito and Pajaro Water Districts during a low point supply interruption. This would require a new 270 cfs pump station and a new 3,900-foot pipeline connecting Anderson Reservoir to the San Benito and Pajaro Water Districts. The existing spillway would need to be demolished and a new one excavated into the rock to the right abutment. A new stilling basin would be constructed to dissipate energy to allow releases to flow to Coyote Creek further downstream.

Increasing the storage capacity at this reservoir location has no significant flood control benefits. Further raising of the water surface at this location will increase the overall risk to the inhabitants and property downstream, should a dam break occur. Assessing the potential hazard at this location is not part of this current effort. A dam hazard reclassification would be conducted should this location be selected for full design.

Land Development and Social Impacts

Anderson Reservoir - Land Development and Social Criteria
Inundated Roadway Miles *– 3.9 mi*
Additional Inundation Area *–1,140 Ac*
Affected Developed Areas *– Extensive*
Land Acquisition *– > 100 Structures*

Anderson Reservoir is adjacent to a residential neighborhood in the City of Morgan Hill. Research competed on the Anderson Reservoir expansion alternative in the Draft Conceptual Alternatives Screening Report (SCVWD 2003) estimated that approximately 100 private residences in the Holiday Lake Estates neighborhood as well as other isolated private residences around the lake would be inundated by the footprint of an expanded Anderson Reservoir. The U.S. Census reports of median home values for the two Census Block Groups that overlay Anderson Reservoir indicate a price range between $609,300 and $750,000 (U.S. Census Bureau 2000). The Draft Conceptual Alternative Screening Report also described the potential inundation of portions of Anderson County Park.

Estimates for this preliminary screening indicate that an expanded Anderson Reservoir would create an estimated inundation area with a larger footprint area than the Draft Conceptual Alternatives Screening Report indicated. This revised footprint would result in the inundation of additional structures well beyond the 100 structures previously reported. The preliminary GIS work completed as a part of this reservoir screening effort also indicated that up to 3.9 miles of roadway could be inundated by the expanded Anderson Reservoir footprint.

Reservoir water level fluctuations to deliver flows to the San Felipe Division would also adversely affect potential redevelopment along the re-established shores of a new reservoir. This has important impacts to the land values of a newly created reservoir.

B.2.2 Chesbro Reservoir Expansion

Physical Conditions

Chesbro Reservoir - Physical Conditions Criteria
Embankment Efficiency *– 24 CY/AF*
Storage Utilization *– 87 AF/Ac*
Dam Raise *–180 ft*

The Chesbro Reservoir Alternative (see Figure B-6) could increase storage capacity from the current 9 TAF to 150 TAF. The alternative would require a dam raise of approximately 180 feet. The reservoir's current storage capacity would be expanded by increasing the height and length of both the downstream and upstream slopes of the existing dam. Table B-3 shows the physical properties of the new dam and Table B-4 summarizes the quantitative parameters utilized in the screening. Table B-2 lists the north and east coordinates of the new crest at the intersections between the new dam axis and the abutments.

Raising the dam height by 180 feet would increase the reservoir capacity by about 142 TAF, which would meet the desired goal of 150 TAF. The additional earthwork required would be approximately 3.4 million cubic yards (MCY). This yields a ratio of additional earthwork to additional reservoir capacity gain of 24 CY per AF. The additional amount of inundated land is approximately 1,625 Ac (see Figure B-6), yielding a ratio of additional storage capacity to additional reservoir footprint of 87 AF per Ac.

Geotechnical and Geological Conditions

> ***Chesbro Reservoir - Geotechnical and Geological Conditions Criteria***
>
> ***Liquefaction*** *– Low to Moderate*
> ***Distance to Faults*** *– 7.0 mi*
> ***Landslide Potential*** *– Moderate*
> ***Foundation Treatment*** *– Moderate (existing dam conditions uncertain)*
> ***On-site material*** *– Considerable hauling may be needed*

Geology Figure B-7 (McLaughlin et. al. 2001) depicts the local geologic conditions near Chesbro Dam. The left dam abutment is underlain by serpentinized ultramafic rocks of Jurassic age. The right dam abutment is underlain by similar rocks (serpentinized ultramafic rocks of Jurassic age) and by Jurassic age basaltic volcanic rocks. The majority of the reservoir area upstream from the dam is underlain by rocks of the Franciscan Complex (Cretaceous and Jurassic age) consisting primarily of melange that is in turn overlain by Jurassic age basaltic volcanic rocks that appear to be in fault (thrust fault) contact with the Franciscan Complex. The valley floor of Llagas Creek is predominantly underlain by unconsolidated stream channel deposits ranging in size from clay to boulder. The thickness of the valley floor deposits along Llagas Creek is unknown.

Seismicity The site lies approximately midway between the active Sargent Fault (a major splay of the San Andreas Fault) and the active Calaveras Fault. However, no known active faults transect the reservoir. Several other low to high angle reverse faults cross the reservoir although their specific age is not known. The computer program EQFAULT lists the Calaveras Fault as the closest fault at 7.0 miles away. The San Andreas Fault is 7.4 miles away. The maximum earthquake site acceleration is estimated to be 0.36g.

Liquefaction The embankment area is generally composed of serpentinized ultramafic rock but there are alluvial fan deposits near the downstream toe of the existing embankment. The liquefaction susceptibility in bedrock is considered very low and in alluvial deposits is considered moderate to high, with an estimated average of these two conditions for the overall site considered to be low to moderate liquefaction susceptibility. Any expansion would likely involve removal of alluvium deposits under the proposed toe depending on previous removal limits. Records of the original dam construction would need to be evaluated for further assessment.

Landsliding According to the geologic map (Figure B-7), there are three mapped landslides along the south/west embankment of Llagas Creek and one mapped landslide on the north/east embankment. These are upstream from the existing Chesbro Reservoir but within the new inundation area. Other smaller unmapped landslides likely exist that are not depicted on the geologic map.

Raising Chesbro Dam would inundate the toes of these landslide areas. Fluctuations in water levels would make these landslide areas subject to wetting and drying cycles. Earthquake activity may also create increased landslide risk. Under such conditions, these landslides may re-activate.

The implementation of this alternative would require inundation of the developed areas and the roads. There do not appear to be adjacent developed areas on the hillsides above the proposed inundation areas, as all existing development appears to be within the inundation area. Therefore, the above-mentioned landslides likely affect undeveloped areas.

There are no mapped landslides at the existing dam site. The proposed embankment expansion and its abutments are likely to encounter serpentinized ultramafic rocks, mélange of the Central belt, alluvial fan deposits, and artificial fill.

This alternative is considered to have some risk in terms of landslides. Sporadic areas along the uninhabited new shoreline would likely remain unremediated.

Material Availability Materials in the immediate vicinity of the dam embankment consist of serpentinized ultramafic rocks, mélange of the Central belt, alluvial fan deposits, and artificial fill. These materials are generally considered suitable provided they are processed as engineered fill. Serpentinized rock may be harder to process depending on local conditions. There may be localized areas of mélange, which can be difficult to excavate with conventional earthmoving equipment. In addition, serpentinized rocks can contain naturally occurring asbestos and special measures may be needed during construction. Material availability for this site may be relatively more difficult due to higher volume needed in the vicinity of a somewhat developed area.

Foundation Treatment Requirements Provided further investigation of the existing dam reveals suitable conditions for the expansion, the need for foundation treatment would not be anticipated. Raising the dam would typically involve keying in to the existing dam and widening on the downstream side. Further investigation of existing dam conditions is needed to assess if additional stabilization of the existing embankment is needed prior to expansion.

In general, the foundation treatment rating for an existing dam would require an evaluation of the previously placed earth materials in addition to the natural site conditions. An existing dam can be considered to be more favorable than a new site with known problems (landslides, faults, etc.), however, less favorable than a new site expected to have stable foundation conditions. Raising a dam that has been previously designed for a certain height may or may not require treatment of the original dam, depending on several factors such as the potential for settlement under additional loads and the verifiable quality of as-built records. Remedial foundation treatment (i.e. stabilization of the existing dam embankment) may become necessary due to less stringent standards which may have been in effect at the time of its original construction (e.g. seismic loads). Also, investigations through existing dams are more complex than those in pristine sites. Increasing a dam height could pose various geotechnical engineering challenges depending on such aforementioned factors, which are not known at this time. At this level of study, an in-depth evaluation of existing dams have not been performed. A rating assignment in the range of moderate to significant is considered to be a reasonable value for existing dams.

Hydraulic Conditions

Similar to the Anderson Reservoir Alternative, an expanded Chesbro Reservoir would store early deliveries from San Luis Reservoir prior to the summer low point months. Deliveries of this San Luis supply would be made from Chesbro Reservoir when algae conditions prevent the pumping of supplies in San Luis Reservoir.

Chesbro Reservoir - Hydraulic Conditions Criteria

Conveyance Length *– 14,150 ft*
Spillway *– Significant Upgrade*
Flood Protection *– Not Significant*

Water stored at Chesbro would need to serve the San Benito and Pajaro Water Districts during low point supply interruptions. This would require a new pump station and a 14,150-foot pipeline connecting Chesbro to the Santa Clara conduit. The existing spillway would need to be demolished and a new one excavated into the right abutment. A new stilling basin would be constructed to dissipate energy to allow releases to flow to the Llagas Creek further downstream.

Increasing the storage capacity at this reservoir location has no significant flood control benefits. Further raising of the water level at this location will increase the overall risk to the inhabitants and property downstream should a dam break occur. Assessing the potential hazard at this location is not part of this current effort. A dam hazard reclassification would be conducted should this location be selected for full design.

Land Development and Social Impacts

> ***Chesbro Reservoir - Land Development and Social Criteria***
>
> ***Inundated Roadway Miles** – 9.8 mi*
> ***Additional Inundation Area** – 1,625 Ac*
> ***Affected Developed Areas** – Extensive*
> ***Land Acquisition** – >40 Structures*

Chesbro Reservoir is adjacent to a residential neighborhood in the City of Morgan Hill. Research completed on the Chesbro Reservoir expansion alternative in the 2002 SLLPIP Conceptual Alternatives Screening Report estimated that the footprint of an expanded Chesbro Reservoir would inundate approximately 40 structures. The U.S. Census reports of median home values for the three Census Block Groups that overlay Chesbro Reservoir indicate a price range between $487,800 and $703,700 (U.S. Census Bureau 2000).

The estimated inundation area that would be created by an expanded Chesbro Reservoir that was developed as a part of preliminary GIS analysis for this reservoir screening effort indicates a larger footprint area than was estimated in the 2002 Alternatives Screening Report. This revised footprint is estimated to result in the inundation of additional structures well beyond the 40 structures described in the screening report. Preliminary GIS analysis completed as a part of this reservoir screening effort also indicated that up to 9.8 miles of roadway could be inundated by the expanded Chesbro Reservoir footprint and would require new access roads.

B.2.3 Pacheco A Reservoir

Physical Conditions

> ***Pacheco A Reservoir - Physical Conditions Criteria***
>
> ***Embankment Efficiency*** *– 53 CY/AF*
> ***Storage Utilization*** *– 102 AF/Ac*
> ***Dam Raise*** *– 255 ft*

The Pacheco A Reservoir Alternative (see Figure B-8) would require the partial demolition of the existing dam on Pacheco Creek with provisions to maintain existing water deliveries during and after the construction of the new dam. The existing North Fork Dam is designed to impound water from the bottom of the original floodplain to elevation 472'. The elevation of the original floodplain at the proposed Pacheco A site has been reported at elevation 400' (SCVWD 2003a). More recent GIS information indicates an existing floodplain elevation of 475'. Also, the aerial photo image of the proposed dam site shows dry conditions. Uncertainties exist, but it is possible that the elevations on the aerial images are not accurate and the dry conditions in the photo may be from a time when the existing dam was drained. It is also possible that there has been excessive siltation which have created the higher ground elevation and the dry conditions. The level of siltation in the existing reservoir has not been evaluated, but the existing ground elevation at the proposed dam site has been taken as 475' for our screening. There may be additional foundation overexcavation involved to remove the silt deposits.

Tables B-3 and B-4 provide the physical properties of Pacheco A site, with alternate quantities and screening parameters for the lower ground elevation provided in the footnotes. Quantities with potential foundation overexcavation are not used in the comparison since other sites with potential overexcavation needs have not been evaluated for that variable as well. However, if this alternative is selected, refined estimates will be provided to account for both the foundation and the abutment overexcavations.

The new reservoir's water surface elevation of 710' would not encroach on Henry Coe National Park and would avoid any inundation of the parkland. However, there is conflicting published information regarding the contour levels along the tributary river as it approaches the property limits of the National Park. It is possible that the discrepancies may be related to the location of the boundary line for the park. Previous reports by SCVWD (2003a) state a normal water inundation contour of 680. This report is based on a normal inundation contour of 710 with a maximum inundation contour of 730 allowing for spillway surcharges. This elevation is still lower than the contour of 760 found at the boundary with the park (see Figure B-8). Based on this, this alternative would meet the desired goal of 150 TAF of storage capacity as stated in Table B-3. This contour assumption would be verified should this alternative move further along the screening process.

Table B-2 lists the east and north coordinates of the new crest at the intersections between the new dam axis and the abutments. Table B-3 shows the physical properties of the new dam and Table B-4 summarizes the quantitative parameters utilized in the screening.

A new 255-foot high dam (based on elevation 475') requires earthwork of approximately 8.0 million cubic yards with an embankment efficiency of 53 CY of earth volume per every AF of additional storage gained. The proposed dam uses 2.5:1 slopes on both sides of the crest. The aforementioned values do not include an allowance for overexcavation along the submerged floodplain. If overexcavation is carried to elevation 400', the earth volume would increase to 14.7 MCY and the embankment efficiency would drop to 98 CY/AF. Any additional earthwork related to landslide remediation at the abutment(s), as will be discussed later, are not included in these figures.

The amount of inundated land is approximately 1,475 Ac , yielding a ratio of additional storage capacity to additional reservoir footprint of 105 AF of stored water capacity gained per every acre of new land required.

Geotechnical and Geological Conditions

Pacheco A Reservoir - Geotechnical and Geological Conditions Criteria
Liquefaction *– Moderate*
Distance to Faults *– 8.7 mi*
Landslide Potential *– Very High*
Foundation Treatment *– Moderate to Significant*
On-site Material *– Adequate*

Geology Figure B-10 (Wagner et. al. 1991) depicts the local geologic conditions near the proposed Pacheco A dam site. The proposed left dam abutment is underlain by deep-seated landslide material that overlie rocks of the Jurassic age Franciscan Formation. The proposed right abutment is underlain by the Franciscan Formation. The majority of the reservoir area upstream from the proposed abutments is also underlain by rocks of the Franciscan Complex (Cretaceous and Jurassic age melange), which largely consist of chaotic mixtures of fragmented rock masses in a sheared matrix. The valley floor upstream from the reservoir is predominantly underlain by unconsolidated stream channel deposits ranging in size from clay to boulder. The thickness of the valley floor deposits is unknown and is an important parameter in further evaluating the embankment volumes with more accuracy.

Seismicity The site is subject to ground shaking caused by earthquakes. There are no mapped active faults in the immediate vicinity. The site lies approximately midway between the active Calaveras Fault and the active Ortigalita Fault. No known active faults transect the abutments or the reservoir.

The computer program EQFAULT lists the Ortigalita Fault, the Quien Sabe Fault, and the Calaveras Fault as the closest faults at 8.7, 9.8 and 10.6 miles away, respectively. The San Andreas Fault is 19.6 miles away. The maximum earthquake site acceleration is estimated to be 0.21g.

Liquefaction The embankment area is expected to consist of alluvium, landslide debris, and bedrock of the Franciscan Complex. Liquefaction susceptibility for these materials vary (high for alluvium to very low for bedrock). The current average liquefaction susceptibility is considered to be moderate. Conditions will likely be improved by removal and replacement of any alluvium under the dam foundation, to competent bedrock.

Landsliding As mentioned previously, the geologic map (Figure B-10) shows a large landslide at the left abutment of the Pacheco A site. There are other landslides in the area but not directly at the abutment location. Figure B-11 (Wentworth et. al. 1997) shows that many areas of the Pacheco Creek valley, especially near the upstream end of the inundation area, are susceptible to landsliding. This map shows areas defined by drawing envelopes around groups of mapped landslides and not each specific landslide.

Inundation of these landslide-prone areas and fluctuations in water levels in these areas may trigger landslides. Earthquake activity may also increase landslide risk. However, due to the relatively remote and uninhabited nature of the site, such risks are considered less critical and it is assumed that remediation to these landslides outside of the abutment area would be unnecessary.

It is assumed that the landslide at the abutment area would need to be removed. The potential cost of this remediation is not known and would need to be determined through additional geotechnical studies as a part of the low point project. The available information reviewed as a part of this screening exercise indicates a very high landslide risk at the dam embankment area. Remediation of such risks could add significant costs to construction of the alternative. However, since this site has several desirable attributes, costs associated with remediating landslides or performing further subsurface investigations to relocate the site to minimize landslide impacts, are considered worthwhile.

Material Availability Materials in the immediate vicinity of the dam embankment consist of Franciscan Complex bedrock and landslide debris. These materials are generally considered suitable provided they are processed as engineered fill. Landslide removal, foundation overexcavation, and related grading could provide suitable materials for the embankment. In general, adequate materials are expected to be available on-site. If needed, additional sources such as impermeable materials are expected to be available within a few miles.

Foundation Treatment Requirements Considerable quantities of foundation and landslide removals may be needed depending on site-specific conditions.

Abutment removals may require 'chasing' the hillside well above the crest elevation. Construction within the existing reservoir area may also pose additional difficulties. Further investigations are needed for a more detailed assessment.

Hydraulic Conditions

> ***Pacheco A Reservoir - Hydraulic Conditions Criteria***
>
> ***Conveyance Length*** *– 2,700 ft*
> ***Spillway*** *– Significant*
> ***Flood Protection*** *– Significant*

Pacheco A reservoir would receive releases from San Luis Reservoir during wet periods and would later release this water to users during the low point supply interruptions. Because this reservoir is upstream from the Hollister conduit, there is no need to construct any reverse flow capacity. The existing conveyance pipeline would be extended 2,700 feet from the existing North Fork Dam upstream to the Pacheco A site and would be expanded along its full length to increase conveyance capacity.

New auxiliary and service spillways would be required at this site. Impounding water at this location has been reported in the Draft Conceptual Alternatives Screening Report as having significant flood control benefits for the Lower Pajaro watershed.

Further raising the storage capacity at this reservoir location will increase the overall risk to the inhabitants and property downstream should a dam break occur. Assessing the potential hazard at this location is not part of this current effort. A dam hazard classification would be conducted should this location be selected for full design.

Land Development and Social Impacts

> ***Pacheco A Reservoir- Land Development and Social Criteria***
>
> ***Inundated Roadway Miles*** *– 0.7 mi*
> ***Additional Inundation Area*** *– 1,475 Ac*
> ***Affected Developed Areas*** *– Minor*
> ***Land Acquisition*** *– Minor*

The estimated inundation area that would be created by the Pacheco A Reservoir is shown on Figure B-8. Preliminary GIS analysis completed as a part of this reservoir screening effort also indicates approximately 0.7 miles of existing roadways would require relocation. The reservoir would not inundate any homes as the nature of the 1,475 acres to be inundated is not currently populated.

B.2.4 Pacheco B Reservoir

Physical Conditions

> ***Pacheco B Reservoir - Physical Conditions Criteria***
>
> ***Embankment Efficiency*** *– 54 CY/AF*
> ***Storage Utilization*** *– 101 AF/Ac*
> ***Dam Raise*** *– 285 ft*

The Pacheco B Reservoir Alternative (see Figure B-9) would require the partial demolition of the existing dam on Pacheco Creek with provisions to assure existing water deliveries during and after construction of the new dam. The existing North Fork Dam is designed to impound water to elevation 472 from an assumed elevation at the bottom of the original floodplain of about 400. The elevation of the floodplain at the proposed Pacheco B site is 440. The new reservoir's water surface elevation of 740' would not encroach on Henry Coe National Park and would avoid any inundation of parkland. However, there is conflicting published information regarding the contour levels along the tributary river as it approaches the property limits of the National Park. It is possible that the discrepancies may be related to the location of the boundary line for the park. Previous reports by MWH state a normal water inundation contour of 680. This report is based on a normal inundation contour of 740 with a maximum inundation contour of 760 allowing for spillway surcharges. This elevation is at or lower than the contour found at the boundary with the park. Based on this, the Pacheco B alternative still does not meet the desired goal of 150 TAF of storage capacity. The maximum storage capacity achieved behind this dam location would be 130 TAF based on the 760 maximum contour.

Table B-2 lists the east and north coordinates of the new crest at the intersections between the new dam axis and the abutments. As discussed in Section B.1, the evaluation includes the Pacheco B Reservoir because the capacity is only slightly smaller than the storage goals and the Pacheco B site has fewer geotechnical constraints than other Pacheco sites. A site located downstream of Pacheco B and upstream of Pacheco A may satisfy the storage volume goal without impacting the park, while possibly reducing the impact of existing landslides at Pacheco A. Such potential site candidates as well as the aforementioned uncertainties regarding existing streambed elevations, the park boundary, and landslide limits would need to be further evaluated if a site on Pacheco Creek moves further along the screening process.

Table B-2 provides the physical properties of the proposed dam at Pacheco B. The quantitative measures for this site used in the screening are summarized in Table B-4.

A new 285-foot high dam requires earthwork of approximately 7.0 million cubic yards; the ratio of earthwork to reservoir capacity would be 54 CY per every AF of additional storage. The amount of inundated land would be approximately 1,290 Ac, as shown on Figure B-9, yielding a ratio of additional storage capacity to additional reservoir footprint of 101 AF of stored water capacity gained per every acre of new land required.

The streambed conditions at Pacheco B have similar uncertainties as described under Pacheco A. Alternate quantities for existing ground elevation of 400' (instead of 475') are: 360-foot high dam with an earth volume of 12.3 MCY and an embankment efficiency of 95 CY/AF.

Geotechnical and Geological Conditions

Pacheco B Reservoir - Geotechnical and Geological Conditions Criteria

***Liquefaction** – Moderate*
***Distance to Faults** – 8.5 mi*
***Landslide Potential** – Some*
***Foundation Treatment** – Moderate*
***On-site Material** – Adequate*

Geology Figure B-10 (Wagner et. al. 1991) depicts the local geologic conditions near the proposed Pacheco B dam site. The proposed abutments are underlain rocks of Jurassic age Franciscan Formation. The reservoir area upstream from the proposed abutments is as described for the Pacheco A dam site.

Seismicity The site is subject to ground shaking caused by earthquakes similar to that described for the Pacheco A dam site. The computer program EQFAULT lists the Ortigalita Fault, the Great Valley Fault, the Quien Sabe Fault, and the Calaveras Fault as the closest faults at 8.5, 10.4, 10.6, and 10.9 miles away respectively. The San Andreas Fault is 20.1 miles away. The maximum earthquake site acceleration is estimated to be 0.22g.

Liquefaction The embankment area is expected to consist of alluvium and bedrock of the Franciscan Complex. Liquefaction susceptibility for these materials vary (high for alluvium to very low for bedrock). The current average liquefaction susceptibility is considered to be moderate. Conditions will likely be improved by removal and replacement of any alluvium under the dam foundation, to competent bedrock.

Landsliding Figure B-11 (Wentworth et. al. 1997) shows that many areas of the Pacheco Creek valley, especially near the upstream end of the inundation area, are susceptible to landsliding. Available reference resources reviewed as a part of this screening effort do not indicate the presence of any landslides at the proposed abutments; however, given the geologic setting and presence of sheared bedrock, it is likely that smaller unmapped landslides also occur near the proposed abutments.

Landslide risks in the reservoir area along the shores of the new inundation area are expected to be similar to those for the Pacheco A reservoir. Since this is an undeveloped area, such risks are not critical. Landslide risk at the abutment area (which is a more relevant screening factor) is expected to be more favorable than the conditions at Pacheco A. Based on the anticipated conditions, this site is considered to have some landslide risk.

Material Availability Materials in the immediate vicinity of the dam embankment consist of Franciscan Complex bedrock and landslide debris in the general vicinity. These materials are generally considered suitable provided they are processed as engineered fill. Remedial grading could provide some suitable materials for the embankment. In general, adequate materials are expected to be available on-site. If needed, additional sources such as impermeable materials are expected to be available within a few miles.

Foundation Treatment Requirements Foundation treatment needs depend on site-specific conditions such as the current level of siltation and will require further investigation. Construction within the existing reservoir area may also pose some difficulties.

Hydraulic Conditions

Pacheco B Reservoir - Hydraulic Conditions Criteria

Conveyance length *– 8,900 ft*
Spillway *– Significant*
Flood protection *– Significant*

Operation of this reservoir would be similar to that of Pacheco A. The reservoir is upstream from the Hollister conduit; there is no need to construct any reverse flow capacity. The existing conveyance pipeline would be extended 8,900 feet from the Lower Pacheco dam upstream to the Pacheco B site and would be expanded along its full length to increase conveyance capacity.

New auxiliary and service spillways would be required at this site. Impounding water at this location has reported in the Draft Conceptual Alternatives Screening Report as having significant flood control benefits for the Lower Pajaro watershed. Further raising the storage capacity at this reservoir location will increase the overall risk to the inhabitants and property downstream should a dam break occur. Assessing the potential hazard at this location is not part of this current effort. A dam hazard classification would be conducted should this location be selected for full design.

Land Development and Social Impacts

Pacheco B Reservoir - Land Development and Social Criteria
Inundated Roadway Miles *– 4.0 mi*
Additional Inundation Area *– 1,290 Ac*
Affected Developed Areas *– Minor*
Land Acquisition *– Minor*

The estimated inundation area that would be created by the Pacheco B Reservoir is shown on Figure B-9. The Henry Coe State Park which is upstream from Pacheco B and adjacent to the northwest side of the reservoir, restricts this alternative's storage goal.

Preliminary GIS analysis completed as a part of this reservoir screening effort indicates approximately 4.0 miles of existing roadways would require relocation. The reservoir would not inundate any homes as the nature of the 1,290 acres to be inundated is not currently populated

B.2.5 San Benito Reservoir

Physical Conditions

San Benito Reservoir - Physical Conditions Criteria
Embankment Efficiency *– 30 CY/AF*
Storage Utilization *– 58 AF/Ac*
Dam Raise *– 160 ft*

The San Benito Reservoir Alternative (see Figure B-12) would create 60 TAF of water storage capacity. It would not be able to meet the storage goal of 150 TAF for new reservoirs on the west side of San Luis Reservoir; therefore, it would be combined with other measures to meet project objectives. The reservoir's water surface elevation would be at Elevation 555. Table B-2 lists the east and north coordinates of the new crest at the intersections between the new dam axis and the abutments.

