INITIAL ALTERNATIVES INFORMATION REPORT

Los Vaqueros Expansion Investigation, California

September 2005

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

CONTRA COSTA WATER DISTRICT

EXECUTIVE SUMMARY

The primary purpose of this Initial Alternatives Information Report (IAIR) is to document the first phase of feasibility studies for the Los Vaqueros Expansion Investigation (LVE). Specifically, this report describes formulation of initial alternative plans to address the problems, opportunities, and planning objectives identified for the LVE that primarily involve enlarging Los Vaqueros Reservoir in Contra Costa County.

BACKGROUND

The United States Department of the Interior, Bureau of Reclamation (Reclamation), California Department of Water Resources (DWR), and Contra Costa Water District (CCWD) began appraisal-level studies in 2001 of the potential to expand Los Vaqueros Reservoir to address regional water quality and supply reliability needs. Expanding Los Vaqueros is one of five potential surface water storage projects identified by the CALFED Bay-Delta Program (CALFED) as warranting further study. Reclamation was directed in Public Law 108-7 (Omnibus Appropriations Act of 2003) to conduct a feasibility-level investigation of the potential expansion of Los Vaqueros Reservoir. Initial results of the first phase of the feasibility investigation are described in this IAIR.

CCWD is the owner and operator of the existing Los Vaqueros Dam and Reservoir, which has a total capacity of 100,000 acre-feet and is located in the Kellogg Creek watershed of Contra Costa County, California. Construction of the existing facility was completed in 1997 to address seasonal water quality degradation associated with CCWD's Sacramento-San Joaquin Delta (Delta) water supplies. The reservoir also provides emergency supply storage and, as secondary benefits, recreation and flood control.

Los Vaqueros Reservoir

As the demand for water in California increases in the future, water resource conflicts in the Delta are likely to intensify. Like many Delta water users, agencies in the San Francisco Bay Area (Bay Area) rely on a variety of local and imported water sources to meet their growing demands. But despite aggressive conservation programs, surface and groundwater storage programs, and water transfer agreements, Bay Area water agencies face substantial cutbacks in water supplies during dry and critically dry years, and degradation in water quality during certain periods.

In recognition of environmental and water resource conflicts in the Delta, a consortium of Federal and State agencies collaborated to create the CALFED Bay-Delta Program. The CALFED Programmatic Record of Decision (ROD), dated August 28, 2000, describes a long-

term comprehensive plan to restore the ecological health of the San Francisco Bay/Delta system and improve water management for all beneficial uses. The Storage Program, one of numerous program elements described in the ROD, identified investigating five potential surface water storage projects: raising Shasta Dam, offstream storage north of the Delta, increased storage in the upper San Joaquin River basin, in-Delta storage, and expansion of Los Vaqueros Reservoir. The CALFED ROD recognized that expanding the existing capacity of Los Vaqueros Reservoir by as much as 400,000 acre-feet could contribute to improving the quality and reliability of Bay Area drinking water supplies delivered from the Delta.

Another program element of the CALFED ROD is the Environmental Water Account (EWA), which facilitates pumping curtailments in the south Delta and other changes to Central Valley Project (CVP) and State Water Project (SWP) operations, to protect at-risk fisheries. To date, the short-term EWA has relied on transfer market water purchases and short-term transfer agreements to secure water supplies for EWA actions. It is expected that some form of the EWA will continue in the future with a primary focus on offsetting water delivery reductions resulting from regulatory actions that curtail Delta pumping to protect at-risk fish. However, a great deal of uncertainty exists regarding the cost of water for programs such as the EWA in the future. Accordingly, an opportunity exists to evaluate whether an expanded Los Vaqueros Reservoir, as part of a regional water resources project, could provide a less-costly and more reliable source of replacement water to the EWA or a similar long-term program. In addition to cost, an expanded Los Vaqueros Reservoir could also provide dedicated storage and conveyance capacity for the EWA, rather than relying on surplus storage space in CVP and SWP reservoirs and surplus south Delta pumping capacity to store and move EWA assets.

Growing demands for additional water supplies and the need for effectively implementing the EWA program consistent with the intent of the CALFED ROD prompted Reclamation and DWR, in cooperation with CCWD, to begin a Federal feasibility investigation in 2003 of the potential expansion of Los Vaqueros Reservoir. The LVE has the following mission:

> *The purpose of the Los Vaqueros Expansion Investigation is to identify and evaluate opportunities to increase drought period water supply reliability for Bay Area water providers; provide a less-costly environmental water supply to facilitate EWA fish protection and recovery actions in the Delta; and, to the extent possible through exploring these opportunities, improve the quality of water delivered to Bay Area water users.*

Reclamation and DWR are the Federal and State agencies conducting the investigation, respectively. CCWD, as owner of the existing Los Vaqueros Project, also has an integral role in the LVE, and has worked under contract to DWR and Reclamation to perform engineering studies and environmental review.

STUDY AREA

The study area for the LVE includes the Los Vaqueros Reservoir watershed and associated dam and reservoir facilities, which are situated in the coastal foothills west of the Delta and east of the Bay Area, the central and south Delta, and service areas of Bay Area water agencies that may be

directly affected by the project. The Bay Area water agencies that may be directly affected include CCWD, Alameda County Water District, Santa Clara Valley Water District, and Alameda County Flood Control and Water Conservation District, Zone 7. Due to the potential influence on other programs and projects, an extended study area includes the service areas of other Bay Area water agencies and the Central Valley of California. Other Bay Area water agencies that may be indirectly affected by the project include East Bay Municipal Utility District and the San Francisco Public Utilities Commission.

PLAN FORMULATION PROCESS

The Federal planning process for the LVE is divided into three major phases: the Initial Plans Phase (documented herein), Alternative Plans Phase, and Recommended Plan Phase. **Figure ES-1** illustrates the relationship of the three LVE phases, including their primary focus and resulting summary documentation.

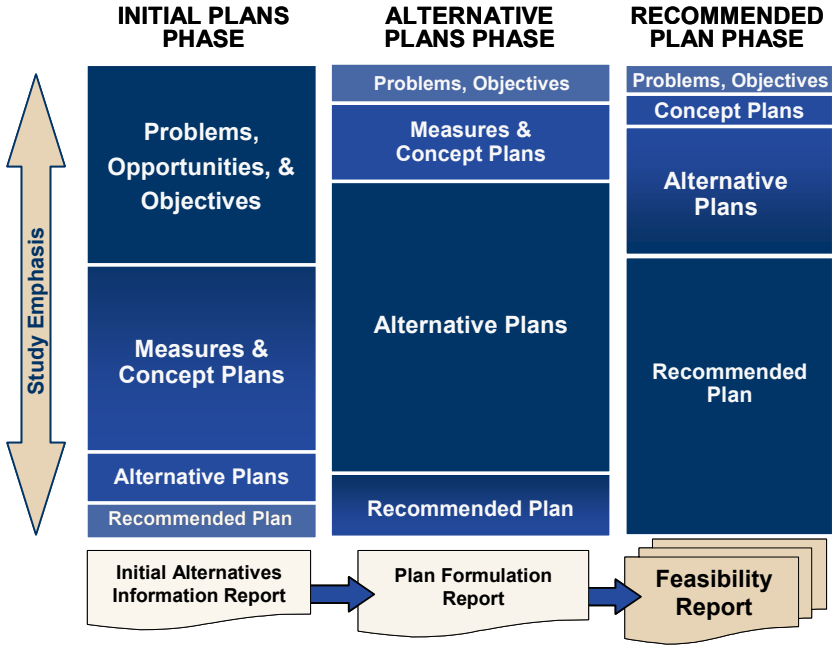

FIGURE ES-1 – PLAN FORMULATION PROCESS

This IAIR describes the formulation of initial plans to address planning objectives identified for the LVE. From these initial plans, comprehensive alternative plans will be developed in later phases of the investigation, and documented in greater detail in the ensuing Plan Formulation Report and Feasibility Report. The planning process for the LVE is consistent with the Federal *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*. The scope of the IAIR and location in the document where topics are discussed are as follows:

- Description of existing and likely future without-project water resources conditions in the study area (**Chapter III**).
- Identification of the water resources problems and opportunities being addressed in the LVE (**Chapter IV**).
- Development of planning objectives to address identified problems and opportunities and planning constraints and criteria (**Chapter V**).
- Identification and evaluation of individual resource management measures to address each planning objective (**Chapter VI**).
- Formulation of a set of concept plans representing a range of potential actions (**Chapter VII**).
- From these plans, identification of initial alternatives to be further developed in the LVE (**Chapter VIII**).

The IAIR should be considered a work-in-progress document that will evolve as the investigation progresses into a Federal Feasibility Report. Consequently, the conclusions herein are expected to mature as additional studies and evaluations are conducted. While this document was drafted specifically to inform Federal decision-makers on subjects relevant to potential Federal participation in the project, it also may provide useful information to participating non-Federal agencies and stakeholders.

STUDY OBJECTIVES

The following objectives were developed on the basis of the identified problems and opportunities in the study area in relation to study authorities, Federal planning guidance, and Reclamation direction:

- *Increase water supply reliability for water providers within the study area, principally to help meet municipal and industrial water demands during drought periods, with a focus on enlarging Los Vaqueros Reservoir.*
- *Use an expanded Los Vaqueros Reservoir to develop replacement water supplies for the long-term Environmental Water Account, if the cost of water provided from an expanded reservoir is found to be less than the cost of water for continued implementation of that program.*
- *To the extent possible through pursuit of the water supply reliability and environmental water objectives, improve the quality of water deliveries to municipal and industrial customers in the study area.*

In addition to the study objectives, various planning constraints, principles, and criteria were identified to help guide the investigation. CCWD Board of Director's Resolution No. 03-24, June 25, 2003, provides important guidance for identifying and evaluating plans involving the expansion of Los Vaqueros Reservoir (see **Chapters II** and **XI** for resolution and related ballot language and discussion of CCWD's principles of participation).

RESOURCE MANAGEMENT MEASURES

A resource management measure is any structural or non-structural action that could address one or more of the planning objectives. Over 30 measures were identified to address the objectives of the LVE. Nine measures were selected for further consideration and development and potential inclusion in concept plans, as summarized in **Table ES-1**.

TABLE ES-1
MEASURES RETAINED TO ADDRESS PLANNING OBJECTIVES

Planning Objectives Addressed	Resource Management Measures Retained	
Bay Area Water Supply Reliability	Raise Los Vaqueros Dam In-Place	Increase storage space in Los Vaqueros Reservoir by up to 25,000 acre-feet by raising the height of the existing dam in-place
	Enlarge Los Vaqueros Dam and Reservoir	Increase storage space in Los Vaqueros Reservoir by up to 400,000 acre-feet by removing and replacing the existing dam with a substantially larger facility
	Increase Delta Diversion Capacity	Increase the capacity of Delta diversion(s) to Bay Area users
	Construct Intertie from Los Vaqueros Reservoir to the Dyer Canal	Construct a new pipeline and pump station to convey water from Los Vaqueros to the Dyer Canal segment of the South Bay Aqueduct
	Desalination	Develop desalination and associated conveyance facilities in Bay-Delta or Pacific locations(s)
Less-Costly EWA Replacement Supply	Enlarge Los Vaqueros Reservoir	Enlarge Los Vaqueros Reservoir to store surplus Delta flows for later EWA use
	Construct Intertie from Los Vaqueros Reservoir to Bethany Reservoir	Construct a new gravity pipeline to convey stored water from Los Vaqueros to Bethany Reservoir
	Construct Intertie from Los Vaqueros Reservoir to the Dyer Canal	Construct a new pipeline and pump station to convey stored water from Los Vaqueros to the Dyer Canal segment of the South Bay Aqueduct
Water Quality	Reservoir / Delivery System Reoperation	Reoperate an enlarged Los Vaqueros Reservoir to improve delivered water quality

KEY: Bay Area = San Francisco Bay Area EWA = Environmental Water Account
Bay-Delta = San Francisco Bay / Sacramento – San Joaquin Delta Estuary

CONCEPT PLANS

Eight concept plans were formulated from the retained management measures shown in **Table ES-1**, representing an array of different strategies to address the planning objectives consistent with the planning criteria, constraints, and principles. The concept plans are intended to promote discussion and help identify concepts that warrant further development into complete alternative plans, with input from participating agencies, stakeholders, and the public. The concept plans are not considered complete alternative plans for various reasons, but primarily because facility sizes have not been refined and specific impacts and mitigation measures have not been identified. The concept plans are highlighted below and their major features, accomplishments, and costs are summarized in **Table ES-2.**

TABLE ES-2
CONCEPT PLAN FEATURES, ACCOMPLISHMENTS, AND COSTS

Concept Plan Focus	Bay Area Water Supply Reliability			EWA Replacement Supply		Combined Objectives		
Item	1 Raise Los Vaqueros Dam In-Place	2 Enlarge Los Vaqueros Dam & Reservoir	3 Desalination w/ Storage (Enlarge Los Vaqueros)	4 Enlarge Los Vaqueros with Dyer Canal Intertie	5 Enlarge Los Vaqueros with Bethany Reservoir Intertie	6 Water Supply/ EWA Combination w/ Dyer Canal Intertie	7 Water Supply/ EWA Combination w/ Bethany Reservoir Intertie	8 Water Supply/ EWA Combination w/ Water Quality
Concept Plan Features [1]								
Los Vaqueros Capacity (TAF)	125	500	500	500	500	500	500	500
Delta Pumping Capacity (cfs) [2]	750	750	750	1,000	1,750	1,750	1,750	1,750
Los Vaqueros Delivery Intertie Location	Dyer Canal	Dyer Canal	Dyer Canal	Dyer Canal	Bethany Reservoir	Dyer Canal	Bethany Reservoir	Dyer Canal
Desalination Capacity (mgd)	-	-	20	-	-	-	-	-
Accomplishments [3]								
Drought Period Yield (TAF/Year) [4]	43	95	110	-	-	34	19	47
Drought Period Shortage Reduction [5]	*28%*	*63%*	*72%*	-	-	*22%*	*13%*	*31%*
EWA Replacement Yield (TAF/year) [6]	-	-	-	140	190	142	173	81
Contribution to EWA [7]	-	-	-	*62%*	*84%*	*63%*	*77%*	*36%*
Decrease in Salinity (mg/L Cl) [8]	11	15	13	16	16	17	15	44 [11]
Costs ($ millions) [9]								
Total First Cost	470	1,050	1,260	1,170	1,470	1,540	1,470	1,540
Present Value Cost [10]	720	1,640	2,270	1,590	2,010	2,160	2,040	2,160

KEY: Cl = chlorides cfs = cubic feet per second EWA = Environmental Water Account mgd = million gallons per day mg/L = milligrams per liter TAF = thousand acre-feet

Notes:

1. *Reservoir storage, pumping, conveyance, and desalination capacities are preliminary estimates, and except as noted in Chapter VII, are sized considering cost efficiency.*
2. *Includes existing diversion and pumping capacity at Old River to Contra Costa Water District (CCWD) of 250 cfs.*
3. *Accomplishments of all concept plans (water supply reliability, EWA replacement, and water quality improvements) are in addition to the without-project condition, which includes Los Vaqueros Reservoir at 100,000 acre-feet, 250 cfs Delta diversion at Old River, and all deliveries made to meet CCWD demands.*
4. *Drought period is defined as October 1986 through September 1992. Future modeling will redefine period to be identical with CALFED Common Assumptions metrics.*
5. *Based on preliminary estimate of 2020 average annual drought period shortage in the region of 152,000 acre-feet; future studies will better quantify shortages in the area.*
6. *EWA replacement supply is based on average annual yield.*
7. *Contribution to EWA based on average annual EWA water acquisition goal of 225,000 acre-feet, consistent with the CVP and SWP Operations Criteria and Plan, 2004. The EWA typically purchases from 200,000 to 300,000 acre-feet per year.*
8. *Long-term average decrease in salinity for deliveries to the South Bay Aqueduct as compared to Clifton Court Forebay salinity values.*
9. *Preliminary cost estimates based on October 2004 pricing levels and rounded to nearest $10 million.*
10. *Includes first cost; interest during construction; and annual operation, maintenance, major replacement allowance, and energy costs computed at a present value over a 100-year period of analysis at 5-3/8 percent interest rate.*
11. *Water quality accomplishments will be reviewed with improved operating logic in future studies.*

The eight concept plans were divided into three sets to address the LVE objectives. The first set focuses on Bay Area water supply reliability, the second on providing a less-costly EWA replacement supply, and the third set of plans was developed to include a combination of measures to address multiple study objectives. Note that the concept plans are not complete alternative plans. Rather, these plans are intended to distinguish different ways the study objectives could be addressed, and to represent a range of potential actions. The facility sizes and combinations shown in the table were selected because they appear to be the most efficient and/or effective based on preliminary evaluations. However, specific facility sizes and combinations will be studied and refined for those plans carried into future phases of the LVE.

Concept Plans Focused on Bay Area Water Supply Reliability

Three concept plans (1 through 3) were formulated that focus on improving water supply reliability for Bay Area water users. These concept plans represent three fundamentally different strategies to address the water supply reliability objective using various combinations of the retained measures: a small dam raise strategy, a major reservoir expansion strategy, and a regional desalination strategy. Because each of the plans focusing on Bay Area water supply reliability also includes diverting water from the Delta during surplus flow conditions, when water quality is typically good, each of the plans also would provide water quality benefits.

1 – Raise Los Vaqueros Dam In-Place for Water Bay Area Supply Reliability – The focus of this concept plan is on increasing water supply reliability through a small raise of the existing Los Vaqueros Dam. Initial studies indicate that the existing dam could be raised by as much as 15 feet, without major reconstruction, to create up to 25,000 acre-feet of additional storage. Surplus Delta flows would be conveyed to the expanded reservoir through new central Delta diversion and conveyance facilities, and water deliveries from the reservoir to South Bay Aqueduct (SBA) agencies would be made via an intertie to the Dyer Canal segment of the SBA, as illustrated in **Figure ES-2**. The additional storage would improve dry-year water supply reliability for CCWD and SBA water agencies.

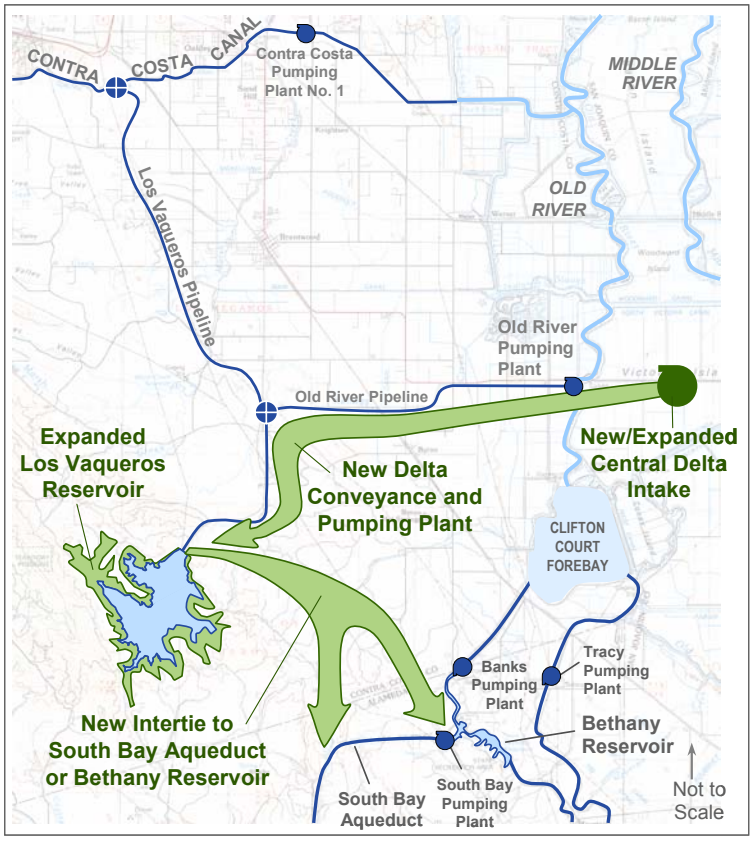

FIGURE ES-2 - ELEMENTS ASSOCIATED WITH AN EXPANSION OF LOS VAQUEROS RESERVOIR

2 – Enlarge Los Vaqueros Dam and Reservoir for Bay Area Water Supply Reliability – This concept plan includes a much larger expansion of Los Vaqueros Reservoir. It would require demolishing the existing dam and constructing a larger dam capable of storing as much as 400,000 acre-feet in addition to the existing 100,000-acre-foot Los Vaqueros Reservoir. Similar to the previous plan, surplus Delta flows would be conveyed to the expanded reservoir, and water would be delivered to SBA agencies through a new intertie to the Dyer Canal. This plan would improve dry-year water supply reliability for CCWD and SBA water agencies.

3 – Desalination with Storage (Enlarge Los Vaqueros Reservoir) for Bay Area Water Supply Reliability – The focus of this concept plan is on increasing water supply reliability through construction of a regional desalination facility in the Bay Area. The exact location and size of the desalination facility would be determined by future studies. Because desalination facilities are most efficient when operated continuously (rather than only during drought conditions, for example), dry period supply reliability benefits are achieved when desalination is combined with storage. In this way, a desalination plant would operate continuously and its supplies used in lieu of other base supplies; the exchanged base supplies, such as contract water, and any excess desalinated supplies would be stored for use during dry periods. For this reason and to take full advantage of a large-scale desalination facility, this plan includes new local storage, by enlarging Los Vaqueros Reservoir, for the purpose of storing excess desalinated water supplies and/or project water. Similar to previous plans, deliveries would be made from Los Vaqueros Reservoir to SBA agencies via a new intertie to the Dyer Canal.

Concept Plans Focused on EWA Replacement Supply

Two concept plans were developed specifically to provide a long-term replacement water supply for the EWA. Supplies developed by these plans would be used in lieu of transfer market purchases and short-term transfer agreements, the primary water acquisition methods used under the current program. In both plans, water would be diverted from the Delta during surplus flow conditions to an enlarged Los Vaqueros Reservoir. Contract deliveries would be made to SBA water users from the expanded reservoir; the resulting pumping reduction at Banks Pumping Plant then could be used either to deliver EWA supplies south of the Delta or to directly accommodate EWA fish actions (pumping curtailments) at the export facilities, as determined by the EWA agencies. Water supplies developed in the reservoir would effectively replace a portion of the EWA's south of Delta purchases. Both of the concept plans focused on EWA replacement supplies could provide incidental water quality benefits.

4 – Enlarge Los Vaqueros Reservoir with Dyer Canal Intertie for EWA – This plan is focused on providing a replacement water supply for a long-term EWA through enlarging the existing Los Vaqueros Reservoir by as much as 400,000 acre-feet and constructing an intertie between the expanded reservoir and the SBA at the Dyer Canal. Delta diversion and conveyance facilities would be enlarged to fill the expanded reservoir during periods of surplus Delta flow; these supplies would be delivered to SBA agencies in lieu of project deliveries via the South Bay Pumping Plant. The intertie would pump water from the expanded reservoir to the Dyer Canal segment of the SBA.

5 – Enlarge Los Vaqueros Reservoir with Bethany Reservoir Intertie for EWA – This concept plan is similar to the previous plan, but water would be delivered either from the expanded reservoir or directly from enlarging Delta pumping and conveyance facilities to the SWP's Bethany Reservoir. Supplies delivered to Bethany from the expanded reservoir via a gravity intertie then would be pumped to SBA agencies via the existing South Bay Pumping Plant, or through the California Aqueduct for other EWA purposes (such as storage in San Luis Reservoir or delivery to other CVP/SWP users impacted by EWA Delta pumping curtailments). A flow separation structure would prevent higher quality Los Vaqueros supplies being delivered to SBA users from mixing with lower quality Bethany Reservoir supplies.

It should be mentioned that a project including an intertie from Los Vaqueros to Bethany Reservoir would not gain local acceptability without certain operating constraints or restrictions that would satisfy the CCWD Principles of Participation (described in **Chapter II**), in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. Water could be supplied for the EWA through either reductions in Delta pumping to benefit fisheries, or replacing south of Delta EWA purchases. In addition, the project could not be operated in conjunction with a peripheral canal or to increase the export of water from Northern California. Just as would be required in the case of a Dyer Canal intertie, permit terms and conditions, as well as contractual arrangements, would be required to ensure that the CCWD principles are satisfied.

Concept Plans Focused on Combined Objectives

Three representative combination plans were formulated from the retained resource management measures to address multiple study objectives. All three combined objective plans provide both water supply reliability and EWA replacement supply benefits, and the third plan is formulated to provide additional water quality benefits.

6 – Water Supply / EWA Combination with Dyer Canal Intertie – This concept plan would provide both water supply reliability benefits and an EWA replacement supply through enlarging the existing Los Vaqueros Reservoir by as much as 400,000 acre-feet in combination with a new intertie to the Dyer Canal segment of the SBA. Delta diversion and conveyance capacity would be increased to supply the enlarged reservoir with surplus Delta flows. A portion of the additional storage space would be dedicated to improving dry period water supply reliability for CCWD and SBA users, and the remainder would be dedicated to EWA purposes.

7 – Water Supply / EWA Combination with Bethany Reservoir Intertie – Similar to the previous plan, this concept plan would provide both water supply reliability benefits and an EWA replacement supply, but a new intertie would connect the expanded reservoir with Bethany Reservoir. This plan would not gain local acceptability without requiring certain operating constraints or restrictions that would satisfy the CCWD principles, in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. Water could be supplied for the EWA through either reductions in Delta pumping to benefit fisheries, or replacing south of Delta EWA purchases. In addition, the project could not be operated in conjunction with a peripheral canal or to increase the export

of Delta water from Northern California. Just as would be required in the case of connection at the Dyer Canal, permit terms and conditions, as well as contractual arrangements, would be required to ensure that the CCWD principles are satisfied.

8 – Water Supply / EWA Combination with Water Quality Improvements – This concept plan would focus on providing water supply reliability and quality improvements and an EWA replacement supply. Facilities would be similar to the combined objective Concept Plan 6, including increased Delta diversion and conveyance capacity to the expanded reservoir and an intertie to the Dyer Canal segment of the SBA. Portions of the new storage space in Los Vaqueros Reservoir would be dedicated to Bay Area water supply reliability and EWA replacement supply purposes similar to the previous plans. However, unlike Concept Plan 6, the reservoir would be operated to provide additional water quality benefits for Bay Area users.

INITIAL ALTERNATIVES

The concept plans described above were compared against four general criteria: completeness, effectiveness, efficiency, and acceptability. This comparison is summarized in **Table ES-3**. An overall relative ranking of the concept plans also is presented in the table, which was used, along with other information, to determine if a concept plan should be considered further in the LVE plan formulation process. It is important to remember that there are many potential combinations of facility sizes (reservoir and pump station capacity, for example) that could be included in each concept plan described above. Accordingly, the recommendations in **Table ES-3** apply primarily to the combination of measures and facilities represented by each plan, with the assumption that appropriate facility sizes or applications will be refined in future studies.

Based on this comparison, and the ability of plans to address LVE study objectives, seven concept plans were identified for further consideration as initial alternatives in the LVE:

Concept Plan 1 - Raise Los Vaqueros Dam In-Place for Bay Area Water Supply Reliability

Concept Plan 2 - Enlarge Los Vaqueros Dam and Reservoir for Bay Area Water Supply Reliability

Concept Plan 4 - Enlarge Los Vaqueros with Dyer Canal Intertie for EWA

Concept Plan 5 - Enlarge Los Vaqueros Reservoir with Bethany Reservoir Intertie for EWA

Concept Plan 6 - Water Supply / EWA Combination with Dyer Canal Intertie

Concept Plan 7 - Water Supply / EWA Combination with Bethany Reservoir Intertie

Concept Plan 8 - Water Supply / EWA Combination with Water Quality Improvements

TABLE ES-3
SUMMARY COMPARISON OF CONCEPT PLANS

Concept Plans	Comparison Criteria				Overall Relative Ranking	Further Development Status
	Completeness	Effectiveness	Efficiency	Acceptability		
Bay Area Water Supply Reliability Focus						
1- Raise Los Vaqueros Dam In-Place for Water Supply Reliability	High	Low	Moderate	High	**Moderate**	Although lower yield, **identified for further development** because of very low implementation cost.
2- Enlarge Los Vaqueros Dam & Reservoir for Water Supply Reliability	High	Moderate	Moderate	High	**Moderate - High**	**Identified for further development** because of potential to address water supply reliability for Bay Area.
3- Desalination with Storage (Enlarge Los Vaqueros Reservoir) for Water Supply Reliability	Moderate	Moderate	Low - Moderate	Moderate	**Low - Moderate**	**Not identified for further consideration** as a stand-alone alternative because of highest cost per unit of output of any plan considered and potential difficulty to mitigate adverse impacts to acceptable levels. Desalination should, however, be considered as a potential increment of any plan if found to be economically viable and otherwise implementable.
EWA Replacement Supply Focus						
4- Enlarge Los Vaqueros with Dyer Canal Intertie for EWA	High	Low - Moderate	Moderate	Moderate - High	**Moderate**	Although not as efficient as an intertie to Bethany Reservoir, at this level of study this concept plan was retained and **identified for further development** .
5- Enlarge Los Vaqueros with Bethany Reservoir Intertie for EWA	High	Moderate - High	Moderate	Moderate- High	**Moderate - High**	**Identified for further development** primarily because it would yield the largest potential EWA replacement supply.
Combined Objective Focus						
6- Water Supply / EWA Combination with Dyer Canal Intertie	High	Moderate	Moderate- High	High	**High**	Although relatively low yields, **identified for further development** because of low to moderate unit costs for both supply reliability and EWA replacement supply.
7- Water Supply / EWA Combination with Bethany Reservoir Intertie	High	Moderate - High	Moderate- High	High	**High**	**Identified for further development** primarily because it would result in the lowest unit cost for EWA replacement supply, and has high potential for Federal interest.
8- Water Supply / EWA Combination with Water Quality Improvements	High	Moderate	Low - Moderate	High	**Moderate - High**	**Identified for further development** primarily because it is consistent with the plan in the CALFED ROD and balances study objectives.

KEY: CALFED = CALFED Bay-Delta Program EWA = Environmental Water Account ROD = Record of Decision

These initial alternatives represent starting points for further formulation of detailed alternative plans, to be evaluated and considered in the Feasibility Report and supporting documentation. Further studies will refine the plans and their components, including determining the most appropriate and efficient sizes, locations, and alignments of facilities. Desalination with new storage, represented in Concept Plan 3, was not identified for further development as a stand-alone alternative. However, it is believed that a desalination facility should be considered similar to other source water diversion and treatment options as a potential increment to detailed alternative plans to be developed in the next phase of study.

Each of the initial alternatives identified for further development contributes to increasing Bay Area water supply reliability and/or providing an EWA replacement supply, and all of the initial alternatives can contribute, to some degree, to improving delivered water quality. Since a Federal interest exists in participating in the EWA, a Federal interest may exist in enlarging Los Vaqueros Reservoir to accomplish similar goals. The degree and magnitude of the potential Federal interest in any alternative will need to be confirmed and quantified as part of future phases of the LVE. It is also believed that the initial alternatives recommended for further development in the next phase of the investigation could be formulated in a manner consistent with the CCWD Board of Directors Principles of Participation for a project involving the enlargement of Los Vaqueros Dam and Reservoir.

PROJECT MANAGEMENT AND PUBLIC INVOLVEMENT

Management of the LVE is carried out by a Study Management Team, which consists of project managers from Reclamation, DWR, and CCWD. This team is responsible for managing the feasibility investigation and preparing necessary decision documents, and briefing an Agency Coordination Work Group (ACWG) on progress and findings. The ACWG is composed of senior representatives from Federal, State, and local agencies, and provides comments and policy-level guidance to the Study Management Team. Day-to-day technical work on the LVE is supervised by a Project Coordination Team, which consists of leaders for the major disciplines: engineering, environmental compliance and analysis, plan formulation, modeling, public involvement, economics, and others, as needed.

Public involvement has been ongoing throughout the LVE, and a detailed public involvement program plan was developed as part of previous study efforts. Public meetings, newsletters, and briefings will continue to mark major milestones of the LVE. CCWD also maintains a Web Site (http://www.lvstudies.com) for information dissemination and sharing, solicitation of comments, event postings, and communication among team members.

FUTURE ISSUES AND IMPLEMENTATION FACTORS

Numerous institutional, agency, and local issues are likely to surface as the LVE progresses toward a Feasibility Report and project implementation. Many of these issues or concerns will become better defined and more appropriate for resolution once detailed alternative plans are developed. However, various issues have been identified that should be addressed early in the next phase of the LVE, as summarized below.

- DWR is the likely non-Federal sponsor for the LVE, in conjunction with other local interests. DWR staff are participating in the formulation of alternatives. For the State to effectively move forward as a potential non-Federal sponsor, DWR will need to continue to assess alternatives with respect to its participation in other surface water storage projects as part of CALFED.
- The LVE is following established Federal planning principles and practices, which include identifying a specific set of planning objectives to address identified water resources problems and opportunities. However, because the LVE is being pursued within the context of the CALFED program, the investigation needs to consider the influence on and of other CALFED program elements as part of the planning process. This includes the potential for other planned or developing CALFED actions to address LVE objectives. For example, other CALFED storage projects also may be addressing an EWA objective similar to that of the LVE. Potential scenarios for how a new project with Federal participation would be implemented and/or integrated with existing projects (such as the CVP) also will be evaluated, as appropriate, when detailed alternative plans are formulated.
- Local cooperation requirements and willingness to participate must continue to be addressed as plan formulation progresses for the LVE. This includes addressing study objectives and corresponding Federal participation conditions, while also satisfying the principles of participating agencies and institutions.
- Because an objective of the LVE is to determine whether an expanded Los Vaqueros Reservoir could provide a less costly EWA replacement supply, studies will need to address the future value of water in California. This will require a detailed economic evaluation that considers the many factors influencing the future cost of water, including population growth, the cost of transferring water from agriculture, conveyance constraints, and hydrologic uncertainty. These studies will require close coordination with participating agencies, CALFED Common Assumptions, and other parties.
- The next phase of the feasibility investigation should continue to explore potential institutional arrangements for ownership, operation, and maintenance of a completed project. Federal, State, and local entities could participate, either jointly or individually, in a project to address the objectives of the LVE under various institutional arrangements or organizational structures.
- As detailed alternative plans emerge in the Plan Formulation Phase, the potential roles and responsibilities of Federal and non-Federal participants will need to be more fully defined, including identification of potential non-Federal sponsor(s). These roles will be influenced by the laws, regulations, and guidelines that govern each agency, the level of Federal interest, cost allocation, institutional arrangements, and the extent of Federal cost-sharing.

MOVING FORWARD

The next major step in the LVE is to further develop the initial alternatives identified in this IAIR and possibly other combinations of measures into a set of detailed alternative plans. The emphasis of upcoming studies will be on hydraulic and hydrologic system modeling, additional study of future regional water demands and economic conditions, preliminary designs and costs,

identifying potential impacts and mitigation features, and completing environmental studies and documentation. The next phase of the LVE – the Alternative Plans Phase – will be summarized in a Plan Formulation Report, anticipated in mid-2006, as shown in **Figure ES-2**. The Federal Decision Document and accompanying Environmental Impact Statement / Environmental Impact Report are scheduled for completion in late 2007.

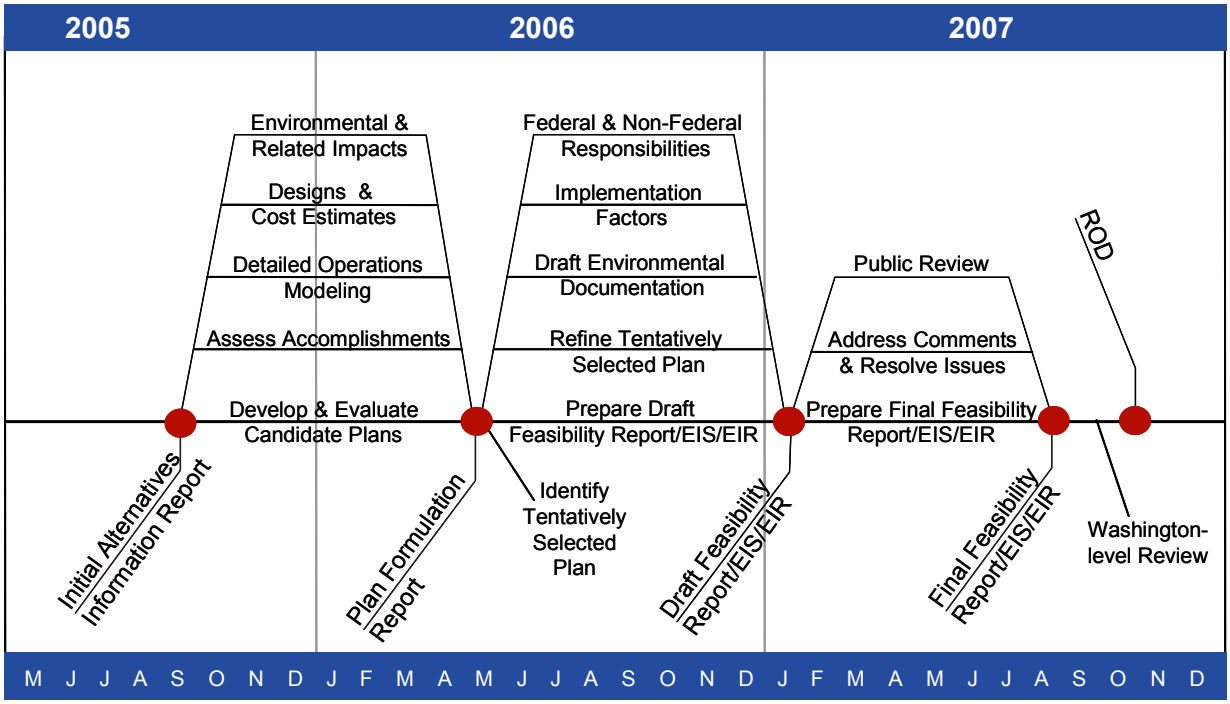

FIGURE ES-2 – LOS VAQUEROS EXPANSION INVESTIGATION SCHEDULE

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ACRONYMS AND ABBREVIATIONS

A	ACWD	Alameda County Water District
	ACWG	Agency Coordination Work Group
	AF	acre-feet
	AFPA	acre-feet per acre
	AFRP	Anadromous Fish Restoration Program
	AFY	acre-feet per year
	Agreement	Sacramento Valley Water Management Agreement
	ANN	artificial neural network
B	BA	Biological Assessment
	Bay Area	San Francisco Bay Area
	Bay-Delta	San Francisco Bay / Sacramento-San Joaquin River Estuary
	Bay-Delta Plan	Water Quality Control Plan for the San Francisco Bay / Sacramento San Joaquin Delta Estuary (California SWRCB 1995)
	BMP	best management practice
	BO	Biological Opinion
	Br	bromide
	(b)(2) water	800,000 acre-feet of water designated in Section 3406(b)(2) of the CVPIA
C	°C	degrees centigrade
	$CaCO_3$	calcium carbonate
	CALFED	CALFED Bay-Delta Program
	CALSIM	California Water Allocation and Reservoir Operations Model
	CCWD	Contra Costa Water District
	CDF	California Department of Finance
	CDFG	California Department of Fish and Game
	CDP	critically dry period
	CEQA	California Environmental Quality Act
	CFG	Customer Feedback Group
	cfs	cubic feet per second
	Cl	chloride
	COA	Coordinated Operation Agreement
	CVP	Central Valley Project
	CVPIA	Central Valley Project Improvement Act
D	D-1422	Water Rights Decision 1422, State Water Resources Control Board
	D-1485	Water Rights Decision 1485, State Water Resources Control Board
	D-1641	Water Rights Decision 1641, State Water Resources Control Board
	Delta	Sacramento-San Joaquin Delta
	DO	dissolved oxygen
	DWR	California Department of Water Resources

E	EA	Environmental Assessment
	EBMUD	East Bay Municipal Utility District
	EC	electrical conductivity
	EIR	Environmental Impact Report
	EIS	Environmental Impact Statement
	elevation	elevation in feet above mean sea level
	ERP	Ecosystem Restoration Program
	ESA	Endangered Species Act
	EWA	Environmental Water Account
F-G	°F	degrees Fahrenheit
	FONSI	Finding of No Significant Impact
	GPCPD	gallons per capita per day
H-I	hp	horsepower
	IAIR	Initial Alternatives Information Report
	IDC	interest during construction
J-K	JPOD	joint point of diversion
	Km	kilometer
	kW	kilowatt
	kWh	kilowatt-hour
L	LOD	level of development
	LTA	long-term average
	LVE	Los Vaqueros Expansion Investigation
M	µg/L	micrograms per liter
	µmhos/cm	micromhos per centimeter (equivalent to µS/cm)
	µS/cm	microSiemens per centimeter (equivalent to µmhos/cm)
	m	meter
	MAF	million acre-feet
	M&I	municipal and industrial
	MG	million gallons
	mg/L	milligrams per liter
	mm	millimeter
	mgd	million gallons per day
	msl	mean sea level
N	NEPA	National Environmental Policy Act
	NMFS	National Oceanic and Atmospheric Administration's National Marine Fisheries Service
	NODOS	North-of-the-Delta Offstream Storage
	NRHP	National Register of Historic Places
	NTU	nephelometric turbidity unit

O-P	O&M	operation and maintenance
	OCAP	Operations Criteria and Plan
	P&G	Federal Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies
	PCT	Project Coordination Team
	pH	measurement of partial hydrogen
	PL	Public Law
	PMF	Probable Maximum Flood
	ppm	parts per million
	ppt	parts per thousand
Q-R	Reclamation	U.S. Department of the Interior, Bureau of Reclamation
	ROD	Record of Decision
S	SBA	South Bay Aqueduct
	SC-RB	separable costs – remaining benefits
	SCVWD	Santa Clara Valley Water District
	SDIP	South Delta Improvements Program
	SDY	single dry year
	Semitropic GBEP	Semitropic Groundwater Banking and Exchange Program
	SFPUC	San Francisco Public Utilities Commission
	SMT	Study Management Team
	State	State of California
	SWP	State Water Project
	SWRCB	State Water Resources Control Board
T-U	TAF	thousand acre-feet
	TDS	total dissolved solids
	TKN	total Kjeldahl nitrogen
	TOC	total organic carbon
	USFWS	U.S. Fish and Wildlife Service
	UV	ultraviolet
	UWMP	Urban Water Management Plan
V-Z	VAMP	Vernalis Adaptive Management Program
	WTP	water treatment plant
	WUE	water use efficiency
	WWTP	wastewater treatment plant
	X2	distance in kilometers from the Golden Gate Bridge to where the salinity concentration is 2,640 micromhos per centimeter
	Zone 7	Alameda County Flood Control and Water Conservation District, Zone 7

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CHAPTER I
INTRODUCTION

In 2001, the U.S. Department of Interior, Bureau of Reclamation (Reclamation), the California Department of Water Resources (DWR), and Contra Costa Water District (CCWD) began appraisal-level studies of the potential to expand Los Vaquero Reservoir to address regional water quality and supply reliability needs. Expansion of Los Vaqueros was one of five potential surface water storage projects identified by the CALFED Bay-Delta Program (CALFED) as warranting further study. The appraisal-level studies indicated that expanding the reservoir by as much as 400,000 acre-feet was technically feasible and could provide water quality and supply reliability to agencies in the region, as well as providing potential benefits to fisheries sensitive to water management operations in the Sacramento-San Joaquin Delta (Delta). Reclamation was directed in Public Law 108-7 (Omnibus Appropriations Act of 2003) to conduct a feasibility-level investigation of the potential expansion of Los Vaqueros Reservoir. Initial results of the first phase of the Los Vaqueros Expansions Investigation (LVE) are described in this Initial Alternatives Information Report (IAIR).

CCWD, owner and operator of the reservoir, completed construction of the Los Vaqueros Project in 1997. The primary purpose of the project is to address seasonal water quality degradation associated with CCWD's Delta water supplies. CCWD stores water in Los Vaqueros Reservoir that is diverted from the Delta when water quality is favorable, for later release and blending when Delta water quality is degraded. The 100,000 acre-foot reservoir also provides important emergency supply storage and, as secondary benefits, recreation and flood control.

Los Vaqueros Reservoir

BACKGROUND

The desire to develop water resources for beneficial uses and to protect and improve ecosystem conditions throughout the State of California has affected the demand for water in the State. A significant portion of California's water resources flow through or are diverted from the Delta, a unique and highly productive environment that is home to a diverse array of plants and animals. Past decades have given rise to increasing conflicts between management of Delta water resources to meet urban and agricultural demands, and sustaining or improving Delta ecosystem functions. As a result of these and other environmental conflicts in the State, several Delta fishery resources have been listed under the State and/or Federal Endangered Species Acts (ESA). Resulting regulatory actions taken to protect these species have constrained water supply management operations and exports in the Delta.

Water agencies in the San Francisco Bay Area (Bay Area) rely on a variety of local and imported water sources, including supplies from the Delta, to meet their growing demands. Aggressive conservation programs, recycling, surface and groundwater storage programs, and water transfers have helped these agencies manage the reliability and quality of their water supplies. However, Bay Area water agencies continue to face substantial cutbacks in water supplies during dry and critically dry years, and degradation in water quality during certain periods.

In recognition of environmental and water resource conflicts in the Delta, a consortium of State and Federal resources management agencies collaborated to create CALFED. The CALFED Programmatic Record of Decision (ROD), dated August 28, 2000, describes a long-term comprehensive plan to restore the ecological health of the San Francisco Bay/Delta (Bay-Delta) system and improve water management for all beneficial uses. The CALFED ROD describes various program elements that, in total, will increase water supply reliability, improve ecosystem health, improve water quality, and increase Delta levee stability.

The CALFED ROD recommended investigating five potential onstream and offstream surface water storage projects as part of its Storage Program element. One of the proposed storage projects involves expanding Los Vaqueros Reservoir. The CALFED ROD recognized that expanding the existing reservoir by as much as 400,000 acre-feet could contribute to improving the quality and reliability of Bay Area drinking water supplies delivered from the Delta.

Another program element described in the CALFED ROD is the Environmental Water Account (EWA), developed to help resolve one of the Bay-Delta's most fundamental conflicts: the competing needs of water management operations and the environment. The EWA facilitates changes to Central Valley Project (CVP) and State Water Project (SWP) operations, such as pumping curtailments in the south Delta to protect at-risk fisheries. The EWA also provides an institutional framework through which water managers can acquire, store, transfer, and release water strategically to respond to fishery and ecosystem needs in the Delta. To date, the short-term EWA Program has relied on transfer market acquisitions and short-term transfer agreements to secure water for actions in the Delta. It is expected that some form of the EWA will continue in the future with a primary focus on offsetting water delivery reductions resulting from regulatory actions that curtail Delta pumping to protect at-risk fish. However, a great deal of uncertainty exists regarding the cost of water for programs such as the EWA in the future.

The primary mission of the LVE, based on the problems, needs, and objectives identified and documented in this IAIR, is as follows:

> *The purpose of the Los Vaqueros Expansion Investigation is to identify and evaluate opportunities to increase drought period water supply reliability for Bay Area water providers; provide a less-costly environmental water supply to facilitate EWA fish recovery actions in the Delta; and, to the extent possible through exploring these opportunities, improve the quality of water delivered to Bay Area water users.*

The three objectives identified for the LVE, discussed later in this document, are as follows:

- *Increase water supply reliability for water providers within the study area, principally to help meet municipal and industrial water demands during drought periods, with a focus on enlarging Los Vaqueros Reservoir.*
- *Use an expanded Los Vaqueros Reservoir to develop replacement water supplies for the long-term Environmental Water Account, if the cost of water provided from an expanded reservoir is found to be less than the cost of water for continued implementation of that program.*
- *To the extent possible through pursuit of the water supply reliability and environmental water objectives, improve the quality of water deliveries to municipal and industrial customers in the study area.*

STUDY AREA LOCATION AND DESCRIPTION

Los Vaqueros Reservoir is located in the Kellogg Creek watershed of Contra Costa County, California. The reservoir lies in the foothills west of the Delta and east of the Bay Area, as illustrated in **Figure I-1.** The study area for the LVE, shown in **Plate 1,** includes the Los Vaqueros Reservoir watershed and associated facilities, the central and south Delta, and service areas of Bay Area water agencies that may be directly affected by the project. The central and south Delta is roughly bound by the San Joaquin River on the north and the boundaries of the legal Delta to the south (as established in Section 12220 of the California Water Code). Bay Area water agencies that could be directly affected by the project include CCWD, Alameda County Water Agency, Santa Clara Valley Water District, and Zone 7 Water Agency. Due to the potential influence on other programs and projects, an extended study area includes the service areas of other Bay Area water agencies and the Central Valley of California. Other Bay Area water agencies that may be indirectly affected by the project include East Bay Municipal Utility District and the San Francisco Public Utilities Commission.

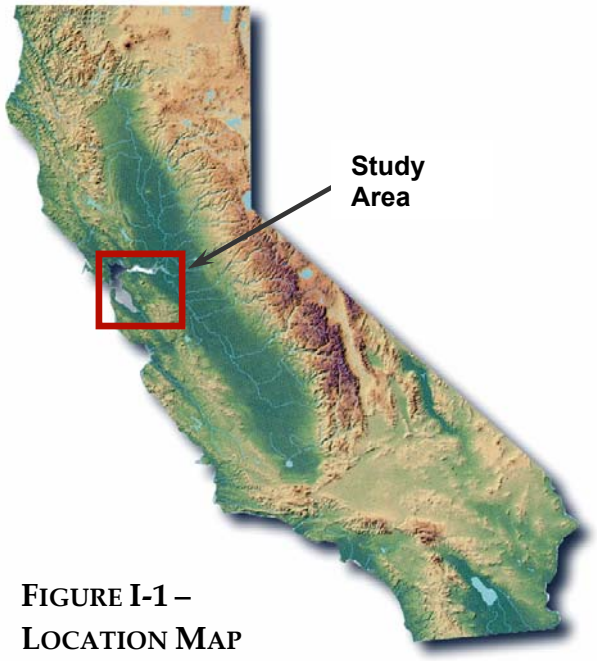

FIGURE I-1 – LOCATION MAP

STUDY AUTHORIZATION AND INFLUENCING LEGISLATION

Reclamation and DWR are the Federal and State agencies conducting the investigation, respectively. CCWD, as owner of the existing Los Vaqueros Reservoir, also has an integral role in the study, and has worked under contract to Reclamation and DWR to perform engineering studies and environmental review. The following sections describe Federal, State, and local

authorization and legislation pertinent to the LVE. These and other study milestones are shown in a study timeline in **Figure I-2**.

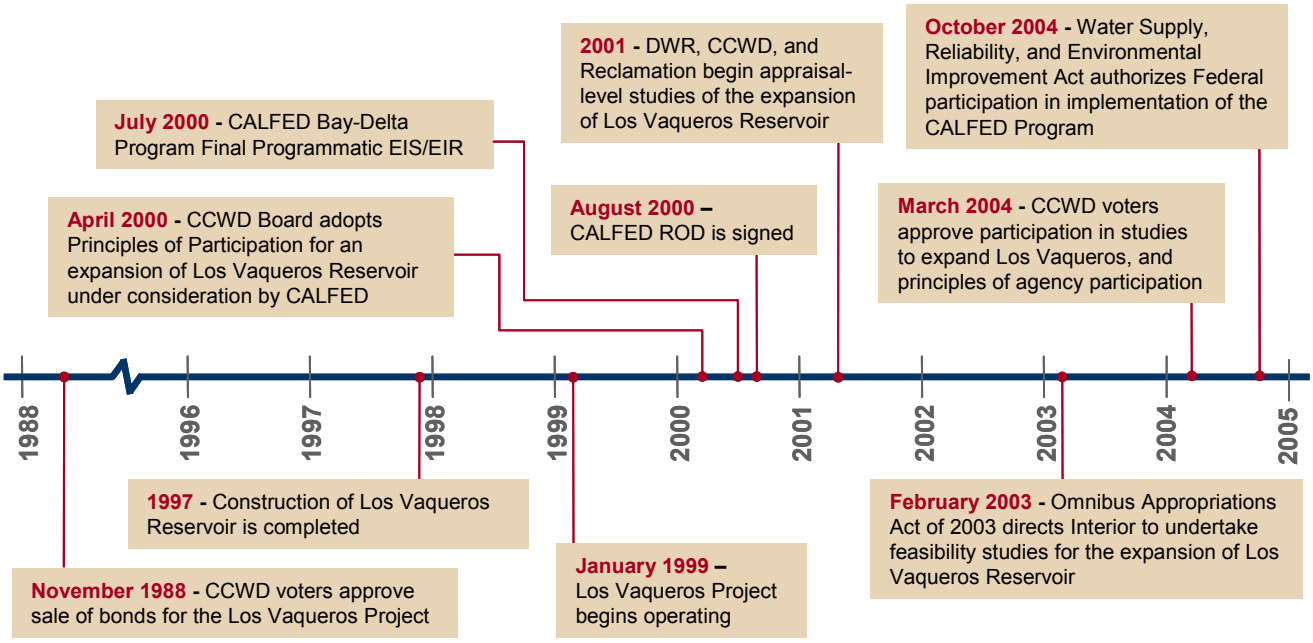

FIGURE I-2 – TIMELINE OF LEGISLATION AND OTHER STUDY MILESTONES

Federal

The Secretary of the Interior was authorized to undertake feasibility studies for enlarging Los Vaqueros Reservoir in February 2003 through the Omnibus Appropriations Act of 2003 (Public Law 108-7):

> *The Secretary of the Interior, in carrying out CALFED-related activities, may undertake feasibility studies for Sites Reservoir, Los Vaqueros Reservoir Enlargement, and Upper San Joaquin Storage projects. These storage studies should be pursued along with ongoing environmental and other projects in a balanced manner.*

In October 2004, the Water Supply, Reliability, and Environmental Improvement Act (Public Law 108-361) authorized Federal agencies to participate in implementing the CALFED Program. Public Law 108-361 specifically authorizes the Secretary of the Interior to carry out planning and feasibility studies for enlarging Los Vaqueros Reservoir:

> *The Secretary of the Interior is authorized to carry out the activities described in paragraphs (1) through (10) of subsection (d), to the extent authorized under the reclamation laws, the Central Valley Project Improvement Act (title XXXIV of Public Law 102-575; 106 State. 4706), the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), and other applicable law.*

Paragraph (1)(A)(i) of the bill further defines authorized activities related to water storage as "planning and feasibility studies for projects to be pursued with project-specific study for enlargement of …the Los Vaqueros Reservoir in Contra Costa County."

State

Section 227 of the State of California Water Code provides authorization for DWR to participate in water resources investigations, as follows:

> *The department may investigate any natural situation available for reservoirs or reservoir systems for gathering and distributing flood or other water not under beneficial use in any stream, stream system, lake, or other body of water. The department may ascertain the feasibility of projects for such reservoirs or reservoir systems, the supply of water that may thereby be made available, and the extent and character of the areas that may be thereby irrigated. The department may estimate the cost of such projects.*

Local

In response to identifying the potential to expand Los Vaqueros Reservoir in the CALFED ROD, the CCWD Board of Directors adopted a set of principles in April 2000 governing CCWD's participation in an expansion project. On June 25, 2003, the CCWD Board of Directors formally adopted the conditions approved by the voters to guide CCWD's participation in any expansion of Los Vaqueros Reservoir. On March 2, 2004, voters within the CCWD service area authorized the CCWD Board of Directors to participate with Federal and State agencies in feasibility studies and environmental review of an expanded Los Vaqueros Reservoir. CCWD's conditions for participation in a project to expand Los Vaqueros Reservoir are discussed in **Chapters II** and **V**.

PURPOSE AND SCOPE OF DOCUMENT

This IAIR documents preliminary results and findings from the first phase of Federal planning studies for the LVE. The basic plan formulation process for Federal water resources studies and projects consists of the following steps:

- Inventory existing conditions and forecast likely without-project future conditions in the study area.
- Specify water resources and related problems and opportunities.
- Identify resource management measures and formulate concept plans.
- Evaluate and compare the effects of alternative plans.
- Select a plan for recommended implementation.

For the LVE, the above planning process was separated into three major phases: the Initial Plans Phase (documented within), Alternative Plans Phase, and Recommended Plan Phase. **Figure I-3** illustrates the relationship of the three phases, the major focus of each phase, and resulting product (report) for each phase.

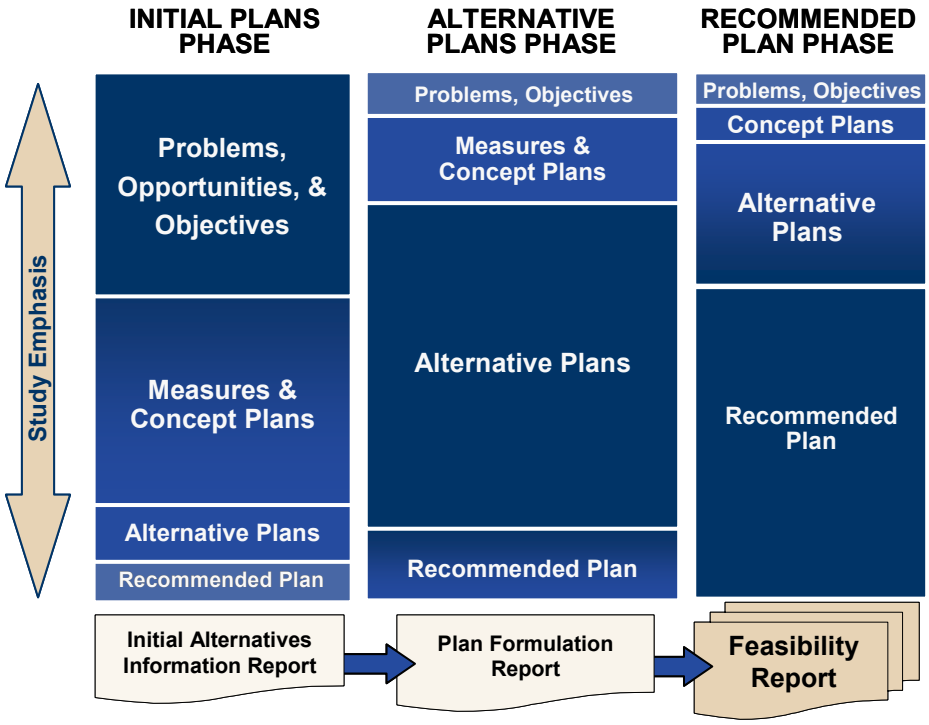

FIGURE I-3 – PLAN FORMULATION PROCESS

As shown in **Figure I-3**, the focus of the first phase is on defining problems, opportunities, and objectives, and identifying measures and concept plans to address these objectives. The focus advances through the Federal planning steps as the feasibility study progresses, with the last phase primarily focused on refining the recommended plan. Each phase concludes with a milestone document that describes the work that was performed, results, and conclusions to date. While these documents are drafted specifically to inform Federal decision-makers on subjects relevant to potential Federal participation in the project, they also may provide useful information to participating non-Federal agencies and stakeholders.

REPORT ORGANIZATION

This report comprises 13 chapters that describe the preliminary results and findings of the LVE:

- **Chapter I** provides background information about the LVE, the study area location, study authorization and defining legislation, and purpose and scope of the IAIR.
- **Chapter II** identifies studies, projects, and programs that may have a direct or indirect influence on the LVE.

- **Chapter III** describes existing and future without-project water resources and related conditions.
- **Chapter IV** identifies fundamental water resources problems and opportunities in the study area based on the conditions described in **Chapter III**.
- **Chapter V** describes the plan formulation process, defines planning objectives for the investigation, and explains planning constraints and criteria for the study. It also presents planning principles that will guide the formulation of alternative plans.
- **Chapter VI** identifies potential resource management measures (or actions) to address the planning objectives and highlights measures to be carried forward for further consideration.
- **Chapter VII** describes the formulation of a set of concept plans for further development in the feasibility study.
- **Chapter VIII** presents the evaluation and comparison of the concept plans, from which the most promising are identified as initial alternatives for further development in the next phase of the feasibility study.
- **Chapters IX** through **XII** include information on special topics, study management and public involvement, future issues and implementation factors, and major findings, respectively.
- **Chapter XIII** contains sources consulted in writing this report.

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CHAPTER II
RELATED STUDIES, PROJECTS, AND PROGRAMS

This chapter summarizes the related activities of various Federal, State, and local agencies and other working groups within the study area. Many of these entities, including the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), are performing current studies, projects, and programs that are directly or indirectly relevant to the Los Vaqueros Expansion Investigation (LVE).

BUREAU OF RECLAMATION

As the owner and operator of the State's largest water project, the Central Valley Project (CVP), Reclamation has a significant effect on water and environmental resources in the study area. This section discusses the CVP, Central Valley Project Improvement Act (CVPIA), and Operations Criteria and Plan (OCAP).

Central Valley Project

Development and construction of the CVP was authorized under Federal Reclamation Law beginning in 1902. The CVP is the largest surface water storage and delivery system in California, with a geographic area covering 35 of California's 58 counties. The project includes 20 reservoirs with a combined storage capacity of approximately 11 million acre-feet (MAF); 8 powerplants and 2 pump-generating plants with a combined generation capacity of approximately 2 million kilowatts (kW); and approximately 500 miles of major canals and aqueducts. The CVP supplies water to more than 250 long-term water contractors in the Central Valley, Santa Clara Valley, and San Francisco Bay Area (Bay Area). **Plate 2** shows the locations of major CVP facilities, rivers that are controlled or affected by the operation of CVP facilities; and other major water facilities in the state.

The CVP has the potential to deliver about 7 MAF annually to agricultural and municipal and industrial (M&I) customers and for environmental purposes. Of this 7 MAF, about 6.2 MAF would be for agricultural uses, 0.5 MAF for urban uses, and 0.3 MAF for wildlife refuges. However, while an annual delivery capability of 7 MAF exists, actual deliveries are currently much lower. For example, approximately 4.1 MAF were delivered for agricultural and M&I users in 2004, combined. Historically, about 90 percent of CVP water has been delivered to agricultural users, including prior water rights holders. Municipal customers include the cities of Redding, Folsom, Tracy, and Fresno; various agencies in the Sacramento metropolitan area; most of Santa Clara County; the East Bay Municipal Utility District (EBMUD) service area; the central and eastern portions of Contra Costa County; and others. The CVP also provides flood control, navigation, power, recreation, and water quality benefits.

Several regulatory requirements and agreements affect operation of the CVP. Prior to passage of the CVPIA, (described below), operation of the CVP was affected by State Water Resources Control Board (SWRCB) Decisions 1422 and 1485 (D-1422 and D-1485), and the Coordinated Operations Agreement (COA). D-1422 and D-1485 identify minimum flow and water quality

conditions at specified locations that are to be maintained in part through operation of the CVP. COA specifies the responsibilities shared by the CVP and the California SWP for meeting the requirements of D-1485. In December 1994, representatives of the Federal and State governments and urban, agricultural, and environmental interests agreed to implementing a Bay-Delta protection plan through the SWRCB that would protect the ecosystem of the Bay-Delta estuary. D-1641 superceded D-1485 in 1999 and was later amended in 2000 (see discussion under California Sate Water Resources Control Board in this chapter). Coordinated operations of the CVP and SWP continue to be based on COA.

Operation Divisions

CVP operations are grouped into 10 divisions. Operations north of the Sacramento-San Joaquin Delta (Delta) include the Trinity, Shasta, American River, and Sacramento River divisions, known collectively as the Northern CVP System. Those south of the Delta, and the Delta, West San Joaquin, and San Felipe divisions are known collectively as the Southern CVP System. Both the East Side and Friant divisions are operated independently of the remainder of the CVP due to the nature of their water supplies and service areas. The Northern and Southern CVP systems are operated as an integrated system, and demands for water and power can be met by releases from any one of several facilities. Demands in the Delta and south of the Delta can be met by the export of excess water in the Delta, which can result from releases from Northern CVP reservoirs. Operational decisions are based on a number of physical and hydrological factors that change depending on conditions.

CVP Water Users

During development of the CVP, the United States entered into long-term contracts in the Central Valley with many major water rights holders, who belong to three major groups: (1) Sacramento River Settlement Contractors, (2) San Joaquin River Exchange Contractors, and (3) Water Service Contractors.

Members of Sacramento River Settlement Contractors primarily claim water rights on the Sacramento River. Because of the significant influence on flows in the Sacramento River, these water rights claimants entered into contracts with Reclamation. Most of the agreements established the quantity of water the contractors are allowed to divert from April through October without payment to Reclamation, and also established a supplemental CVP supply allocated by Reclamation.

San Joaquin River Exchange Contractors are contractors who receive CVP water from the Delta via the Mendota Pool. Under exchange contracts, the parties agreed not to exercise their San Joaquin River water rights in exchange for a substitute CVP water supply from the Delta. These exchanges allowed for water to be diverted from the San Joaquin River for use by water service contractors in the San Joaquin Valley and Tulare Lake Basin.

Before construction of the CVP, many irrigators on the west side of the Sacramento Valley, on the east and west sides of the San Joaquin Valley, and in the Santa Clara Valley relied primarily on groundwater. With completion of CVP facilities in these areas, irrigators signed agreements with Reclamation for delivery of CVP water as a supplemental supply. Several cities also have

similar contracts for M&I supplies; these irrigators and cities are known as CVP Water Service Contractors. CVP water service contracts are between the United States and individual water users or districts and provide for an allocated supply of CVP water to be applied for beneficial uses.

Central Valley Project Improvement Act

The CVPIA was signed into law in October 1992 to address conflicts over water rates, irrigation land limitations, and environmental impacts of the CVP. This legislation mandates changes in management of the CVP, particularly for protection, restoration, and enhancement of fish and wildlife. The CVPIA also addresses the operational flexibility of the CVP and methods to expand the use of voluntary water transfers and improved water conservation. General purposes of the CVPIA, as identified by Congress in Section 3402, include the following:

- Protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California.
- Address impacts of the CVP on fish, wildlife, and associated habitats.
- Improve operational flexibility of the CVP.
- Increase water-related benefits provided by the CVP to the State of California through expanded use of voluntary water transfers and improved water conservation.
- Contribute to the State of California's interim and long-term efforts to protect the Bay-Delta Estuary.
- Achieve a reasonable balance among competing demands for CVP water, including water requirements for fish and wildlife, agriculture, M&I, and power contractors.

The CVPIA redefined the purposes of the CVP to include protection, restoration, and enhancement of fish, wildlife, and associated habitats and protection of the Bay-Delta Estuary as having equal priority with other purposes. The CVPIA identified numerous specific measures and programs to meet the new project purpose and also directed the Secretary of the Interior to operate the CVP consistent with these purposes. Sections of the CVPIA important to this study include those focused on dedicating a portion of CVP yield to be used for environmental purposes; the Anadromous Fish Restoration Program (AFRP), which included a goal of doubling natural production of anadromous fish in Central Valley rivers and streams; the Restoration Fund; urban water reliability; water transfers; refuge water supplies; restoration of the San Joaquin, Trinity, and Stanislaus rivers; and a stakeholder process.

Central Valley Project Improvement Act Environmental Water Acquisition

The combined total amount of water dedicated to the environment by the CVPIA suggests an annual amount of up to 1.2 MAF. This includes reallocation of the 800 thousand acre-feet (TAF) designated in Section 3406 (b)(2) of the CVPIA (commonly called (b)(2) water), dedicated inflows to wildlife refuges of 250,000 acre-feet, and Trinity Reapportion water amounting to 150,000 acre-feet. However, after accounting for system operation flexibility, the total impact of

the CVPIA for CVP contractors is estimated to be a reduction of 585,000 acre-feet annually. It is estimated in the CVPIA Programmatic Environmental Impact Report (EIR) that reduced water supplies and other CVPIA provisions would result in increased groundwater overdraft, fallowing of agricultural land, loss of jobs, and loss of over $150 million in annual agricultural revenues. Most of this loss would be the result of the reduction in water supplies.

Implementation of the CVPIA (b)(2) provision has been a contentious process, marked by conflict between Federal and State parties, and substantial litigation. The primary dispute has been whether (b)(2) water translates into an automatic reduction in exports under water supply contracts. In May 2003, Reclamation released a final decision on implementation of §3406 (b)(2). The decision incorporates parts of an earlier decision (United States Department of the Interior 1999 Final Decision), modifies other decisions, and adds new components. The intent of these changes was to simplify and clarify the accounting process for (b)(2) water uses and to integrate (b)(2) water dedication and management with CVP operations for other CVP purposes. The decision is divided into sections that address calculations of yield; accounting processes; modifications of CVP operations; water banking and transfers/exchanges of water; water to meet the 1995 Bay-Delta Water Quality Control Plan and 1978 Federal ESA obligations; shortage criteria; and coordination.

The total of 800 TAF of water dedicated under CVPIA (b)(2) is used by the U.S. Fish and Wildlife Service (USFWS), in coordination with Reclamation and other agencies, to meet water quality obligations, flow requirements, and other regulations. In the Delta, CVPIA (b)(2) water is used to reduce exports at the CVP Tracy Pumping Plant to in turn reduce entrainment of salmon or delta smelt. The May 2003 Decision on Implementation set aside 200 TAF of the total (b)(2) supply for upstream fish protection actions, reducing the amount of water available in the Delta for water quality control and CVP export curtailments.[1]

The Water Acquisition Program, a joint effort by Reclamation and USFWS, was created to meet water acquisition needs under the CVPIA. The program targets up to 163,000 acre-feet annually to meet optimal waterfowl habitat management needs at various Federal and State wildlife areas in the Central Valley, and to support instream flows. The optimum refuge water supply levels are referred to as Level 4 requirements, as shown in **Table II-1**. Incremental Level 4 is defined as the difference between historic annual average water deliveries (Level 2) and optimum waterfowl habitat management supplies (Level 4). Incremental Level 4 acquisitions to date have been less than the targeted volume primarily because some refuges have been unable to receive full Level 4 supplies due to delivery/conveyance limitations and program funding shortfalls. Acquisitions have been limited in recent years by financial constraints and the increasing cost of water; approximately $5 million is dedicated annually from the CVP Restoration Fund for Level 4 water acquisitions.

[1] It is noted for clarification that actions taken under the CVPIA using water supplies identified for Section 3406 (b)(2) fish actions represent water supply reductions for project users, not water supply replacement actions, such as under the EWA Program.

TABLE II-1
CVPIA WATER ACQUISITION PROGRAM PURCHASES
FOR LEVEL 4 AND OTHER PURPOSES, 1994-2003

Water Year	Annual Level 4 Acquisitions (acre-feet)	Other Water Acquisitions (acre-feet)	Total Water Acquired (acre-feet)	Price Range (per acre-foot)
2004	67,710	98,211	165,921	$60 - $130
2003	70,000	91,526	151,526	$60 - $130
2002	85,390	68,105	153,495	$30 - $120
2001	63,005	109,785	172,790	$60 - $150
2000	67,748	108,880	176,628	$60 - $125
1999	43,618	224,498	268,116	$25 - $65
1998	6,300	80,000	86,300	$15 - $70
1997	69,800	155,983	225,783	$15 - $70
1996	36,395	16,161	52,556	$25 - $50
1995	88,009	0	88,009	$25 - $36
1994	29,415	76,441	105,856	$24 - $50
Total	**559,680**	**918,879**	**1,478,559**	**$15 - $150**

Source: Water Acquisition Program Frequently Asked Questions, November 2003, summary of acquisitions from 1994 through November 2003.

The Water Acquisition Program also acquires water to boost instream flows for the AFRP. Water purchased for instream flows has primarily been used in the San Joaquin Valley to support programs such as the San Joaquin River Agreement/Vernalis Adaptive Management Program (VAMP), a fishery management program on the lower San Joaquin River.

CVP Water Supply Replacement Plan

Section 3408 (j) of the CVPIA directed the Secretary of the Interior to prepare a least-cost plan to increase the yield of the CVP by an amount equal to that dedicated to fish and wildlife under the CVPIA. This plan was also intended to assist the State in meeting its future water needs. Further, appropriate cost-sharing arrangements to implement the CVP Water Supply Improvement Plan were to be recommended. The 1995 Least-Cost CVP Yield Increase Plan, as well as the draft report, *Replacing the Delivery Impact of CVPIA: A Supplement of the Least-Cost CVP Yield Increase Plan,* identified cost and supply estimates for a number of new water supply and management options, including groundwater storage, land fallowing, conservation and reuse, and surface storage. The plan did not, however, propose a specific CVP yield increase. Reclamation is currently preparing a supplement to the 1995 plan.

CVP Water Management Program

Section 3405 (e) of the CVPIA directed the Secretary of the Interior to develop best management practices (BMP) for water conservation and efficient water use, and to identify criteria for evaluating water management plans developed by CVP contractors. Reclamation provides educational, technical, and financial assistance, through cost-sharing, to CVP contractors preparing agricultural and/or urban water management plans, including those plans to meet the

water conservation requirements of the Reclamation Reform Act of 1982. Technical assistance is also provided through State and local partnerships and agreements with the Irrigation and Training Research Center at Cal Poly, San Luis Obispo, and the California Urban Water Conservation. Grant funding for implementation of BMPs is available to CVP contractors through Reclamation's Water Conservation Field Service Program.

CVPIA Contract Renewal Process

In accordance with Section 3404(c) of the CVPIA, Reclamation is currently negotiating long-term water service contracts. It is anticipated that over 100 CVP water service contracts, with users located within the Central Valley, may be renewed during this negotiation process. As of June 2005, about 60 percent of the contracts were executed. As part of this process, Reclamation is also negotiating renewal of 55 interim water service contracts.

Operations Criteria and Plan

In March 2004, Reclamation and DWR prepared a Long-Term CVP and OCAP to address how the CVP and SWP would be operated in the future as several proposed projects come on-line and as water demands increase. This document is a revision of the previous 1992 OCAP release and incorporates numerous additional constraints and criteria that have arisen since 1992. Several incorporations include the 2000 Trinity ROD, AFRP flow objectives, the 1993 Winter Run Biological Opinion (BO), the revised decision on CVPIA §3406(b)(2) water, EWA, and Joint Point of Diversion (JPOD).

CALIFORNIA DEPARTMENT OF WATER RESOURCES

As the owner and operator of the State's second largest water project, DWR has a significant effect on water and environmental resources in the study area. This section discusses the SWP, California Water Plan, South Bay Aqueduct Improvement and Enlargement, and Franks Tract Project.

State Water Project

The SWP was authorized in 1959 and designated to readjust geographical imbalances between California's water resources and water needs. The project extends from Plumas County in the north to Riverside County in the south. The SWP delivers water to service areas in the Feather River basin, Bay Area, San Joaquin Valley, Tulare basin, and Southern California.

