FINAL REPORT

Delta Water Supply Reliability Study

Delta Water Supply Reliability Study

Prepared for:
Alameda County Water District
Santa Clara Valley Water District
Zone 7 Water Agency

May 2009

Prepared by:

CDM
consulting · engineering · construction · operations

CDM

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May 5, 2009

Mr. Kurt Arends
Assistant General Manager
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Subject: Delta Water Supply Reliability Study Report

Dear Kurt:

CDM is very appreciative for the opportunity of working with the South Bay Aqueduct Contractors on this effort to assess interim water supply options to address projected shortfalls in State Water Project supply.

The potential supply shortfalls projected based on changing regulatory conditions (delta smelt biological opinion and beyond) and climate change, as our study demonstrates, are not insignificant. While there are a wide array of alternatives to address this shortfall, our analysis indicates that none of them clearly emerges as "best." Instead, significant uncertainties remain about the benefits and costs of the alternatives.

The proposed strategy seeks to maximize benefits while minimizing costs through a combination of lower capital cost versions of selected alternatives. It is anticipated, with the current pace of analysis that is being undertaken at local, state, and federal levels on these projects that better information to develop a coordinated water supply strategy would be available in 2010.

We have very much enjoyed working with the South Bay Aqueduct Contractors on this interesting project.

Very truly yours,

Phillippe Daniel
Vice President
Camp Dresser & McKee Inc.

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List of Abbreviations

$/AFY	dollars per acre-foot per year
2001 Study	Water Conveyance Study
ACWD	Alameda County Water District
AF	acre-feet
AFY	acre-feet per year
AIP	Alternative Intake Projects
Banks	Harvey O Banks
BARDP	Bay Area Regional Desalination Project
BBID	Byron Bethany Irrigation District
BDCP	Bay-Delta Conservation Plan
CCWD	Contra Costa Water District
cfs	cubic feet per second
CVP	Central Valley Project
cy	cubic yards
DDSD	Delta Diablo Sanitation District
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
DSOD	California Division of Safety of Dams
DSRSD	Dublin-San Ramon Services District
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
EBRPD	East Bay Regional Park District
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
EWA	Environmental Water Account
FAQ	Frequently Asked Questions
GBA	Northeastern San Joaquin County Groundwater Banking Authority
GFDL	Geophysical Fluid Dynamic Lab
IAIR	Initial Alternatives Information Report
IRWMP	Integrated Regional Water Management Plan
ISB	Independent Science Board
kWh	kilowatt-hour
LVE	Los Vaqueros Reservoir Expansion
M&I	municipal and industrial

MAF	million acre-feet
MCL	Maximum Contaminant Level
mgd	million gallons per day
mg/L	milligrams per liter
MWD	Metropolitan Water District of Southern California
NMFS	National Marine Fisheries Service
NODOS	North-of-Delta Offstream Storage
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
OCAP	Operations Criteria and Plan
OMR	Old and Middle Rivers
PCM	Parallel Climate Model
pga	peak ground acceleration
PP	pumping plant
ppb	parts per billion
RO	reverse osmosis
RWQCB	Regional Water Quality Control Board
SBA	South Bay Aqueduct
SBA Contractors	Alameda County Water District, Santa Clara Valley Water District, and Zone 7 Water Agency
SBCWD	San Benito County Water District
SCVWD	Santa Clara Valley Water District
Semitropic	Semitropic Water Storage District
SEWD	Stockton East Water District
SFPUC	San Francisco Public Utilities Commission
SWP	State Water Project
SWRCB	State Water Resources Control Board
SWRU	Stored Water Recovery Unit
TAF	thousand acre-feet
TAF/yr	thousand acre-feet per year
TDS	total dissolved solids
USACE	U S Corps of Engineers
USBR	U S Bureau of Reclamation
USEPA	U S Environmental Protection Agency
USFWS	U S Fish and Wildlife Service
WTP	water treatment plant
Zone 7	Zone 7 Water Agency

Executive Summary

Zone 7 Water Agency (Zone 7), Alameda County Water District (ACWD), and Santa Clara Valley Water District (SCVWD) (collectively, the South Bay Aqueduct [SBA] Contractors) are conducting the Delta Water Supply Reliability Study to assess various supply options and refine their near-term (10- to 15-year) supply reliability strategies This executive summary consists of four sections