Table B-3 provides the physical properties of the proposed dam. The quantitative measures used in the screening are summarized in Table B-4. A new 160-foot high dam requires approximately 1.8 million cubic yards of fill. The ratio of earthwork to reservoir capacity is estimated to be 30 CY per every AF of storage gained. The amount of inundated land would be approximately 1,040 Ac, yielding a somewhat low ratio of storage capacity to reservoir footprint of 58 AF of stored water capacity gained per every acre of new land required.

Geotechnical and Geological Conditions

> ***San Benito Reservoir - Geotechnical and Geological Conditions Criteria***
>
> ***Liquefaction*** *– Moderate*
> ***Distance to Faults*** *– >1 mile*
> ***Landslide Potential*** *– High to Very High*
> ***Foundation Treatment*** *–Extensive*
> ***On-site Material*** *– Substantial hauling*

Geology Figure B-13 (CDMG 1959) depicts local geologic conditions near San Benito Dam. Generally, the proposed site of the dam is characterized by moderately to steeply dipping non-marine sedimentary beds of the Tertiary age Etchegoin Formation on the right abutment and steeply dipping unconsolidated gravel, sand, and silt beds of the Quaternary age San Benito Formation on the left abutment (Majmundar 1994). Movement on faults has deformed the rock strata in the dam site area causing them to become steeply dipping to overturned. The Etchegoin Formation consists of moderately to poorly non-consolidated sandstone, siltstone, shale, mudstone, and pebbly sandstone and grit. The San Benito Formation is an unconsolidated, light-gray to variegated maroon, purple gravel, sand and silt commonly cross bedded and locally unconformable on the underlying Etchegoin Formation. Alluvial deposits occur within the bed of San Benito River. These Quaternary alluvial deposits are described as undifferentiated, unconsolidated sand, silt, gravel, and clay.

Seismicity As shown on Figure B-15, the active Calaveras Fault transects the proposed dam location and the active Paicines Fault is nearby. There are also several other active faults in the immediate vicinity. The proposed abutment location is within a State of California Special Studies Zone. While there have been dams built near active faults that have performed well, the presence of an active fault is considered to be a high risk. Also, the location of the abutment is in a zone requiring special studies according to the Alquist Priolo Earthquake Fault Zoning Act (A-P zone). This is considered to pose significant challenges in the design and permitting phase, if this alternative were to go forward.

Regardless of fault displacement, the site will be subject to strong ground shaking because of earthquakes. The computer program EQFAULT lists the San Andreas Fault as the closest fault at 2.6 miles away. The maximum earthquake site acceleration is estimated to be 0.36g.

Liquefaction Earth materials in vicinity of the dam are likely to consist of alluvium, Pliocene non-marine and marine deposits, and Quaternary lake deposits and non-marine terrace deposits. Some of these deposits are moderately prone to liquefaction depending on local site conditions.

Landsliding Figures B-14 and B-15 indicate landslides near the proposed dam. Areas labeled as 'Massive Landslides' are shown on Figure B-14 but specific slide zones are not mapped in that figure. The Etchegoin beds near the right abutment are associated with numerous bedrock landslides that appear to be deep seated. The San Benito formation is also prone to landsliding. The stream channel deposits within the bed of the San Benito River are generally incised and are subject to unstable banks that can slump into the channel because of undercutting. Landslide areas of varying severity ranging from 'Least Susceptible' to 'Most Susceptible' have been identified in Figure B-15 (Majmundar 1994). Areas close to the potential abutment site vary from 'Marginally Susceptible' to 'Generally Susceptible' (Majmundar 1994). The landslide risk for this site is considered to be high to very high.

Material Availability Materials in the immediate vicinity of the dam embankment consist of alluvium, Pliocene non-marine and marine deposits, and Quaternary lake deposits and non-marine terrace deposits. These materials can be processed and used for embankment construction but may not be suitable for an impervious core material. Landslide zones on nearby hillsides would limit mining for materials. A more detailed evaluation of material availability should be completed in subsequent phases if this alternative is carried forward to the Plan Formulation Phase of the low point project.

Foundation Treatment Requirements Alluvium is expected to be local and of limited extent. In general, removal of all alluvium is desirable for foundation stability and for liquefaction remediation. Depending on site-specific conditions in relation to existing landslides, removals would likely be needed for landslide remediation if they pose a threat at the abutment locations. The presence of the fault will also require further fault trenching studies and foundation stabilization measures. Maintaining this site under consideration would likely require additional siting studies and possible relocation of the dam up or downstream on San Benito Creek.

Hydraulic Conditions

> ***San Benito Reservoir - Hydraulic Conditions Criteria***
>
> ***Conveyance Length*** *– 5.6 mi*
> ***Spillway*** *– Moderate*
> ***Flood Protection*** *– Significant*

The San Benito Reservoir would be close to the SCVWD and PVMWA water users thus providing local operational flexibility. However, this would require a conveyance pipeline 5.6 miles long to tie back to the Hollister pipeline. New auxiliary and service spillways would be required at this site.

The 2007 IAIR reported that this location has significant flood control benefits for the San Benito River basin and well as the Lower Pajaro watershed; however the reservoir would require emptying ahead of large storm events to accomplish this benefit.

Land Development and Social Impacts

Figure B-12 shows the estimated inundation area that the San Benito Reservoir would create. Preliminary GIS analysis completed as a part of this reservoir screening effort also indicates approximately 4.5 miles of existing roadways would require relocation. The reservoir would not inundate any homes; however, large tracks of agricultural land would need to be acquired.

> ***San Benito Reservoir - Land Development and Social Criteria***
>
> ***Inundated Roadway Miles*** *– 4.5 mi*
> ***Additional Inundation Area*** *– 1,040 Ac*
> ***Affected Developed Areas*** *– Some*
> ***Land Acquisition*** *– Some (agricultural)*

B.2.6 Ingram Canyon Reservoir

Physical Conditions

Figure B-16 shows the Ingram Canyon Reservoir Alternative, which would be east of San Luis Reservoir. Ingram Canyon Reservoir would be subject to larger storage goals to meet user needs as well as existing uses, flood control, and dead storage as described in Appendix B of the IAIR. This is a largely undeveloped site, which would impound water within the Ingram Canyon creek. The crest for this dam would be at Elevation 1,005 feet and the crest length would be approximately 2,750 feet. This alternative would meet the 271 TAF storage capacity goal. Table B-2 lists the east and north coordinates of the new crest at the intersections between the new dam axis and the abutments. Table B-3 provides the physical properties of the proposed dam. The quantitative measures used in the screening are summarized in Table B-4.

> ***Ingram Reservoir - Physical Conditions Criteria***
>
> ***Embankment Efficiency*** *– 98 Cy/AF*
> ***Storage Utilization*** *– 136 AF/Ac*
> ***Dam Raise*** *– 540 ft*

The new 540-foot high dam requires earthwork of approximately 26.6 million cubic yards; the ratio of earthwork to reservoir capacity would be 98 CY per every AF of storage gained. The amount of inundated land is approximately

1,995 Ac, yielding a ratio of storage capacity to reservoir footprint of 136 AF of stored water capacity gained per every acre of new land required.

Geotechnical and Geological Conditions

> ***Ingram Reservoir - Geotechnical and Geological Conditions Criteria***
>
> ***Liquefaction*** *– Very Low*
> ***Distance to Faults*** *– > 1.0 mi*
> ***Landslide Potential*** *– Very Low*
> ***Foundation Treatment*** *–Moderate*
> ***On-site Material*** *– Available*

Geology Figure B-17 (Wagner et. al. 1991) depicts the local geologic conditions near the proposed Ingram Dam. The proposed dam abutments are underlain by Upper Cretaceous age sedimentary rocks along the west side of the San Joaquin Valley that strike northwest and dip moderately to steeply toward the northeast. Bedding dips are generally 50 to 65 degrees, but locally some beds are overturned to the west.

The western portion of the proposed reservoir is underlain by complexly folded Jurassic age ultramafic rock of the Franciscan Formation, which is in fault contact with the younger Cretaceous age rocks. These rocks are gabbroic in part, include peridotite and hornblendite, and are locally serpentinized. The eastern reservoir area would inundate younger Cretaceous age sedimentary rocks of the Panoche Formation (Bishop 1970). The Panoche Formation includes a variety of rock types including shale, siltstone, claystone, sandstone and conglomerate. Some of these lithologies represent turbidite (deep water mudflows) deposits and include sedimentary structures such as flute casts, load casts, and cross laminations.

The Ortigalita Fault is generally the boundary between the upthrown, sheared and complexly folded rocks of the Franciscan Formation in the western portion of the proposed reservoir and the younger Mesozoic sedimentary rocks in the east.

The valley floor sediments consist of Quaternary alluvium – unconsolidated stream and basin deposits ranging in size from clay to boulder. The thickness of the valley floor deposits is unknown.

Seismicity The site is subject to ground shaking caused by earthquakes. The geologic map (Figure B-17) does not show a fault crossing this potential reservoir site. However, the computer program EQFAULT lists the Great Valley 7 Fault as the closest fault at less than a mile away. Other close faults include the Great Valley 8 Fault at 8.8 miles, the Greenville Faults at 13.2 miles, and the Ortigalita Fault at 17.7 miles. The San Andreas Fault is 43.0 miles away. The maximum earthquake site acceleration is estimated to be 0.46g.

Liquefaction The site is generally comprised of sedimentary rocks; therefore, liquefaction susceptibility is considered very low.

Landsliding The geologic map (Figure B-17) does not depict the presence of any major landslides, although the 1:24,000 scale map presented may not depict all landslides. Relatively steep terrain may indicate that historical landslides are not very common in the area. Site-specific investigations and review of historic aerial photographs may reveal further information on landsliding.

Material Availability Materials in the immediate vicinity of the dam embankment consist of Moreno Formation and Panoche Formation. These materials can be processed and used for embankment construction. The area is not developed and material availability is not considered to be a concern. However, due to the relatively large embankment volume involved, a more detailed evaluation of materials will be needed in subsequent phases if this alternative is carried forward.

Foundation Treatment Requirements Foundation treatment would involve removal of localized unsuitable materials, weathered zones, and possibly some of the organic shale of the Moreno Formation, depending on site conditions. Due to the large embankment height, there may be a need for other specialized foundation treatment. Need for deep foundation overexcavation is not anticipated at this time.

Hydraulic Conditions

> ***Ingram Reservoir - Hydraulic Conditions Criteria***
>
> ***Conveyance Length*** *– 2.4 mi*
> ***Spillway*** *– Extensive*
> ***Flood Protection*** *– Not Significant*

The Ingram Canyon Reservoir would drain toward the east of San Luis Reservoir within the San Joaquin River Valley. This would require construction of 2.41 miles of conveyance pipeline to deliver water to the California Aqueduct. Because US Highway 5 is west of the California Aqueduct, the pipeline would have to be tunneled under the highway.

New auxiliary and service spillways would be required at this site. Increasing the storage capacity at this reservoir location has no significant flood control benefits. Constructing a new dam at this location will increase the overall risk to the inhabitants and property downstream should a dam break occur. Assessing the potential hazard at this location is not part of this current effort. A dam hazard classification would be conducted should this location be selected for full design.

Land Development and Social Impacts

Ingram Reservoir - Land Development and Social Criteria
Inundated Roadway Miles *– 6.6 mi*
Additional Inundation Area *– 1,995 Ac*
Affected Developed Areas *– Minor*
Land Acquisition *– Minor*

Figure B-16 shows the estimated inundation area that Ingram Canyon Reservoir would create. Preliminary GIS analysis completed as a part of this reservoir screening effort also indicates about 6.6 miles of existing roadways would require relocation. The reservoir would inundate several rural residences and associated structures.

B.2.7 Del Puerto Canyon Reservoir

Physical Conditions

Del Puerto Reservoir - Physical Conditions Criteria
Embankment Efficiency *– 248 CY/AF*
Storage Utilization *– 143 AF/Ac*
Dam Raise *– 505 ft*

The Del Puerto Canyon Reservoir Alternative (see Figure B-18) would be east of San Luis Reservoir. The Del Puerto Canyon Reservoir would be subject to larger storage goals to meet user needs as well as existing uses, flood control, and dead storage as described in Appendix B of the IAIR. This is a largely undeveloped site, which would impound water within the Del Puerto Canyon. The crest for this dam would be at Elevation 780 feet and the crest length would be approximately 6,750 feet. This alternative meets the desired goal of 271 TAF of storage capacity; however, at the expense of a very large dam.. Table B-2 lists the east and north coordinates of the new crest at the intersections between the new dam axis and the abutments. Table B-3 provides the physical properties of the proposed dam. The quantitative measures used in the screening are summarized in Table B-4.

This new 505-foot high dam would require earthwork of approximately 67.9 million cubic yards, which is the largest earth volume of all sites being considered. The ratio of earthwork to reservoir capacity for this site is 248 CY per every AF of storage gained, which indicates a very low efficiency for the dam embankment. The amount of inundated land would be approximately 1,900 Ac, yielding a storage capacity to reservoir footprint value of 142 AF per Ac. This indicates a favorable storage utilization condition.

Geotechnical and Geological Conditions

> ***Del Puerto Reservoir - Geotechnical and Geological Conditions Criteria***
>
> ***Liquefaction –*** *Very Low*
> ***Distance to Faults*** *– >1.0 miles*
> ***Landslide Potential*** *– Very Low*
> ***Foundation Treatment*** *– Moderate*
> ***On-site Material*** *– Available*

Geology Figure B-19 depicts the local geologic conditions near the proposed Del Puerto Canyon Dam (Bishop 1970). Abutment rocks for the proposed Del Puerto Dam are Upper Cretaceous age sedimentary rocks along the west side of the San Joaquin Valley that strike northwest and dip moderately to steeply toward the northeast. Bedding dips are generally 50 to 65 degrees but locally some beds are overturned to the west.

The proposed reservoir is underlain by moderately to steeply dipping Cretaceous age rocks of the Panoche and Moreno formations (Bishop 1970). The Panoche Formation includes a variety of rock types including shale, siltstone, claystone, sandstone and conglomerate. Some of these lithologies represent turbidite (deep water mudflows) deposits and include sedimentary structures such as flute casts, load casts, and cross laminations. The Moreno Formation includes shale and thin sandstone beds.

The valley floor of Del Puerto Canyon is predominantly underlain by unconsolidated stream channel deposits ranging in size from clay to boulder. The thickness of the valley floor deposits is unknown.

Seismicity The site is subject to ground shaking caused by earthquakes. The geologic map (Figure B-19) does not show a fault crossing this potential reservoir site. However, the computer program EQFAULT lists the Great Valley 7 Fault as the closest fault at less than a mile away. Other close faults include the Great Valley 8 Fault at 4.5 miles and the Greenville Faults at 16.8 miles. The San Andreas Fault is 43.2 miles away. The maximum earthquake site acceleration is estimated to be 0.46g.

Liquefaction The site is generally comprised of sedimentary rocks and therefore liquefaction susceptibility is considered very low.

Landsliding The geologic map (Figure B-19) does not depict the presence of any major landslides at the abutments, although local areas of landslides are present just upstream of the abutments. Geologic map coverage of the same area in Figure B-17 does not indicate the presence of any landslides. Owing to the scale of the geologic maps and given the abutment lithologies, it is likely that smaller landslides exist near the proposed abutments but these are not considered significant threats. Site-specific investigations and review of historic aerial photographs may reveal further information. Based on the limited available information, this site is considered to have low to some landslide risk.

Material Availability Materials in the immediate vicinity of the dam embankment consist of Moreno Formation and Panoche Formation. These materials can be processed and used for embankment construction. Due to the large embankment volume involved, a more detailed evaluation of materials is needed in subsequent phases.

Foundation Treatment Requirements Foundation treatment would involve removal of localized unsuitable materials, weathered zones, and possibly some of the organic shale of the Moreno Formation, depending on site conditions. Due to the large embankment height, there may be a need for other specialized foundation treatment.

Hydraulic Conditions

> ***Del Puerto Reservoir - Hydraulic Conditions Criteria***
>
> ***Conveyance Length*** *– 2.0 mi*
> ***Spillway*** *– Extensive*
> ***Flood Protection*** *– Not Significant*

The Del Puerto Canyon Reservoir would drain toward the east of San Luis Reservoir within the San Joaquin River Valley. This would require a conveyance pipeline 1.95 miles long to deliver water to the California Aqueduct. Because US Highway 5 is west of the California Aqueduct, the pipeline would have to be tunneled under the highway.

New auxiliary and service spillways would be required at this site. Increasing the storage capacity at this reservoir location has no significant flood control benefits. Constructing a new dam at this location will increase the overall risk to the inhabitants and property downstream should a dam break occur. Assessing the potential hazard at this location is not part of this current effort. A dam hazard classification would be conducted should this location be selected for full design.

Land Development and Social Impacts

> ***Del Puerto Reservoir - Land Development and Social Criteria***
>
> ***Inundated Roadway Miles*** *– 6.9 mi*
> ***Additional Inundation Area*** *–1,900 Ac*
> ***Affected Developed Areas*** *– Minor*
> ***Land Acquisition*** *– Minor*

Figure B-18 shows the estimated inundation area that the Del Puerto Canyon would create. Preliminary GIS analysis completed as a part of this reservoir screening effort also indicates approximately 6.9 miles of existing roadways would require relocation. The reservoir would inundate several houses and associated structures.

B.2.8 Quinto Creek Reservoir

Physical Conditions

> ***Quinto Reservoir - Physical Conditions Criteria***
>
> ***Embankment Efficiency*** *– 166 CY/AF*
> ***Storage Utilization*** *– 109 AF/Ac*
> ***Dam Raise*** *– 310 ft*

Figure B-20 depicts the Quinto Creek Canyon Reservoir Alternative, which would be constructed east of San Luis Reservoir. The Quinto Creek Canyon Reservoir would be subject to larger storage goals to meet user needs as well as existing uses, flood control, and dead storage as described in Appendix B of the IAIR. This is a largely undeveloped site, which would impound water within the Quinto Creek subwatershed. The crest of this dam would be at Elevation 655 feet and the crest length would be 12,100 feet. This alternative meets the desired goal of 271 TAF of storage capacity; however, at the expense of a very large dam. Table B-2 lists the east and north coordinates of the new crest at the intersections between the new dam axis and the abutments

This new 315-foot high dam would require earthwork of approximately 45.0 million cubic yards; This value does not include potential foundation overexcavation. Considerable overexcavation may be needed since the dam spans over a very wide alluvial basin. The estimated ratio of earthwork volume to reservoir capacity is 166 CY per every AF of storage gained. The amount of inundated land would be approximately 2,480 Ac, yielding a ratio of storage capacity to reservoir footprint of 109 AF per Ac.

Geotechnical and Geological Conditions

> ***Quinto Reservoir - Geotechnical and Geological Conditions Criteria***
>
> ***Liquefaction*** *– High*
> ***Distance to Faults*** *– >1.0 mi*
> ***Landslide Potential*** *– Very Low*
> ***Foundation Treatment*** *–Significant*
> ***On-site Material*** *– Substantial Hauling*

Geology Figure B-21 (Wagner and et. al. 1991) depicts the local geologic conditions near the proposed Quinto Creek Dam. The proposed dam abutments are underlain by Upper Cretaceous age sedimentary rocks along the west side of the San Joaquin Valley that strike northwest and dip moderately to steeply toward the northeast. Bedding dips are generally 50 to 65 degrees but locally some beds are overturned to the west.

The proposed reservoir is underlain by the same sedimentary rock type – Cretaceous age sedimentary rocks of the Panoche Formation described by Bishop (1970). The Panoche Formation includes a variety of rock types including shale, siltstone, claystone, sandstone, and conglomerate. Some of these lithologies represent turbidite (deep water mudflows) deposits and include sedimentary structures such as flute casts, load casts, and cross laminations. Local bedrock faults of unknown age, possibly related to movement of the Ortigalita Fault are within the proposed reservoir area.

The valley floor of the Quinto Creek Canyon is predominantly underlain by unconsolidated stream channel deposits ranging in size from clay to boulder. The thickness of the valley floor deposits along Quinto Creek is unknown.

Seismicity The site is subject to ground shaking caused by earthquakes. The geologic map (Figure B-21) does not show a fault crossing this potential reservoir site. The Ortigalita Fault is near the extreme western end of the proposed reservoir but would not underlie the reservoir.

The computer program EQFAULT lists the Great Valley 8 Fault as the closest fault at less than a mile away. Other close faults include the Ortigalita Fault at 2.9 miles and the Great Valley 9 Fault at 4.7 miles. The San Andreas Fault is 30.4 miles away. The maximum earthquake site acceleration is estimated to be 0.43g.

Liquefaction The dam site would be across a relatively wide alluvial valley (Figure B-21). Available published geologic information characterizes the basin as San Luis Ranch Alluvium, with some of the bordering areas consisting of Los Banos Alluvium. These deposits are locally susceptible to liquefaction depending on their in-place densities. The abutment areas would typically be comprised of Moreno or Panoche formations, which would not be susceptible to liquefaction.

Landsliding The geologic map (Figure B-21) does not depict the presence of any major landslides at the abutments, however, given the abutment lithology, and the potential out of slope bedding at the right abutment, it is likely that smaller landslides may be encountered. Site-specific investigations and review of historic aerial photographs may reveal further information. Based on available limited information, this site is considered to have low to very low landslide risk.

Material Availability Materials in the immediate vicinity of the dam embankment consist of alluvium, Moreno Formation, and Panoche Formation. These materials can be processed and used for embankment construction. A large embankment volume is involved. The dam is situated over a very wide alluvial basin and there may be limitations in the availability of hillside materials which are generally more competent. Mining of the nearby hillsides would require a more detailed evaluation of available materials, which should be done if this alternative is carried forward.

Foundation Treatment Requirements The depth of alluvium in the basin should be determined and the feasibility of removal down to bedrock should be verified. In general, removal of all alluvium is desirable for foundation stability and for liquefaction remediation. Depending on removal depths involved, this would further increase the volumes and decrease the efficiency of this site. The tabulated values for estimated embankment volumes do not include additional removal of alluvium, which may be required.

Hydraulic Conditions

The Quinto Creek Reservoir would drain toward the east of San Luis Reservoir within the San Joaquin River Valley. This would require construction of 2.82 miles of conveyance pipeline to deliver water to the California Aqueduct. New auxiliary and service spillways would be required at this site.

> ***Quinto Reservoir - Hydraulic Conditions Criteria***
>
> ***Conveyance Length*** *– 2.8 mi*
> ***Spillway*** *– Extensive*
> ***Flood Protection*** *– Not Significant*

Increasing the storage capacity at this reservoir location has no significant flood control benefits. However, constructing a new dam at this location will increase the overall risk to the inhabitants and property downstream should a dam break occur. Assessing the potential hazard at this location is not part of this current effort. A dam hazard classification would be conducted should this location be selected for full design.

Land Development and Social Impacts

Figure B-20 shows the estimated inundation area that the Quinto Creek Reservoir would create. Preliminary GIS analysis completed as a part of this reservoir screening effort also indicates approximately 5.6 miles of existing roadways would require relocation. The Quinto Creek Reservoir would inundate several houses and associated structures.

> ***Quinto Reservoir - Land Development and Social Criteria***
>
> ***Inundated Roadway Miles*** *– 5.6 mi*
> ***Additional Inundation Area*** *–2,480 Ac*
> ***Affected Developed Areas*** *– Minor*
> ***Land Acquisition*** *– Minor*

B.3 Screening Results

B.3.1 Screening Scores

The screening criteria described in Section B.1 were used to assign scores to each storage alternative based on the evaluations presented in Section 2. The individual and total scores for each storage alternative are provided in Table B-5. Note that all criteria were considered to have equal weight, and potential overriding issues were not given additional emphasis. Table B-6 highlights the high scoring sites in each of the four screening dimensions (physical, geotechnical, hydraulic, and impact). The overall high scoring site based on total scores is also indicated in Table B-5. The scores for each site and screening dimension have been calculated as percentages and are presented in Table B-5.

B.3.2 Screening Evaluation

Low Screening Criteria Ratings

Both the Anderson and Chesbro Reservoir Expansion storage alternatives have multiple low social and land development impact ratings. The large number of private residences potentially inundated by expanding these reservoirs, as well as the estimated surface streets that would be flooded, present a much larger potential social impact relative to the majority of storage alternatives considered in this screening effort. In addition, there is an increased risk of landslide hazards for other residences that would remain around the expanded reservoir. Based on these findings, the Anderson and Chesbro Reservoir alternatives have been eliminated from further consideration.

The San Benito Reservoir storage alternative was given a storage goal equal to the available capacity at this location. Its abutment as proposed would cross the Calaveras Fault, and the Paicines Fault would be very close to the reservoir. The presence of these faults creates a high risk for dam stability during an earthquake event and would require extensive engineering work to minimize the chance of failure. Because of the high level of engineering work and relatively small potential storage capacity of 60 TAF comparative to other reservoirs being considered, this alternative has been eliminated from further consideration as an alternative.

Del Puerto Canyon Reservoir would require a very large dam embankment to create storage volumes that meet the capacity goals outlined in the IAIR. The Quinto Creek Reservoir would also require a very large dam embankment to develop storage volumes that meet the capacity goals outlined in the IAIR, and would be located near a potentially active fault. Because of the low storage

Table B-5 - Screening Scores

Storage Alternative Site	Physical Condition Scores				Geotechnical/Geological Condition Scores					Hydraulic Condition Scores			Social/Land Development Impact Scores				Total Score
	Embankment Volume CY/ Storage Capacity AF	Storage Capacity AF/ Reservoir Area AC	Dam Raise FT	Meet Capacity Goal	Liquefaction Potential	Distance to Faults	Potential for Landslides	Foundation Treatment Required	On-Site Material Conditions	Conveyance Length MILES	Spillway Construction	Flood Protection Benefits	Inundated Roadways MILES	Additional Inundation Area	Developed Areas Impacted	Land Acquisition Issues	
Anderson	9	5	9	10	8	4	3	4	5	9	3	2	7	6	1	1	86
Chesbro	6	5	7	10	6	6	4	4	3	5	4	2	1	5	1	1	70
Pacheco A	7	7	5	10	5	7	1	4	7	9	4	8	10	5	9	7	**105**
Pacheco B	7	7	5	1	5	7	5	5	7	7	4	8	7	5	9	7	96
San Benito	10	2	7	5	5	1	2	1	3	1	6	8	6	6	7	8	78
Ingram	5	10	1	10	9	2	9	6	9	6	1	2	4	3	8	9	94
Del Puerto	1	10	1	10	9	2	8	6	7	7	1	2	4	3	8	9	88
Quinto Dam	3	7	4	10	3	2	9	3	3	5	1	2	5	1	8	9	75

Color Key:

- (yellow) Site(s) with high subtotal score in a criteria category (physical, geotechnical, hydraulic, land impact)
- (grey) Site with high total score in all criteria categories combined

Notes:

1. Higher scores are more favorable
2. See Table 2.1 for quantitative site parameters
2. See Table 1.1 for scoring criteria of qualitative and quantitative parameters

Same Scores as Percentages (100% = Perfect Score)

Storage Alternative Site	Subtotals				Total
	Physical	Geotechnical	Hydraulic	Impact	
Anderson	83%	48%	47%	38%	54%
Chesbro	70%	46%	37%	20%	43%
Pacheco A	73%	48%	70%	78%	**67%**
Pacheco B	50%	58%	63%	70%	60%
San Benito	60%	24%	50%	68%	50%
Ingram	65%	70%	30%	60%	56%
Del Puerto	55%	64%	33%	60%	53%
Quinto Dam	60%	40%	27%	58%	46%

efficiency of these sites relative to the other reservoir alternatives being considered, and in the case of the Quinto Creek Reservoir, its proximity to a potentially active fault, the Del Puerto Canyon Reservoir and Quinto Creek Reservoir alternatives have been eliminated from further consideration

Highest Scoring Alternatives

The Pacheco A Reservoir storage alternative received the highest total rating score for the selected screening criteria. Pacheco B received the second highest score and did not have any low criteria rating scores; however, it would not meet the total storage volume goal. Pacheco A would meet the goal, but has a single low rating score for landsliding. These alternatives (Pacheco A and Pacheco B) will be carried forward for consideration and refinement in the Plan Formulation Phase of the low point project as a single alternative concept.