Completed project elements include 23 dams and reservoirs, 6 power plants, 17 pumping plants, and 533 miles of aqueduct, as shown in **Plate 2**. The principal storage feature of the SWP is Lake Oroville, with a gross pool capacity of 3.5 MAF. Lake Oroville is located on the Feather River about 4 miles northeast of Oroville. Water released from Oroville Dam flows though the Feather and Sacramento rivers to reach the Delta.

Major SWP conveyance facilities in the Central Valley include the North Bay, South Bay, and California aqueducts. The North Bay Aqueduct diverts water from Barker Slough in the north Delta for agricultural and M&I uses in Napa and Solano counties. The South Bay and California aqueducts carry water from the Delta to the Bay Area and to Southern California, respectively.

In the southern portion of the Delta, the Harvey O. Banks Delta Pumping Plant lifts water into the California Aqueduct from the Clifton Court Forebay. At 444 miles, the California Aqueduct is the State's largest and longest water conveyance system, beginning at Banks Pumping Plant and extending to Lake Perris, south of Riverside in Southern California. **Plate 2** includes a layout of major SWP facilities.

The contracts between DWR and the 29 SWP water contractors define the terms and conditions governing water delivery. Table A is an exhibit in the water supply contracts and is the maximum supply of scheduled water that a contractor may request. The total of the 29 contractors' maximum Table A amount for deliveries is about 4.13 MAF per year. Of this amount, about 2.6 MAF is designated for the Southern California, nearly 1.2 MAF for the San Joaquin Valley, and the remaining 373,000 acre-feet for the San Francisco Bay, central coast, and Feather River areas (as of December 31, 2002).

SWP contracts involve the Feather River Settlement Contractors and SWP Contract Table A Allocations. The Feather River Settlement Contractors are water users who hold riparian and senior appropriative rights on the Feather River. SWP Contract Table A Allocations are contracts executed in the early 1960s that established the maximum annual water amount that each long-term contractor may request from the SWP.

California Water Plan

The State, through DWR, prepares and publishes the California Water Plan through its Bulletin 160 series. Seven versions of the plan were published between 1966 and 1998. A 1991 amendment to the California Water Code directed DWR to update the plan every 5 years. The Bulletin 160 series assesses California's agricultural, environmental, and urban water needs and evaluates water supplies to quantify future water demands and supplies. A focus of the 1998 Bulletin 160 is water management actions that could be implemented to improve California's water supply reliability. While the 1998 Bulletin 160 shows that under existing conditions the north coast and San Francisco Bay areas will not face shortages under average year hydrologic conditions, it characterizes the rest of the State as facing average year shortfalls of between 10,000 acre-feet and 900,000 acre-feet. Under drought year conditions, the entire State is portrayed to face water shortages. While the 1998 Bulletin 160 identifies some potential additional supply measures, little progress has been made in planning and developing these supplies.

DWR, through a highly collaborative process, is currently completing the latest update, Bulletin 160-05. California Water Plan Update 2005 addressees the State's changing water management and better reflects the roles of the State and Federal governments, and the growing role of regional and local agencies, in California water management. The update goes beyond a forecast of statewide water demand and supply. It will include a strategic plan with goals, recommendations, and actions for meeting the challenges of sustainable water use through 2030.

Two key initiatives outline the ways the foundational actions in the Water Plan Update will be achieved. The first is to implement integrated regional water management, which is a comprehensive, systems approach for determining the appropriate mix of demand and supply management options that provide long-term, reliability water supply at lowest reasonable cost

and with highest possible benefits to customers, economic development, environmental quality, and other social objectives. The second initiative is to improve statewide water management systems, on which California depends to provide clean and reliable water supplies, protect lives and property from flooding, withstand drought, and sustain environmental values.

South Bay Aqueduct Improvement and Enlargement

DWR is implementing improvements to and expansion of the existing South Bay Aqueduct (SBA) facilities. The proposed project would make improvements to bring the existing capacity of the water conveyance system up to its design capacity of 300 cubic feet per second (cfs), construct a balancing reservoir, and add 130 cfs to provide a total of 430 cfs conveyance capacity. The final EIR was certified and the project was approved in December 2004. Improvement and enlargement of the SBA system involves modifying and constructing a number of facilities, including the following:

- Installing additional pumps at the South Bay pumping plant, constructing new switchyards, and possibly relocating ½-mile of a 230-kilovolt transmission line.
- Constructing a third Brushy Creek pipeline and surge tank parallel to the existing dual pipelines, and constructing a 500-acre-foot reservoir served by the third pipeline.
- Raising the height of canal embankments, lining, and overcrossing structures for the Dyer, Livermore, and Alameda canals, including modification to Patterson Pass Reservoir.
- Modifying check structures and siphons along the Livermore and Alameda canals.

Proposed modifications and improvements to the SBA system all would occur north of Del Valle Reservoir.

Franks Tract Project

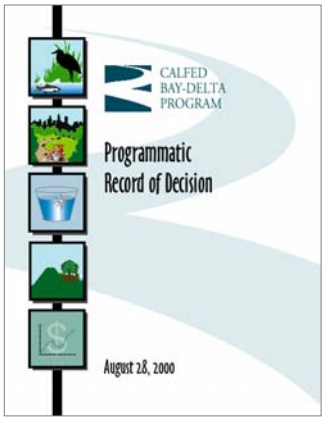
In January 2004, the DWR Levees and North Delta Branch began a feasibility study to evaluate the potential to create ecosystem, water quality, recreational, and other benefits at Franks Tract by modifying remnant levees and constructing tidal gates to inhibit salt trapping and restore tidal marsh habitat. Franks Tract is located in the central Delta, southeast of Brannan-Andrus Island between False River and Bethel Island. Franks Tract flooded in 1936 and again in 1938. The levees were not repaired, and the flooded island was later made a State Recreation Area. The proposed Franks Tract Project may improve the quality of water diverted at CVP and SWP South Delta pumping facilities and for in-Delta water users. Changing hydrodynamic conditions at the flooded island may improve the migration of fish through the Delta, restore the ecosystem by improving the basic food supply essential to the aquatic environment, and enhance recreational opportunities at Franks Tract by providing additional levee beach slopes.

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

The California SWRCB sets flow and water quality objectives in the Delta to protect beneficial uses of the Delta. SWRCB 1999 D-1641 sets specific Delta outflow requirements throughout the year, specific export restraints in the spring, and export limits based on a percentage of estuary inflow throughout the year. D-1641 also obligates the CVP and SWP to comply with the 1995

Water Quality Control Plan for the San Francisco Bay / Sacramento San Joaquin Delta Estuary (Bay-Delta Plan), which sets water quality objectives in the Delta. Included in D-1641 is VAMP, a 12-year program that uses pulse flows on the San Joaquin River, and south Delta CVP/SWP pumping curtailments, to improve habitat conditions in the Delta. CVPIA (b)(2) water can be used to account for VAMP pumping curtailments. VAMP flow modification actions are directed at fall-run Chinook salmon and delta smelt, and typically occur between April and May.

CALFED BAY-DELTA PROGRAM



CALFED is a cooperative effort among Federal and State agencies and California's environmental, urban, and agricultural communities. The Governor of California and the President of the United States initiated work on the program in 1995 to address environmental and water management problems associated with the Bay-Delta system. CALFED has taken a broad approach to addressing four problem areas: (1) water quality, (2) ecosystem quality, (3) water supply reliability, and (4) levee system integrity. Many of the problems and solutions in the Bay-Delta system are interrelated. Program implementation began following circulation of the final programmatic Environmental Impact Statement (EIS)/EIR and signing of the ROD in August 2000. A total of 18 Federal and State agencies participated in developing the EIS/EIR, with 13 signatories to the ROD (some agencies under a single overseeing body). The signatories noted that they would exercise their respective authorities over only those portions relevant to their authority. The CALFED ROD describes a series of programmatic elements that set the long-term direction of the CALFED program to meet its Mission Statement[2] and objectives.[3] Individual programs and solutions are intended to adhere to the CALFED Solution Principles identified in the ROD, which include the following:

- Reduce conflicts in the system
- Be equitable
- Be affordable
- Be durable

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[2] **CALFED Mission Statement -** The mission of the CALFED Bay-Delta Program is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

[3] **CALFED Objectives -** CALFED developed the following objectives:

- Provide good water quality for all beneficial uses.
- Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.
- Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system.
- Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.

- Be implementable
- Have no significant redirected impacts

In 2003, the State of California formed the California Bay-Delta Authority to help oversee the numerous Federal and State agencies working cooperatively to implement the CALFED Program. The California Bay-Delta Act established the authority as the new governance structure and charged it with providing accountability, ensuring balanced implementation, tracking and assessing CALFED progress, using sound science, assuring public involvement and outreach, and coordinating and integrating related government programs. In October 2004, the Water Supply, Reliability, and Environmental Improvement Act authorized Federal participation in implementing the CALFED Program.

Ultimately, implementing the CALFED programs depends on authorization and funding from participating Federal and State agencies. CALFED is expected to take 25 to 30 years to complete. CALFED program elements are summarized below.

Ecosystem Restoration Program

The Ecosystem Restoration Program (ERP) element consists of improving the ecological health of the Bay-Delta watershed through restoring and protecting habitats, ecosystem functions, and native species. This program offers funding, coordination, and technical assistance to support local watershed activities. Primary program elements include (1) an annual grant program to fund local projects for habitat restoration, fish passage, invasive species management, and environmental water quality, (2) habitat restoration in the Delta and its tributary watersheds, (3) stream flow augmentation in upstream areas through voluntary water purchases, (4) fish passage improvements through modification or removal of dams, improvement of bypasses and ladders, (5) integration of flood management and ecosystem restoration, (6) support for efforts to manage watersheds that affect the Bay-Delta system, development of watershed assessments and plans, and implementation of specific watershed conservation, maintenance, and restoration actions, and (7) management of the EWA.

Watershed Program

The goal of the Watershed Program element is to promote locally led watershed management activities and protections that contribute to achieving CALFED goals for ecosystem restoration, water quality improvement, and water supply reliability. The program provides financial and technical assistance to local community watershed programs to further these goals.

Water Supply Reliability Program (Water Management)

One of the primary goals of CALFED is to improve the reliability of California's water supply within the context of unpredictable hydrology and often-conflicting needs of water users and the environment. This program is intended to work with other CALFED program elements, such as the Storage Program and EWA, to address the various factors that influence water supply reliability, including water system flexibility, water use efficiency, regulatory actions, interagency cooperation, and storage and conveyance infrastructure.

Storage Program

The Storage Program element seeks to develop additional storage capacity to help meet the needs of California's growing population and to provide increased system flexibility for helping to improve water quality and restore ecosystems. The first stage of the program consists of increasing by approximately 950,000 acre-feet the storage capacity at existing reservoirs and strategically located offstream sites, and implementing major expansion of groundwater storage for an additional 0.5 to 1.0 MAF.

CALFED work teams have prepared numerous documents on all aspects of the various program elements. An important document in the storage program element is the *Integrated Storage Investigation Report - Initial Surface Water Storage Screening* (August 2000), which assessed and screened numerous potential reservoir sites. Of the potential projects considered, 12 were retained for more detailed evaluation. Of these 12, Reclamation and DWR were tasked to work with other CALFED agencies to pursue implementation of 5 surface water storage projects. The 5 projects, described below and shown in **Figure II-1**, include Los Vaqueros Expansion, Enlarge Shasta, In-Delta Storage, North-of-the-Delta Offstream Storage (NODOS), and Upper San Joaquin River Basin Storage.

FIGURE II-1 – CALFED SURFACE WATER STORAGE PROJECTS RETAINED FOR FURTHER STUDY

- **Los Vaqueros Expansion** – The Los Vaqueros expansion project would consist of enlarging the 100,000-acre-foot existing reservoir by up to 400,000 acre-feet as part of a Bay Area water quality and water supply reliability initiative. The project could help improve the quality and reliability of Bay Area drinking water supplies while reducing the impacts of Delta water management operations on sensitive fisheries, and provide other benefits, such as recreation and environmental enhancement, to the extent possible. The ROD (p. 44) acknowledged that, as an existing reservoir operated by CCWD, the Los Vaqueros Reservoir expansion is subject to a number of mandates and agreements, and DWR and Reclamation should work with CCWD and respect their previous commitments. The CALFED ROD also recognized that expanding the reservoir could have potential habitat impacts on the California red-legged frog, San Joaquin kit fox, and other special-status species.

- **Enlarge Shasta** – The Enlarge Shasta project identified in the CALFED ROD Preferred Project Alternative consists of expanding Shasta Reservoir by approximately 300,000 acre-feet through raising Shasta Dam 6.5 feet. Potential benefits include increasing the pool of cold water available in Shasta Reservoir to maintain lower Sacramento River temperatures for at-risk fish, and to provide other water management benefits, such as water supply reliability for the CVP. Federal feasibility studies are currently underway for the Shasta Lake Water Resources Investigation.

- **North-of-the-Delta Offstream Storage** – This project is evaluating the feasibility of constructing a 1.8 MAF reservoir on the west side of the Sacramento River, about 60 miles northwest of Sacramento. As envisioned, the NODOS project would serve as an offstream storage reservoir filled primarily through pumped diversions from the Sacramento River and its tributaries during high flow periods. The lead agency for this study is DWR. Primary benefits from the new storage would be increased reliability for water supplies for a significant portion of the Sacramento Valley, enhanced operational flexibility for managing fisheries and water quality, and improved Sacramento River diversion management. Public scoping for NODOS has been completed and planning, environmental, engineering, and related work is underway. Authority for Federal feasibility-scope studies for the NODOS project was contained in Section 215 of PL 108-7.

- **Upper San Joaquin River Basin Storage –** The CALFED ROD included a potential storage project on the upper San Joaquin River. Reclamation, in coordination with DWR, is conducting an investigation that includes developing a comprehensive list of water supply alternatives that could add 250,000 to 700,000 acre-feet of new storage in the San Joaquin watershed, primarily through enlarging Millerton Lake at Friant Dam or developing a functionally equivalent project. This project would be designed to contribute to restoring habitat and improving water quality on the San Joaquin River, and facilitate conjunctive management of water exchanges that would improve the quality of water delivered to urban communities. Other potential benefits would include increased hydropower production and enhanced flood control operation. Authority for Federal feasibility-scope studies for the Upper San Joaquin River Basin Storage project also was contained in Section 215 of PL 108-7.

- **In-Delta Storage** – In-Delta Storage (sometimes referred to as Delta Wetlands) would convert two Delta islands comprising 11,000 acres (Webb Tract and Bacon Island) into surface water storage facilities, and two islands (Bouldin Island and Holland Tract) into

9,000 acres of managed habitat. The lead agency for this study is DWR. The two storage islands would provide approximately 220,000 acre-feet of new storage capacity. A State feasibility study conducted by DWR, with technical assistance from Reclamation, was released in early 2004. Hydrodynamic and economic modeling is underway. However, the project as proposed requires modifications and significant additional analyses. DWR and Reclamation are determining whether any redesign or reconfiguration of the project could make it feasible for public ownership.

The CALFED ROD identified the need to pursue these storage projects, not in isolation, but as part of an overall water management strategy that will contribute to or be compatible with ecosystem restoration and other objectives of the program. This overall strategy reflects the overarching principle that many of the problems being addressed by CALFED are interrelated, and individual projects should be developed as components of the overall CALFED solution. The CALFED ROD also states "costs should, to the extent possible, be borne by the beneficiaries of the program actions." That principle is especially relevant in the decision to pursue new surface storage facilities, as the cost of these facilities can be considerable.

Conveyance Program

The Conveyance Program is aimed primarily at moving water through the Bay-Delta as efficiently as possible to increase system flexibility and improve Delta ecosystem health, water quality, and levee stability. This includes increasing export pumping capacity at SWP facilities in the south Delta to increase water supply reliability and fish protection. Several major projects include new fish screens at the Clifton Court Forebay and Tracy Pumping Plant; operable barriers to improve south Delta water levels and quality; the Tracy Fish Test Facility; Delta Cross Channel Reoperation; flood control and environmental enhancements in the north Delta and along the lower San Joaquin River; Clifton Court Forebay/Tracy Pumping Plant Intertie; and CVP/SWP Aqueduct Intertie. Two projects under the Conveyance Program of potential interest to the LVE are discussed below.

South Delta Improvements Program

Reclamation and DWR are the implementing agencies for the South Delta Improvements Program (SDIP), a part of the CALFED Conveyance Program. Goals of the SDIP include providing more reliable long-term export capability by the Federal and State water projects, protecting local diversions, and reducing impacts on San Joaquin River salmon. Potential actions as part of the SDIP include placing a fish barrier at the head of Old River; constructing up to three hydraulic barriers to improve circulation and stage in south Delta channels; dredging and extending agricultural diversions; and increasing the diversion capability of Clifton Court Forebay to 8,500 cfs. A site-specific Draft EIS/EIR is under preparation that will include a range of alternatives but will not have a specific proposed project alternative or preferred alternative. The final EIS/EIR will include identification of the preferred alternative and is scheduled for completion in early 2006.

San Luis Reservoir Low Point Improvement Project

The CALFED ROD identified a bypass canal to the San Felipe Division, operated in conjunction with local storage to avoid potential water quality impairment associated with low storage levels

in San Luis Reservoir. Funding for the study was appropriated by the State through Proposition 13 funds. Santa Clara Valley Water District (SCVWD) has completed environmental scoping. During the locally sponsored feasibility study, Reclamation participated as the National Environmental Policy Act (NEPA) lead, and has since initiated a draft Appraisal Report to assess potential Federal interest in pursuing feasibility-level studies of water quality and water supply reliability problems in the San Felipe Division of the CVP. Recent CALFED legislation provided Reclamation with feasibility study authority. During the feasibility study sponsored by SCVWD, and the appraisal study authorized by Reclamation, additional structural and non-structural measures were identified, in addition to a bypass canal, that could potentially address water quality and supply reliability concerns in the San Felipe Division.

Environmental Water Account

The CALFED ROD defined the EWA as a short-term, 4-year program (2001 to 2004) to help resolve one of the Bay-Delta's most fundamental conflicts: the competing needs of water management operations and the environment. In September 2004, EWA agencies (Reclamation, DWR, USFWS, National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), and the California Department of Fish and Game (CDFG)) signed a Memorandum of Understanding, extending the EWA program through 2007 in accordance with the CALFED ROD and EWA Operating Principles Agreement (2000). This cooperative management program provides protection to at-risk Delta fisheries through environmentally beneficial changes to CVP and SWP operations, including pumping curtailments in the south Delta. The program is aimed at adding flexibility to the State's water delivery systems, and providing water at critical times to meet environmental needs, without water supply impacts on cities, farms, and businesses. The EWA provides an institutional framework through which water managers can acquire, store, transfer, and release water strategically to respond to fishery and ecosystem needs in the Delta, and in upstream tributaries. The EWA is authorized to use acquired water assets to (1) augment instream flows and Delta outflows, (2) modify or reduce water exports to benefit fisheries, and (3) replace regular project water supply reduced by operations to protect at risk fish (*Developing an Optimal Asset Purchasing Strategy for the CALFED Environmental Water Account*, 2002).

Several tools with which EWA purposes could be pursued were identified in the 2000 EWA Operating Principles Agreement. These tools can be broadly categorized as purchases, borrowing, source shifting, conveyance, and project reoperation. EWA buys water from willing sellers or diverts surplus water when safe for fish, then banks, stores, transfers, and releases the water as needed to protect fish and to compensate water users. EWA implementing agencies have developed water acquisition targets (based on south of Delta delivery) for a long-term EWA operation. Typically, the EWA Program purchases 200,000 to 300,000 acre-feet of water annually.

The EWA is granted 500 cfs of pumping capacity at Banks Pumping Plant during July, August, and September and can use the CVP/SWP JPOD. These and other operations agreements, including coordination with CVPIA Section 3406 (b)(2) releases and relaxation of the export/inflow ratio, could potentially result in approximately 70,000 acre-feet of additional water per year for EWA actions.

The EWA agencies currently implement the EWA Program in accordance with the "Flexible Purchase Alternative," as described in the EWA Final EIS/EIR (January 2004) and the ROD (March 2004), for the short-term EWA Program. This EIS/EIR analyzed the effects of the short-term EWA Program's operations on the physical environment through 2007.

Federal legislation enacted in October 2004 authorized appropriations for the EWA for 6 years. Reclamation is leading development of an EIS/EIR for the proposed long-term program that is anticipated to be completed by summer 2007. The proposed long-term EWA is likely to be an acquisitions-based program similar to the short-term EWA. It is expected that the EWA, or a similar water acquisition program, will continue into the future.

Water Use Efficiency Program

The goal of the Water Use Efficiency (WUE) Program is to aggressively make the best use of existing water supplies through defining appropriate water measurement; certifying urban best management practices; and refining quantifiable objectives for agricultural water use efficiency. The program supports local water conservation and recycling projects. Savings resulting from the WUE Program will be accomplished through incentive-based, voluntary programs.

Water Quality Program

The goal of the Water Quality Program is to provide good quality water for all beneficial uses, which include municipal, agricultural, industrial, recreational, and environmental uses both within and outside the Delta. The ROD identifies the following program objectives:

- Improve the reliability and quality of raw water for drinking water needs.
- Reduce constituents in agricultural water that affect operations and crop productivity.
- Improve the reliability and quality of water for industrial needs.
- Improve the quality of raw water for recreational uses, including consumption of aquatic resources.
- Improve the quality of water for environmental needs.

The ROD identified that the CALFED target for providing "safe, reliable, and affordable drinking water in a cost-effective way, is to achieve either (a) average concentrations at Clifton Court Forebay and other south and central Delta drinking water intakes of 50 micrograms per liter (μg/L) bromide and 3.0 milligrams per liter (mg/L) total organic carbon (TOC), or (b) an equivalent level of public health protection using a cost-effective combination of alternative source waters, source control, and treatment technologies."

Water Transfer Program

The Water Transfer Program seeks to develop an effective water transfer market that could stretch existing water supplies by promoting transfers from willing sellers while protecting other water users, local economies, and the environment. The program provides technical information and other resources to facilitate and expedite the water transfer contracting process.

Levee System Integrity Program

The purpose of the Levee System Integrity Program is to reduce the threat of levee failure and seawater intrusion to protect water supplies, water quality, major roadways, cities, towns, agricultural lands, and environmental and aquatic habitat, primarily in the Delta. The program includes funding for local reclamation districts to reconstruct Delta levees to a base level of protection, develop best management practices for beneficial reuse of dredged material, and refine Delta Emergency Management Plans and a Delta Risk Assessment.

Science Program

The long-term goal of the Science Program is to establish a body of knowledge relevant to CALFED actions and their implications. That body of knowledge must be unbiased, relevant, authoritative, integrated across program elements, and communicated to the scientific community, CALFED agency managers, stakeholders, and the public. The Science Program seeks to integrate world-class science and peer review into every aspect of CALFED such that decisions are guided by the best scientific information possible.

Related CALFED Water Management Studies, Projects, and Programs

Ongoing CALFED projects relevant to this feasibility investigation are described below.

Bay Area Water Quality and Water Supply Reliability Program

The Bay Area Water Quality and Water Supply Reliability Program is a joint local agency and regional stakeholder effort funded by a CALFED study grant to explore alternatives for improving water quality and water supply reliability for Bay Area water users. The effort is examining potential projects that would allow Bay Area urban water suppliers to meet drinking water quality program objectives for bromides, TOC, and total dissolved solids (TDS), and to improve water supply reliability in a cost-effective manner. A combination of storage, source control, water exchanges, and other management actions and technology improvements are being considered. Participants include: Alameda County Water District (ACWD), San Francisco Public Utilities Commission (SFPUC), CCWD, EBMUD, San Francisco Bay Area Water Users Association, SCVWD, and Alameda County Flood Control and Water Conservation District Zone 7 (Zone 7).

Common Assumptions for CALFED Surface Water Storage Projects

Efforts are underway primarily by Reclamation and DWR to identify a series of Common Assumptions for use in developing each of the CALFED storage projects. These Common Assumptions would be used to develop without-project conditions, a critical element in the plan formulation process. The Common Assumptions working groups are meant to establish recognized baseline conditions including, at minimum, (1) period of analysis, (2) evaluation levels (i.e., 2001 for existing conditions and 2020 for future conditions), (3) water supply demands, (4) water supply system facilities, (5) regulatory standards, including minimum flow and temperature requirements, (6) system operation criteria, and (7) likely foreseeable actions.

The primary planning analytical tool being used for establishing baseline assumptions for water supply budgeting is the joint Reclamation/DWR simulation model for the CVP-SWP system (CALSIM-II). This mathematical model also is used for studying water supply impacts of various potential alternate system operations and project modifications.

OTHER PROGRAMS AND PROJECTS

Contra Costa Water District Board of Directors Principles of Participation

Commensurate with developing Los Vaqueros Expansion planning and technical documentation, the CCWD Board of Directors on April 19, 2000, adopted seven principles to inform and guide identification of a locally supportable project. These principles state, "Contra Costa Water District will not support a proposal involving the existing Los Vaqueros Project or use of the Los Vaqueros or Kellogg reservoir sites without the following assurances:

- The project improves water quality and reliability for CCWD
- The project enhances the Delta environment
- The project protects and enhances the fisheries and terrestrial species benefits provided by the existing Los Vaqueros Project
- The project preserves and increases the recreation opportunities of the Los Vaqueros Project
- CCWD must retain control of the watershed and operation of the reservoir
- The project protects and reimburses the financial investment made by the CCWD customers, who financed the existing $450 million Los Vaqueros Project
- The proposal would be placed before the voters of the Contra Costa Water District"

On June 25, 2003, the Board adopted Resolution No. 03-24, in which the Board found that "the District will not participate in or support the CALFED Bay-Delta Program proposal for expansion of Los Vaqueros Reservoir unless the Board determines that the CALFED Bay-Delta Program proposal meets the following conditions:

1. Improves drinking water quality for CCWD customers beyond that available from the existing Los Vaqueros Project;

2. Improves the reliability of water supplies for CCWD customers during droughts;

3. Enhances Delta habitat and protects endangered Delta fisheries and aquatic resources by installing state-of-the-art fish screens on all new intakes and creating an environmental asset through improved location and timing of Delta diversions and storage of water for environmental purposes;

4. Increases the protected land and managed habitat for terrestrial species in the Los Vaqueros Watershed and the surrounding region;

5. Improves and increases fishing, boating, hiking, and educational opportunities in the Los Vaqueros Watershed, consistent with the protection of water quality and the preservation of the watershed and the watershed's unique features;

6. CCWD continues as owner and manager of the Los Vaqueros Watershed;

7. CCWD maintains control over recreation in the Los Vaqueros Watershed;

8. CCWD continues as operator of the Los Vaqueros Reservoir system;

9. CCWD will be reimbursed for the value of the existing Los Vaqueros Project assets shared, replaced, rendered unusable or lost with the expansion project and said reimbursement will be used to purchase additional drought supply and water quality benefits or reduce debt on the existing Los Vaqueros Project;

10. Water rates for CCWD customers will not increase as a result of the expansion project."

In accordance with the Principles, continued participation in the LVE was brought before CCWD voters in Measure N and approved on March 2, 2004. Hence, the language of the ballot measure, provided below, is also observed for study purposes.

> *Shall Contra Costa Water District work with public water agencies to expand Los Vaqueros Reservoir, at no cost to District ratepayers, to: (1) increase water supplies for drought protection; (2) improve drinking water quality; and (3) protect endangered fish in the Delta, on condition that: (a) CCWD water rates will not increase; (b) no water will be exported to Southern California or a peripheral canal; and (c) CCWD will still operate the expanded reservoir?*

Contra Costa Water District Alternative Intake Project

CCWD is evaluating the benefits of a new intake in the central Delta to protect and improve water quality for CCWD's customers by accessing better source water quality. The project would help protect CCWD customers from seasonal and drought-caused declines in Delta water quality, ensure that CCWD is able to meet or exceed future drinking water regulatory requirements, and provide increased operational flexibility. Alternatives will be evaluated that may include different intake locations, desalination, and other treatment options. The proposed action could include a new intake and fish screen, pumping plant, and associated pipeline from the new intake to CCWD's Old River Pumping Plant. The proposed project would not increase CCWD's total diversion capacity, but would involve adding a new point of diversion to certain existing water rights held by CCWD and Reclamation. A draft EIS/EIR for the project is planned for early 2006.

Contra Costa Water District Los Vaqueros/Mokelumne Aqueduct Intertie

CCWD is currently pursuing engineering studies for a Los Vaqueros/Mokelumne Aqueduct Intertie. Under an agreement between EBMUD, CCWD, and Sacramento County as part of the Freeport Regional Water Project, this project will consist of facilities to enable up to 3,200 acre-

feet of CCWD's water to be diverted from the Sacramento River at Freeport and wheeled via EBMUD's Mokelumne Aqueduct to CCWD's Los Vaqueros pipeline in Brentwood, California.

Zone 7 Altamont Water Treatment Plant and Altamont Pipeline Project

Zone 7 identified the need for a new water treatment plant (WTP) north of Livermore and potable water transmission facilities to provide sufficient treated water capacity for M&I needs through 2030. An EIR for the proposed Altamont Water Treatment Plant was adopted by the Zone 7 Board of Directors. The *Altamont Pipeline Final EIR* was published and certified in February 2005 and is currently in design. The first phase of the WTP and pipeline is planned to be in service within the 2009 to 2011 time frame.

The WTP will be located off Dyer Road north of Livermore, near the Dyer Canal portion of the SBA, and will receive raw water from the SBA. The ultimate capacity is planned to be 42 million gallons per day (mgd), with a first stage capacity of 24 mgd. The pipeline will begin at the proposed treatment plant site and connect to Zone 7's existing 36-inch Cross Valley Pipeline near Kittyhawk Road in Livermore. The pipeline is expected to be approximately 12 miles in length and up to 48 inches in diameter.

Sacramento Valley Water Management Program (Phase 8)

The purpose of the Sacramento Valley Water Management Program is to promote better water management in the Sacramento Valley and develop additional water supplies through a cooperative water management partnership. The participants include Reclamation, DWR, Sacramento Valley water users, and South of Delta water users. The Program was developed to help resolve water quality and water rights issues arising from the need to meet the flow-related water quality objectives of the 1995 Bay-Delta Water Quality Control Plan and State Water Resources Control Boards Phase 8 Water Rights Hearings process. Implementation of the Sacramento Valley Water Management Program is a two-phase effort: a Short-Term Program, and a Long-Term Program. The Short-Term Program has been developed but not yet implemented, and a Long-term has yet to be identified.

The key provision of the Short-Term Program is the development of project capacity. Upstream water users would implement projects with the capacity to produce up to 185,000 acre-feet of water per year that would otherwise not be available within the Sacramento River watershed. Development of project capacity would be achieved primarily from pumping groundwater in lieu of surface water diversions, and from reservoir reoperation. In addition to conjunctive water management and reservoir reoperation projects, the Short-Term Program Work Plan includes system improvement projects (e.g., canal lining, flow measurement devices), surface water and groundwater planning projects (e.g., feasibility studies), and projects addressing institutional or regulatory barriers. These projects would be implemented for a period of 10 years.

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CHAPTER III
WITHOUT-PROJECT CONDITIONS

One of the most important elements of any water resource evaluation is defining the scope of the problems to be solved and opportunities to be addressed. Significant in this process is defining existing resource conditions and how these conditions may change in the future. The magnitude of change not only influences the scope of the problems and opportunities, but the extent of related resources that could be influenced by possible actions taken to address them. Accordingly, existing conditions and estimated future without-project baseline conditions are briefly assessed below, with a focus on the primary study area of the Los Vaqueros Expansion Investigation (LVE) (shown in **Plate 1**).

EXISTING CONDITIONS

Existing water resources and physical, biological, social and economic, and cultural conditions in the primary study area are described in this section.

Infrastructure, Operations, and Water Resources

The Sacramento-San Joaquin Delta (Delta) is at the center of the California's water resources system. Both the Central Valley Project (CVP) and State Water Project (SWP) have developed infrastructure and institutional mechanisms that rely on the movement of water through the Delta to balance the geographic disparities between water resource supplies and demands. This section describes the existing infrastructure of the CVP, SWP, and other Delta water users, how these facilities operate, the reliability of the supplies provided, and the quality of those supplies.

Existing Infrastructure

The discussion of water facilities located within the primary study area begins with Federal and State water project facilities, followed by a description of local water agency facilities. Water supply facilities that serve the study area are shown in **Figure III-1,** and statewide CVP/SWP facilities are shown in **Plate 2**.

Federal Facilities

The primary Federal project in the study area is the CVP, which received Federal authorization in 1935, and was reauthorized in 1937 as a part of the Rivers and Harbors Act. More than 3 million acres of farmland and nearly 2 million drinking water consumers receive water from the CVP. These distributions are achieved through long-term contracts with over 250 contractors in 29 of the 58 counties in California.

The CVP is organized into nine divisions established in relation to rivers or facilities within the basin: Trinity River, Shasta, American River, West San Joaquin, East Side, Sacramento River, the Delta, Friant, and San Felipe. The Delta and San Felipe divisions have facilities within the primary study area, and are described in greater detail below.

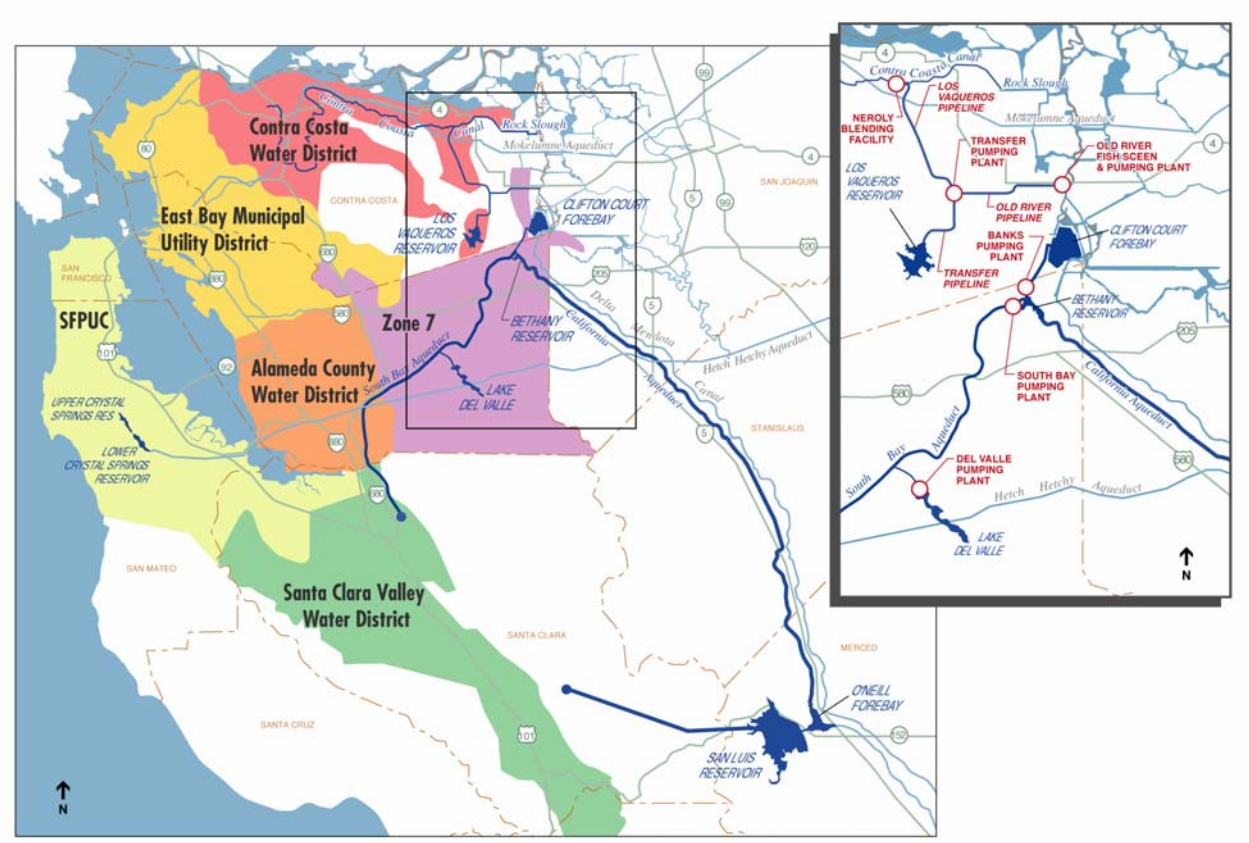


FIGURE III-1 – WATER SUPPLY FACILITIES SERVING THE STUDY AREA

Delta Division – The Delta Division contains facilities the CVP uses to transfer water to various service areas south and west of the Delta. The main features of the Delta Division are the Delta Cross Channel, Tracy Pumping Plant, Tracy Fish Collection Facility, Contra Costa Canal, Contra Loma Dam, and Delta-Mendota Canal.

- **Delta Cross Channel –** The Delta Cross Channel is a controlled diversion structure, used to transport water from the Sacramento River to the Tracy Pumping Plant. Water is drawn from the Sacramento River and delivered to the Mokelumne River to combat saltwater intrusion in the Delta and curb local water pollution. The water then flows through natural channels to the Tracy Pumping Plant, where it is pumped into the Delta-Mendota Canal.

- **Tracy Pumping Plant –** The Tracy Pumping Plant includes an inlet channel, pumping plant, and three discharge pipes. Water in the Delta is lifted 197 feet for delivery to the Delta-Mendota Canal. The plant's six pumps are each capable of pumping 767 cubic feet per second (cfs).

Tracy Pumping Plant

- **Tracy Fish Collection Facility and Fish Louvres –** Fish collection and screening facilities have been implemented to protect fish from the intake at the Tracy Pumping Plant. Collected fish are transported and released elsewhere in the Delta.

- **Contra Costa Canal –** The Contra Costa Canal, owned by Reclamation and operated and maintained by Contra Costa Water District (CCWD), receives water from the Delta through a diversion at Rock Slough near the cities of Brentwood and Oakley. A series of four pumping plants lift the diverted water to a high point in the canal, from which it flows 44.7 miles in a westerly direction through both open channels and pipelines in the cities of Oakley, Antioch, Pittsburgh, and Concord. The canal finally terminates at Martinez Reservoir in the City of Walnut Creek. The canal also receives water from the Los Vaqueros Project, which is mixed with Delta water at the Neroly Blending Facility.

- **Contra Loma Dam and Reservoir –** Contra Loma Reservoir is an offstream storage facility for the Contra Costa Canal, located at the southern end of the City of Antioch. Water is pumped from the Contra Costa Canal into the reservoir for storage, and released by gravity. Contra Loma Reservoir has a capacity of 2,100 acre-feet. The reservoir is owned by Reclamation and operated and maintained by CCWD.

Contra Loma Dam and Reservoir

- **Delta-Mendota Canal –** The Delta-Mendota Canal carries water about 116 miles from the Tracy Pumping Plant intake at Old River, along the west side of the San Joaquin Valley to the Mendota Pool, about 30 miles west of Fresno. The first 95 miles of the 4,600 cfs capacity canal is lined with concrete, and the remaining distance is unlined.

San Felipe Division – The San Felipe Division of the CVP is located in the central coast area of California, and includes portions of Santa Clara, San Benito, and Santa Cruz counties. Facilities in the San Felipe Division transfer water from San Luis Reservoir to agricultural, and municipal and industrial (M&I) users. The primary features of the San Felipe Division are described below:

- **Pacheco Tunnel –** The two reaches of the Pacheco Tunnel, and intermediate Pacheco Pumping Plant, transfer water from San Luis Reservoir through the Diablo Mountain Range. The 9.5-foot-diameter tunnels each have a capacity of 480 cfs and total 7.1 miles in length.

- **Pacheco Conduit –** The Pacheco Conduit is a 7.9-mile-long, 120-inch-diameter pipeline with a capacity of 480 cfs that extends from the Pacheco Tunnel Reach 2 outlet to the bifurcation of the Santa Clara and Hollister conduits.

- **Hollister Conduit** – The Hollister Conduit is a 19.5-mile-long pipeline with a capacity of 83 cfs that connects the Pacheco Conduit to San Justo Reservoir.

- **Santa Clara Tunnel and Conduit –** Santa Clara Tunnel and Conduit have a capacity of 330 cfs and convey water 22.1 miles from the Pacheco Conduit to the Coyote Pumping Plant.

- **San Justo Dam and Reservoir –** San Justo Dam is located about 3 miles southwest of Hollister. The 141-foot-high earthfill dam and a 66-foot-high dike form a reservoir with a capacity of 9,906 acre-feet.

- **Pumping Plants –** The Pacheco Pumping Plant is located at the end of Pacheco Tunnel Reach 1, and the Coyote Pumping Plant is located at the end of the Santa Clara Conduit.

State Facilities

The SWP was approved by California voters in 1960 (California Water Code, Section 12930, et seq.), and is operated by the State Department of Water Resources (DWR). SWP deliveries, of which 70 percent are urban and 30 percent are agricultural, provide water to meet the demands of 20 million people and 600,000 acres of irrigated land. Twenty nine different agencies in California currently hold contracts with the SWP. The northern boundary of the project is Plumas County and the project extends to Riverside County in the south. Completed project facilities include 23 dams and reservoirs, 6 powerplants, 17 pumping plants, and 533 miles of aqueduct.

The main SWP features of water conveyance and storage in the study area are the South Bay Aqueduct (SBA), South Bay Pumping Plant, South Bay Aqueduct Conveyance System, Banks Pumping Plant, Clifton Court Forebay, Bethany Reservoir, Patterson Reservoir, and Del Valle Reservoir and Pumping Plant.

- **South Bay Aqueduct –** The SBA was the first delivery system completed in the State Water Project (1969). It serves three contracting agencies within the study area: Santa Clara Valley Water District (SCVWD), Alameda County Water District (ACWD), and Alameda County Flood Control and Water Conservation District, Zone 7 (Zone 7). This system is designed to deliver 210,000 acre-feet per year (AFY) through a series of facilities. Lifting water from Bethany Reservoir to the Altamont Pass and delivering it by gravity through a system of pipelines, canals, and tunnels across the Livermore and Santa Clara valleys, the SBA ends at a terminal storage reservoir east of San Jose.

- **South Bay Pumping Plant –** The existing South Bay Pumping Plant consists of nine pumping units with a combined rated capacity (based on unit nameplate rating) of 330 cfs. This facility lifts water from the Bethany Reservoir for delivery to the SBA.

- **South Bay Aqueduct Conveyance System –** The SBA conveys water from the Delta through 44.7 miles of pipelines, canals, and tunnels (10.8 miles of canal, 32.1 miles of pipeline, and 1.8 miles of tunnel).

  Brushy Creek Pipeline – The 5-mile-long Brushy Creek Pipelines connect the Surge Tanks and Dyer Canal.

  Dyer, Livermore, and Alameda Canals – Dyer Canal is the initial open-channel, gravity portion of the SBA and conveys water 1.93 miles to the Altamont Pipeline. The 1.96 miles of Livermore Canal carry water from the Altamont Pipeline to the Patterson Reservoir. The

Alameda Canal begins at the control structure downstream from Patterson Reservoir and continues for approximately 6.86 miles to the Del Valle Pipeline.

Altamont Pipeline – The Altamont Pipeline runs from Dyer Canal to Livermore Canal.

Del Valle and Santa Clara Pipelines – Del Valle Pipeline connects Alameda Canal to the Santa Clara Pipeline. Santa Clara Pipeline, the final conveyance facility of the SBA, carries water from Del Valle Pipeline to be stored in the Santa Clara Terminal Reservoir.

- **Clifton Court Forebay –** Clifton Court Forebay, the head of the California Aqueduct, is located on the southwest end of the Delta, about 10 miles northwest of the City of Tracy. With a storage capacity of 31,000 acre-feet, the forebay provides regulation and off-peak storage of water pumped at Banks Pumping Plant.

- **Harvey O. Banks Pumping Plant –** Banks Pumping Plant, located near Byron, about 8 miles northwest of Tracy, lifts water 244 feet from the Delta into Bethany Reservoir. Although the facility's 11 pumps have a total physical capacity of 10,300 cfs, pumping at Banks is limited to 6,680 cfs (average daily) by diversion limitations at Clifton Court Forebay.

Harvey O. Banks Pumping Plant

- **Skinner Fish Collection Facility –** The Skinner Fish Collection Facility has been implemented to salvage fish from the intake at Banks Pumping Plant, reducing mortality at the facility. Fish are collected and transported for release elsewhere in the Delta.

- **Bethany Reservoir –** Water is pumped from the Delta into Bethany Reservoir and is either released into the California Aqueduct or pumped by the South Bay Pumping Plant into the SBA.

- **Patterson Reservoir –** Patterson Reservoir, located near Livermore, has 100 acre-feet of storage capacity and serves the adjacent Patterson Pass Water Treatment Plant (WTP).

- **Del Valle Reservoir –** Del Valle Reservoir was constructed to provide regulatory storage for the SBA, flood control for Alameda Creek, and recreation benefits. This 235-foot-high dam provides 77,100 acre-feet of total storage for SWP water and local runoff.

- **Del Valle Pumping Plant –** Del Valle Pumping Plant, located at the base of the dam, has four variable speed pumps with a total pumping capacity of 120 cfs. Water is carried from the SBA to the pumping plant where it is lifted into Del Valle Reservoir.

- **Santa Clara Terminal Reservoir –** Santa Clara Terminal Reservoir is a 9 acre-foot steel holding tank located at the terminus of the SBA, the water source for the Penitencia WTP.

Local Water Agency Facilities

This section describes local water agencies located in or near the primary study area. Following are brief descriptions of each agency; agency conveyance, storage, and treatment facilities are summarized in **Tables III-1** through **III-3**, respectively. Local water agency boundaries are illustrated in **Figure III-1** and in **Plate 4**.

Contra Costa Water District – CCWD, formed in 1936, services urban and agricultural customers throughout north, central and east Contra Costa County. Approximately 30 percent of its water is used by major industrial customers, less than 2 percent for large area irrigation, 33 percent is used by five municipal customers (Antioch, Pittsburg, Martinez, Southern California Water Company serving Bay Point, and Diablo Water District serving Oakley), and the remainder is treated and served to CCWD's customers in Concord, Clayton, Pleasant Hill and Walnut Creek. CCWD also diverts water for East Contra Costa Irrigation District, treating and conveying it to the City of Brentwood for distribution to the city's customers. CCWD water supply facilities include two water treatment plants (one owned jointly with Diablo Water District), the Contra Costa Canal, Contra Loma and Martinez reservoirs (owned by Reclamation and operated by CCWD), Mallard Reservoir, the 22-mile Multi-Purpose Pipeline, the Los Vaqueros Project (described later), and a treated water distribution system (including over 800 miles of pipelines and associated reservoirs and pump stations).

Contra Costa Canal

Santa Clara Valley Water District – Formed in 1929, SCVWD serves all of Santa Clara County, a total of 1,300 square miles and 1.7 million residents. SCVWD water supply facilities include three water treatment plants, a local groundwater basin, 10 local reservoirs, and a raw water conveyance system.

Alameda County Water District – ACWD was established in 1914 and serves about 318,000 customers (primarily urban) in a 101-square-mile area. Located about 20 miles southeast of San Francisco, ACWD encompasses the cities of Newark and Fremont, and Union City. ACWD water supply facilities include a conveyance and distribution system, two wellfields in the Niles Cone groundwater basin, direct connections to the San Francisco Public Utilities Commission (SFPUC) Bay Division pipeline, a blending facility, two raw water treatment plants, and one desalination facility.

Zone 7– Zone 7 was established in 1957 as one of 10 active zones in the Alameda County Flood Control and Water Conservation District. Zone 7 serves almost 200,000 customers in a 425-square-mile area encompassing the Livermore-Amador Valley, Sunol Valley, and portions of the Diablo Range. Zone 7's water supply facilities include two existing WTPs and the Livermore-Amador Valley groundwater basin.

TABLE III-1
LOCAL CONVEYANCE AND PUMPING FACILITIES IN THE STUDY AREA

Facility	Type	Size/Capacity	Supply	Use
Contra Costa Water District (CCWD)				
Rock Slough Intake & Pump Station[1]	Pump Station	350 cfs	Rock Slough	Primary supply for Contra Costa Canal
Contra Costa Canal[1]	Canal	350 cfs	CCWD Delta Intakes	Distribution to CCWD & customers
Old River Intake & Pump Station	Pump Station	250 cfs	Old River	Supplies Los Vaqueros Reservoir & Contra Costa Canal
Old River Pipeline	78" Pipeline	320 cfs 34,500 feet	Old River PP to Transfer Facility	Supplies Los Vaqueros Reservoir
Los Vaqueros Transfer Facility	Pumping Plant & Reservoir	200 cfs 4 MG	Old River Pipeline	Pumping to Los Vaqueros Reservoir; balancing reservoir for flow control
Los Vaqueros Transfer Pipeline	72" Pipeline	200 – 400 cfs 19,600 feet	Transfer Facility to Reservoir	200 cfs capacity to reservoir; 400 cfs capacity from reservoir to Transfer Facility
Los Vaqueros Pipeline	90"-96" Pipeline	400 cfs 47,000 feet	Transfer Facility	Connects Transfer Facility with the Contra Costa Canal
Santa Clara Valley Water District (SCVWD)				
Central Pipeline	Pipeline	N/A	SBA	Terminal Reservoir; supplies Vasona Pumping Plant
Vasona Pumping Plant	Pump Station	N/A	Central & Alameda Pipelines	Delivers to Rinconada Force Main & Rinconada WTP
Almaden Valley Pipeline	Pipeline	N/A	Almaden Reservoir	Conveyance to Calero Reservoir
Almaden-Calero Canal	Open Canal	N/A	Almaden Reservoir	Conveyance to Calero Reservoir
Anderson Force Main	Pipeline	N/A	Anderson Reservoir	Conveyance to Coyote Pumping Plant
Calero Pipeline	Pipeline	N/A	Calero Reservoir	Conveyance to Cross Valley Pipeline
Cross Valley Pipeline	Pipeline	N/A	San Luis Reservoir	Coyote Pumping Plant to Almaden Valley Pipeline
Stevens Creek Pipeline	Pipeline	N/A	Sevens Creek Reservoir	Conveyance to Rinconada WTP
Blending Facility	-	45 mgd	SFPUC	Blends SFPUC Hetch Hetchy purchases with groundwater
Alameda County Water District (ACWD)				
Various conveyance and distribution facilities				
Alameda County Flood Control and Water Conservation District, Zone 7				
Various conveyance and distribution facilities				

KEY: cfs = cubic feet per second; MG = million gallons; mgd = million gallons per day; N/A = not available; PP = pumping plant; SBA = South Bay Aqueduct; SFPUC = San Francisco Public Utilities Commission; WTP = water treatment plant

Notes:
1. Facilities are owned by Reclamation but operated and maintained by Contra Costa Water District.

TABLE III-2
LOCAL SURFACE STORAGE AND GROUNDWATER BASINS

Facility	Type	Capacity (acre-feet)	Source Supply	Uses
Contra Costa Water District (CCWD)				
Los Vaqueros Reservoir	Offstream Reservoir	100,000	Old River Intake (Delta)	Water quality, emergency storage
Mallard Reservoir	Offstream Reservoir	2,100	Contra Costa Canal and Mallard Slough Intake (Delta)	Emergency storage, flow regulation, & blending; supplies Bollman WTP
Local Groundwater Basins[1]	Groundwater	N/A	Ygnacio, Clayton and Pittsburg/Antioch basins	M&I supply, primarily to Clayton users & Diablo Water District
Santa Clara Valley Water District (SCVWD)				
Local Groundwater Basins[1]	Groundwater	N/A	Local runoff & reservoir releases; onstream and offstream recharge facilities	M&I, irrigation, and environmental uses
Almaden Reservoir	Onstream Reservoir	1,586	Alamitos Creek	M&I, irrigation, and environmental uses
Anderson Reservoir	Onstream Reservoir	90,373	Coyote Creek	M&I, irrigation, and environmental uses
Calero Reservoir	Onstream Reservoir	9,934	Calero Creek	M&I, irrigation, and environmental uses
Chesbro Reservoir	Onstream Reservoir	7,945	Llagas Creek	M&I, irrigation, and environmental uses
Coyote Reservoir	Onstream Reservoir	23,244	Coyote Creek	M&I, irrigation, and environmental uses
Guadalupe Reservoir	Onstream Reservoir	3,415	Guadalupe River	M&I, irrigation, and environmental uses
Lexington Reservoir	Onstream Reservoir	19,044	Los Gatos Creek	M&I, irrigation, and environmental uses
Stevens Creek Reservoir	Onstream Reservoir	3,138	Stevens Creek	M&I, irrigation, and environmental uses
Uvas Reservoir	Onstream Reservoir	9,835	Uvas Creek	M&I, irrigation, and environmental uses
Pacheco Reservoir	Onstream Reservoir	6,143	Pacheco Creek	M&I, irrigation, and environmental uses
Vasona Reservoir	Onstream Reservoir	400	Los Gatos Creek	M&I, irrigation, and environmental uses
Alameda County Water District (ACWD)				
Niles Cone Groundwater Basin[1]	Groundwater	N/A	Alameda Creek Watershed; releases from Del Valle Reservoir & SBA	Principal source of local M&I supply
Alameda County Flood Control and Water Conservation District, Zone 7 (Zone 7)				
Livermore-Amador Valley Groundwater Basin[1]	Groundwater	240,000 – 250,000 (est.)	Local runoff & imported water recharge; Del Valle Reservoir releases	M&I and agriculture

KEY: N/A = not available; M&I = municipal and industrial; SBA = South Bay Aqueduct; WTP = water treatment plant

Notes:

1. *Though not considered property, local groundwater basins are listed with the agencies that use them.*
2. *Del Valle Reservoir, owned by DWR, stores both SWP water and local supplies (up to 7,500 acre-feet per year of reservoir capacity available for ACWD and Zone 7, each, to capture and store local flow from Arroyo Del Valle). This facility was described previously in this chapter with other State facilities.*

TABLE III-3
LOCAL RAW WATER TREATMENT PLANTS IN THE STUDY AREA

Facility	Capacity (mgd)	Source Water	Disinfection Technique
Contra Costa Water District (CCWD)[1]			
Bollman WTP	75	Contra Costa Canal	Intermediate ozone
Randall-Bold WTP	40	Contra Costa Canal	Pre- and post-ozone
Antioch WTP	24	Contra Costa Canal	Chlorine contact
Martinez WTP	14	Martinez Reservoir & Contra Costa Canal	Chlorine contact
Pittsburg WTP	32	Contra Costa Canal	Chlorine contact
Bay Point WTP	5	Contra Costa Canal	Chlorine contact
Santa Clara Valley Water District (SCVWD)			
Rinconada WTP	75	SBA, Del Valle &, San Luis reservoirs[2]	Chlorination (currently); ozonation (2006)
Penitencia WTP	42	Santa Clara Terminal Reservoir (SBA & Del Valle)	Chlorination (currently); ozonation (2006)
Santa Teresa WTP	100	San Luis Reservoir[3]	Chlorination (currently); ozonation (2006)
Alameda County Water District (ACWD)			
Mission San Jose WTP	10	SBA & Del Valle Reservoir	Ultra filtration
WTP Number 2	28	SBA & Del Valle Reservoir	Pre-ozonation
Newark Desalination Facility	5	Brackish groundwater	Desalination by reverse osmosis
Alameda County Flood Control and Water Conservation District, Zone 7 (Zone 7)			
Del Valle WTP	36	SBA & Del Valle Reservoir	Chlorine contact
Patterson Pass WTP	20	SBA	Chlorine contact

KEY: mgd = million gallons per day WTP = water treatment plant SBA = South Bay Aqueduct

Notes:

1. *CCWD owns and operates Bollman WTP, and operates Randall-Bold WTP, which is owned jointly with Diablo Water District.*
   The other WTPs listed are owned and operated by various communities served by CCWD.
2. *Rinconada WTP has the ability to receive flows from local reservoirs as well.*
3. *San Teresa WTP has the ability to receive flows from the SBA and local reservoirs.*

Operation of Existing Facilities

This section discusses the operation of major water resources projects within the study area, beginning with CVP and SWP Delta operations and followed by Los Vaqueros Project operations.

Existing CVP and SWP Delta Operations

Tracy Pumping Plant – The CVP Tracy Pumping Plant is used to export water from the Delta and deliver it to the Delta-Mendota Canal. The facility is authorized to divert up to 4,600 cfs during the peak of the irrigation season, decreasing to 4,200 cfs during the winter (non-irrigation) season. Decreased winter irrigation demands, starting in September, give way to the refilling of San Luis Reservoir with water pumped from the Delta at Tracy, less the water needed to meet demands. However, according to the Central Valley Project Improvement Act (CVPIA), diversion rates during the San Luis fill cycle may be reduced for fishery management. The

amount, timing, and location of water deliveries from the Delta-Mendota Canal, apparent canal subsidence, siltation, facility design, and other factors have resulted in a mismatch between authorized Tracy Pumping Plant export capacity and Delta-Mendota Canal conveyance capacity. The Tracy Pumping Plant is usually operated at a constant, uninterrupted rate. Unless restrictions are imposed by regulatory or fishery requirements, when water supply supports it, the plant operates at the capacity limits of the Delta-Mendota Canal.

Harvey O. Banks Pumping Plant – The SWP Banks Pumping Plant lifts water 244 feet from the Delta to the California Aqueduct. Although the physical capacity of the pumping plant is 10,300 cfs, pumping at Banks is limited to 6,680 cfs (average daily) by flow restrictions at Clifton Court Forebay. Excess Banks pumping capacity may be used to pump CVP water as part of a Joint Point of Diversion (JPOD) operation during the summer months of July and August, when the CVP's Tracy plant is at maximum capacity. Banks exports may be temporarily reduced for fish protection purposes. Exports at Banks are reduced, at a minimum, for the period from April 15 to May 15 under the Vernalis Adaptive Management Program (VAMP). The "shoulder" periods of VAMP (April 1 through 15, and May 15 through 31) are likely periods for voluntary fish protection pumping curtailments due to the proximity of delta smelt to the pumps. Additional curtailment actions could occur during periods of juvenile Chinook salmon out-migration and adult delta smelt upstream migration in February and March. Between December 15, and March 15 Banks can increase pumping above 6,680 cfs if the flow in the San Joaquin River at Vernalis is greater than 1,000 cfs. This increase in permitted pumping is the lesser of 8,500 cfs or 1/3 of the flow at Vernalis.

Existing Los Vaqueros Project

Los Vaqueros Reservoir

The existing Los Vaqueros Project was constructed by CCWD to provide higher quality water for CCWD customers and emergency storage. Construction of the dam and conveyance facilities was completed in 1998, and the reservoir began operating in 1999. The Los Vaqueros Project is an offstream storage system. It diverts water from the Delta at the Old River Intake, pumps water to the Los Vaqueros Reservoir for storage, and delivers water by gravity from the reservoir to the Contra Costa Canal on an as-needed basis. Water also can be pumped directly from the 250 cfs Old River Pumping Plant to the Contra Costa Canal. Los Vaqueros releases are blended with other Delta diversions to improve the quality of CCWD's Delta water supply. Los Vaqueros Project facilities are illustrated in **Figure III-2** and described briefly below:

- **Old River Intake and Pumping Plant –** The Old River Intake diverts water from Old River in the Delta through a fish screen with an area of 1,250 square feet, and delivers it to the Old River Pipeline. The 10,500 horsepower (hp) pump station can pump up to 250 cfs.

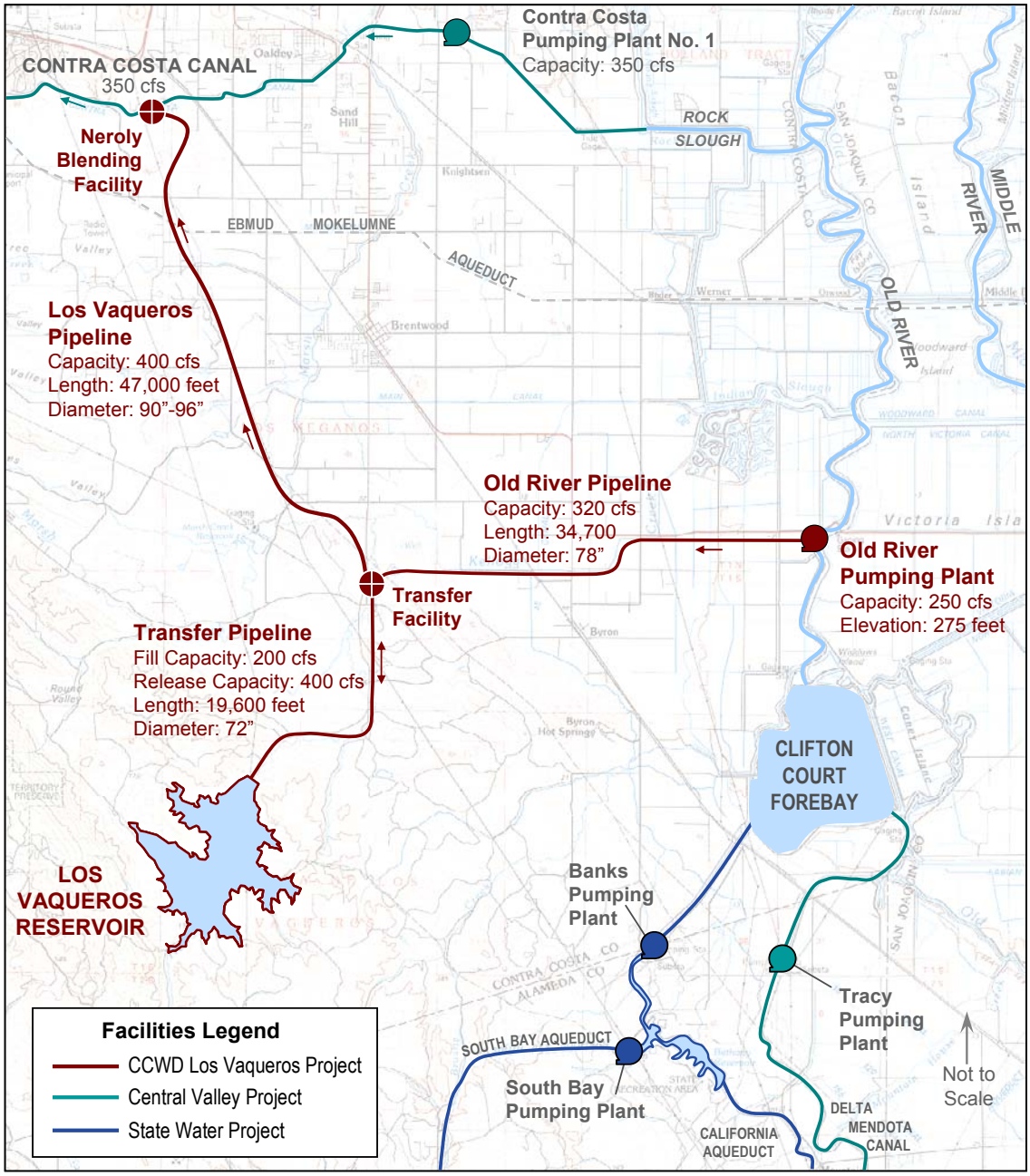


FIGURE III-2 – EXISTING LOS VAQUEROS PROJECT & RELATED FACILITIES

- **Old River Pipeline** – Old River Pipeline connects the Old River Pumping Plant to the Transfer Facility. The pipeline is approximately 34,700 feet long and 78 inches in diameter, and can convey up to 320 cfs.

- **Transfer Facility –** The Los Vaqueros Transfer Facility includes a pumping plant and a reservoir. The 8,400 hp Transfer Pumping Plant has a capacity of 200 cfs and delivers water to Los Vaqueros Reservoir. The Transfer Reservoir is a 4-million-gallon (MG) balancing reservoir that provides a free water surface and storage for flow control operations.

- **Transfer Pipeline –** The Transfer Pipeline connects the Transfer Facility to the Los Vaqueros Reservoir with approximately 19,600 feet of 72-inch-diameter pipe. The Transfer pipeline, regulated by Flow Control Station 1, can convey up to 200 cfs from the Transfer Facility to the reservoir, and up to 400 cfs from the reservoir to the Transfer Facility.

- **Los Vaqueros Reservoir –** The 100,000-acre-foot reservoir, located in the Kellogg Creek watershed, improves delivered water quality and provides emergency storage for CCWD.

- **Los Vaqueros Pipeline –** Los Vaqueros Pipeline has a capacity of 400 cfs and connects the Transfer Facility with the Contra Costa Canal. The Los Vaqueros pipeline consists of two continuous segments: the first is approximately 18,000 feet long and 96 inches in diameter, and the second is 29,000 feet long and 90-inch-diameter.

The existing LVP has three significant operational goals or objectives to perform simultaneously. One objective is to store high quality water for water quality blending purposes to improve the water quality served to CCWD customers. A second objective is to provide emergency storage to CCWD customers in case of severe interruption of Delta water supplies such as a Delta levee failure or a contaminant spill in the Delta. A third objective is to provide the operational flexibility to perform emergency storage and water quality functions while diverting water from the Delta during less sensitive fishery periods.

The existing LVP has the ability to divert up to 200 cfs to storage when Delta water quality conditions are favorable, releasing stored water later in the year for water quality blending needs. The source of stored water is typically Delta surplus flows during winter and spring months (November through June), and CCWD CVP contract water during late spring and summer. Los Vaqueros Reservoir is typically filled during wet weather months when Delta water is low in chlorides and surplus Delta flow is available. An exception is during April, when diversions may be curtailed to maintain higher in-Delta flows for winter-run Chinook salmon and delta smelt.

Water deliveries from Los Vaqueros Reservoir to the Contra Costa Canal are determined based on three parameters: (1) chloride concentration in Rock Slough, (2) chloride concentration in Old River, and (3) canal demand (which, in some periods, may exceed the maximum allowable diversion at Rock Slough and Old River intakes). CCWD uses chloride concentration as a general indicator of water quality in the operation of its facilities. Because of the proximity of the Rock Slough Intake to saltwater intrusions from San Francisco Bay, chlorides concentrations can be very high in Contra Costa Canal if the active intake is not switched to Old River during periods of high salinity. Water is delivered directly from Los Vaqueros Reservoir to the Contra Costa Canal if one of the three following conditions occurs:

Event 1: Old River water and Rock Slough water cannot be blended in any combination such that the resulting chloride concentration is below 65 milligrams per liter (mg/L) and Contra Costa Canal demand is satisfied. In this case, Los Vaqueros water would be used to dilute source water from the Delta to bring the chloride concentration below 65 mg/L.

Event 2: Old River water and Rock Slough water can be blended in a combination such that the resulting chloride concentration is below 65 mg/L, but the canal demand is too high to be accommodated by the pumping rate for this combination. In this case, Los Vaqueros water would be used to supplement source water from the Delta to meet canal demands.

Event 3: A severe interruption of Delta water supplies occurs (due to a levee failure or a contaminant spill in the Delta, for example). In this case, Los Vaqueros water would meet the canal demands entirely. This would be an infrequent, emergency operation.

Reservoir release typically occurs during the dry weather months when Delta water is high in chlorides and needs to be blended with a low-chloride source. One operational goal of the existing Los Vaqueros Project is to store water with a total chloride concentration of less than 50 mg/L. Thus, no filling occurs when chloride levels in the Delta are high or the reservoir is releasing.

Delta diversions for the Los Vaqueros Project also are governed by two biological opinions (BO): the 1993 National Marine Fisheries Service (NMFS) BO for Chinook salmon, and the 1993 U.S. Fish and Wildlife Service (USFWS) BO covering delta smelt. The USFWS BO requires CCWD to preferentially divert CVP water from the screened intake on Old River during the period from January through August, and requires operation of all three CCWD intakes and Los Vaqueros Reservoir as an integrated system to provide greater operational flexibility in minimizing fisheries impacts. In addition, if storage in Los Vaqueros is above emergency storage levels, the BOs require CCWD to cease all Delta diversions for one month in the spring, using releases from the reservoir to meet CCWD demands.

Existing Water Contracts and Supplies

This section describes existing water contracts and local supplies within the study area. The discussion begins with Federal and State water project contracts, followed by a description of local water agency contracts and supplies.

Federal Contracts

Two water districts within the study area have Federal contracts for CVP water: CCWD and SCVWD. **Table III-4** summarizes their contract entitlements and authorized points of delivery for CVP supplies. CCWD uses all of its CVP contracted water for M&I deliveries while almost 15 percent of SCVWD's CVP water is used for agricultural purposes.

State Contracts

Currently, three of the four districts within the study area have contracts for SWP water: ACWD, SCVWD, and Zone 7. **Table III-4** lists these districts, their annual contract amounts, and how their SWP water is delivered. For comparison, the CVP contracts in the study area (totaling about 347,500 acre-feet per year) represent just over 1.5 times the total SWP contracts in the study area.

TABLE III-4
FEDERAL AND STATE CONTRACTS WITHIN THE STUDY AREA

District	Contract Amount (acre-feet per year)	Point of Delivery
Federal Contracts		
CCWD	195,000	Delta at Rock Slough and/or Old River
SCVWD	152,500 (M&I: 130,000 Ag: 22,500)	San Luis Reservoir via Santa Clara and Pacheco Conduits
State Contracts		
SCVWD	100,000	South Bay Aqueduct
ACWD	42,000	South Bay Aqueduct
Zone 7[1]	80,619	South Bay Aqueduct

KEY: ACWD = Alameda County Water District; Ag = agricultural; CCWD = Contra Costa Water District; M&I = municipal and industrial; SCVWD = Santa Clara Valley Water District; Zone 7 = Alameda County Flood Control and Water Conservation District, Zone 7

Note:

1. *While considered an urban contractor, Zone 7 designates from about 6,000 acre-feet to 9,000 acre-feet of its annual deliveries for agricultural use.*

Source: District urban water management plans (CCWD Urban Water Management Plan, December 2000; SCVWD Urban Water Management Plan, April 2001; SCVWD Integrated Water Resources Planning Study, 2003; ACWD Integrated Resources Planning Study, August 1995; and Zone 7 Water Agency Urban Water Management Plan, October 2000 [with updates from District]).

Local Contracts and Water Rights

This section summarizes the water rights, local supplies, and contracted supplies of San Francisco Bay Area (Bay Area) water agencies within the study area. SCVWD, Zone 7, and ACWD each hold contracts with the Semitropic Groundwater Banking and Exchange Program (Semitropic GBEP). Semitropic Water Storage District allows its contractors to store water in its groundwater bank in years when unused water is available and then deliver the stored water to contractors by exchange, when needed. Contractors can deliver water to storage based on their permanent storage allocation, and may be given access to excess delivery capability (when available). Water is delivered from storage to the contractors through a combination of guaranteed pumpback capacity and exchange capacity, subject to availability. These and other local contracts and supplies are described below.

Contra Costa Water District – CCWD's water supplies come from a variety of sources in addition to the 195,000 AFY CVP entitlement drawn from Rock Slough and Old River described previously. Groundwater and recycled water provide about 4,000 acre-feet and 9,200 acre-feet annually, respectively. Local contracts and water rights that contribute to CCWD's water supplies are summarized below:

- East Contra Costa Irrigation District – CCWD has obtained an agreement for up to 12,200 AFY to be conveyed for M&I use within the irrigation district's service area.

- Sacramento-San Joaquin Delta – CCWD has rights to divert up to 26,700 AFY from the Delta at Mallard Slough under Water Rights License No. 3167 and Permit No. 19856. Under Water Rights Permit No. 20749, CCWD can divert up to 95,980 AFY of excess Delta flows to Los Vaqueros Reservoir for storage between November 1 of each year and June 30 of the succeeding year.

CCWD's Mallard Slough Diversion

- San Joaquin River – The City of Antioch holds the rights to divert up to 18,000 AFY from the San Joaquin River. In addition, Gaylord Container, Ultramar Diamond Shamrock, USS-Posco, and DuPont all hold rights to divert water from the San Joaquin River. The total maximum entitlement for these four industries is 44,650 AFY.

Note that these contracts are specific water rights of the identified parties, all of which are located within CCWD boundaries and contribute to CCWD's water demand. These water supplies are not considered reliable water sources because of the potential for San Joaquin River water quality to degrade during low flow (drought) conditions. For this reason, these diversion rights are only considered to contribute to the CCWD water supply when flow in the San Joaquin River reaches a specified level, ensuring acceptable water quality.

Santa Clara Valley Water District – SCVWD's water supplies consist of CVP and SWP contracts (discussed previously), local supplies, groundwater banking, recycling, and transfers. In addition, eight retail agencies within Santa Clara County contract with SFPUC to receive water supplies. SCVWD has one local contract and one permanent water transfer. These supplies are described below:

- SFPUC – Eight retail agencies in Santa Clara County contract with SFPUC to receive Hetch Hetchy and other local watershed supplies. The average annual SFPUC delivery in Santa Clara County has remained around 60,000 AFY in the last 10 years, although the annual delivery is projected to increase in the future. The contracts for these supplies expire in 2009.

- Semitropic Groundwater Banking and Exchange Program (Semitropic GBEP) – SCVWD has secured 200,000 acre-feet of permanent storage allocation and has an option to purchase an additional 150,000 acre-feet in the Semitropic GBEP. SCVWD is contractually guaranteed to be able to deliver 18,100 acre-feet to storage annually during wet years, or to receive up to 18,000 acre-feet of its stored water annually during drought years.

- Mercy Springs Water District – SCVWD, in conjunction with Pajaro Valley Water Management Agency and Westlands Water District, is entitled to a portion of the water from the permanent reassignment of the Mercy Springs Water District 6,260 acre-foot entitlement.

Alameda County Water District – In addition to SWP supplies described previously, a large portion of ACWD's water supply is received locally through the Niles Cone Groundwater Basin. The groundwater aquifer, which is used for both storage and supply, is recharged primarily from local runoff at Alameda Creek. ACWD also has three local contracts that contribute to its water supply:

- SFPUC – A 1984 water supply contract between the City and County of San Francisco and ACWD, as amended, provides for delivery of up to 15,400 AFY to ACWD from various connections to the Bay Division Pipelines.

- Semitropic Groundwater Banking and Exchange Program – According to its 2001 urban water management plan (UWMP), ACWD has secured 150,000 acre-feet of permanent storage in the Semitropic GBEP. ACWD is contractually guaranteed to be able to deliver 13,575 acre-feet to storage annually, or to receive a minimum of 13,500 acre-feet of its stored water annually via pumpback from the Semitropic aquifer into the SWP aqueduct. In addition, entitlement exchange is available in a quantity formulated from the annual SWP availability; ACWD's maximum entitlement exchange is 19,950 acre-feet in a full allocation year.