1 Study overview and purpose

2 Water supply impacts due to Sacramento-San Joaquin Delta (Delta) restrictions and climate change

3 Potential projects to replace Delta supply shortfall

4 Conclusions

E.1 Study Overview and Purpose

In recent years, several issues have come to the forefront of water supply resources in California climate change, short-term threats to reliability of existing Delta facilities, and potential longer-term changes to the Central Valley Project/State Water Project Operation Criteria and Plan due to new regulatory restrictions for fisheries protection

For these reasons, the SBA Contractors embarked on this study to assess and compare storage with other supply options, and to develop a recommended supply strategy Supply strategies are intended to be those that could be implemented in the near-term (e g , in the next 10 to 15 years) that would provide benefits before a longer-term alternative can be implemented

The study evaluated various water supply options, including desalination, regional storage projects, groundwater banking, expanding Del Valle Reservoir and participating in Los Vaqueros Reservoir projects (the latter two receiving the most analysis)

E.2 Water Supply Impacts Due to Delta Restrictions and Climate Change

CDM assessed the SBA Contractors' State Water Project (SWP) potential reductions in deliveries due to both climate change and regulatory restrictions in the Delta Changes in deliveries were estimated using the 2005 *State Water Project Delivery Reliability Report* (Department of Water Resources, Bay Delta Office, 2006), which was used to establish baseline conditions, and the 2007 report (Department of Water Resources, Bay Delta Office, 2008a), which incorporates estimates of deliveries using various climate change models, and potential regulatory restrictions on export pumping to protect delta smelt Impacts of a South Bay Pumping Plant outage were also assessed

E.2.1 Delta Regulatory Restrictions

In *Natural Resources Defense Council v Kempthorne*, the U S Fish and Wildlife Service's 2005 biological opinion for delta smelt was successfully challenged as failing to meet Endangered Species Act requirements In December 2007, the court issued a ruling to protect delta smelt until a new biological opinion was issued, in December 2008 The ruling affected the SWP Harvey O Banks (Banks) pumping operations, and therefore deliveries to SWP contractors downstream of the Banks pumps

Analysis by California Department of Water Resources (DWR) indicates that the Delta restrictions, based on simulations to assess impacts of the ruling, would reduce the SBA Contractors' SWP Table A deliveries[1] by 13 to 24 thousand acre-feet per year (TAF/yr) (6 to 11 percent) on a long-term average basis, and 26 to 36 TAF/yr (11 to 16 percent) in dry years Article 21 deliveries[2] would be significantly reduced in all hydrologic year types, with a long-term average reduction of 70 to 85 percent of total Article 21 deliveries

The U S Fish and Wildlife Service released the new biological opinion for delta smelt on December 15, 2008 This biological opinion will further impact deliveries, since it includes additional restrictions beyond those imposed in the remedial order Future biological opinions for longfin smelt and salmon, anticipated in Spring 2009, could also further impact export deliveries

These losses are deemed to be significant by each of the SBA Contractors

E.2.2 Restrictions Due to Climate Change

Climate change has the potential to change SWP deliveries because of altered hydrologic conditions DWR's CalSim II simulations evaluate the effects of four climate change scenarios on SWP deliveries The modeled results for SBA Contractor's SWP deliveries would not be reduced significantly more than with Delta restrictions only Climate change also has the potential to affect sea level rise and local runoff timing and quantities stored in Del Valle Reservoir, which would also affect SBA Contractor water supply These changes, however, are not included in the CalSim modeling

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[1] The SBA Contractors have long-term water supply contracts with DWR for SWP water Table A deliveries refer to the schedule of the maximum amount of water each contractor may receive annually

[2] Article 21 water is interruptible water allocated to requesting SWP contractors under certain conditions SWP's share of San Luis Reservoir is full or projected to fill in the near term, other SWP reservoirs are full or at their storage targets, or conveyance capacity to fill these reservoirs is maximized, releases from upstream reservoirs plus unregulated inflow exceed the water supply needed to meet Sacramento Valley in-basin uses, Table A deliveries are being fully met, and the Banks Pumping Plant has spare capacity

E.3 Potential Projects to Replace Delta Supply Shortfall

Several projects were evaluated to assess their ability to replace lost Delta supply surface water storage, local desalination projects, and groundwater banking Seven separate projects were evaluated in the study[3] Table E-1 summarizes information on each with respect to the project capacity, yield, benefits, issues, timing, capital costs and unit costs of water Cost information was developed from available information for each project, updated to June 2008 dollars Projects were evaluated based on costs and financing, environmental impacts, regulatory requirements, dependence on others, and operational benefits