B.3.3 Recommended Alternatives

Based on the screening scores and screening evaluation, three recommendation levels were established and assigned to each storage alternative, as follows:

1. Storage alternative should be eliminated from further consideration due to significant higher earthwork costs and/or greater impacts than other alternatives.

2. Storage alternative requires additional study to determine if the higher costs and/or greater impacts than other options might be lessened based on study results.

3. Storage alternative should be carried forward for additional evaluation.

Table B-6 lists the level of further consideration recommended for the storage alternatives along with a brief discussion of the justification for such recommendation. In summary, five of the original alternatives are recommended for elimination, one alternative is reserved for further study if the recommended alternative is found to be infeasible, and the Pacheco Reservoir Alternative concept is recommended for study in the Plan Formulation Phase of the San Luis Low Point Improvement Project Feasibility Study.

Table B-6. Recommended Storage Alternatives

Storage Alternative	Recommended Level	Discussion
Anderson Reservoir	1	Anderson Reservoir is surrounded by extensive potential landslide zones that with reservoir expansion would be subjected to annual wetting and drying cycles that could activate slides. These landslide zones include one slide area directly in line with the expanded dam embankment. The reservoir is also 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.
Chesbro Reservoir	1	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, potentially activate landslides near or under residences not inundated, and inundate app. 9.8 miles of existing roadway.
Pacheco A Reservoir	3	The Pacheco A site has a large landslide area mapped near the potential dam abutment that could require the relocation of the dam site upstream in between the proposed Pacheco A and Pacheco B sites to avoid the landslide areas. Further engineering analysis will be needed to identify the optimal dam site.
Pacheco B Reservoir	2	The Pacheco B site is unable to support the development of the needed 150 TAF to address the objectives of this project. The potential dam site in between Pacheco A and Pacheco B could avoid landslides in the area and provide the needed storage capacity to serve the project objectives. Pacheco B has superior geotechnical qualities over Pacheco A, however it does not meet the storage goal requirements.
San Benito Reservoir	1	The San Benito Reservoir abutment as proposed would cross the Calaveras Fault with an estimated maximum earthquake acceleration of 0.36g. The presence of this fault creates a high risk for dam stability during an earthquake event and would require extensive engineering work to minimize the chance of failure. This high level of engineering work and relatively small potential storage capacity of 60 TAF comparative to other reservoirs being considered resulted in its elimination from further consideration.
Ingram Canyon Reservoir	2	Ingram Canyon Reservoir would create the needed storage capacity to meet the storage objectives but would require a substantially larger amount of embankment volume to achieve that storage target. A reservoir at Ingram Canyon would require 27 million yd^3. Ingram Canyon Reservoir is being tentatively retained in consideration if the landslide issues on Pacheco Creek cannot be avoided.
Del Puerto Canyon Reservoir	1	Del Puerto Canyon Reservoir would require a 505 foot tall earth embankment requiring 68 million yd^3 to store 271 TAF. This is much larger than other dam options and does not meet the project's financial objective.
Quinto Creek Reservoir	1	Quinto Creek Reservoir would be located near a potentially active fault and would require a 310 foot tall earth embankment requiring 45 million yd^3 store 271 TAF. This is much larger than other dam options and does not meet the project's financial objective.

[a] Recommended Level:

1 = Eliminate from further consideration

2= Do not eliminate from consideration pending further analysis of reservoir options

3 = Carry forward for additional review

B.3.4 Next Steps

Based on the findings of this report, storage alternative evaluation in the Plan Formulation Phase should consider the Pacheco Reservoir Alternative concept for further investigation regarding its feasibility as a project alternative. A site visit to the potential location of the dam will need to be performed to visually inspect landslides and other potential issues. Hydraulic modeling will need to be conducted for the proposed dam operations, and geometry that is more detailed will be developed. A conceptual cost estimate of the alternatives selected at this stage will be completed for the site deemed technically and institutionally feasible.

It is recommended that the Pacheco A and B alternatives be investigated as one alternative in order to identify the site that will provide the greatest benefit. If the landslide concerns can be remediated effectively, the Pacheco A site would be well suited relative to the screening criteria. If Pacheco A's landslide concerns are significant after site visits, the Pacheco B alternative would provide similar project benefits with only a slightly smaller capacity. The storage goal for Pacheco B should be reviewed and a better definition of the embankment location and resulting reservoir capacity determined.

It is highly probable that a suitable location on Pacheco Creek would be to move upstream of the Pacheco A site until landslide conditions are more favorable and to move downstream of the Pacheco B site until capacity requirements are met. A desirable dam location can be found within this range, somewhere between the current Pacheco A and Pacheco B sites. Within this reach, detailed geotechnical evaluations can be performed and cost impacts of remediation of different locations can be compared, in order to establish the most suitable location.

Given the geological and geotechnical concerns of the region, it is not expected that a location would be entirely free of landslide concerns. Even with a worst-case scenario requiring a major landslide remediation, the Pacheco A site is considered feasible. If a location can be identified which requires potentially less landslide remediation volume, then that Pacheco alternative would be considered even more feasible than the current Pacheco A site.

Rather than proceeding with further study of the Ingram Canyon Reservoir, which requires a very tall dam, it is recommended that the study be put on hold until a more in-depth study of the Pacheco Reservoir Alternative concept is conducted. If that feasibility is exhausted, then the studies can move on to evaluating the Ingram Canyon alternative.

Detailed studies to address the landslide issues for the Pacheco Reservoir Alternative concept may be phased in progressively increasing steps. These should include: review of aerial photos, site reconnaissance, bucket auger boreholes with downhole logging for landslide evaluations, ground movement monitoring, landslide remediation alternative studies, and other activities, as appropriate and as needed.

B.4 References

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B.5 Figures

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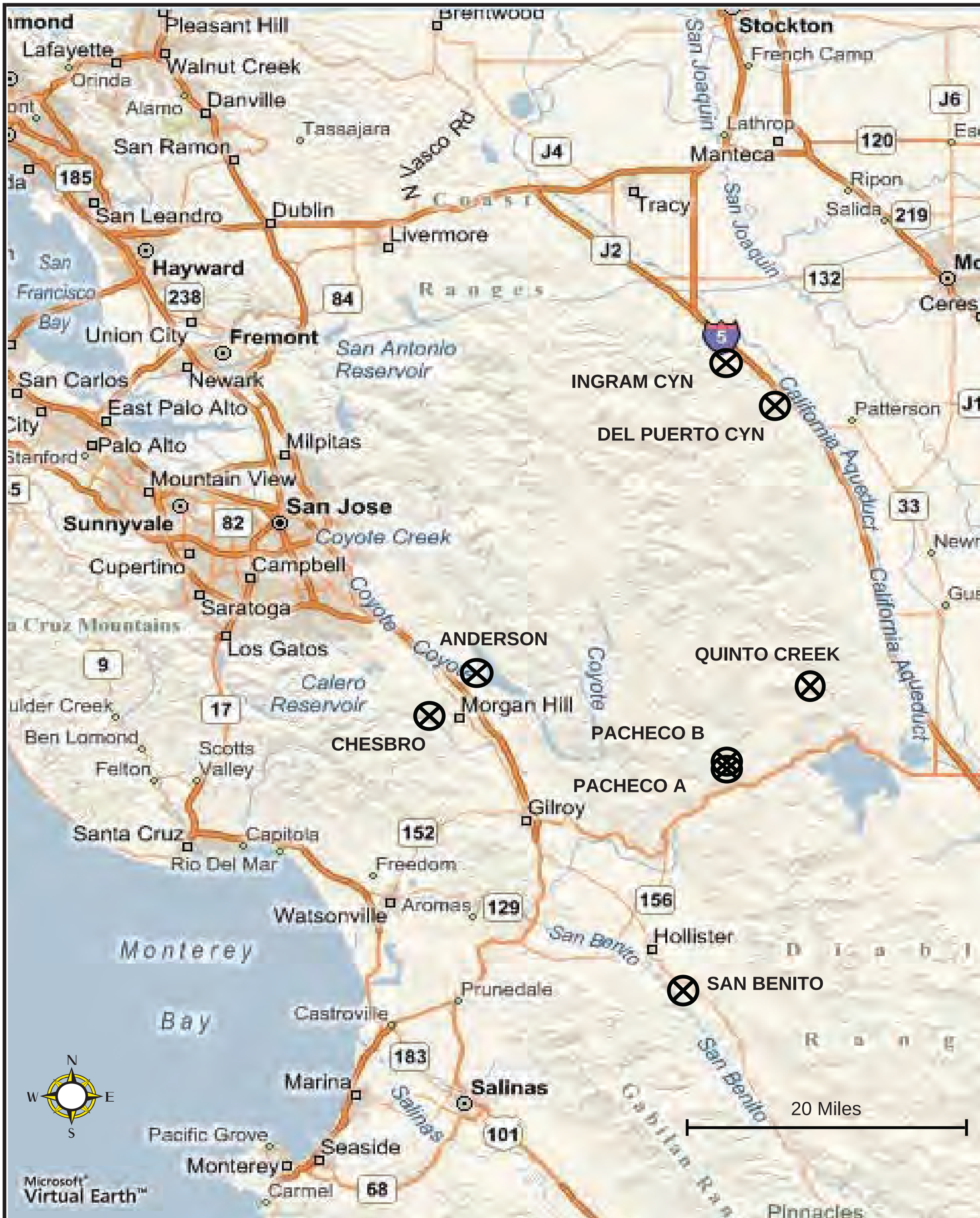
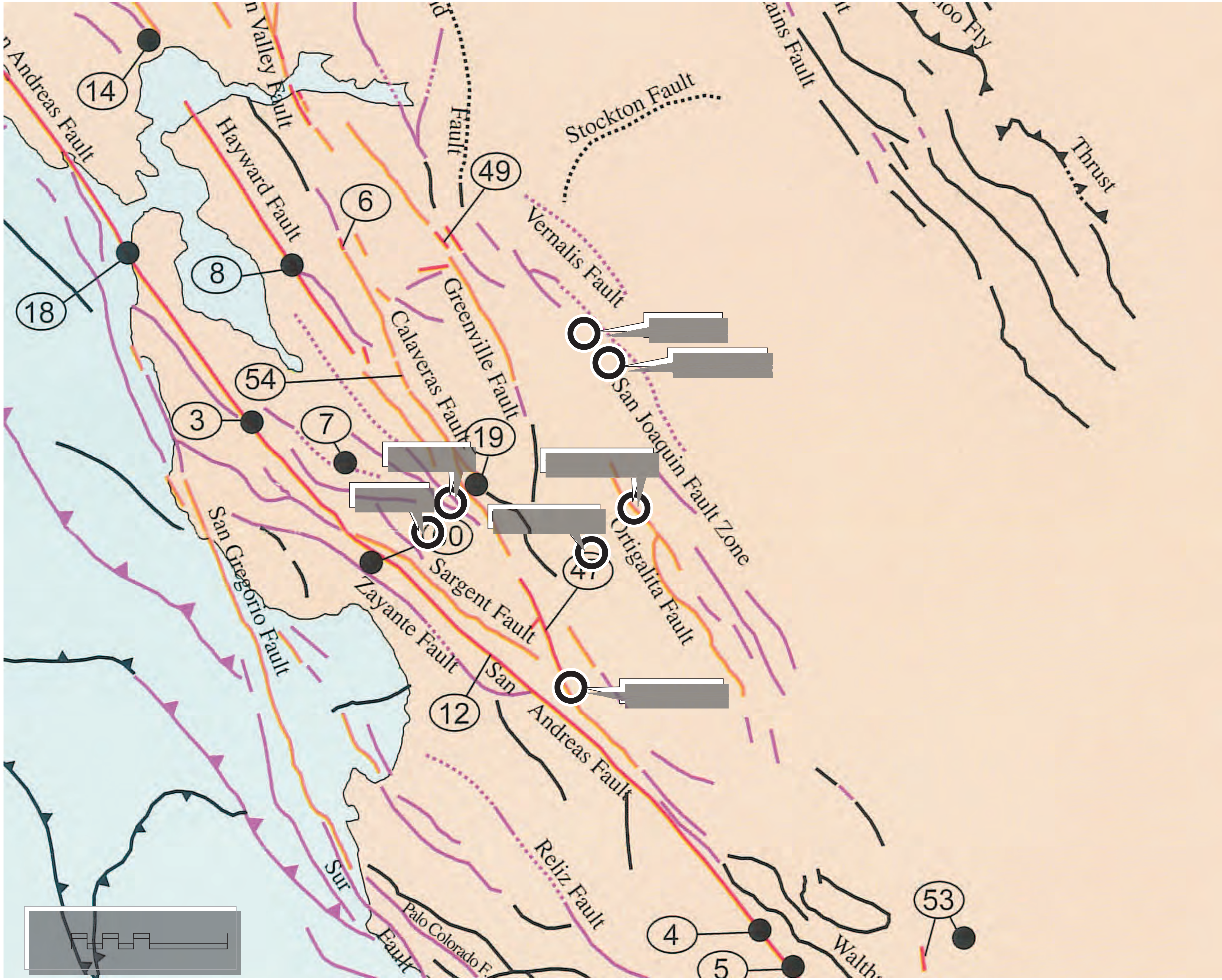


Figure B-1
Reservoir Locations



LEGEND (abbreviated)

Approximate Reservoir Site Locations

Selected Epicenters

Geologic Time		Fault Symbol	Years Before Present	Recency of Movement	Description
Quaternary	Historic				Historic ground ruptures, including creep.
	Holocene				Holocene displacement.
	Pleistocene				Pleistocene faults. Many faults in Sierra Nevada shown as pre-Quaternary may be late Cenozoic.
Pre-Quaternary			4.5 billion		Faults without recognized Quaternary displacement. Not necessarily without future activity potential.

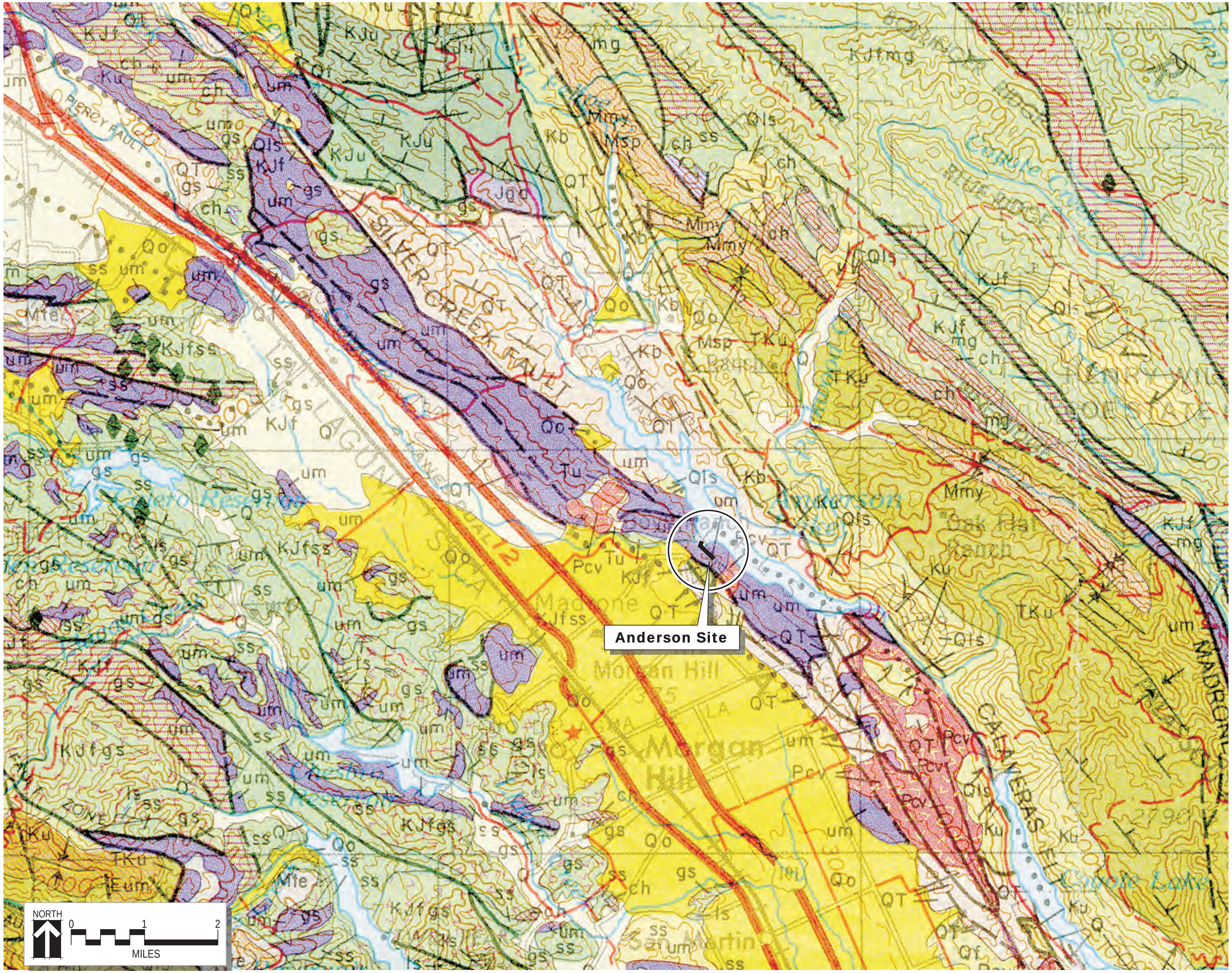
Map No.	Earthquake Date and Fault Location	Mag.	Surface Rupture
3	1838, San Andreas	~7.4	36± mi
4	1853, San Andreas (Lonoak)	~6.0*	
5	1857, San Andreas (Fort Tejon)	7.9	200± mi
6	1861, Calaveras (Dublin)	5.8	8± mi
7	1865, (Santa Cruz Mountains)	6.5*	
8	1868, Hayward	7.0	30± mi
12	1890, San Andreas (San Juan Bautista)	6.3	5± mi
14	1898, Rogers Creek? (Mare Island)	6.4*	
18	1906, San Andreas	7.8	270 mi
19	1911, CAlaveras (Morgan Hill)	6.4*	
47	1979, Calaveras (Coyote Lake)	5.7	23.4 mi?
49	1980, Greenville	5.83	.9 mi
53	1983, Nunez (Coalinga)	6.42	mi
54	1984, Calaveras (Morgan Hill)	6.20	.72 mi?
60	1989, San Andreas (Loma Prieta)	6.90	.6 mi

* Surface rupture either not observed or not recorded

Reference: Simplified Fault Activity Map of California, California Department of Conservation
By: Charles W. Jennings and George J. Saucedo, 1999, Revised by Tousson Toppozada and David Branum, 2002

Figure B-2
Regional Faults

Figure B-3
Anderson Site Location and Inundation Map



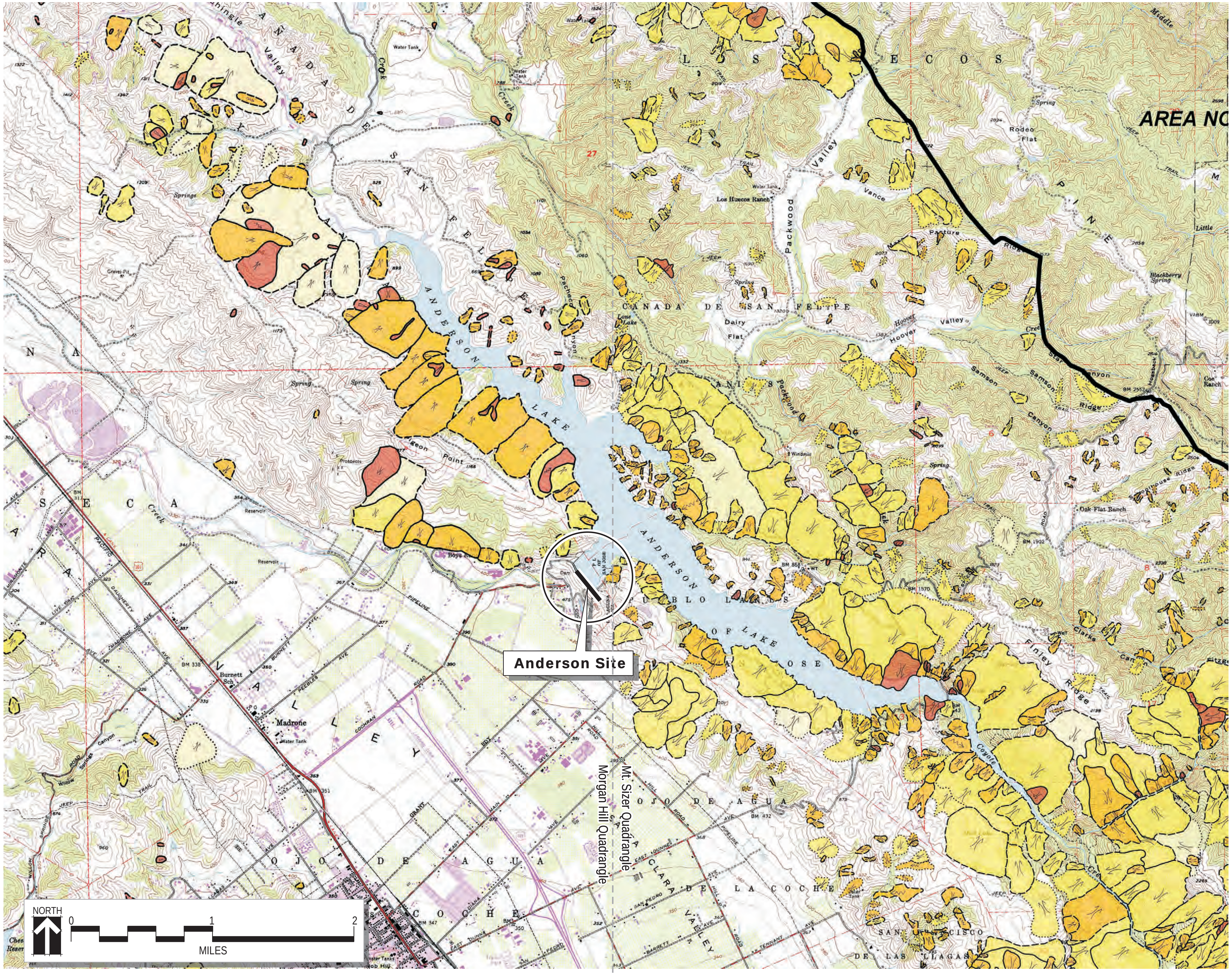
LEGEND

Q	Alluvium
af	Artificial fill
Qi	Intertidal deposits
Qdp	Dos Palos Alluvium
Qf	Alluvial fan deposits
Qls	Landslide deposits
Qt	Terrace deposits
Qsl	San Luis Ranch Alluvium
Qc	Continental and marine deposits
Qmr	Modesto-Riverbank Formations Undivided
Qo	Older Alluvium
Pcv	Basaltic rocks
Plt	Lawlor Tuff
Tu	Undivided Tertiary marine sedimentary rocks
Kl	Lower Cretaceous marine sandstone and shale
KJu	Upper Jurassic-Lower Cretaceous marine sandstone and shale
KJf	Franciscan Complex
gs	greenstone
ss	sandstone, shale, conglomerate
mg	metagraywacke
ls	limestone
ch	chert
um	serpantinized ultramfic rock
◆	blueschist blocks

Contact	Observed or dashed where approximately located; queried where gradational or inferred
Fault	Solid where well located, dashed where approximately located or inferred, queried where continuation or existence is uncertain; except for the offshore area, faults are dotted where concealed by younger rocks or water. Arrows show relative or apparent direction of movement. U, upthrown side and D, downthrown side, relative or apparent.
Thrust Fault-Barbs on the Upper Plate	Generally dips less than 45°, but locally may have been subsequently steepened. Dashed where approximately located or inferred; dotted where concealed by younger rocks or water; queried where continuation or existence is uncertain.
Overturned Fold	Dashed where inferred; dotted where concealed by younger rocks.
Strike and Dip of Beds	General strike and dip of stratified rocks.
Strike and Dip of Overturned Beds	
Strike and Dip of Foliation	General strike and dip of foliation in metamorphic rocks.
Anticlinal Fold	Dashed where inferred; dotted where concealed by younger rocks or water.
Synclinal Fold	Dashed where inferred; dotted where concealed by younger rocks or water.