- Del Valle Reservoir Storage – ACWD and Zone 7 each have a water right permit issued by the State Water Resources Control Board to divert waters of Arroyo Valle into storage. These water right permits are acknowledged in a 1997 agreement between DWR, ACWD, and Zone 7. This agreement provides, in a typical year, 15,000 AF of storage space for local water inflow for subsequent beneficial use, divided between ACWD and Zone 7 as they may agree. Arroyo Del Valle flows may be delivered to ACWD through SBA turnouts under the exchange provisions of the contract.

Del Valle Reservoir

Zone 7 Water Agency – The Zone 7 area water supplies include contracts for imported water, local groundwater, surface water storage, and recycled water. The Livermore-Amador Valley groundwater basin has a storage capacity of about 240,000 AF. Recycled water contributes marginally to the area's irrigation water supply. In addition to the SWP Table A contract amount described previously, local contracts and a long-term water transfer contribute to Zone 7's water supply:

- Semitropic Groundwater Banking and Exchange Program – Zone 7 has secured 65,000 acre-feet in the Semitropic GBEP. Zone 7 is contractually guaranteed to be able to deliver 5,880 acre-feet to storage annually during wet years, or to receive up to 9,100 acre-feet of its stored water annually during drought years.

- Del Valle Reservoir Storage – ACWD and Zone 7 each have a water right permit issued by the State Water Resources Control Board to divert waters of Arroyo Valle into storage. These water right permits are acknowledged in a 1997 agreement between DWR, ACWD, and Zone 7. This agreement provides, in a typical year, 15,000 AF of storage space for local water inflow for subsequent beneficial use, divided between ACWD and Zone 7 as they may agree. Arroyo Del Valle flows may be delivered to Zone 7 through SBA turnouts under the exchange provisions of the contract.

- Byron Bethany Irrigation District – Zone 7 has entered into a long-term transfer agreement with Byron Bethany Irrigation District (BBID), providing a minimum transfer of 2,000 AFY.

Existing Water Supply Reliability

This section describes water supply reliability in the study area, beginning with an overview of general reliability conditions in the State, followed by discussions of CVP, SWP, and local supply reliability.

On the basis of information contained in the 1998 DWR California Water Plan (Bulletin 160-98), it is estimated that water demands in the State in 1995 for urban, agricultural, and environmental purposes under average and drought year conditions were about 79.7 million acre-feet (MAF) and 65 MAF, respectively, as shown in **Table III-5**. To address this demand, available statewide supplies from surface water, groundwater, and recycled and desalinated sources amounted to about 78 and 60 MAF for average and drought years, respectively. For the State as a whole, this represents a 1.8 MAF deficit in average years and a 5.4 MAF deficit in drought years.

TABLE III-5
ESTIMATED STATEWIDE WATER DEMANDS, SUPPLIES, AND SHORTAGES FOR 1995

Item	State of California	
	Average Year	Drought Year
Population (millions)	34.9	
Urban Use Rate (GPCPD)	241	247
Acres In Production (millions)	9.5	
Agricultural Use (AFPA)	3.5	3.6
Applied Water (MAF)		
Urban	9.4	9.7
Agricultural	33.3	34.1
Environmental	36.9	21.2
Total	***79.7***	***65.0***
Water Supply (MAF)		
Surface Water	65.1	43.5
Groundwater	12.5	15.8
Recycled / Desalinated	0.3	0.3
Total	***77.9***	***59.7***
SHORTAGE (MAF)	**1.8**	**5.4**

KEY: AFPA = acre-feet per acre MAF = million acre-feet
GPCPD = gallons per capita per day

Source: The California Water Plan, Bulletin 160-98, Appendix 6A, Regional Water Budgets with Existing Facilities and Programs, November 1998.

It should be noted that an update of the Water Plan is currently underway, and when finalized, relevant information on future water supplies and demands will be considered for the LVE. The April 2005 Draft of the update recognizes that significant water supply and quality challenges

persist on local and regional scales. The major water supply reliability challenges for the primary study area occur during droughts and other emergencies. During drought periods, locally developed water supplies are very limited and imported water supplies can fall short of demands. Challenges facing the primary study area are described in the following sections.

Central Valley Project

Allocation of CVP water supplies for any given water year is based on forecasted reservoir inflows and Central Valley hydrologic water supply conditions, amounts of storage in CVP reservoirs, instream and Delta regulatory requirements, and management of 3406(b)(2) resources and refuge water supplies in accordance with implementation of the CVPIA. In years when CVP water supplies are not adequate to provide water to all water service contractors, CVP M&I water service allocations are maintained at 100 percent as the CVP agricultural water service contract allocations are reduced to 75 percent of contract amount in several incremental steps. Next, M&I CVP water service contract allocations are reduced to 75 percent of contract amount in several incremental steps as Irrigation CVP water service contract allocations are reduced to 50 percent of contract amount. The M&I CVP water service contract allocations are maintained at 75 percent of contract amount until Irrigation CVP water service contract allocations are reduced in incremental steps to 25 percent of contract amount. Finally, M&I CVP water service contract allocations are reduced in incremental steps to 50 percent until Irrigation CVP water service contract allocations are reduced in incremental steps to zero (Reclamation, *Finding of No Significant Impact, Municipal and Industrial Water Shortage Policy, Central Valley Project, California*, March 2005 Draft). **Figure III-3** shows the historical CVP south-of-Delta allocations for M&I and agricultural uses from 1988 through 2002, based on data provided by Reclamation's Central Valley Operations Office.

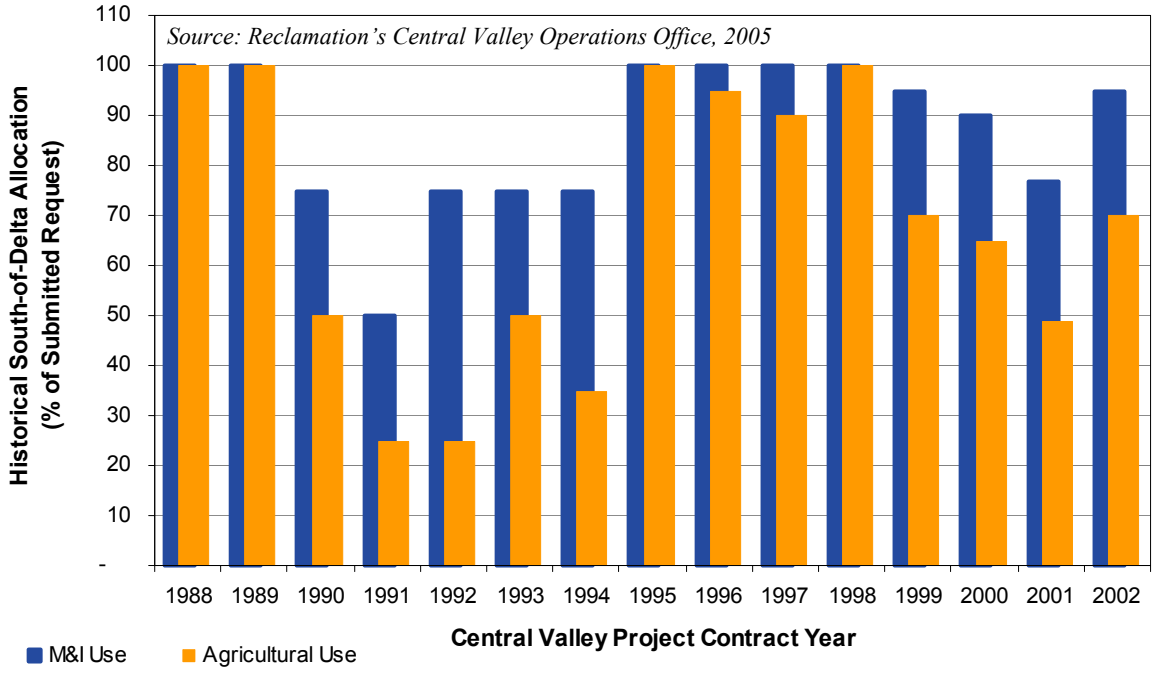


FIGURE III-3 – HISTORICAL CVP SOUTH-OF-DELTA ALLOCATIONS FOR M&I AND AGRICULTURAL USES FROM 1998 THROUGH 2002

Two major regulation changes in the 1990s have significantly affected the availability of CVP water for contract delivery: the CVPIA and SWRCB Decision 1641 (D-1641). The CVPIA, passed by Congress in 1992, was an attempt to restore the environment in the Central Valley and affect a more efficient use of CVP water. The CVPIA established the "protection, restoration, and enhancement of fish, wildlife and associated habitat" as a CVP purpose, and dedicated CVP water for wildlife uses. This resulted in decreased allocations and increased uncertainty for CVP contract holders.

The SRWCB issued D-1641 in December 1999, and later revised it in March 2000 to amend certain terms and conditions of the water rights of the CVP and SWP. This decision requires that the CVP and SWP be responsible for meeting Delta water quality flow and salinity objectives for fish and wildlife protection, M&I water quality, agricultural water quality, and Suisun Marsh salinity, as specified in the 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (Bay-Delta Plan). Under this decision, the CVP and SWP often make additional releases from storage for meeting water quality objectives in the Delta.

The most recent projection of CVP water supply reliability is available in the Biological Assessment (BA) prepared for the Federal Endangered Species Act, as amended, Section 7 consultation on the Long-Term Central Valley Project Operations Criteria and Plan (OCAP). **Table III-6** displays the simulated deliveries to CCWD and SCVWD by water year type under the existing conditions (2001 level of development (LOD)). While the long-term averages of contract allocation for M&I and agricultural uses are comparable to the historical allocation, the projected allocations in dry years are substantially lower than the historical allocations, especially for agricultural uses.

TABLE III-6
SIMULATED CVP CONTRACT DELIVERY TO THE STUDY AREA
BY WATER YEAR TYPE FOR EXISTING CONDITIONS

District	Item	Delivery in AFY (Percentage of Total CVP Contract Amount)[1]		
		Long-Term Average	Critical Dry Period (1929-1934)	Single Dry Year (1977)
Contra Costa Water District		171,600 (88%)	117,000 (60%)	105,300 (54%)
Santa Clara Valley Water District	M&I	100,000 (77%)[2]	78,000 (60%)	70,200 (54%)
	Agriculture	13,725 (61%)	2,475 (11%)	900 (4%)
	Total	113,825	80,475	71,100

KEY: AFY = acre-feet per year CVP = Central Valley Project M&I = municipal and industrial

Notes:

1. *Numbers in parenthesis represent percentage of each district's total CVP contract amount (see Table III-4).*
2. *Includes provisions of SCVWD's Water Reallocation Agreement of April 1997, which converts the dry year delivery basis from 75 percent of historical use to 75 percent of contract quantity.*

Source: CALSIM II Study 3 (2001 Level of Development with CVPIA b(2) and EWA) for Long-Term Central Valley Project and State Water Project Operations Criteria and Plan Biological Assessment (June, 2004).

Reclamation has proposed to implement a Municipal and Industrial Water Shortage Policy for the CVP, and incorporate this M&I shortage policy in the CVP long-term contracts under negotiation for renewal in accordance with CVPIA Section 3404(c). In March 2005, Reclamation released the Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the proposed CVP M&I water shortage policy. Based on the March 2005 draft FONSI, the allocation methodology for CVP M&I water service contractors would be the same as under existing conditions (described above) when the CVP M&I allocations are greater or equal to 75 percent under the proposed alternative. However, in years when the CVP M&I allocations are less than 75 percent, water would be reallocated from the Irrigation CVP water service contractors to provide at least the public health and safety water quantity up to 75 percent of the total entitlement stipulated in the corresponding CVP M&I water service contract. The reallocation would be limited to the total amount allocated to the CVP agricultural water service contractors, if and when the water is available. In some years, allocations to CVP agricultural water service contractors are at or near zero. In those years, the increased allocations to M&I CVP contractors would not be fully realized.

The March 2005 draft FONSI further states that, of the 72 hydrologic years evaluated in CVP water supply studies under a 2020 LOD, CVP M&I water service contract allocations are less than 75 percent in 13 years under the existing allocation policy. Under the proposed alternative, M&I CVP water service contract allocations would increase in 9 of the 13 years by 5 to 13 percent. To provide these allocations, CVP agricultural water service contract allocations would decrease by 1 to 3 percent in these years, including two additional years when Irrigation CVP water service contract allocations would be zero or almost zero (as compared to 4 years in the No Action Alternative). This reduction of only 1 to 3 percent in the CVP Irrigation allocations in only 9 out of 72 hydrologic years is not a significant impact on surface water resources or on the CVP Irrigation allocations. Because water is reallocated between CVP M&I and irrigation users in the same water year, no change occurs in storage in CVP reservoirs or to allocations of water to refuge water supplies, instream flows, or senior water right holders. Because Delta exports are not limited due to capacity limitations during 9 years out of the 72-year hydrologic record, no adverse impact would occur to availability of Delta export capacity for other users.

State Water Project

SWP allocation policies are central to understanding the reliability of the project. Because the availability of SWP supplies is subject to hydrology, storage, and other factors, the project has developed policies for equitably delivering available supplies to contract holders in any given year. Article 18 of SWP water contracts outlines the reallocation of water among contractors in years of temporary shortage and addresses the potential of long-term shortages. The "Table A" amount is the maximum contractual amount that SWP contractors can request each year, and is given the first priority of delivery. Under shortage conditions, the current SWP policy is to equally impact all Table A water contractors.

Table III-7 summarizes the delivery request and allocation process for SWP contractors. In this example, Contractor 1 has 500 thousand acre-feet (TAF) under contract, while Contractor 2 has 300 TAF, and Contractor 3 has a contract for 400 TAF. At the beginning of the year, each contractor requests a different amount of water relative to their respective contract and needs.

In this example, the SWP determines that a 50 percent allocation is appropriate given the year's hydrology, and each contractor is assigned 50 percent of their Table A entitlement. Contractors 1 and 3 result in a shortage condition relative to their requested supplies, while Contractor 2 would receive more water than requested. Contractor 2's "surplus" water is then reallocated to Contractors 1 and 3 according to their share of Table A allocations.

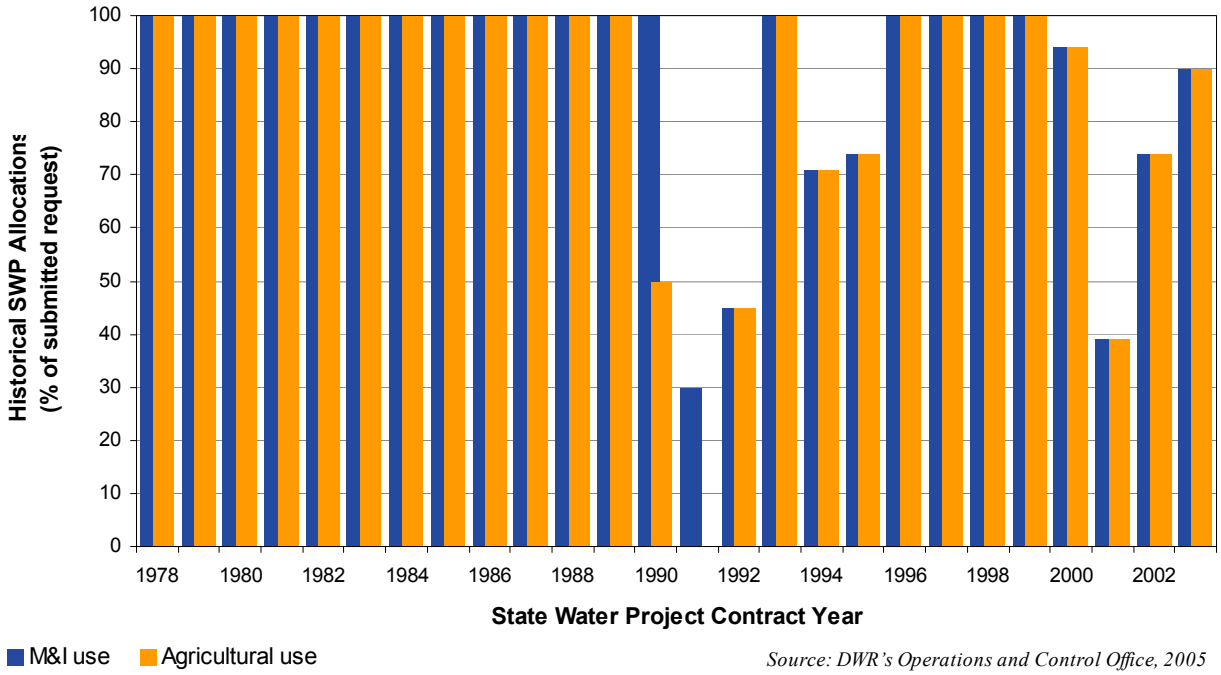
TABLE III-7
EXAMPLE OF STATE WATER PROJECT SHORTAGE POLICY

Contractor	Table A Amount	Request	50% Initial Allocation	Shortage	Surplus	Final After Reallocation
1	500	400	250	160	-	278
2	300	100	150	-	50	100
3	400	400	200	200	-	222

Article 21 of the contracts permits delivery of water in excess of Table A, when it is available, to contractors who request it. Article 21 water is recognized as water in excess of the amount required to meet the needs of the water project and, consequently, has a lower priority for delivery. When available, Article 21 water is distributed in the same proportion as Table A (*The State Water Project Delivery Reliability Report*, 2002).

Figure III-4 shows the historical SWP allocations for agricultural and M&I uses from 1978 through 2003. Prior to 1995, shortage provisions in the SWP contracts favored M&I contractors. In December 1994, DWR and the State Water Contractors entered into the Monterey Agreement, which lays out principles for amending the water supply contracts. Principle 2 of the Monterey Agreement states that each contractor will be allocated part of the total available project supply in proportion to the Table A amounts, irrespective of type of use (*CALSIM II Simulation of Historical SWP/CVP Operations*, November 2003).

The most recent projection of SWP water supply reliability is available in the BA prepared for OCAP consultation. Based on the projected percent allocations of SWP water determined with the CALSIM II modeling tool for the OCAP study, **Table III-8** displays the simulated deliveries by water year type to State Water Contractors in the study area under the existing conditions (2001 LOD). The comparison between these projected allocations with the historical allocations is not obvious because of the execution of the Monterey Agreement. However, the simulated SWP allocations are considered representative in both the *CALSIM II Simulation of Historical SWP/CVP Operations* (November 2003), and a review by DWR's Operations and Control Office as part of its effort for the Oroville Facilities Relicensing Program (Oroville Facilities Relicensing Program, Operations Modeling Workshop No. 2 on August 12, 2003).



Source: DWR's Operations and Control Office, 2005

FIGURE III-4 – HISTORICAL SWP ALLOCATIONS FOR M&I AND AGRICULTURAL USES FROM 1978 THROUGH 2003

TABLE III-8
SIMULATED SWP ALLOCATIONS IN THE STUDY AREA BY WATER YEAR TYPE

District	Delivery in AFY (Percentage of Total Table A Amount)		
	Long Term Average	Critical Dry Period (1929-1934)	Single Dry Year (1977)
Alameda County Water District	35,280 (84%)	17,640 (42%)	1,260 (3%)
Santa Clara Valley Water District	84,000 (84%)	42,000 (42%)	3,000 (3%)
Alameda County Flood Control and Water Conservation District, Zone 7	67,720 (84%)	33,860 (42%)	2,420 (3%)

KEY: AFY = acre-feet per year

Note: Numbers in parenthesis represent percentage of each districts total Table A amount.

Source: CALSIM II Study 3 (2001 Level of Development with CVPIA b(2) and EWA) for Long-term Central Valley Project and State Water Project Operations Criteria and Plan Biological Assessment (June, 2004. Note that these numbers differ slightly from those provided by DWR in " Notice to SWP Contractors No. 05-08 - 2005 SWP Delivery Reliability Report Excerpts" circulated in May 2005 for agencies to prepare their 2005 Urban Water Management Plan.

Local Supplies

Each of the identified districts has different reliability goals and policies regarding local supplies and associated hydrologic uncertainty and seismic vulnerability. **Tables III-9** and **III-10** display the current and anticipated water supplies and demands for each district within the study area. Values were calculated from data obtained from each districts' urban water management plan and from district staff. Note that the hydrologic year types were defined differently in each districts' UWMP, but the following assignments can generally be assumed for local supplies: long-term average (1922 to early 1990s), critical dry period (1987 to 1992), and single dry year (1977).

Del Valle Reservoir, owned by DWR, is a storage reservoir for both local supplies and SWP water, of which the local portion is not subject to allocation but is instead delivered as needed. The contract between DWR, ACWD, and Zone 7 (discussed above), which makes 7,500 AFY of storage available for each district, is part of the local reservoir supplies, and thus, is included in the following discussions.

Existing Quality of Water Resources

This section describes current water quality conditions within the primary study area. The following sections discuss of the quality of Delta export supplies and local supplies within each agency.

In-Delta and Delta Export Water Quality

General factors influencing Delta water quality and the quality of water exported from the Delta to the study area are described in this section. Water quality in the Delta is highly variable and can be influenced by inflows from freshwater tributaries, agricultural and urban discharges, tidal influences from San Francisco Bay, and the operations of SWP and CVP facilities.

Specific activities that can cause contamination of Delta waters include the following: M&I wastewater discharges, urban runoff, highway runoff, agricultural runoff, pesticides, grazing animals, concentrated animal facilities, wild animals, mine runoff, recreational activities, traffic accidents/spills, seawater intrusion, geologic hazards, and solids and hazardous waste disposal facilities. The natural flushing of the Delta, source contamination controls, and existing water treatment practices mitigate this potential contamination. (CCWD *Water Quality Report*, 2004)

DWR maintains water quality data at the following M&I diversion locations in the Delta (summarized in **Table III-11**):

- SWP Harvey O. Banks Pumping Plant
- CVP Contra Costa Pumping Plant No. 1 (Rock Slough)
- CCWD Old River Intake (Los Vaqueros Project)
- CCWD Mallard Slough Intake

Contra Costa Pumping Plant No. 1

TABLE III-9
EXISTING LOCAL SUPPLIES WITHIN THE STUDY AREA BY WATER YEAR TYPE

Source	ACWD[1] (TAFY)			CCWD[2] (TAFY)			SCVWD[3] (TAFY)			Zone 7[4] (TAFY)		
	LTA	CDP	SDY	LTA	CDP	SDY	LTA	CDP	SDY	LTA	CDP	SDY
Contracts[5] (excludes CVP/SWP)	15.0	12.9	11.7	34.4[7]	9.9	9.9	65.4	69.5	46.7	2.0	10.7	7.6
Surface Water[6]	4.5	0.4	0.1	-	-	-	85.4	48.4	44.4	8.0	2.8	0.3
Groundwater	17.7	38.6	35.5	4.0	4.0	4.0	N/A[8]	N/A[8]	N/A[8]	14.3	15.7	52.8
Desalination	5.6	5.6	5.6	-	-	-	-	-	-	-	-	-
Recycling	-	-	-	9.2	9.2	9.2	9.0	9.0	9.0	0.5	0.5	0.5
TOTAL LOCAL SUPPLIES	**42.8**	**57.5**	**52.9**	**47.6**	**23.1**	**23.1**	**N/A**	**N/A**	**N/A**	**24.8**	**29.7**	**61.2**

KEY: CDP = critical dry period (1987-1992, except for ACWD per Note 1) N/A = not available TAFY = thousand acre-feet per year
LTA = long-term average (1922-early 1990s) SDY = single dry year (1977)

Notes:

1. *The LTA condition represents the annual average amount of water available based on 1922-1992 historical hydrologic conditions. The CDP condition is an average of the Multiple Dry Year scenario in the UWMP and is based on the projected supply availability under 1988-1990 drought conditions. The SDY condition is based on projected supply availability under 1977 drought conditions. ACWD "Contracts" refers to SFPUC; values listed reflect 2005 SFPUC revised water supply availability figures for use in 2005 UWMP and differ from the 2000 UWMP. All numbers are subject to change pending completion of 2005 UWMP.*
2. *All hydrologic year type conditions represent projected local supplies.*
3. *The LTA condition represents the average supply available over the historic record (1922-1990), given existing facilities. The CDP condition projected as the equivalent to the 1987-1992 drought extended to a10-year duration and 1 percent probability severity event. The SDY condition is defined as the minimum operationally usable supply available during the historic record, equivalent to what would be experienced if the hydrology of 1977 were repeated with current facilities in place.*
4. *The LTA (1922-1999), CDP (1987-1992), and SDY (1977) conditions represent projected model outputs from the Zone 7 Annual Water System Model – Version 4.0, except groundwater, recycling, and Del Valle values, which are determined from information presented in UWMP and provided by Zone 7 staff.*
5. *Contracts refer to SFPUC Hetch Hetchy (ACWD, SCVWD); Semitropic (SCVWD, Zone 7); Mallard Slough Delta diversion, San Joaquin River diversions, & ECCID Purchase (CCWD); Mercy Springs Transfer (SCVWD); BBID Transfer (Zone 7). CVP and SWP contracts are shown in Table III-10.*
6. *Surface water supplies for ACWD and Zone 7 represent available storage in Del Valle Reservoir.*
7. *Maximum diversion at Mallard Slough (26,780 AFY) noted in Los Vaqueros Project of CCWD and Reclamation, Decision No. 1629.*
8. *Groundwater use is currently under evaluation by SCVWD and is not available at this time.*

Source: District urban water management plans and information provided by district staff (unless otherwise noted above); see references in Chapter XIII.

TABLE III-10
EXISTING WATER BALANCE WITHIN THE STUDY AREA BY HYDROLOGIC YEAR TYPE

	ACWD[1,2] (TAFY)			CCWD (TAFY)			SCVWD (TAFY)			Zone 7 (TAFY)		
Item	**LTA**	**CDP**	**SDY**	**LTA**	**CDP**	**SDY**	**LTA**	**CDP**	**SDY**	**LTA**	**CDP**	**SDY**
Supplies												
Central Valley Project	-	-	-	171.6	117.0	105.3	113.0	80.5	71.1	-	-	-
State Water Project	35.3	17.6	1.3	-	-	-	84.0	42.0	3.0	67.7	33.9	2.4
Local (see Table III-9)	**42.8**	**57.5**	**52.9**	47.6	23.1	23.1	N/A[3]	N/A[3]	N/A[3]	24.8	29.7	61.2
TOTAL SUPPLIES	**78.1**	**75.1**	**54.2**	**219.2**	**140.1**	**128.4**	**N/A**	**N/A**	**N/A**	**92.5**	**63.6**	**63.6**
Demand[4]	71.1	67.1	67.1	173.1	173.1	173.1	446.6	446.6	446.6	66.9	66.9	66.9
Conservation	0.8	0.8	0.8	1.1	1.1	1.1	37.0	37.0	37.0	3.3[6]	3.3[6]	3.3[6]
WATER BALANCE[7]	**7.8**	**8.8**	**-12.1[9]**	**47.2**	**-31.9**	**-43.6**	**N/A[8]**	**N/A[8]**	**N/A[8]**	**28.9**	**-**	**-**

KEY: CDP = critical dry period (CVP/SWP: 1929-1934, Local: 1987-1992) N/A = not available TAFY = thousand acre-feet per year
LTA = long-term average (1922-early 1990s) SDY = single dry year (1977)

Notes:

1. *ACWD demands include Distribution system demands and groundwater system demands, (consisting of private groundwater pumping, aquifer reclamation pumping and groundwater outflows to prevent seawater intrusion). Under critically dry conditions, ACWD's groundwater system demands are assumed to be reduced by 4,000 AF/yr which would occur as a result of temporarily lowering groundwater levels. This temporary drawdown may subsequently reduce the quantity of groundwater outflows to the San Francisco Bay, thereby reducing the overall groundwater system demands.*
2. *ACWD supplies and demands are subject to change pending completion of ACWD's 2005 UWMP.*
3. *Groundwater use, a significant part of SCVWD's local supplies, is currently under evaluation and is not available at this time.*
4. *If a range of demands was presented in a District's UWMP, the "Middle" Scenario was used (ACWD and SCVWD).*
5. *Changes in demand during dry periods reflect partial reduction in saline outflows to San Francisco Bay resulting from naturally low groundwater levels.*
6. *Five percent conservation was assumed for Zone 7.*
7. *A negative water balance represents a shortage.*
8. *Demands not met by imported supplies and local surface supplies are typically met by groundwater pumping (see Note 3).*
9. *Preliminary modeling for ACWD's 2005 UWMP indicates no shortage during the 1977 period under 2005 demands. This is attributed to higher groundwater availability during the single dry-year scenario, lower private pumping demands, and recovery of groundwater reclamation pumping demand as a potable supply vis-à-vis desalination.*

Source: District UWMPs. See Tables III-7, III-10, and III-11 for breakdown of supplies. Conservation figures represent low (conservative) end of ranges presented in the UWMPs.

TABLE III-11
DELTA WATER QUALITY AT SELECTED DIVERSION LOCATIONS

Water Quality Parameter	SWP Banks Pumping Plant (1982 – present)	CVP Contra Costa Pumping Plant No. 1 (Rock Slough) (1990 – present)	CCWD Old River Intake (1990 – present)
Temperature	January: 44 – 50 °F August: 72 – 77 °F Significant diurnal variation (11°F in summer season)	January: 47 – 52 °F August: 75 – 80 °F	January: 46 – 51 °F August: 75 – 79 °F
Dissolved Oxygen	Winter: 10 – 12 mg/L Summer: 6 – 8 mg/L DO levels near saturation	6 – 13 mg/L Low levels in dry season, high levels in winter	Winter: 10 – 12 mg/L Summer: 6.5 – 8 mg/L DO levels near saturation
pH	6.5 – 9 units Significant diurnal variation (1.5 units in summer season)	6.5 – 8.5 units No seasonal trends.	6 to 9 units. High levels in summer (weak seasonal trends)
Turbidity	Typically < 30 NTU but occasional spikes up to 40 NTU	< 25 NTU with occasional peaks up to 50 NTU	< 20 NTU with spikes that exceed 30 NTU
Electrical Conductivity and Total Dissolved Salts	**EC:** 100 – 900 μS/cm **TDS:** 100 – 500 mg/L Lowest levels usually occur during late winter and spring	**EC:** 100 – 1,000 μS/cm **TDS:** 100 – 600 mg/L	**EC:** 150 – 800 μS/cm **TDS:** 100 – 450 mg/L Lowest levels during rainy season (January – April)
Bromide and Chloride	**Chloride:** < 80 mg/L w/ occasional spikes exceeding 100 mg/L **Bromide:** < 0.4 mg/L w/ frequent spikes exceeding 0.5 mg/L	**Chloride:** < 50 mg/L (spring), < 250 mg/L (dry season) **Bromide:** < 0.1 mg/L (spring), < 0.8 mg/L (dry season)	**Chloride:** < 150 mg/L, below 50 mg/L in winter and spring **Bromide:** < 0.6 mg/L (< 0.2 mg/L in winter and spring)
Nutrients	**Nitrogen:** *Nitrates* < 1.5 mg/L-N (higher late winter & spring) *TKN* 0.2 – 0.8 mg/L-N *Ammonia* < 0.2 mg/L-N **Phosphorus:** < 0.16 mg/L (half to three-quarters ortho-phosphate)	**Nitrogen:** *Nitrates* < 2.5 mg/L-N (higher late winter and spring) *Ammonia* < 0.08 mg/L **Phosphorus:** < 0.12 mg/L (ortho-phosphate < 0.07 mg/L)	**Nitrogen:** *Nitrates* < 1.0 mg/L-N *TKN* < 0.5 mg/L-N **Phosphorus:** < 0.12 mg/L (half to three-quarters ortho-phosphate)
Organic Carbon	Late winter and spring: 6 – 8 mg/L Summer and fall: 2 – 3 mg/L (nearly all in dissolved phase)	Winter: < 7 mg/L Summer and fall: 2 – 2.5 mg/L (90-100% in dissolved phase)	Winter: freq. exceeds 6 mg/L Summer: 2 – 3 mg/L (Nearly all in dissolved phase)
Alkalinity	30 – 90 mg/L No apparent seasonal trends	40 – 90 mg/L Weak trends show high rainy season levels	40 – 80 mg/L No apparent seasonal trends
Hardness	Generally > 50 mg/L as $CaCO_3$ Weak seasonal trends: mid-year (low), early year (high)	Weak seasonal trends Mid-year: 50 – 150 mg/L $CaCO_3$ Beginning year: seasonal spikes of 250 mg/L $CaCO_3$	50 – 150 mg/L $CaCO_3$ Weak seasonal trends: mid-year (low), early year (high)
THM Formation Potential	200 – 1,000 mg/L Higher during late winter and spring	Summer and fall: 300 – 1,000 mg/L Winter and spring: up to 800 mg/L	200 – 800 mg/L Higher during winter and spring

KEY: $CaC0_3$ = calcium carbonate; CVP = Central Valley Project; DO = dissolved oxygen; EC = electrical conductivity; °F = degrees Fahrenheit; mg/L = milligrams per liter; N = nitrogen; NTU = nephelometric turbidity unit; SWP = State Water Project; TDS = total dissolved salts; THM = trihalomethane; TKN = total Kjeldahl nitrogen; μS/cm = microSiemens per centimeter

Source: CALFED Los Vaqueros Expansion Studies – Reservoir Water Quality Technical Memorandum (Final Draft, 2004)

From the 1940s through the mid-1970s, Delta water quality in the fall improved such that even in drier years water quality was better than the long-term average. During the 1970s and 1980s, the Delta experienced a dramatic degradation in salinity, which subsequently persisted through the wet years of the late 1990s, primarily as a result of increased diversions by Delta exporters and a shift in the timing of pumping from spring to fall to protect fish. Months with the highest water quality are currently worse than months with the poorest water quality prior to the mid-1970s (CALFED Bay-Delta Program, June 2005). Export water quality measured at three Delta intakes since the declines of the early 1980s is summarized in **Table III-11**. Additional, detailed water quality data can be found in the 2004 CALFED *Los Vaqueros Expansion Studies – Reservoir Water Quality Technical Memorandum (Final Draft)*.

Quality of Local and Other Supplies

All of the agencies within the study area currently receive Delta water supplies, but each agency has different water quality issues pertaining to these supplies, as summarized in **Table III-12**. Water quality within the service area of each agency depends on the quantity and quality of other water sources, internal water quality goals, use of Delta water for groundwater recharge or blending to meet internal goals, WTP locations relative to open channel flow or offstream reservoirs, and treatment processes in existing plants. The following section describes local water quality issues for each of the agencies. Water treatment facilities and their associated capacities and treatment methods were summarized previously in **Table III-3**.

Contra Costa Water District – CCWD currently operates two water treatment plants to ensure meeting water quality standards (Bollman and Randall-Bold WTPs). These facilities use a combination of conventional sedimentation/filtration and ozone treatment processes. Quality problems are typically related to algae and taste-and-odor events. The cities of Antioch, Martinez, Pittsburg, and Bay Point, located in the CCWD service area, also own and operate WTPs. These plants, which use conventional filtration processes, have concerns relating to diurnal fluctuations of temperature and pH in source water, and algae and taste-and-odor events. Because the majority of CCWD's water supply is taken directly from the Delta, these WTPs are highly sensitive to changes in Delta water quality.

Santa Clara Valley Water District – SCVWD currently operates three water treatment plants to ensure meeting water quality standards. Connected to both Federal and State water sources, SCVWD is concerned about salinity in the Delta (SBA diversions), but also has concerns about algal growth resulting from low water levels in San Luis Reservoir.

- **Penitencia WTP –** The Penitencia WTP is subject to variable water quality in the SBA, including fluctuations in temperature, pH, and dissolved oxygen. These often-rapid fluctuations can make it difficult to adjust operations. High concentrations of bromide, originating from seawater, aslo may cause problems during drought conditions. Because the District is adding ozone facilities, bromate formation, caused by the interaction between bromide and ozone, is a concern. SCVWD will be adding pH suppression facilities to help address bromate formation during high bromide conditions.

TABLE III-12
SUMMARY OF WATER QUALITY CONCERNS
FOR WATER AGENCIES WITHIN THE STUDY AREA

Water Agency	Water Quality Concerns	
Contra Costa Water District (from 2003 *Annual Water Quality Report)*	Delta Intakes: - seawater intrusion - agricultural drainage - recreational activities - regulated point discharges Reservoirs: - roads and parking lots - watershed runoff - wastewater treatment plant discharges	Contra Costa Canal: - gas stations - chemical/petroleum processing/storage - septic systems - historic landfills - military installations - agricultural drainage - urban runoff
Santa Clara Valley Water District	All Sources: - agricultural and urban runoff - recreational activities - livestock grazing - residential and industrial development Imported Sources: - seawater intrusion - wildland fires in open space areas	Local Sources: - commercial stables - historic mining practices - South Bay contamination Groundwater: - Septic tanks - Underground storage tanks - Solvent releases - Nitrate contamination from agricultural practices
Alameda County Flood Control and Water Conservation District, Zone 7	Groundwater: - salt loading in groundwater basins - septic tanks - gas stations - Lawrence Livermore National Laboratory groundwater cleanup program - recycled water irrigation deep percolations	Imported Sources: - salt and bromide concentrations affecting management of groundwater basin
Alameda County Water District (from 2003 *Water Quality Report)*	SBA: - agricultural drainage - wastewater treatment plant discharges - urban runoff - recreational activities - seawater intrusion (salt and bromide) - cattle grazing	Groundwater: - seawater intrusion - gas stations - contaminant plumes - leaking underground storage tanks - dry cleaners - metal plating/finishing/fabricating - sewer collection

KEY: SBA = South Bay Aqueduct

- **Rinconada WTP –** The Rinconada WTP currently receives water from the SBA and San Luis Reservoir. Algal episodes can cause taste-and-odor-related problems. The Low Point Improvement Project is currently addressing filter-clogging issues with algae that could enter the Pacheco Intakes with lower drawdown levels. Variable water quality from the SBA also is an operational issue at Rinconada WTP, as rapid changes in temperature, pH, and dissolved oxygen can impact facility performance. High concentrations of bromide may occur during drought conditions. SCVWD plans to add ozone and ultra violet (UV) disinfection.

- **Santa Teresa WTP –** Santa Teresa WTP currently receives the majority of its water supply from the San Luis Reservoir. When SBA water is delivered to Santa Teresa, issues would be similar to those for the Penitencia WTP.

Zone 7 – Zone 7 operates two water treatment plants to meet water quality standards. The Agency also currently has a groundwater management plan that attempts to reduce salt loading in groundwater supplies in the valley. Reduction in imported raw water salt concentrations would benefit these efforts.

- **Patterson Pass WTP** – Patterson Pass WTP receives SBA deliveries via Patterson Reservoir, which has historically buffered diurnal fluctuation of pH and temperature in the SBA and reduced the impact of turbidity events. However, these benefits have been reduced as the residence time in Patterson Reservoir has shortened due to increased demand from the WTP. Diurnally fluctuating temperature and pH, and algae events in the Delta and the SBA, have become more problematic. Organic carbon concentrations also are a concern due to the formation of byproducts from the plant's free chlorine disinfection process.

- **Del Valle WTP –** Del Valle WTP receives its water from the SBA and Del Valle Reservoir releases. The plant experiences diurnal fluctuations in temperature and pH, which can cause daily upsets in the clarification and filtration processes. The plant often receives water with high algae counts, likely due to the growth of algae in the open channel portions of the SBA, and has seen turbidity spikes of over 100 nephelometric turbidity units (NTU) due to algae and turbidity events in the Delta and flow changes in the SBA that cause resuspension of sediment. Operation of the plant appears to be significantly improved when as little as 10 percent of the water it receives is from Lake Del Valle.

- **Groundwater Recharge –** Salts, typically measured as total dissolved solids (TDS), are a concern for groundwater recharge and agricultural use in the Livermore/Amador Valley. Water imported to the valley through the SBA carries salts, which then accumulate in the groundwater basin, degrading groundwater quality. Zone 7 is currently pursuing a salt management program that includes the potential treatment of groundwater using high-pressure membranes and the export of concentrate from the valley. Agriculture water users also are affected by the presence of salt in water, which can reduce agricultural productivity.

Alameda County Water District – ACWD currently operates two water treatment plants, a blending facility, and a desalination facility to ensure meeting water quality standards.

- **Mission San Jose WTP –** Mission San Jose WTP receives SBA water from Bethany Reservoir and/or Lake Del Valle. The facility has historically had operational upsets due to diurnal fluctuations in temperature and pH, and turbidity spikes in the SBA. Algae have also caused taste-and-odor issues and upsets to the clarification and filtration processes. The plant has recently undergone upgrades intended to address the operational problems associated with temperature, pH, and turbidity by combining improved clarification with membrane filtration (ultrafiltration).

- **WTP No. 2 –** WTP No. 2 receives SBA water from Bethany Reservoir and/or Lake Del Valle. Problems associated with diurnal temperature and pH fluctuations have been moderated with the addition of carbonic acid ahead of pre-ozonation. The use of carbonic acid also has been shown to be effective in controlling bromate production in the late summer and fall months, when lower Delta outflows increase the influence of seawater.

Seasonal algae problems resulting in taste-and-odor events have been effectively controlled with ozonation.

- **Groundwater Recharge** – The use of imported SBA water was critical for reversing saline water intrusion from San Francisco Bay, the result of historic groundwater over-pumping. Enhanced recharge capacity, remediation through the aquifer recharge program, and expanded reliance on surface water treatment has enabled ACWD to develop a conjunctive use groundwater management plan that is both improving groundwater quality and preventing future saltwater intrusion while maintaining dry year supply. Watershed runoff in the summer and fall months is relatively high in TDS (about 800 mg/L compared to 500 mg/L in the winter and spring). SBA imports are used during summer months to maintain ideal groundwater levels in the Above Hayward Fault aquifer. Only in water deficient years, when import supplies are available, would SBA water be used for recharge during the winter or spring. It also is foreseen that SBA imports will play an important role in post-drought scenarios to rebuild healthy groundwater elevations.

- **Blending Facility –** High quality water purchased from SFPUC is blended with high hardness local groundwater to improve groundwater quality.

- **Newark Desalination Facility –** Brackish water is delivered from aquifer recharge program wells, located in salt contaminated pockets of the Niles Cone groundwater basin, to the Newark Desalination Facility. The water is first pre-treated to prevent crystallization, followed by filtration to remove silt and particulate matter from the water. High-pressure pumps then send the water through a series of reverse osmosis membranes to remove the salts. The final step is flow through a decarbonator to remove excess carbon dioxide. Finally, the desalinated water is blended with a fraction of brackish groundwater to achieve a balanced mineral content.

Physical Environment

This section describes the physical environment of the study area in terms of topography, geology, soils, geomorphology, climate and hydrology, flood control, air quality, and noise.

Topography

The topography of the study area is dominated by the confluence of California's two major rivers, the Sacramento River and the San Joaquin River, and the Coastal Range. The Delta consists of about 738,000 acres of low-lying land and interconnected waterways. The Sacramento River enters the Delta from the north, picking up additional flows from numerous tributaries, including Cottonwood Creek, Stony Creek, and the Feather and American rivers. The San Joaquin River enters the Delta from the south, and receives water from tributaries draining from the Sierra Nevada and Coast ranges. The Delta is crossed by about 700 miles of natural and artificial waterways with a total surface area of about 61,000 acres, forming more than 600 islands and tracts. Much of the land is below sea level and protected from flooding by about 1,100 miles of levees. The land surface on some islands is up to 20 feet below the water surface. The Delta drains via an interconnected estuary system that includes Suisun Marsh and San Francisco Bay.

Los Vaqueros Reservoir is located within the Kellogg Creek watershed, east of the Delta in the Coastal Range Mountains. The Kellogg Creek watershed is bounded by the foothills of the Diablo Range to the west, the upper portion of the Livermore Valley to the south, and foothills leading to the Sacramento Valley and Delta to the east and northeast. Kellogg Creek flows through the 16,650-acre watershed for about 15 miles to its terminus at Old River, near the Delta community of Discovery Bay.

Geology

The Delta is located in the Great Valley geomorphic province. This geologic province is composed of thousands of feet of sediments that have been deposited almost continuously since the Jurassic Period (approximately 160 million years ago). East of the Delta is the Coast Ranges geomorphic province. The Coast Ranges province consists of complexly folded and faulted Tertiary marine and non-marine formations and Cretaceous marine formations. Recent surface deposits have originated from alluvial fans, streams, and landslides.

Most of the upland areas within the Los Vaqueros Reservoir watershed are underlain by upper Cretaceous marine sedimentary rocks primarily of the Panoche formation (65 millions years old), but also including the Meganos, Moreno, and Deer Creek formations. Hard bedrock is typically encountered at depths of 25 feet or less, ranging from soft to hard and massive to fractured states. Rock outcrops are commonly found on ridges and hilltops, which is a common pattern in the Coast Ranges province. The low-lying areas comprise recent alluvial deposits derived from adjacent upland materials. Bedrock at the existing Los Vaqueros Dam site consists of interbedded sandstone and claystone.

Soils

The Delta comprises primarily of intertidal deposits of soft mud and peat. Delta islands are characterized by soft, organic soils that are subject to subsidence from oxidation and erosion. Soil associations of the poorly drained soils in the Delta, saltwater marshes, and tidal flats include Rindge-Kingile, Sacramento-Omni, and Joice-Reyes associations. Organic peat soils are up to 60 feet deep in some areas. To the west, two categories of soils have been identified in the foothills of the Coast Range. One category consists of soils on valley fill, basins, low terraces, and alluvial fans, including Brentwood-Rincon-Zamora, Capay-Sycamore-Brentwood, Capay-Rincon, Delhi, Clear Lake-Cropley, and Marcuse-Solano-Pescadero associations. The second category consists of steep, well-drained soils on terraces and mountainous uplands, including Tierra-Antioch-Perkins, Altamont-Diablo-Fontana, Los Osos-Millsholm-Los Gatos, Gilroy-Vallecitos, and Rock outcrop-Xerorthent associations. The two major soil associations found in the vicinity of Los Vaqueros Reservoir are the Altamont-Diablo-Fontana (well-drained clays and silty clay loams forming the uplands) and the Bentwood-Rincon-Zamora (well-drained clay and silty clay loams formed of alluvial material).

Geomorphology

The Great Valley geomorphic province is a nearly flat, 450-mile-long alluvial plain extending from the Tehachapi Mountains in the south to the Klamath Mountains in the north, and from the Sierra Nevada batholiths in the east to the coast ranges in the west (Hackel, 1966). Elevations

across the alluvial plain generally range from a few feet below sea level to about 400 feet. The southern portion of the valley, which includes the study area, is referred to as the San Joaquin Valley. The San Joaquin Valley is a deep basin filled with a thick sequence of Jurassic to Holocene (recent) alluvial deposits that are eroded from the eastern Sierra Nevada Range and the western Coast Range. Alluvial sediments that form the central plain are transported to the valley primarily by tributaries of the San Joaquin River. Tertiary and Cretaceous outcrops border the central plain of the valley. A slight slope allows the valley to drain north into the Delta, which flows into the San Francisco Bay, a broad depression in the Franciscan bedrock that resulted from an east-west expansion of the San Andreas and Hayward fault systems.

The Coastal Range lies between the Pacific Ocean and the Great Valley Geomorphic Province, and stretches from the Oregon border to the Santa Ynez River. Discontinuous northwest-trending mountain ranges, ridges, and intervening valleys characterize this province. The valleys and hills of the Los Vaqueros Reservoir watershed often are defined by active and inactive seismic faults, including the Calaveras, Greenville, Las Positas, Pleasanton, Livermore, and Verona faults. Upland areas are flanked by large alluvial fans, and all of the major streams in the watershed are somewhat to deeply incised. The bed materials of the streams range from clayey to gravelly.

Climate and Hydrology

The San Francisco Bay-Delta (Bay-Delta) comprises the West Coast's largest estuary, encompassing approximately 1,600 square miles of waterways and draining over 40 percent of the freshwater in California. In the estuary, the Sacramento and San Joaquin Rivers flow from low lying inland valleys into the Delta – a labyrinth of islands, sloughs, canals and channels – continuing through Grizzly Bay, Suisun Bay and San Pablo Bay before emptying into San Francisco Bay and then the Pacific Ocean. Freshwater from the rivers mingles with saltwater from ocean tides, creating a rich and diverse aquatic ecosystem. Because of its geographical position, the Delta serves as the collection point for much of the runoff and resulting water supplies of northern California. It is through the channels of the Delta that this water must pass to satisfy the needs of the Delta, Bay Area, agricultural lands of the San Joaquin Valley, and densely populated southlands.

The climate of the study area is temperate, influenced by cool air moving inland from the Pacific Ocean and warm air amassing in the Central Valley. Winters are mild, with average low temperatures in the 30s. Summers in the Delta are dry and hot, with extreme temperatures in the 100s. A strong Pacific high pressure cell coupled with hot inland temperatures causes a strong onshore pressure gradient, which can produce strong afternoon winds during the summer. Mean annual precipitation ranges from about 12 inches in the valley to nearly 20 inches on the higher, Coast Range ridges. About 90 percent of annual precipitation occurs between November and April. Fog is common at night and in the early morning during the fall and winter, especially under clear, calm, and cold conditions.

Flood Control

The Sacramento and San Joaquin river basins receive flow from multiple rivers and streams, draining a combined area greater than 43,000 square miles. Flood management upstream of the Delta is provided by numerous multipurpose reservoirs on major tributaries. Most of the Delta

lowlands are protected by locally constructed levees. Maintaining these largely non-engineered levees built on unstable peat foundations can be difficult. Each of the 70 islands and tracts that constitute the legal Delta has flooded at least once since they were originally reclaimed. Today, however, the potential impacts of levee failure in the Delta extend beyond local flood damages to include potential disruption of the major Delta water management systems that provide water to a large portion of Californians. Various small reservoirs in the study area provide local flood management benefits, including Los Vaqueros Reservoir.

Air Quality

Strong atmospheric inversions during the summer months trap and concentrate pollutants in the Central Valley. Strong onshore breezes, such as the summer "Delta Breeze," can move pollutants inland from urban areas around San Francisco Bay. These conditions create a high potential for air pollution in the Central Valley, although less so in the Delta. Air pollution potential in the Bay Area is high, especially for photochemical pollutants in the summer and fall. High temperatures increase the potential for ozone to build up. In the fall, northeasterly winds may carry ozone west from the San Joaquin Valley. Pollutants such as carbon monoxide and particulate matter, generated by motor vehicles, fireplaces, and agricultural burning, also can be problematic. Within the Los Vaqueros Reservoir watershed, winds are channeled through the region's hilly terrain at high speeds, dispersing pollutants and creating a low to moderate potential for air pollution. The Bay Area Air Quality Management District, created in 1955, regulates air quality in the region. Since the district's formation, air quality conditions in the Bay Area have improved significantly, including ambient concentrations of air pollutants and the number of days when air quality standards in the region are exceeded.

Noise

Ambient noise level is defined as the normal or existing level of environmental noise at a given location. In the Delta region, the major contributors to noise levels are traffic, farming activities, and watercraft. In the Los Vaqueros Reservoir watershed, wind turbines and high-voltage transmission lines are major contributors to ambient noise levels. Other noise sources in the watershed include remote and local traffic, farming activities, and occasional aircraft.

Biological Environment

This section discusses the biological setting for the project, vegetation and habitat, aquatic and fishery resources, and special-status species. Important to understanding biological conditions in the region is how the physical landscape of the Delta has been significantly altered over the past 150 years by human activities. Beginning in the late 1800s, settlers constructed levees to reclaim rich Delta marshlands and tidal wetlands for agriculture, creating islands in a network of interconnected channels. The channels were further altered in the 20th century to support navigation, and flood control, and to provide materials for Delta levees. Water resources development in the mid-1900s further altered the Delta environment, with water exported from the Delta to meet both local and statewide water demands. Although these factors have greatly changed the flow regime, hydrodynamics, and natural environment of the Delta, significantly reducing marshland and tidal wetland habitats, the Delta remains home to a diverse array of over 500 species of plants and animals. Although protective actions and restoration activities have had

some success in the Delta, conflicts continue between the management and enhancement of Delta ecosystem functions and management of Delta water resources for beneficial uses.

Vegetation & Habitat

Dominant habitats in the Delta region include valley/foothill riparian and fresh and saline emergent wetlands. Although less prominent, other important habitats include seasonal freshwater wetlands and nontidal freshwater, tidal freshwater, and brackish water emergent marsh.

- **Valley/foothill riparian scrub** typically occurs on islands or levees, and along unmaintained banks of creeks, ditches, and other waterways. The riparian zone along levee islands is usually very narrow, with additional areas scattered throughout the Delta system on islands, in backwater areas, in sloughs, and in thin bands along agricultural channels.

- **Tidal freshwater emergent habitat** includes portions of the intertidal zones of the Delta that support emergent wetland plant species intolerant of saline or brackish conditions. This habitat occurs primarily on instream islands and along unleveled, tidally influenced waterways, and provides habitat for many special-status species. The dominant vegetation for tidal freshwater emergent habitat includes California, river, and big bulrush; tule; cattails; and common reed. Suisun Marsh is the largest contiguous brackish wetland in California (USFWS, 2000).

- **Nontidal freshwater permanent emergent habitat** occurs on the landward side of Delta levees and in the interiors of Delta islands, mostly in constructed waterways, ponds, and low-lying agricultural areas. This habitat typically occurs in areas where soils are inundated or saturated for all or most of the growing season, including backwater areas and thin bands along rivers and channels where sediment has accumulated.

- **Saline (brackish) emergent habitat** includes the portions of San Francisco, San Pablo, and Suisun bays and the Delta that support plant species tolerant of saline or brackish conditions within the intertidal zone, or on lands that historically were subject to tidal exchange. The dominant vegetation for saline emergent habitats includes cordgrass, pickleweed, bulrush, glasswort, saltwort, saltgrass, arrowgrass, seablite, hairgrass, common reed, and algae.

- **Natural seasonal freshwater wetlands** include inland freshwater marshes that maintain surface water during only a portion of the year, and vernal pools associated with grasslands. Grasslands occur on islands within the Delta and in many outlying areas.

According to the Central Valley Wetlands Supply Investigation (USFWS 2000) the Delta Basin (including lands bound by the American River, Stanislaus River, Sierra Nevada foothills, Sacramento Deep Water Ship Channel, and Coast Range) contains 32,210 acres of privately managed wetlands, 92 percent of which occurs in the Suisun Bay area. Large seasonal wetlands managed for waterfowl also are found in the northwestern part of the Delta, west of the Sacramento Deep Water Ship Channel. These managed seasonal wetlands are of great importance to migratory waterfowl and shorebird populations during fall, winter, and spring, when bird populations in the Delta increase dramatically.

The most abundant vegetative cover type in the Los Vaqueros Reservoir watershed is grassland, covering nearly 13,700 acres, followed by valley/foothill woodland and forest, dominated by blue oak. Upland shrub cover types are most abundant on the western side of the watershed, and cover nearly 850 acres. Saline emergent wetlands cover just over 300 acres and include communities of salt-tolerant plants such as saltgrass, bulrush, cattail, and seepweed. This vegetative cover type is generally considered rare by Federal and State resource agencies, often supporting special-status species. Nontidal freshwater emergent vegetation covers nearly 50 acres and seasonal wetlands cover about 15 acres, represented by vernal pools in the eastern area of the watershed. Valley/foothill riparian vegetative cover, predominately composed of the Fremont cottonwood and remnant valley oak stands, is found along Kellogg Creek.

Aquatic and Fishery Resources

The Delta is home to a variety of resident and migratory fish and other aquatic species. Fish species common in the area include striped bass, threadfin shad, largemouth bass, American shad, longfin smelt, gobies, catfish, salmon, steelhead, and a variety of other freshwater and estuarine fish species. For some fish species, such as Chinook salmon and steelhead, adults migrate seasonally upstream through the Delta to spawning and juvenile rearing areas located in upstream tributary areas. Their young later emigrate from the upstream rearing areas, moving downstream through the Delta before entering coastal marine waters. Returning and outmigrating anadromous fish are particularly susceptible to flow and water quality conditions in the Delta, and predation. The Delta also provides habitat for a variety of invertebrates, including planktonic species such as mysid shrimp and copepods, and epibenthic species such as bay shrimp and amphipods.

The seasonal composition, distribution, and abundance of fish and invertebrate species within the Delta depends on a variety of factors related to habitat quality and availability. These factors include seasonal and interannual variability in hydrologic conditions, variation in water temperature and salinity, operation of the Delta Cross Channel and south Delta fish barriers, operation of screened and unscreened water diversions, and CVP and SWP water export operations. These factors affect different regions of the Delta in different ways, influencing flow direction, saline intrusion, and water surface elevations. Biological factors that affect individual fish species include the timing of spawning activity, egg incubation and hatching, larval dispersal, juvenile rearing, and, for a number of species, seasonal patterns in juvenile and adult migration. Several of the fish species inhabiting the Delta also support recreational angling, most notably striped bass, largemouth bass, and catfish.

Effect of Water Resources Development on Delta Fisheries

Migratory and resident fish populations in the Delta have declined significantly over the past century. Changes in the Delta environment, including land reclamation and water resources development, have contributed to this decline and the subsequent listing of winter-run Chinook salmon and delta smelt as threatened under Federal and State Endangered Species Acts. Other Delta fish species, including Sacramento splittail, longfin smelt, and green sturgeon, have been identified as species of concern. The USFWS *1996 Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes* identifies recovery objectives and criteria for these species. Chinook salmon, delta smelt, and Sacramento splittail are discussed in more detail below.

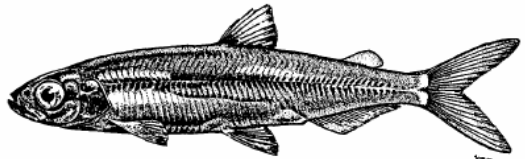
Oncorhynchus tshawytscha
(Chinook salmon)

Chinook salmon and other anadromous fish have been affected by water resources development and other changes throughout the Sacramento and San Joaquin river basins. Chinook salmon and other anadromous fish pass through the Delta when migrating upstream to spawn, and while out-migrating to the Pacific Ocean. Spawning and rearing occurs upstream of the Delta, primarily in the Sacramento River and its tributaries.

Delta smelt, unlike salmon, are a resident fish species primarily restricted to the Bay-Delta estuary system, relying on the habitat it provides during all life stages. Although once the most common pelagic fish in the Delta, a tenfold decline in the population of delta smelt has occurred over the past 20 years. Because delta smelt have a 1-year life cycle (born, mature, reproduce, and die in 1 year), they are very sensitive to environmental changes and have the potential for extinction in a single year of poor recruitment. Major population declines have typically occurred in unusually dry years when Delta outflows are significantly reduced, and during wet years with extreme Delta outflows. In dry years, water quality, water temperature, and food supplies become limiting factors. During very wet years, high outflows flush smelt out of the Delta, along with a significant portion of their food supply.

Delta smelt also experience high mortality as a result of south Delta export operations due to disorientation (caused by reverse flows and other changes in Delta flow patterns), physical entrainment, handling losses, and predation. They are particularly prone to impingement and entrainment mortality at Delta pumping facilities because they are not strong swimmers. Because they are relatively small (adult smelt are only 2 inches to 3 inches in length), predation from birds and other fish can be problematic. A relationship also may exist between delta smelt decline and the reduction in zooplankton production in the Delta (at the base of the smelt food web) caused by pollution and non-native introduced/competing species.

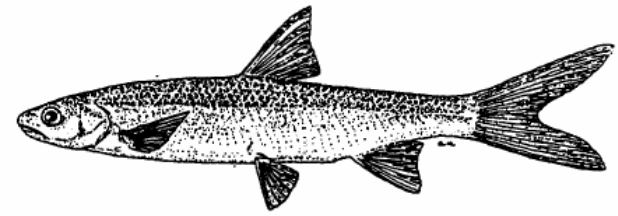
The preferred habitat for delta smelt is shallowwater in the brackish-freshwater mixing zone. The California Department of Fish and Game (CDFG) collects monthly data as part of a long-term fisheries survey program in the Delta. Trawl surveys conducted since 1967 indicate significant variability in smelt population from year to year. This variability, in combination with the reduced population, raises the concern that a single year of poor recruitment, as could occur during a severe flood year with large Delta outflows, could result in extinction of the species.



Hypomesus transpacificus McAllister
(delta smelt)

Although listed as threatened in 1999, USFWS downgraded Sacramento splittail to a species of concern in 2003 following a Federal court determination. Splittail are a relatively long-lived (5-7 years), endemic fish that prefers freshwater but can tolerate some brackish conditions. Like smelt, their population fluctuates annually depending on spawning success and other factors. Their preferred spawning habitat is submerged vegetation in temporarily flooded upland and

riparian areas, primarily found in the lower reaches of Delta tributaries, flood bypasses, and dead-end sloughs.



Pogonichthys macrolepidotus Ayres
(Sacramento Splittail)

Historically, splittail were once found throughout Central Valley lakes and stream, from Redding to Friant Dam. However, they are now primarily confined to the Delta and other parts of the Bay-Delta Estuary, Suisun Bay and Suisun Marsh, the Cosumnes River, and Napa and Petaluma rivers. Their decline is believed to be related to construction of onstream dams and diversions, and agricultural development, which have eliminated or drastically altered much of the lowland habitat splittail once occupied. Water quality, including temperature and agricultural and industrial pollution, also has been correlated to splittail abundance on the San Joaquin River. Unlike most salmon, splittail appear to be unable to navigate fishways and fish ladders, further reducing the extent of available upstream habitat (USFWS 1996 *Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes*).

Fish Losses at Delta Export Facilities

Delta water export operations have had a significant impact on Delta fisheries. For example, over 1,800 agricultural and municipal pumping facilities are located within the range of delta smelt, and many more within the range of Chinook salmon. While many of these facilities are now screened and other preventative actions have been taken, large Delta export facilities still present both direct and indirect impacts on fisheries. Diversions from the major south Delta pumping facilities (Banks and Tracy pumping plants) can change local currents and hydraulic conditions within Old and Middle rivers and the lower San Joaquin River. These changes can attract fish into southern Delta areas where they are more vulnerable to mortality due to predation, entrainment, or fish salvage operations at the pumping facilities.

Skinner Delta Fish Protective Facility

The magnitude of fish losses at the major CVP and SWP Delta export facilities is a function of many factors, including the volume of water exported, the density of fish vulnerable to entrainment at these facilities, and predation. Direct mortality occurs at various stages within the facilities, and includes pre-screen predation, screening losses, and handling and trucking mortality. Both the CVP Tracy Fish Collection Facility and the SWP Skinner Delta Fish Protective Facility divert fish away from pump intakes into holding facilities, where the fish are counted and measured, then transported and released elsewhere in the Delta. These salvage operations target fish greater than 20 millimeters (mm) in fork length, but juveniles less than 20 mm are most susceptible to entrainment and loss. Unfortunately, USFWS estimates that delta smelt suffer 100 percent mortality during catch, handle, transport, and release operations at both the CVP and SWP facilities (*Delta Smelt 5-Year Review,* March 2004). Furthermore, significant

predation can occur in Clifton Court Forebay, in the channels approaching the pumping plants, and after capture and release.

Extensive data are available on species-specific salvage at both the CVP and SWP pumping facilities. The average density (number of fish per acre-foot) of fish present at both the CVP and SWP facilities is estimated monthly, covering a range of water year types. Fish density, the number of fish salvaged at the pumps, screening efficiency, and estimated handling and trucking losses are then used to estimate direct mortality at the pumps for salmonids, smelt, and striped bass. However, these estimates do not include predation and may underestimate actual losses. Delta smelt experience the highest salvage densities during May and June, and appear to be at highest risk during dry years when they are drawn farther upstream, and extreme flow years when juveniles can be washed downstream from the Delta. Historic entrainment rates also are available for the CCWD Old River Fish Screen Facility. Although state-of-the-art positive barrier fish screens, such as those used at CCWD's Old River facility, have proven very effective in reducing and avoiding entrainment and impingement of juvenile and larger fish species, these screens do not completely exclude planktonic fish eggs and larvae.

Fish Screens at CCWD's Old River Intake

A definitive link between south Delta pumping and overall fish abundance is difficult to establish due to the myriad of environmental factors that can affect individual species. However, biologists have identified an apparent relationship between delta smelt salvaged at CVP and SWP Delta pumping facilities, and both export volume and total Delta outflow. For example, flow reversals typically occur on the lower San Joaquin River and other channels when the ratio of Delta export rates to Delta outflow is high. One hypothesis is that reverse flow conditions may disorient juvenile smelt and make them more susceptible to predation and entrainment at the pumps, or prevent smelt larvae from being carried away from the pumps to preferred downstream rearing areas near the saltwater – freshwater mixing zone (USFWS *Delta Smelt 5-Year Review*, March 2004). Environmental factors, such as food supply and predation, also influence fish losses at south Delta pumping facilities. However, scientific evidence has not pointed to any single factor responsible for the decline of Delta fisheries.

Protective Actions

Various water quality, ecosystem restoration, and water resource operations regulations have been implemented to support the sustainability and recovery of threatened Delta fisheries. These regulatory actions and programs include the following (in chronological order):

- NMFS 1993 Long-term BO on the effects of CVP and SWP operations on winter-run Chinook salmon (superceded)
- USFWS 1993 BO on the effects of the Los Vaqueros Project on delta smelt

- USFWS 1993, 1994 and 1995 BOs of the effects of the CVP and SWP on Delta Smelt, delta smelt critical habitat, and Sacramento splittail (superceded)
- SWRCB 1995 *Water Quality Control Plan for the San Francisco Bay / Sacramento-San Joaquin Delta Estuary* (Bay-Delta Plan)
- 1996 VAMP
- Management of the full 800,000 acre-feet of CVP yield pursuant to Section 3406(b)(2) of the CVPIA (also known as (b)(2) water)
- CALFED Bay-Delta Program (CALFED) Environmental Water Account (EWA) management actions (2001 to present)
- Reclamation and DWR 2004 *Biological Assessment on the Long-term CVP and SWP Operations Criteria and Plan* (OCAP)
- NMFS 2004 Supplemental BO for CVP and SWP operations, April 1, 2004 through March 31, 2006
- USFWS February 2005 BO for delta smelt

Upstream from the Delta, various actions and programs, including the CVPIA's Anadromous Fish Restoration Program, have made significant contributions to the sustainability and recovery of anadromous fish species, particularly Chinook salmon. These actions have included removal of migration barriers, screening of diversions, and flow and temperature improvements in the Sacramento River. These actions have primarily targeted upstream conditions, but they have also improved flow and water quality conditions in the Delta.

A significant regulatory action in the Delta is the restriction of pumping at CVP and SWP south Delta export facilities to reduce fish losses. CVP and SWP facilities must comply with requirements established in the 2004 OCAP BO, which includes curtailment of pumping during specific periods to reduce fish losses when abundance is low and salvage rates are high. The potential water supply impacts of these pumping curtailments are partially offset by (b)(2) water and the EWA, discussed below and in **Chapter II**.

The EWA provides the resources and operational flexibility needed for participating agencies (Reclamation, USFWS, NMFS, DWR, and CDFG) to cooperatively manage water resources in a way that provides protection for at-risk fish species. Fish mortality estimates at the major pumping facilities, and other sampling survey data, are used to determine whether pumping curtailments or EWA actions are needed. The EWA provides benefits in two ways:

(1) It provides the opportunity for additional pumping curtailment (above regulatory requirements) for fishery protection and avoidance of command and control type pumping regulations

(2) It maintains water supply reliability to the export service area under voluntary curtailment times and, to a lesser degree, under required curtailment periods.

In addition to enabling pumping curtailment for fish protection without impacting CVP and SWP customers, the EWA also provides water to improve flow conditions in the Delta. While a general decline in delta smelt populations has occurred during the 4 years of the short-term EWA, this may not be an indication that the program is ineffective because the time-frame is too short to overcome natural variance in smelt populations. Further, the numerous factors affecting the abundance of delta smelt and other species make it difficult to assess or quantify the benefits of a program such as the EWA.

VAMP also contributes to fisheries protection in the south Delta. Since its initiation in 1996, VAMP has altered the movement of water in the south Delta to provide better spawning and rearing conditions and reduce reverse flow conditions that draw juvenile fish toward CVP and SWP pumping facilities. VAMP works in coordination with pumping curtailments, EWA actions, and other programs to promote the recovery of threatened fisheries.

The California SWRCB sets water flow and quality objectives in the Delta to protect the environment and other beneficial uses of the Delta. The SWRCB 1999 Water Rights D-1641 obligates the CVP and SWP to comply with the California SWRCB 1995 *Water Quality Control Plan for the San Francisco Bay / Sacramento San Joaquin Delta Estuary* (Bay-Delta Plan). The freshwater – saline water mixing zone in the Delta represents an area of high biological productivity in the aquatic environment. This zone provides ideal conditions for delta smelt and various other aquatic species. The location of this mixing zone varies depending on tidal conditions and Delta inflows and outflows. A standard, termed X2, was developed to track and regulate the location of the mixing zone, measured as the distance in kilometers (km) from the Golden Gate Bridge to where the salinity concentration is 2 parts per thousand (ppt) and the electrical conductivity (EC) is 2,640 micromhos per centimeter (µmhos/cm). The1995 Bay-Delta Plan manages the X2 location in San Francisco Bay and the Delta to benefit fisheries and other aquatic resources. The X2 location can be adjusted by altering the Delta's inflow-outflow ratio (releasing more water from upstream reservoirs to increase Delta inflow, for example).

Wildlife

The dominant wildlife habitat in the Delta is agricultural lands, which account for approximately 72 percent of the land area. Rabbits, foxes, mice, and numerous other mammals inhabit the agricultural lands, levees, and riparian areas of the Delta. Various species of snakes, turtles, frogs, and salamanders also are common. The Delta is home to a large number of resident bird species and migratory birds traveling the Pacific Flyway. Large-scale reclamation of tidal marshes in the Delta, and loss of wetlands in other portions of the State, have contributed to a decline in resident and migratory waterfowl over the past century. Common species include tundra swans, white-fronted geese, snow geese, greater sandhill cranes, northern pintails, and mallards.

The Los Vaqueros Reservoir watershed is home to numerous indigenous terrestrial and avian species. A Watershed Master Plan developed for the existing Los Vaqueros Project incorporates provisions for protecting area wildlife, including the golden eagle, California red-legged frog, California tiger salamander, Alameda whipsnake, and San Joaquin kit fox. CCWD has a conservation easement in the watershed to protect kit fox habitat on 4,150 acres.

Special-Status Species

The study area supports numerous special-status plant and wildlife species designated in accordance with Federal and State endangered species legislation. Delta smelt, Chinook salmon, and Sacramento splittail, among the species of special concern in the Delta, are described in greater detail previously in this chapter. Special-status species likely to occur in the Delta and Los Vaqueros watershed regions are listed in **Tables III-13** and **III-14**, respectively.

TABLE III-13
SPECIAL-STATUS SPECIES POTENTIALLY OCCURRING IN THE DELTA REGION

Species	Regulatory Status	Habitat
Aster lentus Suisun marsh aster	FSC / 1B	Salt, brackish and freshwater marshes at or above the zone of tidal fluctuation. Elev. <150 m.
Carex comosa Bristly sedge	2	Coastal prairie, marshes and swamps (lake margins), valley and foothill grassland; Elev. 0-425 m.
Carex vulpinoidea Fox sedge	2	Marshes and swamps (freshwater), riparian woodland; Elev. 30-1,200 m.
Cirsium crassicaule Slough thistle	1B	Shallow water or saturated soils in chenopod scrub, marshes, swamps, and riparian scrub. Elev. 3 – 100 m.
Cryptantha hooveri Hoover's cryptantha	1B	Sandy soils in valley or foothill grassland. Elev. < 150 m.
Eleocharis parvula Small spikerush	4	Wet, generally saline flats in marshes and swamps. Elev. < 2,530 m.
Erysimum capitatum ssp. angustatum Contra Costa wall flower	FE / CE / 1B	Interior dunes with sparse herb and shrub cover. Elev. 3 – 20 m.
Gratiola heterosepala Bogg's Lake hedge-hyssop	CE / 1B	Shallow water along the margins of lakes, marshes, swamps, and vernal pools. Often in clay. Elev. 10 – 2375 m.
Hibiscus lasiocarpus Rose-mallow	2	Freshwater marsh, often in riparian areas with slow moving water. Canals, sloughs, ponds, and oxbow lakes. Elev. < 120 m.
Lathyrus jepsonii var. jepsonii Delta tule-pea	FSC / 1B	River and canal banks in association with freshwater and brackish marshes and riparian woodlands at or above the zone of tidal influence.
Lilaeopsis masonii Mason's lilaeopsis	FSC / CR / 1B	On newly deposited or exposed sediments, wood pilings, or sometimes on levee riprap, within the tidal zone. Elev. < 10 m.
Limosella subulata Delta mudwort	2	Edges of riverbanks and sloughs in marsh vegetation, rooted within the zone of tidal fluctuation. Elev. < 3 m.
Oenothera deltoides ssp. howellii Antioch Dunes evening primrose	FE / CE / 1B	Interior bluffs and dunes with sparse herb and shrub cover. Elev. < 30 m.
Potamogeton zosteriformis Eel-grass pondweed	2	Ponds, lakes, streams and marshes. Elev. < 1,860 m.
Sagittaria sanfordii Sanford's arrowhead	FSC / 1B	Shallow freshwater marshes, ponds, sloughs, streams and ditches. Prefers silty or muddy substrate. Elev. < 610 m.
Scutellaria galericulata Marsh skullcap	2	Meadows, marshes, and seeps (mesic) in lower montane coniferous forest. Occurrences in the Delta need further study.
Scutellaria lateriflora Blue skullcap	2	Mesic meadows, seeps, and freshwater marshes. Elev. < 500 m.
Desmocerus californicus dimorphus Valley elderberry longhorn beetle	FT	Elderberry shrubs in riparian habitat.
Thamnophis gigas Giant garter snake	FT / CT	Sloughs, canals, and other waterways; requires grassy banks and emergent vegetation; areas of high ground protected from winter flooding.
Emys marmorata Western pond turtle	FSC / CSC	Aquatic habitats with suitable basking sites. Nest sites most often found on gentle slopes (<15%) with little vegetation or sandy banks.
Grus canadensis tabidia Greater sandhill crane	CT	In summer, occurs near shallow lakes and marshes; in winter, in plains and valleys near freshwater.
Buteo swainsoni Swainson's hawk	CT	Nests in oaks or cottonwoods near riparian areas, forages in grasslands, irrigated pasture, and agricultural fields.

TABLE III-13 (CONT.)