E 3.1 Surface Water Storage Projects

Four reservoir projects were evaluated in the study expansion of Upper Del Valle (several configurations evaluated), Los Vaqueros Expansion (LVE) Project, Sites Reservoir, and Temperance Flat Reservoir Of the reservoir projects, only the regional-scale projects (LVE, Sites and Temperance Flats) have the potential to provide significant supply reliability benefits to the SBA Contractors Del Valle Reservoir expansion alternatives provide only small storage volumes and were screened from further consideration due to their small yields The remaining projects all have considerable uncertainty with a) implementation time-frame, b) yields due to unfolding Delta regulations, c) potential project partners and d) costs

Of the surface water storage projects, LVE, sponsored by Contra Costa Water District (CCWD), is the furthest along in the planning process and, at this point in time, appears to have the shortest projected implementation time frame The 100 TAF (existing) to 275 TAF (expanded) LVE project evaluated in this study is seeking State or Federal partners for project environmental benefits, and the SBA Contractors for reliability supply LVE may provide a means of maintaining deliveries that would normally come through the SWP when it would otherwise be restricted due to environmental or other constraints through those SWP facilities This assumes an ability to move the SWP water through LVE facilities, which may require modification of existing water rights (an assumption that requires verification), otherwise new sources of supply would be needed It may be possible to move new sources of supply through LVE facilities These sources could be unappropriated Delta water[4], transfer water conveyed on behalf of SBA Contractors when capacity is unavailable at Banks, or water available under existing water rights permits Uncertainty remains as to who would obtain/purchase additional supplies Assessments by the State of California may affect the extent to which existing and future supply will be able to conveyed through LVE This project would likely require State or Federal cost sharing to move forward

[3] Upper Del Valle Reservoir is one of several local options that were evaluated for storage, and was selected for comparison with other projects as the best local option

[4] Assuming unappropriated water is available

Table E-1
Summary of Alternatives

Alternative	Capacity (1)	Average Annual Yield (TAF/yr)	Capital Cost ($M, June 2008)	Unit Cost ($/AFY)	Principal Benefits	Key Issues	Approximate Timing (2)
Los Vaqueros Reservoir Expansion	275 TAF (total capacity)	18 to 25 for SBA Contractors	$793	Ranges from $280 to $1,800 depending whether obtain 90% Federal/State Cost Share (low end of cost range) or no State/Federal cost share (high end of cost range) Does not include $100M buy in fee	• Potentially meets a significant portion of projected shortfall	• State or Federal cost share required for lower cost for SBA Contractors No established procedures to determine potential State cost share • 1,000 acres of new inundation area	Construction completed by 2015
Upper Del Valle Reservoir	15 TAF	0 9 (unregulated runoff only)	$108 $115	$11 500 $12 300 with local runoff only	• Locally controlled project • Would make use of Zone 7 and ACWD prior water rights	• Small reservoir capacity limits ability to meet projected needs	Construction completed by 2015
Sites Reservoir (3)	1 800 TAF	75 to 163 (all SWP contractors), 4 to 9 to SBA Contractors (assuming 5 3% of SWP yield)	$2,600 $3,600	$230 $430 when costs shared proportionally by all users $350-$1,000 when water supply users pay 90% of project costs	• Potential for increased SWP supplies in dry years • Project has State interest so costs could be reduced by State participation	• Low potential supply benefits • State and Federal approval needed • 14 000 acre inundation area • Requires moving water through the Delta • Long term project	Operation in 2020 (based on timing in DWR s 2007 FAQ)
Temperance Flat Reservoir	450 TAF – 1,300 TAF	35 to 53 (all SWP contractors) 2 to 3 to SBA Contractors (assuming 5 3% of SWP yield)	$3,200	$900 (without O&M costs), $1 000 when O&M costs estimated at 0 5% of capital costs	• Potential for increased SWP supplies in dry years • Project has State interest, so costs could be reduced by State participation	• Low potential supply benefits • State and Federal approval needed • 6 000 acre inundation area • Requires moving water through the Delta • Long term project	Operation in 2018 2020 (based on timing in DWR's 2007 FAQ)
Bay Area Regional Desalination Project (BARDP)	65 mgd (total capacity) 10 mgd (SCVWD-alone capacity, or SBA Contractors capacity if SCVWD partners with other contractors)	11-27 total normal/wet year supply for SCVWD/SBA Contractors, assuming 95% plant factor 5 month to year-round operation	$52 (based on 10 mgd SCVWD capacity)	$1 300 + wheeling/ conveyance (for operation in all years)	• Potential opportunities for average/wet year deliveries for SBA Contractors when capacity not planned by partners	• Could require wheeling agreements/ interties thru EBMUD for use by Zone 7, City of Hayward for SCVWD/ACWD or exchange with CCWD • Potential impingement/ entrainment of larval and juvenile fish species	Construction completed in 2013 (current BARDP schedule)