Reference: Geologic map of the San Francisco-San Jose Quadrangle, California, 1:250,000
Compilation by D.L. Wagner, E.J. Botugno, and R.D. McJunkin, Published 1991, CDMG Regional Geologic Map Series

Figure B-4
Anderson Geologic Map



LEGEND (abbreviated)

Active or Historic:	The landslide appears to be currently moving (at the time the aerial photograph was taken or field observation occurred) or to have moved within historic time	
Dormant - Young:	The observed landforms related to the landslide are fresh or uneroded, but there is no evidence of historic movement	
Dormant - Mature:	The observed landforms related to the landslide have been smoothed and subdued by erosion and vegetation	
Dormant - Old:	The observed landforms related to the landslide have been greatly eroded, including significant gullies or canyons cut into the landslide mass and/or main scarp by small streams	

Rock Slide
Rock Fall
Soil Slide
Earth Flow
Debris Flow

CDM

Reference: Landslide Inventory Maps of the Morgan Hill and Mt. Sizer Quadrangles, Santa Clara County, California, By Mark O. Wiegers and Marc Delarettre, California Geological Survey, December 2006

Figure B-5
Anderson Landslide Hazards

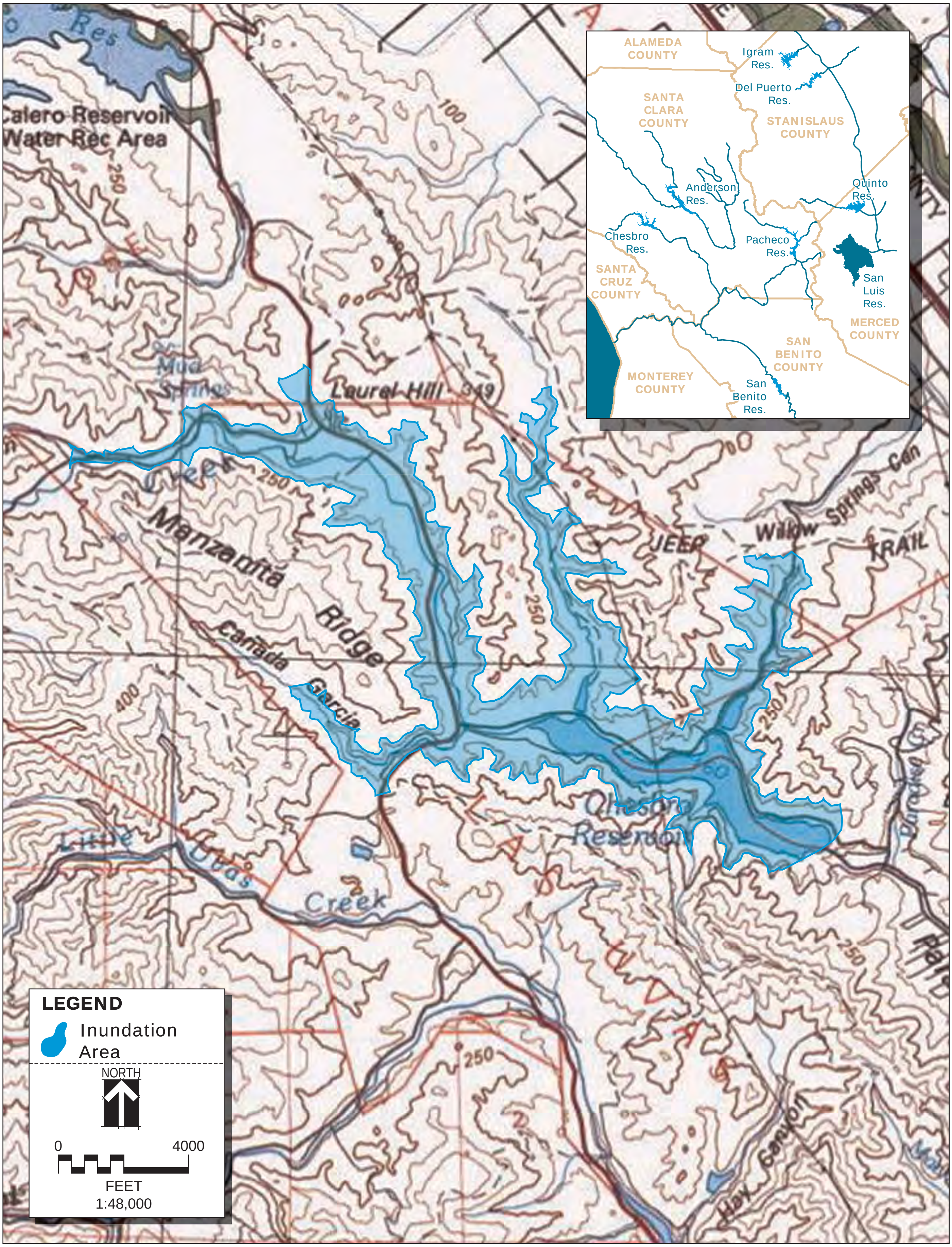
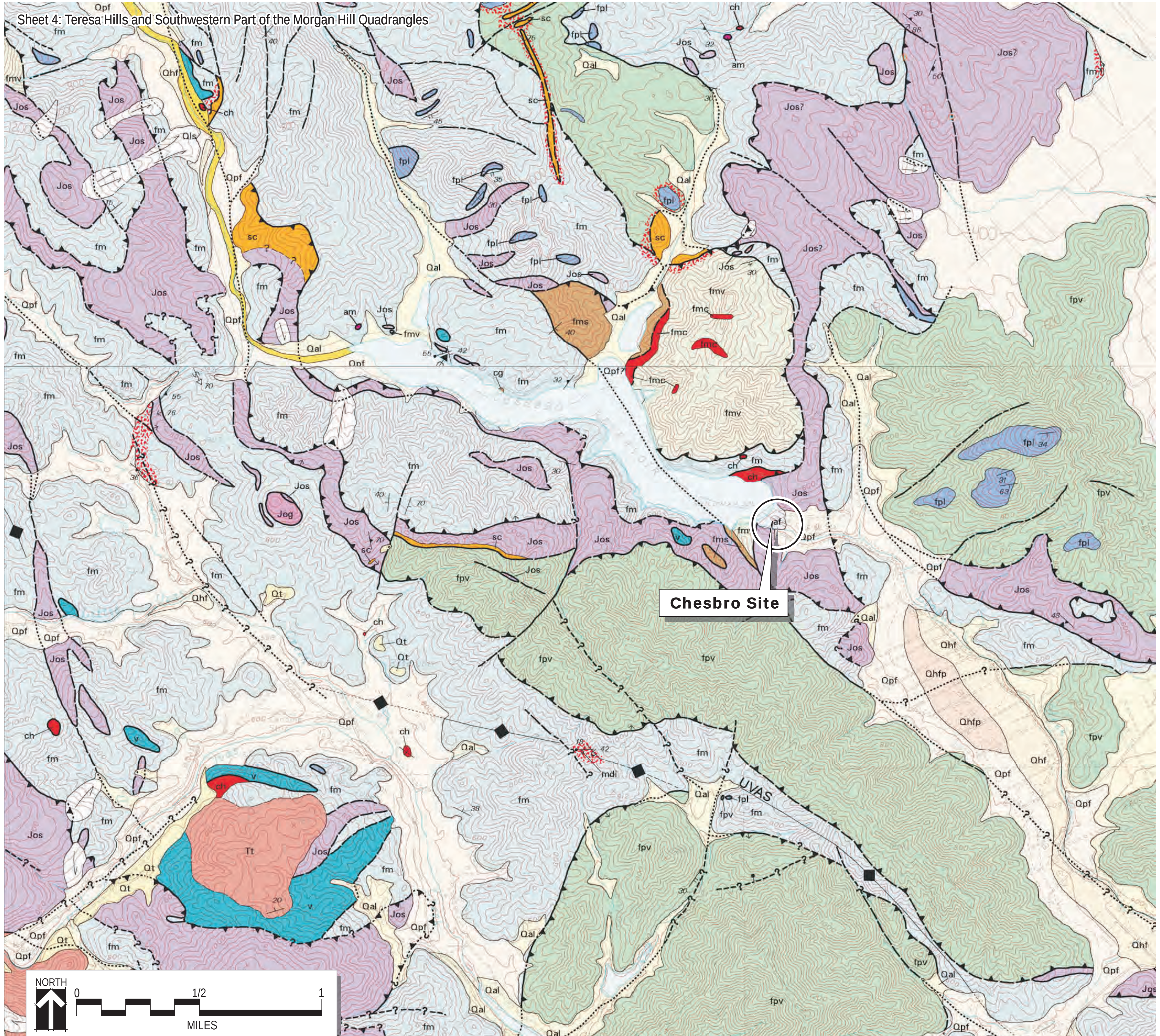


Figure B-6
Chesbro Site Location and Inundation Map



LEGEND (abbreviated)

Qal	Alluvium
Qhfp	Floodplain deposits (Holocene)
Qpf	Alluvial fan deposits (Pleistocene)
Jos	Serpentanized ultramafic rocks (Jurassic)
fm	Melange of the Central belt (Upper Cretaceous) Includes: Blueschist blocks, Amphibolite blocks, Chert blocks, Basaltic volcanic rock blocks, conglomerate block, metadiorite block
ch	Chert blocks
v	Basaltic volcanic rock blocks
fpl	Foraminiferal limestone (Upper and Lower Cretaceous)
fpv	Volcanic rocks (Lower Cretaceous)
fms	Sandstone (Upper and/or Lower Cretaceous)
fmc	Radiolarian chert (Lower Cretaceous and Jurassic)
fmv	Basaltic volcanic rocks (Lower Jurassic)

Contact	Dashed where approximate, dotted where concealed, queried where uncertain
Fault (U / D)	Dashed where approximate, dotted where concealed, queried where uncertain. U and D denote upthrown and downthrown blocks. Arrows with (without) numbers denote fault dip (or dip direction). Bar and ball locally denote downthrown block. Horizontal arrows denote relative movement. Double barb denotes vertical fault.
Thrust Fault-Barbs on the Upper Plate	Generally dips less than 45º, but locally may have been subsequently steepened. Dashed where approximately located or inferred, dotted where concealed by younger rocks or water, queried where continuation or existence is uncertain.

Reference: Geologic Maps and Structure Sections of the Southwestern Santa Clara Valley and Southern Santa Cruz Mountains, Santa Clara and Santa Cruz Counties, California, Compilation by R.J. McLaughlin, E.E. Brabb, E.J. Helley, and C.J. Colón, 2001

Figure B-7

Chesbro Geologic Map

Figure B-8
Pacheco A Site Location and Inundation Map

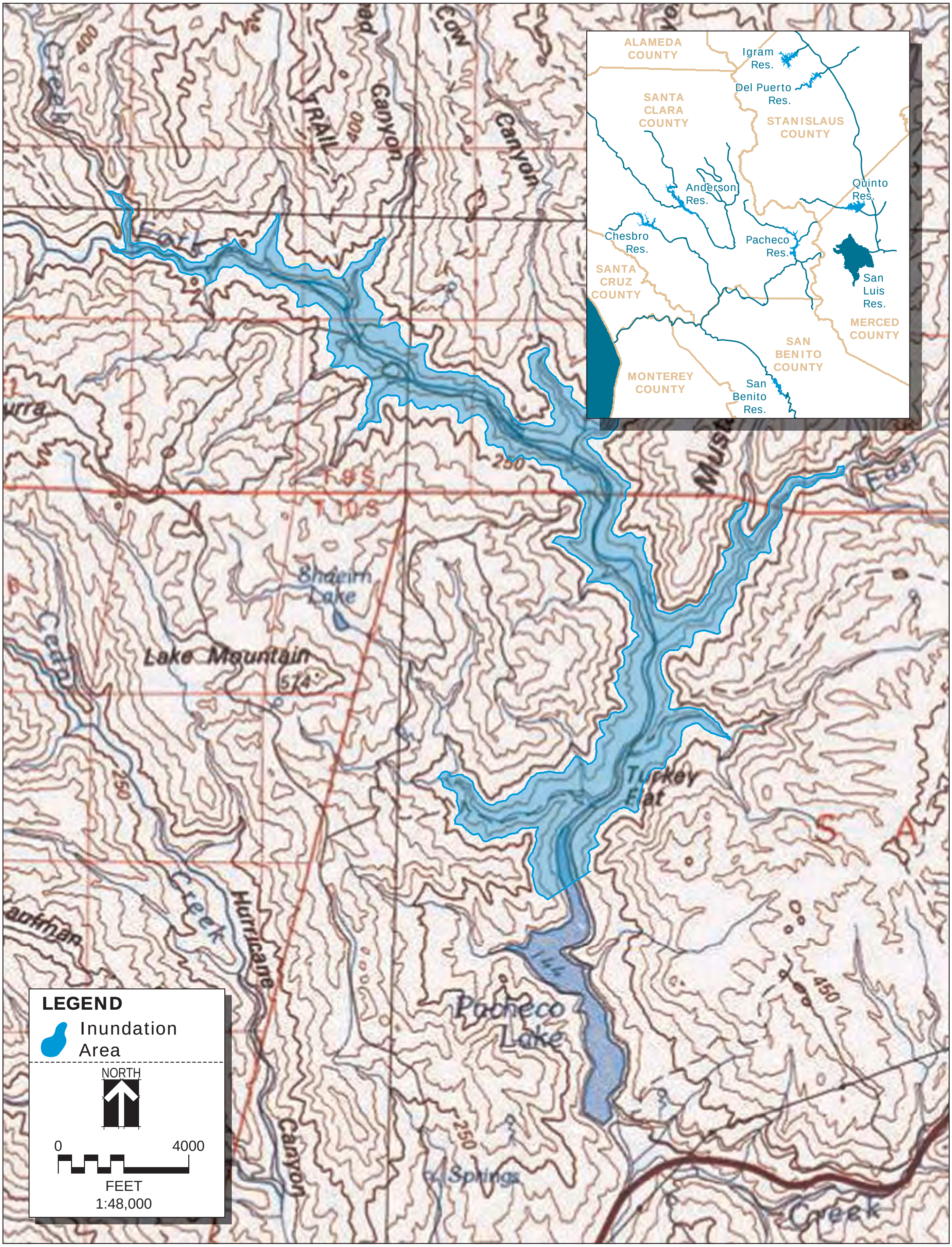
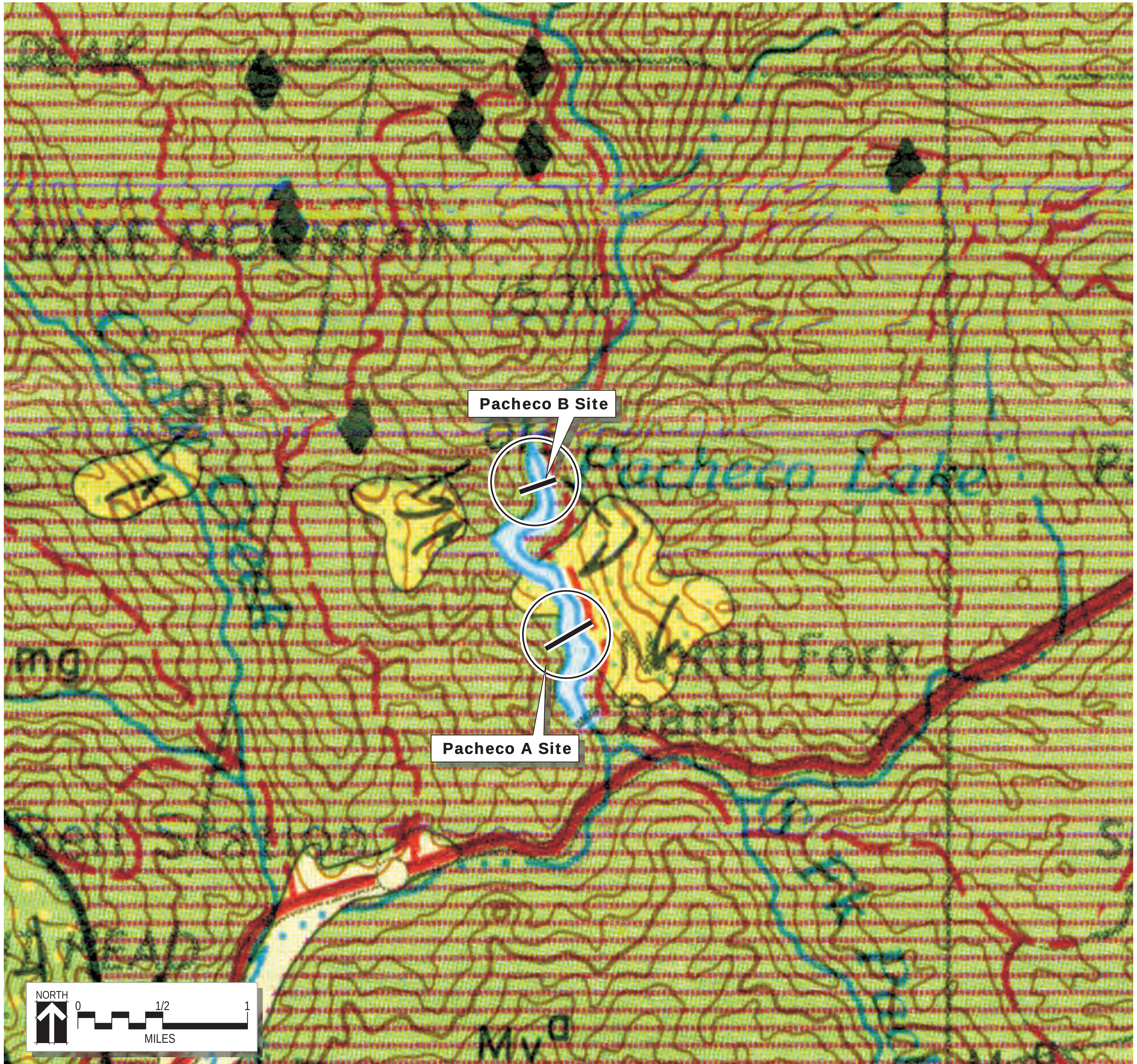


Figure B-9
Pacheco B Site Location and Inundation Map



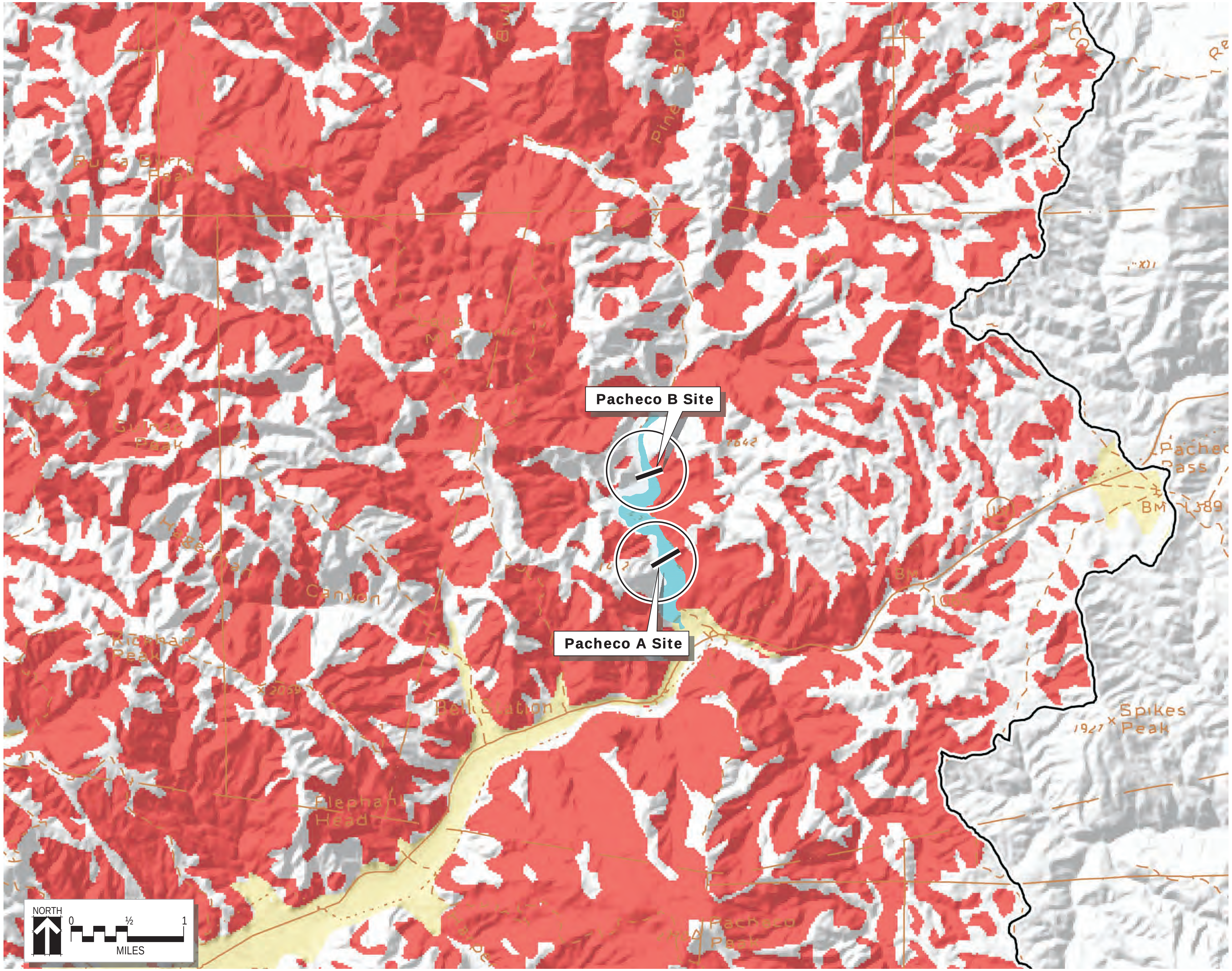
LEGEND (abbreviated)

- Qls Landslide deposits
- Mv Miocene volcanic rocks
- KJf Franciscan Complex*
  - gs greenstone
  - ss sandstone, shale, conglomerate
  - mg metagraywacke
  - ls limestone
  - ch chert
  - um serpantinized ultramfic rock
- blueschist blocks

* horizontal line pattern denotes melange terrane

Reference: Geologic map of the San Francisco-San Jose Quadrangle, California, 1:250,000
Compilation by D.L. Wagner, E.J. Botugno, and R.D. McJunkin, Published 1991, CDMG Regional Geologic Map Series

Figure B-10
Pacheco A and B Geologic Map



LEGEND (abbreviated)

Mostly Landslide:	Consists of mapped landslides, intervening areas typically narrower than 1500 feet, and narrow borders around landslides, defined by drawing envelopes around groups of mapped landslides
Few Landslides:	Contains few, if any, large mapped landslides, but locally contains scattered small landslides and questionably identified larger landslides, defined in most of the region by excluding groups of mapped landslides but defined directly in areas containing the "many Landslides" unit by drawing envelopes around areas free of mapped landslides
Flat Land:	Areas of gentle slope at low elevation that have little or no potential for the formation of slumps, trnaslational slides, or earth flows except along stream banks and terrace margins, defined by the distribution of surficial deposits (Wentworth, 1997)

Reference: Summary Distribution of Slides and Earth Flows in Santa Clara County, California
By: Carl M. Wentworth, Scott E. Graham, Richard J. Pike, Gregg S. Beukelman, David W. Ramsey, and Andrew D. Barron, 1997

Figure B-11
Pacheco A and B Landslide Hazards

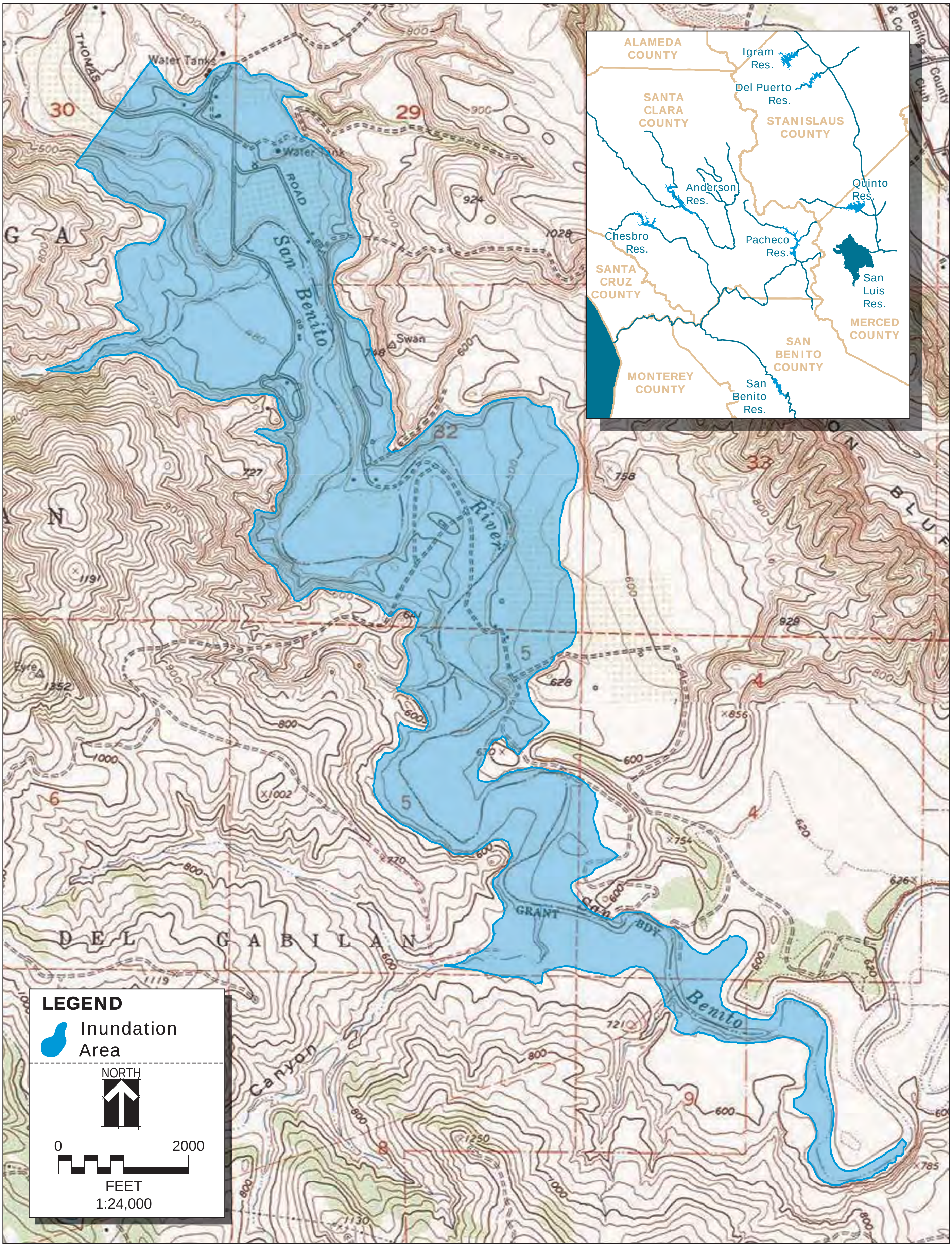
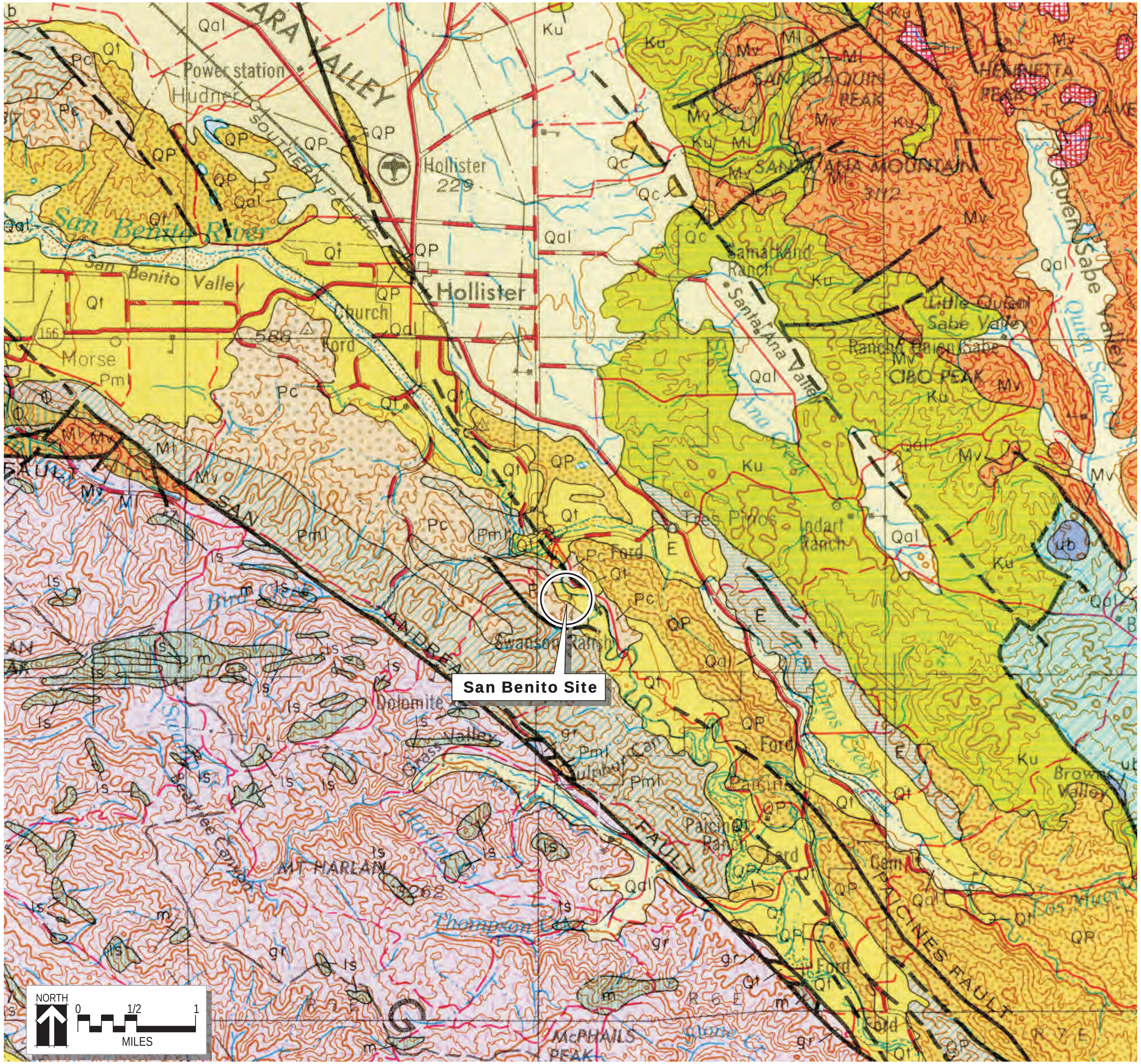