Species	Regulatory Status	Habitat
Laterallus jamaicensis coturniculus California black rail	FSC / CSC	Tidal salt marshes, characteristically associated with heavy growths of pickleweed (Salicornia), but also in brackish and freshwater marshes.
Athene curnicularia hypugaea Western burrowing owl	FSC / CSC	Nests in burrows in sparse grassland, especially old ground squirrel burrows.
Agelaius tricolor Tricolored blackbird	FSC / CSC	Nests in emergent marsh and other wetlands; forages in wetlands, agricultural fields, pastures.
Lanius ludovivianus Loggerhead shrike	FSC / CSC	Open terrain with well-spaced lookouts.
Corynorhinus townsendii Townsend's big-eared bat	FSC / CSC	Found in all habitats up to alpine zone. Requires caves, mines, or buildings for roosting. Prefers mesic habitats where it gleans from brush or trees along habitat edges.
Antrozous pallidus Pallid bat	CSC	Primarily found below 6,000 feet in a variety of habitats, especially oak, ponderosa pine, and giant sequoia habitats. Roosts in rock outcrops, caves, and especially hollow trees.
Myotis ciliolabrum Small-footed myotis	FSC	Open stands in forests/ woodlands and shrublands. Forages among trees, over water. Breeds in colonies in buildings, caves, and mines.
Myotis yumanensis Yuma myotis	FSC	Usually occurs below 8,000 feet. Forages over open, still, or slow moving water and above low vegetation in meadows. Roosts in buildings, caves, or crevices. Nursery colonies in buildings, caves, or mines.
Falco peregrinus anatum American peregrine falcon	CE	Nests and roosts on protected ledges of high cliffs, usually near areas supporting large populations of other bird species.
Pelecanus erythrorhynchos American white pelican	CSC	Prefers aquatic habitats (ponds, lakes, streams)
Larus californicus California gull	CSC	Lake, rivers, ponds, irrigated fields.
Eremophila alpestris actia California horned lark	CSC	Sparse grassland, sagebrush, grazed pastures.
Accipiter cooperi Cooper's hawk	CSC	Found in wooded areas up to 9,000 feet in the Sierra Nevada, especially in Yosemite Valley area. Habitat destruction in its range has led to population declines. Frequently hunts along wooded edges.
Buteo regalis Ferruginous hawk	CSC	Open terrain in plains and foothills where ground squirrels and other prey are available
Circus cyaneus Northern harrier	CSC	Predominately grassland and wetland communities, however, use of variable of habitats.
Pandion Haliaetus Osprey	CSC	Prefer lakes, ponds, rivers and marshes bordered by trees. They require open water containing adequate fishing opportunities.
Buteo lagopus Rough-legged hawk	FSC / CSC	Prefer shrubland, prairies, and agricultural areas.
Accipiter striatus Sharp-shinned hawk	CSC	Prefer coniferous and deciduous forests, shrubland, and riparian areas.
Elanus leucurus White-tailed kite	FSC	Low rolling foothills or valley margins with scattered oaks, or river bottomlands with nearby marshes.
Dendroica petechia Yellow warbler	CSC	Prefers riparian woodlands, but also breeds in chaparral, ponderosa pine, and mixed conifer habitats with substantial amounts of brush.
Oncorhyncus tshawytscha Winter-run Chinook salmon	FE / CE	Adults first appear in the Sacramento River near Red Bluff in December and continue to pass Red Bluff through May; typically hold in the river before spawning on upper Sacramento River (river mile 284 to 298).
Oncorhyncus tshawytscha Spring-Run Chinook Salmon	FT / CT	Spawns on tributaries of Sacramento River, Deer and Mill creeks; generally ascend to natal streams during spring snowmelt run-off and spend the summer in deep pools with suitable water quality.
*Oncorhyncus t*shawytscha Late fall-run Chinook salmon	FC / CSC	Adults immigrate into the river system from mid-October through mid-April; begin spawning in January; and continue to spawn through mid-April. Embryo incubation occurs from January through June, rearing and emigration of fry and smolts from April through mid-October.
Oncorhyncus tshawytscha Fall-run Chinook salmon	FC / CSC	Adults immigrate into the river system from mid-October through mid-April; begin spawning in January; and continue through mid-April. Embryo incubation from January through June, rearing and emigration of fry and smolts from April through mid-October.

TABLE III-13 (CONT.)

Species	Regulatory Status	Habitat
Oncorhynchus kisutch Central CA coastal Coho salmon	FT / CE	Move upstream in response to increased stream flows caused by fall storms, especially in small streams when water temperatures are 4-14°C. Spawning sites typically at the heads of riffles or tails of pools where beds are present of loose, silt-free, coarse gravel and cover nearby for adults.
Oncorhyncus mykiss Central CA coastal steelhead	FT	Spawn in small streams where cool, well-oxygenated water is available year-round.
Oncorhyncus mykiss Central Valley steelhead	FT	Spawn in small streams where cool, well-oxygenated water is available year round.
Hypomesus transpacificus delta smelt	FT / CT	Estuarine waters of Delta.
Pogonichthys macrolepidotus Sacramento splittail	FT / CSC	Slow-moving stretches of Delta and Central Valley rivers.
Spirinchus thaleichthys Longfin smelt	FSC	Occur in salt and brackish water of estuaries.
Acipenser medirostris Green sturgeon	FC	Occur in lower reaches of large rivers, including the Sacramento, and seldom penetrate far upstream to tributaries.
Lampetra ayresi River lamprey	FSC	Known from the Sacramento River to southeast Alaska.
Lampetra hubbsi Kern Brook lamprey	FSC	Known from the upper San Joaquin River in Millerton Lake.
Lampetra tridentata Pacific lamprey	FSC	Found in upper drainages of the Sacramento-San Joaquin River system, American, Sacramento, and Napa rivers, and Sonoma and Walnut creeks.

KEY:

FEDERAL: U.S. Fish and Wildlife Service and National Marine Fisheries Service
- FE Listed as Endangered by the Federal Government
- FT Listed as Threatened by the Federal Government
- FPT Proposed for Listing as Threatened
- FC Candidate for Federal Listing
- FSC Federal Species of Special Concern
- BEPA Bald Eagle Protection Act of 1940

STATE: California Department of Fish and Game
- CE Listed as Endangered by the State of California
- CT Listed as Threatened by the State of California
- CR Listed as Rare by the State of California (plants only)
- CSC California Species of Special Concern

OTHER: California Native Plant Society
- 1A Plants presumed extinct in California
- 1B Plants considered rare, threatened, or endangered in California
- 2 Plants considered rare in California but common elsewhere

OTHER:
- C = degrees centigrade
- CA = California
- Delta = Sacramento-San Joaquin Delta
- M = meter

Source: California Natural Diversity Database 2004.

TABLE III-14
SPECIAL-STATUS SPECIES POTENTIALLY OCCURRING IN THE LOS VAQUEROS WATERSHED

Species	Regulatory Status	Habitat
Amsinckia grandiflora Large-flowered fiddleneck	FE / CE / 1B	Grassy slopes below 1,200 feet in valley grassland and foothill woodland.;
Arctostaphylos auriculata Mt. Diablo manzanita	1B	Dry sandstone slopes below 2,000 feet in chaparral.
Astragalus tener var. *tener* Alkali milk-vetch	FSC / 1B	Seasonally inundated alkali flats with vernal pools, alkali playa, or valley grasslands.
Atriplex cordulata Heartscale	FSC / 1B	Alkaline flats with sandy soils in chenopod scrub, meadows, and grasslands.
Atriplex depressa Brittlescale	FSC / 1B	Alkaline scalds or clay in meadows, chenopod scrub, grasslands, and vernal pools (rarely with riparian / marshes).
Atriplex joaquiniana San Joaquin spearscale (=saltbush)	FSC / 1B	Seasonal alkali wetlands or sink scrub within chenopod scrub, meadows, and grasslands.
Calocortus pulchellus Mt. Diablo fairy lantern	FSC / 1B	Chaparral, cismontane woodland, riparian woodland, and valley and foothill grassland. Found in oak woodlands and brushy slopes.
Delphinium recurvatum Recurved larkspur	FSC / 1B	Chenopod scrub, cismontane woodland, and valley and foothill grasslands with alkaline soils up to 2,500 feet.
Erodium macrophyllum Round-leaved filaree	2	Open habitat with friable clay soils in valley and foothill grasslands and foothill woodlands.
Eschscholzia rhombipetala Diamond-petaled California poppy	FSC / 1B	Clay soils in valley and foothill grasslands of the inner coast range.
Helianthella castanea Diablo helianthella (=rock-rose)	FSC / 1B	From 500 to 4,000 feet in grasslands and foothill woodlands of the San Francisco Bay region.
Hesperolinon breweri Brewer's western-flax (=western flax)	1B	Serpentine soils in chaparral, woodlands, and valley foothill grasslands.
Hibiscus lasiocarpus *Rose mallow*	2	Marshes and swamps.
Lasthenia conjugens Contra Costa goldfields	FE / 1B	Vernal pools and moist habitats in valley and foothill grasslands.
Lathyrus jepsonii var. *jepsonii* Delta tule pea	1B	Freshwater and brackish marshes. Associated with bulrush, cattail, and coyotebrush.
Lilaeopsis masonii Mason's lilaeopsis	CR / 1B	Riparian scrub, freshwater and brackish marsh, within the tidal zone in muddy or silty soil, dunes.
Scutellaria galericulata Marsh skullcap	2	Lower montane coniferous forest, dry meadows and seeps, marshes, and swamps to 6,900 feet.
Tropidocarpum capparideum Caper-fruited tropidocarpum	FSC / 1A	Low alkaline hills below 500 feet in elevation within valley grassland communities.
Branchinecta longiantenna Longhorn fairy shrimp	FE	Lifecycle restricted to vernal pools.
Branchinecta lynchi Vernal pool fairy shrimp	FT	Lifecycle restricted to vernal pools.
Hygrotus curvipes Curved-foot hygrotus diving beetle	FSC	Vernal pools and shallow water in alkali flats.
Linderiella occidentalis California linderiella fairy shrimp	FSC	Lifecycle restricted to vernal pools.
Ambystoma californiense California tiger salamander	FC / CSC	Annual grassland and grassy understory of valley-foothill hardwood habitats in central and Northern California. Needs underground refuges and seasonal and perennial water sources for breeding.
Rana aurora draytonii California red-legged frog	FT / CSC	Breeds in slow moving streams, ponds, and marshes with emergent vegetation and an absence of predators.
Clemmys marmorata Western pond turtle	FSC / CSC	Requires aquatic habitats with suitable basking sites. Nest sites most often characterized as having gentle slopes (<15%) with little vegetation or sandy banks.
Masticophis flagellum ruddocki San Joaquin whipsnake (coachwhip)	FSC / CSC	Open, dry, valley grassland and saltbush scrub associations. May associate with mammals and use burrows for refuge and egg-laying.

TABLE III-14 (CONT.)

Species	Regulatory Status	Habitat
Masticophis lateralis euryxanthus Alameda whipsnake (=coachwhip)	FT / CT	Restricted to valley-foothill hardwood habitat of the Coast Range between the vicinity of Monterey and north San Francisco Bay.
Accipiter cooperii Cooper's hawk	CSC	Nests in riparian areas and oak woodlands; forages at woodland edges.
Agelaius tricolor Tricolored blackbird	FSC / CSC	Nests in dense thickets of cattails, tule, willow, blackberry, wild rose, and other tall herbs near freshwater.
Aquila chrysaetos Golden eagle	BEPA / CSC	Primarily nests on cliff faces and tall trees on hillsides.
Ardea Herodias Great blue heron (rookery)	CSC	Groves of tall trees, especially near shallow water foraging areas.
Athene cunicularia hypugaea Western burrowing owl	FSC / CSC	Uses rodent or other burrow for roosting and nesting. Frequents open grasslands and shrublands.
Falcomexicanus Prairie falcon	CSC	Breeds on cliffs, bluffs, and outcrops near large, open areas.
Haliaeetus leucocephalus Bald eagle	FT / CE	Nests near lakes, reservoirs, and large rivers. Winters near similar habitats at lower latitudes.
Vulpes macrotis mutica San Joaquin kit fox	FE / CT	Valley and foothill grasslands and chenopod scrub communities of the valley floor. Also use oak woodland, alkali sink scrubland, and vernal pool and alkali meadow communities. Require friable soil for denning.

KEY: See Key from **Table III-13**

Source: California Natural Diversity Database 2004.

Social and Economic Environment

Existing social and economic resources described in this section include population, land use, employment and business/industrial activities, local government and finance, public health and safety, traffic and transportation, recreation and public access, utilities and public services, hazardous materials and waste, fire hazards, natural resources, and aesthetics.

Population

The number of persons living in California as of the year 2000 totaled an estimated 34 million persons. Over 500,000 people reside in the Delta region (*Census 2000*), concentrated primarily in the uplands and on the periphery. Communities include Stockton, Rio Vista, Walnut Grove, Discovery Bay, and Isleton. To the east, about 5.6 million people live in the five counties that encompass the most populated portion of the study area (Alameda, Contra Costa, San Francisco, San Mateo, and Santa Clara). The population within the vicinity of the existing Los Vaqueros Reservoir is over 1 million in Contra Costa County and 1.4 million in Alameda County.

Land Use

The legal Delta contains about 538,000 acres of agricultural land, comprising approximately 72 percent of the total land area. Cities and towns account for about 64,000 acres, and about 75,000 acres are undeveloped. The Los Vaqueros watershed area owned by CCWD consists of approximately 19,500 acres of land, with 1,460 acres covered by reservoir. Most of the land area in the watershed is zoned for agricultural uses, primarily grazing and dryland farming. A major portion of the agricultural property west of the reservoir has additional zoning restrictions that limit the use of pesticides and other practices that might affect water quality. Nearly all of the

remaining watershed land is zoned for recreation or resource management use, including wind energy facilities. The East Bay Regional Park District owns lands bordering the western edge of the watershed that are open to recreation and grazing. Employment and Business/Industrial Activities

Agriculture is the primary industry in the Delta, with an average annual gross value of over $500 million. More than 75 percent of the Delta region's total production consists of corn, grain, hay and pasture. Recreation also supports an important seasonal service industry. Many residents of the Delta region commute to adjacent commercial and industrial centers in the Central Valley and the San Francisco Bay area. The Delta provides passage to two inland ports, in Stockton and Sacramento, which accommodate ocean-going cargo ships.

The Bay Area is one of California's busiest urban centers. Trade, transportation and utilities, government, and professional and business services are the predominate industries (2002). The major share of employment is in trade, transportation, and the utilities industry, with the majority of these jobs in the retail trade sector. The government (specifically local education) and professional/business services sector are the next major employers. Unemployment rates vary throughout the region, typically ranging from 5 percent to over 8 percent.

Local Government and Finance

Local government services in California are provided by county agencies, school districts, fire districts, water districts, and other special districts. These government agencies generally obtain their funding from State government revenue transfers, property tax payments from local residents, or through user fees. Portions of six counties lie within the legal Delta – Alameda, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo – and portions of Santa Clara, San Mateo, and San Francisco counties cover other portions of the study area.

Traffic and Transportation

Federal Highways 5 and 205, and State Highway 99 pass through the periphery of the Delta. The central Delta is accessed via State Highways 4, 12, and 160, and numerous county roads. Most of the major roadways are elevated or constructed atop Delta levees. Numerous drawbridges accommodate traffic on both land and water. The Stockton and Sacramento deep water ship channels each carry ocean-going vessels about 80 miles inland from the San Francisco Bay. The Santa Fe and Southern Pacific railroads traverse the central and south Delta, respectively.

Vasco Road is the primary north-south access around and to the Los Vaqueros Reservoir watershed. Vasco Road connects with I-580, a major east-west eight-lane freeway linking the watershed with Alameda County to the west and San Joaquin County to the east. Vasco Road also functions as a commuter route between Brentwood/east Contra Costa County and the Livermore/Interstate-580/Tri-Valley area. Los Vaqueros Road and Walnut Boulevard provide access to the reservoir.

Utilities and Public Services

Several water agencies exist within the Delta region, including the North, Central, and South Delta Water Agencies, Byron-Bethany Irrigation District, East Contra Costa Irrigation District, and CCWD. The Pacific Gas and Electric Company and the Western Area Power Administration operate several high-voltage transmission lines across the Delta, and several natural gas extraction facilities in the Delta. Other public services are provided by a variety of local, State, and Federal service agencies.

Public services provided in the Bay Area portion of the study area include water service, sewer service, drainage and flood control, police and fire protection, solid waste disposal and schools. There are six water districts east of the Delta: CCWD, ACWD, SCVWD, Zone 7, EBMUD, and SFPUC. Those located in the LVE study area (CCWD, ACWD, SCVWD, and Zone 7) are described previously in this chapter. Major utility infrastructure within the Los Vaqueros Reservoir watershed includes two buried petroleum pipelines; three buried natural gas pipelines; an overhead electric transmission line; buried fiber optic communications lines; and a water conveyance pipeline that delivers water from Old River Pumping Plant to Los Vaqueros Reservoir, and conversely to the Contra Costa Canal. Police, fire, and other emergency services are provided by a variety of agencies on local, regional, State, and Federal levels.

Recreation and Public Access

The Delta accommodates various water- and land- based recreational activities, including boating, hunting, sport fishing, camping, picnicking, bicycling, wildlife viewing and photography, and hiking. Boating is the most popular recreation activity in the Delta, accounting for about 17 percent of visitors. Facilities available to boaters and other recreational users include marinas, city or county public access areas, and yacht or ski clubs. Recreational visitors account for over 12 million user days annually.

Table III-15 summarizes various recreation activities supported by Los Vaqueros Reservoir. Overall, the Los Vaqueros Reservoir has about 55 miles of hiking and multiuse trails, in addition to numerous features related to day-use picnicking and fishing. The majority of visitors to Los Vaqueros Reservoir use the south entry, where the marina and the majority of fishing piers are located.

Hazardous Materials and Waste

Residual pesticides may exist in the Delta region due to the agrarian nature of the area. The application of chlorinated pesticides, such as dieldrin, chlordane, and dichloro-diphenyl-trichloroethane (a.k.a. DDT), has been a common agricultural practice in the Central Valley, including the Delta area. A potential for localized petroleum fuel contamination also exists at area refueling stations and fuel transfer facilities. There are no known hazardous materials or waste sites identified in the Los Vaqueros watershed.

TABLE III-15
EXISTING RECREATION FACILITIES AT LOS VAQUEROS RESERVOIR

Area	Parking Spaces	Toilets	Display Panel / Water Station	Picnic Tables	BBQ Units	Fishing Piers	Description
Below Dam							
Walnut Staging Area	45	1	1	2	-	-	
Kellogg Creek Picnic Area	40	4	1	11	11	-	Three shade shelters over seven picnic tables
Interpretive Center	87	2	1	10	4	1	Outdoor amphitheater
Above Dam							
County Line Staging Area	29	1	1	1	--	-	
Los Vaqueros Staging Area	61	2	1	-	-	1	Ramp to fishing pier
Oak Point Picnic Area	-	-	-	7	3	1	
Marina	59	6	-	6	-	-	Marina; fish cleaning station; amphitheater
Knoll Picnic Area	21	-	-	18	9	-	
North west Cove	-	1	-	-	-	1	
TOTALS	**342**	**18**	**5**	**55**	**27**	**4**	

Fire Hazards

Fire hazards in the study area are typically attributed to human activities and land uses, rather than natural causes. Fire hazards in the Delta are primarily related to agricultural activities (equipment operation and burning practices), levee maintenance (vegetation removal and burning activities), and recreational activities. In the Delta, peat materials found naturally in the earth are highly flammable and can be difficult to suppress. In the Los Vaqueros Reservoir watershed, hazard abatement policies and actions primarily address the potential for grassland fires, and include fuelbreak networks, plowed control lines, prescribed burns, and other methods of minimizing the spread and intensity of wildfires. CCWD has created a fire management plan for the Los Vaqueros Reservoir watershed that addresses proactive planning (such as prevention programs and weather data), hazard abatement, and fire response.

Natural Resources

Natural resources in the study area primarily include land, water, and wildlife. In addition to food production, lands in the region provide habitat for wildlife. The CDFG manages thousands of acres in the region specifically for wildlife, including Lower Sherman Island and White Slough wildlife areas, Woodbridge Ecological Reserve, and Palm Tract Conservation Easement. Several natural gas wells and a large wind farm are also present in the region. Water resources in the study area are described earlier in this chapter.

Aesthetics

The Delta and surrounding lands provide important aesthetic resources in the region. The rural environment and wildlife of the Delta attract a large number of recreational users. While the Delta landscape has changed significantly over the past century, the Los Vaqueros Reservoir watershed has remained largely intact, with the exception of the reservoir facilities and nearby wind farm. From the highest hills east of the reservoir, panoramic views encompass the diverse landscapes of the Sacramento Valley and the Los Vaqueros Reservoir watershed. The natural beauty of the rolling hills attracts hikers, wildlife enthusiasts, and other recreational users.

Cultural Environment

This section briefly describes the archaeology, history, and ethnography of the study area.

Archaeology

California is rich in both prehistoric and historic archaeological remains. The Delta region was intensely investigated during the first half of the 20th century due to its high prehistoric population. Although much of the land area has been disturbed by agriculture, investigations have identified prehistoric village sites, temporary campsites, milling-related activity sites, and lithic scatters. Various Native American groups inhabited the Delta region, including the Valley Nisenan, Plains and Bay Miwok, Patwin, and Northern Valley Yokuts. European and American settlers rapidly displaced these groups and their cultures in the 18th and 19th centuries, but several Native American burial and cremation sites have been recorded. Further, over 170 sites in the Delta region are listed in the National Register of Historic Places (NRHP) and 10 sites are listed as California Historical Landmarks or Points of Historical Interest. Historic sites are primarily related to agriculture, but also include farmsteads, labor camps, ferry crossings, and boat landings.

According to evidence gathered from archaeological investigations conducted for CCWD, the upper Los Vaqueros Reservoir watershed experienced one of the longest sequences of human occupation yet identified in a single locality in the broader Bay-Delta region. In the period preceding Euroamerican contact, native peoples speaking four languages (Ohlone or Costonoan, Bay Miwok, Plains Miwok, and Northern Valley Yokuts) lived in and around the Kellogg Creek watershed. Archaeological and ethnographic sites include villages, ceremonial sites, burial grounds, and others. Based on a review of cultural resources mitigation documents, 32 prehistoric and 12 combination historic/sites exist within the Los Vaqueros Reservoir watershed, described in **Table III-16**.

History

Spanish settlers began to arrive in the region around 1775. As the mission system was established and acculturation progressed, a rapid and major reduction occurred in native California populations. Almost all of the native peoples who survived this period abandoned their indigenous hunter-gatherer lifestyle and become agricultural laborers.

TABLE III-16
SUMMARY OF KNOWN CULTURAL RESOURCES
IN THE LOS VAQUEROS WATERSHED

Cultural Resource Type	Number Identified		Number Identified
Rockshelter	4	Stone fence or corral	4
Milling station (historic / prehistoric)	18 / 2	Artifact scatter (historic / prehistoric)	2 / 1
Petroglyph	1	Water management feature	9
Occupation site	10	Rock feature or shelter	3
Ranch headquarters or ancillary facility	21	Burial site (historic / prehistoric)	5 / 1
Homestead	1	Other feature	2

In the early 1840s, the 17,000-acre Rancho Canada de los Vaqueros land grant (which included the Kellogg Creek watershed) was issued to private owners. The land was used for grazing and other agricultural activities until California was annexed to the United States in 1848, at which time American settlers arrived and began claiming portions of the land. Grazing continued and the land remained in primarily single ownership until plans for Los Vaqueros Reservoir materialized in the 1960s and 1970s.

Ethnography

California is home to many linguistically and culturally diverse Native American groups. The indigenous residents were primarily from four tribal groups: Ohlone or Costonoan, Coast Miwok, Plains Miwok, and Northern Valley Yokuts. Different groups of Ohlone lived in the Bay Area, and tended to be less transient than neighboring tribes due to the abundance of resources in and around the bay. The Coast Miwok lived in small bands by hunting and gathering. The Plains Miwok and Northern Valley Yokuts were also hunter-gatherers, but focused their settlement along major stream courses with abundant salmon runs. The Miwok and Yukuts traveled periodically to avoid floods and summer heat, collect seasonal resources, hunt large game, and engage neighboring groups. Today, a diverse international community, comprising people of many cultures and ethnic backgrounds, has replaced these indigenous tribes.

FUTURE WITHOUT-PROJECT BASELINES

Identification of the magnitude of potential water resources and related problems and needs in the study area is not based only on the existing conditions described in this chapter, but also on an estimate of how these conditions may change in the future. Two conditions were identified to help define the extent of potential resources problems/opportunities and for use in comparing the relative effectiveness of alternative plans to be formulated to address these problems/opportunities:

- **California Environmental Quality Act (CEQA) Baseline and No Project Alternative** – Development of this baseline, to be presented in the Environmental Impact Report (EIR) that will accompany the LVE feasibility report, is necessary to meet the requirements of CEQA.

The California Environmental Quality Act (CEQA) Existing Conditions Baseline represents conditions at the time the Notice of Preparation is filed. The CEQA No Project Alternative, on the other hand, also includes actions that are reasonably expected to occur in the future. Under CEQA, all alternatives (including the CEQA No Project Alternative) are compared against the Existing Conditions Baseline. Because this Initial Alternatives Information Report (IAIR) is primarily focused on informing Federal decision-makers, the CEQA No Project Alternative is not discussed herein.

- **National Environmental Policy Act No Action Alternative** – The National Environmental Policy Act (NEPA) No Action Alternative (also considered the NEPA benchmark) is developed in the Environmental Impact Statement (EIS) to meet the requirements of NEPA. Under this without-project future condition, only actions reasonably expected to occur in the future would be included. This would include projects and actions that are currently authorized, funded, permitted, and/or highly likely to be implemented. Under NEPA, all alternatives are compared against the NEPA benchmark (No Action Alternative). Differences between the NEPA and CEQA baseline comparisons are shown in **Figure III-5**.

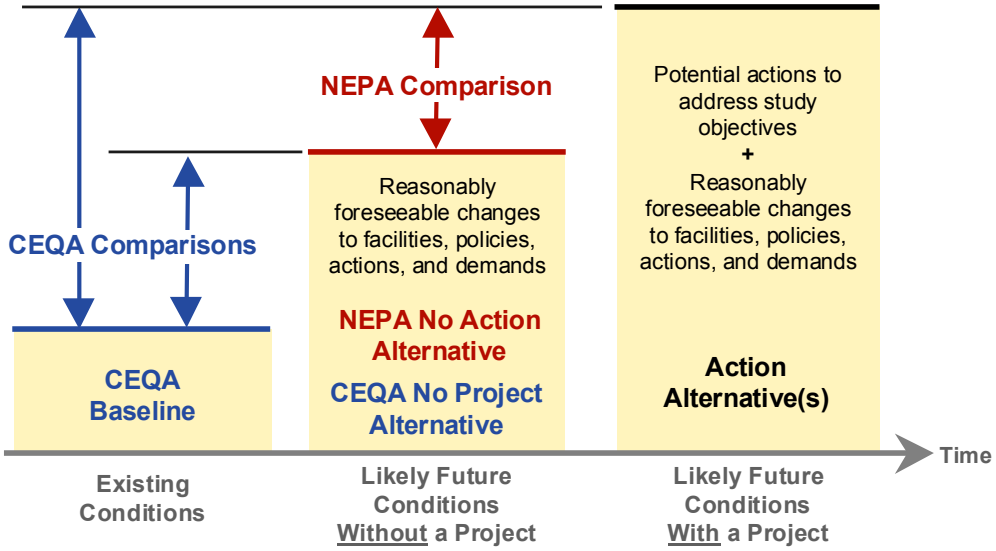


FIGURE III-5 – DIFFERENCES BETWEEN NEPA AND CEQA ANALYSES

Predicting future changes to the physical, biological, social, and economic environments in the study area is complicated by ongoing programs and projects, particularly those related to CALFED, the CVP, and SWP. It is difficult to estimate how these individual projects may influence future conditions because they are not part of a well-defined, integrated or regional plan. Various ongoing water supply reliability, water quality, and ecosystem restoration efforts in the study area are likely to be implemented over the planning horizon (the LVE utilizes a 100-year period of analysis). However, these efforts may not meet the conditions generally required for projects to be included in the NEPA No Action Alternative (authorized, funded, and permitted, or under construction at this time). Several significant projects that could affect conditions in the primary study area, and are highly likely to be implemented in the future, are described below. These projects may be appropriate for inclusion in the NEPA No Action Alternative, described in **Chapter VII**.

- **Environmental Water Account** – The EWA program recently received authorization through 2011 under the Water Supply, Reliability, and Environmental Improvement Act (2004). The corresponding EIS/EIR under preparation will evaluate a planning horizon through 2030. However, it is likely that the EWA (or a similar program) will continue in the long-term future to promote fish recovery.

- **Water Use Efficiency** – CALFED seeks to accelerate implementation of cost-effective actions of its Water Use Efficiency (WUE) Program to conserve and recycle water throughout the State. As with the EWA, it is believed that some form of this program will continue into the long-term future. CCWD, SCVWD, Zone 7, and ACWD already are implementing WUE programs in their service areas, and have plants to implement additional projects in the future. The unmet water demands described later in this chapter assume that these programs are in place.

- **South Delta Improvements Program** – DWR and Reclamation are responsible for implementing CALFED's South Delta Improvements Program (SDIP), which includes providing more reliable, long-term export capability by Federal and State water projects, protecting local diversions, and reducing impacts on San Joaquin River salmon. Specifically, proposed actions in the SDIP include placing a fish barrier at the head of Old River, constructing up to three hydraulic barriers in south Delta channels, dredging and extending some agricultural diversions, and increasing the diversion capability of the Banks Pumping Plant at the Clifton Court Forebay from 6,680 cfs to 8,500 cfs during certain periods. The SDIP is still in the environmental review phase and not yet approved, but was included in early consultations for OCAP. Because it is an essential element of the CALFED Record of Decision (ROD) and has broad Federal and State agency support, there is a strong likelihood that it will be implemented in the future.

- **Operation Criteria and Plan** – Numerous actions contained in the 2004 revision to the 1992 OCAP will be implemented to address how the CVP and SWP will operate in the future as new projects come on-line and as water demands increase. This includes increasing south Delta pumping at Banks to 8,500 cfs as part of the SDIP.

- **Trinity River Restoration Plan** – It is expected that elements of the December 2000 ROD for the Trinity River Restoration Plan will be implemented. This includes reducing annual exports of Trinity River water to the Sacramento River from 74 percent of Trinity River flow to 52 percent. A reduction in high quality Trinity River diversions to the Sacramento River may affect water quality conditions in the Delta.

- **Folsom Dam Modifications** – Modifications consist of enlarging existing outlets and constructing new low-level outlets to increase releases during lower pool stages, and revising the surcharge storage space in the reservoir. This project may influence project operations or flow conditions in the Delta.

- **Freeport Regional Water Project –** The Freeport Regional Authority (comprised of Sacramento County Water Agency and East Bay Municipal Utility District (EBMUD) in close coordination with Reclamation is developing a joint regional water supply project on

the Sacramento River near the community of Freeport. The Freeport Regional Water Project will supplement aggressive water conservation and recycling programs in the East Bay and help meet future drinking water needs in the central Sacramento County area. In April 2004, a Final EIS and EIR were released in accordance with NEPA and CEQA , respectively.

- **Phase 8 Short-Term Agreement** – It is highly likely that some of the 45 projects identified in the Phase 8 Short-Term Settlement Agreement will be implemented, including the dedication of up to 185,000 acre-feet of water for environmental needs. A portion of this water will likely be made available for environmental needs in the future, and may influence flow and water quality conditions in the Delta.

- **Other Projects** – Various other projects and programs are expected to be implemented in the future, including CVP Contract Renewals and further implementation of CVPIA (b)(2) water accounting.

- **Local Actions –** Various local projects may be implemented that affect the primary study area. Zone 7 is pursuing construction of the Altamont WTP to reduce its reliance on groundwater. Due to the accelerated implementation schedule and inclusion of the project in the 2004 Capital Improvement Plan, it is highly likely that this project will be implemented in the future. In addition, CCWD has begun studying an alternate intake location in the central Delta; however, because environmental documentation is not yet available, it is uncertain whether this project will be completed in the near future and, if so, in what form.

FUTURE WITHOUT-PROJECT CONDITIONS

This section summarizes conditions that are expected to occur in the future in the study area. These conditions are described in terms of water resources, physical environment, biological environment, social and economic environment, and cultural environment.

Water Resources

This section discusses the expected future reliability and quality of water resources in the primary study area.

Water Supply Reliability

Anticipated increases in population growth in California will result in increased demands on water resource systems for additional and reliable water supplies. These increasing demands on California's finite water resources are likely to affect all water users, either directly or indirectly. **Table III-17** summarizes Bulletin 160-98 estimated water demands (applied water), supplies, and potential shortages for 2020 levels of demand in the State of California. As shown in the table, estimated future shortages of water supplies in drought years are expected to equal about 6 MAF for the State. It should be noted that an update of the Water Plan is currently underway and, when finalized, relevant information on future water supplies and demands will be considered for the LVE.

Central Valley Project and State Water Project

For the purpose of this analysis, two different water supply scenarios were analyzed for the without-project condition. In one scenario, CVP and SWP supplies are assumed to remain constant, meaning future supplies would be the same as those values shown in **Tables III-7** and **III-10**. In the second scenario, future CVP and SWP values, as simulated in the OCAP study, were implemented (see **Table III-19**, Notes 5 and 6, for adjusted percent allocations). It also is assumed that demands will be fully developed in the future. As contractors request their full entitlements in pace with growing demands, agricultural users would see the greatest cutbacks in deliveries, followed by M&I users. The geographic distribution of project supplies, primarily in the north, is likely to put additional pressure on CVP and SWP Delta conveyance and pumping facilities, even with increased pumping at Banks Pumping Plant. Pumping capacity available for non-project transfers may diminish in the future.

TABLE III-17
ESTIMATED STATEWIDE WATER DEMANDS,
SUPPLIES, AND SHORTAGES FOR 2020

Item	State of California (2020)	
	Average Year	Drought Year
Population (millions)	45.6	
Urban Water Use Rate (GPCPD)	235	242
Acres In Production (millions)	9.2	
Agricultural Water Use (AFPA)	3.4	3.5
Applied Water (MAF)		
Urban	12.0	12.4
Agricultural	31.5	32.3
Environmental	37.0	21.3
Total	**80.5**	**66.0**
Water Supply (MAF)		
Surface Water	65.0	43.3
Groundwater	12.7	16.0
Recycled/Desalinated	0.4	0.4
Total	**78.1**	**59.8**
SHORTAGE (MAF)	**2.4**	**6.2**

KEY: GPCPD = gallons per capita per day AFPA = acre-feet per acre
MAF = million acre-feet

Source: The California Water Plan, Bulletin 160-98, Appendix 6A, Regional Water Budgets with Existing Facilities and Programs, November 1998.

Local Agencies

The following summarizes published Bay Area water agency plans to meet future water demands in the primary study area.

Contra Costa Water District – Following its 2000 UWMP, CWD has renewed its CVP contract, implemented an expanded conservation program, secured one 8,000 AFY long-term transfer, and developed over 9,000 AFY recycled water in its service area. CCWD is continuing to examine additional water transfers to meet future needs.

Santa Clara Valley Water District – SCVWD's 2001 UWMP indicates that development of non-structural water supplies through long-term water transfers, increased development of its water recycling program, and further water conservation requirements will be implemented to meet water supply needs in the next 20 years.

Alameda County Water District – ACWD's 2001-2005 UWMP outlines its proposal for water supply management to meet customer water demands through 2020. The plan includes increased desalination and recycled water supplies, water conservation, groundwater management, and off-site banking and transfer opportunities.

Zone 7 – Zone 7's 2000 UWMP outlines multiple programs the Agency plans to pursue to increase its water supply reliability and ensure that Zone 7 meets 100 percent of estimated future demands 100 percent of the time. These plans include imported water, recycled water, demand reduction (conservation), increased conjunctive use of the groundwater basin, and additional out-of-valley storage (Semitropic GBEP). Zone 7 also has begun negotiation of a long-term (through 2035) in-lieu water banking program with Cawelo Water District to increase dry-year supply reliability. As currently envisioned, Zone 7 could store a maximum of 120,000 acre-feet, and Cawelo would provide up to 10,000 AFY on request.

In most cases, no action has been taken to legally secure or develop the supplies outlined above. Many of the agency UWMPs identify additional transfers and long-term contracts to meet future demands. For example, several area water agencies have entered into agreements with the Semitropic GBEP to help meet their dry period needs. In addition, much uncertainty exists regarding the effect of ever-increasing demands on the State's water transfer market, including the ability and cost to acquire water in the future.

Tables III-18 and **III-19** summarize future water supplies and demands under two conditions: if only existing supplies are available in the future, or if both existing and planned local supplies are available in the future, respectively. These supplies and demands are based on data gathered from agency UWMPs and the Bay Area Water Quality and Water Supply Reliability Program's *Water Demand Projections Draft Technical Memorandum*.

Assuming that only those supplies currently available and/or under contract would be available in 2020, the only factor that affects the future 2020 water balance is increased demand. The 2020 water demands are based on each agency's UWMP and information provided by agency staff, excluding CCWD, whose projected water use was obtained from the *CCWD Future Water Supply Study 2002 Update*. Under these conditions, Bay Area water agencies may experience shortages under drought periods, and possibly during average years (as calculated from historical data). Further, Bay Area water agencies currently have aggressive conservation programs; therefore, increased levels of conservation in the future may not provide significant benefits.

TABLE III-18
FUTURE (2020) WATER BALANCE BY YEAR TYPE CONSIDERING EXISTING WATER SUPPLIES

Item	ACWD[1,2] (TAFY)			CCWD (TAFY)			SCVWD (TAFY)			Zone 7[3] (TAFY)		
	LTA	CDP	SDY	LTA	CDP	SDY	LTA	CDP	SDY	LTA	CDP	SDY
Supplies												
CVP	-	-	-	171.6	117.0	105.3	113.0	80.5	71.1	-	-	-
SWP	35.3	17.6	1.3	-	-	-	84.0	42.0	3.0	67.7	33.9	2.4
Local/Other	**42.8**	**57.5**	**52.9**	47.6	23.1	23.1	N/A[4]	N/A[4]	N/A[4]	24.8	40.0	76.5
TOTAL	**78.1**	**75.1**	**54.2**	**219.2**	**140.1**	**128.4**	**N/A**	**N/A**	**N/A**	**92.5**	**73.9**	**78.9**
Demand[5]	77.5	73.5[6]	73.5[6]	207.1	207.1	207.1	488.1	488.1	488.1	83.1[7]	83.1[7]	83.1[7]
Conservation[8]	0.8	0.8	0.8	1.1	1.1	1.1	37.0	37.0	37.0	4.2	4.2	4.2
WATER BALANCE[9]	**1.4**	**2.4**	**-18.5**	**13.2**	**-65.9**	**-77.6**	**N/A[10]**	**N/A[10]**	**N/A[10]**	**13.6**	**-5.0**	**0**

KEY: ACWD = Alameda County Water District
CCWD = Contra Costa Water District
CDP = critical dry period (CVP/SWP: 1929-1934, Local: 1987-1992)
LTA = long-term average (1922 through early 1990s)
N/A = not available
SCVWD = Santa Clara Valley Water District
SDY = single dry year (1977)
TAFY = thousand acre-feet per year
Zone 7 = Alameda County Flood Control and Water Conservation District, Zone 7

Notes: *Source: District Urban Water Management Plans, unless otherwise noted.*

1. *ACWD demands include Distribution system demands and groundwater system demands, (consisting of private groundwater pumping, aquifer reclamation pumping and groundwater outflows to prevent seawater intrusion). Under critically dry conditions, ACWD's groundwater system demands are assumed to be reduced by 4,000 AF/yr which would occur as a result of temporarily lowering groundwater levels. This temporary drawdown may subsequently reduce the quantity of groundwater outflows to the San Francisco Bay, thereby reducing the overall groundwater system demands.*
2. *ACWD supplies and demands are subject to change pending completion of ACWD's 2005 UWMP.*
3. *Changes in local supplies represent an increase in groundwater supply to meet increased demand.*
4. *Groundwater use, a significant part of SCVWD's local supplies, is currently under evaluation and can not be quantified at this time.*
5. *If a range of demands was presented in a district's urban water management plan, the "middle" scenario was used (applies to ACWD and SCVWD).*
6. *Demands during dry periods reflect partial reduction in saline outflows to San Francisco Bay resulting from naturally low groundwater elevations.*
7. *Zone 7 recently revised its demand projections to account for changes in land use zoning. For this reason, these projects may not match those published in Zone 7's UWMP.*
8. *Five percent conservation was assumed for Zone 7.*
9. *A negative water balance represents a shortage.*
10. *The future water balance for SCVWD can not be quantified at this time. See also Note 4.*

TABLE III-19
FUTURE (2020) WATER BALANCE BY YEAR TYPE INCLUDING PLANNED WATER SUPPLIES

Item	ACWD[1] (TAFY)			CCWD[2] (TAFY)			SCVWD[3] (TAFY)			Zone 7[4] (TAFY)		
	LTA	CDP	SDY	LTA	CDP	SDY	LTA	CDP	SDY	LTA	CDP	SDY
Supplies												
CVP[5]	-	-	-	169.7	115.1	109.2	125.5	79.0	74.2	-	-	-
SWP[6]	34.9	17.6	1.7	-	-	-	83.0	42.0	4.0	66.9	33.9	3.2
Local Supplies	50.2	65.3	62.5	80.7	42.7	28.5	N/A	N/A	N/A	25.2	40.9	71.6
TOTAL	**85.1**	**82.9**	**64.2**	**250.4**	**157.8**	**137.7**	**N/A**	**N/A**	**N/A**	**92.1**	**74.8**	**74.8**
Demand[7]	77.5	73.5[7]	73.5[7]	207.1	207.1	207.1	488.1	488.1	488.1	83.1[8]	83.1[8]	83.1[8]
Conservation[9]	2.9	2.9	2.9	6.4	6.4	6.4	52.7	52.7	52.7	8.3	8.3	8.3
WATER BALANCE[10]	**10.5**	**12.3**	**-6.4[12]**	**49.7**	**-42.9**	**-63.0**	**N/A[11]**	**N/A[11]**	**N/A[11]**	**17.3**	**0**	**0**

KEY:
ACWD = Alameda County Water District
CCWD = Contra Costa Water District
CDP = critical dry period (CVP/SWP: 1929-1934, Local: 1987-1992)
LTA = long-term average (1922 through early 1990s)
N/A = not available
SCVWD = Santa Clara Valley Water District
SDY = single dry year (1977)
TAFY = thousand acre-feet per year
Zone 7 = Alameda County Flood Control and Water Conservation District, Zone 7

Notes:

1. *ACWD planned local supplies include water recycling and added desalination (2001-2005 Urban Water Management Plan (UWMP)), and slightly improved SFPUC water supply availability. All supply and demand figures are subject to change pending completion of ACWD's 2005 UWMP.*
2. *CCWD planned local supplies include projected East Contra Costa irrigation District transfers, proposed water recycling projects, and an additional 30,000 acre-feet annually in water transfers.*
3. *SCVWD planned local supplies include full use of Semitropic GBEP and planned water recycling projects. Groundwater use can not be quantified at this time.*
4. *Changes in Zone 7 local supplies: LTA - increase in Del Valle storage capacity (2020 sustainable supply) and a decrease in groundwater recharge, CDP & SDY - decrease in groundwater supply to account for increased conservation.*
5. *Federal contract allocations north-of-Delta vary by water use and hydrologic year type (OCAP_2020D09D_FutureEWA values):*
   Municipal and Industrial (M&I) – LTA: 1922-1994 (87%), CDP: 1929-1934 (59%), SDY: 1977 (56%)
   Federal contract allocations south-of-Delta vary by water use and hydrologic year type (OCAP_2020D09D_FutureEWA values):
   M&I – LTA: 1922-1994 (86%), CDP: 1929-1934 (59%), SDY: 1977 (56%)
   Agriculture – LTA: 1922-1994 (61%), CDP: 1929-1934 (10%), SDY: 1977 (6%)

Notes continued on following page.

Table III-19 Notes, continued.

6. *State contract M&I allocations vary by hydrologic year type (OCAP_2020D09D_FutureEWA values): LTA (83%), CDP: 1929-1934 (42%), SDY: 1977 (4%)*
7. *If a range of demands was presented in a District's UWMP, the "Middle" Scenario was used (applies to ACWD and SCVWD demands). ACWD demands include Distribution system demands and groundwater system demands, (consisting of private groundwater pumping, aquifer reclamation pumping and groundwater outflows to prevent seawater intrusion). Under critically dry conditions, ACWD's groundwater system demands are assumed to be reduced by 4,000 AF/yr which would occur as a result of temporarily lowering groundwater levels. This temporary drawdown may subsequently reduce the quantity of groundwater outflows to the San Francisco Bay, thereby reducing the overall groundwater system demands.*
8. *Zone 7 recently revised its demand projections to account for changes in land use zoning. For this reason, these projects may not match those published in Zone 7's UWMP.*
9. *Ten percent conservation was assumed for Zone 7.*
10. *A negative water balance represents a shortage.*
11. *The future water balance for SCVWD can not be quantified at this time.*
12. *This shortage is within ACWD's accepted water supply reliability goal to sustain a shortage of no more than 10% during dry and critically dry conditions as outlined in ACWD's Integrated Resource Plan and UWMP. ACWD plans to mitigate this level of shortage through voluntary and, if necessary, mandatory conservation measures.*

Source: District Urban Water Management Plans, unless otherwise noted (see also notes for Table III-10).

If planned water supplies within the study area (supplies identified in UWMPs but not yet secured or developed, including planned future conservation) and future CVP and SWP deliveries as per the OCAP study also are included, the water balance would be as shown in **Table III-19**. This table indicates that the region would experience water shortages even if planned supplies outlined in agency UWMPs are secured.

Water Quality

Water quality in the Delta is expected to remain generally as under existing conditions, with seasonal and drought related declines. Historically, water quality tends to be poorest in the fall and during dry years; these trends are not likely to reverse in the future. Various programs are in place to prevent further deterioration of Delta water quality. Implementation of projects that would increase Delta exports, such as the SDIP, would include measures to mitigate for any water quality impacts. Saline intrusion into local aquifers is expected to remain as under existing conditions as local groundwater supplies are increasingly relied on, but recycling and recharge programs are likely to slow the progression. In the future, it is likely that local water agencies will not achieve their overall water quality objectives as frequently as under existing conditions. As local substitute supplies to Delta exports are relied on more heavily and become less available, and rising demands for water in the Central Valley exert pressure on the Delta, it will become more difficult and costly for Bay Area water agencies to provide high-quality water in the future.

In addition to regulatory environments that increase the demands on water supplies, a growing institutional regime to facilitate exchanges and operational flexibility will place additional demands on water supplies and conveyance systems. Institutions include the Sacramento Valley Water Management Program, SDIP, Coordinated Operation Agreement (COA), JPOD, the DWR Dry Year Program, Drought Risk Reduction Investment Program, and EWA.

Delta Fishery Resources

Planned increases in pumping rates at major Delta export facilities are likely to increase the population effects on threatened and endangered fisheries. Regarding delta smelt specifically, increased water demands both inside and outside the Delta are likely to result in less favorable rearing conditions in Suisun Marsh, increased vulnerability to entrainment, and less water available for maintaining the X2 position (USFWS *5-year Review* of delta smelt recovery status, March 2004). These impacts would be offset to some degree by pumping restrictions and other protective actions. BOs and other regulatory actions of Federal and State wildlife agencies with regard to special-status species are expected to remain as under existing conditions.

Efforts are underway to implement programs and projects to help protect and restore threatened fisheries resources in the Delta. For example, as described previously and in **Chapter II**, the EWA provides an institutional structure through which water can be predelivered to Delta-export storage areas prior to pumping curtailment, or post-delivered from Delta-import storage following a pumping curtailment. Key factors that may influence whether EWA water acquisition targets are met in the future include water procurement and conveyance costs, transfer market liquidity, dedicated pumping and conveyance capacity in the south Delta, storage reliability, Federal and State funding, and hydrologic conditions.

To date, the EWA has obtained water from surplus Delta flows, source shifting, and short-term borrowing arrangements, but has primarily relied on single-year, transfer market water acquisitions to meet its water supply and fishery action objectives. Under this mode of operation, the effectiveness of the EWA is primarily governed by two factors: its ability to acquire sufficient water, and the availability of surplus pumping capacity at CVP and SWP export facilities needed to bank the water in south-of-Delta export service areas. EWA implementing agencies have developed estimates of water acquisition for a long-term EWA. Typically, the EWA program purchases 200,000 to 300,000 acre-feet of water annually.

While water is abundant in wet years, conveyance capacity is lacking, making it more difficult for the EWA to move supplies through the Delta and take advantage of surplus conditions. While the delivery impacts of pumping curtailment are less for contracted water, other transfers have conveyance priority over EWA water acquisitions. Additionally, the scarcity of supplies available on the transfer market in the future will increase the cost of these supplies as contractors compete with the regulated allocation of water to environmental purposes. In summary, it is likely that future implementation of the long-term EWA will be limited by reduced pumping capacity at south Delta export facilities and changes in the cost and availability of water on the transfer market.

Further, the EWA does not have a firm, fixed storage asset where it can store water or carry water over to the following year. While EWA uses San Luis, Oroville, Folsom, and Shasta reservoirs, a risk always exists of losing water if the reservoir needs to spill for flood control or other reasons. Also, as pumping exports south of the Delta increase to meet demands, the CVP and SWP are likely to store more water in San Luis Reservoir. Because EWA space in San Luis is secondary to CVP and SWP storage allocations, EWA water would be more likely to spill under these conditions.

Physical Environment

Basic physical conditions in the study area are expected to remain relatively unchanged in the future. No major changes to area topography, geology, or soils are foreseen. From a geomorphic perspective, ongoing restoration efforts in the Delta and its upstream tributaries are expected to marginally improve natural processes in the Delta. Without major physical changes to the river systems or significant increases in south Delta pumping, overall hydrologic and hydrodynamic conditions in the Delta will probably remain unchanged. Some speculation exists that the region's hydrology could be altered should there be significant changes in global climatic conditions. Scientific work in this field of study is continuing.

Much effort has been expended to control the levels and types of herbicides, fungicides, and pesticides that can be used in the environment. Further, efforts are underway to better manage the quality of runoff from urban environments to major stream systems. However, water quality conditions are expected to generally remain unchanged and similar to existing conditions. Most of the air pollutants in the study area will continue to be influenced by both urban and agricultural land uses. As population continues to grow, and remaining open space and agricultural lands are converted to urban centers, a general degradation of air quality conditions could occur.

As urban water demands increase, additional agricultural lands are likely to be fallowed in the Central Valley and the Delta. Land use in the Bay Area is expected to remain as under existing conditions, but current agricultural-to-urban land conversion trends in the Central Valley and around existing Delta communities will likely continue.

Biological Environment

Significant efforts are underway by numerous agencies and groups to restore various biological conditions in the Delta and throughout the study area. These include elements of the CALFED programs, continued habitat conservation actions by CDFG and other State agencies, efforts by local recreation agencies and private conservation groups, and numerous other programs and projects. Accordingly, additional areas of wildlife habitat, including wetlands, grasslands, and riparian areas, are expected to be protected or restored. However, as population and urban growth continues, many wildlife species also are likely to be impacted.

Social and Economic Environment

The population of the State is estimated to increase from about 35 million in 2000 to about 46 million by 2020, and to over 55 million by 2050 (*Census 2000*). To support these expected increases in population, some conversion of agricultural and other rural land to urban uses is anticipated, particularly in the Central Valley. Modification of existing traffic corridors and construction of new transportation routes likely will occur, further connecting the Bay Area to anticipated population growth centers in the Central Valley.

The increase in population during this time will be accompanied by an increase in the economic output of the State, which is likely to at least double (based on the State's historical economic performance with respect to output and corporate taxes). However, shortages in key inputs, including water resources, could limit economic output, and have potentially other serious effects throughout the economy and population.

Anticipated increases in population growth also will have impacts on visual resources within the Central Valley and primary study area, as areas of open space are converted to urban uses. These increases also will result in increased demands for electric, natural gas, water, and wastewater utilities; public services such as fire, police protection, and emergency services; water-related infrastructure; and communication infrastructure. Further, the increasing population will increase the potential for hazardous toxic radiologic waste issues in the future. In addition, the increasing population will place pressures on preservation of existing historic and prehistoric cultural sites within the study area

The increase in population and aging "baby boomer" generation will increase the need for health services. During the 2000 to 2010 decade, many workers will reach 60 years and older. The general migration of retirees and older Americans from colder northeastern regions to warmer southern regions is expected to continue. Many of the region's high school graduates will remain in the Bay Area or move to Southern California to attend college and find employment. However, housing opportunities and a lower cost of living are likely to continue to attract Bay Area residents to adjacent Delta and Central Valley communities.

Cultural Environment

Any paleontological, historic, archaeological, or ethnographic resources currently being affected by agricultural practices or other ongoing activities in the study area would continue to be impacted.

CHAPTER IV
PROBLEMS AND OPPORTUNITIES

This chapter describes major identified water resource problems and related opportunities in the study area based on the existing and likely future conditions described in **Chapter III**. The discussion is divided into sections on reliability and quality, and related opportunities.

RELIABILITY AND QUALITY OF WATER RESOURCES

The primary water resource problems in the study area are water supply reliability and quality. The discussion below begins with a general overview of water resource problems in California, and then describes problems and opportunities specific to the LVE study area.

Current and Future Water Shortages

Today, significant challenges exist for urban, agricultural, and environmental water users in California. Competition for finite water resources often leads to shortages. With finite opportunities to develop new water sources, California faces increasing water supply shortages in the future, particularly during dry years, as the State's population continues to rise. In the study area, a trend exists of increasing shortages through 2020 and further into the future. **Table IV-1** compares demands and supplies under drought year conditions for 2000 and 2020, based on the 1998 California Water Plan (Bulletin 160-98). For comparison purposes, the 6.2-million acre-foot (MAF) shortage projected in 2020 in the table below is roughly equal to the total current CVP agricultural water delivery capacity of about 7 MAF. As mentioned in **Chapter II**, an update of the Water Plan is currently underway, and when finalized, relevant information on future water demands and supplies will be included in future studies for the LVE.

However, the magnitude of future shortages throughout the state of California may be even greater than indicated in **Table IV-1** due to the difficulty in forecasting future conditions. For example, if applied water for agricultural uses does not decline in the future, as shown above, this water would not be available to meet M&I needs, and projected shortages would increase. Similarly, the ongoing drought in the Colorado River basin, and reductions in supplies associated with the Quantification Settlement Agreement, may not be adequately reflected in the projections. Further, it is anticipated that the amount of water dedicated to environmental purposes will increase in the future in response to continued environmental restoration efforts in the Central Valley. Finally, **Table IV-1** does not consider the effect of increasing statewide water shortages on the water transfer market, on which many agencies rely to meet demands in dry years.

TABLE IV-1
COMPARISON OF EXISTING AND FUTURE CALIFORNIA WATER USE VERSUS SUPPLIES UNDER DROUGHT YEAR CONDITIONS

Item	2000	2020
Population (millions)	**35**	**46**
Water Demand (million acre-feet)		
Urban	9.7	12.4
Agricultural	34.1	32.3
Environmental	21.2	21.3
Total	***65.0***	***66.0***
Water Supply (million acre-feet)		
Surface Water	43.5	43.3
Ground Water	15.8	16.0
Recycled/Desalinated	0.3	0.4
Total	***59.7***	***59.8***
SHORTAGE (million acre-feet)	**5.4**	**6.2**

Source: 1998 California Water Plan (Bulletin 160-98)

Notes: Drought years reflect successions of dry and critically dry years. Current modeling identified drought period delivery as the average quantity for the combination of the periods of May 1928-October 1934; October 1975-Septebmer 1977; and June 1986-September 1992. Water year determination is made by Reclamation and DWR according to hydrologic region (Sacramento River Valley or San Joaquin River Valley) and service area. The year type determination of wet, above normal, below normal, dry, or critical is based on storage, runoff, and previous year classification.

Water supply reliability in the LVE study area is strongly linked to statewide water supply problems and shortages. Many Bay Area water agencies rely on CVP and/or SWP Delta contract deliveries to meet a large portion of their demands. Many factors influence the amount of water available from CVP and SWP for delivery to water users, including hydrology, the amount of water in storage, and facility and conveyance losses. In any given year, user allocations are based on available supplies and contractor requests, with the most significant supply reductions occurring in dry and critically dry years. Bay Area water agencies look to local supplies to meet demands within their service areas when CVP and SWP allocations are reduced. However, local dry periods often coincide with periods when imported CVP and SWP supplies also are reduced, and opportunities are limited to develop new local supplies.

Although contractors may be allocated less water than they request during dry years, their CVP and SWP allocations often are greater than these agencies request during wet years. Some Bay Area water agencies are unable to take advantage of higher wet year allocations because they lack local facilities to store the excess water for use in dry years. To meet this challenge, all three SBA contractors have entered into agreements with the Semitropic Groundwater Banking and Exchange Program (GBEP) to store excess SWP allocations during wet years, enabling them to take water from storage during dry and critical dry years. In the future, however, this program may not be sufficient to meet the needs of Bay Area Water agencies during dry and critically dry periods.

Table IV-2 summarizes current and anticipated 2020 water balances for ACWD, CCWD, SCVWD, and Zone 7 water agencies under two conditions: with existing supplies only, and with both existing and anticipated future supplies. Although a water balance is not available for all districts, the table indicates that the region could experience growing water shortages during drought periods in the next 15 years, even if planned future supplies can be developed and/or acquired as outlined in current local water management plans (such as increased conservation, demand management, desalinization, and future water transfer agreements). Beyond 2020, shortages are expected to become more severe as the population in both the Bay Area and California continues to grow.

TABLE IV-2
COMPARISON OF EXISTING & FUTURE (2020) WATER DEMANDS VERSUS SUPPLIES IN THE STUDY AREA UNDER DROUGHT PERIOD CONDITIONS

Item	ACWD		CCWD		SCVWD		Zone 7	
	2000	2020	2000	2020	2000	2020	2000	2020
Existing & Likely Future Supplies & Demand Reductions (1,000 acre-feet/year)								
Demand (less conservation)	66.3	72.7	172.0	206.0	420.0	451.1	63.6	78.9
Supply	*75.1*	*75.1*	*140.1*	*140.1*	*N/A*[2]	*N/A*[2]	*63.6*	*73.9*
Balance[3]	**8.8**	**2.4**	**-31.9**	**-65.9**	**N/A**	**N/A**	**0**	**-5.0**
Existing & Planned[4] Future Supplies & Demand Reductions (1,000 acre-feet/year)								
Demand (less conservation)	66.3	70.6	172.0	200.7	420.0	435.4	63.6	74.8
Supply	*75.1*	*82.9*	*140.1*	*157.8*	*N/A*[2]	*N/A*[2]	*63.6*	*74.8*
Balance[3]	**8.8**	**12.3**	**-31.9**	**-42.9**	**N/A**	**N/A**	**0**	**0**

KEY: ACWD = Alameda County Water District; CCWD = Contra Costa Water District; N/A = not available; SCVWD = Santa Clara Valley Water District; Zone 7 = Alameda County Flood Control and Water Conservation District, Zone 7

Notes:

1. *Refer to Chapter III, Tables III-9, III-10, III-18, and III-19, for details regarding the sources and assumptions used for the supplies and demands presented for each agency.*
2. *Groundwater use, an important part of SCVWD's local supplies, can not be quantified at this time. Consequently, a water balance is not presented for SCVWD.*
3. *A negative water balance value indicates a potential water shortage.*
4. *Planned supplies include potential water sources identified in an agency's Urban Water Management Plan but not yet secured or developed.*
5. *Critical drought period: Water Years 1987-1992.*

Source: District Urban Water Management Plans. See Chapter III for further breakdown.

For comparison, **Figure IV-1** illustrates potential future drought-year shortages in the region based solely on population growth projections in Alameda, Santa Clara, and Contra Costa counties. Population growth in the region corroborates the trend of increasing shortages shown in the previous table, and indicates that shortages are likely to continue to increase beyond 2020 if new supplies are not developed. Please note that water agency service areas and county boundaries in the study area differ; because the values in **Figure IV-1** are based on total

estimated county population growth (rather than projected demand in each water district), these values differ from the values in **Table IV-2**. However, **Figure IV-1** is included to further illustrate the trend toward increasing water shortages beyond 2020.

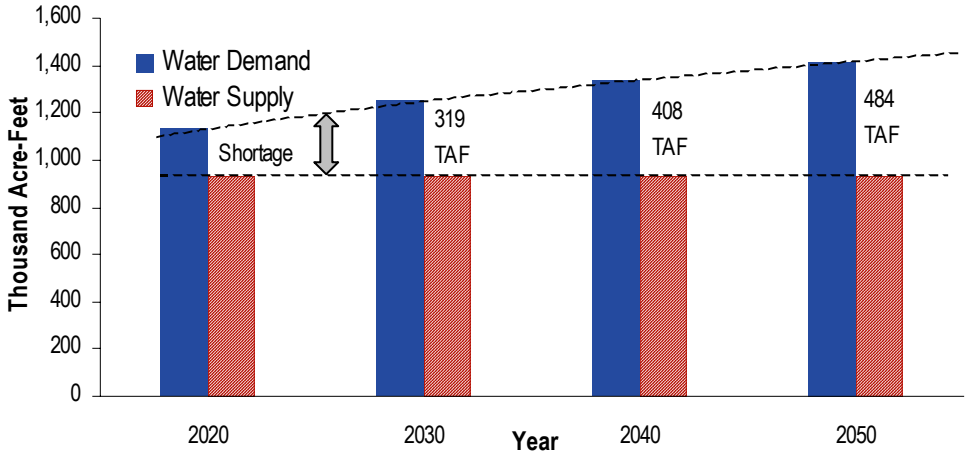


FIGURE IV-1 - PROJECTED DRY YEAR WATER SUPPLY SHORTAGES BEYOND 2020 BASED ON COUNTY POPULATION GROWTH IN ALAMEDA, SANTA CLARA, AND CONTRA COSTA COUNTIES

During recent droughts, Bay Area water agencies have experienced substantial cutbacks in water supply. Aggressive conservation programs, storage in local reservoirs and groundwater basins, and water transfers have helped these agencies manage water supplies and minimize the severity of rationing for their customers during dry years. Local water management plans also have been developed to guide how Bay Area water agencies will meet future water demands through 2020. However, as demands both within and outside the study area increase, shortages in dry and critically dry years will increase, and may even occur during average years. Further, competition for the State's finite water supplies in the midst of future shortages will also affect the ability of Bay Area water providers to acquire water on the open market to supplement their local and contract supplies. *An increasing need remains to improve dry-year water supply reliability for Bay Area providers and the State as a whole, particularly into the future beyond 2020.*

Water Quality

Although State water quality standards have been maintained, the quality of water supplies in the study area has generally declined over the past century due to saline intrusion resulting from water resources development; polluted runoff from urban, agricultural, and other development; and changes to the physical environment. Because Bay Area water agencies typically blend water from various sources to attain a desired quality, water quality in the study area is a function of both water source and volume. Providers in the study area use imported supplies from the Delta and local groundwater and surface water supplies. The ratio of local to imported supplies in any given year, and effectiveness of blending, depends upon CVP and SWP allocations, the quality of supplies drawn from the Delta, and the availability of local supplies.

Delta supplies, which provide a significant portion of the region's water, are subject to considerable seasonal and geographic variations in water quality due to hydrology, the Delta inflow/outflow ratio, water temperature, seawater intrusion, and numerous other factors. Seasonally high salinity, bromide, and organic carbon concentrations found in water delivered to the Bay Area, particularly in the late summer and fall, can increase the cost of treatment, cause water to taste bad, and reduce the life of household appliances. High levels of bromide can also react with disinfectants used in conventional treatment processes to produce harmful by-products that pose a human health hazard. Imported water of poor quality also reduces the effectiveness of blending and limits the beneficial uses of the water for groundwater recharge and other purposes. Agencies without the ability to accept and store Delta water deliveries in excess of their immediate needs can not take advantage of periods of higher water quality in the Delta; they must take deliveries coincident with demands, regardless of quality.

While local water supplies do not experience the wide seasonal variation in quality of Delta supplies, seawater intrusion into groundwater basins and urban and rural pollutants can be problematic. Local supplies are relied on heavily during dry and critically dry years when both the quantity and quality of Delta project supplies are reduced. Furthermore, water imported from the Delta represents a key resource for local groundwater recharge and management programs.

Various projects and programs have been implemented to improve the quality of Bay Area water supplies. Delta water quality is monitored and regulated, groundwater is managed more effectively, treatment plants have been constructed, and projects such as the Los Vaqueros Project, which provides access to higher quality winter water, have been implemented. However, seasonal degradation of Delta water quality will likely continue into the future as rising demands for water in the Central Valley exert pressure on the Delta system. As substitute supplies become less available, it will become more difficult and costly for Bay Area water agencies to provide high quality water in the future. Accordingly, *the desire to improve the quality of water deliveries to M&I customers in the Bay Area will increase*.

RELATED OPPORTUNITIES

The Delta is the largest estuary on the West Coast and provides essential habitat for a diverse array of fish and wildlife. A variety of factors have contributed to the decline of fish species in the Delta, including loss of habitat and water resources development, resulting in the listing of these species as threatened or endangered. Because the Delta is unlikely to return to known historic conditions, Delta fisheries recovery will depend on continued legal mandates and operational mechanisms to ensure success in the face of continually changing conditions. Several programs and practices to address Delta fisheries have been developed in response to ESA listings, the CVPIA, and other regulatory requirements. Legislation and water rights decisions, which include CVPIA (b)(2), SWQCB D-1641, VAMP, and EWA, allow project managers to meet and/or exceed regulatory requirements contained in the biological opinions.

Water deliveries from the Delta have been curtailed in recent years to help protect threatened and endangered fish populations and their habitats. However, while pumping curtailments and other actions in the Delta have been beneficial to fish, they often have had adverse impacts on cities, farms, and businesses that depend on water supplies pumped from or through the Delta.

Consequently, the EWA was developed to provide water project operators with additional flexibility in meeting or exceeding fishery requirements in the Delta.

It is expected that, under without-project future conditions, CVP and SWP pumping at Banks and Tracy will increase to meet south-of-Delta demands, resulting in greater impacts to Delta fisheries and the potential for more frequent pumping curtailments. Consequently, it is also likely that the EWA or a similar program will continue to operate in the future to preserve important at-risk Delta fish resources, and to do so without adverse major curtailments of supplies to south-of-Delta and Bay Area urban and agricultural water users. Currently, the EWA relies primarily on water acquisitions and transfers to obtain targeted supplies. However, a great deal of uncertainty is associated with the future of the California water market in the face of ever-growing demands in the state. As discussed in **Chapter IX**, it is expected that major increases will occur in demands for urban and related water supplies in the future. These increases will result in extensive competition for limited supplies. Without developing new water sources, these supplies will need to be rediverted primarily from agricultural uses. It is believed that this, in turn, will drive up the cost of water on the open market available for the program. In addition, for an acquisitions-based program such as the EWA, the increasing cost of water likely will be compounded by future budget constraints.

Accordingly, *an opportunity exists to evaluate whether an expanded Los Vaqueros Reservoir, as part of a regional water resources project, could provide a less-costly and more reliable source of replacement water to the EWA or a similar long-term program.* In addition to the potential to provide a less-costly water supply, an expanded Los Vaqueros Reservoir could provide dedicated storage and conveyance capacity for EWA supplies, rather than relying on surplus storage space in reservoirs such as San Luis Reservoir (first to spill EWA supplies), or surplus pumping capacity at Banks and Tracy pumping plants to move EWA water south of the Delta. An expansion project could also provide the opportunity for the EWA to divert Delta supplies from new and more efficient screened intakes, further reducing impacts to Delta fisheries.

CHAPTER V
PLAN FORMULATION APPROACH

This chapter discusses the process followed for formulating plans for the LVE, and presents the planning objectives, planning constraints and criteria, and mission statement for the study.

PLAN FORMULATION PROCESS

The basic plan formulation process for Federal water resources studies and projects consists of the following steps:

- Specify water resources and related problems and opportunities.
- Inventory existing conditions and forecast likely without-project future conditions in the study area.
- Identify resource management measures and formulate alternative plans.
- Evaluate effects of alternative plans.
- Compare alternative plans.
- Select a plan for recommended implementation.

For the LVE, the above process was separated into three major phases:

- **Initial Plans Phase –** Identify without-project future conditions, define resulting resource problems and opportunities; define a specific set of planning objectives; identify the constraints and criteria in addressing the planning objectives; identify potential resource management measures to address planning objectives; and formulate, coordinate, and compare a set of concept plans. From these concept plans, identify a set of initial alternatives.

- **Alternative Plans Phase –** From the initial alternatives, formulate specific alternative plans to address the planning objectives; evaluate, coordinate, and compare the plans; and identify a plan for tentative recommendation.

- **Recommended Plan Phase –** Complete the development of a tentatively recommended plan and prepare, coordinate, and process supporting decision documentation.

Figure V-1 shows the relationship of the three phases, major elements within each phase, and the resulting product (report) for each phase.

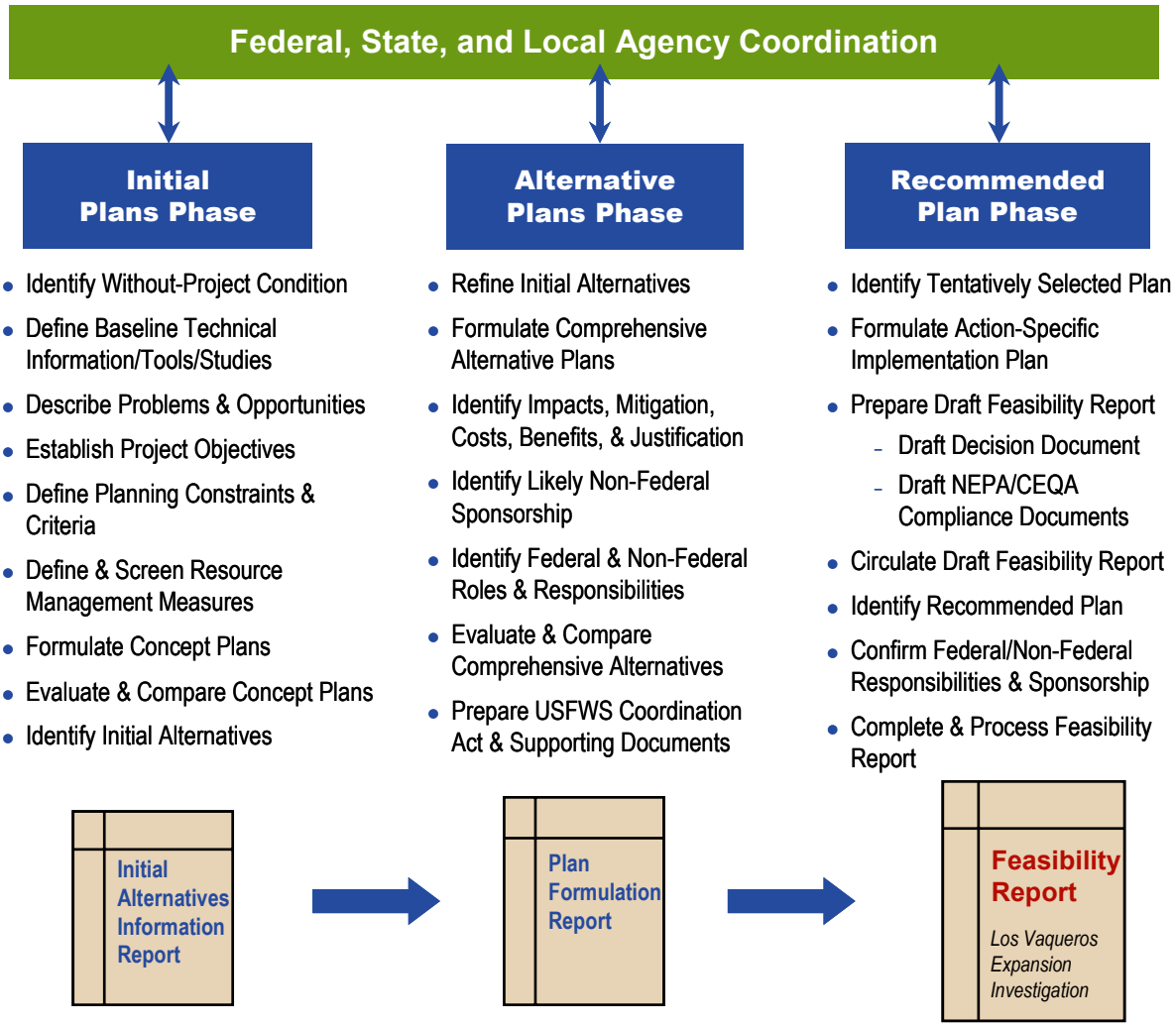


FIGURE V-1 – PLAN FORMULATION PROCESS

The Initial Plans phase, documented herein, is nearing completion. A summary of existing and potential future without-project conditions (consistent with the NEPA Baseline) and problems and opportunities is included in **Chapters III** and **IV**, respectively. This chapter presents the identified planning objectives, principles, constraints, and criteria to help guide the LVE. **Chapters VI**, **VII**, and **VIII** describe the formulation of a set of initial plans. **Chapter VI** identifies resource management measures. From these measures, a representative set of concept plans was formulated, which is discussed in **Chapter VII**. **Chapter VIII** compares the concept plans and identifies initial alternatives for further development in feasibility studies for the LVE.

PLANNING OBJECTIVES

The following objectives were developed on the basis of the previously identified and defined problems and opportunities in the study area, specific direction in the study authorization, and requirements in the P&G and other Reclamation guidance. These objectives were used as a basis for identifying and screening measures and formulating concept plans to address the identified problems and opportunities.

- *Increase water supply reliability for water providers within the study area, principally to help meet municipal and industrial water demands during drought periods, with a focus on enlarging Los Vaqueros Reservoir.*
- *Use an expanded Los Vaqueros Reservoir to develop replacement water supplies for the long-term Environmental Water Account, if the cost of water provided from an expanded reservoir is found to be less than the cost of water for continued implementation of that program.*
- *To the extent possible through pursuit of the water supply reliability and environmental water objectives, improve the quality of water deliveries to municipal and industrial customers in the study area.*

The planning objectives help clarify the identified problems and opportunities and narrow the focus of future study efforts. For example, the first study objective clarifies the need to improve water supply reliability in the primary study area (Bay Area) during drought periods. Drought periods are when water supplies for urban uses are needed most, rather than in average or wet periods when supplies are in greater abundance. The objective also stresses that enlarging Los Vaqueros Reservoir is an important study focus, although it does not limit which alternatives should be considered to solve potential problems.