Table E-1
Summary of Alternatives

Alternative	*Capacity* (1)	*Average Annual Yield (TAF/yr)*	*Capital Cost ($M, June 2008)*	*Unit Cost ($/AFY)*	*Principal Benefits*	*Key Issues*	*Approximate Timing* (2)
Delta Diablo Desalination Project	5-7 5 mgd pilot potentially up to 50 mgd	5 to 8 total assuming 90% plant factor (pilot project total for all participants)	$57 for the pilot plant	$1 500 - $1,900 for 5 mgd output, $1 000-$1 300 for 7 5 mgd output Does not include wheeling/conveyance	• Potentially shorter implementation time frame for pilot project rather than reservoir projects	• Small project • Could require wheeling agreements/interties thru EBMUD for use by Zone 7, City of Hayward for SCVWD/ACWD • Potential impingement/ entrainment of larval and juvenile fish species	Construction completed in 2014 (based on DDSD study)
Semitropic Stored Water Recovery Unit (Phase 2) (4)	450 TAF firm, plus 200 TAF when available	150 firm plus up to 276 when available (total for all participants)	$187 (of which $12 is to be paid by Phase 1 partners)	$480 to $530 for high priority shares, $300 to $350 for low priority shares Does not include cost of water banked and conveyance to Semitropic	• Extension of existing program in which SBA Contractors participate • Provides operational flexibility in dry years • Can significant increase return capacity from original (existing) Semitropic stored supplies • CEQA and permitting work is completed • Available immediately	• Project would need to be developed in conjunction with a supply project to obtain water to store in the bank • Recovered groundwater may need arsenic treatment • Requires exchange of California Aqueduct water for delivery to SBA	As of February 2007 25% of facilities were constructed

Notes $/AFY = dollars per acre-foot per year $M = millions of dollars CCWD = Contra Costa Water District CEQA = California Environmental Quality Act DDSD = Delta Diablo Sanitation District EBMUD = East Bay Municipal Utility District FAQ = Frequently Asked Questions O&M = operations and maintenance TAF/yr = thousand acre-feet per year

(1) Capacity represents total capacity of project, except where explicitly noted for BARDP

(2) Timing in contingent upon a number of factors including completion of feasibility studies financing environmental documentation permitting and project approval

(3) DWR has not yet performed modeling to incorporate potential flow restrictions due to the Wanger decision into estimates of annual average yield

(4) Semitropic Stored Water Recovery Unit (Phase 2) is not a new source of water with additional yield but rather a method for storing and using the SBA Contractors water Unit costs shown in this table represent costs for Semitropic SWRU participation only Additional costs would be incurred to acquire water supply for groundwater banking

In addition to the 275 TAF LVE expansion project evaluated in this study, CCWD is also evaluating a smaller reservoir expansion to 160 TAF, with the potential to provide 30 TAF of storage to other interested partners The smaller project could be developed as a CCWD only project, or with local partners, and would not require State or Federal cost sharing partners While the reliability supply would be much smaller than for the 275 TAF reservoir expansion, the smaller project does not require costly conveyance pipelines, so could potentially be implemented more quickly and at considerably lower cost

The LVE studies team has completed analysis to assess project impacts for the project environmental impact report/environmental impact statement, currently scheduled to be released in early 2009 State and Federal Feasibility studies to assess interest in the project and potential cost sharing will be completed in 2009 and 2010

E.3.2 Desalination Projects

Two desalination projects were evaluated in the study the Bay Area Regional Desalination Project (BARDP) and the Delta Diablo Desalination Project The BARDP project is being sponsored by four Bay Area agencies East Bay Municipal Utility District (EBMUD), San Francisco Public Utilities Commission (SFPUC), SCVWD and CCWD The project is planned to provide dry-year and emergency supply to participating agencies at one or two locations There is an opportunity to seek additional partners who would be interested in average and wet year supply BARDP sponsors are currently conducting a pilot study at the preferred plant location adjacent to the Mirant Power Plant in Pittsburg Thus far, studies for the BARDP project have been conducted using grant funding Funding has not been secured beyond the current pilot phase Delta Diablo Sanitation District (DDSD) is developing a 5 to 7 5 million gallon per day (mgd) demonstration-scale project that would treat brackish bay water for delivery to other agencies Depending on the outcome of the demonstration project, the project has the potential to be expanded to 50 mgd