Figure B-12

San Benito Site Location and Inundation Map

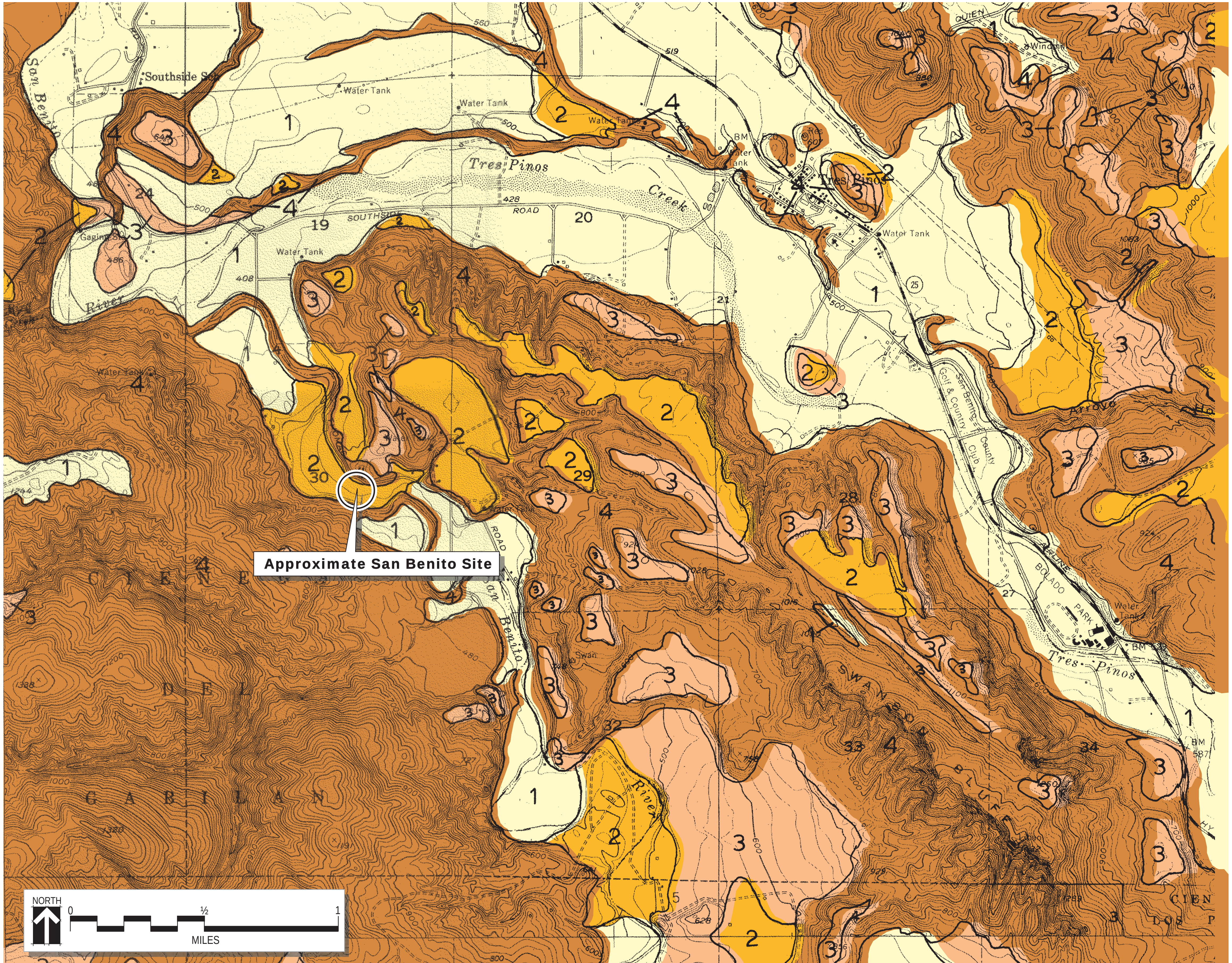


LEGEND (abbreviated)

Qal	Alluvium
Qt	Quarternary nonmarine terrace deposits
QP	Plio-Pleistocene nonmarine
Pc	Undivided Pliocene nonmarine
Pml	Middle and/or lower Pliocene marine
Ku	Upper Cretaceous marine

Reference: Geologic map of California, Santa Cruz Sheet, 1:250,000
Compilation by Charles W. Jennings and Rudolph G. Strand, 1958, Printed 1992

Figure B-13
San Benito Geologic Map



LEGEND (abbreviated)

Area 1 — Least Susceptible Area: Landslides and other features related to slope instability are very rare to nonexistent within the area. Included in this area are topographically low-lying valley bottoms and alluviated floodplains. Part of the area may be underlain by material that lacks the strength to support steep slopes (such as unconsolidated alluvium) but occupies a relatively stable position due to the flatness of the slope (lacks potential energy). Land within area 1 will probably remain relatively stable unless the topography is radically modified.

Area 2 — Marginally Susceptible Area: This area includes gentle to moderate slopes underlain by relatively competent material or colluvium that is considered unlikely to remobilize under natural conditions. Also includes redgetops and spur crests that are underlain by relatively competent material but flanked by steep, potentially unstable slopes. The stability of slopes within Area 2 may change radically in response to modification of adjacent terrain.

Area 3 — Generally Susceptible Area: Slopes within this area are at or near their stability limits due to a combination of weaker materials and steeper slopes. Although most slopes within area 3 do not currently contain landslide deposits, the materials that underlie them can be expected to fail, locally, when modified because they are close to their stability limits.

Area 4 — Most Susceptible Area: This area is characterized by steep slopes and includes most landslides in upslope areas, whether apparently active at present or not, and slopes upon which there is substantial evidence of downslope creep of surface materials. Slopes within area 4 should be considered naturally unstable, subject to failure even in the absence of the activities of man.

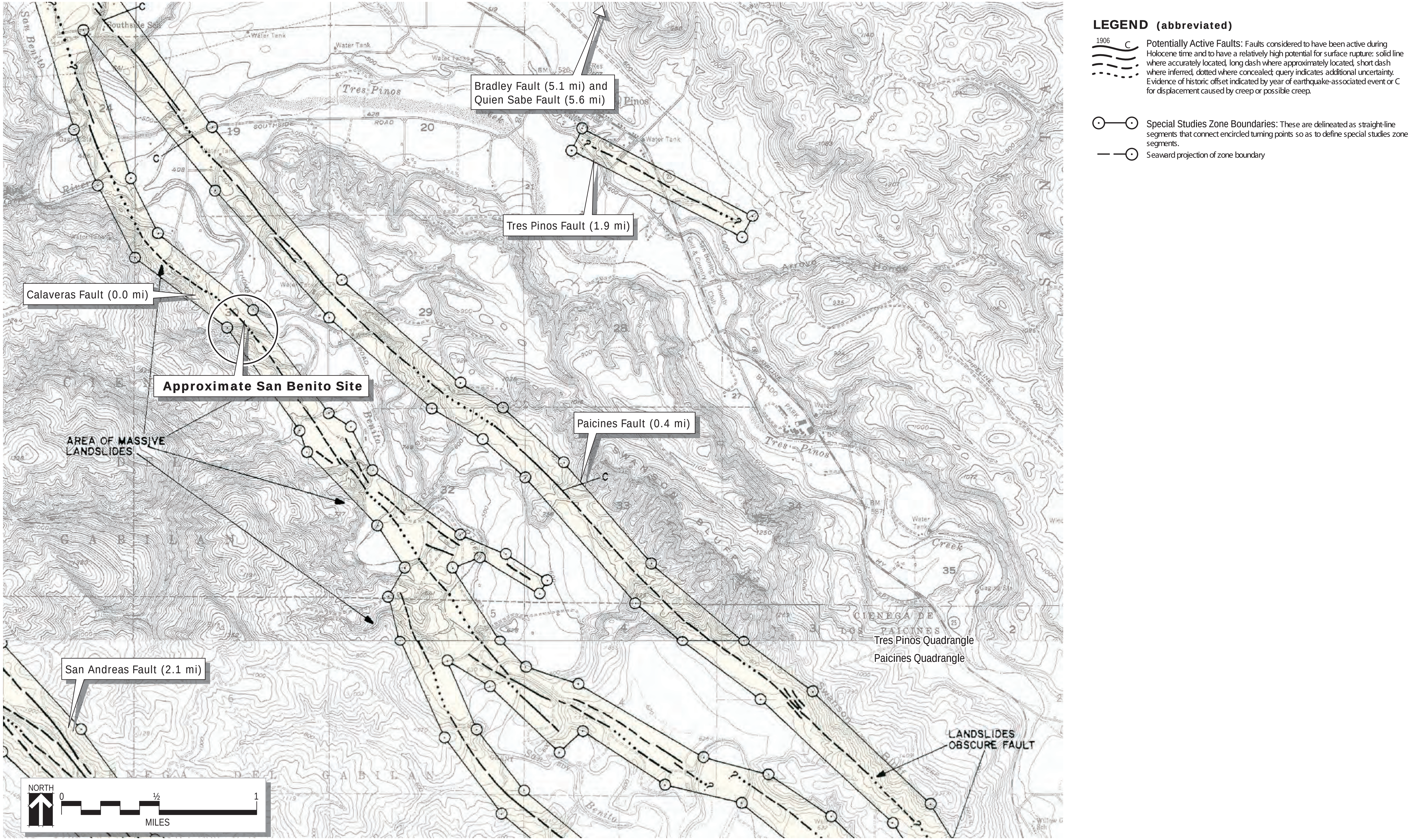
NOTES

General: This Relative Landslide Susceptibility Map has been prepared to aid in general land-use planning. It is not intended, nor suitable, for evaluation of individual sites. Such evaluations often require engineering geologic studies and soils engineering investigations of the underlying soil and bedrock for proper planning of specific construction projects.

1. The boundaries of the areas were determined by combining observations shown on the accompanying maps Plate B and Plate C (objective data), with judgements and interpretations (subjective data) drawn from the experience of the author with the field araea at the time the map was made.
2. It is possible that modifications to the landscape by the activities of man may significantly alter the relative stability of slopes in specific areas. Thus, the relative landslide susceptibility of these areas may change in the future.
3. This map is based on judgements that are interpretive and apply generally to large areas. Therefore, within each area conditions my range, locally, through all levels of susceptibility. Hence, small, unmapped landslides may exist, locally, within area 1 and there may be, locally, relatively stable sites within area 4.
4. The delineation of the various areas of susceptibility is limited by the scale of the map..

Reference: Relative Landslide Susceptibility Map, Landslide Hazards in the Tres Pinos and Paicines Area, San Benito County, California, Map No. 31
By: Hasmukhrai H. Majmundar, Geologist, 1994

Figure B-14
San Benito Landslide Hazards



Reference: State of California, Special Studies Zones, Tres Pinos and Paicines Quadrangles
Delinieated in compliance with Chapter 7.5, Division 2 of the California Public Resources Code, July 1986

Figure B-15
San Benito Fault Hazards

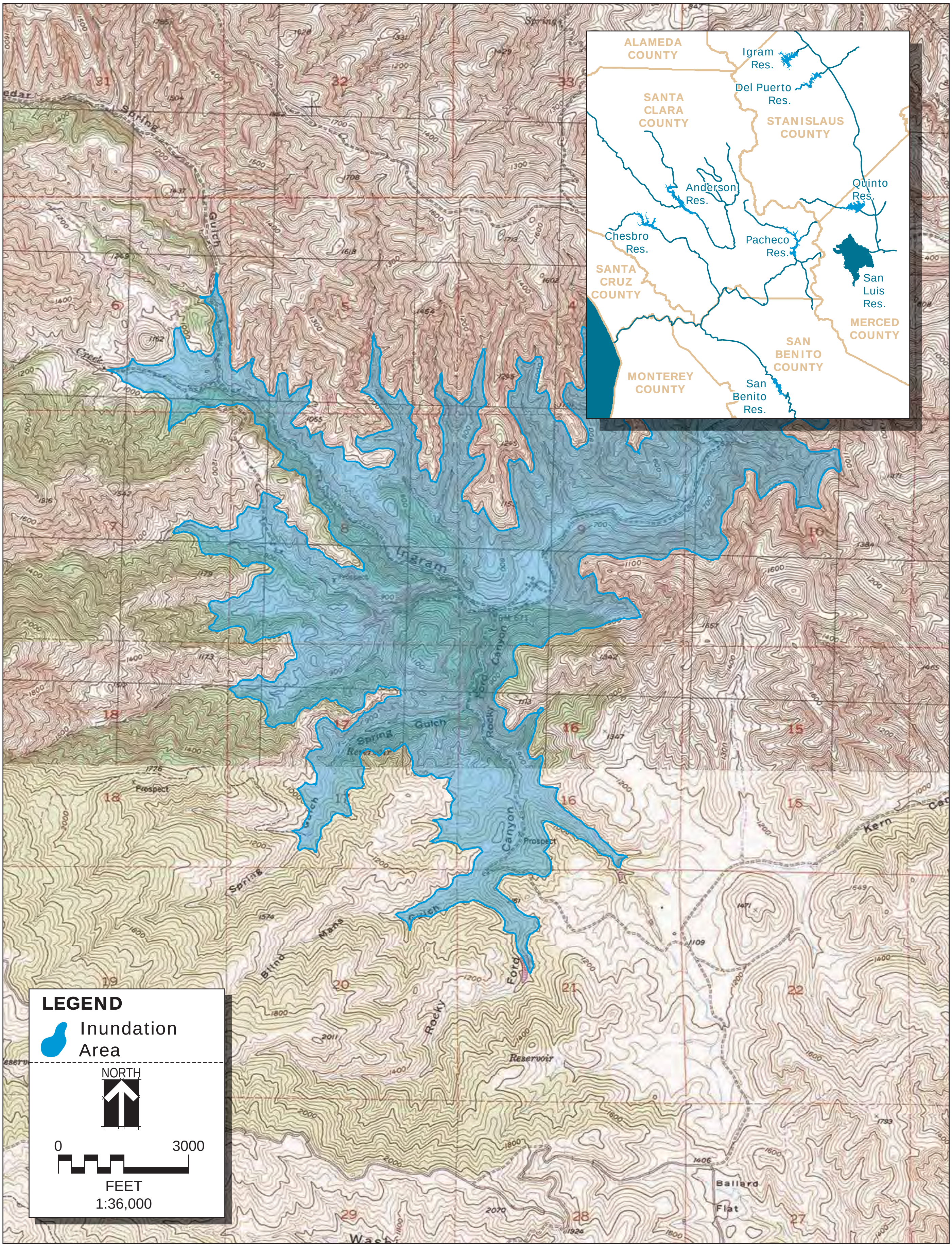
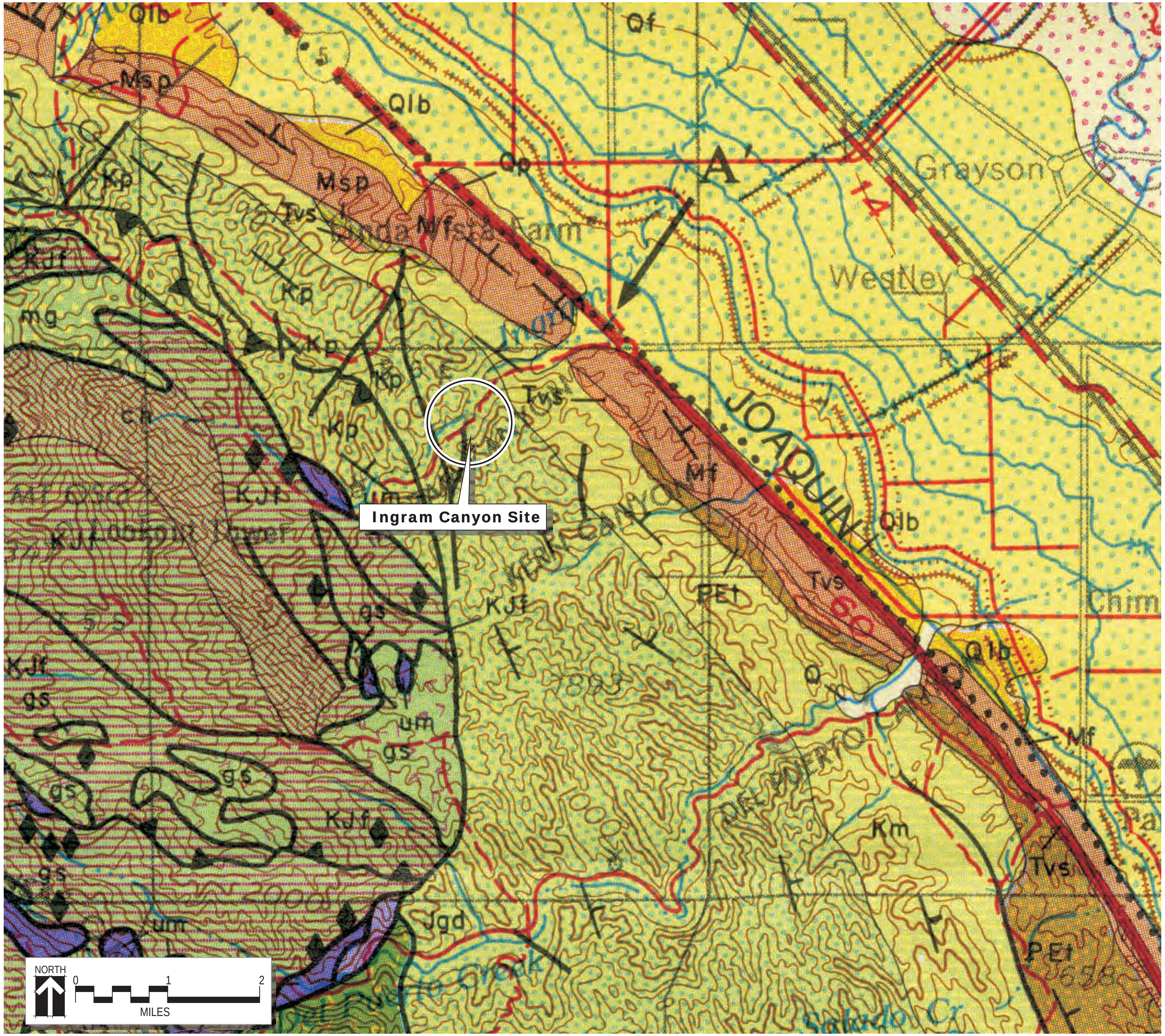


Figure B-16
Ingram Canyon Site Location and Inundation Map



LEGEND (abbreviated)

- Qls Landslide deposits
- Mf Fanglomerate
- Tvs Valley Springs Formation
- Km Moreno Formation
- Kp Panoche Formation
- PEt Tesla Formation

- KJf Franciscan Complex*
  - gs greenstone
  - ss sandstone, shale, conglomerate
  - mg metagraywacke
  - ls limestone
  - ch chert
  - um serpantinized ultramfic rock
- blueschist blocks

* horizontal line pattern denotes melange terrane

Reference: Geologic map of the San Francisco-San Jose Quadrangle, California, 1:250,000
Compilation by D.L. Wagner, E.J. Botugno, and R.D. McJunkin, Published 1991, CDMG Regional Geologic Map Series

Figure B-17
Ingram Canyon Geologic Map

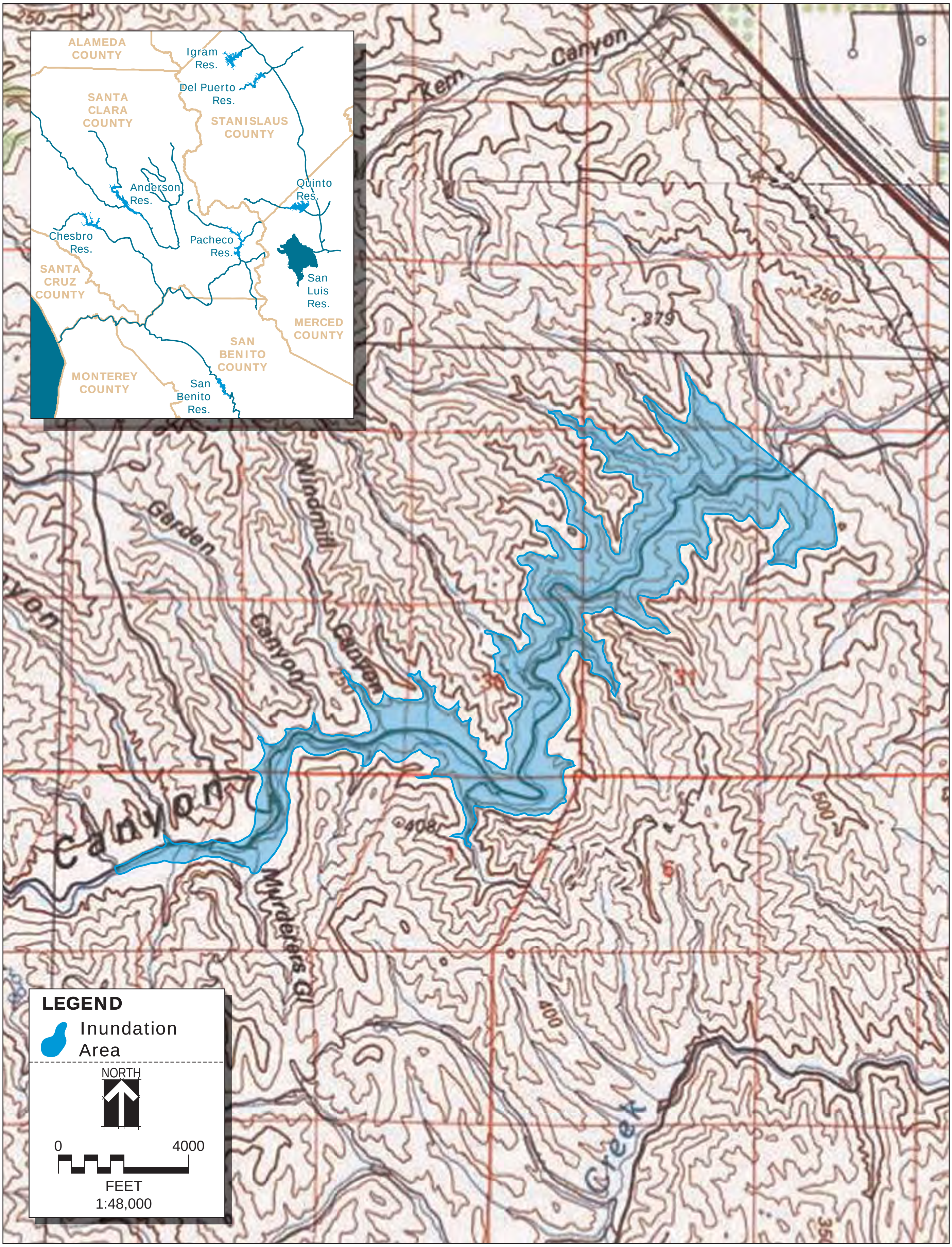
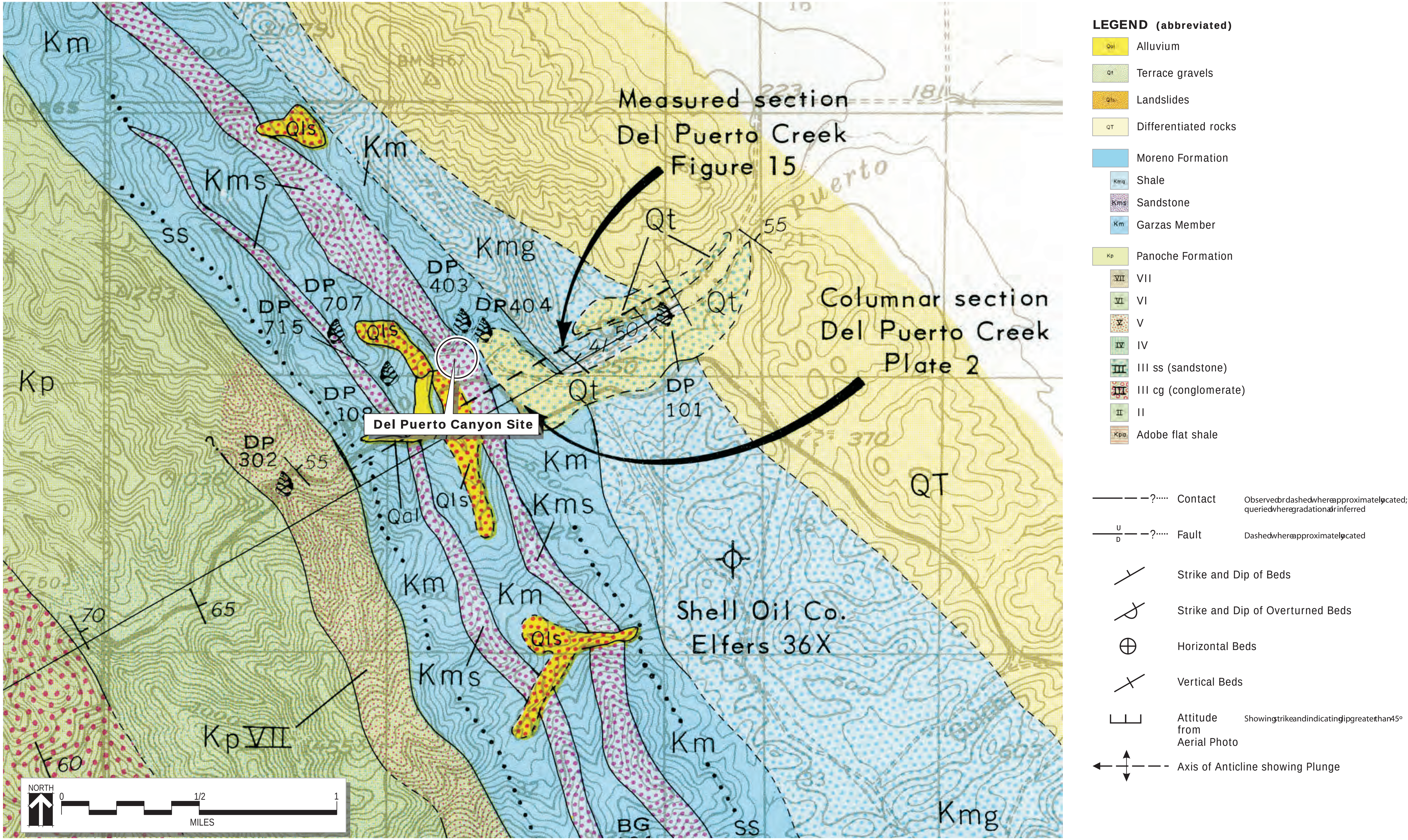