The second planning objective focuses the study on determining whether an expansion of Los Vaqueros Reservoir could provide a less-costly water supply for the EWA; such a supply would replace all or a portion of the water the EWA currently acquires through short-term transfers and/or transfer market water purchases. It is important to distinguish the difference between identifying a less-costly replacement supply versus a least-cost replacement supply. The LVE will not be evaluating all of the potential ways the EWA could acquire water or determine the least-costly alternative supply; instead, the LVE will focus on how an expanded Los Vaqueros Reservoir could be implemented to provide replacement water supplies for the EWA, and whether those supplies would cost less than under the existing acquisitions-based program. An important without-project condition in the analysis is that the EWA, or a similar water acquisition program, will continue into the long-term future (beyond the currently authorized program), and the study will examine a 100-year project life (generally considered the useful life of a dam and reservoir).

The last objective highlights the opportunity to improve delivered water quality while addressing the objectives of water supply reliability and EWA replacement supply. This objective does not focus on identifying ways to improve delivered water quality independent of the first two objectives; instead, alternatives to address the first two study objectives would be refined, modified, and/or enhanced, as appropriate, to improve the quality of delivered water supplies.

PLANNING CONSTRAINTS, PRINCIPLES, AND CRITERIA

This section describes planning constraints, principles, and criteria used to help guide the investigation. In particular, attention is paid to the CCWD Board of Director's Resolution No. 03-24, June 25, 2003, and the language of Measure N, approved by the CCWD voters in March 2004. These considerations provide important guidance for the ultimate identification and formulation of a locally preferred plan, to the extent that a recommended plan involves modification of Los Vaqueros Reservoir.

Constraints

Fundamental to the plan formulation process is identifying and developing basic constraints specific to this investigation. Planning constraints, along with the objectives, are used to help guide the conduct of the feasibility study. Some planning constraints are rigid, such as congressional instruction; current applicable laws, regulations, and policies; and physical conditions (topography, hydrology, etc.). Other planning constraints are less stringent but are still influential in guiding the feasibility study. Examples include existing water resource projects and programs such as CALFED and the CVPIA. Major constraints in formulating and ultimately implementing a plan to address LVE study objectives are described below:

- **Study Authorization** – The Omnibus Appropriations Act of 2003 authorized the Secretary of Interior, in carrying out CALFED-related activities, to undertake feasibility studies for enlarging Los Vaqueros Reservoir. Congress again authorized the Secretary to conduct planning and feasibility studies for enlarging Los Vaqueros Reservoir in the October 2004 Water Supply, Reliability, and Environmental Improvement Act (Public Law 108-361).

- **Laws, Regulations, and Policies** – Numerous laws, regulations, executive orders, and policies need to be considered, including NEPA, Fish and Wildlife Coordination Act, Clean Air Act, Clean Water Act, Federal and State ESAs, CEQA, and the CVPIA.

Other considerations in the planning process include the CALFED ROD and the CCWD Board of Director's Principles, as discussed below.

The ROD includes program goals, objectives, and projects primarily to benefit the Bay-Delta system. The multiagency adoption of the ROD recognized that by signing the ROD, each agency would exercise its respective authority over only those portions of the ROD relevant to its existing Federal or State authority. While signatories may individually support programs and planning consistent with their specific authorities, it is believed that all projects, especially those directly affecting the Bay-Delta system, should be in harmony with the ROD and the Preferred Program Alternative it supports.

The CCWD Board of Directors Principles, and voter approval, represent a significant institutional agreement between one of the non-Federal sponsors and its constituents. (these principles and voter approval are described in **Chapter II)**. For maximum influence on the planning process, it is important to consider these principles and voter approval where they will have the greatest effect. This has been achieved by (1) identifying planning objectives to improve water quality and reliability for CCWD and other study area water purveyors, and (2)

identifying planning principles (presented in the next section) to protect historical resources and preserve and increase recreational and environmental opportunities associated with Los Vaqueros Reservoir. CCWD's principles related to Los Vaqueros ownership, project operation, and financial involvement are issues of potential local acceptability (see criteria discussion below and in **Chapter VIII**).

Planning Principles

In addition to the planning constraints, a series of planning principles was identified to help guide plan formulation and evaluation and help assess which alternatives best address the planning objectives. Planning principles and guidelines relate to economic justification, environmental compliance, technical standards, and other issues. Many of the planning principles result from the Federal Economic and Environmental Principles and Guidelines for water and Related Land Resources Implementation Studies, or "P&G," and other Federal planning regulations. Others result from local policies, practices, and conditions. Planning principles used throughout the LVE in formulating, evaluating, and comparing concept plans, initial alternatives, and later, detailed alternatives, include the following:

- Alternatives and their major elements should be consistent with the identified planning constraints above.

- A direct and significant geographical, operational, and physical dependency should exist between major components of alternatives.

- Alternatives should address at least one of the identified planning objectives, but preferably all of the objectives.

- Measures to address the objectives should be either directly or indirectly related to one another (i.e., plan features should not be independent increments).

- Alternatives should avoid potential adverse impacts to hydrologic and/or hydraulic systems such as water supply pumping and conveyance facilities, flood control works, or other significant water resources related impacts in the primary study area.

- Alternatives should consider and avoid impacting CVP and SWP programs and projects outside the primary study area.

- Alternatives should either avoid potential adverse impacts to environmental resources or include features to mitigate unavoidable impacts through enhanced designs, construction methods, and/or facilities operations.

- Alternatives should avoid potential adverse impacts to present or historical cultural resources or include features to mitigate unavoidable impacts.

- Alternatives should not result in a significant adverse impact to existing or future water supplies, recreation facilities, hydropower generation, and related water resource conditions.

- Alternatives should reflect the purposes, operations, and limitations of existing and without-project future projects and programs.

- Alternatives should avoid adverse impacts to and, to the extent possible, improve recreational opportunities at the existing Los Vaqueros Project.

- Alternatives involving a new dam or modification of an existing dam and reservoir should be formulated and evaluated based on a 100-year period of analysis.

- First costs for alternatives should reflect current prices and price levels, and present worth costs are to use the current Federal discount rate and an allowance for interest during construction, operation and maintenance, and major replacements.

- Alternatives should have a high certainty of achieving the intended benefits and not significantly depend on long-term actions (past the initial construction period) for success.

- Alternatives should be formulated to neither preclude nor enhance development and implementation of other elements of CALFED or other water resources programs and projects in the Central Valley.

Criteria and Concept Plan Evaluation

Alternatives in a Federal feasibility study are initially evaluated according to four criteria based on the Federal P&G for water resources: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability. Alternatives will be evaluated on their relative ability to meet each of the criteria as described and explained below (see also **Chapter VIII**).

- **Completeness -** Completeness is a determination of the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. Each alternative is given a completeness ranking ranging from low to high, primarily depending on the degree of uncertainty (or reliability) of achieving the intended objectives and adequately mitigating significant adverse impacts.

- **Effectiveness -** Effectiveness is the extent to which an alternative plan alleviates problems and achieves its objectives. For example, in the case of water supply reliability or water quality objectives, effectiveness may be considered in terms of a measured increase in water supply or the ability to achieve a specific water quality goal, respectively.

- **Efficiency -** Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating specified problems and realizing specified opportunities, consistent with protecting the Nation's environment. Some potential ways to evaluate efficiency include comparing dollars per unit of economic benefit, least-cost of attaining a given objective, and lower opportunity cost relative to the accomplishments of other alternatives.

- **Acceptability -** 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. Acceptability may be evaluated according to a plan's ability to be implemented within existing laws and policies; consistency with stated

project principles; or the potential for broad-spectrum acceptance or support. For the LVE, one example of acceptability to the local sponsor may include the extent to which CCWD retains control of the watershed and operation of Los Vaqueros Reservoir.

As the study progresses, specific metrics for, and methods of, both qualitatively and quantitatively comparing the completeness, effectiveness, efficiency, and acceptability of alternative plans will be developed. However, because detailed alternative plans will not be developed until the next stage of the LVE (the Plan Formulation Phase), the four criteria are applied more broadly to the concept plans identified later in this document.

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CHAPTER VI
RESOURCE MANAGEMENT MEASURES

Following development of the planning objectives, constraints, conditions, and criteria for the Los Vaqueros Expansion Investigation (LVE), the next major step in formulating initial alternatives is to identify and evaluate potential resource management measures. A resource management measure is any structural or non-structural action that could address one or more of the planning objectives. This chapter provides a general description of the measures considered and reasons for either retaining or eliminating measures from further development in the LVE. The most promising resource management measures retained herein were used to formulate the initial plans described in **Chapter VII**.

MEASURE IDENTIFICATION AND SCREENING

Numerous potential resource management measures have been identified as part of previous studies, programs, and projects to address water resources and related problems and opportunities in the study area. These measures were developed and reviewed during study team meetings, field inspections, and outreach for their ability to address the planning objectives of the LVE. Because the purpose of the LVE is primarily to address problems and opportunities within the Sacramento-San Joaquin Delta (Delta) and San Francisco Bay Area (Bay Area) region, the geographic location of potential measures was limited. Therefore, whether structural (such as constructing a new pipeline) or operational (such as modifying the operation of an existing facility), all measures listed herein could be implemented within the LVE study area.

Measures are typically developed to address a specific planning objective. By combining measures, alternative plans are constructed that address all of the identified planning objectives. Because measures are not complete alternatives, the screening process for measures differs from that for alternative plans. Alternatives are evaluated according to the four standard P&G criteria for water resources (completeness, effectiveness, efficiency, and acceptability), while measures are screened based primarily on their relative ability to contribute to study goals and objectives and their consistency with study planning criteria, constraints, and principles (**Chapter V**). This includes the potential for a measure to contribute to other study objectives when part of a complete alternative plan. For example, if a measure to address a single objective could be implemented independently, and no benefit would occur in combining it with measures to address other study objectives, it would likely be dropped from further study.

Various reasons exist for retaining a measure for possible inclusion in an initial alternative plan or deleting it from further study. An important factor is the potential for a measure to directly address at least one planning objective without adversely impacting other study objectives. To directly address an LVE planning objective, measures should have a geographic, operations, or physical relationship to problems and opportunities in the LVE study area. Measures were rated on a scale of low to high based on their relative ability to address the planning objectives of the LVE. In most cases, measures that were rated as moderately or less than moderately addressing a planning objective were deleted from further consideration, while measures rating higher were

retained. Other major factors and rationale used to retain or delete a measure are included in the discussion of each resource management measure. It should be noted that measures dropped from consideration and further development as part of the LVE may be revisited at a later date. Measures that do not directly address the planning objectives may be reconsidered for inclusion in future alternative plans as mitigation elements or as part of other plan features. These elements will be identified and developed at a later time.

Measures are presented in this chapter relative to the objective they best address: measures to increase water supply reliability in the study area, measures with the potential to provide a less-costly Environmental Water Account (EWA) replacement supply, and measures to improve water quality in the study area.

MEASURES TO ADDRESS BAY AREA WATER SUPPLY RELIABILITY

Measures to address the planning objective of increasing drought-period Bay Area water supply reliability are described below and summarized in **Table VI-1**. Of the management measures identified, five were retained for possible inclusion in initial alternatives. The ensuing discussion briefly summarizes measures identified for consideration, followed by a specific description of measures retained for further study.

Measures Considered

Measures identified for this study focused on Bay Area water supply reliability are as follows.

Surface Water Storage

One very important water resources management measure to address water supply reliability in this study is surface water storage. Following is a summary of the various surface water storage options considered.

Enlarge Los Vaqueros Reservoir to Increase Conservation Storage Space - This measure includes expanding the existing conservation[1] storage space in Los Vaqueros Reservoir (**Plate 5**) by raising Los Vaqueros Dam to as high as 170 feet. Raising the dam approximately 170 feet would increase gross pool storage by 400,000 acre-feet from 100,000 acre-feet to 500,000 acre-feet, as shown in **Figure VI-1**. Because of site and foundation limitations, raises greater than 10 to 15 feet would require the construction of a new dam a short distance downstream from the existing dam. Larger dam raises also would require a new pipeline and pump station to provide up to about 430 cubic feet per second (cfs) delivery capacity from the reservoir to the South Bay Aqueduct (SBA). Some facilities associated with the existing Los Vaqueros Project would be preserved and integrated into the expanded project. For example, smaller dam raises would not require enlarging the south Delta diversion and conveyance facilities from Old River.

[1] Conservation storage space is the portion of water stored in a reservoir that can be released for useful purposes other than flood control, such as municipal water supply, power, irrigation, etc. Conservation storage is typically defined as the volume of water stored between the inactive pool elevation and the flood control stage.

TABLE VI-1
RESOURCE MANAGEMENT MEASURES TO INCREASE BAY AREA WATER SUPPLY RELIABILITY

Resource Management Measure	Potential to Address Planning Objective	Status & Considerations
Surface Water Storage		
Enlarge Los Vaqueros Reservoir to increase conservation storage space	**High –** Could provide up to 400 TAF of local storage for water supply reliability, and has potential to contribute to other LVE planning objectives	**Retained** – Specifically authorized for study and could contribute to other LVE planning objectives.
Raise Los Vaqueros Dam in place to increase conservation storage space	**Moderate –** Could provide 15 – 25 TAF of local storage for water supply reliability	**Retained –** Potentially less-costly method of providing a smaller increment of storage, and could contribute to other LVE planning objectives.
Raise Calaveras Dam to increase conservation storage space	**Low –** Could provide up to 320 TAF of local storage, but would only benefit agencies with existing SFPUC contracts (ACWD and SCVWD)	**Deleted** – Low potential to provide regional supply reliability benefits in the Bay Area.
Raise San Luis Dam to increase conservation storage space	**Low –** Could provide up to 200 TAF but would only serve one agency (SCVWD)	**Deleted** – High unit cost, low potential to contribute to increasing regional Bay Area supply reliability.
Raise Pacheco Dam to increase conservation storage space	**Low –** Could provide up to 120 TAF but would serve only one agency (SCVWD)	**Deleted** - High unit cost, low potential to contribute to increasing supply reliability in the study area, and limited potential to support other objectives.
Construct new conservation storage at Upper Del Valle Dam site	**Low –** Could capture up to 15 TAF local runoff, but effectiveness would depend on expansion of SBA by DWR	**Deleted** – Effectiveness depends on actions by others, and low potential to provide regional benefits and high unit cost compared with other measures.
Construct other local area storage facilities considered in lieu of the original Los Vaqueros Project	**Moderate –** Various sites could provide small to moderate increase in local storage	**Deleted -** Major site acquisition issues, high likelihood of local opposition, and high unit cost.
Construct new conservation storage in Sacramento/San Joaquin rivers watersheds	**Low –** Various sites could provide small to moderate storage outside the study area	**Deleted –** Low potential to address LVE planning objectives, most promising evaluated by ongoing CALFED studies.
Construct new conservation storage in the Sacramento/San Joaquin Delta	**Low –** Uncertainty regarding ability to provide water supply reliability benefits to the study area	**Deleted** – Low potential to address LVE planning objectives, most promising evaluated by ongoing CALFED studies.
Reservoir/System Reoperation		
Increase effective conservation storage space in existing Lake Del Valle Reservoir	**Low –** Small potential to provide water supply reliability benefits to study area without affecting other reservoir functions	**Deleted** - Low potential to provide regional supply reliability benefits and high unit cost compared with other measures.

Resource Management Measure	Potential to Address Planning Objective	Status & Considerations
Improve Delta export and conveyance capability through coordinated CVP and SWP operations	**Low –** Limited potential for additional reoperation benefits beyond current plans	**Deleted** – JPOD and other system efficiency improvement measures are being actively pursued in other programs. A likely without-project condition.
Groundwater Storage		
Develop additional groundwater banking in San Joaquin River Watershed	**Low –** Existing banks have sufficient capacity to store unused contract supplies; uncertainty regarding ability to secure additional supplies for banking and withdrawal limitations	**Deleted** – Existing Bay Area programs sufficient to store unused contract water, and limited available capacity in current and planned banks.
Develop additional groundwater banking in Sacramento River Watershed	**Low –** Significant physical limitations to banking in Sacramento River watersheds	**Deleted** – Low likelihood of developing a reliable conjunctive use program for Bay Area supplies in the Sacramento River basin due to significant physical, groundwater, and other related problems.
Conveyance/System Modifications		
Increase Delta diversion capacity to Bay Area water user facilities	**Moderate –** Increased export capacity could provide water supply reliability benefits, particularly in combination with storage	**Retained** – Additional Delta diversion capacity with enlarged capacity at existing site and/or new central Delta diversion likely to be effective when used in combination with reoperation and/or new storage.
Construct intertie from SFPUC to SBA	**Low –** Uncertainty regarding availability of Hetch Hetchy supplies and ability to provide regional benefits	**Deleted** – Low potential to contribute to overall supply reliability conditions in study area, can be independently implemented, and has limited contribution to other LVE planning objectives.
Expanded use of Freeport Regional Water Project	**Low –** Little potential to improve supply reliability because benefits would be limited to surplus project capacity during wet periods	**Deleted** – Very high capital and unit costs, and benefits would be limited to a single agency.
Increase Banks Pumping Plant capacity to greater than 8,500 cfs	**Low –** Limited potential to benefit supply reliability in study area due to physical and regulatory constraints on increased exports	**Deleted** – Limited potential for increased supply reliability in the study area, and limited potential to contribute to other LVE planning objectives.
Construct intertie from Los Vaqueros Reservoir to SBA at Dyer Canal Back Surge Pool	**Moderate –** Could provide supply reliability benefits to SBA agencies with reoperation or expansion of Los Vaqueros	**Retained** – Constructing a pump station and pipeline from Los Vaqueros Reservoir to the SBA would be an important component of any reservoir expansion action.
Construct intertie from Los Vaqueros Reservoir to SBA at Bethany Reservoir	**Low –** Although this measure could provide supply reliability benefits to SBA agencies similar to the Dyer Canal intertie, it would be much more costly due to increased pumping from Bethany Reservoir	**Deleted** – An SBA intertie at Bethany Reservoir was deleted as a measure for water supply reliability due to estimated high O&M costs. However, it was **retained** as a measure for plans focused on developing EWA replacement supplies.

Resource Management Measure	Potential to Address Planning Objective	Status & Considerations
Source Water Treatment Improvement		
Implement treatment/supply of agricultural drainage water	**Low –** Uncertain ability to treat agricultural runoff to a quality standard acceptable to the public	**Deleted** – Very costly, low certainty of success, and likely low acceptability to stakeholders and general public.
Construct desalination facility	**Moderate –** Potential to provide base water supply, but would require storage to provide dry year supply reliability benefits	**Retained** – Limited application as a dry-year supply, high unit cost, and potential environmental impacts from treatment byproducts, but potential to provide benefits in combination with storage.
Demineralize poor quality groundwater	**Low –** Limited groundwater resources in study area suitable for additional development; highly localized benefits	**Deleted** – High implementation costs, limited application and benefits, and potential for adverse impacts to groundwater resources.
Water Use Efficiency		
Implement additional wastewater reclamation	**Low –** Could provide localized supply reliability benefits, limited by acceptable uses of recycled water	**Deleted –** Measure being actively pursued by other CALFED Programs. Most effective elements are likely without-project condition.
Implement additional demand management facilities	**Low –** Low potential to significantly address dry year supply reliability over and above existing / planned conservation programs	**Deleted –** Does not effectively address LVE planning objectives and constraints/criteria. Features being actively pursued by other CALFED Programs. Most effective elements are likely without-project condition.
Water Transfers and Purchases		
Implement water transfers within the study area	**Low –** Highly unlikely that surplus supplies would be available in the study area during dry years	**Deleted –** Low potential to effectively address drought period water reliability through transfers within the study area because region is water-deficient (no surplus supplies available).
Increase water transfers outside the study area	**Low** – High uncertainty regarding the availability, cost, and reliability of water transfers from outside the study area in the future	**Deleted** - Does not effectively address LVE planning objectives and constraints/criteria. High uncertainty of future cost-effectiveness and will likely be implemented with or without development of new water sources.
Retire agricultural lands	**Moderate –** Uncertainty regarding ability to re-direct agricultural supplies to M&I uses	**Deleted –** Does not effectively address LVE planning objectives consistent with criteria/constraints.

KEY:
ACWD = Alameda County Water District
CALFED = CALFED Bay-Delta Program
CVP = Central Valley Project
cfs = cubic feet per second
DWR = Department of Water Resources
EWA = Environmental Water Account
JPOD = Joint Point of Diversion
LVE = Los Vaqueros Expansion Investigation
M&I = municipal and industrial
O&M = operation and maintenance
SFPUC= San Francisco Public Utilities Commission
SCVWD = Santa Clara Valley Water District
SBA = South Bay Aqueduct
SWP = State Water Project
TAF= thousand acre-feet

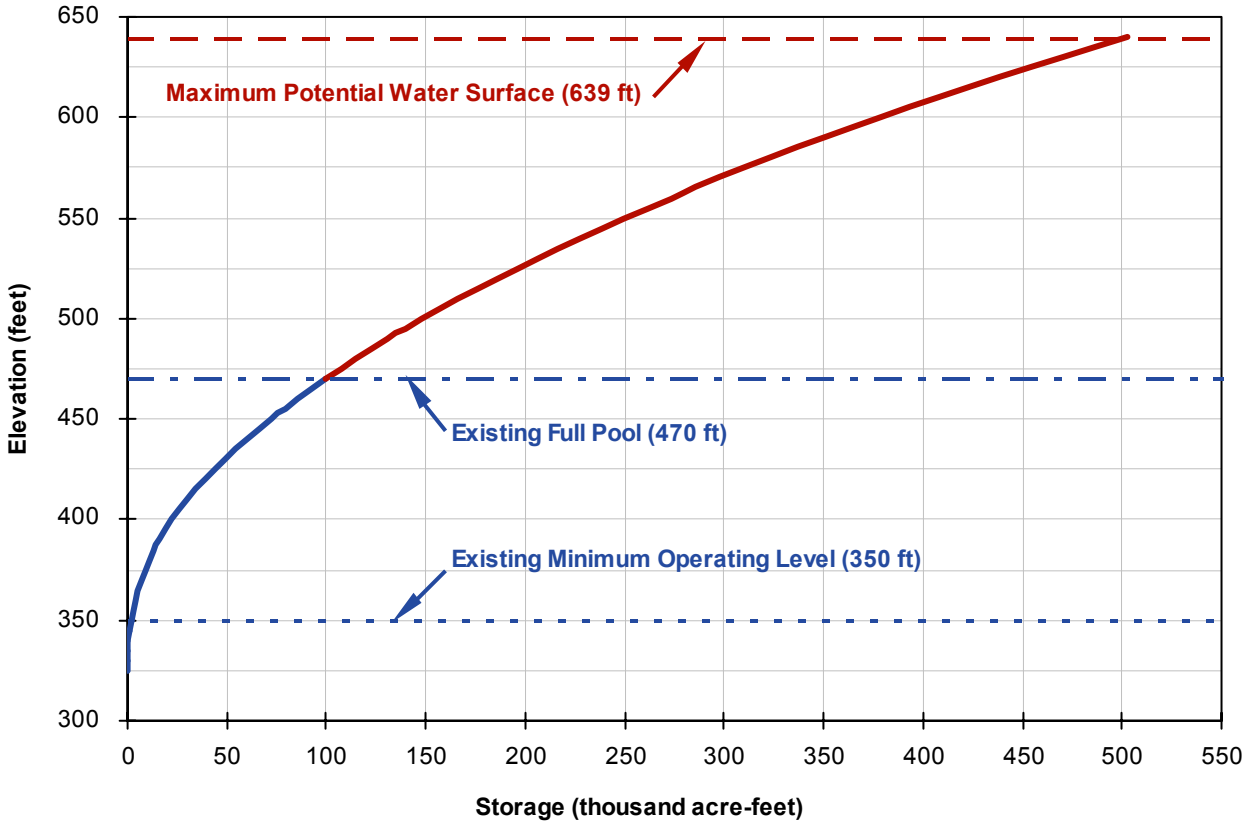


FIGURE VI-1 – POTENTIAL CAPACITY OF ENLARGED LOS VAQUEROS RESERVOIR

Larger dam raise sizes could result in a significant contribution to each of the planning objectives. Further, this measure was specifically identified in Federal authorization for the LVE. Therefore, larger dam raise sizes were retained as a measure for further development.

Raise Los Vaqueros Dam in Place to Increase Conservation Storage Space - This measure includes expanding the existing conservation water storage in Los Vaqueros Reservoir (**Plate 5**) by raising Los Vaqueros Dam in-place by 10 to 15 feet. A 10- to15-foot dam raise would result in an increase in gross pool storage of about 15,000 to 25,000 acre-feet. Because of site and foundation limitations, this represents the maximum raise that could be accomplished without moving the existing dam. Similar to the previous measure, it also would require a new pipeline and pump station to provide up to 430 cfs delivery capacity from the reservoir to the SBA. Most facilities associated with the existing Los Vaqueros Project would be preserved and integrated into the expanded project. Therefore, this measure was retained for further development.

Raise Calaveras Dam to Increase Conservation Storage Space - This measure includes expanding the conservation storage space of Calaveras Reservoir from 96,850 acre-feet to as much as 420,000 acre-feet (about a 323,000 acre-foot increase). The existing Calaveras Dam was built in 1925 in Alameda and Santa Clara counties. Calaveras Dam and Reservoir are located approximately 6 miles northwest of Milpitas in the Alameda Creek Watershed (see **Plate 4**). Calaveras Dam impounds water from Calaveras and Alameda creeks in the Sunol

Valley. Expansion of Calaveras Reservoir would require the construction of a new dam, either at the existing dam site or downstream. Other new facilities would include a pump station and conveyance facilities to store excess Hetch Hetchy water or other sources of supply in an expanded Calaveras reservoir, primarily in wet years. The expansion would provide increased dry year reliability to agencies served by the San Francisco Public Utilities Commission (SFPUC), which includes ACWD and common customers served by SFPUC, and Santa Clara Valley Water District (SCVWD). It also could contribute to improvements in water quality conditions for ACWD and SCVWD during years when Hetch Hetchy deliveries otherwise would have been reduced. An expanded Calaveras could also provide a water quality benefit in average years by transferring Calaveras water into the South Bay Aqueduct. Under this scenario, an intertie with the SBA would be required. Any adverse impacts from an expanded Calaveras, particularly on Alameda Creek, would need to be mitigated through project development and operations. Because expansion of Calaveras Reservoir would provide only incremental reliability improvements to those agencies with existing SFPUC contracts, and because major mitigation elements likely would be required, it is believed that an expanded Calaveras Reservoir would not be a viable alternative to an expanded Los Vaqueros Reservoir. Accordingly, this measure was deleted from further consideration in the LVE.

Enlarge San Luis Reservoir to Increase Conservation Storage Space – This measure includes increasing the gross pool storage space in San Luis Reservoir by raising the B.F. Sisk Dam. The existing dam is a zoned earth and rockfill embankment with a maximum height of 385 feet. San Luis Reservoir has a total capacity of 2 million acre-feet (MAF). On the basis of previous studies to assess the potential of increasing storage space in San Luis Reservoir, it is estimated that raising B.F. Sisk Dam by about 15 feet would add approximately 200,000 acre-feet of additional storage. San Luis Reservoir (shown in **Plate 2**) is a joint Federal and State facility that provides seasonal storage for project water pumped from the Tracy and Banks pumping plants in the Delta. Although some carryover storage has been provided historically, water is typically pumped into the reservoir in the fall and winter, then released in the spring and summer to south-of-Delta Central Valley Project (CVP) and State Water Project (SWP) contractors. SCVWD and other contractors in the CVP San Felipe Division receive a portion of their imported water supply from San Luis Reservoir.

This measure could improve water supply reliability primarily for SCVWD and other San Felipe Division contractors, and potentially for south-of-Delta CVP and SWP contractors. It also could provide marginal water quality benefits to SCVWD. Enlarging San Luis Reservoir could provide supplies or dedicated storage space for a long-term environmental water program, as EWA supplies are often stored in San Luis Reservoir when space is available. However, it would not increase supply reliability for Contra Costa Water District (CCWD), ACWD, or Alameda County Flood Control and Water Conservation District Zone 7 (Zone 7). Two previous studies have preliminarily estimated the first and annual costs to raise B.F. Sisk Dam about 15 feet as $1.1 billion and $77 million, respectively. The estimated increase in dry period yield would be about 30,000 acre-feet, resulting in a unit cost for the increased yield of over $2,500 per acre-foot. Because of the limited benefit to increasing water supply reliability in the study area, and high unit cost, this measure would not be a viable alternative to increasing storage space in Los Vaqueros Reservoir and was deleted from further consideration.

Raise Pacheco Dam to Increase Conservation Storage Space – This measure consists of expanding the existing 6,000-acre-foot Pacheco Reservoir to about 135,000 acre-feet by constructing a new 300-foot-high dam. Pacheco Reservoir is located on the North Fork of Pacheco Creek, approximately 6 miles west of San Luis Reservoir and ½ mile north of Highway 152 (see Plate 4). The expanded reservoir would store CVP water delivered from the Delta to San Luis Reservoir and pumped to the Pacheco Reservoir. Under this measure, water from San Luis Reservoir for the San Felipe Division contractors would be pre-delivered from about November through June, stored in an expanded reservoir, and released through the Pacheco Conduit during the dryer months (July to October). Increasing storage in Pacheco Reservoir could provide supplies to SCVWD and the other CVP San Felipe Division contractors, San Benito County Water District and in the future, potentially the Pajaro Valley Water Management Agency. The measure would include a two-way pump station to be used to lift water from the Pacheco Conduit to the expanded reservoir, or the reverse when gravity flow is not possible. The measure would not provide significant water quality benefits to SCVWD and would not benefit any of the other Bay Area water agencies in the study area. This measure could provide storage for EWA replacement supplies but its effectiveness would be limited because SCVWD is the only potential recipient. On the basis of previous preliminary studies, it is estimated the first and annual costs to enlarge Pacheco Reservoir to about 135,000 acre-feet would be about $660 million and $46 million, respectively. The estimated increase in dry period yield would be about 19,000 acre-feet, resulting in a unit cost for the increased yield of over $2,000 per acre-foot. Because this measure would benefit only one agency in the study area, and would have a high unit cost for new supplies compared with Los Vaqueros Reservoir, it was deleted from further consideration.

Construct New Conservation Storage at Upper Lake Del Valle Dam Site – This measure primarily consists of constructing a 160-foot-high roller-compacted concrete dam on Arroyo Valle (upstream from the existing Lake Del Valle Reservoir) with a capacity of approximately 15,000 acre-feet (**Plate 4**). It also includes constructing new conveyance facilities between the SBA and the new reservoir. This measure could help improve water supply reliability for SCVWD, ACWD, and Zone 7 by permitting storage of additional runoff during high flow periods in the Del Valle watershed. Because the new supplies would be low in salinity, this measure also could provide water quality benefits for these agencies. Prior studies of new storage at the site have shown strong opposition by numerous local interests and East Bay Regional Parks District that operates the recreation at Del Valle. Further, this measure would be most effective if coupled with a project underway by the California State Department of Water Resources (DWR) that includes increasing the capacity of the SBA. Because the effectiveness of this measure would depend on the completion of projects by others, the potential for local opposition, the low yield and high unit cost for new supplies, this measure was deleted from further consideration in the LVE.

Construct Other Local Area Storage Concepts Considered for the Original Los Vaqueros Project – This measure consists of the potential to develop and implement other dam and reservoir projects in the study area. Initial studies for the Los Vaqueros Project during the early 1970s, and later planning and environmental studies in the 1980s and 1990s, identified and considered numerous other potential local area dam and reservoirs sites. These sites are shown in **Figure VI-2**.

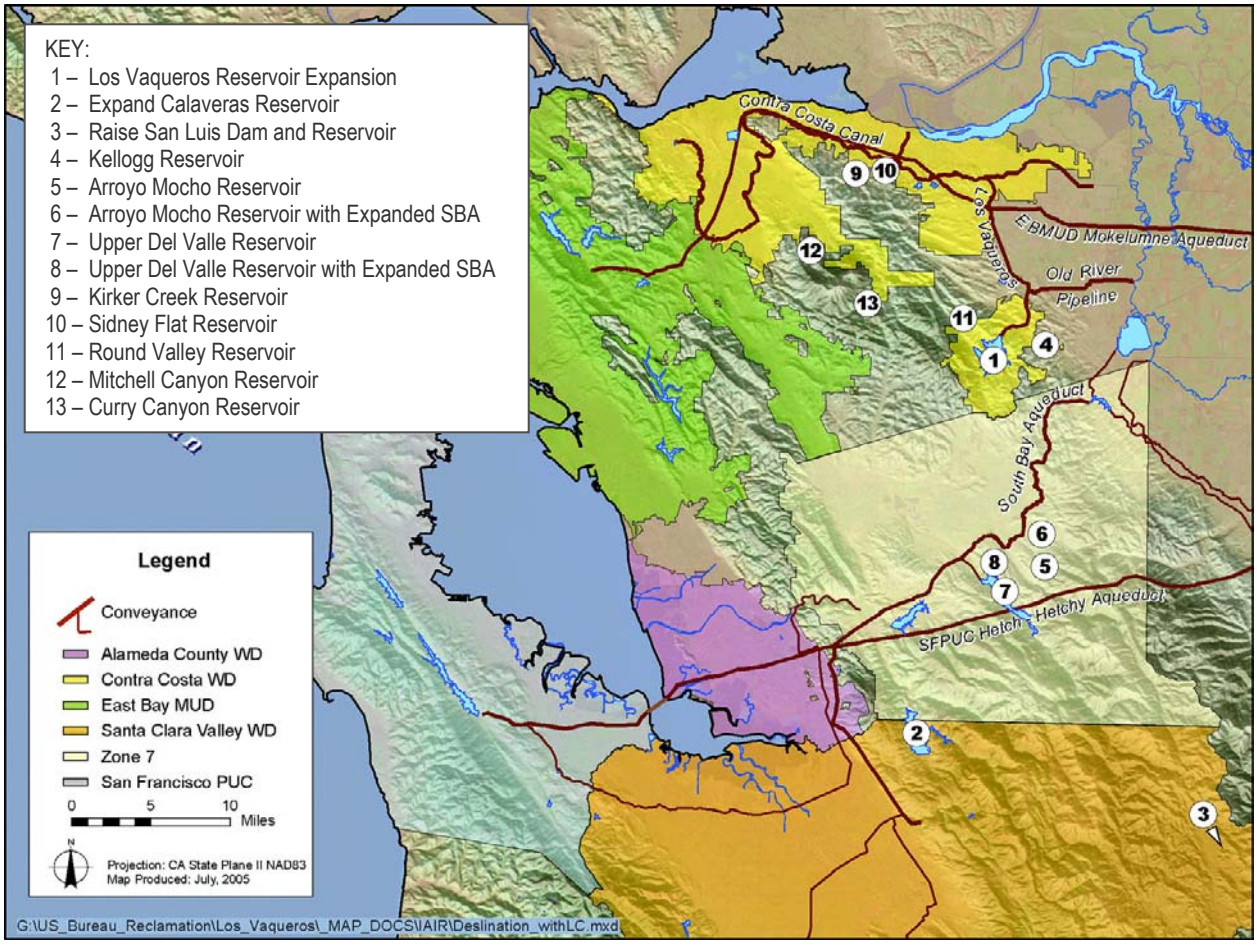


FIGURE VI-2 – LOCAL STORAGE CONCEPTS CONSIDERED FOR THE ORIGINAL LOS VAQUEROS PROJECT

Each of these new or enlarged reservoir measures would contribute, to some degree, to one or more of the study objectives. However, previous studies have shown that each would involve major land acquisition issues, possess a high likelihood for significant local opposition due to environmental and other area impacts, and result in significantly higher water costs relative to other measures. Therefore, these sites were not considered as viable alternatives to expanding Los Vaqueros Reservoir and were deleted from further consideration.

Construct New Conservation Storage in Sacramento / San Joaquin River Watersheds – Over 50 potential onstream and offstream storage projects were identified in the CALFED Bay-Delta Program's (CALFED) August 2000 *Initial Surface Water Storage Screening, Integrated Storage Investigation*, to address regional or state-wide water supply reliability issues. The general location of these storage sites is shown on **Figure VI-3**. Five of the potential storage sites were identified for further development in the CALFED Record of Decision (ROD), and seven sites were identified for further consideration but deferred from study at this time.

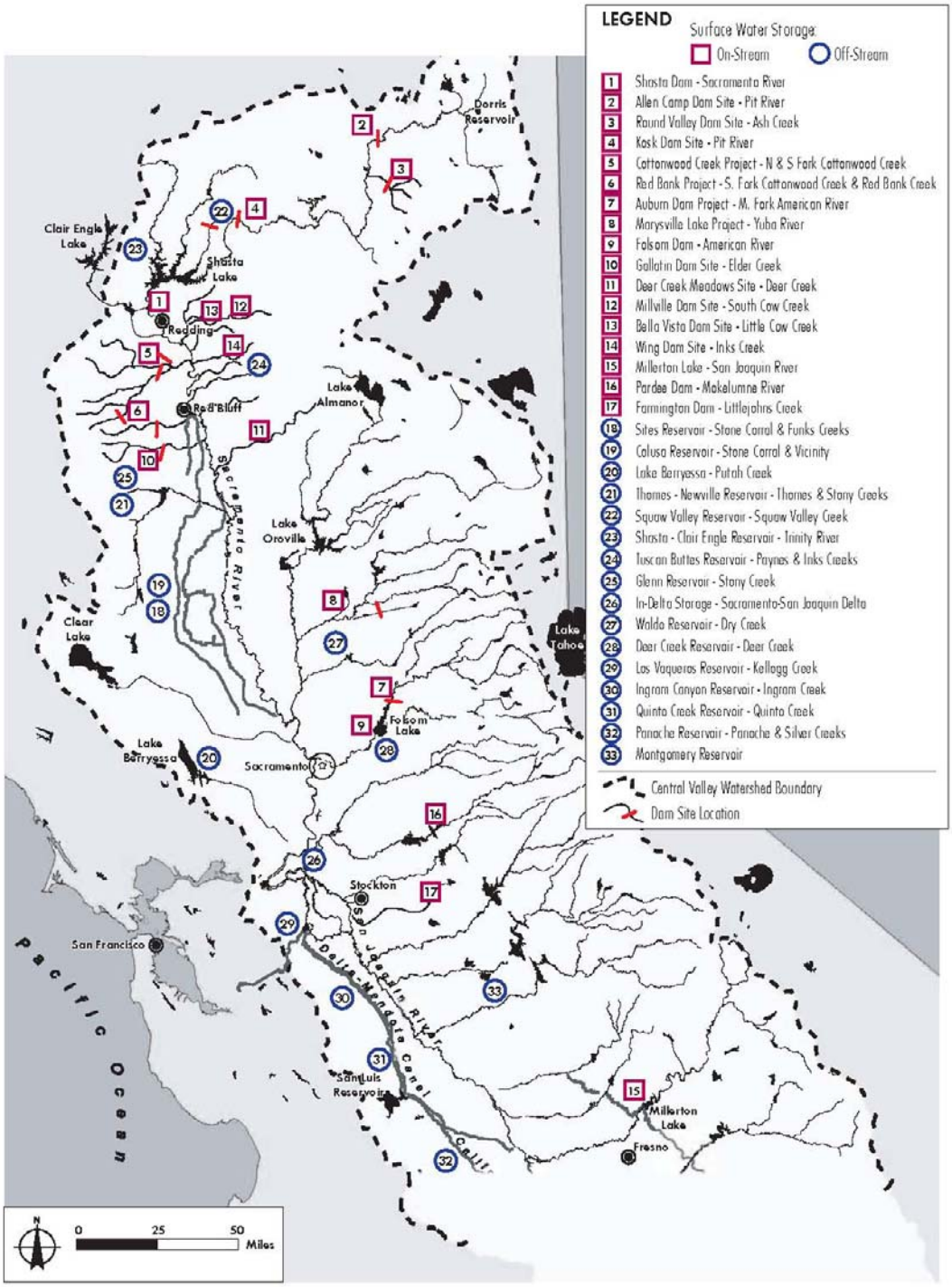


FIGURE VI-3 – INITIAL SURFACE WATER STORAGE PROJECTS IDENTIFIED BY CALFED

Feasibility studies are currently underway for each of the five potential projects: (1) Shasta Lake enlargement (Shasta Lake Water Resources Investigation), (2) In-Delta Storage (IDS), (3) Millerton Lake enlargement (Upper San Joaquin River basin Storage Investigation), (4) Sites Reservoir (North-of-Delta Offstream Storage Project), and (5) Los Vaqueros Reservoir expansion.

The remaining potential dam and reservoir sites were eliminated from further consideration primarily due to their relatively small size, potential for significant adverse environmental impacts, low potential for efficient implementation (including economic feasibility), and poor hydrologic conditions. Of the remaining sites considered in the CALFED report, none are believed to be capable of directly and significantly addressing the LVE study objectives, with the exception of a potential project to expand Los Vaqueros Dam and Reservoir, which would create opportunities for additional storage in the Delta area. Other projects are being developed to solve other regional water resource problems in separate feasibility studies, and/or lack a geographic, operations, or physical relationship to problems in the LVE study area. Accordingly, none of the sites outside the LVE study area that were considered in the CALFED ROD and supporting studies were retained for further consideration.

Construct New Conservation Storage in the Sacramento/San Joaquin Delta – This measure would convert several Delta islands into water storage facilities. IDS is one of the five projects recommended for study in the CALFED Storage Program. The IDS project would incorporate two islands (Webb Tract and Bacon Island) and two habitat islands (Holland Tract and Bouldin Island), similar to a measure previously proposed by Delta Wetlands Project. The current version of the IDS project would provide capacity to store approximately 217,000 acre-feet of water in the south Delta for water supply, water quality, and ecosystem benefits. Project operations would result in additional water deliveries to in-Delta and south of Delta urban and agricultural users, and additional system-wide carryover storage could improve the reliability of other CVP and SWP deliveries. The project also could be used to facilitate water transfers from upstream areas to areas south of the Delta. Although IDS is currently formulated to provide seasonal storage in the Delta for average annual water supply reliability benefits, the project could be formulated and operated to improve dry year reliability. Seasonal filling at high flows and release during low flows could lower salinity and provide storage to help meet spring pulse flows for fisheries. Because this measure is already under study by DWR as part of the five CALFED surface water storage projects in the ROD, and because it would provide very little increase in water supply reliability to the Bay Area, it was deleted from further consideration.

Reservoir/System Reoperation

Increase Effective Conservation Storage Space in Lake Del Valle – This measure includes reoperation of the existing Lake Del Valle Reservoir (shown in Plate 4) to increase its effective water conservation storage capacity. Reoperation options are aimed at lowering the seasonal pool maintained for recreation, reducing the prescribed flood control storage space, or revising the flood control operation. The Del Valle complex is owned by DWR and operated for water conservation as part of the SWP, but also provides flood control benefits under rules prescribed by the U.S. Army Corps of Engineers, recreation, and fish and wildlife benefits. Of the 77,000 acre-foot reservoir, 39,000 acre-feet are reserved all year for flood

control. The remaining 38,000 acre-feet are operated primarily as a pumped storage facility for supplies from the SBA for water conservation. Because the East Bay Regional Parks District is the contractor for recreation at Del Valle, they have a direct interest in the reservoir levels and can influence water levels and operations. For example, it is a current goal to avoid drawing the reservoir down below 20,000 acre-feet in the summer for recreation purposes. One reoperation scenario would be to encroach a portion of this informal recreation space to provide additional reliability storage. Another reoperation scenario would be to work with the U.S. Army Corps of Engineers to develop revised operation rules for flood control that would allow encroachment into the existing flood control storage space under certain circumstances. This measure would result in a marginal increase in storage space, primarily improving the reliability of the SBA contractors. Even with additional flood control operation changes, this measure would still provide only minimal water supply reliability benefits compared with other potential measures and would negatively impact local recreation opportunities. Consequently, it was deleted from further consideration.

Improve Delta Export and Conveyance Capability Through Integrated CVP and SWP Operations – This measure primarily consists of improving Delta export and conveyance capability through a more effective integrated management of surplus flows in the Delta. A specific application of the measure would be the joint point of diversion (JPOD). JPOD operations would allow Federal and State water managers to use excess or available capacity in their respective south Delta diversion facilities at the Tracy and Banks pumping plants. Currently, little excess capacity exists in the Federal pumps at Tracy, but some additional capacity is available in the SWP pumps at Banks. The potential added benefit to the CVP through JPOD operations during average and critically dry years would be about 61,000 and 32,000 acre-feet, respectively. The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and DWR are actively pursuing this measure, and it is highly likely that some form of the JPOD will be implemented in the future. This measure was deleted from further consideration because it would not effectively address the study objectives and is likely to be implemented, in some form, independent of the LVE.

Groundwater Storage

Develop Additional Groundwater Banking in the San Joaquin River Watershed - This measure consists of Bay Area water agencies acquiring additional interests in groundwater banking and storage opportunities in the San Joaquin basin (south of the Delta), beyond their current level of investment, to improve drought period supply reliability. Historical overdrafting of groundwater supplies in the San Joaquin River basin has created opportunities to develop groundwater banks in the area. Groundwater banking is an element of "conjunctive use", the coordinated management of surface and groundwater. It primarily consists of taking surplus surface water when it is available during wet years and "banking" it in an underground aquifer for later use, usually during drought periods. In addition to the physical banking opportunities caused by overdraft, the western San Joaquin River basin is also in close proximity to the California Aqueduct, which can significantly increase banking effectiveness by facilitating water exchanges with surface water storage facilities. The measure would build on existing groundwater storage banks in the San Joaquin Valley such as the Semitropic Groundwater Banking Project, the next increment of the Semitropic

Project, and the proposed Cawelo Groundwater Banking Project in Kern County. Semitropic Water Storage District and Cawelo Water District, both of which are members of the Kern County Water Agency, operate these banks. SCVWD, ACWD, and Zone 7 are already participants in the existing Semitropic Groundwater Banking and Exchange Program (GBEP), delivering their excess SWP supplies to storage when available. Under this measure, these water agencies would participate in an expansion of the San Joaquin Valley banking projects.

It is believed, however, that while additional groundwater banking south of the Delta could help improve reliability in the short-term, as water demands intensify in the future statewide, the ability of Bay Area water agencies to effectively participate in additional groundwater banking will decline. Additional participation by Bay Area water agencies would not be as effective as current banking programs because existing programs already are sufficient to store unused contract water. Accordingly, additional firm water supplies would be needed to increase participation. Further, the ability to swap supplies and compete for limited south-of-Delta groundwater storage space with other south-of-Delta water agencies will decline. Prices for water transfers will likely significantly increase as competition for available supplies becomes more intense, especially as the EWA and similar programs become more prolific. Competition will make it difficult for Bay area water agencies to purchase water as well as increase capacity in groundwater banks. In addition, infrastructure improvements would be required to overcome current conveyance limitations, particularly in dry years when groundwater bankers are calling on their supplies. Because of these factors, it is believed that increased groundwater banking in the San Joaquin basin would not be a viable alternative to increased storage in Los Vaqueros Reservoir and this measure was deleted from further consideration in this study.

Additional Groundwater Banking in the Sacramento River Watershed - This measure consists of participating in efforts to develop groundwater banking and storage in the Sacramento Basin (north of the Delta). Currently, Sacramento River basin water supplies are typically moved to Bay Area agencies through transfers or assignment of SWP contractual rights, rather than through groundwater banking. Unlike conditions in the San Joaquin River basin, groundwater overdrafting is limited to highly urbanized areas such as Sacramento, where agencies are actively engaged in conjunctive use programs. Other large aquifers in the Sacramento River basin do not appear to have the physical capacity needed for large-scale banking. Further, the institutional and scientific understanding of Sacramento Basin groundwater banking has not reached the same level as San Joaquin Basin groundwater banks. Consequently, no large groundwater banks currently exist north of the Delta. Because of the lack of fully developed and successful large-scale banking programs in the Sacramento River basin, this measure was deleted from further consideration.

Conveyance/System Modifications

Increase Delta Diversion Capacity to Bay Area Water User Facilities - This measure consists of enlarging the diversion capacity from the Delta to Bay Area water user facilities. Examples include enlarging the size of existing pumping and conveyance facilities at Old River; developing new pumping capacity at another central Delta location; or increasing the capacity of pumping to the CCWD service area or Los Vaqueros Reservoir. Other examples

include enlarging the size of these facilities and pumping directly to the SBA. However, the delivery of excess Delta flows would be limited to high-demand periods because SBA agencies lack the storage facilities necessary to carry over water for later use. Consequently, this measure by itself would not be effective in increasing water supply reliability to the study area. However, when in combination with enlarged storage in Los Vaqueros Reservoir or elsewhere in the Bay Area, this measure would allow increased volumes of water to be delivered to these facilities during periods of excess Delta outflows. Accordingly, this measure was retained for further consideration when used in combination with new storage.

Construct Intertie from SFPUC to SBA - This measure consists of connecting the SFPUC Hetch Hetchy Aqueduct or Alameda Creek watershed supply (see **Plate 4**) to the SBA to improve water supply reliability primarily for the SFPUC service area. An emergency intertie exists from the SBA to Hetch Hetchy facilities within the Sunol Valley in Alameda County, and there are several possibilities for additional connections between the two systems. This measure primarily focuses on only one entity in the study area, is physically removed from other potential actions to address study objectives, and could be implemented independently by SFPUC and DWR. Consequently, it was deleted from further consideration.

Expanded Use of Freeport Regional Water Project – This measure would expand the planned Freeport Regional Water Project (FRWP) to deliver water to Zone 7 in addition to East Bay Municipal Utility District (EBMUD). The FRWP, as described in the final Environmental Impact Statement (EIR), includes a 185 million gallon per day (mgd) turnout on the Sacramento River, and 100 mgd conveyance capacity to EBMUD's Mokelumne Aqueduct. The expanded project would primarily include constructing an increased increment to the FRWP, obtaining rights/permits for a changed point of diversion from the SWP, and constructing new conveyance facilities. The project would be limited to increasing average and wet period water supplies to Zone 7. The cost of an added increment to the Freeport Regional Water Authority (FRWA) facilities, including construction of expanded facilities, intertie facilities, and for use of FRWA facilities, is estimated to be significantly greater than for other Delta diversion opportunities. Another option would be to use an intertie between the Mokelumne Aqueduct and CCWD's Los Vaqueros Pipeline to also deliver water supplies to CCWD. Under either scenario, however, limited capacity in the Mokelumne Aqueduct would significantly limit the potential to deliver dry-period supplies to the Bay Area in excess of EBMUD demands. Further, this measure would only benefit single agencies (either Zone 7 or CCWD) and provides little improvement in dry-period supply reliability. Because of the relatively high cost, limited potential to increase drought period supplies, and various institutional issues making this measure difficult to implement, this measure was deleted from further consideration.

Expand Banks Pumping Plant Capacity (greater than 8,500 cfs) – The current allowable pumping capacity at the SWP Banks Pumping Plant is 6,680 cfs. Efforts are underway by Reclamation and DWR to construct fish protection features under the South Delta Improvements Program (SDIP) to allow increasing the allowable pumping capacity to 8,500 cfs during certain seasonal periods. The maximum installed pumping capacity at Banks is about 10,300 cfs. This measure primarily includes implementing additional physical features and operational improvements aimed at benefiting the overall water quality of the Delta to

further increase the allowable pumping capacity at Banks from 8,500 cfs to 10,300 cfs during certain seasonal periods. This increased capacity would allow more water that otherwise would flow to the Pacific Ocean to be conveyed south of the Delta. Potential benefits include the potential to refill San Luis Reservoir more quickly and increased ability to move EWA water south of the Delta. This could improve water deliveries to the SBA and/or the San Felipe Unit of the CVP (including SCVWD) but would provide little or no water quality benefits. In addition, this project would have only a limited potential to improve dry-year water supply reliability conditions in the study area, and only then in conjunction with new storage south of the Delta. Consequently, it was not considered a viable alternative to new storage in Los Vaqueros Reservoir and this measure was therefore deleted from further consideration.

Construct Intertie from Los Vaqueros Reservoir to the SBA at Dyer Canal Back Surge Pool – This measure consists of constructing a new conveyance system from Los Vaqueros Reservoir to the SBA. By delivering water to the SBA via Los Vaqueros Reservoir, it has been suggested that potential exists to increase the efficiency of Los Vaqueros Reservoir, its Delta diversion facilities, and Banks pumping, thereby improving water supply reliability for SBA water agencies. A likely location to intertie with the SBA would be at the Dyer Canal Back Surge Pool. By itself, this measure has little potential to significantly increase water supply reliability, but the measure was retained because preliminary system operation analyses show that this measure would be important in conjunction with the enlargement of Los Vaqueros Reservoir.

Construct Intertie from Los Vaqueros Reservoir to the SBA at Bethany Reservoir – For the objective of improving water supply reliability to SBA water agencies, this measure would be similar to constructing an intertie from Los Vaqueros Reservoir to the SBA at Dyer Canal. With this measure, water would be diverted from Los Vaqueros by gravity to Bethany Reservoir and then pumped from Bethany Reservoir to the SBA. A connection to the South Bay Pumping Plant could be made in a way that preserves the water quality benefits of the reservoir, preventing the mixing of Los Vaqueros and Bethany reservoir supplies before delivery to SBA users.

It should be mentioned that a project including an intertie from Los Vaqueros to Bethany Reservoir would not gain local acceptability without certain operating constraints or restrictions that would satisfy the CCWD Principles of Participation (described in **Chapter II**), in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. In addition, the project could not be operated in conjunction with a peripheral canal or to increase the export of water from Northern California. Just as would be required in the case of a Dyer Canal intertie, permit terms and conditions, as well as contractual arrangements, would be required to ensure that the CCWD principles are satisfied.

Because this intertie would convey water via gravity, power generation facilities could potentially be included to help offset some of the implementation and operation costs. However, at this level of analysis, it is believed that the amount of potential power gained would not represent a significant advantage over the Dyer Canal connection described above. Accordingly, for the objective of water supply reliability, this measure was deleted from

further consideration. As described later, however, this measure was retained for the objective of developing an EWA replacement supply (described later in this chapter).

Source Water Treatment Improvement

Implement Treatment/Supply of Agricultural Drainage Water – This measure consists of collecting agricultural drainage from farms on southern and central Delta islands (Middle River and Old River region) and treating the drainage water for potable use. Major elements of this measure likely include an agricultural drainage collection system, pre-treatment of drainage water, desalination facilities, ancillary facilities associated with desalination and brine disposal, and conveyance of treated water to end users. In addition, removal of total organic carbon (TOC) and pesticides plus supplementary disinfection may also be required before municipal agencies would consider using the treated agricultural runoff as a potable supply. While this measure has the potential to provide some water supply reliability to Bay Area users, it is not judged to be a feasible alternative because it could result in reduced Delta water quality from brine disposal, would be costly and difficult to implement, and would likely be unacceptable to stakeholders and the public. Accordingly, this measure was deleted from further evaluation.

Construct Desalination Facility – This measure consists of constructing desalination plants at one or multiple locations around the Bay-Delta area to supplement existing water supplies. The EBMUD, SFPUC, CCWD, and SCVWD are jointly exploring developing a regional desalination facility. As currently envisioned, the Bay Area Regional Desalination Project (BARDP) may consist of one or more desalination facilities, with an ultimate total capacity of up to 120 million gallons per day (134,000 acre-feet per year). Studies to date have focused on assessing potential sites for desalination plants and evaluating alternative institutional and engineering arrangements to meet the needs of the project partners. One potential site in the San Francisco Bay area would be near the Bay Bridge in Oakland (see **Figure VI-4**) where the salinity is 30,400 milligrams per liter (mg/L) total dissolved solids (TDS) (closer to salt water than freshwater). Another site nearer the Bay-Delta estuary would be along the Carquinez Straits in Pittsburg near the Mirant Power Plant. Another option under consideration is a desalination facility drawing water with a salinity of about 35,000 mg/L TDS from the Pacific Ocean near the City of San Francisco.

Primary facilities at any of the sites would include an intake, pretreatment, desalination, brine disposal, and ancillary facilities for the desalination treatment plant. In addition, a distribution system would need to be constructed to transport either desalinated water or exchange water to partner agencies throughout the region. The BARDP may consider expanding the project scope and potential project partners to include other Bay Area water agencies in future phases of the study, upon unanimous consent of the current project partners.

Desalination facilities are technically feasible, as exemplified by a number of operational facilities around the world. In California, permitting issues have slowed the application of desalination technology, particularly regarding brine disposal. Although technological advances have substantially decreased treatment costs, desalination remains costly compared with most other water sources. Initial plant construction costs are relatively high, and

ongoing operation, maintenance, and replacement needs also are higher, primarily due to the high-energy requirements. Because a portion of the water processed by a desalination plant is either returned to the source or disposed elsewhere as highly concentrated brine, there is potential for impacts on environmental resources.[2] For example, a large desalination facility at the Mirant site could require costly transport and disposal of brine waste at a suitable offsite facility due to concerns over the discharge of brine concentrate back into the sensitive estuary.

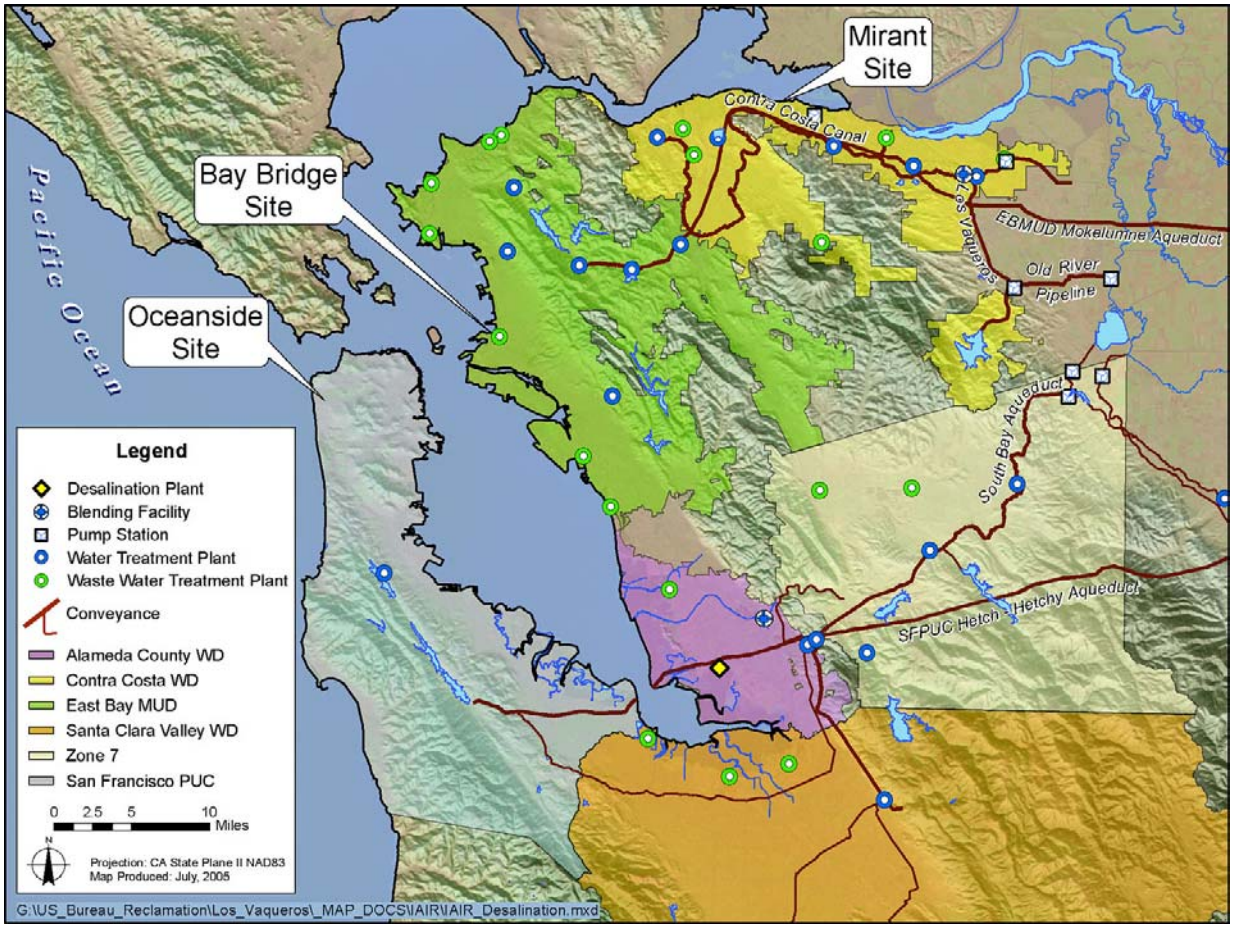


FIGURE VI-4 – POTENTIAL DESALINATION FACILITY SITES IDENTIFIED IN PREVIOUS STUDIES

[2] Depending on source water and facility design, brine waste from a desalination plant may contain high salt concentrations, chemicals used to maintain plant equipment, metals, or potentially harmful concentrations of other constituents found in the source water (*Seawater Desalination and the California Coastal Act*, California Coastal Commission, 2004). The concentration and volume of brine effluent or waste varies, depending on the source water (brackish versus ocean) and the efficiency of the treatment technology. The 2003 *Desalting Handbook for Planners* by Reclamation suggests that the water recovery efficiency of reverse osmosis desalination ranges from as low as 30 percent (70 percent as brine waste) for ocean water to as high as 85 percent (15 percent as brine waste) for brackish water; distillation processes are somewhat less efficient. Continuing advances in treatment technology will likely produce higher water recovery efficiencies, resulting in smaller volumes of more highly concentrated brine waste.

Desalination is most efficient when used as a base-supply because the plants can be better and more cost-effectively maintained if continuously operated, rather than if they are only operated during drought periods. Alternately, if desalination were operated as a base-supply in all years, reserving contract water for use during drought periods, less expensive average and wet-year contract water would be forgone in most years. Consequently, desalination by itself would be a highly inefficient option for agencies that rely on multiple water sources or only intend to use desalination as a drought or emergency supply. However, desalination in combination with new storage would provide an opportunity to continuously operate a plant, storing the treated water during average and wet years when less expensive contract supplies are available, and carry over stored supplies for use in dry periods. New storage could be accomplished with surface or groundwater facilities, which could be located either near the plant or at the point(s) of use. Desalination also could contribute to the water quality objective of the LVE.

With improvements in treatment technology, the cost of desalination has significantly decreased over the last decade. Depending greatly on the quality of the source water and cost of power, desalinization today can range from about $700 to several thousand dollars per acre foot.[3] As an example, the cost of a 20,000-acre-foot-per-year (17.9 mgd) desalination plant in Monterey County, California, was estimated in 2004 as about $250 million, or about $1,600 per acre-foot to construct and operate. The unit cost would likely be lower for a brackish water desalting plant in the San Francisco Bay area. However, desalinization is energy intensive and, with rising power costs, it is expected to continue to be relatively expensive. Even if the unit cost for a base-supply plant were measurably reduced, desalination by itself would likely not be superior to other potential water sources to meet future supply reliability needs in the primary study, such as enlarging Los Vaqueros Reservoir. Accordingly, this measure was deleted from further evaluation as a stand-alone means for improving water supply reliability, but was retained for use in combination with new storage.

Demineralize Poor Quality Groundwater - This measure consists of increasing Bay Area water supply reliability by extracting and demineralizing poor quality groundwater. Various candidate locations have been identified to date. One area would be in the eastern portion of Contra Costa County, where new wells could be constructed at various locations to lessen the potential for adverse impacts on local groundwater levels. A centralized plant or group of smaller, regional plants would demineralize or soften the water to remove hardness, and a suitable site for brine disposal would need to be identified. Water quality objectives could be achieved by blending the demineralized groundwater with surface water or untreated groundwater. New wells would extract groundwater during drought periods, while treated CCWD water would be provide to local groundwater users during wet periods in lieu of their current groundwater supplies. An in-lieu or indirect recharge program would replace pumped groundwater to maintain aquifer integrity. The total quantity of water available from

[3] Sources include *Seawater Desalination and the California Coastal Act*, California Coastal Commission, March 2004; *Desalination Handbook for Planners*, Reclamation, July 2003; *Water Desalination – Findings and Recommendations* of the California Water Desalination Task Force, DWR, October 2003; and *Seawater Desalination in California*, California Coastal Commission, 1993. Values exclude delivery costs.

this measure would be limited by hydrogeologic conditions (probably less than about 5,000 acre-feet per year).

Another site identified in recent studies is in Alameda County. This measure would include further expansion of a groundwater demineralization plant at the Newark and Peralta Tyson sites. This measure would increase water supply reliability to the ACWD by building out the Newark desalter from 5 to 10 mgd and the Peralta-Tyson desalter from 4 to 14 mgd. The reliability of ACWD's groundwater supplies would be improved (providing 15 percent of total supplies), as well as overall water quality. However, no benefits would result for other Bay Area agencies.

Under either of the scenarios described, this measure would increase reliability to only one area water purveyor unless rights to use local groundwater supplies out-of-basin were acquired. Obtaining these groundwater rights would likely be difficult, with a high potential for claims of real or perceived impacts on groundwater conditions. Consequently, this measure was not viewed as a comparable alternative to new storage in Los Vaqueros Reservoir and was not carried forward for further consideration.

Water Use Efficiency

Implement Additional Wastewater Reclamation – This measure consists of the increased use of reclaimed wastewater from Bay Area wastewater treatment plants (WWTP), beyond the recycling projects that are currently planned, to offset potable water demands and to increase water supply reliability, particularly in dry years. Reclaimed wastewater is currently applied to a variety of non-potable uses such as irrigation, industrial processes, cooling tower make-up water, and aquifer recharge. This measure would include constructing new filtration and disinfection treatment systems at existing WWTPs, pump stations, distribution systems to end-users, and reservoirs (to ensure system reliability). A separate distribution system would be required because reclaimed wastewater cannot be conveyed via potable water systems.

It is expected that the use of reclaimed water will increase in the future, as indicated in various Bay Area water management plans, and some level of increased recycling will be included as a without-project future condition. Bay Area agencies that currently produce reclaimed wastewater for irrigation and industrial use include Central Contra Costa Sanitation District, cities of San Jose and Santa Clara, Dublin-San Ramon Services District, Union Sanitation District, South Central Regional Wastewater Authority, and the cities of Palo Alto and Sunnyvale. This measure would provide Bay Area users with an additional, supplemental supply for non-potable uses. The Bay Area Water Recycling Master Plan identified methods with the potential for annual recycling of up to 125,000 acre-feet in the region.

Because recycled water is limited to non-potable applications, facilities are ideally located near end-users to reduce the cost of distribution. Further, the yield of wastewater recycling is limited by the size of the WWTP with which it is associated, and facilities are most efficient when operated continuously, such as for a base-supply. To provide meaningful water supply

reliability benefits during a drought, a wastewater recycling program likely would fall under one of the following scenarios:

(1) A large recycling facility would continuously serve a consumer with a high demand for non-potable water who is willing to accept recycled water in lieu of their existing supply, which would be reserved for use during dry periods, or

(2) A smaller recycling facility would continuously deliver water to surface or groundwater storage, for later use during dry periods.

The substitution of recycled water as a base-supply would mean supplies that currently fill that need, such as less-costly SWP contract water, would be forgone in most years. It is likely that the most cost-effective recycling projects – those located at existing, large-sized WWTPs – already are planned and/or will be included as a future condition. Consequently, it is believed that volume and efficiency of wastewater recycling projects which could be implemented as part of this measure would be very low. In addition, this measure would not contribute to other study objectives, and may result in degraded water quality to some water users. It also could be implemented independently by individual utilities or agencies. Accordingly, this measure was deleted from further consideration.

Implement Additional Demand Management Facilities – For this study, water demand management is defined as improvements in urban water use efficiency through technological improvements or behavioral changes in indoor and outdoor residential, commercial, industrial and institutional water use, leading to reduced demand, and reduced per capita water use. This measure would consist of additional demand management programs beyond the current programs and plans being actively pursued by Bay Area water agencies (ACWD, CCWD, SCVWD, and Zone 7). Most of the more easily implementable and cost efficient demand management measures have either already been implemented, or are likely to be implemented under without-project conditions as part of the CALFED ROD. The degree of effectiveness for this measure would be determined in part by the state of existing water demand management programs and the types of additional programs that are currently planned. While future demand management facilities and programs including water conservation and reuse in addition to those being considered by the State would provide reliability benefits, it is likely that the economic efficiency of these facilities would be lower than previous actions. Consequently, the incremental costs to implement these facilities are expected to significantly increase. There also would be little potential to contribute to the other planning objectives of the LVE. Accordingly, demand management measures on a large scale are not believed to be a viable substitute for additional storage in Los Vaqueros Reservoir and this measure was deleted from further consideration.

Water Transfers and Land Retirement

Water Transfers Within the Study Area – This measure consists of implementing water transfers (or exchanges) within the study area to improve reliability during dry and critical years when Reclamation or DWR reduce allocations to SWP and/or CVP contractors. CCWD, Zone 7, and SCVWD have developed plans to use transfers to meet existing and

future demands. This measure would involve developing the necessary long-term implementation agreements and facilities for these and additional water transfers.

The use of water transfers has and will continue to provide Bay Area water supply reliability, with numerous agencies relying on transfers to meet portions of their current and long-term demands. However, because transfers are performed on a year-to-year basis, significant uncertainty exists regarding the availability and cost of water. In dry and critical years, the supply of water decreases while the demand increases, resulting in higher prices for water. Uncertainty is highest in dry and critical years and for transfer market-dependent agencies. Although ACWD has not used transfers in the past, it estimates it would need supplemental water from transfers about 1 year in 25, so reliance on future transfers to meet infrequent dry-year needs may be reasonable. Zone 7 and CCWD have used transfers regularly and could benefit from additional supplemental water if available in the future, depending on the cost of alternative supplies. Further, the efficiency of transfers is reduced in some cases by Delta carriage water losses.

Although the physical potential for water transfers within the study area is well established, it is believed that even if long-term enforceable agreements could be developed, they would have only a minor effect during a critical dry period or extended drought when nearly all water agencies would be in need of supplies. In addition, transfers within the study area are unlikely to contribute to improving water quality (particularly during dry periods) or providing a less-costly EWA replacement supply. Accordingly, this measure was not considered a viable alternative to new storage in Los Vaqueros Reservoir and was deleted from further consideration.

Increase Water Transfers Outside the Study Area - This measure primarily consists of transferring water between users within the Central Valley, depending on year type, agricultural water availability, storage capabilities, transmission capacity, and purchase/transfer costs to allow more efficient use of available supplies. Several potential water transfer projects were considered by CALFED, including the Semitropic Water Storage District's GBEP and Kern Water Bank. In addition, the Sacramento Valley Water Management Program (Phase 8) depends on water transfers. Both Reclamation and DWR also have active water transfer programs, and a significant number of water transfers will continue to occur in the future under without-project conditions as available supplies become scarce. Further, the future of the EWA depends on the ability to acquire and transfer water through the Delta to mitigate impacts of south Delta pumping curtailment to benefit at-risk fish. Because of these and other projects and actions, and ongoing infrastructure limitations on conveying water from north of the Delta south, it is believed that as water supply demands continue to grow and exceed developed supplies, especially during dry years, and as market conditions change, the cost of water is expected to increase significantly. It is likely that the most feasible and reliable out-of-basin water transfers will be implemented under without-project conditions. Any remaining opportunities for transfers likely would be small, include high uncertainties, be difficult to implement, and be more costly. In addition, water transfers are unlikely to contribute to improving water quality (particularly during dry periods) or provide a less-costly EWA replacement supply (transfers are a water acquisition tool already used by the EWA). Consequently, this measure was deleted from further consideration

primarily because it would not be a long-term reliable substitute for new storage in Los Vaqueros Reservoir.

Retire Agricultural Lands – This measure consists of long-term retirement of agricultural lands in the Central Valley and use of the forgone agricultural supplies in the study area. Recent studies indicate that the demand for irrigation water could be reduced by about 236,000 acre-feet per year under average conditions by retiring 200,000 acres of irrigated croplands in the San Joaquin Valley. It is estimated that in dry and critically dry years, potential savings could amount to as much as 140,000 acre-feet per year. The estimated first cost to acquire land rights to permanently retire lands from irrigated agriculture would be over $600 million, resulting in an equivalent dry-period unit water cost on the order of $300 per acre-foot. However, it is believed that there is a high degree of uncertainty regarding the institutional ability to re-dedicate those CVP supplies to urban uses in the study area, and the ability to acquire sufficient agricultural land rights in the Central Valley. Further, long-term agricultural land retirement may not be consistent with CALFED solution principles and may have local and/or regional economic effects. Accordingly, this measure was deleted from further consideration.

Measures Retained

As described above and shown in **Table VI-1**, five measures focused primarily on increasing water supply reliability in the study area were retained for further consideration for development into initial alternatives. Following is additional information on the features and potential benefits of each measure.

Enlarge Los Vaqueros Reservoir

General Description

This measure includes the expansion of the Los Vaqueros Reservoir from 100,000 acre-feet to up to 500,000 acre-feet by demolishing the existing dam and constructing a larger dam and reservoir at a nearby site with suitable foundation conditions. Some facilities associated with the existing Los Vaqueros Project would be abandoned while others would be preserved and integrated into the expanded project. The size of the expansion would be determined by future studies. Specific features and facilities associated with this measure are described in **Chapter VII**.

Ability to Address Study Objectives

Following is a summary of the potential ability of this measure to address the study objectives.

- **Bay Area Water Supply Reliability -** This measure would improve water supply reliability by allowing Bay Area water agencies to store surplus Delta water during wet periods for later use during dry years when full CVP and/or SWP contract requests can not be filled. The reservoir could be enlarged by as much as 400,000 acre-feet. The measure would be most effective when combined with an enlarged Delta diversion and an intertie between Los Vaqueros and the SBA, which would enable SBA users to receive deliveries from the expanded reservoir. Storage of CVP and/or SWP contract water in an expanded reservoir, in

addition to surplus Delta water, also could provide supplemental water supplies when contract deliveries are reduced. Potential participants include ACWD, CCWD, SCVWD, Zone 7, and SFPUC.

- **Less-Costly EWA Replacement Supply –** An expanded reservoir has the potential to provide a less costly EWA water supply, which could replace a portion of the water the EWA currently acquires through short-term transfers or transfer market purchases. Water supplies stored in an expanded reservoir could be delivered to SBA users; the resulting pumping reduction at Banks Pumping Plant then could be used either to deliver EWA supplies south of the Delta or to directly accommodate EWA fish actions (pumping curtailments) at the export facilities, as determined by the EWA agencies.