Both desalination projects have similar unit costs and similar implementation time frames, which are slightly shorter than the LVE implementation time frame Given their location in Pittsburg adjacent to the Delta, both projects would also require partnerships/exchange agreements with other agencies (potentially EBMUD, CCWD and/or SFPUC) to convey water to the SBA Contractors While these projects potentially have less supply reliability uncertainty than storage projects that are subject to Delta conveyance limitations, the amount that could be delivered to SBA Contractors is highly dependent on conveyance capacity in adjacent utility systems, as well as the ability of SBA Contractors to receive water at interconnection locations, and distribute water effectively Since conveyance capacity would be more likely available during winter season months, these projects could potentially be paired with existing groundwater banking programs, or the Semitropic Water Storage District (Semitropic) Stored Water Recovery Unit (SWRU) either to meet demand directly from projects, and bank SWP water normally delivered through the SBA, or to exchange water through other agencies for delivery to Semitropic groundwater bank The Semitropic SWRU has limited capacity to receive wet-season water, since most recharge is in-lieu Semitropic has demonstrated some flexibility in shifting monthly schedule to accommodate wet season banking

E.3.3 Groundwater Banking

All three SBA Contractors participate in the current Semitropic Groundwater Banking program, with a 57 percent share of the 1 million acre-feet of storage Semitropic is currently seeking partners for Phase 2 of the SWRU, which is currently under construction SWRU is not a new source of water with additional yield, but rather a method for storing and using the SBA Contractors' water The SWRU provides an additional storage amount of 650 TAF Arsenic, in concentrations exceeding State maximum contaminant levels has been found in some supply and monitoring wells and Semitropic is currently evaluating the need for arsenic treatment Cost of the banking program is estimated at $280 to $430/AF, including treatment[5] Participation in the SWRU could provide additional dry-year operational flexibility to the SBA Contractors, but only if a banking source of water can be identified For example, Article 21 water, which might have been a source, is not expected to be as readily available

E.4 Conclusions

All of the potential alternatives analyzed have limitations in their ability to meet the SBA Contractors' needs None of the alternatives are without significant costs, even the alternatives with lower apparent costs (LVE and Sites) include assumptions that may not be realized[6] While the study found that all of the alternatives have significant limitations, some of the alternatives merit continued investigation

- *LVE* This alternative has made substantial progress towards implementation, and appears to be on a faster track than other regional storage projects While the expansion from 100 TAF to 275 TAF has considerable uncertainty, associated with both benefits and costs, CCWD proposed an intermediate alternative - a 160 TAF expansion project - that would reduce the capital costs by elimination of costly conveyance It would also obviate the need for state or federal partnerships, but would have more limited supply benefits At the current time, there is little additional information available on this option SBA Contractors should continue to work with CCWD to refine both projects to assess benefits and costs of the LVE projects

- *Desalination* Two projects currently appear to be proceeding BARDP and the Delta-Diablo Sanitation District (DDSD) Desalination Project Both are in early phases of implementation The primary benefits of desalination projects are that they provide a new, and therefore more reliable, water supply regardless of

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[5] Unit costs are for participation in the banking program only Additional costs would be incurred to acquire water supply for groundwater banking

[6] LVE assumes that State and Federal funding will pay for 90 percent of the project, but this funding may be difficult to obtain The cost per acre-foot for Sites and Temperance Flat Reservoirs may also be understated because they are based on reservoir yield, but that yield may not be able to be moved through the Delta to reach the SBA

hydrological conditions. The DDSD project may also have fewer implementation hurdles because the SBA Contractors would be dealing with a single project sponsor, and may be an attractive alternative for individual agencies depending on the comparison of agency supply and demand. Both desalination projects would require agreements with neighboring agencies (EBMUD and potentially SFPUC) to wheel water through their systems, so conveyance issues would need to be explored.