Figure B-18
Del Puerto Canyon Site Location and Inundation Map



Reference: Geologic map of the Upper Cretaceous on the West Side of the Northern San Joaquin Valley, Stanislaus and San Joaquin Counties, California, 1:62,500, Compilation by Charles C.Bishop, 1970

Figure B-19
Del Puerto Canyon Geologic Map

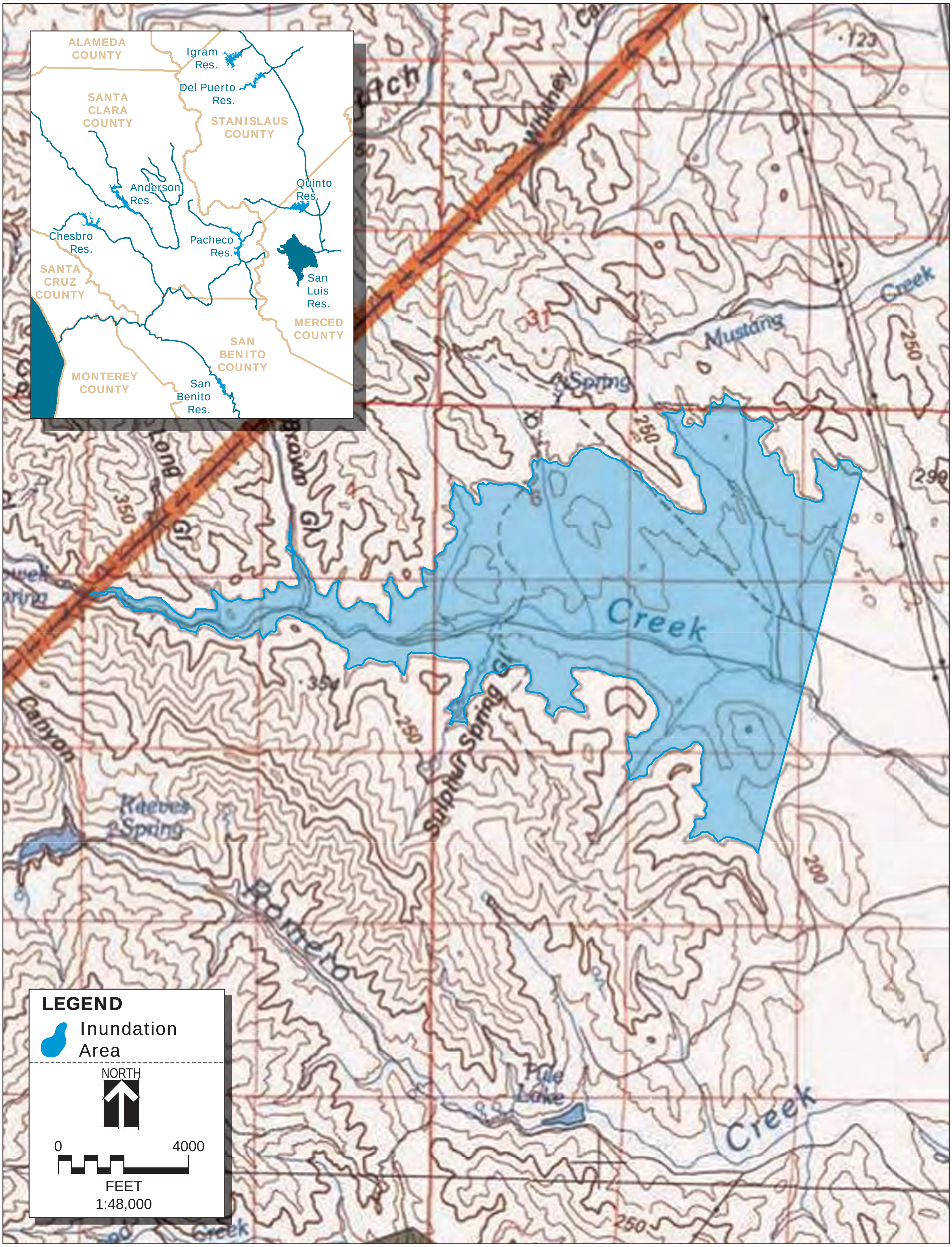
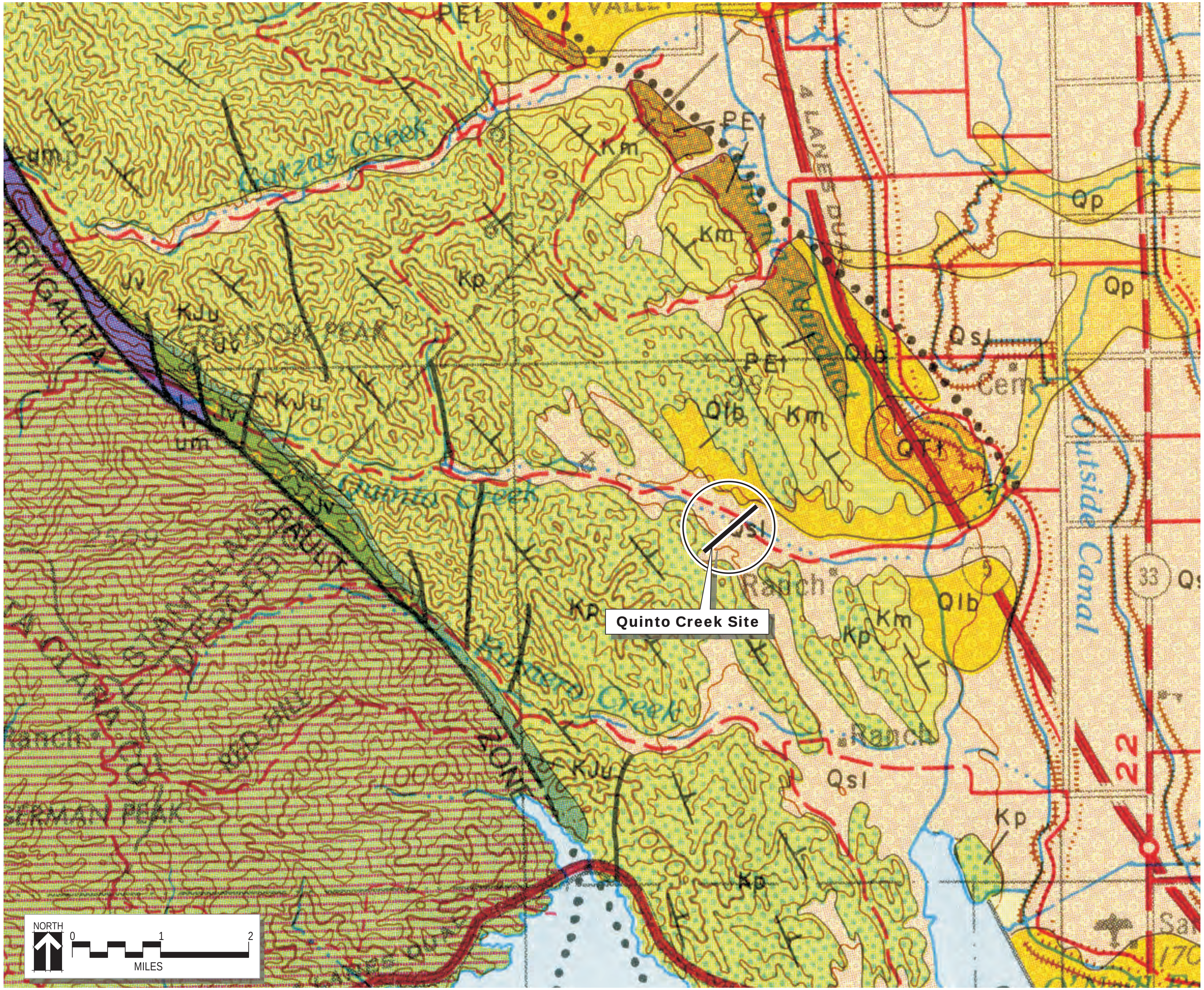


Figure B-20
Quinto Creek Site Location and Inundation Map



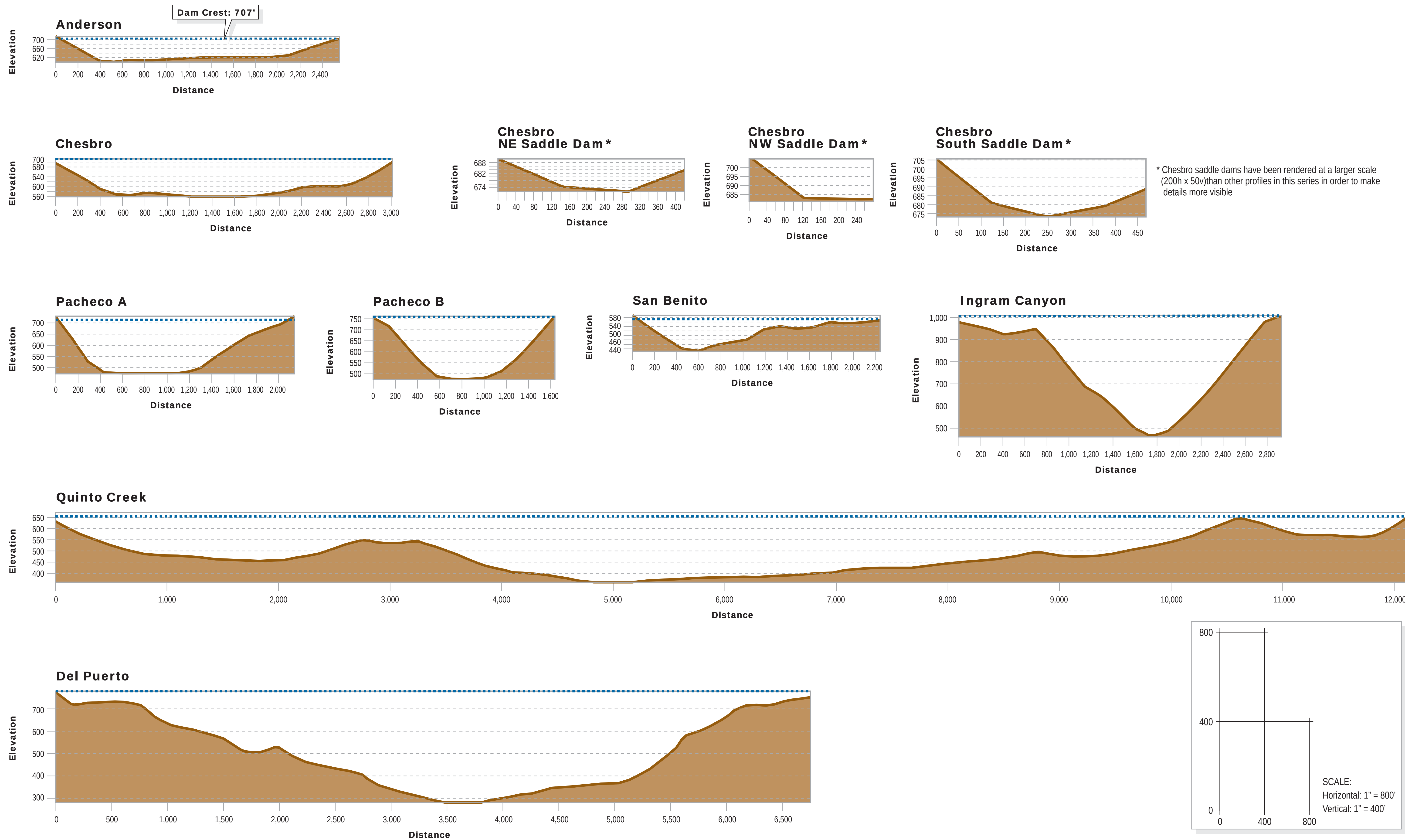
LEGEND (abbreviated)

- Qlb Los Banos Alluvium
- Qp Patterson Alluvium
- Qsl San Luis Ranch Alluvium
- QTt Tulare Formation
- Km Moreno Formation
- Kp Kb: Kb Berryessa Formation; Kp Panoche Formation
- KJf Franciscan Complex*
  - gs greenstone
  - ss sandstone, shale, conglomerate
  - mg metagraywacke
  - ls limestone
  - ch chert
  - um serpantinized ultramfic rock
- blueschist blocks

* horizontal line pattern denotes melange terrane

Reference: Geologic map of the San Francisco-San Jose Quadrangle, California, 1:250,000
Compilation by D.L. Wagner, E.J. Botugno, and R.D. McJunkin, Published 1991, CDMG Regional Geologic Map Series

Figure B-21
Quinto Creek Geologic Map



Note: Vertical scale has been exaggerated to aid visual clarity.

Figure B-22
Dam Profiles

Appendix C
Economic Analysis

Appendix C
Economic Analysis

C.1 Introduction

The economic analysis is guided by the process outlined in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&Gs) Executive Order 11747. The P&Gs state that the Federal objective of water and related land resource project planning is to contribute to National Economic Development (NED), while protecting the nation's environment. The Federal planning process is an iterative planning process where the level of detail and specificity of analysis increases as the process moves forward. The SLLPIP is currently at the Plan Formulation Report (PFR) stage. The PFR presents the comprehensive plans that are carried forward for additional review and analysis in the Feasibility Report Phase.

The economic analysis in the PFR is an initial assessment of each comprehensive plan's benefits and costs and is still at a preliminary level of analysis. At the PFR level, comprehensive plans can be carried forward into the Feasibility Report that may not have benefits in excess of costs because plan refinement and a more detailed economic analysis in the Feasibility Study could refine the economic results.

This appendix describes the economic analysis and results completed for the PFR and additional steps needed for the economic analysis in the Feasibility Report.

C.2 Plan Evaluation

C.2.1 Principles and Guidelines

Through the P&Gs planning process, a single alternative plan is selected for recommendation from among all plans considered. The economic analysis in the Feasibility Report will present a final estimate of net benefits (expected benefits less expected costs) for each comprehensive plan. The alternative plan that reasonably maximizes net economic benefits consistent with protecting the nation's environment (the NED plan) is typically the selected plan. To facilitate evaluation and display the benefits of alternative plans, the P&Gs establish four accounts: NED, environmental quality (EQ), regional economic development (RED), and other social effects (OSE) accounts. The NED is the only required account and is the focus of the economics evaluation in the PFR. The other accounts will be addressed in the Feasibility Report/EIS.

The NED account analyzes changes in the economic value of the national output of goods and services. To maximize the Federal investment, the P&Gs require identification of an appropriately scaled plan that reasonably maximizes net economic benefits to the nation. The P&Gs suggest approaches to complete an NED analysis to measure the various economic benefits and costs of project alternatives.

The EQ account displays non-monetary effects on ecological, aesthetic, and cultural attributes of natural and cultural resources.

The RED analysis measures changes in the distribution of regional economic activity that result from alternative plans. Changes in economic activity and employment that occur locally or regionally when a project is implemented are excluded from the NED account to the extent that they are offset through transfers of this economic activity and employment to other regions of the Nation.

The OSE account captures the qualitative social beneficial and adverse impacts on the individuals affected within the region that are not dealt with in the NED and RED accounts. The impacts captured in the OSE account include urban and community impacts and effects to health, life, and safety.

C.2.2 Period of Analysis

The P&Gs states the following criteria on the period of analysis:

“The period of analysis is to be the same for each alternative plan. The period of analysis is to be the time required for implementation plus the lesser of — (1) The period of time over which any alternative plan would have significant beneficial or adverse effects; or (2) A period not to exceed 100 years.”

The economic analysis assumes a period of analysis of 100 years, beginning in 2010, which is assumed the earliest that funds could be available for project implementation.

C.2.3 Federal Discount Rate

Discounting is used to convert future monetary values to present values. The Water Resources Planning Act of 1965 and the Water Resources Development Act of 1974 require an annual determination of a discount rate for Federal water resources planning. The discount rate for Federal water resources planning for fiscal year 2008 is 4.875 percent. The discount rate period is October 1, 2007 through September 30, 2008. The discount rate for fiscal year 2009 will be used in the Feasibility Report.

C.3 NED Benefits

The economic benefits analysis focuses on water supply benefits to M&I users in the San Felipe Division and to agricultural users in the San Luis-Delta Mendota Water Authority (SLDMWA) service area and the San Felipe Division. Water supply benefits are the incremental change in water supply provided by the SLLPIP comprehensive plans relative to the two baseline conditions. Chapter 4 of the PFR describes the SLLPIP comprehensive plans and Chapter 2 describes the baseline conditions. The P&Gs identify several other categories of potential NED benefits, such as recreation, flood protection, and hydropower. At the PFR level, the comprehensive plans are not developed to a point where the other categories of NED benefits can be validated or quantified. Therefore, the PFR focuses on M&I and agricultural water supply benefits only. The Feasibility Report will include valuation of project benefits of additional NED categories, if appropriate. Quantification of benefits for additional NED categories will be accomplished in accordance with the P&Gs. Recreation benefits will likely be based on willingness to pay estimates for recreation activities; power benefits will be estimated using the avoided costs of alternative generation sources; and flood damage reduction benefits will be based primarily on repair and replacement costs of otherwise flooded property.

C.3.1 M&I Water Supply Benefits

The P&Gs identify the following conceptual basis for evaluating M&I water supply benefits:

“The conceptual basis for evaluating benefits from municipal and industrial water supply is society's willingness to pay for the increase in the value of goods and services attributable to the water supply. Where the price of water reflects its marginal cost, use that price to calculate willingness to pay for additional water supply. In the absence of such direct measures of marginal willingness to pay, the benefits from a water supply plan are measured instead by the resource cost of the alternative most likely to be implemented in the absence of that plan.”

The economic analysis for the PFR uses the avoided cost approach, or the “cost of the alternative most likely to be implemented in the absence of that plan” to estimate M&I water supply benefits. This method assumes that benefits are equal to the costs avoided by not implementing other alternatives, and does not explicitly measure the underlying value of the water supply to water users. For the avoided cost analysis, the benefits of an alternative become the costs of the next likely alternative to be implemented or the next lowest cost alternative. The avoided cost method will always lead to one alternative with positive net benefits even if the underlying value of the output to water users is low; therefore, it is necessary to assume the value of the M&I supply provided for at least one of the action alternative is greater than its costs.

To use avoided costs for benefits, the alternatives must provide similar physical water supplies for M&I users. The CALSIM II Version 9VA model results provide water supplies to the San Felipe Division under the SLLPIP comprehensive plans. In general, the comprehensive plans provide similar supplies. The Pacheco Reservoir Comprehensive Plans options provide slightly more water than the Lower San Felipe Intake Comprehensive Plan options; however, for the level of analysis in the PFR, it is adequate to assume that the plans provide a similar water supply.

The CALSIM II model results provide SLLPP comprehensive plans water supplies relative to two baselines: Future No Action– 79 TAF and the Future No Action– 300 TAF . Because the economic analysis for the PFR uses the avoided cost approach for M&I benefits estimation, the CALSIM II model results are not specifically used to calculate M&I benefits.

The SLLPIP comprehensive plans include both a structural component and an institutional component to meet the project objectives. The structural components provide M&I water supplies to the San Felipe Division; therefore, the costs of the structural components represent the M&I benefits for the avoided cost analysis. The institutional measures provide some M&I benefits to the SLDMWA service area relative the Future No Action 300 TAF. CALSIM II results show the plans would provide water to the City of Tracy, Avenal, Coalinga, and Huron in the CVP service area; however, water supplies would average only about 1 TAF annually in total. Because the M&I benefits from institutional measures to the SLDMWA are minor, they are not included in the PFR economic analysis.

For the PFR, the comprehensive plan cost estimates do not include treatment and delivery costs to retail agencies and water customers after the water leaves San Luis Reservoir. Treatment and delivery costs would be additional NED costs of the comprehensive plans and would reduce net benefits. The PFR assumes treatment and delivery costs would be similar for all plans and would not change the relative ranking of comprehensive plans. The cost estimates in the Feasibility Report will include costs to deliver water to the end users.

Based on the existing present value cost estimates, the Lower San Felipe Intake – Pipeline Option has the lowest costs of all the plans ($314.1 million). The next lowest cost is the Lower San Felipe Intake – Tunnel Option ($339.0 million). As described above, the M&I benefit analysis uses the avoided cost approach, or the "cost of the alternative most likely to be implemented in the absence of that plan". Therefore, the benefits of the least cost plan are the costs of the next least cost plan and the benefits of the remaining plans are the costs of the least cost plan. Table C-1 shows the alternatives' benefits, based on present value of avoided costs.

Table C-1. M&I Benefits Summary Based on Avoided Costs

Comprehensive Plan	Plan Option	M&I Benefits (million $)
Lower San Felipe Intake	Tunnel	314.1
	Pipeline	339.0
Pacheco Reservoir - 80,000 AF	No Landslide Remediation	314.1
	With Landslide Remediation	314.1
Pacheco Reservoir - 130,000 AF	No Landslide Remediation	314.1
	With Landslide Remediation	314.1
Combination		314.1

Next Steps in Feasibility Report

The economic analysis in the Feasibility Report will use a more direct approach than the avoided cost method to estimate consumer willingness to pay for additional water supplies from the SLLPIP comprehensive plans. The analysis will focus on incremental M&I water supplies provided by each of the SLLPIP plans to water users.

Under the baseline conditions, end users would experience a water shortage during the low point months. SLLPIP comprehensive plans would provide water supplies to avoid shortages during months with low point conditions, and depending on the plan, provide additional water supplies to SCVWD. End users are willing to pay a certain dollar amount to avoid water shortages. Willingness to pay is estimated as the area under a demand curve for water and represents the value of water to the customer, or the benefit value of water supply.

There are several technically acceptable methods to estimate willingness to pay for M&I water which will be considered in the Feasibility Report Phase. One method for consideration is to use existing prices and price elasticity measurements to develop a demand curve for M&I water supply. Price elasticity of demand is defined as the percentage change in quantity demanded of a good divided by the percentage change in price. Price elasticities always have a negative value, indicating that an increase in price will result in decrease in quantity demanded, and vice versa. Empirical studies typically demonstrate that the demand for residential water is very inelastic, that is, an increase or decrease in price will lead to a much lower percentage change in quantity demanded. Demand is usually more inelastic in the short-run versus the long-run, in the winter versus the summer, and in areas where residential users have already implemented conservation measures. Price elasticity values for residential users generally fall in the range of -0.10 to -0.2 for the Western United States.

If price elasticity is known, and the current price and quantity demanded is known, then a demand curve can be specified to estimate changes in residential willingness to pay (benefits) to avoid potential water shortages. The benefits to water users of avoided shortages can then be compared to the costs of various alternatives to determine if the alternatives are economically justified.

C.3.2 Agricultural Water Supply Benefits

The P&Gs identify the following conceptual basis for evaluating agricultural water supply benefits:

"The NED benefits are the value of increases in the agricultural output of the Nation and the cost savings in maintaining a given level of output. The benefits include reductions in production costs and in associated costs; reduction in damage costs from floods, erosion, sedimentation, inadequate drainage, or inadequate water supply; the value of increased production of crops; and the economic efficiency of increasing the production of crops in the project area."

The SLLPIP comprehensive plans provide agricultural water supplies to the SLDMWA service area and the San Felipe Division. Agriculture water supply benefits are measured using the Central Valley Production Model (CVPM), which is an optimization model that maximizes farm profit based on cropping decisions and production inputs. CVPM calculates the changes in net farm income from additional surface water supply provided by the SLLPIP comprehensive plans relative to the baseline conditions. The model first assumes that farmers would reduce groundwater pumping with additional surface water supply deliveries. If enough water is provided, CVPM assumes that farmers may change the cropping decisions to plant more acreage or higher value crops. The potential changes in groundwater pumping costs or cropping decisions would translate to an increase in net farm income. This increase in income is considered the NED benefit.

CALSIM II estimates agricultural water supplies provided by the SLLPIP comprehensive plans to the SLDMWA service area and the San Felipe Division; and, CVPM estimates changes in net farm income based on average annual changes in water supplies from the CALSIM II output. For this analysis, CVPM results are presented as long-term average changes in net farm income. In the CVPM, agricultural water supply benefits are realized in Region 10 (Upper DMC) and Region 14 (Westlands Water District) of the San Joaquin Valley. The SLLPIP comprehensive plans provide some agricultural benefits to the San Felipe Division relative to the Future No Action – 300 TAF. For the PFR analysis, the agricultural water supplies to the San Felipe Division are added to agricultural water supplies to Regions 10 and 14. The total water supplies to agricultural users in the San Felipe Division, Region 10 and Region 14 are input into CVPM, which then estimates annual changes in net farm income, or the economic benefit. . Agricultural supply benefits to the San Felipe Division relative to the Future No Action- 79 TAF are very minor and not included in this analysis.

Implementation of the institutional measures provides agricultural water supply benefits under the Lower San Felipe Intake Comprehensive Plan relative to the Future No Action – 79 TAF. The economic analysis assumes the benefits of the institutional measures would begin at the start of the period of analysis and continue throughout the period of analysis. Under the Lower San Felipe Intake Comprehensive Plan relative to the Future No Action– 300 TAF, implementation of both the structural measures and the institutional measures provides agricultural water supply benefits. The benefits provided by the institutional measures would begin at the start of the period of analysis and the benefits from the structural measures would begin after construction is complete.