- **Bay Area Water Quality** - This measure could improve water quality delivered to the SBA and to the Contra Costa Canal by capturing higher quality, surplus Delta water and storing it in the reservoir for use or blending when Delta water quality is poor. Improvements to water quality would include lower turbidity, hardness, temperature, and concentrations of TDS, chlorides, bromides, and organic carbon.

Raise Los Vaqueros Dam in Place

General Description

This measure is similar to the previous measure to enlarge Los Vaqueros Reservoir except the dam would be raised in-place by between 10 and 15 feet, as permitted by existing foundation and dam safety conditions. This could include a small, mass raise of the dam structure, or modification of the spillway to accommodate a higher water surface. This measure would result in a significantly smaller potential increase in storage in the reservoir compared with the previous measure, between about 15,000 and 25,000 acre-feet, but it would not require demolition and reconstruction of the existing dam. In addition, most facilities associated with the existing Los Vaqueros Project would be preserved and integrated into the expanded project. The allowable magnitude of the dam raise would be determined by future engineering studies. Specific features and facilities associated with this measure are described in **Chapter VII**.

Ability to Address Study Objectives

Following is a summary of the potential ability of this measure to address the study objectives.

- **Bay Area Water Supply Reliability** – Potential water supply reliability benefits of this measure would be similar to, although smaller than, those described previously for the enlargement of Los Vaqueros Reservoir.

- **Less-Costly EWA Replacement Supply –** Raising Los Vaqueros Dam has the potential to provide a less-costly EWA water supply, similar to the previously described measure, but the yield would be much smaller than could be provided by a larger reservoir expansion.

- **Bay Area Water Quality** - This measure could improve water quality delivered to the SBA and to the Contra Costa Canal by capturing higher quality, surplus Delta water and storing it in the reservoir for use and/or blending when Delta water quality is poor.

Increase Delta Diversion Capacity

General Description

This measure consists of increasing diversion and conveyance capacity from the Delta to local storage, such as an enlarged Los Vaqueros Reservoir. The measure would include developing between about 500 and 1,500 cfs of new diversion capability, within or near the existing Delta diversion facility on Old River or at a new location in the central Delta. This measure would include retaining the existing diversion capacity to CCWD of 250 cfs. An advantage of a new central Delta diversion would be to obtain increased volumes of water often at a higher quality which could reduce treatment costs. It also would include new conveyance facilities from the Delta to the reservoir. The new pump station would incorporate state-of-the-art fish screens to minimize impacts to Delta fisheries.

Ability to Address Study Objectives

Following is a summary of the potential ability of this measure to address the study objectives.

- **Bay Area Water Supply Reliability** - This measure could help increase water supply reliability for Bay Area water users primarily when combined with increased surface water storage. Water diverted during surplus flow conditions in the Delta could be stored for later use during dry periods or droughts.

- **Less-Costly EWA Replacement Supply** – This measure by itself would not directly support development of a less-costly replacement supply for a long-term EWA because it would not resolve problems related to moving and storing wet-year EWA purchases south of the Delta.

- **Bay Area Water Quality** - Depending on the size and location of the increased Delta diversion facilities, this measure could help improve Bay Area water quality. A larger intake near the existing facility could be used to divert more water to local storage during periods of good water quality, for later use when Delta water quality is poor. In addition, a diversion facility could be located further east into the central Delta to divert water of higher quality. This could result in lower costs to treat municipal supplies.

Construct Intertie from Los Vaqueros Reservoir to SBA at Dyer Canal Back Surge Pool

Preliminary studies have identified two potential intertie scenarios for conveying water from Los Vaqueros Reservoir to SBA users. The first consists of a pumped connection from Los Vaqueros Reservoir to the Dyer Canal segment of the SBA; the second consists of a gravity connection to Bethany Reservoir. Distinct differences exist between the cost and operation of these connection scenarios. As mentioned and described below, the Dyer Canal intertie was retained for further consideration for water supply reliability and is included in this measure. The Bethany Reservoir intertie is described later in this chapter.

General Description

This measure consists of constructing a pipeline from Los Vaqueros Reservoir to the Dyer Canal Back Surge Pool segment of the SBA. This measure would require a pump station to lift water from Los Vaqueros to Dyer Canal.

Ability to Address Study Objectives

Following is a summary of the potential ability of this measure to address the study objectives.

- **Bay Area Water Supply Reliability** - This measure could help increase dry-year reliability for SBA water users when combined with increased surface water storage.

- **Less-Costly EWA Replacement Supply** - This measure has the potential to support the development of a less-costly EWA replacement supply when combined with increased surface water storage. Water supplies stored in an expanded Los Vaqueros Reservoir, for example, could be delivered to SBA users via the intertie; the resulting pumping reduction at Banks Pumping Plant then could be used either to deliver other EWA supplies south of the Delta or to directly accommodate EWA fish actions at the export facilities, as determined by the EWA agencies.

- **Bay Area Water Quality** - This measure could improve the quality of water delivered to SBA agencies because water quality in Los Vaqueros Reservoir, which is supplied by surplus flows from the central Delta, is generally superior to that in the south Delta.

Construct Desalination Facility

This measure would include constructing a desalination plant in the Bay-Delta estuary to improve water supply reliability for CCWD, ACWD, SCVWD, and Zone 7.

General Description

Studies are ongoing for a Bay Area Regional Desalination Project under a joint effort of CCWD, SCVWD, SFPUC, and EBMUD. A number of potential sites (see **Figure VI-4**) and plant capacities have been considered. Primarily from information gathered as part of these and other studies, and to address the identified study objectives, this measure consists of constructing a brackish water desalination plant in the Bay-Delta Estuary as a supplemental water diversion and treatment facility. For efficient operation, a desalination facility needs to operate continuously, either as a base water supply or a supply stored for later use (such as during dry periods). Primarily for this reason, desalination is being considered in the LVE in combination with new storage. As envisioned, the desalination plant could be located at or near the Mirant Pittsburg plant site identified in studies to date. It would operate continuously by treating and supplying water either (1) directly to CCWD's distributions system, or (2) to storage, supplementing other Delta water supplies for later delivery to the SBA.

Ability to Address Study Objectives

Following is a summary of the potential ability of this measure to address the study objectives.

- **Bay Area Water Supply Reliability** – This measure could provide a high quality supplemental water to users in the study area. The direct recipient likely would be CCWD through direct pumping from the desalination plant. However, it also could help meet water needs of ACWD, SCVWD, and Zone 7.

- **Less-Costly EWA Replacement Supply** – This measure has limited potential to support development of a less-costly EWA replacement supply.

- **Bay Area Water Quality** - Desalination would reduce some of the constituents that are at issue in the Delta water supplies, namely chloride and bromide. Desalinated water could be blended with other sources to bring down the salinity of water diverted from the Delta. The product water goal at Mirant is 200-mg/L TDS and 100-mg/L hardness (as calcium carbonate).

MEASURES TO PROVIDE A LESS-COSTLY EWA REPLACEMENT SUPPLY

Three measures were identified with the potential to support development of a less-costly EWA replacement supply that also met the LVE planning criteria and constraints, as summarized in **Table VI-2** and described below. All three measures were retained for potential inclusion in initial alternatives.

TABLE VI-2
RESOURCE MANAGEMENT MEASURES WITH THE POTENTIAL TO PROVIDE A LESS-COSTLY EWA REPLACEMENT SUPPLY

Resource Management Measure	Potential to Address Planning Objective	Status & Considerations
Enlarge Los Vaqueros Reservoir to store EWA replacement supplies	**High –** Could store up to 400,000 acre-feet of surplus Delta flows or transfer water for EWA use.	**Retained –** High potential to provide a replacement supply for a portion of the EWA.
Construct an intertie from Los Vaqueros Reservoir to the SBA – Bethany Reservoir connection	**High –** Could be used to deliver replacement water supplies for the EWA. Most effective when combined with expanded storage at Los Vaqueros.	**Retained –** Connection to the SBA would be an integral component in any enlargement of Los Vaqueros to store EWA replacement supplies; an intertie to Bethany Reservoir could provide additional flexibility.
Construct an intertie from Los Vaqueros Reservoir to the SBA – Dyer Canal connection	**Moderate - High –** Could be used to provide replacement supplies for the EWA, for delivery to SBA agencies. Most effective when combined with expanded storage at Los Vaqueros Reservoir.	**Retained –** Connection to the SBA would be an integral component in any enlargement of Los Vaqueros Reservoir. Although beneficial to EWA flexibility, this measure would be limited by the existing capacity of the SBA.

KEY: EWA = Environmental Water Account SBA = South Bay Aqueduct

Enlarge Los Vaqueros Reservoir to Store EWA Replacement Supplies

As demands for water increase in the future, the ability of a long-term EWA or similar program to continue to reliably obtain affordable water also will decrease. With this measure, a portion of the storage space in an expanded Los Vaqueros Reservoir would be dedicated to EWA purposes, replacing all or a portion EWA supplies acquired through short-term transfers or transfer market purchases. Contract deliveries would be made primarily to SBA water users from the expanded reservoir; the resulting pumping reduction at Banks Pumping Plant then could be used either to deliver EWA supplies south of the Delta or to directly accommodate EWA fish actions (pumping curtailments) at the export facilities, as determined by the EWA agencies. Water supplies developed in the reservoir would effectively replace a portion of the EWA's south of Delta purchases.

General Description

This measure consists of enlarging Los Vaqueros Reservoir to develop new surface water supplies to facilitate Delta pumping curtailment impacts associated with a long-term EWA or similar program. As part of this measure, Los Vaqueros Reservoir would be enlarged by up to 400,000 acre-feet. This measure would likely be combined with a connecting pipeline or intertie between the expanded reservoir and the SBA (see below) primarily to serve SBA water users.

A new or expanded diversion facility would be constructed in the central Delta and equipped with state-of-the-art fish screens. Surplus flows in the Delta would be pumped to the enlarged Los Vaqueros Reservoir during times when Delta inflows are in excess of mandatory flow requirements and otherwise available for use. Stored water would be delivered primarily to the SBA to serve SWP customers; the resulting pumping reduction at Banks Pumping Plant then could be used either to deliver other EWA supplies south of the Delta or to directly accommodate EWA fish actions (pumping curtailments), as determined by the EWA agencies.

Ability to Address Study Objectives

Following is a summary of the potential ability of this measure to address the study objectives.

- **Bay Area Water Supply Reliability** – This measure would have the ability to release water from Los Vaqueros Reservoir into the SBA when deliveries would be reduced due to pumping curtailments at Banks. This measure also could be implemented in conjunction with increased storage for water supply reliability.

- **Less-Costly EWA Replacement Supply** - This measure has the potential to provide a less-costly replacement supply for the EWA, or a similar long-term program, that could offset the impacts of fisheries actions at Banks and Tracy pumping plants. Storage in the expanded reservoir would replace a portion of EWA south-of-Delta acquisitions and reduce the need to move and store EWA supplies south of the Delta.

- **Bay Area Water Quality** – As with other measures involving enlarging Los Vaqueros Reservoir, it is believed that this measure could contribute to improving the quality of municipal and industrial (M&I) water delivered to Bay Area water agencies. Water would be

diverted from the central Delta during surplus conditions when water quality is generally good, and delivered during periods when pumping curtailments are occurring, which often coincides with periods of low flow and poor quality in the south Delta.

Construct Intertie from Los Vaqueros Reservoir to SBA – Bethany Reservoir Connection

As described previously, two potential conveyance alignments / intertie locations have been identified that appear to be the most promising ways to connect Los Vaqueros Reservoir to the SBA. Because distinct differences exist between the cost and operation of these alternative connection scenarios, they are described as two separate measures, starting below with the Bethany Reservoir connection.

General Description

This measure consists of constructing a gravity pipeline from Los Vaqueros Reservoir to Bethany Reservoir that would facilitate the movement and storage of EWA supplies to offset the impacts of fisheries actions at Banks and Tracy Pumping Plants. Water delivered from Los Vaqueros Reservoir to Bethany Reservoir could be delivered to SBA users via the existing South Bay Pumping Plant; the resulting pumping reduction at Banks Pumping Plant then could be used either to deliver EWA supplies south of the Delta or to directly accommodate EWA fish actions (pumping curtailments) at the export facilities, as determined by the EWA agencies. Alternatively, water supplies delivered to Bethany could flow south via the California Aqueduct for storage or delivery. A flow separation structure would prevent higher quality Los Vaqueros supplies being delivered to SBA users from mixing with lower quality Bethany Reservoir supplies. This measure might also include hydropower generation facilities to take advantage of the elevation difference between Los Vaqueros and Bethany reservoirs.

It should be mentioned that a project including an intertie from Los Vaqueros to Bethany Reservoir would not gain local acceptability without certain operating constraints or restrictions that would satisfy the CCWD Principles of Participation (described in **Chapter II**), in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. Water could be supplied for the EWA through either reductions in Delta pumping to benefit fisheries, or replacing south of Delta EWA purchases. In addition, the project could not be operated in conjunction with a peripheral canal or to increase the export of water from Northern California. Just as would be required in the case of a Dyer Canal intertie, permit terms and conditions, as well as contractual arrangements, would be required to ensure that the CCWD principles are satisfied.

Ability to Address Study Objectives

Following is a summary of the potential ability of this measure to address the study objectives.

- **Bay Area Water Supply Reliability** - This measure could help increase dry-year reliability for SBA water users when combined with increased conservation storage in Los Vaqueros Reservoir.

- **Less-Costly EWA Replacement Supply** - This measure has the potential to support development of a less-costly EWA replacement supply when combined with increased surface water storage. Water supplies developed in an expanded reservoir could be delivered via the intertie to SBA users; the resulting pumping reduction at Banks Pumping Plant then could be used either to deliver EWA assets south of the Delta or to directly accommodate EWA fish actions (pumping curtailments) at the export facilities, as determined by the EWA agencies. The connection to Bethany Reservoir would provide greater flexibility in conveying and storing EWA assets than a connection to the SBA at Dyer Canal primarily because deliveries would not be limited by the existing capacity or demand of the SBA.

- **Bay Area Water Quality** – This measure has the potential to improve the quality of water delivered to SBA agencies when combined with an expansion of Los Vaqueros Reservoir to capture higher quality surplus flows. If necessary, a flow split could be constructed at the Bethany Reservoir connection to prevent mixing of higher quality Los Vaqueros water with lower quality Bethany water before delivery to the SBA agencies.

Construct Intertie from Los Vaqueros Reservoir to SBA – Dyer Canal Connection

As mentioned, this measure consists of constructing a pipeline from Los Vaqueros Reservoir to the Dyer Canal segment of the SBA. Unlike a gravity connection to Bethany Reservoir, this measure would require a pump station near Los Vaqueros Reservoir to lift water to the SBA. The potential ability of this measure to address study objectives would be similar to that described for the previous measure. However, it would provide somewhat less flexibility than a connection to Bethany Reservoir in terms of storing and delivering EWA water assets primarily because deliveries would be limited by the capacity of the existing SBA.

MEASURES TO ADDRESS WATER QUALITY IN THE STUDY AREA

Measures to address the planning objective of increasing water quality in the study area are described below and summarized in **Table VI-3**. Of the five measures identified, one was retained for possible inclusion in initial alternatives. Note that many of the above measures identified for water supply reliability coincidentally result in improvements to water quality. The monetary amount of this improvement is a water supply benefit and attributable to that purpose.

Measures Considered

Following is a brief description of measures identified to improve water quality in the study area.

Implement Point-of-Use Water Quality Actions - This measure consists of improving the quality of water delivered to many Bay Area residences, businesses, and public facilities through implementing point-of-use water quality concepts. As mentioned in **Chapter III,** under without-project conditions, all water delivered for ultimate domestic uses will at least meet regulatory public health and safety standards. However, often these supplies can exhibit elevated levels of minerals such as calcium and magnesium, making the water "hard."

TABLE VI-3
RESOURCE MANAGEMENT MEASURES ADDRESSING WATER QUALITY

Resource Management Measure	Potential to Address Planning Objective	Status & Considerations
Implement point-of-use water quality actions	**Low –** Difficult to implement over the entire study area	**Deleted** – Likely very high costs to implement and maintain with marginal benefits.
Rehabilitate Franks Tract for water quality improvement	**Moderate –** Some potential to improve water quality during certain periods as at some existing Delta diversions	**Deleted** – Being pursued by others and unlikely to contribute to other planning objectives.
Cover open channel sections of the SBA	**Moderate –** Would benefit SBA user agencies during certain periods	**Deleted** – Low potential to contribute to other study objectives and can be pursued independently.
Improve Bay Area water treatment plants	**High –** Potential to significantly improve treatment processes and delivered water quality	**Deleted** – While technically feasible, could be pursued independently by individual agencies and has a low potential to contribute to other study objectives.
Reoperate an enlarged Los Vaqueros Reservoir and/or other study area reservoir and system to improve water quality	**High –** Potential to improve water quality for CCWD and SBA agencies, particularly combined with enlarged reservoir and diversion capacity	**Retained** – High potential to address area water quality conditions and contribute to other LVE planning objectives.

KEY: CCWD = Contra Costa Water District LVE = Los Vaqueros Expansion Investigation SBA = South Bay Aqueduct

Hard water is not a health hazard; in fact, consuming hard water generally contributes a small amount toward total calcium and/or magnesium human dietary needs. However, hard water can be a nuisance (e.g. it can affect the amount of soap and detergent necessary for cleaning). In addition to elevated hardness, taste and odor problems are often associated with domestic supplies.

This measure would include, at those locations exhibiting higher levels of hardness or having taste and odor problems, the provision of bottled water for drinking or installing point-of-use water delivery/treatment features and devices. Primary benefits would include the aesthetics associated with softer and better tasting water, reduced use of soaps and detergents, and reduced frequency of equipment replacements. It also could include assisting the implementation of point-of-use devices primarily by commercial and industrial facilities requiring significantly elevated levels of water quality. Because this measure could be implemented independently by individual water agencies or individuals and because of the estimated high cost to install and maintain delivery/point-of-use type devices over the project life, this measure was deleted from further consideration.

Rehabilitate Franks Tract for Water Quality Improvement - This measure consists of constructing tidal gates, levee improvements, and/or other closure devices at Franks Tract to reduce tidal flows and salinity mixing. Delta water currently flows through Franks Tract on its way to Middle River, Old River, and Clifton Court Forebay, thereby influencing water

quality delivered to CVP/SWP contractors. It has been suggested through water quality modeling that closing Franks Tract could improve the quality of water exported from the central and south Delta. Franks Tract is a State Recreation Area and a protected wetland marsh, only accessible by water. The area is home to beaver, muskrat, river otter, mink, and over 70 species of birds. Currently, DWR is planning potential improvements at Franks Tract, and the California Bay-Delta Authority has identified funding to study the "Ecosystem and Water Quality Benefits Associated with Restoration of Franks Tract". Because this area is significantly important to recreation and environmental interests, is unlikely to contribute to other study objectives, and is being studied by other agencies, it was deleted from further consideration in the LVE.

Cover Open Channel Portions of the SBA - This measure consists of covering the open channel portions of the SBA to reduce the effects of temperature, sunlight, and wind on water quality delivered to SBA contractors. A concrete cap or other type of cover would be constructed along the entire length of the open channel portion. The cover would reduce the algal growth stimulated by sunlight that can cause undesirable pH and diurnal temperature fluctuations. Some improvements to SBA canal berms and relocation or reconfiguration of existing crossings may be required. Because this measure is unlikely to contribute to other study objectives, and could be pursued by others as an independent project, it was deleted from further consideration in the LVE.

Improve Bay Area Water Treatment Plants - This measure consists of making improvements to existing water treatment plants owned and operated by ACWD, CCWD, and/or Zone 7 and/or constructing new treatment facilities to improve the quality of delivered water. The additional treatment capabilities would reduce concentrations of organic carbon and salinity (TDS, chloride, and bromide), reduce hardness, and provide other water quality benefits. Because this measure could be implemented independently by individual water agencies, it would not contribute to overall regional water quality. Further, it has a very low likelihood of contributing to other LVE objectives when combined with other identified measures. For these reasons, it was deleted from further consideration in the LVE.

Reoperate Study Area Water Supply Systems to Improve Water Quality – This measure consists of reoperating local storage, such as an expanded Los Vaqueros Reservoir, and other potential system operational changes, to improve the quality of delivered water supplies. This would be accomplished primarily by changing the timing of Delta exports, or deliveries from an expanded reservoir to the study area, to improve the efficiency of blending in meeting local water quality targets. Improvements to water quality could include lower turbidity, hardness, temperature, and concentrations of TDS, chlorides, bromides, and organic carbon. Because this measure also has the potential to contribute to other study objectives when combined with new surface storage, it was retained for further consideration.

Measures Retained

As described above and shown in **Table VI-3**, one measure addressing the water quality objective of the LVE was retained for further consideration in the development of initial alternatives: reoperation of an enlarged Los Vaqueros Reservoir to improve delivered water quality. With this measure, deliveries to and from an expanded reservoir would be made in a

way that enhanced the water quality benefits of the project to CCWD and SBA users. A description of this measure is included in **Chapter VII**.

SUMMARY OF RETAINED MANAGEMENT MEASURES

Table VI-4 summarizes the water resource management measures carried forward for potential inclusion in concept plans to address the LVE planning objectives. Those measures carried forward are believed to best address the objectives of the LVE, with consideration of the planning constraints and criteria. It should be noted that measures dropped from consideration at this stage might be reconsidered in the future. Similarly, additional measures or components not considered herein may be added to alternative plans as they are formulated.

TABLE VI-4
MEASURES RETAINED TO ADDRESS THE LVE PLANNING OBJECTIVES

Planning Objective Addressed	Resource Management Measures Retained	
Bay Area Water Supply Reliability	Raise Los Vaqueros Dam In-Place	Increase storage space in Los Vaqueros Reservoir by up to 25,000 acre-feet by raising the height of the existing dam in-place
	Enlarge Los Vaqueros Dam and Reservoir	Increase storage space in Los Vaqueros Reservoir by up to 400,000 acre-feet by removing and replacing the existing dam with a substantially larger facility
	Increase Delta Diversion Capacity	Increase the capacity of Delta diversion(s) to Bay Area users
	Construct Intertie from Los Vaqueros Reservoir to the Dyer Canal	Construct a new pipeline and pump station to convey water from Los Vaqueros to the Dyer Canal segment of the South Bay Aqueduct
	Desalination	Develop desalination and associated conveyance facilities in Bay-Delta or Pacific location(s)
Less-Costly EWA Replacement Supply	Enlarge Los Vaqueros Reservoir	Enlarge Los Vaqueros Reservoir to store surplus Delta flows for EWA use
	Construct Intertie from Los Vaqueros Reservoir to Bethany Reservoir	Construct a new gravity pipeline to convey stored water from Los Vaqueros to Bethany Reservoir
	Construct Intertie from Los Vaqueros Reservoir to the Dyer Canal	Construct a new pipeline and pump station to convey stored water from Los Vaqueros to the Dyer Canal segment of the South Bay Aqueduct
Water Quality	Reservoir / Delivery System Reoperation	Reoperate an enlarged Los Vaqueros Reservoir to improve delivered water quality

KEY: Bay Area = San Francisco Bay Area
Bay-Delta = San Francisco Bay / Sacramento – San Joaquin Delta Estuary
EWA = Environmental Water Account

CHAPTER VII
CONCEPT PLANS

This chapter describes a set of concept plans that were formulated from the retained resource management measures presented in **Chapter VI**. Because a large array exists of potential measure combinations and sizes, the planning approach was not to develop an exhaustive list of alternatives or to optimize outputs. Rather, the purpose of this phase of the formulation process is (1) to explore a group of different strategies to address the planning objectives, constraints, and criteria and (2) to identify concept plans that may warrant further development into initial alternatives and later into comprehensive alternative plans. The concept plans described herein are intended to promote discussion and provide a background for formulating alternative plans in the remainder of the feasibility study, with input from participating agencies, stakeholders, and the public.

The plans described in this chapter represent a range of potential actions to address the planning objectives of the Los Vaqueros Expansion Investigation (LVE), formulated by combining the retained resource management measures. First, concept plans were developed that focus on single project objectives: water supply reliability or Environmental Water Account (EWA) water replacement. A third set of plans was then developed that includes a mixture of measures to address all of the objectives of the LVE, termed combined objective plans. The plans are numbered to facilitate discussion, but neither the numbering, nor the order in which the plans appear, is indicative of their performance or standing.

This chapter begins with a discussion of the Federal No-Action plan, followed by a description of common physical features associated with enlarging Los Vaqueros Reservoir and related facilities. This is followed by a brief description of each of the concept plans. The chapter concludes with a summary of estimated benefits and costs for each of the concept plans.

NO-ACTION PLAN (NO FEDERAL ACTION)

Under the No-Action plan, the Federal Government would take no-action toward implementing a specific plan to address water supply reliability or developing a less-costly replacement supplies for the EWA. The following summarizes the consequences of implementing the No-Action plan in relation to the objectives of the LVE.

Bay Area Water Supply Reliability and Quality

Within the State of California (State), the demand for water in the future will significantly exceed available supplies. Competition for finite water supplies will intensify as water demands increase to support municipal and industrial (M&I) needs, urban growth, and the State's agricultural and industrial economy. During drought years, statewide water shortages could be as high as 10 million acre-feet (MAF) by 2040. Within the primary study area, the demand for M&I water supplies also is expected to significantly exceed supplies. No additional water supplies or storage facilities would be developed in the study area under the No-Action plan. Water shortages will continue to increase beyond 2020, particularly in dry periods, even if

planned supplies identified in the various urban water management plans are successfully secured. Projects and programs to help conserve and reuse more water are expected to continue, but the incidence of forced conservation will increase. Without the development of new water supplies, pressure will increase to shift water use from agriculture to meet urban demands. Over time, decreases in water supplies available for agricultural uses in the Central Valley of California will result in increased water rates and a shifting in the type and amount of crops grown and resulting goods and services produced. The overall socioeconomic and environmental impacts to the Central Valley and elsewhere in California resulting from this shift in water use and related agricultural production is speculative.

The quality of water in the Sacramento-San Joaquin Delta (Delta) is expected to remain as under existing conditions. In addition, the quality of local surface and groundwater supplies is expected to remain relatively constant. Water users in the study area who rely on the Delta will find that local blending programs are less effective, Delta supplies are less suitable for recharge and environmental uses, and M&I water is more costly to treat. These trends will contribute to increased water shortages in the future.

Long-Term EWA

It is expected that some form of the EWA will continue in the future with a primary focus on offsetting water delivery reductions resulting from regulatory actions that curtail Delta pumping to protect at-risk fish. However, as demand and competition for water increases throughout the State, driven primarily by forecasted major increases in urban population, the cost of available supplies for exchanges or transfers will increase dramatically. Because the EWA relies heavily on transfer market purchases and short-term transfer agreements, the cost of the program is expected to significantly increase in the future.

CONCEPT PLAN COMMON FEATURES

This section begins by describing measures or features that are common to many of the concept plans. **Table VII-1** summarizes how the retained measures were combined to form concept plans that focus on San Francisco Bay Area (Bay Area) water supply reliability, EWA replacement supply, or combined objectives. As shown in the table, most of the concept plans include enlarging Los Vaqueros Reservoir, enlarging diversion and conveyance facilities from the Delta to Los Vaqueros Reservoir, and conveying water from Los Vaqueros Reservoir to project beneficiaries. Following is a highlight of these common features, while features that are specific to an individual concept plan are described later with each plan.

Los Vaqueros Reservoir Enlargement

Engineering studies have estimated that Los Vaqueros Reservoir could be expanded by as much as 400,000 acre-feet. **Plate 6** illustrates the relationship between reservoir stage, area and capacity for a range of potential enlargements. For the purpose of this initial alternatives study, two enlargement options are under consideration: a 15-foot dam raise to create a reservoir with up to about 125,000 acre-feet, and removal and reconstruction of the dam to create a reservoir with up to about 500,000 acre-feet. Basic facilities and features of an enlarged Los Vaqueros Project are shown in **Plate 7** and described below.

TABLE VII-1
SUMMARY OF CONCEPT PLAN FEATURES

Concept Plans	Resource Management Measures						
	Raise Los Vaqueros Dam In-Place	Enlarge Los Vaqueros Reservoir	Enlarge Delta Pumping/ Convey-ance	Los Vaqueros with Dyer Canal Intertie	Los Vaqueros - Bethany Reservoir Intertie	Desal-ination Plant	Water Quality Reop-eration
Bay Area Water Supply Reliability Focus							
1 Raise Los Vaqueros Dam In-Place for Water Supply Reliability	✓		✓	✓			
2 Enlarge Los Vaqueros Dam and Reservoir for Water Supply Reliability		✓	✓	✓			
3 Desalination with Storage (Enlarged Los Vaqueros Reservoir) for Water Supply Reliability		✓	✓	✓		✓	
EWA Replacement Supply Focus							
4 Enlarge Los Vaqueros Reservoir with Dyer Canal Intertie for EWA		✓	✓	✓			
5 Enlarge Los Vaqueros Reservoir with Bethany Reservoir Intertie for EWA		✓	✓		✓		
Combined Objective Focus							
6 Water Supply / EWA Combination with Dyer Canal Intertie		✓	✓	✓			
7 Water Supply / EWA Combination with Bethany Reservoir Intertie		✓	✓		✓		
8 Water Supply / EWA Combination with Water Quality Improvements		✓	✓	✓			✓

KEY: EWA = Environmental Water Account

Dam and Reservoir

Preliminary studies indicate that Los Vaqueros Dam could be raised in-place by as much as 15 feet without major dam and abutment reconstruction, creating up to about 25,000 acre-feet of additional storage. Larger expansion of the reservoir would require demolishing the existing dam and constructing a new dam about 500 feet upstream. The new dam would have a similar earthfill design and be constructed parallel to the existing dam. **Plate 8** shows a plan and section view of a new earthfill dam for a 500,000-acre-foot reservoir, the largest practical expansion of Los Vaqueros Reservoir. **Table VII-2** summarizes various physical features and construction components associated with these reservoir expansion options.

TABLE VII-2
PHYSICAL FEATURES OF RESERVOIR ENLARGEMENT SCENARIOS

Item	Total Reservoir Capacity (acre-feet)			
	100,000 (existing)	**125,000 (dam raise)**	**300,000**	**500,000**
Los Vaqueros Dam				
Type	Earthfill	Earthfill	Earthfill	Earthfill
Embankment Volume (million cubic yards)	2.85	3.88	10.75	18.50
Crest Elevation (feet)	487	502	587	656
Height Above Downstream Toe (feet)	190	205	290	360
Crest Length (feet)	980	1,095	1,850	2,300
Crest Width (feet)	40	40	40	40
Los Vaqueros Reservoir				
Water Surface Elevation (feet)				
Gross Pool (maximum water surface)	472	487	567	636
Increase in Gross Pool	-	15	140	164
Minimum Operating Pool	380	380	380	380
Capacity (1,000 acre-feet)				
Total at Gross Pool	100	125	300	500
Capacity Increase	-	26	200	400
Minimum Operating Pool [2]	44	44	44	44
Surface Area (acres) at Gross Pool	1,500	1,640	2,600	3,300
Spillway & Outlet Works				
Type	Ogee	Ogee	Ogee	Ogee
Length (feet)	2,000	2,000	2,000	2,000
Width (feet)	15	15	TBD	TBD
Crest Elevation (feet)	481	481	TBD	TBD
Probable Maximum Flood (cfs) [1]	21,500	Same	Same	Same
Spillway Capacity (cfs) [1]	1,420	Same	Same	Same

KEY: cfs = cubic feet per second TBD = to be determined

Notes:

1. *The Probable Maximum Flood (PMF) is used in planning and design of the dam, reservoir, spillway, and appurtenance. Although it will be reviewed during future studies, it is not expected to differ significantly from existing estimates.*
2. *The minimum operating pool of 44 TAF represents the normal range of reservoir operations; capacity between 44 TAF and dead storage (4 TAF) is reserved as emergency storage for CCWD.*

Spillway

As shown in **Table VII-2**, the spillway for an enlarged reservoir would have a total capacity of 1,420 cubic feet per second (cfs), which is sufficient to accommodate the Probable Maximum Flood (PMF) with a peak reservoir inflow of 21,500 cfs. For a 15-foot dam raise, the existing spillway would not require significant modification and would remain about 15 feet wide and 2,000 feet long with an ogee-shaped crest. The spillway for a larger reservoir expansion would likely have a similar design.

Inlet and Outlet Facilities

A 15-foot dam raise would likely use existing inlet and outlet facilities. Separate inlet and outlet facilities would be constructed for a larger reservoir expansion to allow simultaneous delivery to, and releases from, the reservoir. The separate inlet facility also would provide water quality benefits by improving mixing within the reservoir. Inlet facilities would consist of an inlet control structure located at the downstream face of the dam, a tunnel throughout the dam abutment, and a vertical gate shaft connecting to the tunnel immediately upstream of the axis of the dam. Outlet facilities would consist of a multilevel intake structure in the reservoir, an outlet tunnel, an outlet control structure, and connection to a water delivery pipeline. The location of outlet facilities, either adjacent to the dam or elsewhere on the reservoir, would depend on the alignment of the delivery pipeline. Potential also exists to interconnect the inlet and outlet facilities with delivery conveyance features to allow Delta diversions to be provided directly to the South Bay Aqueduct (SBA) or to Bethany Reservoir (see below). These, and other potential arrangements, will be considered in future studies.

Reservoir Enlargement Impacts

Table VII-3 summarizes potential relocations and other reservoir area impacts associated with enlarging Los Vaqueros Reservoir to a capacity of 500,000 acre-feet. These impacts would generally be proportionally similar for other enlargement scenarios. The potential inundation area for enlarging the reservoir up to 500,000 acre-feet is shown in **Plate 9**. Enlarging the reservoir would cause direct impacts due to inundation, and indirect impacts related to facilities access, operation, and maintenance. General types of impacts would include loss of up to 1,960 acres of grasslands, oak woodland, chaparral, and wetland vegetation. Existing recreation facilities and access around the reservoir also would be impacted.

Delta Diversion, Conveyance, and Appurtenance

Additional pertinent facilities related to the expansion of Los Vaqueros Reservoir include (1) new screened intakes in the Delta, (2) new pumping capacity in the Delta to deliver supplies to the reservoir, and (3) new conveyance pipelines to deliver water from the new Delta intake and pump station to the enlarged reservoir. Other elements would include a small forebay or balancing reservoir (for larger reservoir expansion options), a flow control structure, and flood control features to support the diversion and conveyance facilities.

TABLE VII-3
RESERVOIR AREA IMPACTS ASSOCIATED WITH 500,000-ACRE-FOOT ENLARGEMENT OF LOS VAQUEROS RESERVOIR

Facility Types	Description
Recreation Facilities	
Boating	Marina Complex: • Docks and boathouse • 59 parking stalls • Restrooms • Concession stand • Miscellaneous picnic and visitor facilities
Fishing	• 4 fishing piers • Miscellaneous shoreline access
Picnic & Parking	Los Vaqueros Staging Area: • 61 parking stalls • 1 restroom Oak Point and Knoll picnic areas: • 18 parking stalls • 25 picnic tables
Trails	10.7 miles existing trails
Roads	Access road to marina
Wildlife Habitat	1,960 acres total (grassland, oak woodland, and chaparral/scrub)
Aquatic Habitat	0.5 acres (existing wetland)
Other	175 acres (created as a mitigation for the existing reservoir project)

New screened Delta intakes located along Old River or other locations in the central Delta would be required to provide additional water diversions for conveyance to the enlarged reservoir. General locations for the intake facilities are illustrated in **Figure VII-1**. Future studies on potential diversion facility sites will consider cost comparisons, improvements in the quality of water supplies in the central Delta (as opposed to along Old River), area impacts, and flexibility in the timing and duration of the increased diversions. Estimated total capacities needed for the new intakes would range from about 500 cfs to 1,750 cfs. State-of-the-art fish screens would be mounted to the face of the intakes to prevent entrainment of juvenile and adult fish in the intakes and reduce entrainment of debris and sediment in the system.

FIGURE VII-1 – POTENTIAL LOCATION OF NEW CENTRAL DELTA INTAKE FACILITIES

The Los Vaqueros enlargement concept plans would include a new pumping station to lift water

to the expanded Los Vaqueros Reservoir. The size of the pump station would be based on a combination of the conveyance flow rate to the reservoir and the maximum reservoir water level. Because of the volume of flow and increase in pumping head associated with an enlarged reservoir, the concept plans would include new pipeline(s) connecting the Delta pumping station to the expanded Los Vaqueros Reservoir. The pipeline(s) would have capacities ranging from about 500 cfs to 1,750 cfs. A new transfer facility and balancing reservoir would be constructed to allow deliveries from the new Delta diversion either to Los Vaqueros Reservoir or to the Contra Costa Canal via the existing Transfer and Los Vaqueros pipelines.

Los Vaqueros Reservoir Delivery Conveyance

Concept plans that include enlarging Los Vaqueros Reservoir also would include facilities to deliver water from Los Vaqueros to SBA agencies or other project beneficiaries. Two potential intertie options have been identified in previous studies: a pumped pipeline to the Dyer Canal segment of the SBA, or a gravity pipeline to Bethany Reservoir. Potential pipeline alignments for the gravity and pumped interties are illustrated in **Figure VII-2**.

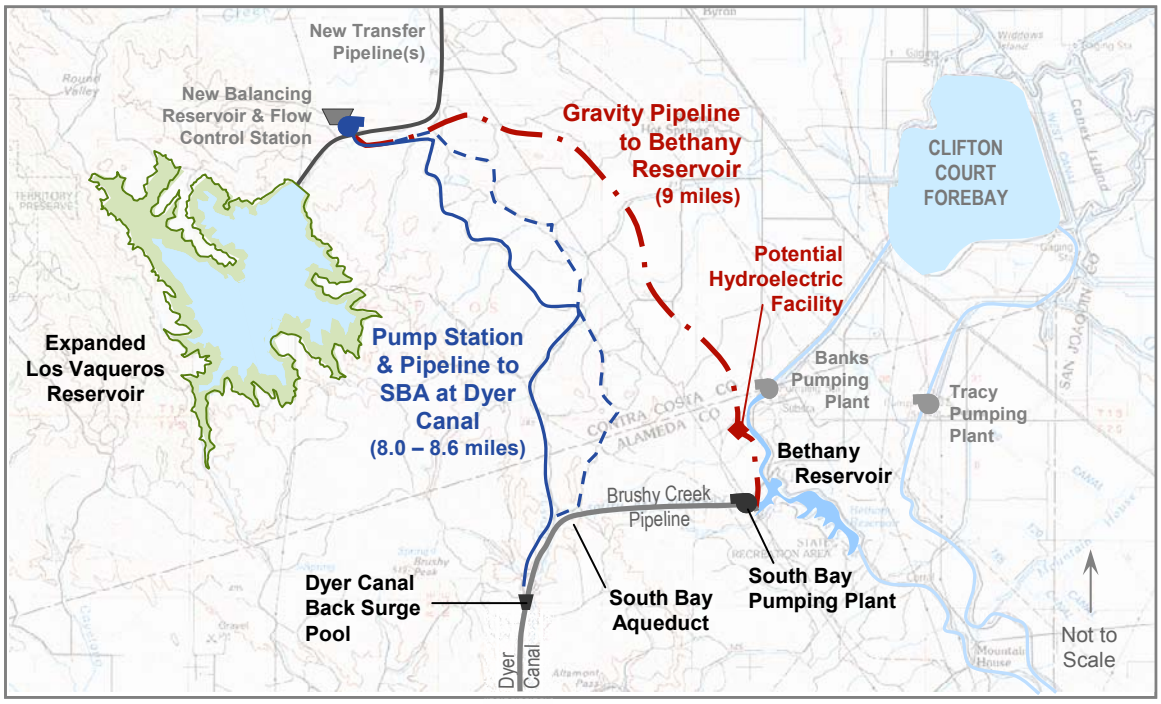


FIGURE VII-2 – POTENTIAL LOS VAQUEROS RESERVOIR INTERTIE OPTIONS

Various potential pipeline alignments exist from Los Vaqueros Reservoir to the Dyer Canal Back Surge Pool, located at the beginning of the Dyer Canal segment of the SBA. A connection to this location would require a 90-inch-diameter pipeline and a pump station to lift water from Los Vaqueros Reservoir to the Dyer Canal (illustrated in **Figure VII-3**). The most promising alignments would originate near the reservoir inlet (located adjacent to the dam), and travel between 8.0 and 8.6 miles to the Dyer Canal. The pump station for this route would have a capacity matching the capacity of the SBA of 430 cfs, including 10 pumps with a total of 36,000 horsepower. The advantage of this intertie option is that further pumping would not be required to deliver water to SBA user agencies.

The second option would be to deliver water from Los Vaqueros Reservoir to the existing Bethany Reservoir at the head of the SBA. Bethany Reservoir has an elevation of 245 feet, which would allow water to flow from Los Vaqueros via gravity. The intertie would connect to the South Bay Pumping Plant in a manner that preserved the water quality benefits of the project by delivering directly to the pumping plant intake, preventing mixing of higher quality Los Vaqueros water with lower quality water in Bethany Reservoir prior to delivery to SBA users. In addition, the elevation difference could facilitate a small hydropower generation facility to help offset some of the energy required to pump water from the Delta to an enlarged Los Vaqueros Reservoir.

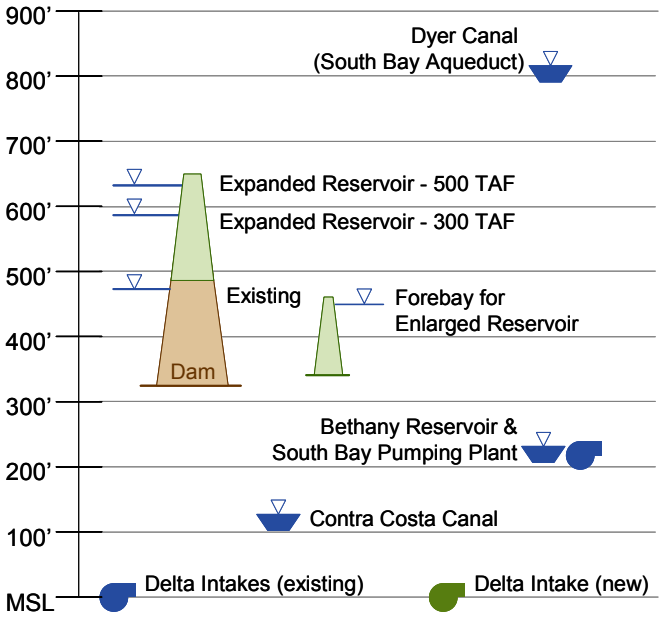


FIGURE VII-3 –FACILITY ELEVATIONS

An intertie from Los Vaqueros to Bethany Reservoir would be advantageous for concept plans focused on developing an EWA replacement supply. An intertie to Bethany would allow greater flexibility in the delivery of EWA supplies to SBA users via the existing South Bay Pumping Plant or to other water users via the California Aqueduct. EWA replacement supplies developed by a project with an intertie to the Dyer Canal would be limited by the existing capacity of the SBA. Although additional analysis is needed, it appears that a connection to Bethany Reservoir for water supply reliability for SBA water users would not be cost-effective due to the additional pumping required.

It should be mentioned that a project including an intertie from Los Vaqueros to Bethany Reservoir would not gain local acceptability without certain operating constraints or restrictions that would satisfy the CCWD Principles of Participation (described in **Chapter II**), in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. Water could be supplied for the EWA through either reductions in Delta pumping to benefit fish or replacing south of Delta EWA purchases. In addition, such a project could not be operated in conjunction with a peripheral canal or to increase the export of water from Northern California. Just as would be required in the case of a Dyer Canal intertie, permit terms and conditions, as well as contractual arrangements, would be required to ensure that the CCWD principles are satisfied.

CONCEPT PLANS FOCUSED ON BAY AREA WATER SUPPLY RELIABILITY

As shown in **Table VII-1**, three concept plans were formulated from management measures retained to address the objective of increasing water supply reliability (LVE planning objectives are discussed in **Chapter V**). Following is a summary of each concept.

1 - Raise Los Vaqueros Dam In-Place for Bay Area Water Supply Reliability

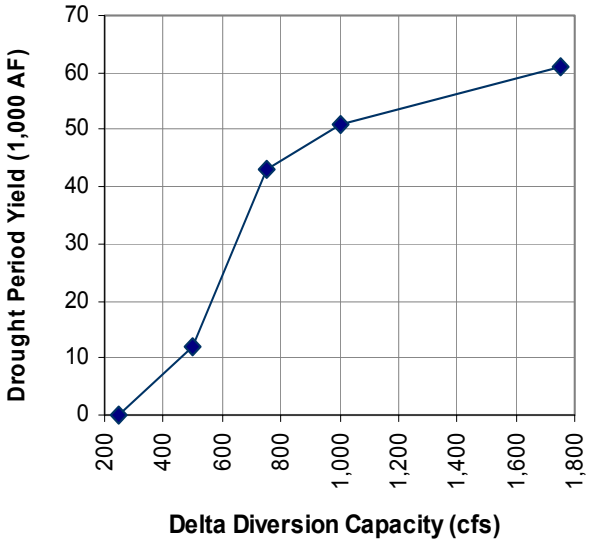
This concept plan focuses on raising the existing Los Vaqueros Dam up to about 15 feet. The existing dam was not designed to allow a significant raise without reconstructing the dam core. However, it is believed that a minor raise of about 10 to 15 feet could be accomplished without demolition and reconstruction of the existing structure. Significant analysis and coordination, especially with the State Division of Safety of Dams, is needed concerning foundation and embankment conditions to confirm the physical feasibility of raising Los Vaqueros Dam in-place. A potential dam raise of 15 feet was selected for this concept plan, as described in the following summary of plan features, accomplishments, and economics.

Primary Features

Primary features of this concept plan include the following:

- Raising Los Vaqueros Dam from a crest elevation of 487 feet to 502 feet and enlarging Los Vaqueros Reservoir from 100,000 acre-feet up to about 125,000 acre-feet.
- Increasing diversion and conveyance capacity from the Delta to the enlarged reservoir, which would include maintaining the existing pumping capacity at Old River of 250 cfs and constructing an additional diversion and pumping facility in the central Delta of about 500 cfs. Total Delta diversion capacity under this concept plan would be about 750 cfs.
- Constructing conveyance facilities from the outlet of the expanded reservoir to the Dyer Canal segment of the SBA.

Under this concept, the existing Los Vaqueros Dam would be raised by increasing the height of the impervious core of the existing dam and applying a layer of material at a slightly steeper slope on the upstream and downstream faces of the dam. The existing spillway would likely be used with minor modification or gated to allow for the increased dam height. However, future analysis may indicate the need to raise the spillway crest. Again, significant analysis is needed to estimate the scope of effort needed to raise the existing dam in-place by any amount.



Note: Yield for specific total capacities would vary depending on relative combination of delta diversion and pumping plant sizes.

FIGURE VII-4 – POTENTIAL RANGE IN DROUGHT PERIOD YIELD FOR 15-FOOT DAM RAISE IN COMBINATION WITH VARIOUS DELTA DIVERSION CAPACITIES

Accomplishments

A plot of increases in water supply reliability for a 15-foot raise of Los Vaqueros Dam with Delta pumping capacity increases up to about 1,750 cfs is shown in **Figure VII-4**. Depending on Delta diversion and pumping

capacity, this concept plan could potentially increase drought period yield in the Bay Area through the SBA to over 60,000 acre-feet per year.

For concept plan evaluation and comparison purposes, if storage in Los Vaqueros Reservoir were increased by 25,000 acre-feet in combination with about 500 cfs additional Delta diversion/pumping capacity (750 cfs total), this plan could increase water supply reliability during drought periods by about 43,000 acre-feet per year. This would reduce Bay Area drought period water shortages by about 28 percent.[1] The Delta diversion capacity increase identified for this concept was selected because it appeared to result in the lowest cost per unit of increased water yield of the sizes considered. Because the focus of this plan is on water supply reliability, there would be no specific benefits to replacing water supplies to support the EWA. In terms of water quality, average annual chloride concentrations would decrease by about 11 milligrams per liter (mg/L) (18 percent) over without-project conditions.[2] In addition, a reduction would occur in maximum or peak concentrations of about 147 mg/L (80 percent).

Impacts and Mitigation

A 25,000-acre-foot increase in the size of the existing Los Vaqueros Reservoir would increase the surface area at gross pool from about 1,460 acres to approximately 1,600 acres. Major types of reservoir area relocations and other impacts related to enlarging Los Vaqueros Reservoir would be similar to, although less than, those shown previously in **Table VII-3**. Detailed impacts and mitigation measures were not identified for the concept plans, but will be evaluated in future studies as detailed alternative plans emerge. Preliminary impacts and mitigation features presented in this report are based on existing and available information.

Costs

The preliminary estimated cost (first cost) and anticipated benefits for representative sizes of each concept plan are summarized in **Table VII-4**. The first cost is the estimated total cost at current prices to construct the project including allowances for contingencies, engineering and design, and construction supervision and administration. These costs are based largely on information contained in the April 2004 *Planning Report*, updated to October 2004 price levels (see discussion of preliminary costs in **Chapters VIII** and **IX**). As shown in the table, the estimated first cost for this concept plan is about $470 million.

2 - Enlarge Los Vaqueros Dam and Reservoir for Bay Area Water Supply Reliability

This concept primarily consists of enlarging Los Vaqueros Reservoir for the purpose of increasing water supply reliability. A general layout of this concept is presented in **Plate 7**. Following is a summary of its primary features, accomplishments, and economics.

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[1] Percentage is based on a preliminary estimate of the 2020 average annual drought period shortage for the region of about 152,000 acre-feet and is used for the purpose of comparing the relative benefits of the concept plans. Future studies are required to better quantify potential shortages in the study area, as noted in Chapter III.

[2] Reduction represents the long-term average decrease in salinity for deliveries to the South Bay Aqueduct as compared to salinity in Clifton Court Forebay.

TABLE VII-4
SUMMARY OF CONCEPT PLAN BENEFITS AND FIRST COSTS

Concept Plans	Total Reservoir & Diversion Capacities (TAF / cfs)	Increase in Water Supply Reliability[1] (TAF/Year)	EWA Replacement Supply[2] (TAF/year)	Decrease in SBA Chloride (mg/L)[3]	First Costs (millions)[4]
Bay Area Water Supply Reliability Focus					
1 – Raise LV Dam In-Place	125 / 750	43	-	11	470
2 – Enlarge LV Dam & Reservoir	500 / 750	95	-	15	1,060
3 – Desalination with Storage (Enlarge LV)	500 / 750	110	-	13	1,260
EWA Replacement Supply Focus					
4 – Enlarge LV Reservoir with Dyer Canal Intertie	500 / 1,000	-	140	16	1,170
5 – Enlarge LV Reservoir with Bethany Reservoir Intertie	500 / 1,750	-	190	16	1,470
Combined Objective Focus					
6 – Water Supply / EWA Combination with Dyer Canal Intertie	500 / 1,750	34	142	17	1,540
7 – Water Supply / EWA Combination with Bethany Reservoir Intertie	500 / 1,750	19	173	15	1,470
8 – Water Supply / EWA Combination with Water Quality Improvements	500 / 1,750	47	81	44	1,540

KEY: cfs = cubic feet per second; LV = Los Vaqueros Reservoir; SBA = South Bay Aqueduct; EWA = Environmental Water Account; mg/L = milligrams per liter; TAF = thousand acre-feet

Notes:
1. *Increase in water supply reliability measured as average increase during drought year conditions (1987- 1992).*
2. *Long-term average annual EWA replacement supply provided by the concept plan.*
3. *Decrease in average annual chloride concentrations in delivered water to South Bay Aqueduct.*
4. *Costs reflect October 2004 price level.*

Primary Features

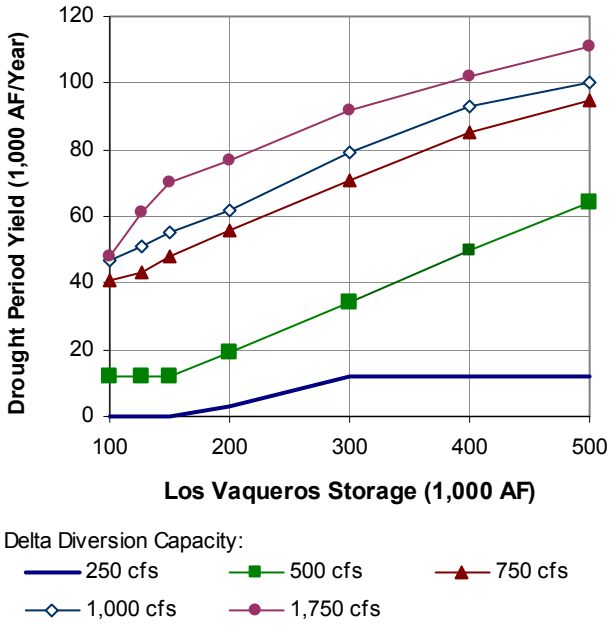
The primary features of this concept plan include the following:

- Reconstructing Los Vaqueros Dam from a crest elevation of 487 feet to 587 feet and enlarging Los Vaqueros Reservoir from 100,000 acre-feet to 500,000 acre-feet.
- Increasing the diversion and conveyance capacity from the Delta to the enlarged Los Vaqueros Reservoir from 250 cfs to 750 cfs.
- Constructing conveyance facilities from the outlet of Los Vaqueros Reservoir to the SBA at the Dyer Canal Back Surge Pool.

Numerous potential combinations exist of increased storage in Los Vaqueros Reservoir and Delta diversion capacity, each of which could provide different contributions to the study objectives. Further, many factors can influence the potential efficiencies of these combinations.

Although additional study is needed to confirm specific facility sizes, this concept plan was formulated to generally represent a combination of features and sizes believed to be relatively effective in addressing the stated plan objectives.

Figure VII-5 shows a plot of estimated increases in drought period water supply reliability for various increases in storage in Los Vaqueros (ranging from 100,000 acre-feet to 500,000 acre-feet) and for various Delta diversion capacities. A comparison of facility costs and estimated increases in water supply reliability indicates that a 500,000-acre-foot reservoir in combination with 750 cfs total Delta diversion capacity (250 cfs from the existing pumping plant and 500 cfs from a new central Delta diversion) might represent the most efficient combination. These facility sizes were chosen to represent this concept plan primarily because it appears that significantly larger or smaller facilities sizes would result in higher costs per unit for water supplies. Should this concept plan be carried forward, facility sizes would be optimized in more detailed studies.



Note: Yield would vary depending on relative combination of Delta diversion/pumping plant sizes for specific total capacities.

FIGURE VII-5 – INCREASE IN WATER SUPPLY RELIABILITY FOR VARIOUS COMBINATIONS OF LOS VAQUEROS ENLARGEMENT AND DELTA PUMPING CAPACITY

Accomplishments

Enlarging Los Vaqueros Reservoir by 400,000 acre-feet, increasing diversion capacities from the Delta by about 500 cfs, and connecting the reservoir with the SBA would increase water supplies during drought year conditions by about 95,000 acre-feet per year. This would result in an estimated 63 percent reduction in 2020 water shortages in the study area (see footnote 1 on page VII-10).

Although this plan would focus on Bay Area water supply reliability through developing drought year supplies, incidental EWA replacement supplies could be developed under this concept plan. Further, it is estimated that this concept plan could decrease average annual chloride concentrations by about 15 mg/L over without-project conditions (24 percent) (see footnote 2 on page 10). Maximum salinity concentrations would be reduced by about 140 mg/L (76 percent).

Impacts and Mitigation

The general types and scope of major reservoir area impacts related to enlarging Los Vaqueros Reservoir are summarized in **Table VII-3**.

Costs

The preliminary estimated first cost for this plan is $1.06 billion (see **Table VII-4)**.

3 - Desalination with Storage (Enlarge Los Vaqueros Reservoir) for Bay Area Water Supply Reliability

This concept also includes enlarging Los Vaqueros Reservoir, increasing the capacity of Delta diversion facilities, and constructing an intertie to the SBA primarily for improving Bay Area water supply reliability. In addition, however, it includes constructing a desalination facility within the Bay-Delta Estuary. The desalination facility would be used to supplement water supplies from the Delta diversion facilities. The desalination facility would include diverting brackish water from the estuary, treating the water to remove salts and other constituents, and either supplying potable water directly to Bay Area municipal customers, or to storage for later distribution when demands exceed normal supplies. This concept could support desalination efforts in the Bay Area as part of the Bay Area Regional Desalination Project, a joint effort of CCWD, SCVWD, San Francisco Public Utilities District (SFPUC), and East Bay Municipal Utility District (EBMUD). Although desalination remains relatively costly compared with other water sources, it is considered a highly reliable, local supply because seawater is not subject to hydrologic uncertainties.

Primary Features

To help increase water supply reliability to the four Bay Area water agencies consistent with the planning objectives, this concept could be formulated in several basic ways. It could consist of multiple, small desalination plants delivering water directly to the distribution systems of ACWD, CCWD, SCVWD, and Alameda County Flood Control and Water Conservation District, Zone 7 (Zone 7). Alternately, this concept could include a single, large desalination plant with independent conveyance systems to each of the districts. Desalination facilities are most efficient when they are operated at generally a constant capacity. Accordingly, under either of the above scenarios and during periods of excess supplies within the districts, water from the desalting plant(s) would be temporarily stored in local storage facilities or used conjunctively to decrease reliance on another water supply source (such as groundwater). Although studies by others have considered these scenarios, more detailed evaluation would be required to determine the most cost-effective way for a desalination facility to contribute to LVE objectives.

For the purpose of initial comparison, this concept plan includes a single, large brackish water desalination plant. As mentioned, the plant would supplement other Delta diversion facilities, but with a high enough quality to be provided directly to the CCWD distribution system or be stored in Los Vaqueros Reservoir for later use. **Figure VII-6** shows a general layout of this concept. Depending on its placement, pumping may not be limited by the timing of current diversions from the existing Old River Pumping Plant.

Several potential brackish water desalination plant sizes were considered in developing this concept plan, ranging from 10 to 40 million gallons per day (mgd). Preliminary analysis indicates that that a 20 mgd (31 cfs) plant combined with a 500,000-acre-foot expansion of Los Vaqueros Reservoir and 750 cfs Delta diversion capacity may be the most cost-effective

combination of facilities. Smaller sizes of reservoir and diversion capacities could be considered. However, when considered as a complete project, larger reservoir expansions appear to be more cost-efficient. Further, as new storage capacity becomes smaller, the effectiveness of the additional Bay-Delta diversion at the desalination plant is reduced.

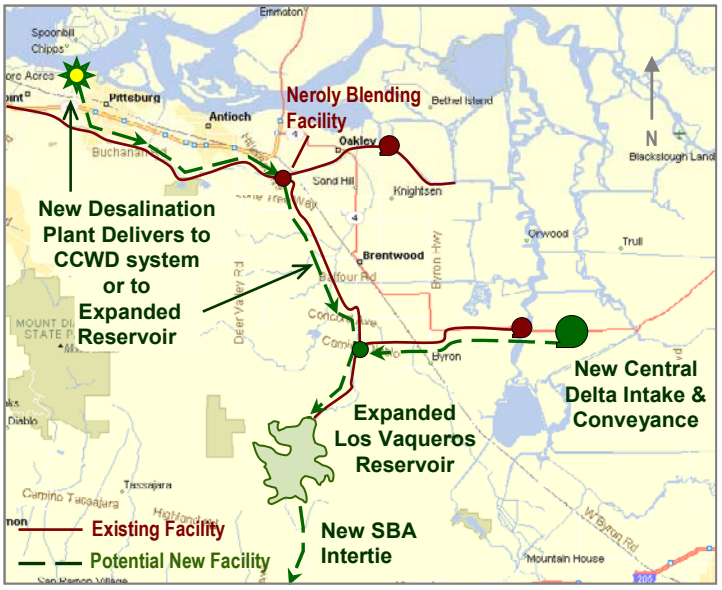


FIGURE VII-6 – SCHEMATIC OF DESALINATION PLANT AND APPURTENANT FACILITIES

Primary features of this concept plan would include the following:

- Intake, pretreatment, desalination, power supply, brine disposal, and ancillary facilities for a 20 mgd brackish water desalination treatment plant. For purposes of this concept, the desalination plant would be located at, or near, the Mirant Pittsburgh site identified in the Bay Area Regional Desalination Project.
- New conveyance facilities (pump stations, pipelines, interties, and/or mixing facilities) to deliver water from the desalination plant to existing distribution facilities for immediate use of storage. As shown in **Figure VII-6**, this concept includes transmission facilities from the desalination plant to the existing Neroly Blending facility, and a pumping station and conveyance from that location to the new pipeline to Los Vaqueros Reservoir.
- Reconstruction of Los Vaqueros Dam from a crest elevation of 487 feet to 587 feet, and enlarging Los Vaqueros Reservoir from 100,000 acre-feet to 500,000 acre-feet.
- Increasing the diversion and conveyance capacity from the Delta to Los Vaqueros Reservoir from 250 cfs to 750 cfs.
- Construction of conveyance facilities from the enlarged reservoir to the SBA at the Dyer Canal Back Surge Pool.

Accomplishments

Constructing a 20 mgd desalination plant (including acquiring additional water rights), enlarging Los Vaqueros Reservoir by 400,000 acre-feet, increasing Delta diversion capacity by about 500 cfs, and connecting the reservoir to the SBA would yield about 110,000 acre-feet per year during drought year conditions. This would result in an estimated 72 percent reduction in 2020 water shortages in the study area (see footnote 1 on page VII-10). An advantage of desalination is that it is less subject to hydrologic uncertainty than other water supplies and reduces dependence on imported and local water resources. However, the higher reliability of a desalinated supply is

offset somewhat by uncertainties regarding its cost per unit of output, which is highly sensitive to changes in the cost of power.

Desalination would reduce some of the water quality constituents that are problematic in Delta water supplies, namely chloride and bromide. Desalinated water could be blended with other water sources to reduce the salinity of delivered supplies. The primary beneficiary of water quality improvements would be CCWD. Average annual water quality for other Bay Area agencies that received water from the project also would improve. However, it should be noted that desalinated water stored in Los Vaqueros Reservoir for future use during dry periods would require re-treatment before being introduced into the water supply system.

Impacts and Mitigation

Major reservoir area relocation and other impacts related to enlarging Los Vaqueros Reservoir are summarized in **Table VII-3**. Other potential impacts related to desalination primarily concern the environmental impacts of feedwater intake and disposal of the high-salinity concentrate (brine) that is a byproduct of desalination. The amount of water potentially recoverable from brackish water sources using current reverse-osmosis treatment technology is about 60 to 85 percent. Based on this, a 20 mgd desalination plant could generate from 3 to 12 mgd of waste concentrate. In addition to the biological impacts of introducing high salinity waste into the environment, disposal of waste concentrate is further complicated by the high temperatures associated with desalination treatment processes. Disposal options range from surface water disposal, deep well injection, evaporation or salt processing ponds, land application, and disposal to sewage treatment facilities. It is assumed for this concept plan that brine waste would be reintroduced to the Bay-Delta.

Costs

As with other water sources, it is difficult to estimate the true range of costs and benefits for desalination without a highly detailed evaluation of factors such as plant siting, treatment process, energy consumption, brine disposal, and source water quality. Based on preliminary assumptions and available information on existing and planned desalination facilities, the estimated first cost for this concept plan is about $1.26 billion (see **Table VII-4**). This total cost is most sensitive to the cost of the desalination plant, for which a detailed estimate would be required. One of the most costly aspects of desalination is energy consumption for treatment and delivery, which is subject to power market conditions. These costs are reflected in the estimate of economic efficiency described in **Chapter VIII**.

Preliminary cost estimates for the desalting plant portion of the concept plan in this report are based on information from Reclamation's *Desalting Handbook for Planners*, 3rd edition, July 2003. These costs are for a plant that would be supplied with brackish water with an average total dissolved solids (TDS) of about 3,000 mg/L (seawater has an average concentration of about 35,000 mg/L). It should be mentioned that the average TDS concentration in the portion of the Bay-Delta considered for this concept is about 6,000 TDS and varies widely depending on hydrologic conditions. Accordingly, it is likely that through more detailed evaluations the costs specific to construct the 20 mgd desalting plant would be significantly greater than developed for this report (about $130 million).

CONCEPT PLANS FOCUSED ON DEVELOPING EWA REPLACEMENT SUPPLIES

As shown in **Table VII-1**, two concept plans were formulated to address the planning objective of developing less-costly EWA replacement water supplies. Each includes diverting surplus flows from the Delta to an expanded Los Vaqueros Reservoir, and constructing delivery facilities to Central Valley Project (CVP) and State Water Project (SWP) water users affected by EWA pumping curtailments. The facilities associated with these concept plans would generally be similar to those previously described for Concept Plan 2 – Enlarge Los Vaqueros Dam and Reservoir for Water Supply Reliability. In both of the concept plans, deliveries would be made to SBA water users from the expanded reservoir; the resulting pumping reduction at Banks Pumping Plant then could be used either to deliver EWA supplies south of the Delta or to directly accommodate EWA fish actions (pumping curtailments) at the export facilities.

To provide a measure of the relative accomplishments of the concept plans, an average annual EWA purchase of 225,000 acre-feet per year, consistent with the Operations Criteria and Plan (OCAP), was used. During dry years, the majority of EWA supplies are purchased from sources north of the Delta where more water is typically available. During wet years, the program typically obtains all supplies from sources south of the Delta. Because the impacts of pumping curtailments are more evident during average and wet years, the supplies developed in these concept plans would primarily replace EWA south-of-Delta purchases.

A primary unit of measurement for determining EWA replacement supply benefits in this study is acre-feet yield over long-term average annual conditions. This differs from the drought period yield used to estimate benefits for the water supply reliability concept plans. This is because the major benefit of the EWA is the ability to reduce pumping from the Delta often, in both average and wet years.

The two concept plans described below are similar; however, the first delivers water from Los Vaqueros Reservoir to the SBA at the Dyer Canal Back Surge Pool, while the second delivers water to Bethany Reservoir.

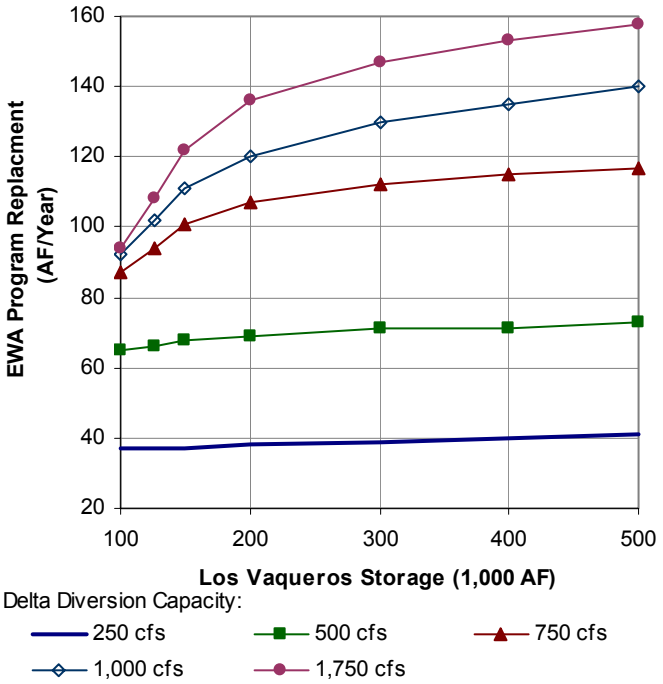
4 - Enlarge Los Vaqueros with Dyer Canal Intertie for EWA

This concept plan includes expansion of Los Vaqueros Reservoir and Delta diversion capacity, and transmission facilities from an expanded Los Vaqueros Reservoir directly to the SBA at the Dyer Canal Back Surge Pool. The plan would address the EWA replacement supply objective by developing water supplies in Los Vaqueros Reservoir for delivery to SBA users during periods of EWA pumping curtailment at Banks Pumping Plant. Water that would have been pumped to the SBA from Bethany Reservoir during periods of EWA pumping curtailment could then be directed elsewhere in the CVP/SWP system to compensate other impacted water users. The potential EWA replacement supplies developed from this concept plan would be limited by the existing capacity of the SBA.

Primary Features

As with previously described plans, numerous potential combinations of Los Vaqueros Reservoir enlargement and Delta diversion capacity exist, and additional study would be required to

determine the most appropriate facility sizes for each plan. **Figure VII-7** shows a plot of estimated average annual EWA replacement yield resulting from various Los Vaqueros Reservoir enlargements (ranging from 100,000 acre-feet to 500,000 acre-feet) and Delta diversion capacities. The replacement amounts shown in the figure were derived using CALSIM II with average annual EWA demands ranging up to 225,000 acre-feet. Comparing the relationships in **Figure VII-7** with possible costs for various sizes of projects suggests that a concept plan consisting of (1) enlarging the Delta diversion/pumping capacity to approximately 1,000 cfs would be the most cost-efficient of the sizes considered and (2) enlarging Los Vaqueros Reservoir up to 500,000 acre-feet would result in significant additional EWA replacement supply benefits at only marginally increased costs. Accordingly, the primary features of this concept plan are as follows:



Note: EWA replacement supply for specific reservoir capacities varies depending on relative combination of Delta diversion/pumping sizes.

FIGURE VII-7– EWA REPLACEMENT SUPPLIES DEVELOPED UNDER VARIOUS LOS VAQUEROS ENLARGEMENTS AND DELTA PUMPING CAPACITY COMBINATIONS (DYER CANAL INTERTIE)

- Reconstructing Los Vaqueros Dam from a crest elevation of 487 feet to 656 feet, and enlarging Los Vaqueros Reservoir from 100,000 acre-feet to 500,000 acre-feet.
- Increasing the diversion and conveyance capacity from the Delta to Los Vaqueros Reservoir to 1,000 cfs. The capacity of the existing 250 cfs Old River facility would likely be increased by 250 cfs and supplemented with a new 750 cfs central Delta pumping facility.
- Constructing conveyance facilities from Los Vaqueros Reservoir to the SBA at the Dyer Canal Back Surge Pool.

As mentioned, future studies are needed to consider the relative advantages of a new central Delta diversion facility as opposed to increasing the capacity at or near the existing Old River facility. In addition, future studies will consider numerous pumping and pipeline configurations from the Delta to Los Vaqueros Reservoir and from the reservoir to the SBA or to Bethany Reservoir (see Concept Plan 5).

Accomplishments

As shown in **Figure VII-7**, enlarging Los Vaqueros Reservoir by 400,000 acre-feet, increasing diversion capacities from the Delta to 1,000 cfs, and constructing an intertie to the SBA Dyer

Canal could replace about 140,000 acre-feet per year (average annual yield) of EWA purchases. This represents about 62 percent of the EWA's average annual water acquisition target.[3]

In addition to potentially providing a less-costly supply for the EWA, this concept plan would also provide additional flexibility and reliability to the program. Currently, the EWA relies on surplus capacity in reservoirs such as Oroville or San Luis reservoirs to store acquired water supplies; these supplies typically have low priority, and are first to spill from the reservoirs. The EWA also relies partly on surplus pumping capacity at Banks and Tray pumping plants to move EWA supplies south of the Delta; as demands in the Central Valley continue to grow, surplus pumping capacity may be available to the EWA less often. This concept plan would provide dedicated storage and conveyance facilities for the EWA, improving operational flexibility and reliability. In addition, an expanded Los Vaqueros Reservoir would be supplied by a new Delta intake with more efficient screens than those at the south Delta export facilities, thereby reducing impacts to Delta fisheries caused by moving EWA water supplies.

Although this concept plan would focus on EWA water supply replacement, some increase would occur in drought period water supply reliability for Bay Area agencies. However, the water supply reliability benefits are considered incidental. This concept could decrease average annual chloride concentrations by about 16 mg/L (25 percent) over without-project conditions, and reduce the maximum salinity concentrations in delivered water by about 152 mg/L (83 percent).

Impacts and Mitigation

Major reservoir area relocations and other impacts related to enlarging Los Vaqueros Reservoir by 400,000 acre-feet are summarized in **Table VII-3**.

Costs

The preliminary estimated first cost for this plan is about $1.2 billion (see **Table VII-4**).

5 - Enlarge Los Vaqueros Reservoir with Bethany Reservoir Intertie for EWA

This concept also would focus on providing a less-costly replacement water supply for the EWA. It would be similar to the concept above, except a gravity pipeline would convey water from Los Vaqueros Reservoir to Bethany Reservoir instead of to the Dyer Canal. Existing facilities could then be used to deliver EWA replacement supplies from Bethany Reservoir, effectively replacing south of Delta EWA purchases. The primary advantage of a Bethany Reservoir intertie is the potential to offset a larger portion of EWA acquisitions than pumping directly to the SBA. Unlike the previous plan, the capacity or demands of the SBA would not restrict EWA deliveries under this concept plan. In addition, a potential exists for the Bethany Reservoir intertie to be less-costly to construct or operate.

[3] For the purpose of comparing concept plants, contribution to EWA is based on an average annual EWA water acquisition target of 225,000 acre-feet consistent with the Operations Criteria and Plan (OCAP). The EWA typically purchases from 200,000 to 300,000 acre-feet per year.

This concept plan would not gain local acceptability without certain operating constraints or restrictions that would satisfy the CCWD Principles of Participation (described in **Chapter II**), in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. Water could be supplied for the EWA through either reductions in Delta pumping to benefit fish, or replacing south of Delta EWA purchases. In addition, such a project could not be operated in conjunction with a peripheral canal or to increase the export of water from Northern California. Just as would be required in the case of a Dyer Canal intertie, permit terms and conditions, as well as contractual arrangements, would be required to ensure that the CCWD principles are satisfied.

Primary Features

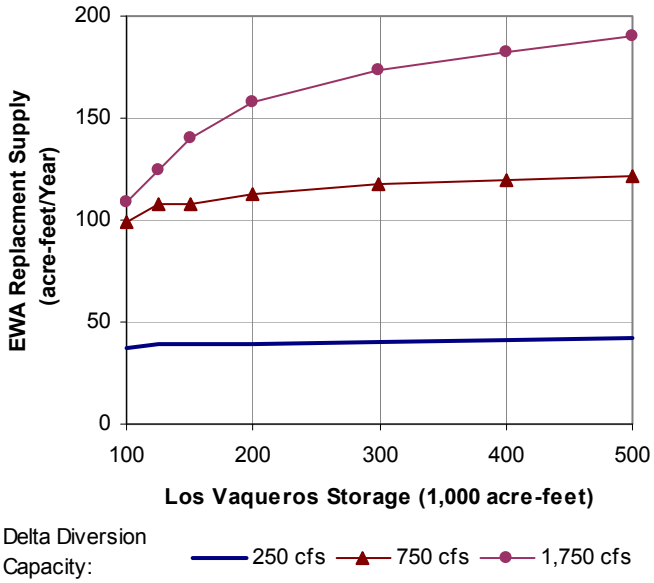
Primary features of this concept plan are listed below. As noted previously, facility sizes are preliminary and would be refined in future studies, if this concept plan is carried forward.