- *Semitropic SWRU*: Although not a new source of supply, groundwater storage has the potential to improve the performance of either LVE or desalination water supply options by storing water when it is available for later use. SBA Contractors would need to assess how reductions in Article 21 water and LVE or desalination would work with existing banking programs, to determine whether there would be benefits to pursuing additional storage in the SWRU. Timing of supply would be a key issue for the SWRU, since most of the recharge is in-lieu, and winter recharge is limited.

These three alternatives are selected because of a combination of characteristics: costs that may be feasible, decreased reliance on Delta diversions through Banks pumping plant, and a schedule for implementation within the study period (10-15 years).

Figure E-1 compares the potential supply shortfall with potential yields for the alternatives, and also shows unit costs.

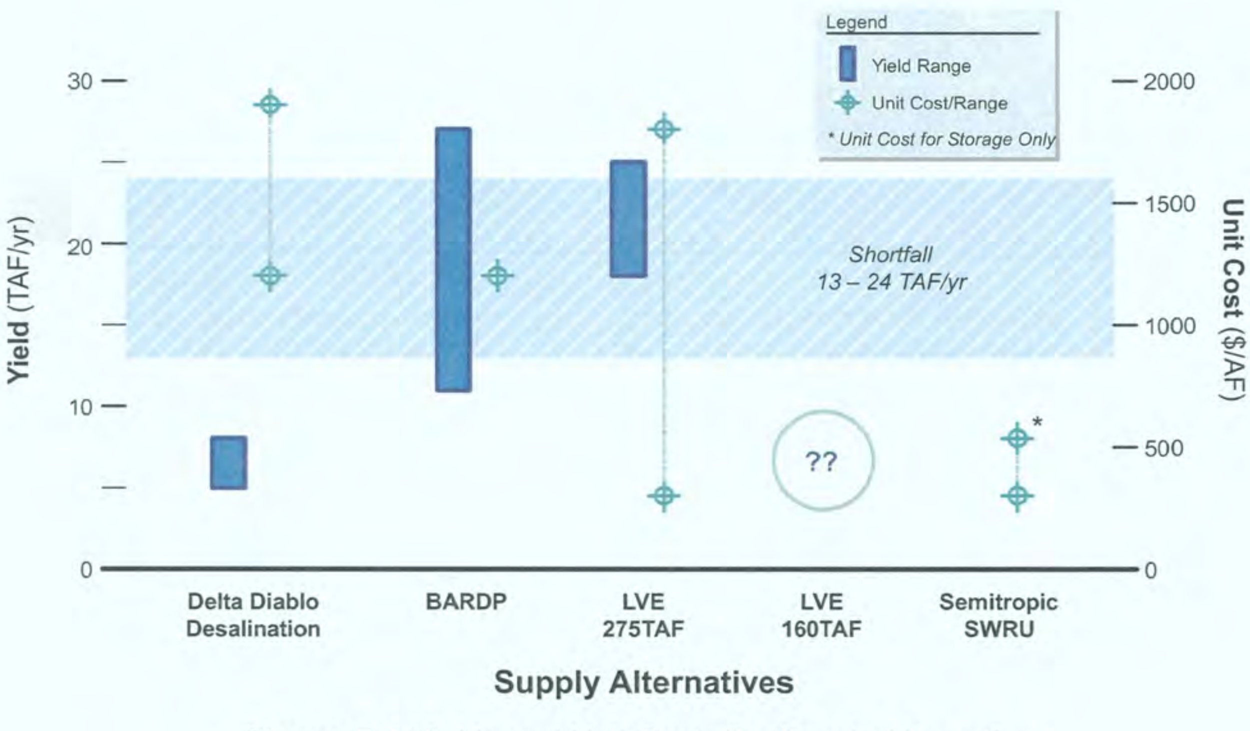


Figure E-1 *Yields and Unit Costs for Supply Alternatives*

The remaining alternatives were screened out for the following reasons:

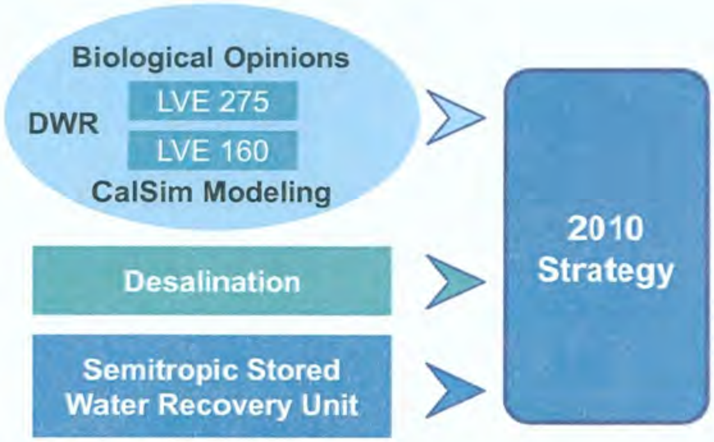
- *Upper Del Valle Reservoir*: high cost per acre-foot.
- *Sites and Temperance Flat Reservoirs*: extended timeline for implementation and dependence on multiple other partners.