The Pacheco Reservoir Comprehensive Plan provides agricultural water supplies through both institutional measures and the reservoir, under both baselines. The benefits provided by the institutional measures would begin at the start of the period of analysis and the benefits from the reservoir would begin after construction is complete. Therefore, for the Pacheco Reservoir Comprehensive Plan, agricultural benefits increase in Year 9 of the period of analysis. Table C-2 shows annual benefits from CVPM and the expected years they would occur.

Table C-2. Agricultural Water Supply Annual Benefits Summary (million $)

Comprehensive Plan[(1)]	Benefits timeframe	Future No Action – 79 TAF[(1)]	Future No Action – 300 TAF
Lower San Felipe Intake	Year 1-6	3.0	3.3
	Year 7-100	3.0	17.5
Pacheco Reservoir - 80,000 AF	Year 1-8	3.1	3.2
	Year 9-100	7.0	21.6
Pacheco Reservoir - 130,000 AF	Year 1-8	2.8	2.8
	Year 9-100	10.5	25.3
Combination Alternative	Year 1-6	3.0	3.3
	Year 7-100	3.0	17.5

(1) Annual benefits are the same for plan options. Plan options are not shown in this table.

Table C-3 shows total agricultural benefits in present value provided by the SLLPIP comprehensive plans. The present value benefits are based on annual benefits to net farm income in Table C-2, discounted at 4.875 percent over a 100-year period of analysis. Benefits are larger for the Future No Action– 300 TAF relative to the Future No Action– 79 TAF because the former assumes the reservoir would be held at 300 TAF to avoid the low point; therefore, the water deliveries to the SLDMWA service area are lower relative to full operation of the reservoir to 79 TAF. In other words, the SLLPIP comprehensive plans would make up for a bigger agricultural water supply loss under the Future No Action– 300 TAF relative to the Future No Action– 79 TAF.

Table C-3. Agricultural Water Supply Present Value Benefits Summary

Comprehensive Plan	Plan Option	Agricultural Benefits (million $) Future No Action – 79 TAF[(1)]	Future No Action – 300 TAF[(2)]
Lower San Felipe Intake	Tunnel	64.4	287.2
	Pipeline	64.4	287.2
Pacheco Reservoir - 80,000 AF	No Landslide Remediation	120.3	348.7
	With Landslide Remediation	120.3	348.7
Pacheco Reservoir - 130,000 AF	No Landslide Remediation	166.7	402.2
	With Landslide Remediation	166.7	402.2
Combination Alternative		64.4	287.2

(1) Benefits relative to Future No Action – 79 AF include deliveries to SLDMWA service area, assumes no deliveries to San Felipe Division agriculture

(2) Benefits relative to Future No Action – 300 AF include deliveries to SLDMWA service area and San Felipe Division

Next Steps in Feasibility Report

For the Feasibility Report, the economic analysis of agricultural water supply benefits will further assess the effect earlier allocations would have on farming decisions. For the PFR, CVPM estimates the additional water supplies primarily result in changes in groundwater pumping costs. However, more aggressive early allocations could result in the suspension of planned water transfers that would have been secured absent the higher allocation or cropping pattern changes. Suspension of water transfers and cropping pattern changes will be further analyzed and, if applicable, quantified in the Feasibility Report. To the extent any benefits occur from cropping patterns changes, CVPM net farm income results will be adjusted to reflect measurement criteria contained in the P&Gs.

The current CVPM benefits reflect only a single model run using the average water supply change over the CALSIM period of record. This approach does not likely provide adequate resolution on year-to-year benefits, since the average includes many “zero effect” years. Representative years may be modeled in CVPM for the Feasibility Report.

In the Feasibility Report, CVPM will estimate benefits within the San Felipe Division rather than lumping them into Regions 10 and 14 benefits. This will give a more accurate estimate of agricultural water supply benefits to the San Felipe Division. The economic analysis in the Feasibility Report will also address potential costs to San Felipe Division irrigators from poor water quality in the reservoir clogging irrigation sprinklers. This would be an avoided cost, or benefit, under the SLLPIP comprehensive plans.

C.4 NED Costs

Cost estimates for the major components that would be developed by each comprehensive plan were estimated using the approach outlined in the Reclamation Manual (Reclamation Undated (c)) and the Cost Estimating Handbook (Reclamation 1989). The estimates were developed at a planning level based on preliminary layouts and designs for each comprehensive plan. The preliminary layouts present a level of detail sufficient to develop planning-level costs for the approximate quantities of material, equipment, or labor that would be required for the development of each component.

Cost estimates are being used as a part of the plan formulation and economic evaluation process to compare potential costs with potential benefits and maximize each plan’s relative feasibility by designing features at the most efficient size relative to the benefit provided. The cost estimates presented in this section are presented in 2008 dollars.

Table C-4 shows the costs of the capital, O&M, and present value costs of the structural component for the SLLPIP comprehensive plans. The costs shown in Table C-4 do not include delivery of M&I and agricultural water supplies from the reservoir to the user. The present value is based on a 100-year period of analysis beginning in 2010 and 4.875% discount rate.

Detailed planning level cost estimates are provided at the end of this appendix. Cost estimates for the Combination plan include recharge basins, extraction wells, and the desalination facility. SCVWD costs for the desalination facility would only be a portion of the total costs shown in the estimate, about 10 mgd of the total 65 mgd facility. Table C-4 shows total costs for the Combination plan, including only SCVWD's share of the desalination facility.

Table C-4. Estimated Capital and Annual Costs (million $)

Item	Lower San Felipe Intake		Pacheco Reservoir 80,000 AF		Pacheco Reservoir 130,000 AF		Combination
	Tunnel	Pipeline	No Landslide Remediation	With Landslide Remediation	No Landslide Remediation	With Landslide Remediation	
Capital Cost							
Construction Costs (1)	300.5	281.9	536	711.3	654.4	814.9	328.1
Land Purchase/Easements	NA	NA	10.4	10.4	10.4	10.4	73.2
Environmental Mitigation (2)	15	14.1	26.8	35.6	32.7	40.7	8.3
Recreational Facilities (3)	9	8.5	16.1	21.3	19.6	24.4	--
Program Costs (4)	75.1	70.5	134.1	177.8	163.6	203.7	68.6
Total Capital Cost	399.7	374.9	723.8	956.3	880.7	1094.1	478.0
Annual Cost							
Operation & Maintenance	1.1	0.88	3.4	3.6	3.6	3.8	11.0
Present Value (Structural Component)	339.0	314.1	598.6	778.9	720.8	885.7	559.6

NA – Not Applicable, State Lands
(1) See end of appendix for Detailed Construction Cost Estimates. Includes 30 percent contingency
(2) 5 percent of construction cost
(3) 3 percent of construction cost, not applicable for Combination Plan
(4) Engineering Design, Construction Support and Supervision/Administration. 25 Percent of Construction Cost

The comprehensive plan cost estimates also include costs for the institutional measures: groundwater banking, CVP and SWP source shifting, and water transfers. CALSIM II model results estimated water supplies provided by each institutional measure and a cost was assigned to each type of measure, based on NED cost standards. The economic analysis then estimated a total annual cost for implementation of the institutional measures for each comprehensive plan. Table C-5 shows the costs for each institutional measure and the NED basis for the estimate; and, Table C-6 shows the total annual cost and present values over the period of analysis for the SLLPIP comprehensive plans. The $82 value used for water transfers is the loss in net farm income which would occur in the North of Delta region; the $82 value is based on past CVPM runs in the North of Delta region. Although the financial cost of the transfer (market price) would be considerably higher, the economic cost from an NED perspective is limited to the loss in farm income.

Table C-5. Institutional Measure Unit Costs

Institutional Measure	$/AF cost	NED cost basis
CVP Source Shifting	$110.00	Based on groundwater pumping costs in Westlands Water District.
MWD Source Shifting	$70.00	Based on average costs from EWA source shifting actions with MWD
Groundwater banking	$470.00	Based on Semitropic Stored Water Recovery Unit costs
Water Transfers	$82.00	Based on changes in net farm income from water transfers in North of Delta region

Table C-6. Annual and Present Value Costs of Implementing Institutional Measures Component of Comprehensive Plans

Comprehensive Plan	Plan Option	Institutional Measures Annual Cost (million $)	Institutional Measures Present Value (million $)
Lower San Felipe Intake	Tunnel	2.5	53.8
	Pipeline	2.5	53.8
Pacheco Reservoir - 80,000 AF	No Landslide Remediation	2.4	51.8
	With Landslide Remediation	2.4	51.8
Pacheco Reservoir - 130,000 AF	No Landslide Remediation	2.3	50.0
	With Landslide Remediation	2.3	50.0
Combination		2.5	53.8

Table C-7 presents the total present value costs of the SLLPIP comprehensive plans, including the structural costs and the institutional measures costs. The present value costs are compared to the present value benefits to determine the net benefits of the comprehensive plan.

Table C-7. Present Value Total Cost Summary of Comprehensive Plans

Comprehensive Plan	Plan Option	Total Present Value Costs (million $)
Lower San Felipe Intake	Tunnel	$392.8
	Pipeline	$367.9
Pacheco Reservoir - 80,000 AF	No Landslide Remediation	$650.4
	With Landslide Remediation	$830.7
Pacheco Reservoir - 130,000 AF	No Landslide Remediation	$770.9
	With Landslide Remediation	$935.7
Combination		$613.4

Next Steps in Feasibility Report

Capital, O&M, and institutional measures costs will be revised as the comprehensive plans are further refined. The SCVWD and agricultural water supply delivery costs will be added to the structural costs in order to represent total costs to end users from deliveries.

C.5 NED Net Benefits

Net benefits are calculated based on total present value benefits less present value costs. Table C-8 summarizes the net benefits, or net costs, of the SLLPIP alternatives. Under the Future No Action – 79 TAF, the Lower San Felipe Intake Pipeline Option is the only comprehensive plan which has net benefits; all other comprehensive plans show a net cost. Under the Future No Action – 300 TAF baseline, the Lower San Felipe Intake Pipeline Option has the highest net benefits, followed by the Lower San Felipe Tunnel Option, and the Pacheco Reservoir 80 TAF No Landslide Remediation comprehensive plan, ; the Combination comprehensive plan and the remaining three Pacheco comprehensive plans show net costs under the Future No Action 300 TAF baseline. Because of the relative closeness of the net benefits of some plans and proposed revisions in the economic benefits evaluation, the cost estimates, and the water supply modeling, all comprehensive plans will move forward to the Feasibility Report.

Table C-8. Present Value NED Costs, Benefits, and Net Benefits Summary of Comprehensive Plans (million $)

Comprehensive Plan	Plan Options	Costs	Benefits		Net Benefits (Costs)	
			Future No Action– 79 TAF	Future No Action– 300 TAF	Future No Action– 79 TAF	Future No Action– 300 TAF
Lower San Felipe Intake	Tunnel	$392.8	$378.5	$601.3	($14.3)	$208.5
	Pipeline	$367.9	$403.4	$626.2	$35.5	$258.3
Pacheco Reservoir - 80,000 AF	No Landslide Remediation	$650.4	$434.4	$662.8	($216.0)	$12.4
	With Landslide Remediation	$830.7	$434.4	$662.8	($396.3)	($167.9)
Pacheco Reservoir - 130,000 AF	No Landslide Remediation	$770.9	$480.8	$716.3	($290.0)	($54.5)
	With Landslide Remediation	$935.7	$480.8	$716.3	($455.0)	($219.4)
Combination		$613.4	$378.5	$601.3	($234.9)	($12.1)

C.6 References

Reclamation 1989. Cost Estimating Handbook. Bureau of Reclamation March 1989.

Reclamation Undated (c). Bureau of Reclamation's Directives System (the Reclamation Manual (RM)). Accessed on: June 19, 2008. Available at: http://www.usbr.gov/recman/.

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U.S. Bureau of Reclamation
San Luis Reservoir Low Point Improvement Project
PFR - Lower

Project name	BuRec- San Luis Reservoir San Luis Reservoir CA
Estimator	Nick Agnew
Labor rate table	CA08 Santa Clara
Equipment rate table	00 071H Equip Rental
Report format	Sorted by 'Alternate/Area/Division' 'Detail' summary Combine items Paginate

Alternate	Division	Description	Takeoff Quantity	Total Cost/Unit	Total Amount
		Lower San Felipe Intake - Tunnel Option			
		Intake Tap			
	02	**Site Construction**			
		Intake Tap	1.00 allw	15,000,000.00 /allw	15,000,000
		02 Site Construction			**15,000,000**
		Intake Tap			**15,000,000**
		Aeration			
	11	**Equipment**			
		Hypolimnetic Aeration	1.00 allw	3,000,000.00 /allw	3,000,000
		11 Equipment			**3,000,000**
		Aeration			**3,000,000**
		Tunneling			
	02	**Site Construction**			
		Launch/Retrieval Shaft	500.00 vf	15,000.00 /vf	7,500,000
		156" Tunnel	20,000.00 lf	7,000.00 /lf	140,000,000
		02 Site Construction			**147,500,000**
		Tunneling			**147,500,000**
		Infrastructure			
	03	**Concrete**			
		152 Access - Basalt & Dinosaur	1.00 allw	9,000,000.00 /allw	9,000,000
		03 Concrete			**9,000,000**
		Infrastructure			**9,000,000**
		Connection			
	03	**Concrete**			
		Connection to Existing Intake	1.00 allw	10,000,000.00 /allw	10,000,000
		03 Concrete			**10,000,000**
		Connection			**10,000,000**
		Lower San Felipe Intake - Tunnel Option			**184,500,000**

Estimate Totals

Description	Amount	Totals	Hours	Rate
CONSTRUCTION COSTS	184,500,000			
	184,500,000	**184,500,000**		
FIELD OFFICE OVERHEAD	14,760,000			8.00 %
	14,760,000	**199,260,000**		
HOME OFFICE OVERHEAD	5,977,800			3.00 %
CONTINGENCY	59,778,000			30.00 %
	65,755,800	**265,015,800**		
MARGIN	21,201,264			8.00 %
	21,201,264	**286,217,064**		
BUILDER'S ALL RISK INSURANCE	2,862,171			1.00 %
LIABILITY INSURANCE	5,724,341			2.00 %
BOND	5,724,341			2.00 %
TOTAL CONSTRUCTION	**14,310,853**	**300,527,917**		
LAND (EASEMENTS) - STATE LAND				
ENVIRONMENTAL MITIGATION	15,026,396			5.00 %
RECREATIONAL FACILITIES	9,015,838			3.00 %
PROGRAM COSTS	75,131,979			25.00 %
	99,174,213	**399,702,130**		
Total		***399,702,130***		

U.S. Bureau of Reclamation
San Luis Reservoir Low Point Improvement Project
PFR - Lower

Project name	BuRec- San Luis Reservoir San Luis Reservoir CA
Estimator	Nick Agnew
Labor rate table	CA08 Santa Clara
Equipment rate table	00 071H Equip Rental
Report format	Sorted by 'Alternate/Area/Division' 'Detail' summary Combine items Paginate

Alternate	Division	Description	Takeoff Quantity	Total Cost/Unit	Total Amount
		Lower San Felipe Intake - Pipeline Option			
		Intake Tap			
	02	**Site Construction**			
		Intake Tap	1.00 allw	10,000,000.00 /allw	10,000,000
		02 Site Construction			**10,000,000**
		Intake Tap			**10,000,000**
		Aeration			
	11	**Equipment**			
		Hypolimnetic Aeration	1.00 allw	3,000,000.00 /allw	3,000,000
		11 Equipment			**3,000,000**
		Aeration			**3,000,000**
		Pipelines			
	15	**Mechanical**			
		Mobilization	1.00 allw	37,440,000.00 /allw	37,440,000
		156" Pipeline - Underwater Construction	20,000.00 lf	4,680.00 /lf	93,600,000
		15 Mechanical			**131,040,000**
		Pipelines			**131,040,000**
		Infrastructure			
	03	**Concrete**			
		152 Access - Basalt & Dinosaur	1.00 allw	9,000,000.00 /allw	9,000,000
		03 Concrete			**9,000,000**
		Infrastructure			**9,000,000**
		Connection			
	03	**Concrete**			
		Connection to Existing Intake	1.00 allw	20,000,000.00 /allw	20,000,000
		03 Concrete			**20,000,000**
		Connection			**20,000,000**
		4b Alternative 4b: Lower San Felipe Intake - Pipeline Option			**173,040,000**

Estimate Totals

Description	Amount	Totals	Hours	Rate
CONSTRUCTION COSTS	173,040,000			
	173,040,000	**173,040,000**		
FIELD OFFICE OVERHEAD	13,843,200			8.00 %
	13,843,200	**186,883,200**		
HOME OFFICE OVERHEAD	5,606,496			3.00 %
CONTINGENCY	56,064,960			30.00 %
	61,671,456	**248,554,656**		
MARGIN	19,884,372			8.00 %
	19,884,372	**268,439,028**		
BUILDER'S ALL RISK INSURANCE	2,684,390			1.00 %
LIABILITY INSURANCE	5,368,781			2.00 %
BOND	5,368,781			2.00 %
TOTAL CONSTRUCTION	**13,421,952**	**281,860,980**		
LAND (EASEMENTS) - STATE LAND				
ENVIRONMENTAL MITIGATION	14,093,049			5.00 %
RECREATIONAL FACILITIES	8,455,829			3.00 %
PROGRAM COSTS	70,465,245			25.00 %
	93,014,123	**374,875,103**		
Total		***374,875,103***		

U.S. Bureau of Reclamation

San Luis Reservoir Low Point Improvement Project

PFR - Pacheco

Project name	BuRec- San Luis Reservoir San Luis Reservoir CA
Estimator	Nick Agnew
Labor rate table	CA08 Santa Clara
Equipment rate table	00 071H Equip Rental
Report format	Sorted by 'Alternate/Area/Division' 'Detail' summary Paginate

Alternate	Division	Description	Takeoff Quantity	Total Cost/Unit	Total Amount
		Pacheco Reservoir - 130 TAF w/ Landslide Remediation			
		Regulating Tank			
	13	**Special Construction**			
		3 MG Steel Tank @ Pump Station	1.00 allw	5,000,000.00 /allw	5,000,000
		13 Special Construction			**5,000,000**
		Regulating Tank			**5,000,000**
		Pacheco Conduit Tie-in			
	02	**Site Construction**			
		Connection into Existing Pacheco Conduit	1.00 allw	2,000,000.00 /allw	2,000,000
		02 Site Construction			**2,000,000**
		Pacheco Conduit Tie-in			**2,000,000**
		Conveyance Pipeline: Pacheco Conduit-Pump Station			
	15	**Mechanical**			
		108" Pipeline - Pacheco Conduit to Highway 152	200.00 lf	1,650.00 /lf	330,000
		Bore and Jack Tunnel - 132" Casing, under Highway 152	500.00 lf	3,300.00 /lf	1,650,000
		108" Carrier Pipe - under Highway 152	500.00 lf	864.00 /lf	432,000
		108" Pipeline - Highway 152 to Pump Station	3,150.00 lf	1,650.00 /lf	5,197,500
		15 Mechanical			**7,609,500**
		Conveyance Pipeline: Pacheco Conduit-Pump Station			**7,609,500**
		Pacheco Reservoir Pump Station			
	11	**Equipment**			
		Pump Station	13,750.00 hp	1,500.00 /hp	20,625,000
		11 Equipment			**20,625,000**
	15	**Mechanical**			
		Valve Yard Piping - 2 way Pump Station	1.00 allw	5,000,000.00 /allw	5,000,000
		15 Mechanical			**5,000,000**
		Pacheco Reservoir Pump Station			**25,625,000**
		Conveyance from Pump Station to Inlet/Outlet Structure			
	15	**Mechanical**			
		132" Pipeline - Pump Station to Toe of Dam	470.00 lf	1,850.00 /lf	869,500
		216" Walk in Tunnel w/ 192" Useable - Toe of Dam to Valve Chamber	750.00 lf	7,200.00 /lf	5,400,000
		132" Carrier Pipe - Toe of Dam to Valve Chamber	750.00 lf	396.00 /lf	297,000
		156" Standard Tunnel w/ 132" Useable - Valve Chamber to Upstream Toe of Dam	950.00 lf	5,400.00 /lf	5,130,000
		15 Mechanical			**11,696,500**
		Conveyance from Pump Station to Inlet/Outlet Structure			**11,696,500**
		Inlet/Outlet Structures			
	15	**Mechanical**			
		Sloping Intake/Outlet with Controls and Valving	1.00 allw	6,000,000.00 /allw	6,000,000
		Outlet Control Structure	1.00 allw	2,000,000.00 /allw	2,000,000
		15 Mechanical			**8,000,000**
		Inlet/Outlet Structures			**8,000,000**
		New Dam and Reservoir			
	02	**Site Construction**			
		Clearing of Reservoir, Borrow and Haul Road Areas	2,400.00 acre	3,000.00 /acre	7,200,000
		Restoration of Borrow and Haul Roads	500.00 acre	3,050.00 /acre	1,525,000
		Removal of Existing North Fork Pacheco Dam / Placement of Material as Random Fill	325,000.00 cy	4.00 /cy	1,300,000
		Haul Road Construction	7.00 mile	350,000.00 /mile	2,450,000
		Foundation Preparation for Footprint of Dam	296,000.00 sy	10.00 /sy	2,960,000
		Foundation Preparation for Spillway and Sloping Intake	4,300.00 sy	25.00 /sy	107,500
		Grouting of Dam Foundation	1.00 allw	10,000,000.00 /allw	10,000,000
		Common Excavation/Stripping	2,140,000.00 cy	3.50 /cy	7,490,000
		Excavation for Spillway/Stilling Basin	303,000.00 cy	5.00 /cy	1,515,000
		Construction of Coffer Dam	1,150,000.00 cy	8.00 /cy	9,200,000
		Impervious Core	3,950,000.00 cy	10.00 /cy	39,500,000
		Filter and Drain	2,480,000.00 ton	30.00 /ton	74,400,000
		Random Fill	13,300,000.00 cy	9.00 /cy	119,700,000
		Rip Rap	325,000.00 ton	45.00 /ton	14,625,000
		Other Dam Costs - Access Road, Rip-Rap Lined Channel	1.00 allw	3,000,000.00 /allw	3,000,000
		Concrete for Spillway	10,000.00 cy	650.00 /cy	6,500,000
		Hypolimnetic Aeration	1.00 allw	3,000,000.00 /allw	3,000,000
		Other Miscellaneous Structures and Improvements (6% of Dam & Spillway Costs)	1.00 allw	25,350,000.00 /allw	25,350,000
		02 Site Construction			**329,822,500**
		New Dam and Reservoir			**329,822,500**
		Landslide Remediation			
	02	**Site Construction**			
		Landslide Excavation	13,000,000.00 cy	3.50 /cy	45,500,000
		Landslide Fill	10,600,000.00 cy	5.00 /cy	53,000,000
		02 Site Construction			**98,500,000**
		Landslide Remediation			**98,500,000**
		Substations			
	16	**Electrical**			
		High Voltage Substation	1.00 allw	4,000,000.00 /allw	4,000,000
		Transmission Line	16.00 mile	500,000.00 /mile	8,000,000
		16 Electrical			**12,000,000**
		Substations			**12,000,000**
		Pacheco Reservoir - 130 TAF w/ Landslide Remediation			**500,253,500**

Estimate Totals

Description	Amount	Totals	Hours	Rate
CONSTRUCTION COSTS	500,253,500			
	500,253,500	**500,253,500**		
FIELD OFFICE OVERHEAD	40,020,280			8.00 %
	40,020,280	**540,273,780**		
HOME OFFICE OVERHEAD	16,208,213			3.00 %
CONTINGENCY	162,082,134			30.00 %
	178,290,347	**718,564,127**		
MARGIN	57,485,130			8.00 %
	57,485,130	**776,049,257**		
BUILDER'S ALL RISK INSURANCE	7,760,493			1.00 %
LIABILITY INSURANCE	15,520,985			2.00 %
BOND	15,520,985			2.00 %
TOTAL CONSTRUCTION	**38,802,463**	**814,851,720**		
LAND (PURCHASE)	9,750,000			
LAND (EASEMENTS)	625,000			
ENVIRONMENTAL MITIGATION	40,742,586			5.00 %
RECREATIONAL FACILITIES	24,445,552			3.00 %
PROGRAM COSTS	203,712,930			25.00 %
	279,276,068	**1,094,127,788**		
Total		***1,094,127,788***		

U.S. Bureau of Reclamation
San Luis Reservoir Low Point Improvement Project
PFR - Pacheco R

Project name	BuRec- San Luis Reservoir San Luis Reservoir CA
Estimator	Nick Agnew
Labor rate table	CA08 Santa Clara
Equipment rate table	00 071H Equip Rental
Report format	Sorted by 'Alternate/Area/Division' 'Detail' summary Combine items Paginate