- Reconstructing Los Vaqueros Dam from a crest elevation of 487 feet to 656 feet to increase storage capacity from 100,000 acre-feet to 500,000 acre-feet.
- Increasing diversion and conveyance capacity from the Delta to the enlarged Los Vaqueros Reservoir from 250 cfs to 1,750 cfs (the existing Old River Pumping Plant increased to 750 cfs and supplemented with a new 1,500 cfs central Delta pumping facility).
- Constructing conveyance facilities from the expanded reservoir to Bethany Reservoir. This would include a check structure to prevent higher quality water from Los Vaqueros Reservoir from mixing with lower quality water in Bethany Reservoir prior to delivery to SBA agencies.

Accomplishments

As shown in **Figure VII-8**, enlarging Los Vaqueros Reservoir by 400,000 acre-feet, increasing Delta diversion capacity to 1,750 cfs, and connecting the reservoir to the SBA at Bethany Reservoir would yield about 190,000 acre-feet per year (average annual) EWA replacement supplies. This represents about 84 percent of the average annual water acquisition target for the EWA of about 225,000 acre-feet per OCAP (see footnote 3 on page VII-18).

Although this concept would focus on developing EWA replacement supplies, some increase in drought period water



Note: EWA replacement supply for specific reservoir capacities varies depending on relative combination of Delta diversion/ pumping plant sizes.

FIGURE VII-8 – EWA REPLACEMENT SUPPLIES DEVELOPED UNDER VARIOUS COMBINATIONS OF LOS VAQUEROS RESERVOIR ENLARGEMENT AND DELTA PUMPING CAPACITY (BETHANY INTERTIE)

supply reliability would occur. However, this contribution is considered incidental. Further, with this concept plan, average annual chloride concentrations would decrease by about 16 mg/L (25 percent) over without-project conditions, and the maximum salinity concentration would decrease by about 151 mg/L (82 percent) (see footnote 2 on page VII-10).

Impacts and Mitigation

Primary reservoir area relocations and other impacts related to enlarging Los Vaqueros Reservoir by 500,000 acre-feet are summarized in **Table VII-3**.

Costs

The preliminary estimated first cost for this plan is about $1.47 billion (see **Table VII-4**).

CONCEPT PLANS FOCUSED ON COMBINED OBJECTIVES

Retained measures could be combined in numerous ways, with many potential facility size combinations. However, three concept plans were formulated to represent a reasonable balance between the objectives of water supply reliability, EWA replacement supply, and water quality. Each of the combined objective concept plans consists of enlarging Los Vaqueros Reservoir and associated Delta diversion and conveyance facilities primarily for the purposes of increasing water supply reliability and developing EWA replacement supplies.

As with other concept plans, numerous potential combinations and sizes of the various system components exist. For example, **Figure VII-9** shows potential average annual contributions to EWA and drought period yield for water supply reliability for various sizes of an enlarged Los Vaqueros Reservoir and increased Delta diversion capacities under a scenario of water delivery to the SBA at the Dyer Canal. Similar relationships would be indicated for a water delivery scenario to Bethany Reservoir but, as noted below, the contribution to EWA replacement supplies would be larger.

However, for comparison purposes in this report, each of the combination concept plans was formulated with the following major components:

- Reconstructing Los Vaqueros Dam from a crest elevation of 487 feet and enlarging Los Vaqueros Reservoir from 100,000 acre-feet to 500,000 acre-feet.
- Increasing the diversion and conveyance capacity from the Delta to the enlarged Los Vaqueros Reservoir from 250 cfs to 1,750 cfs. Under each concept plan, the Old River facility would be expanded to a capacity of 750 cfs and a new central Delta facility would provide an additional 1,000 cfs capacity.
- Construct new pumping and conveyance facilities from the central Delta diversion to Los Vaqueros Reservoir.

There are numerous other combinations of facilities and facility sizes that will need to be evaluated in future studies should these concept plans be carried forward for development into detailed alternative plans.

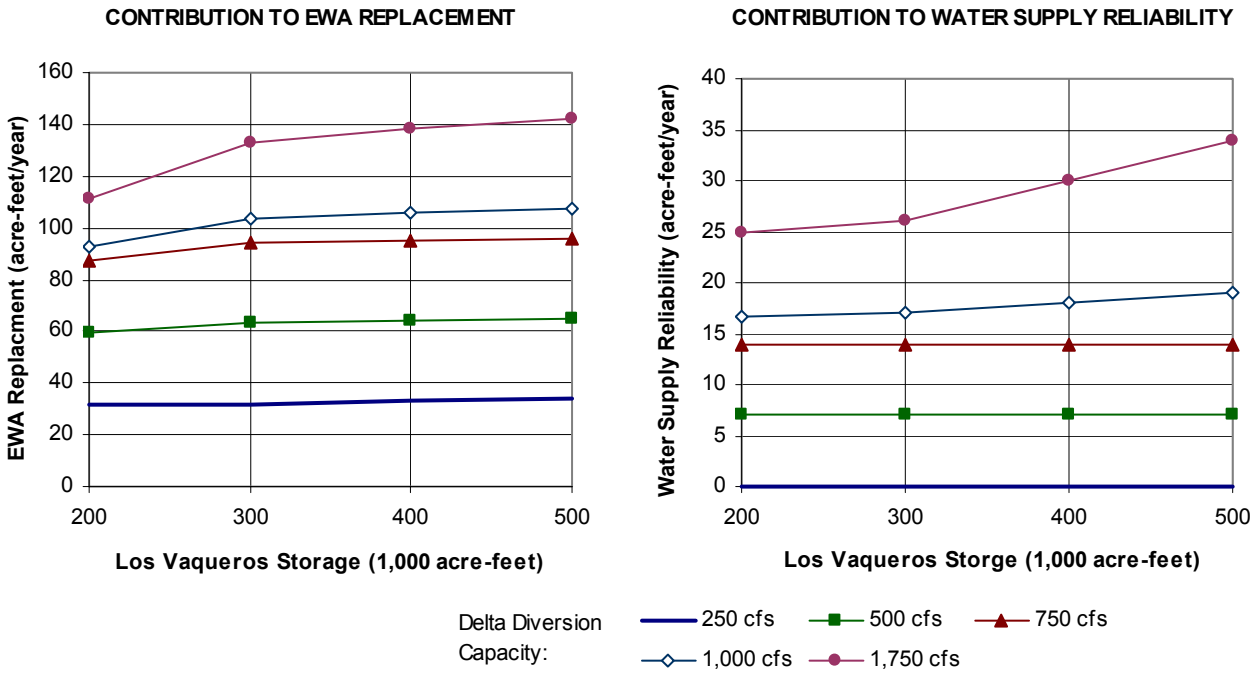


FIGURE VII-9 – POTENTIAL CONTRIBUTIONS TO EWA SUPPLY REPLACEMENT AND DROUGHT PERIOD WATER SUPPLY RELIABILITY FOR VARIOUS COMBINATIONS OF LOS VAQUEROS RESERVOIR ENLARGEMENT AND DELTA DIVERSION CAPACITY (DYER CANAL INTERTIE) FOR COMBINED OBJECTIVE PLAN

6 - Water Supply / EWA Combination with Dyer Canal Intertie

This concept was formulated for the purposes of providing EWA replacement supplies and improving Bay Area water supply reliability. It is similar to Concept Plan 4 described previously, except a portion of the increased space in Los Vaqueros would be dedicated to water supply reliability. As mentioned, the facility sizes for this concept were chosen primarily for comparison consistency with the other combination concept plans. The accomplishments and economics of this concept plan are summarized below.

Accomplishments

Enlarging Los Vaqueros Reservoir by 400,000 acre-feet to 500,000 acre-feet, increasing diversion capacity from the Delta, and connecting the reservoir with the SBA at the Dyer Canal appear to provide the maximum increase in drought year reliability and EWA replacement supply. This plan could yield as much as 34,000 acre-feet per year during drought periods, and replace about 142,000 acre-feet per year (average annual) EWA purchases. This would result in an estimated 22 percent reduction in 2020 water shortages in the study area (see footnote 1 on page VII-10), and an estimated 63 percent of the total average annual acquisition target of the EWA (see footnote 3 on page VII-18). Further, average annual chloride concentrations would decrease by about 17 mg/L (26 percent) (see footnote 2 on page VII-10) over without-project

conditions, and maximum salinity concentrations would decrease by about 152 mg/L (82 percent).

Impacts and Mitigation

Major reservoir area relocation and other impacts related to enlarging Los Vaqueros Reservoir by 400,000 acre-feet are summarized in **Table VII-3**.

Costs

The preliminary estimated first cost for this concept plan is $1.54 billion (see **Table VII-4**).

7 - Water Supply / EWA Combination with Bethany Reservoir Intertie

This concept plan primarily consists of enlarging Los Vaqueros Reservoir for the purposes of increasing Bay Area water supply reliability and replacing EWA assets. It is similar to the combination concept plan described above, but it includes a gravity pipeline to convey water from Los Vaqueros Reservoir to Bethany Reservoir rather than to the Dyer Canal. Existing facilities would be used to deliver EWA supplies to CVP and SWP users primarily on the SBA. Unlike Concept Plan 6, the capacity or demands of the SBA would not limit the amount of EWA supplies that could be developed under this concept plan.

This concept plan would not gain local acceptability without certain operating constraints or restrictions that would satisfy the CCWD Principles of Participation (described in **Chapter II**), in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. Water could be supplied for the EWA through either reductions in Delta pumping to benefit fish, or replacing south of Delta EWA purchases. In addition, such a project could not be operated in conjunction with a peripheral canal or to increase the export of water from Northern California. Just as would be required in the case of a Dyer Canal intertie, permit terms and conditions, as well as contractual arrangements, would be required to ensure that the CCWD principles are satisfied.

There are numerous potential combinations of facility sizes for this concept plan. As with the previous concept plan, facility sizes were chosen such that the plan contributed to each primary objective, resulted in a relatively low unit water cost for each objective, and was comparable with the other concept plans.

Accomplishments

Enlarging Los Vaqueros Reservoir by 400,000 acre-feet to 500,000 acre-feet, increasing diversion capacity from the Delta, and connecting Los Vaqueros Reservoir to Bethany Reservoir would provide the maximum drought year water supplies and EWA replacement supplies for this concept plan. Drought year yield from the project could be as high as 19,000 acre-feet per year, and average annual EWA replacement yield as high as 173,000 acre-feet per year. This would represent a 13 percent reduction in 2020 water shortages in the study area (see footnote 1 on page VII-10), and an estimated 77 percent of the total average annual water acquisition target for the EWA (see footnote 3 on page VII-18). Further, average annual chloride concentrations

would decease by about 15 mg/L (23 percent) (see footnote 2 on page VII-10) over without-project conditions, and maximum (peak) salinity concentrations would decrease by about 152 mg/L (82 percent).

Impacts and Mitigation

Major reservoir area relocation and other impacts related to enlarging Los Vaqueros Reservoir by 400,000 acre-feet are summarized in **Table VII-3**.

Costs

The preliminary estimated first cost for this concept plan is $1.47 billion (see **Table VII-4**).

8 - Water Supply / EWA Combination with Water Quality Improvements

This concept plan is similar to Concept Plan 6, which focuses on increasing Bay Area water supply reliability and replacing EWA supplies. However, the completed project for this concept plan would be operated to improve the quality of water developed for both supply reliability and EWA purposes. In addition to increasing the capacity of Los Vaqueros Reservoir to 500,000 acre-feet and the Delta diversion and pumping capacity to 1,750 cfs, this concept consists of conveyance facilities from the outlet of Los Vaqueros Reservoir to the SBA at Dyer Canal, as in Concept Plan 6.

Each of the previous concept plans, on average, improves the quality of water delivered to SBA water users and developed for EWA replacement. However, occasions occur when the quality of water delivered by the project would be slightly worse than what would be delivered under existing conditions, as illustrated by the lower (blue) line in **Figure VII-10**. The objective of this concept plan is to achieve equivalent or better delivered water quality than under without-project conditions at all times, as illustrated by the upper (red) line in **Figure VII-10**. The primary impact of these operational changes for water quality is a reduction in the amount of water available for EWA replacement and a slight increase in the drought period yield for water supply reliability.

Accomplishments

Enlarging Los Vaqueros Reservoir by 400,000 acre-feet to 500,000 acre-feet, increasing diversion capacity from the Delta, connecting the reservoir with the SBA at the Dyer Canal, and operating the project to enhance water quality would improve water supply reliability during drought years and develop EWA replacement supplies. It is estimated that the drought year yield could be as much as 47,000 acre-feet per year, and the project would develop about 80,000 acre-feet per year (average annual) EWA replacement supply. This would result in a 31 percent reduction in 2020 water shortages in the study area (see footnote 1 on page VII-10), and 36 percent of the total average annual water acquisition target for the EWA (see footnote 3 on page VII-18). Further, the quality of water available for water supply reliability and EWA replacement would consistently improve.

Impacts and Mitigation

Major reservoir area relocations and other impacts related to enlarging Los Vaqueros Reservoir by 400,000 acre-feet are summarized in **Table VII-3**.

Costs

The preliminary estimated first cost for this concept plan is $1.54 billion (see **Table VII-4**).

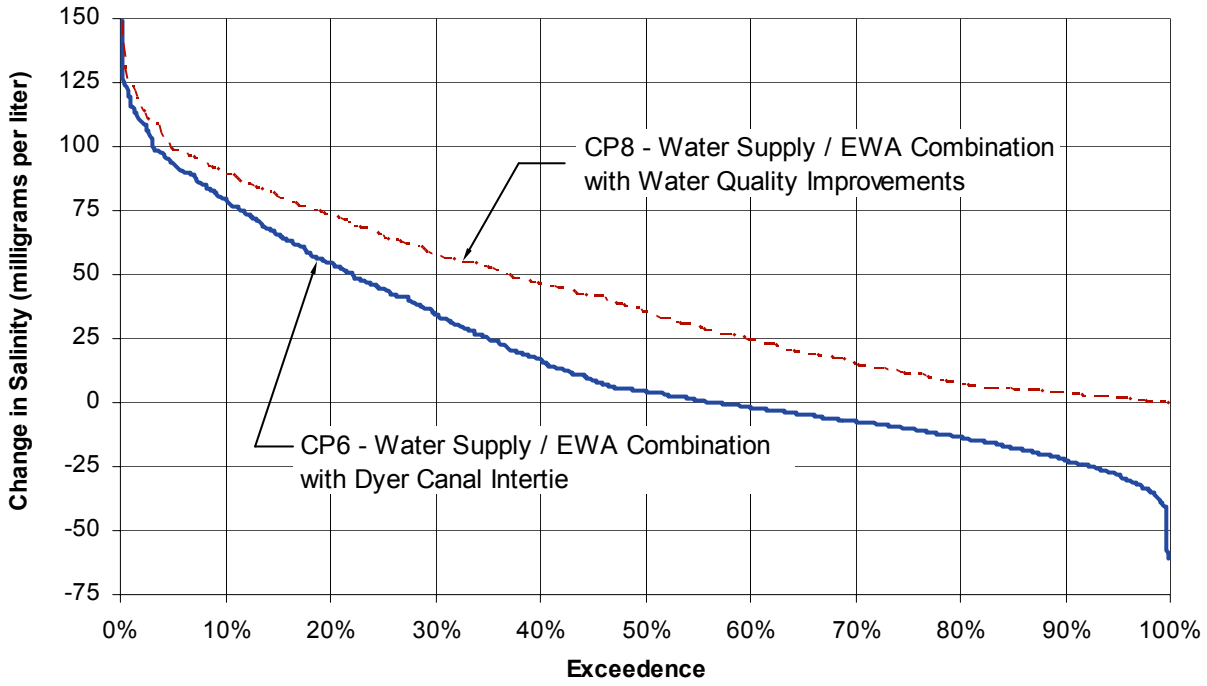


FIGURE VII-10 – FREQUENCY DISTRIBUTION PLOT ILLUSTRATING THE DIFFERENCE IN WATER QUALITY FOR CONCEPT PLANS 6 AND 8

CHAPTER VIII
CONCEPT PLAN COMPARISON

This chapter compares the concept plans described in **Chapter VII** and identifies initial alternatives that should be further developed into detailed alternative plans in the Los Vaqueros Expansion Investigation (LVE).

CRITERIA AND COMPARISON

To help focus the plan formulation process and develop the most appropriate detailed plans to be considered for implementation, the concept plans in **Chapter VII** were compared against each other using four general criteria - completeness, effectiveness, efficiency, and acceptability – based on the Federal Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). Below are descriptions of each criterion and how it was applied to the comparison. **Table VIII-1** compares the plans in terms of their ability to address each of the four criteria, with each plan assigned a relative ranking ranging from very low to very high. An overall relative ranking of the concept plans also is presented in the table, based on equal weighting of the rankings for the four criteria. This overall ranking was used, along with other information, to determine if a concept plan should be considered further in the LVE plan formulation process.

It is important to reiterate that there are many potential combinations and sizes of facilities that could be included in each concept plan described in **Chapter VII** and compared herein. Accordingly, the recommendations in **Table VIII-1** apply primarily to the combination of measures and facilities represented by each plan, with the assumption that appropriate facility sizes or applications will be refined in future studies. Similarly, it should be noted that the estimated costs and benefits of the concept plans presented in this chapter are based on previous studies and supplemented with other preliminary analyses. Additional tools and analyses will be developed in the next phase of the feasibility study to refine these preliminary cost and benefit estimates as detailed alternative plans take shape.

Completeness Criterion

Completeness is a determination of whether a plan includes all elements necessary to realize planned effects. It also is an indication of the degree that intended benefits of the plan depend on the actions of others. Completeness does not focus on the relative magnitude of plan benefits or accomplishments; rather, it indicates whether a plan has considered everything necessary to successfully implement the plan (without unmitigated adverse impacts) and reliably achieve the stated benefits.

TABLE VIII-1
CONCEPT PLAN COMPARISON SUMMARY

Concept Plans	Comparison Criteria				Further Development Status and Overall Ranking
	Completeness	**Effectiveness**	**Efficiency**	**Acceptability**	
Bay Area Water Supply Reliability Focus					
1 – Raise Los Vaqueros Dam In-Place for Bay Area Water Supply Reliability	Can be physically implemented with minimal impacts; would not require future elements; is consistent with study authorization; and addresses water supply reliability objective.	Potential to provide nearly 30 percent reduction in 2020 drought period shortages for Bay Area water users.	Lowest implementation cost but lower drought period yield. Low cost per unit of output compared with other plans focused on water supply reliability.	Consistent with goals of CALFED.	Although lower yield, **identified for further development** because of very low implementation cost.
	High	*Low*	*Moderate*	*High*	***Moderate***
2 – Enlarge Los Vaqueros Dam and Reservoir for Bay Area Water Supply Reliability	Can be physically implemented; would not require future elements; is consistent with study authorization; and addresses water supply reliability objective.	Potential to provide almost 65 percent reduction of 2020 drought period shortages for Bay Area water users.	Moderate yield but higher cost per unit of output for water supply reliability than above concept plan.	Consistent with plan in CALFED ROD.	**Identified for further development** because of potential to significantly address water supply reliability for Bay Area.
	High	*Moderate*	*Moderate*	*High*	***Moderate-High***
3 – Desalination with Storage (Enlarge Los Vaqueros Reservoir) for Bay Area Water Supply Reliability	Can be physically implemented; is consistent with study authorization; and addresses water supply reliability objective. Increased uncertainty relating to reliability and efficiency to implement and maintain desalination facilities and mitigate for brine disposal impacts.	Potential to provide about 75 percent reduction of 2020 drought period shortages for Bay Area water users.	Highest yield but also the highest cost per unit of output for water supply reliability.	Consistent with goals of CALFED. May be difficult to mitigate process byproducts (brine) to a level acceptable to other Bay Area water resources interests.	**Not identified for further development** as a stand alone alternative primarily because of highest cost per unit of water supply developed of any plan considered.
	Moderate	*Moderate*	*Low - Moderate*	*Moderate*	***Low-Moderate***

Table VIII-1 (CONT.)

Concept Plans	Comparison Criteria				Further Development Status and Overall Ranking
	Completeness	**Effectiveness**	**Efficiency**	**Acceptability**	
EWA Replacement Supply Focus					
4 – Enlarge Los Vaqueros Reservoir with Dyer Canal Intertie for EWA	Can be physically implemented; would not require future elements; is consistent with study authorization; and addresses EWA replacement supply objective.	Potential to replace over 60 percent of average annual EWA water acquisition target.	Moderately high cost per unit of output for relatively low EWA replacement supply.	Consistent with goals of CALFED and potential for Federal interest in EWA replacement supply objective.	**Identified for further development,** although, at this time, does not appear to be as efficient as Concept Plan 5 (with intertie to Bethany Reservoir).
	High	*Low-Moderate*	*Moderate*	*Moderate-High*	***Moderate***
5 – Enlarge Los Vaqueros Reservoir with Bethany Reservoir Intertie for EWA	Can be physically implemented; would not require future elements; consistent with study authorization; and addresses EWA replacement supply objective.	Potential to replace about 85 percent of average annual EWA water acquisition target.	Moderate cost per unit of output for EWA replacement supply and highest yield of the concept plans.	Similar to Concept Plan 4.	**Identified for further development** primarily because it would result in the largest potential EWA replacement supply.
	High	*Moderate-High*	*Moderate*	*Moderate-High*	***Moderate-High***
Combined Objective					
6 – Water Supply / EWA Combination with Dyer Canal Intertie	Can be physically implemented; would not require future elements; consistent with study authorization; and addresses primary study objectives.	Potential to provide over 20 percent reduction of 2020 drought period shortages for Bay Area water users and replace over 60 percent of average annual EWA water acquisition target.	Relatively low drought period yield and EWA replacement supplies with low to moderate cost per unit of output for both water supply reliability and EWA.	Consistent with goals of CALFED and potential for Federal interest in EWA replacement supply objective.	Although relatively low yields, **identified for further development** because of low to moderate costs per unit of output for both supply reliability and EWA replacement supply.
	High	*Moderate*	*Moderate-High*	*High*	***High***

Table VIII-1 (CONT.)

Concept Plans	Comparison Criteria				Further Development Status and Overall Ranking
	Completeness	**Effectiveness**	**Efficiency**	**Acceptability**	
7 – Water Supply / EWA Combination with Bethany Reservoir Intertie	Can be physically implemented; would not require future elements; consistent with study authorization; and addresses primary study objectives.	Potential to provide about 15 percent reduction of 2020 drought period shortages for Bay Area water users and replace nearly 80 percent of average annual EWA water acquisition target.	Similar to Concept Plan 6.	Similar to Concept Plan 6.	**Identified for further development** primarily because it would result in the lowest cost for EWA replacement supply, and high potential for Federal interest.
	High	*Moderate-High*	*Moderate-High*	*High*	***High***
8 – Water Supply / EWA Combination with Water Quality Improvements	Can be physically implemented; would not require future elements; reduced certainty of improving water quality conditions under all circumstances; is consistent with study authorization; and addresses all study objectives.	Potential to provide nearly about 30 percent reduction of 2020 drought period shortages for Bay Area water users and replace about 40 percent of average annual EWA water acquisition target. Also provides a significant improvement in SBA water quality.	Overall highest cost per unit of water supply reliability and EWA replacment output of combination plans considered.	Consistent with plan in CALFED ROD and potential for Federal interest.	**Identified for further development** primarily because it is consistent with the plan in the CALFED ROD and balances study objectives.
	High	*Moderate*	*Low-Moderate*	*High*	***Moderate-High***

KEY: CALFED = CALFED Bay-Delta Program EWA = Environmental Water Account ROD = Record of Decision SBA = South Bay Aqueduct

Each concept plan was assigned a relative completeness ranking, from low to high, depending on the relative degree of completeness and considering the following completeness factors:

- **Authorization / Objectives –** A complete plan would be consistent with the basic study authorization and would address each of the major planning objectives, while providing opportunities to address other identified objectives or needs. For example, a plan that only addresses water supply reliability for San Francisco Bay Area (Bay Area) water users would rate lower for this sub-criterion because the plan did not significantly address all of the study objectives. Accordingly, the combination concept plans would generally rate higher for completeness than other concept plans.

- **Reliability –** A complete plan would be capable of providing the specific and sustained benefits for which it was formulated over the life of the project. Reliability reflects whether other projects, programs, or actions are necessary to implement the project and develop the full level of benefits for which the plan was intended, over and above identified operations and maintenance (O&M). For example, a plan that requires complex legal arrangements between multiple parties might have lower reliability due to the uncertainty associated with the ability to obtain these agreements. Concept Plan 3 ranked lower for completeness, partly because desalination technologies are relatively new and untested under long-term operating conditions.

- **Physical Implementability –** A complete plan can be physically constructed or implemented within the study area as described, with disclosure of any unusual construction challenges. For example, implementability might consider uncertainty regarding the ability to construct a project feature along a major, active earthquake fault. All of the concept plans are believed to have a high potential for physical implementation.

- **Environmental Resources –** A complete plan must either avoid potential adverse environmental impacts or successfully mitigate for unavoidable adverse impacts. All of the concept plans are believed to have a high potential to avoid or successfully mitigate environmental impacts, with the exception of Concept Plan 3 (due to potential environmental issues associated with brine disposal).

- **Water and Related Resources –** Completeness also considers whether or not a plan can be implemented to mitigate any unavoidable impacts to water, power, recreation, water quality, flood control, and/or related resources. All plans that include enlarging Los Vaqueros Reservoir could provide additional recreation and ecosystem restoration opportunities, and plans with an intertie to Bethany Reservoir have the potential to provide hydropower benefits.

- **Other Redirected or Adverse Impacts –** A complete plan would avoid or mitigate for other potential adverse or redirected impacts. These could include hydraulic impacts to area streams or Sacramento-San Joaquin Delta (Delta) waterways, historic or cultural resources, or water quality.

Effectiveness Criterion

Effectiveness is the extent to which a plan alleviates the identified problems and achieves study planning objectives. For the LVE, effectiveness of the concept plans was evaluated in three ways: (1) contribution to Bay Area water supply reliability, (2) potential Environmental Water Account (EWA) replacement supply, and (3) potential to improve water quality. Preliminary water supply yield and water quality estimates were derived from a "stand-alone" Los Vaqueros Reservoir model, developed using the CALSIM software. The stand-alone model uses pre-processed data from CALSIM II (availability of Delta Surplus) and DSM2 (water quality at Delta intakes). The stand-alone model is described in **Chapter IX**. When determining a plan's overall effectiveness ranking, water supply reliability and EWA replacement supply achievements were given greater consideration than water quality improvement.

- **Water Supply Reliability -** Because the greatest need for water in the study area is during dry and critically dry periods, a plan's contribution to Bay Area water supply reliability was measured using drought period yield (October 1986 through September 1992). As shown in **Table VIII-2**, the plans with the greatest water supply reliability yields were the Desalination and Los Vaqueros Enlargement concept plans focusing on water supply reliability. The combined objective concept plans provided significantly less supply reliability benefits.

- **EWA Replacement Supply –** Unlike water supply reliability, effectiveness of an EWA replacement supply was evaluated using average annual yield. This is because EWA actions are tied primarily to the presence of at-risk fish at the south Delta pumps, which occurs in all year types. It should be noted that modeling tools necessary to simulate integrated operation of EWA with the Central Valley Project (CVP) and State Water Project (SWP) are currently under development. Consequently, EWA yield estimates presented in **Table VIII-2** are preliminary and were developed using existing tools. Actual benefits may differ when an integrated operations model is completed that can consider EWA operations in relation to California's overall water management system. The greatest average annual replacement yield for EWA was achieved by Concept Plan 5, followed by Concept Plan 7.

- **Water Quality –** Although a detailed evaluation of water quality was not performed for the concept plans, Concept Plan 8 appears to have the greatest potential to provide significant water quality benefits.

As indicated in **Table VIII-1**, the concept plans that ranked highest in effectiveness were Concept Plans 5 and 7. These plans appear to have the greatest potential to provide a high EWA replacement yield. Several of the concept plans ranked moderate for effectiveness, but no plans appeared highly effective at meeting all three of the LVE planning objectives.

TABLE VIII-2
SUMMARY OF CONCEPT PLAN FEATURES, ACCOMPLISHMENTS, AND COSTS

Concept Plans	Bay Area Water Supply Reliability Focus			EWA Replacement Focus		Combined Objective Focus		
Item	1 Raise Los Vaqueros Dam In-Place	2 Enlarge Los Vaqueros Dam & Reservoir	3 Desalination w/ Storage (Enlarge Los Vaqueros)	4 Enlarge Los Vaqueros with Dyer Canal Intertie	5 Enlarge Los Vaqueros with Bethany Reservoir Intertie	6 Water Supply/ EWA Combination w/ Dyer Canal Intertie	7 Water Supply/ EWA Combination w/ Bethany Reservoir Intertie	8 Water Supply/ EWA Combination w/ Water Quality
Concept Plan Features [1]								
Los Vaqueros Capacity (TAF)	125	500	500	500	500	500	500	500
Delta Pumping Capacity (cfs) [2]	750	750	750	1,000	1,750	1,750	1,750	1,750
Los Vaqueros Delivery Intertie Location	Dyer Canal	Dyer Canal	Dyer Canal	Dyer Canal	Bethany Reservoir	Dyer Canal	Bethany Reservoir	Dyer Canal
Desalination Capacity (mgd)	-	-	20	-	-	-	-	-
Accomplishments [3]								
Drought Period Yield (TAF/Year) [4]	43	95	110	-	-	34	19	47
Drought Period Shortage Reduction [5]	*28%*	*63%*	*72%*	-	-	*22%*	*13%*	*31%*
EWA Replacement Yield (TAF/year) [6]	-	-	-	140	190	142	173	81
Contribution to EWA [7]	-	-	-	*62%*	*84%*	*63%*	*77%*	*36%*
Decrease in Salinity (mg/L Cl) [8]	11	15	13	16	16	17	15	44 [11]
Costs ($ Millions) [9]								
Total First Cost	470	1,050	1,260	1,170	1,470	1,540	1,470	1,540
Present Value Cost [10]	720	1,640	2,270	1,590	2,010	2,160	2,040	2,160

KEY: Cl = chlorides cfs = cubic feet per second EWA = Environmental Water Account mgd = million gallons per day mg/L = milligrams per liter TAF = thousand acre-feet

1. *Reservoir storage, pumping, conveyance, and desalination capacities are preliminary estimates, and except where noted in Chapter VII, are sized considering cost efficiency.*
2. *Includes existing diversion and pumping capacity at Old River to CCWD of 250 cfs.*
3. *Accomplishments of all concept plans (water supply reliability, EWA replacement, and water quality improvements) are in addition to the without-project conditions. Several without-project conditions include Los Vaqueros Reservoir at 100,000 acre-feet, 250 cfs Delta diversion at Old River, and all deliveries made to meet CCWD demands.*
4. *Drought period is defined as October 1986 through September 1992. Future modeling will redefine period to be identical with CALFED Common Assumptions metrics.*
5. *Based on preliminary estimate of 2020 average annual drought period shortage in the region of about 152,000 acre-feet. Future studies will better quantify shortages in the area.*
6. *EWA replacement supply is based on average annual yield.*
7. *Contribution to EWA based on average annual EWA acquisition target of 225,000 acre-feet, consistent with OCAP. EWA typically purchases 200,000 to 300,000 acre-feet per year.*
8. *Long-term average decrease in salinity for deliveries to the South Bay Aqueduct as compared to Clifton Court Forebay salinity values.*
9. *Preliminary cost estimates based on October 2004 pricing levels and rounded to nearest $10 million.*
10. *Includes first cost; interest during construction; and annual operation, maintenance, major replacement allowance, and energy costs computed at a present value over a 100-year period of analysis at 5-3/8% interest rate.*
11. *Preliminary water quality accomplishments will be reviewed with improved operating logic in future studies.*

Efficiency Criterion

The efficiency criterion is primarily the measure of how economically efficiently a plan can alleviate the identified problems while realizing specified objectives consistent with protecting the Nation's environment. Concept plans generally ranked high for this criterion if they provided a significant increase in water supply reliability and/or EWA replacement supply at a relatively low cost, while also contributing to the water quality objective.

Comparing the efficiency of concept plans is challenging for several reasons. The concept plans have not been developed to a high level of detail, operational simulations have not yet been refined to optimize benefits, and benefits are expressed differently for the water supply reliability objective (drought period yield) and the EWA replacement supply objective (average annual yield). **Table VIII-3** compares the relative efficiency of the concept plans within each plan category (water supply reliability, EWA replacement supply, or combined objective) using a relative comparison value. The relative comparison value represents a dimensionless measure of relative efficiency. It is the present value cost divided by the yield and then normalized using the sum of all three plans to the base 10. These preliminary calculations were performed to assess which concept might provide the greatest benefits at the lowest relative cost. The figures presented in the table are summarized below.

- **Bay Area Water Supply Reliability Concept Plans –** As can be seen from **Table VIII-3**, the drought period yield for each of the three water supply reliability concept plans varies from 43,000 to about 110,000 acre-feet per year with present value costs ranging from about $720 million to approximately $2.2 billion, respectively. From this information, a relative comparison value was developed. As can be seen, Concept Plans 1 and 2, even with significantly varying yields and costs, appear to result in similar efficiencies. In comparison, it is estimated that Concept Plan 3 would be significantly less efficient, as it would result in the largest cost per unit of water supply output (i.e., higher relative comparison values).

  An analysis to estimate monetary benefits to assess the economic feasibility of enlarging Los Vaqueros Reservoir for water supply reliability will be accomplished in future phases of the feasibility study. However, it is believed that a new drought period supplemental supply for Bay Area water users, including enlarging Los Vaqueros Reservoir, would be highly reliable, result in significant incidental increases in water quality benefits, and significantly add to the overall water supply flexibility of the region. No other known new water source can provide these benefits as cost-efficiently as enlarging Los Vaqueros Reservoir.

- **EWA Replacement Concept Plans –** Similar to the above calculation, a relative comparison value was developed for the two EWA concept plans. As can be seen from **Table VIII-3**, it appears that Concept Plan 5 would be measurably more efficient than Concept Plan 4 even though it would have a higher present value cost. It is believed that the reason for the differences in efficiencies is primarily due to the restricted capacity of the SBA with respect to EWA replacement supplies and the relative cost savings due to the reduced need to pump all EWA water from Los Vaqueros Reservoir to the Dyer Canal.

TABLE VIII-3
SUMMARY COMPARISON OF CONCEPT PLAN EFFICIENCY

Concept Plans	Yield (1,000 acre-feet per Year)		Present Value Cost ($ Millions)		Relative Efficiency	
	Supply Reliability[1]	EWA Replace-ment[2]	Creditable to WSR	Creditable to EWA	Relative Comparison Value[3]	Remarks
Bay Area Water Supply Reliability (WSR) Focus						
1	43	-	720	-	3.0	Lowest cost per unit of output (unit cost) of WSR concepts
2	95	-	1,640	-	3.2	Relatively low unit cost
3	110	-	2,270	-	3.8	Highest unit cost for WSR concepts
					Σ 10.0	
EWA Replacement Focus						
4	-	140	-	1,590	5.2	Highest unit cost of EWA concepts
5	-	190	-	2,010	4.8	Lowest unit cost of EWA concepts
					Σ 10.0	
Combination Plans						
6	34	142	520	1,640	3.0	Lowest unit cost of combination plans
7	19	173	390	1,650	3.3	Relatively low unit cost
8	47	81	520	1,640	3.8	Highest unit cost of combination plans
					Σ 10.0	

KEY: EWA = Environmental Water Account WSR = water supply reliability

Notes:

1. *Drought period yield (October 1986 through September 1992).*
2. *Average annual EWA replacement supply.*
3. *The comparison values represent a dimensionless measure of relative efficiency, and can only be compared against the comparison values of other plans within the same group of concept plans. They represent the cost per unit yield of each plan divided by the sum of the cost per unit yields in that concept plan group, normalized to a base of 10. Using the plans focusing on EWA replacement as an example, the calculations are as follows:*

Plan 4 1,590 / 140 = 11.4 ÷ 21.9 x 10 = 5.2
Plan 5 2,010 / 190 = 10.6 ÷ 21.9 x 10 = 4.8
Σ 21.9 Σ 10.0

The calculation is similar for the combination concept plans except the cost per unit yield is calculated for each purpose (water supply reliability and EWA) then multiplied before being summed and normalized to base 10. The lower the comparison value, the more efficient a plan is in meeting the stated objective(s) compared with other concept plans in that group.

One of the objectives of the LVE is to consider whether supplies developed in an expanded Los Vaqueros Reservoir could be used as a less-costly replacement for EWA supplies acquired through short-term transfers and water market purchases. Detailed economic evaluations will be conducted in the next phase of the LVE to estimate the potential cost of supplies on the water transfer market over the 100-year project life. These costs will be compared with the cost of EWA supplies developed by detailed alternative plans in order to fully quantify the potential benefits of a project.

- **Combination Plans –** Relative comparison values were also developed for the combination plans 6, 7, and 8. This was accomplished by first estimating the portions of the present value costs that could reasonably be creditable to the water supply reliability and EWA replacement objectives, respectively. This relative crediting was based on the ratio of system demands currently in the CALSIM II model for the two purposes. For a Dyer Canal intertie, the ratio was about 25 percent for water supply reliability and 75 percent for EWA. For the Bethany Reservoir intertie, the ratio was approximately 20 and 80 percent, respectively. Future studies using traditional cost allocation procedures will be needed to more accurately estimate these costs. The relative comparison value was then developed by taking the product of the cost per unit yield for each objective and dividing by the sum of the products normalized to the base 10. The comparison values for the combination plans indicate that the relative efficiencies of plans with an intertie to the Dyer Canal or an intertie to Bethany Reservoir would be similar.

  The comparison values also indicate that the economic efficiency of a similarly sized reservoir enlargement plan that includes reoperation for water quality improvements (Concept Plan 8) would decline. However, chlorides in Concept Plan 8 decreased by up to about 44 mg/L over similarly sized plans without reoperation for water quality benefits. Future studies would be needed to determine if the cost savings associated with this improvement in water quality to SBA users would at least equal the value of the resulting reduction in water supply and EWA replacement yield.

Acceptability Criterion

Acceptability is the workability and viability of a plan with respect to acceptance by State and local entities and the public, and compatibility with existing laws, regulations, and public policies. Acceptability may be evaluated according to a plan's ability to be implemented within existing laws and policies; consistency with project planning principles; or the potential for broad-spectrum acceptance or support. Factors influencing local acceptance might include the financial burden of project implementation or the extent to which recreation opportunities are enhanced.

Another factor relating to acceptability by the local sponsor may include the extent to which Contra Costa Water District (CCWD) would retain control of the watershed and operation of the Los Vaqueros Project, as described in CCWD's Principles of Participation in **Chapter II**. Local acceptability may also depend on facility designs or operating constraints put in place to satisfy CCWD's principles, in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. Water could be supplied for the EWA through either reductions in Delta pumping to benefit fish, or replacing south of Delta EWA purchases. In addition, such a project could not be operated in conjunction with a peripheral canal or to increase the export of water from Northern California. Permit terms and conditions, as well as contractual arrangements, could be used to ensure that the CCWD principles are satisfied.

Chapter XI discusses several potential ownership and operation scenarios for an expanded Los Vaqueros Reservoir, but little is known at this time about the specific institutional arrangements that would apply to each of the concept plans. Similarly, it is difficult at this early stage in the feasibility study to gauge the ultimate likelihood for Federal agency acceptance, non-Federal sponsorship, and broad-spectrum support. Consequently, the likelihood for Federal interest, consistency with the CALFED Bay-Delta Program (CALFED) Record of Decision (ROD), and consistency with study planning principles are the primary factors used to assess potential acceptability of the concept plans.

Note that less weight is given to the acceptability criterion at this stage of the study primarily because the project has yet to receive public and agency review and details regarding project operation and institutional arrangements have not been identified. This criterion will become a much more dominating factor as the feasibility study progresses, especially with input from other agencies. For discussion purposes, however, the concept plans that ranked highest for this criterion include Concept Plans 2, 6, and 8. These plans appear to be most consistent with the goals of CALFED and have the highest potential for Federal interest and/or local support. Concept Plan 3 ranked lowest for this criterion, primarily because it has a high first cost for implementation, a lower potential for Federal interest, and may be opposed by environmental stakeholders because of issues associated with brine disposal.

INITIAL ALTERNATIVES

After comparing each concept plan to the planning criteria described above, as summarized in **Table VIII-1**, seven plans appear to warrant further investigation. Accordingly, these plans and the No-Action plan are identified for further development into detailed initial alternatives in the next phase of the LVE. Although Concept Plan 3 is not identified for further development as a stand-alone alternative, it is believed that desalination similar to other source water diversions and treatment facilities should be considered as potential future increments to any alternative. Combinations of various feature sizes likely will change in future studies, some alternatives may be dropped from further development, and other measures or combinations of measures may emerge that warrant further study. Based on results summarized in this report, the following plans are identified as initial alternatives:

- **No-Action –** No further action would be taken by the Federal government to resolve the identified water resources problems and needs in the study area.
- **1 - Raise Los Vaqueros Dam In-Place for Bay Area Water Supply Reliability** – Raise the existing Los Vaqueros Dam in-place with increased Delta diversion and conveyance capacity and an intertie with the SBA at the Dyer Canal, primarily to improve Bay Area water supply reliability during dry periods.
- **2 - Enlarge Los Vaqueros Dam and Reservoir for Bay Area Water Supply Reliability** – Reconstruct and enlarge Los Vaqueros Reservoir with increased Delta diversion and conveyance capacity and an intertie with the SBA at the Dyer Canal, primarily to improve Bay Area water supply reliability during dry periods.

- **4 – Enlarge Los Vaqueros Reservoir with Dyer Canal Intertie for EWA –** Reconstruct and enlarge Los Vaqueros Reservoir with increased Delta diversion and conveyance capacity and an intertie with the SBA at the Dyer Canal, primarily to develop EWA replacement supplies.
- **5 - Enlarge Los Vaqueros Reservoir with Bethany Reservoir Intertie for EWA** – Reconstruct and enlarge Los Vaqueros Reservoir with increased Delta diversion and conveyance capacity and an intertie with Bethany Reservoir, primarily to develop EWA replacement supplies.
- **6 - Water Supply / EWA Combination with Dyer Canal Intertie** - Reconstruct and enlarge Los Vaqueros Reservoir with increased Delta diversion and conveyance capacity and an intertie with the SBA at the Dyer Canal to improve Bay Area water supply reliability and develop EWA replacement supplies.
- **7 - Water Supply / EWA Combination with Bethany Reservoir Intertie** - Reconstruct and enlarge Los Vaqueros Reservoir with increased Delta diversion and conveyance capacity and an intertie with Bethany Reservoir to improve Bay Area water supply reliability and develop EWA replacement supplies.
- **8 - Water Supply / EWA Combination with Water Quality Improvements -** Reconstruct and enlarge Los Vaqueros Reservoir with increased Delta diversion and conveyance capacity and an intertie with the SBA at the Dyer Canal to improve Bay Area water supply reliability, develop EWA replacement supplies, and improve the quality of delivered water supplies.

It should be reemphasized that the concept plans are not complete alternative plans. Rather, they represent fundamentally different ways of combining the retained measures to address specific objectives. Concept plans retained for further consideration may significantly change during further analysis or be dropped completely. Through future public input and scoping, other measures or combinations of the measures may be identified. Further, some of the measures not carried forward may be reassessed and included in future plans. Future plan formulation will focus on refining the concepts into detailed alternative plans for inclusion in the feasibility report and supporting National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) documentation. In addition to more detailed development of alternative plans, much future emphasis will be on refining the acceptability criteria in **Table VIII-1**. As described in **Chapter XI**, emphasis will be on establishing Federal interest in the alternatives and on how they could be implemented. These efforts could in turn result in significant modifications to the concept plans above.

CHAPTER IX
SPECIAL TOPICS

This chapter summarizes various topics and analyses that, in addition to information in the appendices and reference documents, supported the development and evaluation of concept plans and initial alternatives. Special topics discussed in this chapter include the following:

- Concept plan cost estimates
- Less-costly Environmental Water Account (EWA) replacement supply
- Preliminary water operations modeling
- Allocation of project costs
- Potential financing arrangements
- Project integration

CONCEPT PLAN COST ESTIMATES

As described in **Chapters VII** and **VIII**, eight concept plans were formulated to facilitate comparison of a broad range of potential actions. The alternatives chosen are intended to identify concept plans that may warrant further development. Specific sizes and/or combinations of plan features will be accomplished in the next phase of the feasibility study. Further, at this phase of the feasibility study, the cost estimates were developed from existing and available sources and are at a planning level of detail appropriate for identifying trends in cost-effectiveness between the numerous potential combinations of facilities, rather than to derive absolute project costs. Future studies will need to examine more closely the most effective and efficient facility sizes and combinations.

Table IX-1 summarizes the first costs, implementation costs, and annual costs of the eight concept plans. The facility sizes represented in the concept plans were selected to provide a level basis for comparing the plans while also considering apparent trends in the cost-effectiveness of various facility combinations. This section describes major facilities considered in the cost estimates, followed by a discussion of how the first costs, implementation costs, and annual costs shown in **Table IX-1** were calculated.

TABLE IX-1
SUMMARY OF CONCEPT PLAN COSTS

Concept Plans	Bay Area Water Supply Reliability			EWA Replacement Supply		Combined Objectives		
Distinguishing Features	**1 Raise Los Vaqueros Dam In-Place**	**2 Enlarge Los Vaqueros Dam & Reservoir**	**3 Desalination with Storage (Enlarge Los Vaqueros)**	**4 Enlarge Los Vaqueros with Dyer Canal Intertie**	**5 Enlarge Los Vaqueros with Bethany Reservoir Intertie[5]**	**6 Water Supply/ EWA Combination - Dyer Canal Intertie**	**7 Water Supply/ EWA Combination - Bethany Reservoir Intertie[5]**	**8 Water Supply/ EWA Combination with Water Quality**
Los Vaqueros Capacity (TAF)	125	500	500	500	500	500	500	500
Delta Pumping Capacity (cfs)[1]	750	750	750	1,000	1,750	1,750	1,750	1,750
Los Vaqueros to SBA Intertie	Dyer Canal	Dyer Canal	Dyer Canal	Dyer Canal	Bethany Reservoir	Dyer Canal	Bethany Reservoir	Dyer Canal
Desalination Capacity (mgd)	-	-	20	-	-	-	-	-
First Cost ($ millions)								
Lands	2	17	32	17	17	17	17	17
Recreation Relocations	1	5	5	5	5	5	5	5
Construction								
Intake Facilities	18	18	18	29	53	53	53	53
Delta Conveyance	18	18	18	28	55	55	55	55
Pipelines	77	96	96	114	185	183	185	183
Pump Stations & Related Facilities	97	143	143	169	207	252	207	252
Dam	44	285	285	285	285	285	285	285
Power Facilities	10	10	10	11	16	16	16	16
Desalination Plant & Appurtenance	-	-	115	-	-	-	-	-
Cultural Resources	5	12	14	14	16	17	16	17
Environmental Mitigation	13	30	35	34	41	43	41	43
Contingency (Construction)	71	158	189	183	220	232	220	232
Planning, Engineering, & Design	43	95	113	110	132	139	132	139
Construction Management	28	63	74	73	88	93	88	93
Total	*427*	*950*	*1,131*	*1,057*	*1,320*	*1,390*	*1,320*	*1,390*
Update from 2002 to 2004 [2,3]	*474*	*1,053*	*1,258*	*1,172*	*1,465*	*1,541*	*1,465*	*1,541*

TABLE IX-1 (CONT.)

Concept Plans / Distinguishing Features	Water Supply Reliability			EWA Replacement		Combination Objectives		
	1 Raise Los Vaqueros Dam In-Place	2 Enlarge Los Vaqueros Dam & Reservoir	3 Desalination with Storage (Enlarge Los Vaqueros)	4 Enlarge Los Vaqueros with Dyer Canal Intertie	5 Enlarge Los Vaqueros with Bethany Reservoir Intertie	6 Water Supply/ EWA Combination - Dyer Canal Intertie	7 Water Supply/ EWA Combination - Bethany Reservoir Intertie	8 Water Supply/ EWA Combination with Water Quality
Present Value Cost ($ Millions) [4]								
First Cost	474	1,053	1,258	1,172	1,465	1,541	1,465	1,541
Interest During Construction (IDC)	54	151	181	167	210	220	210	220
O&M, Major Replacement, and Energy	192	436	831	248	335	399	365	399
Total[4]	**720**	**1,640**	**2,270**	**1,590**	**2,010**	**2,160**	**2,040**	**2,160**

KEY: cfs = cubic feet per second; ELV = Enlarge Los Vaqueros; EWA = Environmental Water Account; mgd = million gallons per day; O&M = operation and maintenance; SBA = South Bay Aqueduct; TAF = thousand acre-feet

Notes:

1. *Includes existing diversion and pumping capacity of 250 cfs at Old River.*
2. *Costs updated to October 2004 price levels.*
3. *Rounded to nearest $10 million.*
4. *Summation of first cost, interest during construction, and present value of a uniform series of costs over a 100-year period of analysis and a 5-3/8 percent interest rate.*
5. *Power generation facilities and associated costs not included in the Los Vaqueros to Bethany Reservoir intertie estimates. Future studies will evaluate whether power generation facilities would be cost effective in conjunction with this intertie option.*

Facilities Associated with Enlarging Los Vaqueros Reservoir

Three major components are associated with enlarging Los Vaqueros Reservoir for the purpose of either increasing San Francisco Bay Area (Bay Area) water supply reliability or providing replacement supplies for the EWA: (1) constructing new and modifying existing Sacramento-San Joaquin Delta (Delta) intake(s), pumping, and conveyance facilities to the reservoir, and constructing a small forebay (balancing reservoir); (2) raising Los Vaqueros Dam and increasing the size of Los Vaqueros Reservoir; and (3) constructing pumping and transmission facilities from Los Vaqueros Reservoir to the South Bay Aqueduct (SBA) or Bethany Reservoir. Highlights of each major component are presented below.

Delta Intake, Pumping, and Conveyance Facilities

Numerous potential combinations of facilities exist to divert water from the Delta and pump and convey the water to Los Vaqueros Reservoir, while continuing to support the existing connections with Contra Costs Water District (CCWD) water supply system components. These options range from retaining the existing diversion facility at Old River but increasing pumping and conveyance reliability to accommodate the increased head associated with enlarging the reservoir, to constructing a new diversion facility in the central Delta with new pumping facilities and a pipeline to convey water to the expanded reservoir. For this analysis, five different configurations, shown in **Table IX-2**, were considered in combination with several sizes of reservoir enlargement. Each of the diversion configurations would include new fish screens (including expansion or modification of the existing Old River diversion facility). A new central Delta diversion facility also would be designed to reduce the likelihood of attracting fish to the facility.

TABLE IX-2
DELTA DIVERSION CAPACITIES CONSIDERED

Total Diversion Capacity (cfs)	Old River Diversion	New Central Delta Diversion
250	Existing	-
500	Expand existing by 250 cfs	-
750	Existing	500 cfs
1,000	Expand existing by 250 cfs	500 cfs
1,750	Expand existing by 500 cfs	1,000 cfs

KEY: cfs = cubic feet per second

The increased pumping rates would range from 112,000 gallons per minute (gpm) for a 250 cubic feet per second (cfs) increase in capacity, to about 673,000 gpm for a 1,500 cfs increase (representing a total pumping capacity of 1,750 cfs, including existing capacity at Old River). The static lifts would range from 340 feet to about 568 feet for a 200,000 acre-foot increase in reservoir capacity to 685 feet for a 400,000 acre-foot increase in capacity. The total number of pumps would range from as few as three for a 250 cfs facility to as many as eighteen for a 1,750 cfs diversion facility.

Depending on the pumping capacities and pumping heads required, single or parallel pipelines would be constructed to convey water to the expanded reservoir. New pipelines would be high pressure, motor lined and coated steel piping with sizes ranging from about 132 to 144 inches. The pipeline(s) would traverse a distance of about 9.32 miles from the Delta to the enlarged reservoir.

Enlarge/Replace Los Vaqueros Dam, Spillway, and Appurtenances

Six potential reservoir sizes were considered: 125,000, 150,000, 200,000, 300,000, 400,000, and 500,000 acre-feet. These represent increases in the current capacity of 25,000 to 400,000 acre-feet. The 25,000 acre-foot increase corresponds to a dam raise of about 15 feet, the likely maximum height the existing structure can be raised without major reconstruction. Larger dam raises would require construction of a new dam a short distance from the existing facility. Preliminary engineering studies have indicated that locating the new dam upstream from the existing structure would be preferable to a downstream location. This is primarily because an upstream dam would require fewer materials, have less environmental impacts, have a shorter construction duration, and avoid potential geologic hazards downstream from the existing dam. Similar to the existing facility, the new spillway likely would be located on the left (north) abutment of the new dam and be sized to pass the Probable Maximum Flood (PMF), which has a maximum inflow of about 21,500 cfs. Significant expansion of the reservoir also would require construction of a new balancing reservoir and flow control station near the new dam. These facilities would not be required for the 15-foot dam raise.

Los Vaqueros Delivery Intertie

A range of potential conveyance capacities for the intertie between the reservoir and the SBA was not evaluated at this time; consequently, all concept plans assume a capacity of 430 cfs for the intertie (representing the maximum future capacity of the SBA). However, future studies likely will find that smaller pumping and conveyance capacities are more cost-effective in combination with specific reservoir enlargements. Two potential intertie connection locations are identified this report: the SBA at the Dyer Canal surge pool, and Bethany Reservoir near the South Bay Pumping Plant. The new intertie from Los Vaqueros Reservoir to the SBA at the Dyer Canal primarily would include a pump station and a 90-inch-diameter pipeline traveling 6 to 7 miles, depending upon the capacity and alignment. Preferred alignments have been identified for the intertie to the SBA at the Dyer Canal and will be evaluated in greater detail in the next phase of study.

A new intertie from Los Vaqueros to Bethany Reservoir primarily would include a reinforced concrete gravity pipeline extending approximately 9 miles from Los Vaqueros dam to Bethany Reservoir, at or near the existing South Bay Pumping Plant. The South Bay Pumping Plant would be used to deliver water to SBA agencies. Due to the large elevation difference between Los Vaqueros and Bethany reservoirs, a potential exists to include power generation facilities with the intertie to help offset pumping costs associated with deliveries to the reservoir or to SBA users. Additional study is needed to determine the feasibility of power facilities and compare facility costs with the energy produced. Consequently, power facilities were not included in the construction cost estimates pending further study.

It should be mentioned that a project including an intertie from Los Vaqueros to Bethany Reservoir would not gain local acceptability without certain operating constraints or restrictions that would satisfy the CCWD Principles of Participation (described in **Chapter II**), in particular that the project would provide for long-term environmental benefits in the Delta by supplying water for the EWA. Water could be supplied for the EWA through either reductions in Delta pumping to benefit fisheries, or replacing south of Delta EWA purchases. In addition, the project could not be operated in conjunction with a peripheral canal or to increase the export of water from Northern California. Just as would be required in the case of a Dyer Canal intertie, permit terms and conditions, as well as contractual arrangements, would be required to ensure that the CCWD principles are satisfied.

First Costs

First costs for each concept plan are based on the facilities described above and data contained in the 2004 *CALFED Bay-Delta Program Los Vaqueros Reservoir Expansion Studies Planning Report (Planning Report*, updated to October 2004 price levels. The *Planning Report* cost estimates includes the following major features: (1) Delta intake and conveyance features, (2) pipelines and pump stations from the Delta to Los Vaqueros Reservoir, and from the reservoir to the SBA, (3) a balancing reservoir and flow control stations, (4) Los Vaqueros dam reconstruction for reservoir enlargement, (5) power supply, and (6) recreation enhancements. Costs in the *Planning Report* were prepared for 300,000 and 500,000 acre-foot enlargements of Los Vaqueros, and 1,000 cfs and 1,750 cfs Delta diversion capacities. Preliminary cost estimates for the concept plans are based on these values, with the following exceptions and additions:

- Costs for additional reservoir sizes and pumping capacities were extrapolated from data in the 2004 *Planning Report* based on engineering judgment and other available information.
- Per Federal planning guidelines, first costs for the concept plans include allowances for cultural resources; environmental mitigation; planning, engineering, and design; and construction management.
- Recreation enhancements (described in the *Planning Report*) were not discussed in the concept plans, but an allowance was included for relocating existing recreation facilities impacted by reservoir enlargement.
- Cost estimates for desalination facilities were derived primarily from the October 2003 *Bay Area Regional Desalination Project Pre-Feasibility Study Final Report* prepared by the East Bay Municipal Utility district, CCWD, Santa Clara Valley Water District, and the San Francisco Public Utilities Commission and preliminary data from 2004 prepared for the CALFED Bay-Delta Program Bay Area Water Quality and Water Supply Reliability Study.

Table IX-3 summarizes the methodology and factors used to estimate costs for the concept plans. Total investment cost is calculated by adding interest during construction (IDC) to the first cost. IDC was calculated according to Department of the Interior, Bureau of Reclamation (Reclamation) guidelines. Construction periods ranging from 2 to 5 years were assumed, depending on the scope of the project.

TABLE IX-3
SUMMARY OF COST ESTIMATING METHODOLOGY

Cost Category	Methodology and Cost Factors
Recreation Relocations [1]	$5 million
Lands	
Land unit cost	$5,000 / acre
Land requirements for various facilities & facility sizes	Acres:
120,000 acre-foot reservoir	120
150,000 acre-foot reservoir	400
200,000 acre-foot reservoir	870
300,000 acre-foot reservoir	1,620
400,000 acre-foot reservoir	2,380
500,000 acre-foot reservoir	3,140
Pipelines, pump stations, & associated facilities from Delta to Los Vaqueros Reservoir	133
Pipelines, pump stations, & associated facilities from Los Vaqueros Reservoir to SBA	200[5]
Cultural Resources [2]	2%
Environmental Mitigation [2]	5%
Contingency [3]	25%
Planning, Engineering, & Design [4]	12% of subtotal
Construction Management [4]	8% of subtotal
CPI (August 2002 to October 2004)	1.109

KEY: CPI = consumer price index SBA = South Bay Aqueduct

Notes:

1. *The sum of $5 million was included for relocations associated with enlarging Los Vaqueros Reservoir to 500 thousand acre feet (TAF). Smaller reservoir enlargements included proportionally smaller relocation costs.*
2. *Cultural resources and environmental mitigation costs were calculated as percentages of the subtotal construction cost, including costs for lands and relocations.*
3. *Contingency applied to the subtotal of construction, lands, relocations, cultural resources, and mitigation costs.*
4. *Planning, engineering, and design and construction management costs were calculated as percentages of the total construction cost (including lands, relocations, cultural resources, environmental mitigation, and contingency).*
5. *Cost varies depending on the intertie location, either the SBA a the Dyer Canal or Bethany Reservoir.*

Estimated first costs ranged from under $200 million for concept plans that primarily used existing facilities, to about $1.5 billion for a concept plan that included enlarging Los Vaqueros Reservoir by 400,000 acre-feet and increasing diversion capacity from the Delta to 1,750 cfs. In general, the majority of the first costs for the concept plans was related to enlarging the reservoir (reconstructing the dam and associated facilities), followed by pump stations and pipelines.

Figure IX-1 illustrates the general contribution of facility costs to the total construction cost for concept plans that include enlarging Los Vaqueros Reservoir to 500,000 acre-feet.

Figures IX-2 and **IX-3** summarize the likely range of first and present value costs, respectively, estimated for various combinations of facilities and facility sizes. Costs are based on a project with an intertie to the SBA at the Dyer Canal. The first cost of a similar sized project with an intertie to Bethany Reservoir would be about 5 percent less.

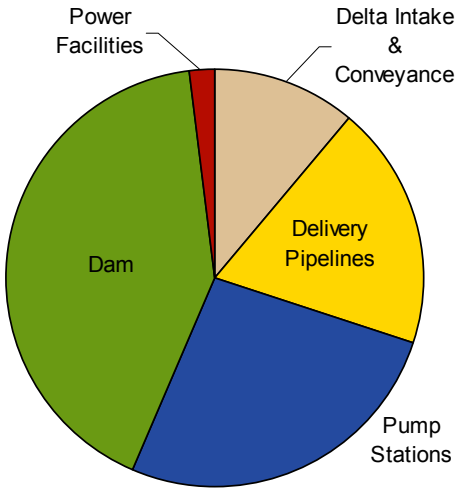


FIGURE IX-1 – RELATIVE COSTS OF MAJOR COMPONENTS FOR CONCEPT PLANS THAT INCLUDE A 500,000 ACRE-FOOT LOS VAQUEROS RESERVOIR EXPANSION

Present Value Costs

Present value costs include the summation of first costs, interest during the construction period; and the present value of major facility replacements, power requirements, and operation and maintenance (O&M) costs. The present value of the regularly occurring annual costs is based on an interest rate of 5-3/8 percent and a project life of 100 years. For this analysis, estimated power costs are based primarily on the present worth value of an expected annual energy cost of $0.10 per kilowatt-hour (kWh) to divert and pump water from the Delta to the SBA either at Dyer Canal or Bethany Reservoir. Present value cost estimates shown in **Figure IX-3** range from about $200 million to just under $2.1 billion.

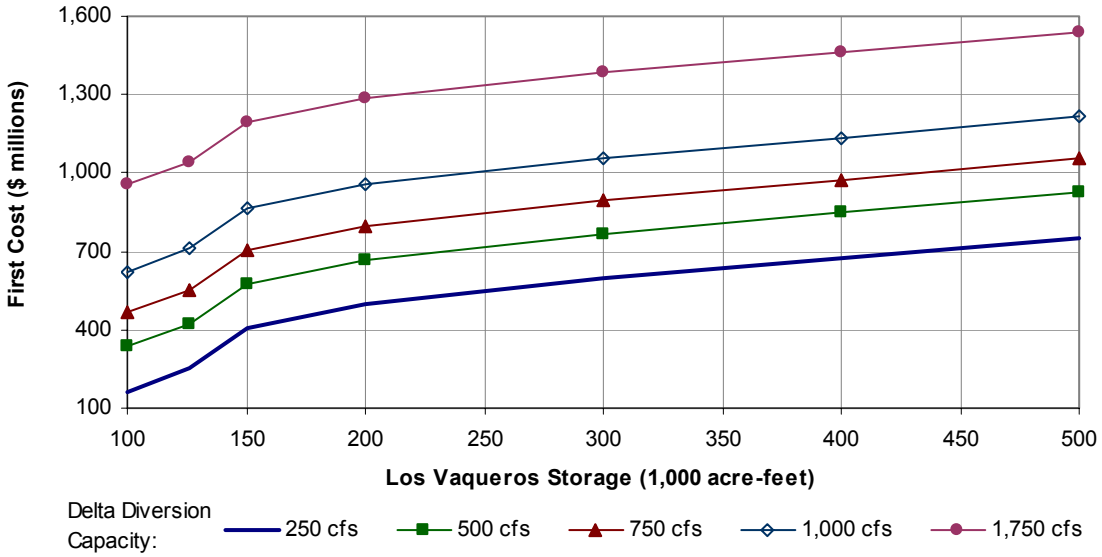


FIGURE IX-2 – ESTIMATED FIRST COSTS FOR VARIOUS COMBINATIONS OF INCREASED STORAGE AND DELTA PUMPING CAPACITY WITH DYER CANAL INTERTIE

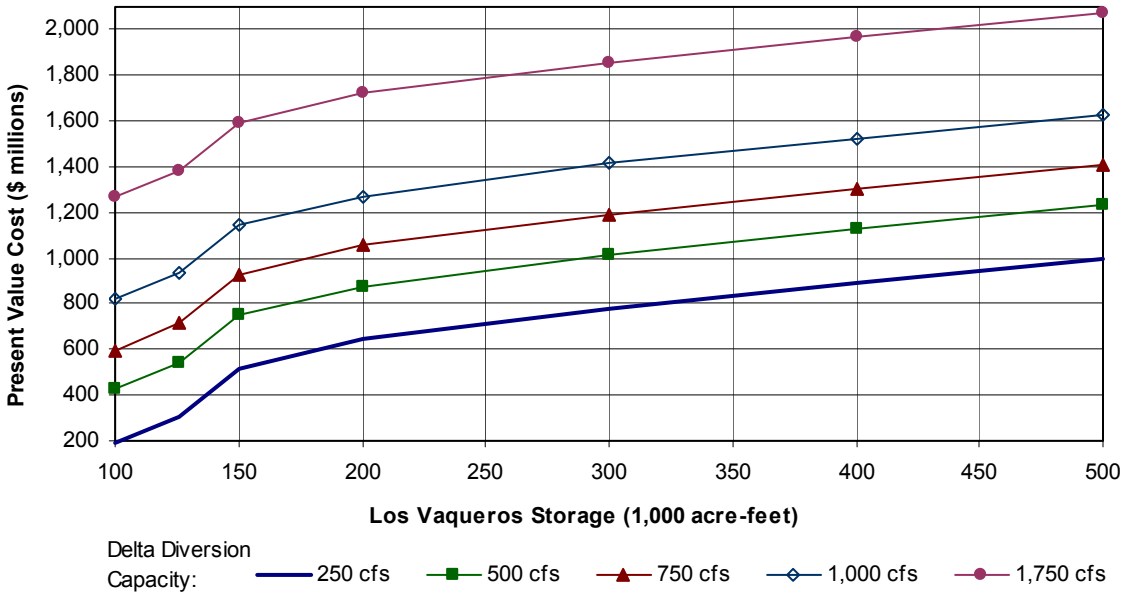


FIGURE IX-3 – ESTIMATED PRESENT VALUE COSTS FOR VARIOUS COMBINATIONS OF INCREASED STORAGE AND DELTA PUMPING CAPACITY WITH DYER CANAL INTERTIE

LESS-COSTLY EWA REPLACEMENT SUPPLY

One of the two major planning objectives for the Los Vaqueros Expansion Investigation (LVE) is to determine if enlarging Los Vaqueros Reservoir is less-costly than an increment of Federal involvement in the EWA as currently implemented. Water developed through storage in LVE would provide a portion of the EWA annual water demand, which is currently met primarily through transfer market purchases and implemented through the use of existing facilities. The hydrologic, structural, environmental, social, economic and institutional factors that influence water demands and supplies are subject to great uncertainty. Forecasting future transfer market conditions and costs of implementing the transfers (including environmental and lost opportunity costs) will require significant additional study due to the sources and corresponding ranges of uncertainty for each of these factors. To identify the relationships of key variables over the 100-year project period of analysis, and determine whether water supplies developed from an expanded Los Vaqueros Reservoir would be a less-costly replacement supply for the EWA, further study is needed during the Plan Formulation Report phase of the LVE. Additional refinements of project features, designs, and costs, should also be developed to support this comparison.

PRELIMINARY WATER OPERATIONS MODELING

The concept plans described in **Chapter VII** were compared using results from preliminary computer modeling. These simulations were performed using a new modeling tool to represent Los Vaqueros Reservoir operations. This section briefly describes the simulation model, its use and results, and future modeling needs for the LVE.

Background

Assessment of the potential benefits and impacts of an expanded Los Vaqueros Reservoir requires analysis of three interdependent systems: statewide Central Valley Project-State Water Project (CVP-SWP) operations, the Delta, and an expanded Los Vaqueros Reservoir and associated conveyance. The first phase of modeling for the Los Vaqueros Expansion Studies used a spreadsheet model initially developed by CCWD to determine Los Vaqueros Reservoir operations. The spreadsheet model was used in conjunction with two other modeling tools, CALSIM II and DSM2, to determine water supply and water quality inputs. CALSIM II, jointly developed by Reclamation and the California Department of Water Resources (DWR), simulates CVP-SWP operations, reservoir releases and water allocations. DSM2 is a branched one-dimensional hydrodynamic and water quality model of the Delta developed at DWR in the late 1990s. Key DSM2 inputs include tidal stage, boundary inflow and salinity concentration, and operation of flow control structures. CALSIM II and the general CALSIM software are discussed in further detail below.

A typical integrated model simulation is conducted as follows. First, the CALSIM II Common Assumptions baseline model is used to determine monthly data on various Delta flow conditions and CVP-SWP operations, including Delta surplus flows, monthly Export-Inflow ratios, and deliveries to the SBA. Output from the CALSIM II baseline model is then input to the 73-year repeating tide version of DSM2 to obtain Delta water quality at Clifton Court Forebay and at existing and proposed diversion locations in the Delta. The water quality from DSM2, and Delta surplus and Export-Inflow constraints from CALSIM II, are all used as input to the spreadsheet model, which determines the amount of water that can be pumped from the Delta for use by the Los Vaqueros Expansion Project while still ensuring all operating restrictions are met.

However, because the Los Vaqueros Project is an integral part of Delta operations, the revised Delta pumping must be input to the CALSIM II baseline model, and the entire process discussed above must be rerun. By repeating the process, one can ensure that diversions for the Los Vaqueros Reservoir can be checked for consistency with the State Water Resources Control Board (SWRCB) water rights Decision 1641 (D-1641) Delta water quality requirements, and that Delta water quality inputs are correctly modeled.

To simplify the modeling approach described above, and to analyze possible integration of a Los Vaqueros Project with CVP-SWP and EWA operations, Reclamation has funded the development of an integrated Los Vaqueros Reservoir – CALSIM II model using the CALSIM software.

CALSIM is a generalized water resources tool developed by DWR's Bay-Delta Office. The model is entirely data driven and can be applied to most reservoir-river basin systems. The model represents the physical system (reservoirs, streams, canals, pumping stations, etc.) by a network of nodes and arcs. The model user describes the system connectivity and various operational constraints using the modeling language Water Resources Simulation Language (WRESL). CALSIM subsequently simulates system operation using optimization techniques to route water through the network. A linear programming solver determines an optimal set of decisions for each time-step for a set of user-defined priorities (weights) and system constraints. The model is described by DWR (2000) and Draper et al. (2004).

CALSIM II is the application of the CALSIM software to model the CVP and SWP. This application was jointly developed by Reclamation and DWR for planning studies relating to CVP-SWP operations. The primary purpose of CALSIM II is to evaluate the water supply reliability of the CVP and SWP at current or future levels of development (LOD) (e.g., 2001, 2020), with and without various assumed future facilities, and with different modes of facility operations. Geographically, the model covers the drainage basin of the Delta, the CVP (excluding operation of the Friant-Kern Canal), and the entire SWP. CALSIM II provides a set of operations that meet all applicable regulatory and operational constraints in the Central Valley and the Delta.

CALSIM II typically simulates system operation for a 73-year period using a monthly time-step. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over this period, representing a fixed LOD (e.g., 2001 or 2020). The historical flow record from October 1921 to September 1994, adjusted for the influence of land use change and upstream flow regulation, is used to represent the possible range of water supply conditions. It is assumed that the past is a good indicator of future hydrologic conditions.

CALSIM-Based Los Vaqueros Reservoir Model

An integrated Los Vaqueros Reservoir-CALSIM II model is currently being developed to support analysis in subsequent phases of the feasibility investigation. The initial step in this integration process has been conversion of the spreadsheet model to a CALSIM-based model of Los Vaqueros Reservoir operations. The CALSIM-based Los Vaqueros model, similar to the spreadsheet model, requires timeseries inputs derived from CALSIM II and DSM2 for Delta water quality, availability of Delta surplus, and SBA demands (water supply reliability or EWA replacement). Operation of the CALSIM-based Los Vaqueros model was validated by comparing model results to those obtained from the spreadsheet model. The CALSIM-based model has been used for the analysis in this Initial Alternatives Information Report (IAIR). However, model inputs, operating rules and assumptions were obtained from previous modeling efforts conducted using the spreadsheet model.

Due to the preliminary nature of the modeling simulations preformed in support of this IAIR, the following considerations should be noted:

- As mentioned above, no significant changes were made to the decision criteria and operational parameters that were integrated into the freestanding CALSIM-based Los Vaqueros model. These parameters will be evaluated and refined as the integrated model is developed. This includes the evaluation of water demands, for both water supply reliability and the EWA, currently incorporated in the model.
- The CALSIM-based Los Vaqueros model used to evaluate the concept plans is not capable of explicitly simulating EWA actions and operations. Future modeling studies will be required to investigate the potential impacts to the CVP and SWP systems of revised EWA operations, and the integration of Los Vaqueros Reservoir operations with San Luis Reservoir.
- Preliminary modeling simulations were designed to evaluate a broad range of potential facilities and operating scenarios associated with an enlarged Los Vaqueros Reservoir. This includes a range of potential Delta export and conveyance capacities, reservoir sizes, and

demand and delivery scenarios. Results from these modeling runs were used to graph project yield as a function of Delta export capacity and reservoir size. These relationships were used in combination with preliminary cost estimates to identify the combination of storage and pumping that might be most effective for a given concept plan, and quantify its potential benefits. However, additional modeling is needed to refine these preliminary facilities combinations and sizes and verify potential plan benefits. The potential for water quality improvements through reoperation of the project also will be explored in future modeling efforts.

- Potential impacts of the concept plans on Delta water quality and CVP-SWP operations have not been evaluated and therefore will be considered in future modeling efforts.

Modeling Assumptions

The following are assumptions used throughout all Los Vaqueros modeling of the concept plans included in this IAIR:

- The achievements of each concept plan were calculated compared to a baseline condition. The baseline condition assumes existing reservoir facilities (100 thousand acre-feet (TAF), 350 cfs capacity at Rock Slough, 250 cfs capacity at Old River, 200 cfs reservoir fill capacity, 350 cfs release capacity), deliveries only to CCWD to meet its anticipated future base demand, and projected operating restrictions as per anticipated changes to the Biological Opinion (BO) discussed below.
- All demand inputs were derived from CALSIM II. For the with-project condition, CCWD demands include its anticipated future demand plus 10 TAF of reliability demand in dry and critically dry years. Further, to optimize use of the reservoir, SBA demands assume full use of an expanded Los Vaqueros to meet water supply needs, therefore restricting the use of other potential water supplies (i.e., Semitropic) to years when the expanded reservoir cannot fully meet demands. Demand inputs also include the use of Los Vaqueros to meet full Table A deliveries to SBA contractors receiving water from the reservoir.
- A Rock Slough Pumping Plant capacity of 30 cfs is reserved for potential use associated with planned development in eastern Contra Costa County that is outside the Los Vaqueros Project service area but within CCWD's boundary.
- The monthly water quality target for Los Vaqueros reservoir is established based on the storage level in the reservoir in June of the previous year, which corresponds to a respective water quality target. This varying target allows for filling the reservoir with water of poorer quality once the reservoir is drawn down below 200 TAF. Water quality targets vary between 55 milligrams per liter (mg/L) chloride to 100 mg/L chloride.
- The CCWD delivered water quality target is 65 mg/L, but this is relaxed in months when water delivered in the without-project condition is greater than 65 mg/L. This rule effectively maximizes the yield of the expanded reservoir while maintaining water quality benefits to CCWD achieved with baseline conditions.