The larger alternatives are, generally, more expensive, more complex to implement and therefore are expected to be on-line later. Nevertheless, the SBA Contractors should continue to support State and Federal agencies in developing Sites Reservoir as an SWP facility.

E.5 Recommended Action Plan for the SBA Contractors

Based on a) the potential of three alternatives (LVE, desalination and Semitropic SWRU), b) the uncertainties pertaining to the costs and benefits of these, and, c) the regulatory flux associated with the biological opinions for various species, CDM recommends that the SBA Contractors:

1. Assess impacts of regulatory decisions on SBA deliveries and anticipated LVE yields.
2. Assess how new supplies could be coupled with existing banking programs to determine whether increased banking participation through the Semitropic SWRU would be beneficial.
3. Further refine the costs and benefits of the LVE and desalination alternatives during 2009 and early 2010.
4. In mid-2010, based on the above findings, formulate a supply strategy based on the optimal combination of the 1) LVE Project (either 275 TAF or 160 TAF); 2) DDSD or BARDP project; and/or 3) Semitropic SWRU.



Further evaluation of best alternatives necessary prior to formulating water supply strategy

The SBA Contractors may more efficiently and reliably meet their objectives by focusing on multiple smaller projects than a single larger project. This approach may reduce the SBA Contractors' risk since they will not be relying on any single alternative to address future water supply shortfalls.

Potential general next steps and specific actions for the projects are outlined below

E.5.1 General

- Evaluate impacts of upcoming regulatory changes pertaining to Delta fisheries, in particular biological opinions for longfin smelt and salmon, and work with DWR to assess potential supply ramifications

- As alternatives are more fully developed, each agency should re-evaluate their supply reliability policies with respect to costs

E.5.2 LVE Project

There are a number of uncertainties associated with LVE project, including potential supply reliability yields, how those will be affected by ongoing actions to protect Delta fisheries, and costs, which will depend on potential project participants Since a decision to proceed is difficult at present due to the uncertainties, CDM recommends that the SBA Contractors clarify the costs and benefits of the LVE project by working with CCWD

- *Refining water supply sources, amounts and timing of water* CCWD has requested input from the SBA Contractors regarding specific operational needs, and has indicated a willingness to refine modeling analyses completed to date to evaluate differences in modeling assumptions and identify alternative delivery scenarios/assumptions In addition to modeling analysis, the SBA Contractors should also work with CCWD to better understand the types of water available (e g unappropriated Delta Water, transfer water, or water under existing water rights permits) as this will be critical to state and federal agencies (i e , how amounts can be further quantified, and the permitting and other institutional issues that would need to be addressed to obtain supply) Uncertainty remains as to who obtains/purchases these supplies Similarly, the SBA Contractors would need to evaluate potential LVE deliveries and how they integrate with existing supplies to specifically address usability of LVE supplies

- *Expanding analysis to include SBA capacity constraints* The effectiveness of LVE, as well as some alternatives such as an isolated conveyance facility and groundwater banking, depends on capacity availability in the SBA A detailed study of the seasonal capacity availability by reach would help refine these discussions

- *Developing potential participation costs to SBA Contractors* To date, CCWD has not completed cost analysis to determine potential participation costs for SBA Contractors Participation in the 275 TAF LVE would be contingent on state and federal participation Potential state and federal cost sharing will be examined in the federal and state feasibility studies SBA Contractors will need more information on cost sharing and buy-in costs from CCWD

- *Further developing the 160 TAF Expansion Option* In December 2008, CCWD identified a potential variant of the 160 TAF CCWD-only project, with up to 30 TAF storage available to other participating partners Offering significant cost savings, this project may be implemented with existing conveyance facilities, and delivery to the SBA Contractors through exchanges The SBA Contractors should continue to work with CCWD to refine this potential option to quantify potential supply reliability benefits and costs

E.5.3 DDSD (or BARDP) Desalination Project

Pursue desalination projects to determine if they are financially and institutionally viable