Alternate	Division	Description	Takeoff Quantity	Total Cost/Unit	Total Amount
		Pacheco Reservoir -130 TAF w/o Landslide Remediation			
		Regulating Tank			
	13	**Special Construction**			
		3 MG Steel Tank @ Pump Station	1.00 allw	5,000,000.00 /allw	5,000,000
		13 Special Construction			**5,000,000**
		Regulating Tank			**5,000,000**
		Pacheco Conduit Tie-in			
	02	**Site Construction**			
		Connection into Existing Pacheco Conduit	1.00 allw	2,000,000.00 /allw	2,000,000
		02 Site Construction			**2,000,000**
		Pacheco Conduit Tie-in			**2,000,000**
		Conveyance Pipeline: Pacheco Conduit-Pump Station			
	15	**Mechanical**			
		108" Pipeline - Pacheco Conduit to Highway 152	200.00 lf	1,650.00 /lf	330,000
		Bore and Jack Tunnel - 132" Casing, under Highway 152	500.00 lf	3,300.00 /lf	1,650,000
		108" Carrier Pipe - under Highway 152	500.00 lf	864.00 /lf	432,000
		108" Pipeline - Highway 152 to Pump Station	3,150.00 lf	1,650.00 /lf	5,197,500
		15 Mechanical			**7,609,500**
		Conveyance Pipeline: Pacheco Conduit-Pump Station			**7,609,500**
		Pacheco Reservoir Pump Station			
	11	**Equipment**			
		Pump Station	13,750.00 hp	1,500.00 /hp	20,625,000
		11 Equipment			**20,625,000**
	15	**Mechanical**			
		Valve Yard Piping - 2 way Pump Station	1.00 allw	5,000,000.00 /allw	5,000,000
		15 Mechanical			**5,000,000**
		Pacheco Reservoir Pump Station			**25,625,000**
		Conveyance from Pump Station to Inlet/Outlet Structure			
	15	**Mechanical**			
		132" Pipeline - Pump Station to Toe of Dam	470.00 lf	1,850.00 /lf	869,500
		216" Walk in Tunnel w/ 192" Useable - Toe of Dam to Valve Chamber	750.00 lf	7,200.00 /lf	5,400,000
		132" Carrier Pipe - Toe of Dam to Valve Chamber	750.00 lf	396.00 /lf	297,000
		156" Standard Tunnel w/ 132" Useable - Valve Chamber to Upstream Toe of Dam	950.00 lf	5,400.00 /lf	5,130,000
		15 Mechanical			**11,696,500**
		Conveyance from Pump Station to Inlet/Outlet Structure			**11,696,500**
		Inlet/Outlet Structures			
	15	**Mechanical**			
		Sloping Intake/Outlet with Controls and Valving	1.00 allw	6,000,000.00 /allw	6,000,000
		Outlet Control Structure	1.00 allw	2,000,000.00 /allw	2,000,000
		15 Mechanical			**8,000,000**
		Inlet/Outlet Structures			**8,000,000**
		New Dam and Reservoir			
	02	**Site Construction**			
		Clearing of Reservoir, Borrow and Haul Road Areas	2,400.00 acre	3,000.00 /acre	7,200,000
		Restoration of Borrow and Haul Roads	500.00 acre	3,050.00 /acre	1,525,000
		Removal of Existing North Fork Pacheco Dam / Placement of Material as Random Fill	325,000.00 cy	4.00 /cy	1,300,000
		Haul Road Construction	7.00 mile	350,000.00 /mile	2,450,000
		Foundation Preparation for Footprint of Dam	296,000.00 sy	10.00 /sy	2,960,000
		Foundation Preparation for Spillway and Sloping Intake	4,300.00 sy	25.00 /sy	107,500
		Grouting of Dam Foundation	1.00 allw	10,000,000.00 /allw	10,000,000
		Common Excavation/Stripping	2,140,000.00 cy	3.50 /cy	7,490,000
		Excavation for Spillway/Stilling Basin	303,000.00 cy	5.00 /cy	1,515,000
		Construction of Coffer Dam	1,150,000.00 cy	8.00 /cy	9,200,000
		Impervious Core	3,950,000.00 cy	10.00 /cy	39,500,000
		Filter and Drain	2,480,000.00 ton	30.00 /ton	74,400,000
		Random Fill	13,300,000.00 cy	9.00 /cy	119,700,000
		Rip Rap	325,000.00 ton	45.00 /ton	14,625,000
		Other Dam Costs - Access Road, Rip-Rap Lined Channel	1.00 allw	3,000,000.00 /allw	3,000,000
		Concrete for Spillway	10,000.00 cy	650.00 /cy	6,500,000
		Hypolimnetic Aeration	1.00 allw	3,000,000.00 /allw	3,000,000
		Other Miscellaneous Structures and Improvements (6% of Dam & Spillway Costs)	1.00 allw	25,350,000.00 /allw	25,350,000
		02 Site Construction			**329,822,500**
		New Dam and Reservoir			**329,822,500**
		Substations			
	16	**Electrical**			
		High Voltage Substation	1.00 allw	4,000,000.00 /allw	4,000,000
		Transmission Line	16.00 mile	500,000.00 /mile	8,000,000
		16 Electrical			**12,000,000**
		Substations			**12,000,000**
		Pacheco Reservoir -130 TAF w/o Landslide Remediation			**401,753,500**

Estimate Totals

Description	Amount	Totals	Hours	Rate
CONSTRUCTION COSTS	401,753,500			
	401,753,500	**401,753,500**		
FIELD OFFICE OVERHEAD	32,140,280			8.00 %
	32,140,280	**433,893,780**		
HOME OFFICE OVERHEAD	13,016,813			3.00 %
CONTINGENCY	130,168,134			30.00 %
	143,184,947	**577,078,727**		
MARGIN	46,166,298			8.00 %
	46,166,298	**623,245,025**		
BUILDER'S ALL RISK INSURANCE	6,232,450			1.00 %
LIABILITY INSURANCE	12,464,901			2.00 %
BOND	12,464,901			2.00 %
TOTAL CONSTRUCTION	**31,162,252**	**654,407,277**		
LAND (PURCHASE)	9,750,000			
LAND (EASEMENTS)	625,000			
ENVIRONMENTAL MITIGATION	32,720,364			5.00 %
RECREATIONAL FACILITIES	19,632,218			3.00 %
PROGRAM COSTS	163,601,819			25.00 %
	226,329,401	**880,736,678**		
Total		***880,736,678***		

U.S. Bureau of Reclamation
San Luis Reservoir Low Point Improvement Project
PFR - Pacheco R

Project name	BuRec- San Luis Reservoir San Luis Reservoir CA
Estimator	Nick Agnew
Labor rate table	CA08 Santa Clara
Equipment rate table	00 071H Equip Rental
Report format	Sorted by 'Alternate/Area/Division' 'Detail' summary Combine items Paginate

Alternate	Division	Description	Takeoff Quantity	Total Cost/Unit	Total Amount
		Pacheco Reservoir - 80 TAF w/ Landslide Remediation			
		Regulating Tank			
	13	**Special Construction**			
		3 MG Steel Tank @ Pump Station	1.00 allw	5,000,000.00 /allw	5,000,000
		13 Special Construction			**5,000,000**
		Regulating Tank			**5,000,000**
		Pacheco Conduit Tie-in			
	02	**Site Construction**			
		Connection into Existing Pacheco Conduit	1.00 allw	2,000,000.00 /allw	2,000,000
		02 Site Construction			**2,000,000**
		Pacheco Conduit Tie-in			**2,000,000**
		Conveyance Pipeline: Pacheco Conduit-Pump Station			
	15	**Mechanical**			
		108" Pipeline - Pacheco Conduit to Highway 152	200.00 lf	1,650.00 /lf	330,000
		Bore and Jack Tunnel - 132" Casing, under Highway 152	500.00 lf	3,300.00 /lf	1,650,000
		108" Carrier Pipe - under Highway 152	500.00 lf	864.00 /lf	432,000
		108" Pipeline - Highway 152 to Pump Station	3,150.00 lf	1,650.00 /lf	5,197,500
		15 Mechanical			**7,609,500**
		Conveyance Pipeline: Pacheco Conduit-Pump Station			**7,609,500**
		Pacheco Reservoir Pump Station			
	11	**Equipment**			
		Pump Station	13,750.00 hp	1,500.00 /hp	20,625,000
		11 Equipment			**20,625,000**
	15	**Mechanical**			
		Valve Yard Piping - 2 way Pump Station	1.00 allw	5,000,000.00 /allw	5,000,000
		15 Mechanical			**5,000,000**
		Pacheco Reservoir Pump Station			**25,625,000**
		Conveyance from Pump Station to Inlet/Outlet Structure			
	15	**Mechanical**			
		132" Pipeline - Pump Station to Toe of Dam	470.00 lf	1,850.00 /lf	869,500
		216" Walk in Tunnel w/ 192" Useable - Toe of Dam to Valve Chamber	750.00 lf	7,200.00 /lf	5,400,000
		132" Carrier Pipe - Toe of Dam to Valve Chamber	750.00 lf	396.00 /lf	297,000
		156" Standard Tunnel w/ 132" Useable - Valve Chamber to Upstream Toe of Dam	950.00 lf	5,400.00 /lf	5,130,000
		15 Mechanical			**11,696,500**
		Conveyance from Pump Station to Inlet/Outlet Structure			**11,696,500**
		Inlet/Outlet Structures			
	15	**Mechanical**			
		Sloping Intake/Outlet with Controls and Valving	1.00 allw	6,000,000.00 /allw	6,000,000
		Outlet Control Structure	1.00 allw	2,000,000.00 /allw	2,000,000
		15 Mechanical			**8,000,000**
		Inlet/Outlet Structures			**8,000,000**
		New Dam and Reservoir			
	02	**Site Construction**			
		Clearing of Reservoir, Borrow and Haul Road Areas	1,800.00 acre	3,000.00 /acre	5,400,000
		Restoration of Borrow and Haul Roads	500.00 acre	3,050.00 /acre	1,525,000
		Removal of Existing North Fork Pacheco Dam / Placement of Material as Random Fill	325,000.00 cy	4.00 /cy	1,300,000
		Haul Road Construction	7.00 mile	350,000.00 /mile	2,450,000
		Foundation Preparation for Footprint of Dam	224,000.00 sy	10.00 /sy	2,240,000
		Foundation Preparation for Spillway and Sloping Intake	4,300.00 sy	25.00 /sy	107,500
		Grouting of Dam Foundation	1.00 allw	10,000,000.00 /allw	10,000,000
		Common Excavation/Stripping	1,630,000.00 cy	3.50 /cy	5,705,000
		Excavation for Spillway/Stilling Basin	303,000.00 cy	5.00 /cy	1,515,000
		Construction of Coffer Dam	865,000.00 cy	8.00 /cy	6,920,000
		Impervious Core	2,990,000.00 cy	10.00 /cy	29,900,000
		Filter and Drain	1,880,000.00 ton	30.00 /ton	56,400,000
		Random Fill	10,010,000.00 cy	9.00 /cy	90,090,000
		Rip Rap	246,000.00 ton	45.00 /ton	11,070,000
		Other Dam Costs - Access Road, Rip-Rap Lined Channel	1.00 allw	3,000,000.00 /allw	3,000,000
		Concrete for Spillway	10,000.00 cy	650.00 /cy	6,500,000
		Hypolimnetic Aeration	1.00 allw	3,000,000.00 /allw	3,000,000
		Other Miscellaneous Structures and Improvements (6% of Dam & Spillway Costs)	1.00 allw	20,250,000.00 /allw	20,250,000
		02 Site Construction			**257,372,500**
		New Dam and Reservoir			**257,372,500**
		Landslide Remediation			
	02	**Site Construction**			
		Landslide Excavation	14,100,000.00 cy	3.50 /cy	49,350,000
		Landslide Fill	11,600,000.00 cy	5.00 /cy	58,000,000
		02 Site Construction			**107,350,000**
		Landslide Remediation			**107,350,000**
		Substations			
	16	**Electrical**			
		High Voltage Substation	1.00 allw	4,000,000.00 /allw	4,000,000
		Transmission Line	16.00 mile	500,000.00 /mile	8,000,000
		16 Electrical			**12,000,000**
		Substations			**12,000,000**
		Pacheco Reservoir - 80 TAF w/ Landslide Remediation			**436,653,500**

Estimate Totals

Description	Amount	Totals	Hours	Rate
CONSTRUCTION COSTS	436,653,500			
	436,653,500	**436,653,500**		
FIELD OFFICE OVERHEAD	34,932,280			8.00 %
	34,932,280	**471,585,780**		
HOME OFFICE OVERHEAD	14,147,573			3.00 %
CONTINGENCY	141,475,734			30.00 %
	155,623,307	**627,209,087**		
MARGIN	50,176,727			8.00 %
	50,176,727	**677,385,814**		
BUILDER'S ALL RISK INSURANCE	6,773,858			1.00 %
LIABILITY INSURANCE	13,547,716			2.00 %
BOND	13,547,716			2.00 %
TOTAL CONSTRUCTION	**33,869,290**	**711,255,104**		
LAND (PURCHASE)	9,750,000			
LAND (EASEMENTS)	625,000			
ENVIRONMENTAL MITIGATION	35,562,755			5.00 %
RECREATIONAL FACILITIES	21,337,653			3.00 %
PROGRAM COSTS	177,813,776			25.00 %
	245,089,184	**956,344,288**		
Total		***956,344,288***		

U.S. Bureau of Reclamation
San Luis Reservoir Low Point Improvement Project
PFR - Pacheco I

Project name	BuRec- San Luis Reservoir San Luis Reservoir CA
Estimator	Nick Agnew
Labor rate table	CA08 Santa Clara
Equipment rate table	00 071H Equip Rental
Report format	Sorted by 'Alternate/Area/Division' 'Detail' summary Combine items Paginate

Alternate	Division	Description	Takeoff Quantity	Total Cost/Unit	Total Amount
		Pacheco Reservoir - 80 TAF w/o Landslide Remediation			
		Regulating Tank			
	13	**Special Construction**			
		3 MG Steel Tank @ Pump Station	1.00 allw	5,000,000.00 /allw	5,000,000
		13 Special Construction			**5,000,000**
		Regulating Tank			**5,000,000**
		Pacheco Conduit Tie-in			
	02	**Site Construction**			
		Connection into Existing Pacheco Conduit	1.00 allw	2,000,000.00 /allw	2,000,000
		02 Site Construction			**2,000,000**
		Pacheco Conduit Tie-in			**2,000,000**
		Conveyance Pipeline: Pacheco Conduit-Pump Station			
	15	**Mechanical**			
		108" Pipeline - Pacheco Conduit to Highway 152	200.00 lf	1,650.00 /lf	330,000
		Bore and Jack Tunnel - 132" Casing, under Highway 152	500.00 lf	3,300.00 /lf	1,650,000
		108" Carrier Pipe - under Highway 152	500.00 lf	864.00 /lf	432,000
		108" Pipeline - Highway 152 to Pump Station	3,150.00 lf	1,650.00 /lf	5,197,500
		15 Mechanical			**7,609,500**
		Conveyance Pipeline: Pacheco Conduit-Pump Station			**7,609,500**
		Pacheco Reservoir Pump Station			
	11	**Equipment**			
		Pump Station	13,750.00 hp	1,500.00 /hp	20,625,000
		11 Equipment			**20,625,000**
	15	**Mechanical**			
		Valve Yard Piping - 2 way Pump Station	1.00 allw	5,000,000.00 /allw	5,000,000
		15 Mechanical			**5,000,000**
		Pacheco Reservoir Pump Station			**25,625,000**
		Conveyance from Pump Station to Inlet/Outlet Structure			
	15	**Mechanical**			
		132" Pipeline - Pump Station to Toe of Dam	470.00 lf	1,850.00 /lf	869,500
		216" Walk in Tunnel w/ 192" Useable - Toe of Dam to Valve Chamber	750.00 lf	7,200.00 /lf	5,400,000
		132" Carrier Pipe - Toe of Dam to Valve Chamber	750.00 lf	396.00 /lf	297,000
		156" Standard Tunnel w/ 132" Useable - Valve Chamber to Upstream Toe of Dam	950.00 lf	5,400.00 /lf	5,130,000
		15 Mechanical			**11,696,500**
		Conveyance from Pump Station to Inlet/Outlet Structure			**11,696,500**
		Inlet/Outlet Structures			
	15	**Mechanical**			
		Sloping Intake/Outlet with Controls and Valving	1.00 allw	6,000,000.00 /allw	6,000,000
		Outlet Control Structure	1.00 allw	2,000,000.00 /allw	2,000,000
		15 Mechanical			**8,000,000**
		Inlet/Outlet Structures			**8,000,000**
		New Dam and Reservoir			
	02	**Site Construction**			
		Clearing of Reservoir, Borrow and Haul Road Areas	1,800.00 acre	3,000.00 /acre	5,400,000
		Restoration of Borrow and Haul Roads	500.00 acre	3,050.00 /acre	1,525,000
		Removal of Existing North Fork Pacheco Dam / Placement of Material as Random Fill	325,000.00 cy	4.00 /cy	1,300,000
		Haul Road Construction	7.00 mile	350,000.00 /mile	2,450,000
		Foundation Preparation for Footprint of Dam	224,000.00 sy	10.00 /sy	2,240,000
		Foundation Preparation for Spillway and Sloping Intake	4,300.00 sy	25.00 /sy	107,500
		Grouting of Dam Foundation	1.00 allw	10,000,000.00 /allw	10,000,000
		Common Excavation/Stripping	1,630,000.00 cy	3.50 /cy	5,705,000
		Excavation for Spillway/Stilling Basin	303,000.00 cy	5.00 /cy	1,515,000
		Construction of Coffer Dam	865,000.00 cy	8.00 /cy	6,920,000
		Impervious Core	2,990,000.00 cy	10.00 /cy	29,900,000
		Filter and Drain	1,880,000.00 ton	30.00 /ton	56,400,000
		Random Fill	10,010,000.00 cy	9.00 /cy	90,090,000
		Rip Rap	246,000.00 ton	45.00 /ton	11,070,000
		Other Dam Costs - Access Road, Rip-Rap Lined Channel	1.00 allw	3,000,000.00 /allw	3,000,000
		Concrete for Spillway	10,000.00 cy	650.00 /cy	6,500,000
		Hypolimnetic Aeration	1.00 allw	3,000,000.00 /allw	3,000,000
		Other Miscellaneous Structures and Improvements (6% of Dam & Spillway Costs)	1.00 allw	20,250,000.00 /allw	20,250,000
		02 Site Construction			**257,372,500**
		New Dam and Reservoir			**257,372,500**
		Substations			
	16	**Electrical**			
		High Voltage Substation	1.00 allw	4,000,000.00 /allw	4,000,000
		Transmission Line	16.00 mile	500,000.00 /mile	8,000,000
		16 Electrical			**12,000,000**
		Substations			**12,000,000**
		Pacheco Reservoir - 80 TAF w/o Landslide Remediation			**329,303,500**

Estimate Totals

Description	Amount	Totals	Hours	Rate
CONSTRUCTION COSTS	329,303,500			
	329,303,500	**329,303,500**		
FIELD OFFICE OVERHEAD	26,344,280			8.00 %
	26,344,280	**355,647,780**		
HOME OFFICE OVERHEAD	10,669,433			3.00 %
CONTINGENCY	106,694,334			30.00 %
	117,363,767	**473,011,547**		
MARGIN	37,840,924			8.00 %
	37,840,924	**510,852,471**		
BUILDER'S ALL RISK INSURANCE	5,108,525			1.00 %
LIABILITY INSURANCE	10,217,049			2.00 %
BOND	10,217,049			2.00 %
TOTAL CONSTRUCTION	**25,542,623**	**536,395,094**		
LAND (PURCHASE)	9,750,000			
LAND (EASEMENTS)	625,000			
ENVIRONMENTAL MITIGATION	26,819,755			5.00 %
RECREATIONAL FACILITIES	16,091,853			3.00 %
PROGRAM COSTS	134,098,774			25.00 %
	187,385,382	**723,780,476**		
Total		***723,780,476***		

Combination Alternative - Capital Costs

ASR Wells

	Takeoff Quantity		Unit Cost	
West Side Extraction/Injection Wells	20	ea	$ 1,350,000.00	$ 27,000,000
East Side Extraction/Injection Wells	20	ea	$ 1,350,000.00	$ 27,000,000
Additional Wells - Non-site specific	50	ea	$ 1,350,000.00	$ 67,500,000
21" Water Distribution Line	10000	LF	$ 2,950.00	$ 29,500,000
				$ 151,000,000
Contingency (30%)				$ 45,300,000
Subtotal				$ 196,300,000
Program and Environmental Mitigation Costs (25%, 3%)				$ 54,964,000
Land Acquisition				$ 15,651,500
Total Project Cost				$ 266,915,500

East Contra Costa Desal O&M (65 mgd)

Construction Cost (see detail)	$ 210,321,000
Contingency (30%)	$ 63,096,300
Subtotal	$ 273,417,300
Program and Environmental Mitigation Costs (25%, 3%)	$ 76,556,844
Total	$ 349,974,144

SCVWD Share of East Contra Costa O&M (10 MGD)

Construction Cost (see detail)	$ 53,800,000

Recharge Facilities

Construction Cost (see detail)	$ 59,987,000
Contingency (30%)	$ 17,996,100
Subtotal	$ 77,983,100
Program and Environmental Mitigation Costs (25%, 3%)	$ 21,835,268
Land Acquisition	$ 57,500,000
Total Project Cost	$ 157,318,368

Total Construction Costs

ASR Wells	$ 266,900,000
East Contra Costa Desal	$ 53,800,000
Recharge Facilities	$ 157,300,000
Total Construction Costs	$ 478,000,000

Bureau of Reclamation
East Contra Costa Desalination Facility - 65 MGD
PDR

Project name	BuRec -Contra Costa Desal Contra Costa CA
Estimator	Nick Agnew
Labor rate table	CA08 Santa Clara
Equipment rate table	00 081H R Equip Rate
Bid date	8/5/2008
Notes	Assumptions: 1. All Unit Costs are fully burdened with the contractors Overhead, Profit, Bonds and Insurance.
Report format	Sorted by 'Area/Division' 'Detail' summary Combine items

Division	Description	Takeoff Quantity	Total Cost/Unit	Total Amount
	Raw Water Supply Facilities			
15	**Mechanical**			
	Intake Tie-in & Facilites	1.00 lot	5,240,000.00 /lot	5,240,000
	15 Mechanical			**5,240,000**
	Raw Water Supply Facilities			**5,240,000**
	Filtration & Reverse Osmosis			
11	**Equipment**			
	Filtrate - $0.60/gpd	1.00 lot	55,800,000.00 /lot	55,800,000
	First Pass Brackish Water Reverse Osmosis - $0.90/gpd	1.00 lot	58,500,000.00 /lot	58,500,000
	Second Pass Brackish Water Reverse Osmosis - $0.72/gpd	1.00 lot	6,500,000.00 /lot	6,500,000
	11 Equipment			**120,800,000**
	Filtration & Reverse Osmosis			**120,800,000**
	Concentrate Disposal Facilites			
11	**Equipment**			
	Concentrate Disposal Facilites	1.00 lot	2,400,000.00 /lot	2,400,000
	11 Equipment			**2,400,000**
	Concentrate Disposal Facilites			**2,400,000**
	Product Water Pipeline & Pump Station			
04	**Architectural**			
	Pump Station Building	1.00 lot	1,500,000.00 /lot	1,500,000
	04 Architectural			**1,500,000**
11	**Equipment**			
	Pumps - 1,600 hp	4.00 ea	400,000.00 /ea	1,600,000
	11 Equipment			**1,600,000**
13	**Special Construction**			
	Steel Storage Tank - 36' dia x 33' high	1.00 ea	1,875,000.00 /ea	1,875,000
	13 Special Construction			**1,875,000**
15	**Mechanical**			
	54" Welded Steel Pipeline - open space, no ROW cost	7,000.00 lf	1,190.00 /lf	8,330,000
	54" Welded Steel Pipeline	4,400.00 lf	1,790.00 /lf	7,876,000
	15 Mechanical			**16,206,000**
	Product Water Pipeline & Pump Station			**21,181,000**
	Chemical Feed Facilities			
11	**Equipment**			
	Chemical Feed Systems - 3%	1.00 lot	5,800,000.00 /lot	5,800,000
	11 Equipment			**5,800,000**
	Chemical Feed Facilities			**5,800,000**
	Buildings & Site Modifications			
02	**Sitework**			
	Site Civil	1.00 lot	9,800,000.00 /lot	9,800,000
	02 Sitework			**9,800,000**
04	**Architectural**			
	Site Structures - 5%	1.00 lot	9,800,000.00 /lot	9,800,000
	04 Architectural			**9,800,000**
	Buildings & Site Modifications			**19,600,000**
	Electrical and Instrumentation			
16	**Electrical**			
	Electrical and Instrumentation - 15%	1.00 lot	26,300,000.00 /lot	26,300,000
	16 Electrical			**26,300,000**
	Electrical and Instrumentation			**26,300,000**

Estimate Totals

Description	Amount	Totals	Hours	Rate
CONSTRUCTION COST	201,321,000			
	201,321,000	**201,321,000**		
CONTINGENCY	60,396,300			30.000 %
	60,396,300	**261,717,300**		
PROGRAM COSTS	65,429,325			25.000 %
ENVIRONMENTAL MITIGATION	7,851,519			3.000 %
	73,280,844	**334,998,144**		
Total		***334,998,144***		

Bureau of Reclamation
Recharge Facility

Project name	BuRec-Recharge Facility CA
Estimator	Nick Agnew
Labor rate table	CA08 Santa Clara
Equipment rate table	00 081H R Equip Rate
Bid date	8/5/2008
Report format	Sorted by 'Area/Division' 'Detail' summary Combine items

Area	Division	Description	Takeoff Quantity	Total Cost/Unit	Total Amount
01		**Recharge Facility**			
	02	**Site Construction**			
		Clear, Grub & General Grading	50.00 acre	8,050.00 /acre	402,500
		Excavation of Ponds	484,000.00 cy	20.00 /cy	9,680,000
		Disposal of graded material	242,000.00 cy	80.00 /cy	19,360,000
		Landscaping	2.00 acre	50,000.00 /acre	100,000
		02 Site Construction			**29,542,500**
	15	**Mechanical**			
		24" Conveyance Pipeline	25,000.00 lf	600.00 /lf	15,000,000
		15 Mechanical			**15,000,000**
		01 Recharge Facility			**44,542,500**

Estimate Totals

Description	Amount	Totals	Hours	Rate
CONSTRUCTION COSTS	44,542,500			
	44,542,500	**44,542,500**		
FIELD OFFICE OVERHEAD	4,454,250			10.000 %
	4,454,250	**48,996,750**		
HOME OFFICE OVERHEAD	2,939,805			6.000 %
	2,939,805	**51,936,555**		
MARGIN	5,193,656			10.000 %
	5,193,656	**57,130,211**		
BUILDER'S RISK INSURANCE	571,302			1.000 %
GENERAL LIABILITY INSURANCE	1,142,604			2.000 %
BONDS	1,142,604			2.000 %
	2,856,510	**59,986,721**		
CONTINGENCY	17,996,016			30.000 %
	17,996,016	**77,982,737**		
PROGRAM COSTS	19,495,684			25.000 %
ENVIRONMENTAL MITIGATION	2,339,482			3.000 %
	21,835,166	**99,817,903**		
LAND ACQUISITION	57,500,000			
	57,500,000	**157,317,903**		
Total		***157,317,903***		

Combination Alternative - Operating and Maintenance Costs

ASR Wells

	Takeoff Quantity		Unit Cost	
Site Monitoring and Maintenance Personnel - Per Year	7	ea	$ 90,000.00	$ 630,000
Well Cleaning - Every 10 Years per Well	70	ea	$ 2,000.00	$ 140,000
Power	70	ea	$ 1,900.00	$ 133,000
Miscellaneous Maintenance (2% of construction cost)	1	LS	$ 3,020,000.00	$ 3,020,000
				$ 3,923,000

East Contra Costa Desal O&M (65 mgd)

Site Monitoring and Maintenance Personnel - Per Year	16	ea	$ 90,000.00	$ 1,440,000
Power - 65 MGD, 7,500 kWh/MG	23725	MGY	$ 600.00	$ 14,235,000
Membrane Replacement	1	LS	$ 2,820,000.00	$ 2,820,000
Chemical Feed Systems	1	LS	$ 5,890,000.00	$ 5,890,000
Miscellaneous Maintenance (2% of Construction cost)	1	LS	$ 4,000,000.00	$ 4,000,000
				$ 28,385,000

SCVWD Share of East Contra Costa O&M (10 MGD)

Non-Power Costs				$ 2,200,000
Power Costs	2900	MGY	$ 600.00	$ 1,740,000
				$ 3,940,000

Recharge Facilities

Site Monitoring and Maintenance Personnel - Per Year	0.5	ea	$ 90,000.00	$ 45,000
Basin Dredging - every 5 years	50	ac	$ 37,000.00	$ 1,850,000
Miscellaneous Maintenance (2% of construction cost)	1	LS	$ 1,200,000.00	$ 1,200,000
				$ 3,095,000

Total O&M Costs

ASR Wells	$ 3,923,000
East Contra Costa Desal	$ 3,940,000
Recharge Facilities	$ 3,095,000
Total O&M Costs	$ 10,958,000