- To address anticipated changes to the BO for environmental constraints, the operating rules for the future expansion of Los Vaqueros Reservoir are not the same as for the reservoir as it is currently operated. In the case of the expanded reservoir, no pumping is allowed at the Old River or Middle River intakes for the months of April and May. The expected adjustments to the BO also relieve all pumping restrictions at Rock Slough, compared to the 30-day no pumping restriction currently imposed.
- An emergency storage level of 50 TAF (for all year types, including 5 TAF of inactive storage) has been established for all Los Vaqueros modeling scenarios. Actual emergency storage levels for the existing reservoir are associated with CCWD's existing biological opinion, and vary by year type from 44 TAF in dry and critically dry years to 70 TAF in all other year types (including inactive storage).
- Deliveries to CCWD for reliability demand are reduced when reservoir storage is below 60 TAF. Maximum deliveries for water supply reliability are reduced linearly, reaching zero once the reservoir is drawn down to emergency storage (50 TAF). This is done to protect the delivery of CCWD base demands.
- The availability of CVP contract water varies between 140 TAF to 177 TAF per contract year (March to February) depending on CCWD demand. Reductions in CVP allocations are not modeled explicitly, as it is assumed that shortages in CVP supply are covered by short-term purchase agreements for north-of-Delta's supplies, as planned in CCWD's Future Water Supply Study Implementation Plan.
- Use of CVP contract water to fill Los Vaqueros Reservoir is restricted to 100 cfs from June through October, with no filling during other times of the year. Rescheduling deliveries of CVP contract water for an expanded facility allows filling of Los Vaqueros Reservoir during periods of relatively high Delta water quality, while minimizing impacts to other CVP contractors or CVP operations. Additional diversion constraints for filling Los Vaqueros Reservoir with CVP contract water are imposed, due to additional water quality concerns, in contract years 1924, 1932, 1977, and 1991.
- The availability of Delta surplus is an input to the model, calculated using CALSIM II model results. Only surplus flows in excess of a buffer are available for diversion to ensure that Los Vaqueros Reservoir operations do not significantly impact delta water quality. The buffer varies from 2,000 cfs to 20,000 cfs depending on conditions.
- Delta surplus is preferentially used over CVP contract water to fill Los Vaqueros Reservoir. Direct diversion of Delta surplus (for direct delivery to CCWD) occurs only when alternate water supplies from the Delta are unavailable.

Model Details

The network schematic for the CALSIM-based Los Vaqueros Reservoir model is shown in **Figure IX-5**. The model incorporates three cycles in each time-step to determine monthly Delta diversions, reservoir operations, and deliveries for the period of simulation.

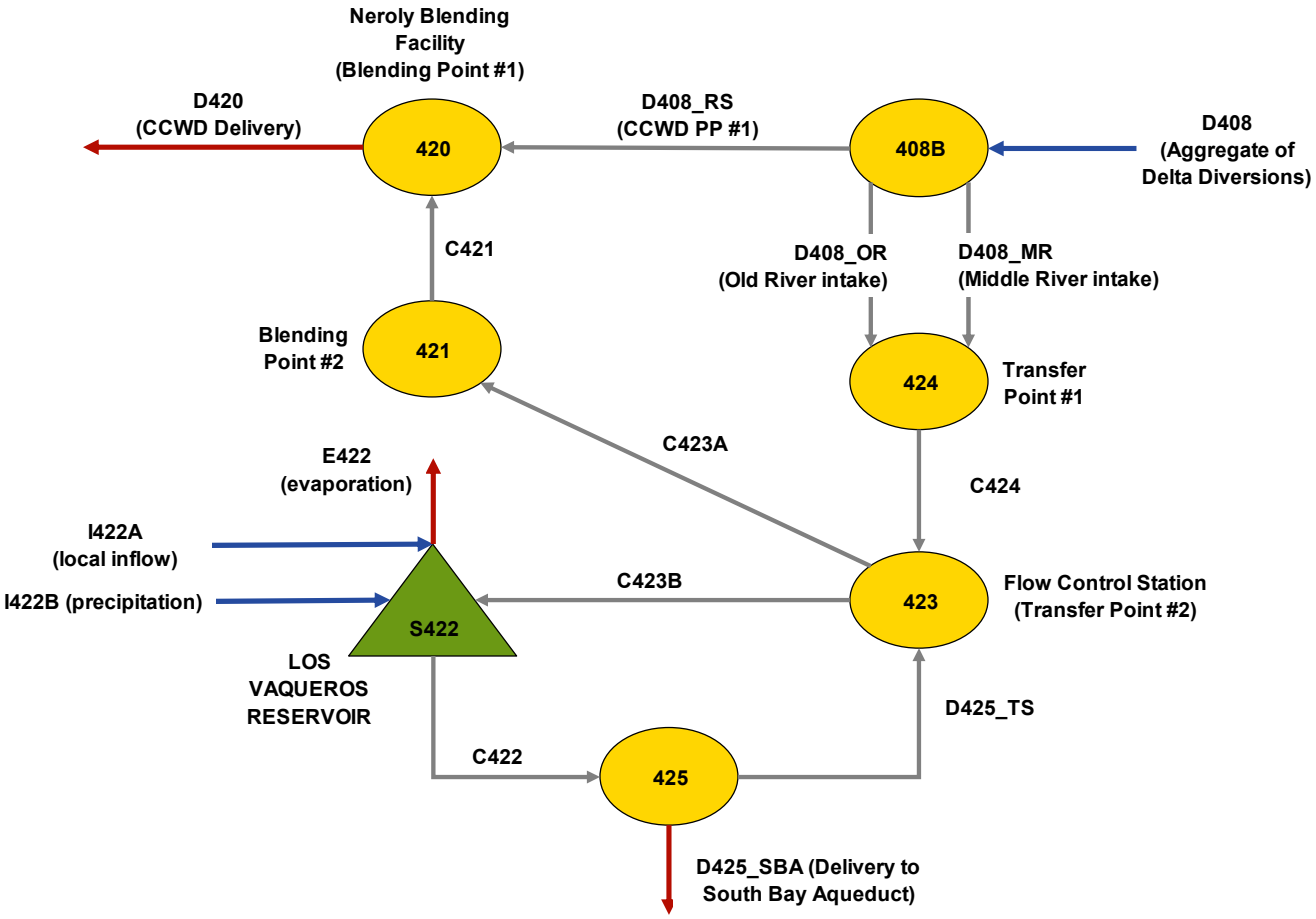


FIGURE IX-5 – MODEL SCHEMATIC FOR EXPANDED LOS VAQUEROS RESERVOIR

The three model cycles are summarized below:

- **Cycle 1** simulates the system in the absence of water quality targets for CCWD service area deliveries or stored water in Los Vaqueros Reservoir. Available water is used to its maximum to meet CCWD service area and SBA/EWA demands, and fill the reservoir. No reservoir releases for blending are made in Cycle 1.
- **Cycle 2** adjusts diversion at Delta intakes and makes blending releases, if necessary, from Los Vaqueros Reservoir to ensure that the CCWD service area is receiving water that meets the delivered water quality target.
- **Cycle 3** maintains the CCWD service area delivered water quality and quantity from Cycle 2, but reduces filling of Los Vaqueros Reservoir, if necessary, to ensure that receiving water and reservoir water mix to a water quality that meets the target for the reservoir.

Future Operations Modeling

The next step in LVE operations modeling is the integration of the freestanding CALSIM-based Los Vaqueros Reservoir model into CALSIM II. The integrated model will allow for the following:

- Dynamic calculation of Delta surplus
- Dynamic routing of Los Vaqueros Reservoir deliveries along the SBA
- Dynamic integration of Los Vaqueros Reservoir operations for EWA with north-and south-of-Delta purchases, and storage of EWA water in San Luis Reservoir
- Dynamic integration of Los Vaqueros Reservoir operations with CVP-SWP operations

The integrated model also will have the capability to dynamically calculate water quality at Delta intakes, and water quality at Clifton Court Forebay, based on Artificial Neural Network (ANN) routines developed by DWR. This use of CALSIM II water quality predictors to determine Los Vaqueros Reservoir operations will be reviewed. Overall, use of the integrated model will be more efficient, as only CALSIM II and DSM2 will need to be run, instead of the three-model cycle currently used.

The CALFED Common Assumptions working group is developing an updated CALSIM II model for use by all of the ongoing CALFED storage investigations, including the LVE. This model will include the integration of Los Vaqueros Reservoir operations, EWA operations, and various other model refinements and updates. It also will contain recommended existing and future without-project assumptions, such as pumping capacity at Banks and Tracy pumping plants, to promote consistency among CALFED studies and investigations. Because the Common Assumptions model will not be available for use until later in 2005, it could not be used to simulate the initial concept plans for the LVE.

ALLOCATION OF PROJECT COSTS

Cost allocation is the process of equitably distributing project costs among project purposes to determine repayment according to project beneficiary and project use. It also is a process of defining the allocated costs of a project between Federal and non-Federal interests – usually called cost apportionment. Cost allocations are made to derive an equitable distribution of project costs among Congressionally authorized project purposes. The allocation and repayment of the Federal share of costs of any project would be subject to Federal law and policy. The basic authority for recovering the Federal investment in constructing, operating, and maintaining authorized water resource projects is the Reclamation Project Act of 1939.

The primary purpose of this section is to introduce cost allocation and some preliminary considerations if it is established that an enlargement of Los Vaqueros Reservoir warrants Federal participation. It should be mentioned, however, that the potential Federal role in a project has not yet been identified. Even if one is identified, important issues will need to be resolved such as integration into the CVP, repayment periods, and others.

Cost allocation in a multiple-purpose Federal water resources project is a three-step process:

1. **Identify Costs to be Allocated** - Costs to be allocated include construction costs, interest during construction, and O&M costs.

2. **Allocate Costs to Project Purposes** - For allocation purposes, costs may be evaluated in two categories: separable costs and joint costs. Separable costs are the reduction in financial costs that would result if a purpose were excluded from an alternative. Joint costs are the costs remaining when separable costs are subtracted from the total project cost. Joint costs may be allocated among purposes in proportion to remaining benefits. To accommodate projects with joint costs, the likely cost allocation method would be the separable costs-remaining benefits method (SC-RB).

3. **Calculate Repayment Responsibilities** - The cost allocation process is designed so that costs of project purposes and their benefits can be apportioned to beneficiaries for repayment. Costs allocated to water supply, fish and wildlife, ecosystem restoration, flood control, and hydropower purposes are either fully or partly reimbursable by project beneficiaries. Once project costs and components are identified, project costs may be delineated as the Federal share and the non-Federal sponsor share. The Federal share is allocated among reimbursable and non-reimbursable functions. Reimbursable costs are identified as either separable or joint costs according to project purpose authorization. Separable costs then may be directly attributed to the beneficiaries. Joint costs are allocated to project beneficiaries according to SC-RB principles.

Pertinent Terms

Following are several terms important in the SC-RB process:

- **Separable Costs -** Separable costs are costs that are specifically necessary because a purpose is included in a multiple-purpose project. These costs are determined during plan formulation. The separable cost is the minimum amount to be considered for allocating costs to a given purpose. The separable cost for any specific purpose is determined by subtracting from the costs of the multiple-purpose project the cost of the most economical alternative to obtain the same benefits for the other purposes with the specified purpose omitted.

- **Specific Cost -** Specific costs are the costs of project features normally serving only one specific project purpose, such as water supply. They are costs incurred specifically to add a purpose to a project.

- **Joint Costs** - Joint costs are defined as the total project cost less the separable costs.

- **Joint Use Costs** - Joint use costs are costs of facilities used for more than one purpose, such as a dam and reservoir.

- **Alternative Costs** – Alternative costs are costs of alternative projects with one purpose eliminated. This is to determine the separable costs or the costs of single-purpose projects necessary to obtain the same benefits for the corresponding purpose as for the multiple-purpose project.

- **Reimbursable** – This is the portion of initial Federal investment in a project that beneficiaries repay.
- **Non-Reimbursable** – This is the portion of initial Federal investment in a project that does not require repayment.

Purposes to Which Costs Are Allocated

As noted previously, costs are allocated to project purposes in order to identify repayment responsibilities. For the CVP, reimbursable costs are repaid by water and power contractors while non-reimbursable costs, as authorized by Congressional legislation, are the responsibility of the Federal taxpayer. Reimbursable costs include those allocated to irrigation and municipal and industrial water supply, hydropower, and some fish and wildlife mitigation and some wildlife refuge water supply. Non-reimbursable costs include those allocated to flood control, navigation, water quality improvement, recreation, fish and wildlife enhancement, and some fish and ***w***ildlife mitigation and some wildlife refuge water supply.

Fish and Wildlife Enhancement

A potential authority for Federal participation in fish and wildlife enhancement would be through the Federal Water Project Recreation Act, Public Lay (PL) 89-72, as amended by PL 102-575, Section 2804 (Title 28). Under PL 89-72, the Federal Government would pay up to 75 percent of the costs to plan, design, and construct (including interest during construction) the fish and wildlife enhancement elements. The minimum 25 percent non-Federal share would be due on project implementation (construction). Under PL 89-72, up to 50 percent of operation, maintenance, and major replacement costs could be paid for with Federal funding.

Agricultural Water Supply

Several authorities exist under which a water supply increment or purpose can be considered in cost allocation. One would be The Reclamation Act of 1902, as amended, and another would be The Water Supply Act of 1958, also as amended. The basic difference between the two authorities is the amount of up-front Federal funding for construction and repayment options.

- **The Reclamation Act of 1902, as amended –** Most Reclamation projects, including water supply, have been implemented under this authority. Under the act, the Federal Government could provide up-front funding for implementation (construction) of new water supply, of which 100 percent of the capital cost allocated to agricultural supply is repaid at no interest over a 50-year repayment period. In addition to the no-interest repayment subsidy, "ability-to-pay" provisions of Federal Reclamation Law permit agricultural contractors to apply for additional relief from their capital repayment obligations. Further, 100 percent of O&M costs are non-Federal.
- **The Water Supply Act of 1958, as amended** – Another authorization vehicle that could provide a substantial benefit to a non-Federal agricultural water supply sponsor is The Water Supply Act of 1958. Under this act, eligible projects can receive up to 85 percent total

Federal funding, with at least 35 percent of the non-Federal share due on completion of construction. Again, 100 percent of O&M costs are non-Federal.

M&I Water Supply

The two basic authorities also governing Federal cost-sharing for M&I water supply are The Reclamation Act of 1902, as amended, and The Water Supply Act of 1958, also as amended.

- **The Reclamation Act of 1902, as amended –** Similar to agricultural water supply, The Reclamation Act of 1902 allows for up-front Federal financing of M&I water supply purposes, with 100 percent repayment of capital costs (including interest during construction). However, repayment includes interest over the 50-year repayment period. O&M costs are the responsibility of the non-Federal sponsor.

- **The Water Supply Act of 1958, as amended –** Development and O&M cost sharing for M&I supplies is the same as described in the previous section for agricultural supplies.

Recreation

A potential authority for Federal participation would be through PL 89-72, as amended by PL 102-575, Section 2804 (Title 28). Under PL 89-72, Federal cost sharing can be up to 50 percent with no less than 50 percent non-Federal funding, including planning, design, construction, and interest during construction. The non-Federal share of the implementation costs would be provided concurrent with project implementation. Up to 50 percent of the costs for O&M could be provided by the Federal government. Note, however, that recreation is not currently a purpose in the LVE investigation. Further, recreation is currently viewed as having a relatively low priority for Federal involvement.

Application

As mentioned, the potential for Federal interest and participation in a project to address the planning objectives has not yet been determined for the LVE. Further, the above information is intended only to provide an introduction to cost allocation. Accordingly, application of Federal cost sharing procedures and policies to the LVE will be a major subject in future studies. Assuming that an economically feasible project plan can be determined, it appears that a portion of a project allocated to water supply reliability would be a non-Federal responsibility, although a possibility exists under the Reclamation Act of 1902 for up-front funding. If a portion of a project is allocated to EWA replacement, it could be considered fish and wildlife enhancement, under PL 89-72 as amended, in which case the Federal share could be as much as 75 percent of the total project cost.

POTENTIAL FINANCING ARRANGEMENTS

Construction and operation of a project to address the LVE planning objectives could be accomplished under various financing arrangements involving the Federal Government, State of California, and/or other local project sponsors. Several possible scenarios are described below.

Construction

Funding for project construction could come from Federal, State, and/or local entities. The process by which funds would be obtained by these agencies is summarized as follows:

- **Federal –** Traditionally, Congress would authorize the Federal interest in the project on the basis of information and recommendations contained in a final Federal Feasibility Report and other documentation. Following project authorization, and subject to Federal and non-Federal implementation agreements, Congress would appropriate funds through the budget process to implement the Federal portion of the project.

- **State of California** – As explained in the April *2004 Los Vaqueros Expansion Studies Planning Report*, potential construction funding from the State of California would likely come from the issue of general obligation (GO) bonds or revenue bonds. A GO bond would require approval by the State legislature and approval by a majority vote of the public. For state projects that generate revenues from the sale of vendible outputs, such as the SWP, the sponsoring State agency (DWR, in this case) can issue revenue bonds. A State revenue bond could be enacted by statute without voter approval.

- **Other Local Sponsors** – Local funding for construction likely would come from local water agencies that would directly benefit from the project, and funding would be generated from issuance of debt (such as GO bonds or revenue bonds). Other options include loans from the State.

Operation and Maintenance

Following completion of the construction phase, the project would need to be operated and maintained to consistently accomplish the project purposes over the project life. Although a potential exists for Federal participation in up to 50 percent of a project element allocated to fish and wildlife enhancement under PL 89-72, ongoing O&M normally would be accomplished and funded by project beneficiaries. For water supply reliability, O&M funding would typically come from the sale of the water, depending on how the water was marketed.

PROJECT INTEGRATION

Additional study and coordination is required to determine how a new project with Federal participation would be implemented and/or integrated with existing projects. Besides Federal processes, State, CALFED, and local processes exist for participation in the funding, construction, and operation of projects. The CALFED ROD established a "beneficiary pays" principle, but it is not clear at this time how that principle compares with Federal standards, or which would take precedence.

However, should a project be identified and implemented that addresses water supply objectives warranting Federal interest, it could potentially be integrated into the Delta Division of the CVP. Delta Division facilities primarily provide for the transport of water though the Delta to contractors served by the Contra Costa and Delta-Mendota canals. The main features of the

Delta Division are the Delta Cross Channel, Contra Costa Canal, Tracy Pumping Plant, and Delta-Mendota Canal. The Delta Division is operated in conjunction with the SWP through the Coordinated Operation Agreement, or COA, to meet the requirements of in-Delta riparian water rights holders and Delta water quality standards imposed by the SWRCB. This and other potential project integration scenarios will be evaluated as detailed alternative plans are developed in the next phase of the feasibility study.

CHAPTER X
STUDY MANAGEMENT AND PUBLIC INVOLVEMENT

This chapter describes the management structure being used for the Los Vaqueros Expansion Investigation (LVE). The public involvement and stakeholder outreach strategy for the study also is described.

STUDY MANAGEMENT

The study management structure for the LVE consists of a Study Management Team (SMT), Project Coordination Team (PCT), and Agency Coordination Work Group (ACWG).

- **Study Management Team –** The SMT consists of study managers from the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), California Department of Water Resources (DWR), and Contra Costa Water District (CCWD). The SMT provides overall guidance for the study, and ensures that PCT members have sufficient resources and direction to complete the various tasks required. More importantly, the SMT is responsible for briefing higher-level agency staff and decision-makers on study progress, key issues, and schedule status. The SMT also is responsible for addressing the views and comments of other agencies.

- **Project Coordination Team –** The PCT consists of technical leaders and other specialists who direct and coordinate the completion of work products in their respective disciplines, based on guidance from the SMT. The PCT includes discipline leaders for engineering, environmental compliance and analysis, plan formulation, modeling, public involvement, economics, and others as needed. PCT members attend team meetings and manage the incorporation of results and work products into the overall study.

- **Agency Coordination Work Group -** The ACWG consists of representatives from Federal, State, and local governmental agencies and stakeholder groups. The ACWG is briefed by the study team on a regular basis, reviews study materials and documents, and provides comments and input over the course of the study. Participants in the ACWG include the following: Alameda County Water District, Bay Area Water Supply and Conservation Agency, Contra Costa County, CCWD, California Department of Fish and Game, California Bay-Delta Authority, DWR, East Bay Municipal Utility District, Environmental Protection Agency, National Marine Fisheries Service, Santa Clara Valley Water District, San Francisco Public Utilities Commission, U.S. Army Corps of Engineers, Reclamation, U.S. Fish and Wildlife Service, and the Alameda County Flood Control and Water Conservation District, Zone 7. The ACWG holds breakout meetings on specific subjects that may not be of interest to the entire group, such as modeling and environmental studies, to discuss issues in more detail with PCT members.

Other focused work groups are ongoing and new work groups will continue to be established as needed to assist in accomplishing the study. These technical work groups focus on specific study areas such as designs and costs, environmental studies, plan formulation and economics, and others. The work groups are primarily composed of LVE project staff, but may include other experts or specialists.

PUBLIC INVOLVEMENT

Public involvement has been ongoing throughout the LVE. Public meetings, newsletters, and briefings will continue to mark major milestones of the feasibility study. A Customer/Stakeholder Feedback Group (CFG), comprising local business, government, and special interests, was created to provide guidance and feedback during the LVE. CCWD also maintains a Web site (http://www.lvstudies.com) for information dissemination and sharing; solicitation of comments; event postings; and communication among team members. Public involvement efforts for the project have progressed in three main phases, described briefly below.

The first phase focused on development of the Draft *Project Concept Report*, which provided general project overview materials and an outline of future steps for the project. Activities included the following:

- LVE mailing list developed
- Public Involvement Plan developed
- Interactive Web site developed
- Two CFG meetings held
- Los Vaqueros Reservoir tour conducted for the CFG
- Two rounds of public meetings held in Concord and Sacramento
- Fact sheets and "Frequently Asked Questions" materials created
- Eighteen CCWD Board meeting presentations
- Over 30 presentations to elected officials, local organizations, and community groups.

In September 2002, the project moved into development and publication of the Draft *Planning Report*, which included preliminary information and analysis of LVE facilities, benefits, impacts, and institutional issues. In addition to ongoing public outreach, this phase also focused on project updates for relevant Federal and State agencies (see previous description of the ACWG). Activities included the following:

- Five CFG meetings held
- Five ACWG meetings held
- Five ACWG Technical Breakout Sessions held
- Four rounds of public meetings held in Concord, Antioch, and Sacramento
- Over one hundred presentations made to elected officials, local organizations, and community and stakeholder groups

- Briefings held with mayors, city managers and wholesale customers
- Twenty topic-specific fact sheets and an informational brochure developed
- Bill inserts describing LVE developed
- "On Tap" newsletter produced quarterly
- Media briefings developed
- Fourteen CCWD Board meeting presentations
- Public comments tracked and responses made (more than 1,000 comments received)
- Comment and Response Report prepared summarizing and addressing comments received.

Following the successful CCWD customer vote in March 2004, the project moved into the third and current phase of outreach corresponding to public communication and interagency coordination regarding development of the Feasibility Report for the LVE. To date, public involvement activities in the current phase include the following:

- Nine ACWG meetings held
- Thirteen ACWG Technical Breakout Sessions held
- Fifteen presentations made to elected officials, local organizations, and community and stakeholder groups
- Six CCWD Board meeting presentations
- "On Tap" newsletter produced

Public outreach and agency coordination efforts will continue through the remainder of the LVE.

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CHAPTER XI
FUTURE ISSUES AND IMPLEMENTATION FACTORS

This chapter summarizes issues related to the Los Vaqueros Expansion Investigation (LVE), including areas that may require further consideration in the next phase of the feasibility investigation.

INVESTIGATION PROCESS FACTORS

Numerous institutional, agency, and local issues are likely to surface as the LVE progresses toward a Feasibility Report and project implementation. Many of these issues or concerns will become better defined and more appropriate for resolution once alternative plans, and later the tentatively selected plan, are defined. However, at least five areas have been identified that should be addressed early in the next phase of the LVE: active study involvement by the State of California (State), the relationship of the LVE to the CALFED Bay-Delta Program (CALFED) and other programs/projects; local cooperation and support; Contra Costa Water District (CCWD) Board of Directors principles of participation, and Environmental Water Account (EWA) replacement planning objective fulfillment. These issues are summarized below.

State of California Active Study Involvement

The California Department of Water Resources (DWR) is a likely non-Federal sponsor for the LVE, in conjunction with other local interests. However, for the State to effectively move forward as a potential non-Federal sponsor of the project, DWR will need to continue to assess alternatives with respect to the water resources needs and objectives of the State. This includes continued active involvement in evaluating alternatives within the context of the State Water Project (SWP), broad public benefits, or identifying specific State and regional goals or preferences for the project. Active involvement by the State will entail heightened coordination among agency representatives, local water agencies, study managers, and technical teams.

Relationship to CALFED and Other Programs and Projects

The LVE is following established Federal planning principles and practices, which require definition of water resources and related problems and needs, identification of planning objectives and criteria, development of alternatives to address planning objectives, and selection, if appropriate, of a plan with Federal interest for implementation. A specific set of planning objectives has been developed (**Chapter V**) to address identified water resources problems and opportunities (**Chapter IV**). However, because the LVE is being pursued within the context of CALFED, the study must consider the influence on and of other CALFED elements as part of the planning process described in **Chapter V**. For example, the CALFED Record of Decision (ROD) established a "beneficiary pays" principle. Future studies will need to interpret this principle in relation to established Federal cost-sharing and allocation standards and authorities.

When detailed alternative plans are developed in the next phase of the LVE, their influence on and contributions to the goals and objectives of CALFED (as defined in the 2000 CALFED ROD) will be evaluated and described in the draft and final Feasibility Report. This includes the ability of other planned or potential CALFED actions to address LVE planning objectives. Similarly, potential scenarios for how a new project with Federal participation would be implemented and/or integrated with existing projects (such as the Central Valley Project (CVP)) will be evaluated, as appropriate, when detailed alternative plans are formulated.

Local Cooperation and Support

Local cooperation requirements and willingness to participate must continue to be addressed as plan formulation progresses for the LVE. This includes addressing planning objectives, and corresponding Federal participation conditions while also satisfying local principles and institutions. For each project purpose, a non-Federal sponsor must be identified that is willing to share in the cost for the purpose. This can be challenging for multipurpose projects that address local objectives and Federal purposes, while also providing other benefits. For example, the likely purposes of a project to expand Los Vaqueros Reservoir are to improve San Francisco Bay Area (Bay Area) water supply reliability and provide a less-costly EWA replacement supply, to which costs would be allocated and shared according to Federal cost-sharing requirements. However, such a project is likely to provide other benefits, such as water quality or recreation. These other benefits may or may not warrant identification as separate project purposes, or modification of Federal cost-sharing responsibilities. This would depend on whether specific features are included to enhance these other benefits, which may be desired by participating agencies or be a condition of local participation. These and other issues related to local cooperation, project support, and participation in project funding and implementation will be addressed in greater detail in the next phase of the LVE.

CCWD Board of Directors Principles of Participation

The CCWD Board of Directors established various principles for participation in a project to expand Los Vaqueros Reservoir, as described in **Chapter II**. It is believed that agreements could be developed between the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and CCWD honoring the intent of each of the CCWD Board of Directors principles if a project is developed that includes Federal participation in implementation. Following is a summary of how each of the principles could be respected in a joint project addressing the objectives of the LVE:

- **A project is to improve water quality and reliability for CCWD –** It is believed that any enlargement of Los Vaqueros Reservoir could contribute to water supply reliability for CCWD, while also providing water quality improvements.

- **A project is to improve CCWD customer dry year reliability –** Each of the initial alternatives can provide CCWD with increases in water supply reliability benefits.

- **A project is to enhance the Delta environment –** A project that supported long-term implementation of the EWA would benefit at-risk fish in the Delta, which would subsequently help improve the Delta environment.

- **A project is to protect and enhance the fisheries and terrestrial species benefits provided by the existing Los Vaqueros Project –** Any project including the enlargement of Los Vaqueros Reservoir would include features to either avoid or mitigate adverse impacts to environmental resources. Features to further enhance ecosystem resources near the existing reservoir could be included in the project as an additional project purpose, at the request of the non-Federal sponsor.

- **A project is to preserve and increase the recreation opportunities of the Los Vaqueros Project** – A project including the enlargement of Los Vaqueros Reservoir would likely include features to avoid or mitigate adverse impacts to recreation resources. Features to increase recreation opportunities could be added to the project as a new project purpose, at the request of the non-Federal sponsor.

- **CCWD continues as owner and manager of the Los Vaqueros Watershed –** Various institutional arrangements could be developed for a joint project to expand Los Vaqueros Reservoir. For a project in which Reclamation participates in both implementation and operation, Reclamation would likely hold ownership of the dam and related structures, lands inundated by the reservoir, and lands immediately adjacent to the inundation area (as required for operation and maintenance). CCWD would maintain ownership of the lands and watershed surrounding the expanded reservoir.

- **CCWD maintains control over recreation in the Los Vaqueros Watershed –** Reclamation would likely develop agreements that would defer management of recreation facilities and activities at the expanded reservoir (and any adjacent Federal lands) to local entities. CCWD would maintain control over recreation and other activities on adjacent watershed lands for which it maintained ownership.

- **CCWD continues as operator of the Los Vaqueros Reservoir System –** An expanded Los Vaqueros Reservoir would continue to perform the water quality functions of the current project for CCWD, while also meeting new operational objectives. It is believed that institutional arrangements and agreements exist under which CCWD could continue to operate the project on behalf of project beneficiaries.

- **A project protects and reimburses the financial investment made by CCWD customers, who financed the existing $450 million Los Vaqueros Project –** A principle in the formulation process (**Chapter V**) was to make recipients of benefits of the existing Los Vaqueros Reservoir project whole. Under this principle, present recipients would receive essentially the same benefits as they currently do and at no increased costs. The cost of existing Los Vaqueros Project facilities that would be modified, and/or replaced as part of an enlargement project would be included as a cost of the new project. These costs would be shared in the same manner as other project costs with project beneficiaries (see potential

institutional arrangements discussion below and cost allocation discussion in **Chapter IX**). Accordingly, it is expected that the original CCWD investment would be retained.

- **Water rates for CCWD customers will not increase as a result of the expansion project** – The extent of CCWD's participation in a project to enlarge Los Vaqueros Reservoir could range from that of a cooperating agency to cost-sharing local sponsor depending on the type and extent of benefits attributable to the district. Costs would be attributed to participating agencies relative to the benefits they receive from the project in accordance with Federal cost allocation procedures. CCWD has made a commitment to their rate payers that rates would not increase as a result of a project to enlarge Los Vaqueros Reservoir. They intend to manage this using their equity in the existing Los Vaqueros Project to contribute toward their share of project costs; if that value is not sufficient to pay CCWD's share, then payment for any remaining benefits would come from other projects in CCWD's future Capital Improvements that would become unnecessary as a result of participation in the project.

Fulfilling the EWA Replacement Supply Planning Objective

As mentioned, one of the two primary planning objectives is to use an expanded Los Vaqueros Reservoir to develop EWA replacement supplies if the cost of water provided from an expanded reservoir is less than the cost of water otherwise obtained through the program. Included in **Chapter IX** (Special Topics) is a summary discussion of a potential least-cost EWA replacement analysis. It generally concludes that from available information on water supplies and demands in the State, and potentially reasonable estimates about future population growth rates and other water resources trends, water prices in transfer markets will potentially significantly increase in the future. However, to confirm this conclusion, a much more rigorous analysis is needed. This analysis must not only include projections about population growth and resulting future water demands, supplies, and shortages, but also projections about the future of emerging water markets and how those markets may function and water pricing possibilities in highly uncertain water supply environments. In addition, this analysis will need to be sophisticated enough to garner support from multiple water interests and undergo scrutiny from numerous agencies, groups, and individuals. Accordingly, an evaluation to assess the relative cost of the long-term implementation of the EWA Program compared with the cost to enlarge Los Vaqueros Reservoir will be an important activity in the next phase of the LVE.

POTENTIAL INSTITUTIONAL ARRANGEMENTS

Federal, State, and local entities could participate, either jointly or individually, in a project to address the objectives of the LVE under various institutional arrangements or organizational structures. These arrangements would be subject to the laws, regulations, and guidelines that govern each agency. For example, Public Law 93-251 specifies that, in the absence of specific legislative directive, fish and wildlife enhancement may be given full consideration as a purpose of Federal water development projects if local sponsors bear certain financial and operational responsibilities. Federal financial participation would include 25 percent of separable costs, administration of project land and water areas devoted to these purposes, and all costs related to operation, maintenance, and replacement of project facilities. The Water Resources

Development Act of 1986, and corresponding Department of the Interior policy and Reclamation guidelines, require non-Federal financial participation in environmental improvements and for multiple-purpose projects for water supply and recreation. Similarly, the CCWD Board Principles of Participation may influence the type of institutional arrangements possible for implementing and operating a joint reservoir expansion project.

The extent of Federal cost-sharing in Reclamation projects, such as a project involving the expansion of Los Vaqueros Reservoir, is defined in various laws and administrative provisions. Although it is recognized that an expanded Los Vaqueros Reservoir could contribute to area recreation and in-basin ecosystem enhancement, studies to date indicate that the primary interest in the project by Reclamation would be for the purposes of water supply for the Bay Area and lower cost participation in the EWA. The level of Federal interest and extent of Federal cost share for these primary purposes would depend on various factors, including, but not limited to, a determination of the contributions toward the planning objectives, non-Federal sponsorship, economic feasibility, the method of marketing new water supplies, and regional acceptability.

From a Federal perspective, a project to enlarge Los Vaqueros Reservoir could be implemented under three basic arrangements: either as (1) a Federal project, (2) a joint Federal and non-Federal project, or (3) a non-Federal (local only) project. Each of these basic implementation arrangements is summarized below.

Federal Project

Civil works water resources projects that include Federal participation require a non-Federal sponsor. For projects in which there is a demonstrated Federal interest, this participation ranges from active involvement in project development studies and construction support, to operation and maintenance (O&M) of the completed works, to purchase of project benefits/outputs. Under this arrangement, Reclamation would fund and construct a Federal increment beyond the existing CCWD 100,000-acre-foot Los Vaqueros Reservoir. The completed project would be a Federal increment. In the case of a water supply project, repayment would be made over time by the non-Federal sponsor(s) through long-term water supply contracts, similar to other Reclamation projects. Basic authority for this arrangement would likely be through The Reclamation Act of 1902. Future studies will need to consider numerous issues regarding long-term contracts, among which is acquisition of water rights.

Federal and Non-Federal Project

Under this arrangement, the non-Federal sponsor would be an active partner in project development studies, construction support, and O&M of the completed works. Various forms or options exist of a potential Federal and non-Federal partnership in the implementation of a new project increment at Los Vaqueros Reservoir. Following is a summary of two of the most likely implementation options:

- **Federal and CCWD Project –** Under this option, Reclamation and CCWD would proceed to implement a new project that included expanding Los Vaqueros Reservoir. A new project would be constructed by Reclamation with reimbursement of certain costs based on

additional benefits received by CCWD for its allocated share of the project at the time of construction. Potential arrangements concerning project ownership requires further investigation. The magnitude of CCWD reimbursement would depend on future studies, including cost allocation and apportionment analysis. How the project would be maintained also would need to be evaluated, but it is believed that it could be maintained by CCWD through agreements with Reclamation.

- **Federal, CCWD, and Other Non-Federal Sponsor(s) Project -** Under this option, Reclamation, CCWD, and one or more other non-Federal sponsors would proceed to implement a new Los Vaqueros Project. It is believed that CCWD (State and/or local agencies) would be a project sponsor under any scenario because of its ownership of the existing project and the CCWD Board of Directors Principles of Participation. Other potential non-Federal sponsors would include the State of California, likely through DWR, and/or other Bay Area water agencies. The extent of the Federal and non-Federal contribution toward project construction and methods by which the project would be operated and maintained would be determined in future analyses. It is believed that an agreement could be made between Reclamation and CCWD consistent with each of the CCWD Board of Directors Principles of Participation.

Non-Federal (Local) Project

A number of potential arrangements exist under which a project involving the expansion of Los Vaqueros Reservoir could be implemented by non-Federal interests. These options range from a CCWD-only project to one involving several State and local area sponsors. Following is a summary of several local project implementation options.

- **CCWD-Only Project –**Under this option, CCWD would proceed with implementing the LVE project. Primary project elements likely would include enlarging Los Vaqueros Reservoir and facilities similar to existing Delta pumping and conveyance features to provide water to the reservoir. CCWD would own and operate the completed project. CCWD also would be the primary beneficiary from increased water supply reliability, water quality, and other incidental benefits. CCWD would have the option of making project benefits (water supply, improved water quality, or EWA) available to local Bay Area agencies.
- **State and CCWD Project –** Under this option, the project would be implemented by both the State, through DWR, and CCWD. It is likely that each entity would own an increment of the project, which would be operated by CCWD through agreements with the State. Increased water supplies from the project would benefit both CCWD and the State, likely through the SWP. The project also could include water quality improvement and ecosystem restoration benefits to at-risk fish in the south Delta.
- **CCWD and Others Project –** Various other potential non-Federal project ownership and implementation options exist. Each of the options would involve implementation by CCWD with the State and/or other Bay Area water agencies. These options are illustrated in the April 2004 Planning Report for the Los Vaqueros Reservoir Expansion Studies.

IMPLEMENTATION

The next major step in the feasibility study is to further develop the initial alternatives presented herein into a set of detailed alternative plans. The emphasis of upcoming studies will be on operations modeling, additional study of future regional water demands and economic conditions, preliminary designs and costs, identifying potential impacts and mitigation features, and completing environmental studies and documentation. The next phase of the LVE – the Alternatives Plans Phase - will be summarized in a Plan Formulation Report, anticipated in mid-2006, as shown in **Figure XI-1**. The Feasibility Report and accompanying Environmental Impact Statement/Environmental Impact Report (EIS/EIR) are scheduled for completion in late 2007.

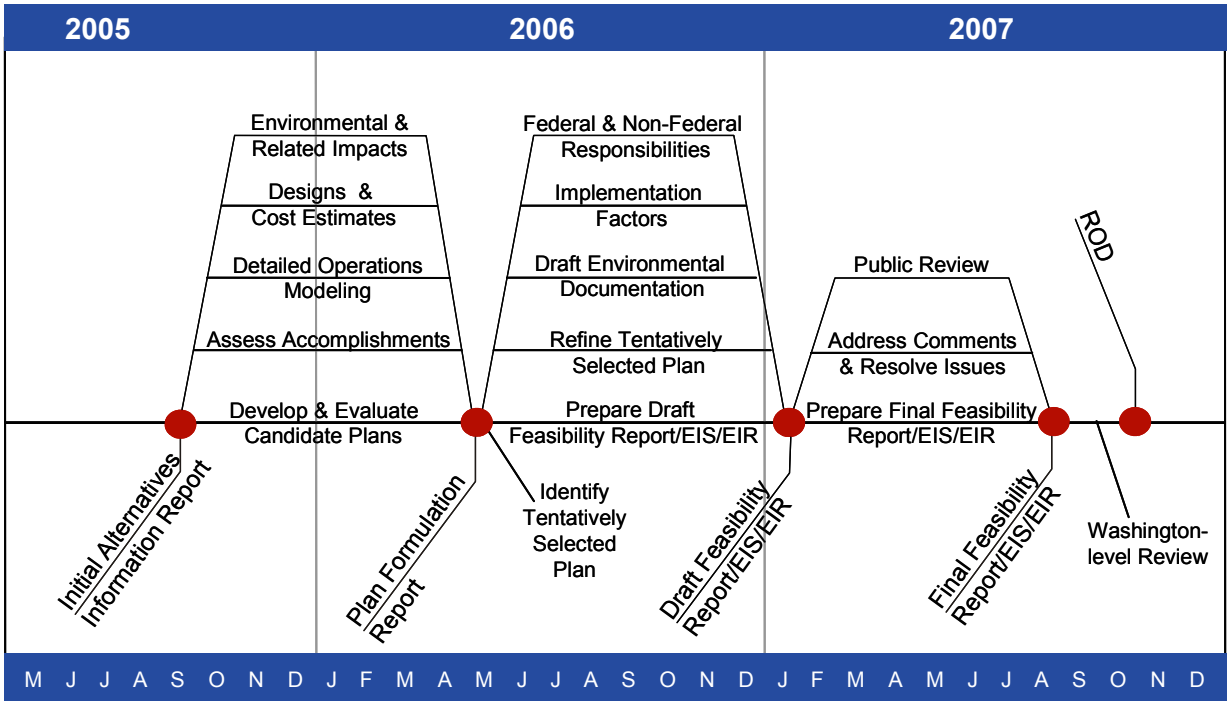

FIGURE XI-1 – LOS VAQUEROS EXPANSION INVESTIGATION SCHEDULE

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CHAPTER XII
SUMMARY OF FINDINGS

Major findings for this report include the following:

- Demands for water in the Central Valley and elsewhere in the State of California (State) exceed available supplies. This condition is expected to become more pronounced in the future with one likely result that more agricultural supplies will be transferred to urban uses.

- A need exists to improve water supply reliability for San Francisco Bay Area (Bay Area) water users primarily during drought periods.

- A need also exists to promote the continued and successful implementation of actions such as pumping curtailments at Central Valley Project (CVP) and State Water Project (SWP) facilities to protect at-risk fish in the Sacramento-San Joaquin Delta (Delta). At the same time, it is important to carry out these protective actions without significantly impacting water users who are dependent on the Delta for their water supplies.

- It is expected that the EWA or a similar program will continue in the future, acquiring water supplies for fisheries actions primarily through water market purchases and short term transfer agreements. However, a great deal of uncertainty exists regarding the future cost and availability of water supplies on the State's water transfer market as demands for limited water supplies continue to rise.

- Based on the identified problems and opportunities, the following objectives were developed for the Los Vaqueros Expansion Investigation (LVE):

  - ✧ *Increase water supply reliability for water providers within the study area, principally to help meet municipal and industrial water demands during drought periods, with a focus on enlarging Los Vaqueros Reservoir.*

  - ✧ *Use an expanded Los Vaqueros Reservoir to develop replacement water supplies for the long-term Environmental Water Account, if the cost of water provided from an expanded reservoir is found to be less than the cost of water for continued implementation of that program.*

  - ✧ *To the extent possible through pursuit of the water supply reliability and environmental water objectives, improve the quality of water deliveries to municipal and industrial customers in the study area.*

- Of numerous water resource management measures identified and evaluated, eight were retained for potential inclusion into concept plans to address the planning objectives.

- Eight concept plans were formulated from the retained management measures to represent a range of potential actions to address the planning objectives. Three concept plans focus on increasing water supply reliability for Bay Area water agencies, two concept plans focus on

providing an EWA replacement supply, and three concept plans combined various measures to address multiple objectives.

- From the eight concept plans, seven plans (in addition to the No-Action plan) were identified for further development as initial alternatives in the remainder of the feasibility study:

  1 – Raise Los Vaqueros Dam In-Place for Bay Area Water Supply Reliability - Raise the existing Los Vaqueros Dam to provide up to 25,000 acre-feet of additional storage and construct an intertie to the South Bay Aqueduct (SBA) at the Dyer Canal Back Surge Pool primarily to improve Bay Area water supply reliability during drought periods.

  2 – Enlarge Los Vaqueros Dam and Reservoir for Bay Area Water Supply Reliability - Enlarge Los Vaqueros Reservoir by up to 400,000 acre-feet and construct an intertie to the Dyer Canal primarily to improve Bay Area water supply reliability during drought periods.

  4 – Enlarge Los Vaqueros Reservoir with Dyer Canal Intertie for EWA - Enlarge Los Vaqueros Reservoir by up to 400,000 acre-feet in combination with an intertie to the Dyer Canal to provide an EWA replacement supply.

  5 – Enlarge Los Vaqueros Reservoir with Bethany Reservoir Intertie for EWA - Enlarge Los Vaqueros Reservoir by up to 400,000 acre-feet in combination with an intertie to Bethany Reservoir primarily to provide an EWA replacement supply.

  6 – Water Supply / EWA Combination with Dyer Canal Intertie - Enlarge Los Vaqueros Reservoir by up to 400,000 acre-feet in combination with an intertie to the Dyer Canal to improve Bay Area water supply reliability and provide an EWA replacement supply.

  7 – Water Supply / EWA Combination with Bethany Reservoir Intertie - Enlarge Los Vaqueros Reservoir by up to 400,000 acre-feet in combination with an intertie to Bethany Reservoir to improve Bay Area water supply reliability and provide an EWA replacement supply.

  8 – Water Supply / EWA Combination with Water Quality Improvements – Enlarge Los Vaqueros Reservoir by up to 400,000 acre-feet in combination with an intertie to the Dyer Canal and operate the project to improve Bay Area water supply reliability, provide an EWA replacement supply, and improve the quality of delivered water supplies.

- Desalination with new storage, represented by Concept Plan 3, was not identified for further development as a stand-alone alternative. However, it is believed that a desalination facility should be considered similar to other source water diversion and treatment options as a potential increment to detailed alternative plans to be developed in the next phase of study.

- Each of the initial alternatives identified for further development contributes to increasing Bay Area water supply reliability and/or providing an EWA replacement supply, and all of the initial alternatives can contribute, to some degree, to improving delivered water quality.

- It is believed that the initial alternatives recommended for further development in the next phase of the investigation could be formulated in a manner consistent with the CCWD Board of Directors Principles of Participation for a project involving the enlargement of Los Vaqueros Dam and Reservoir.

- It appears that for potential projects either focused on or including development of EWA replacement supplies, conveyance facilities from Los Vaqueros Reservoir directly to Bethany Reservoir could be more cost-effective than from Los Vaqueros to the SBA at Dyer Canal. This is primarily because deliveries to Bethany Reservoir would not be limited by the capacity or demands of the SBA.

- Since a Federal interest exists in participating in the EWA, a Federal interest may exist in enlarging Los Vaqueros Reservoir to accomplish similar goals. The degree and magnitude of the potential Federal interest will need to be confirmed and quantified as part of future phases of the LVE.

- Several significant next steps in the plan formulation process for the LVE include detailed development of complete alternative plans, including the locally preferred plan; completing environmental baseline studies; identifying potential impacts and mitigation features; identifying a tentatively selected plan; defining project ownership and implementation relationships; and completing the Federal Feasibility Report and State and Federal environmental compliance documentation.

- Future technical studies for the LVE will focus on water operations modeling to better define potential benefits to water supply reliability and the EWA, and on defining possible impacts in the CVP and SWP systems. Technical studies also will concentrate on preparing detailed facilities designs, refining cost estimates, and conducting economic analyses, including analysis of the future cost of water transfers and purchases.

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CHAPTER XIII
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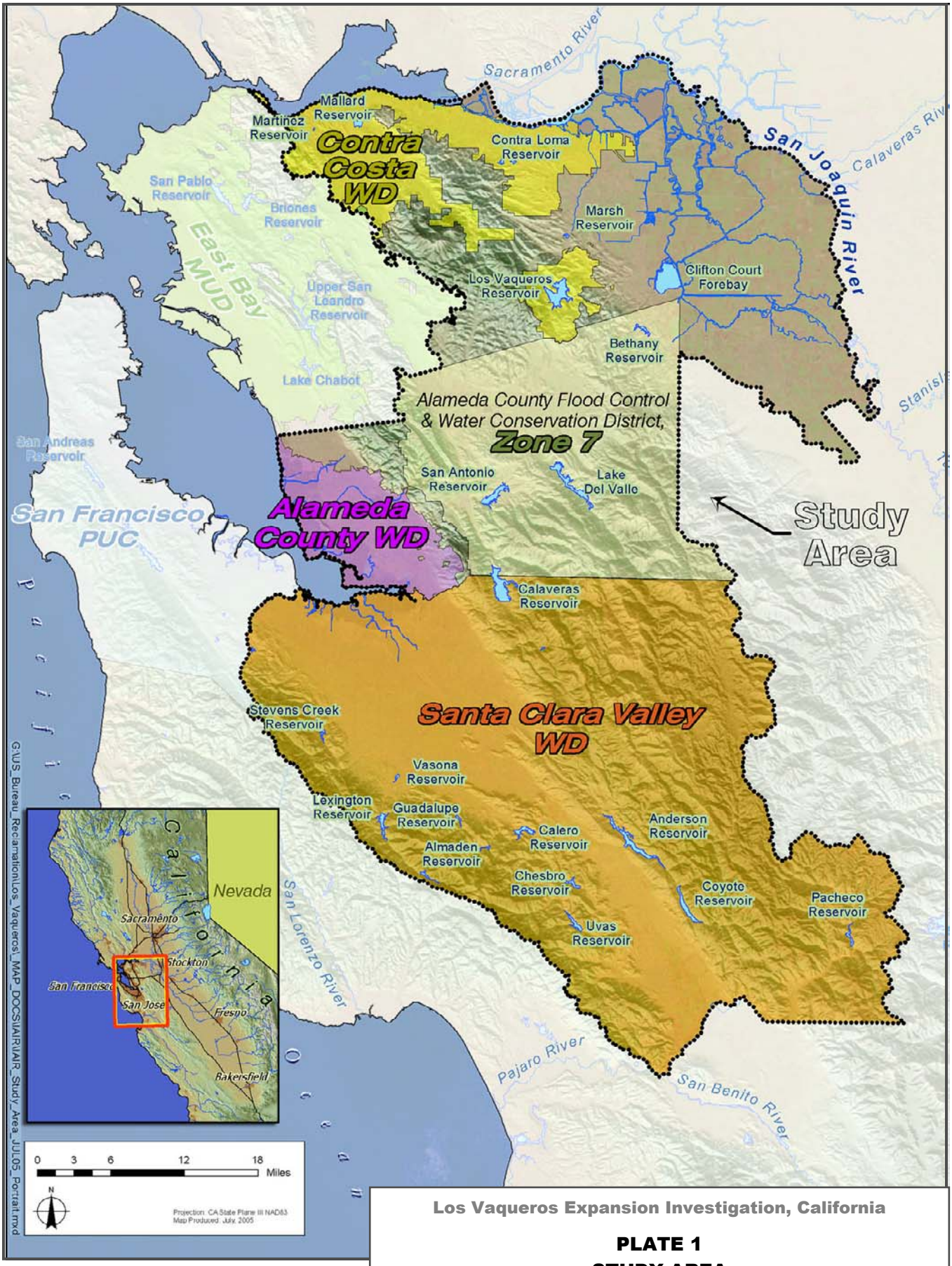
PLATES

Los Vaqueros

Expansion Investigation,

California

September 2005



Los Vaqueros Expansion Investigation, California

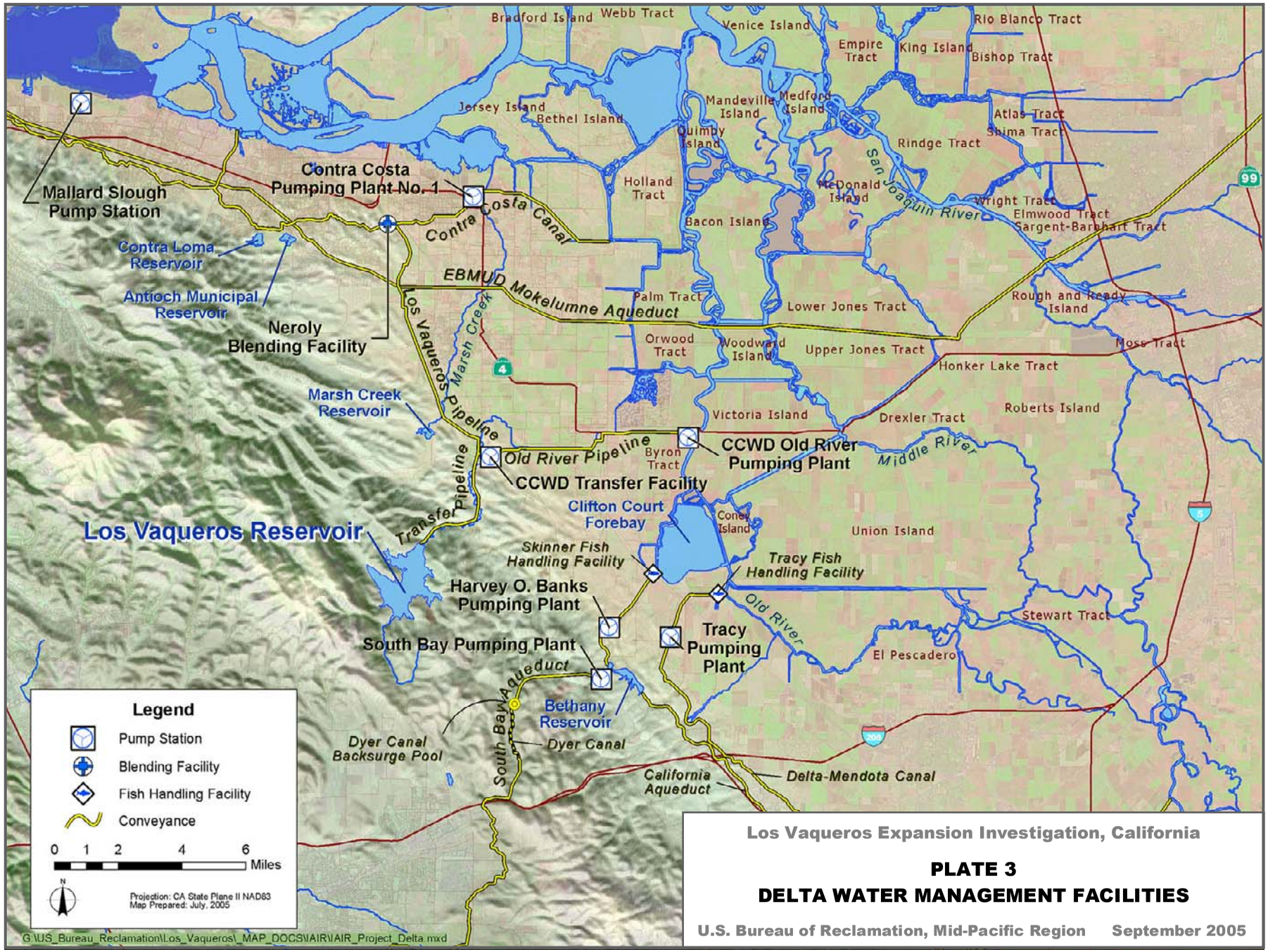
PLATE 1
STUDY AREA

U.S. Bureau of Reclamation, Mid-Pacific Region **September 2005**

Los Vaqueros Expansion Investigation, California

PLATE 2
CVP AND SWP FACILITIES

U.S. Bureau of Reclamation, Mid-Pacific Region September 2005



Los Vaqueros Expansion Investigation, California

PLATE 3
DELTA WATER MANAGEMENT FACILITIES

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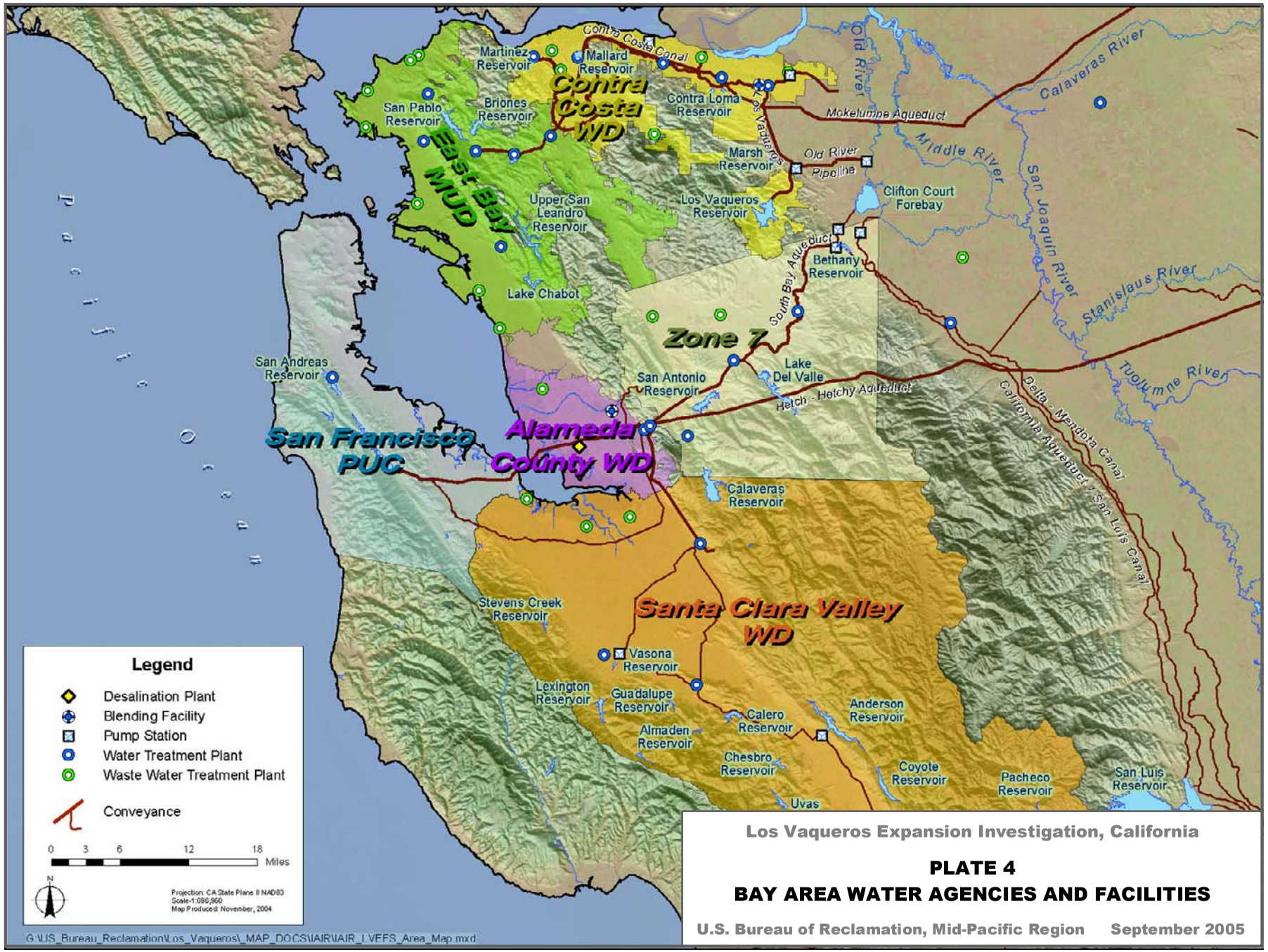


Los Vaqueros Expansion Investigation, California

PLATE 4

BAY AREA WATER AGENCIES AND FACILITIES

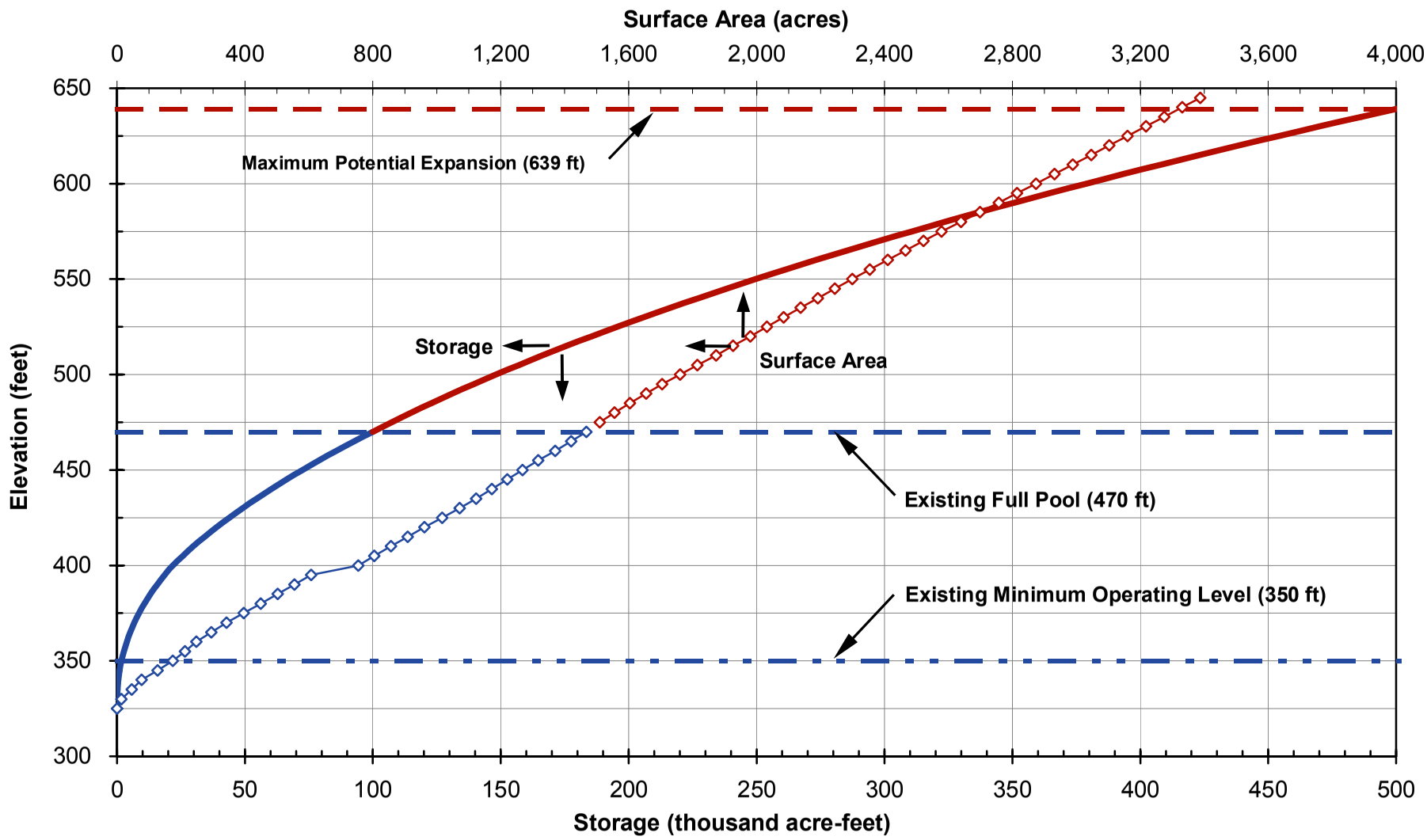
U.S. Bureau of Reclamation, Mid-Pacific Region September 2005

Los Vaqueros Expansion Investigation, California

PLATE 5

EXISTING LOS VAQUEROS PROJECT

U.S. Bureau of Reclamation, Mid-Pacific Region September 2005



LEGEND

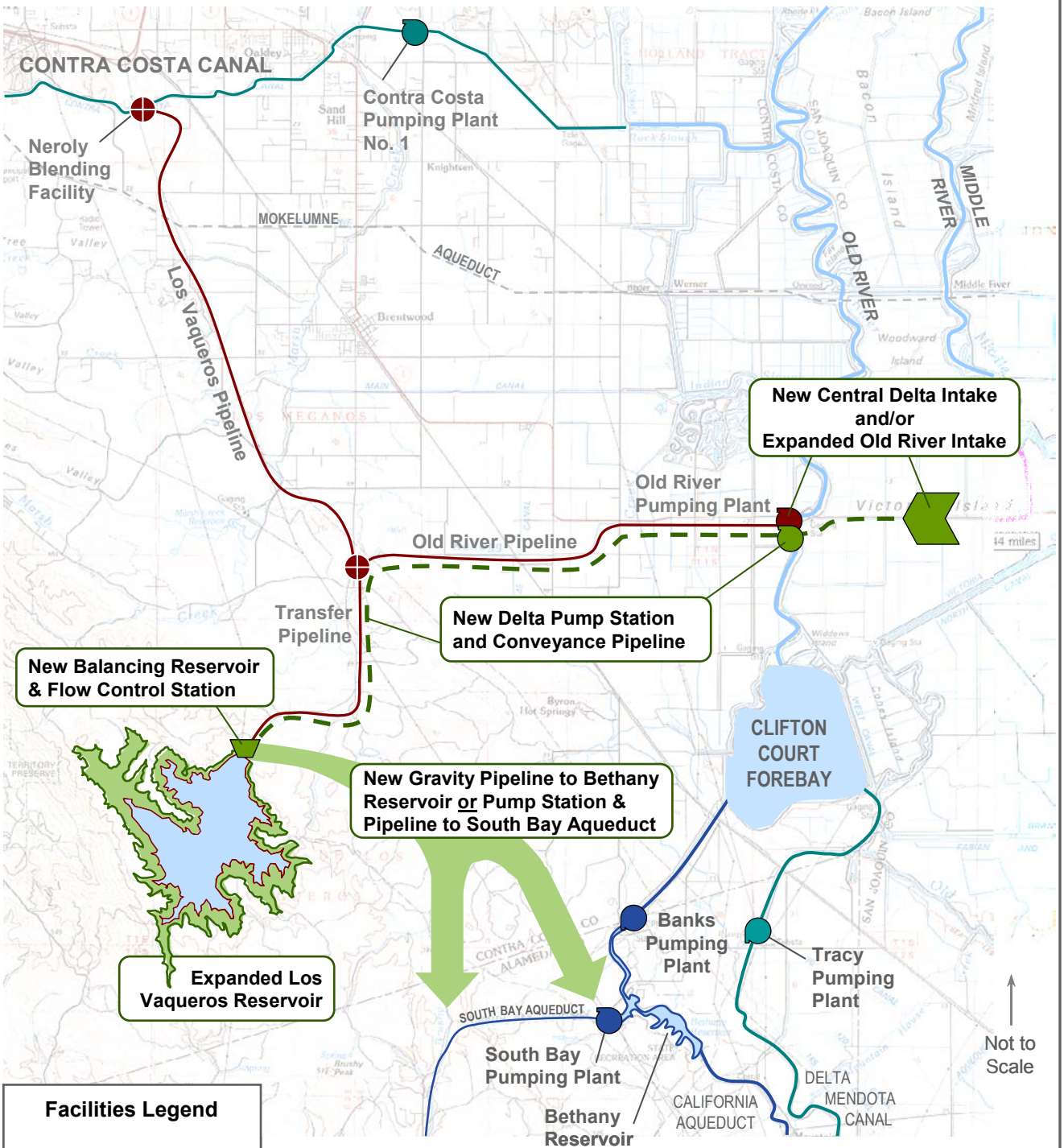
- Existing Storage
- Expanded Storage
- Existing Surface Area
- Expanded Surface Area

Los Vaqueros Expansion Investigation, California

PLATE 6

STAGE-AREA-CAPACITY RELATIONSHIPS FOR EXPANDED LOS VAQUEROS RESERVOIR

U.S. Bureau of Reclamation, Mid-Pacific Region September 2005

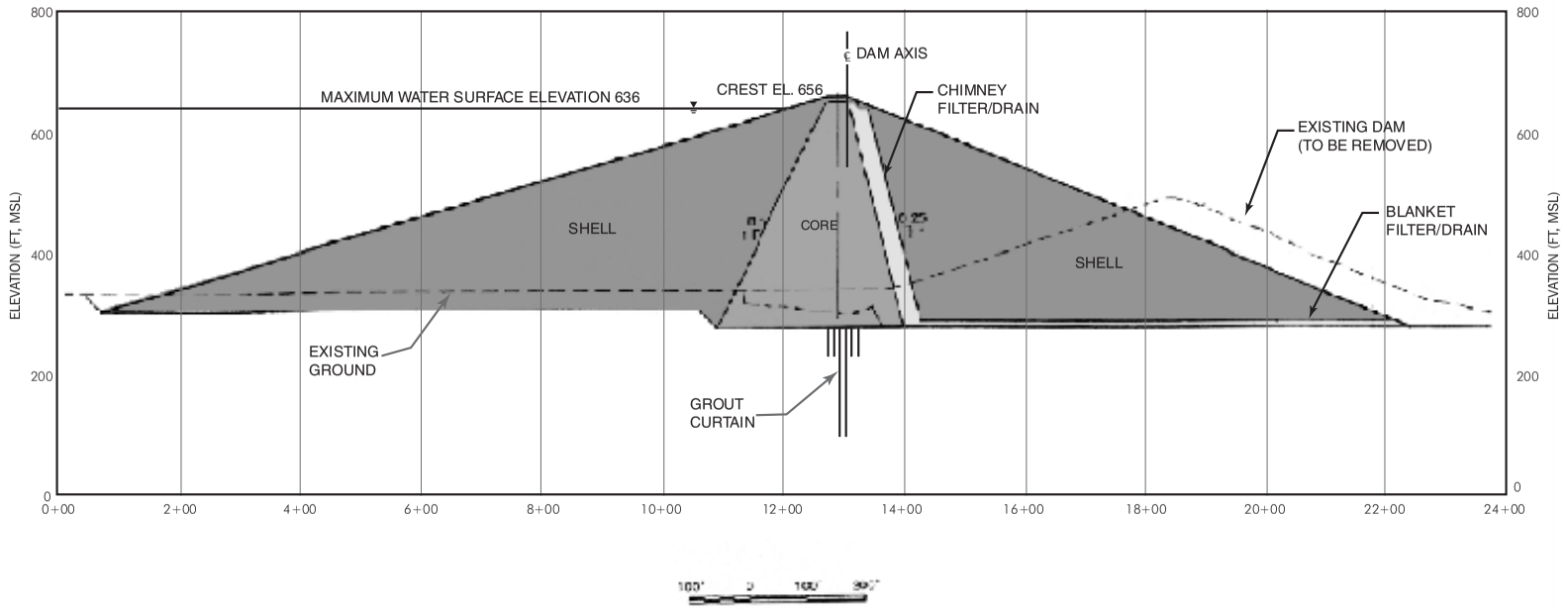


Los Vaqueros Expansion Investigation, California

PLATE 7

FACILITIES ASSOCIATED WITH AN EXPANDED LOS VAQUEROS PROJECT

U.S. Bureau of Reclamation, Mid-Pacific Region September 2005



Los Vaqueros Expansion Investigation, California

PLATE 8

CROSS SECTION OF 500,000 AF DAM OPTION

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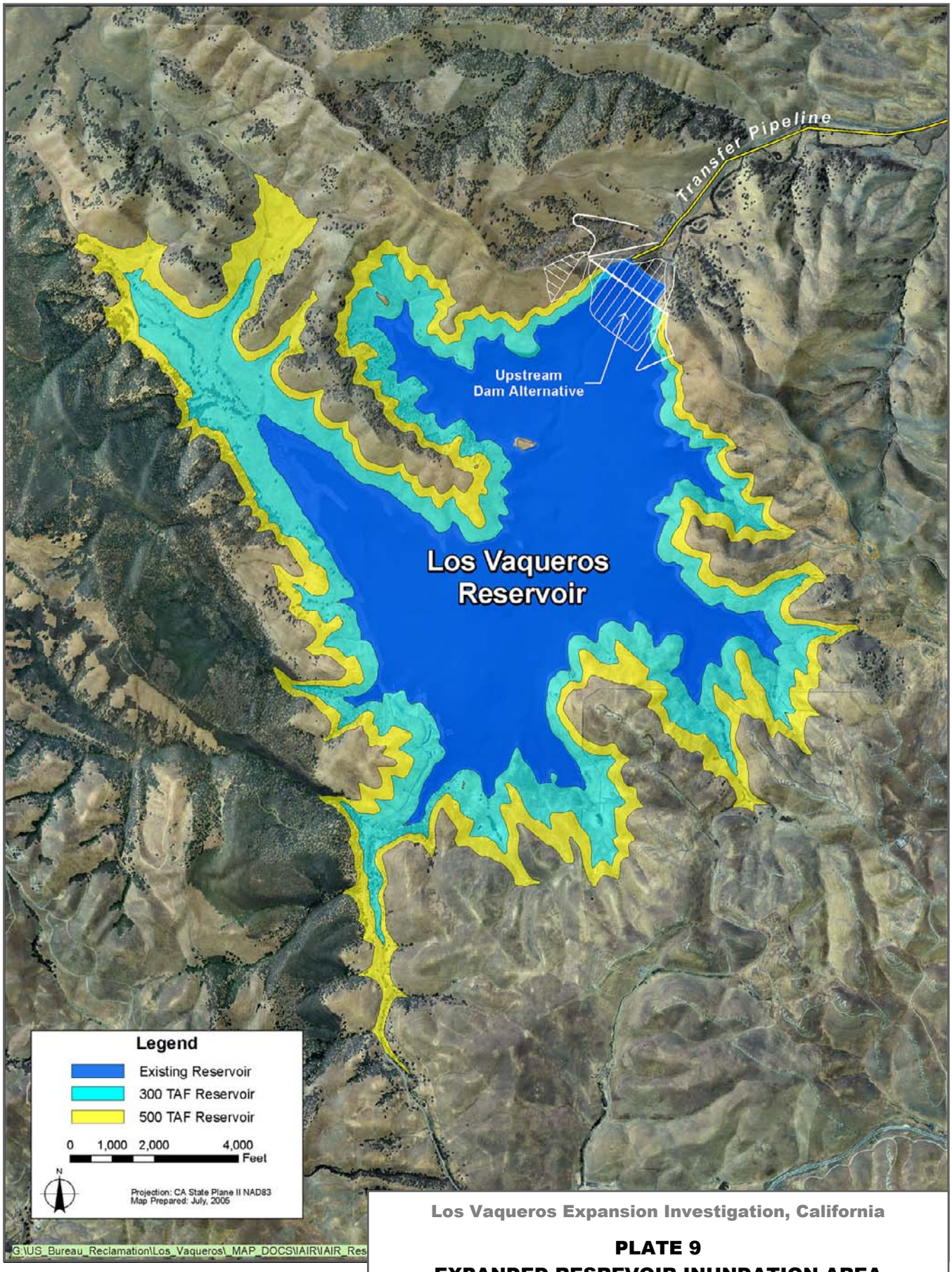

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PLATE 9
EXPANDED RESREVOIR INUNDATION AREA

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