- Continue to work with DDSD to explore participation in pilot project, and timing of supply
- Track progress of BARDP pilot studies
- Discuss the potential for wheeling desalinated water through adjacent systems with EBMUD (all SBA Contractors) and SFPUC (ACWD and SCVWD), and identify steps necessary to refine available capacity and timing for transfers
- Revisit potential new intertie between Zone 7 and EBMUD to increase delivery capacity to Zone 7
- Perform system operational studies to assess ability to integrate supply source with local resources and groundwater banking programs

E.5.4 Semitropic Stored Water Recovery Unit

The Semitropic SWRU may be an option to supplement new supply projects and existing banking programs Zone 7 has already purchased shares in the SWRU, and should assess purchasing additional shares ACWD and SCVWD should assess participation

- Investigate whether it is still possible to purchase shares in Phase 1 of the SWRU, because of the more favorable storage and recovery ratio for each share
- As supply quantities and timing are refined for LVE and/or desalination projects, perform system operational studies to assess use of new supplies with existing banking programs and need for additional banking capacity

Section 1
Introduction

1.1 Study Overview and Purpose

Zone 7 Water Agency (Zone 7), Alameda County Water District, and Santa Clara Valley Water District (collectively, the South Bay Aqueduct [SBA] Contractors) are conducting the Delta Water Supply Reliability Study to assess various supply options and refine their supply reliability strategies

Recently, several issues have emerged as significant water supply planning considerations in California climate change, short-term threats to reliability of existing Sacramento-San Joaquin Delta (Delta) facilities, and potential longer-term changes to the Central Valley Project/State Water Project Operation Criteria and Plan

For these reasons, the SBA Contractors embarked on this study to assess and compare storage with other supply options, and to develop a recommended supply strategy The study focuses on comparative benefits of expanding Del Valle Reservoir and participating in Los Vaqueros Reservoir projects Other water supply options, including desalination, regional storage projects and groundwater banking were also included in the comparative analysis to develop the recommended supply plan Figure 1-1 is a general location map showing the projects included in the comparative analysis

1.2 CDM Scope of Work

The Delta Water Supply Reliability Study included the following principal work areas

1 <u>Water Supply Impacts due to Delta Biological Opinion and Climate Change (Section 2)</u> The SBA Contractors' State Water Project (SWP) potential reductions in deliveries due to both climate change and regulatory restrictions in the Delta were assessed Changes in deliveries were estimated using the *State Water Project Delivery Reliability Report* from 2005, which was used to establish baseline conditions, and the report from 2007, which incorporates estimates of deliveries using various climate change models, and the court-issued Interim Remedial Order to protect delta smelt

2 <u>Los Vaqueros Expansion Project (Section 3)</u> This section summarizes information provided by the Los Vaqueros Expansion (LVE) study team, which is evaluating projects that would expand the reservoir from its current size of 100 thousand acre-feet (TAF) to 160 TAF or 275 TAF The project is formulated to provide 1) environmental benefits by shifting pumping from state and federal pumps to LVE diversions which have state-of-the-art fish screens, and 2) reliability supply to the SBA Contractors' to replace a portion of deliveries lost due to regulatory restrictions

3 Del Valle Reservoir Expansion Alternatives (Section 4) CDM's 2001 *Water Conveyance Study* (2001 Study) (CDM, 2001) evaluated several new surface water reservoir sites and re-operation of the Del Valle Reservoir as alternatives to enlargement of the SBA The alternatives help meet peak demands, providing more flexibility in reservoir operations for Zone 7's increased SWP entitlement and increased SBA capacity allotment In this task, CDM updated and summarized information from the earlier study on the Del Valle Reservoir alternatives, their costs and benefits

4 Other Supply Alternatives (Section 5) CDM evaluated a number of other water supply projects that the SBA Contractors may consider as part of their supply strategy These represent a range of projects, including surface storage options, desalination, and groundwater banking Information for other alternatives was summarized from available documentation on these projects, with updates of project costs to June 2008 dollars

5 Comparison of Alternatives and Recommended Plan (Sections 6 and 7) CDM prepared a conceptual comparison of the alternatives, examining issues such as costs and financing, environmental impacts, regulatory requirements, and dependence on others for implementation The analysis also evaluates the operational benefits of projects in relation to the SBA Contractors existing supply programs, such as the Semitropic Water Storage District groundwater banking program, and existing facilities, such as the South Bay pumping plant, and presents a recommended supply strategy

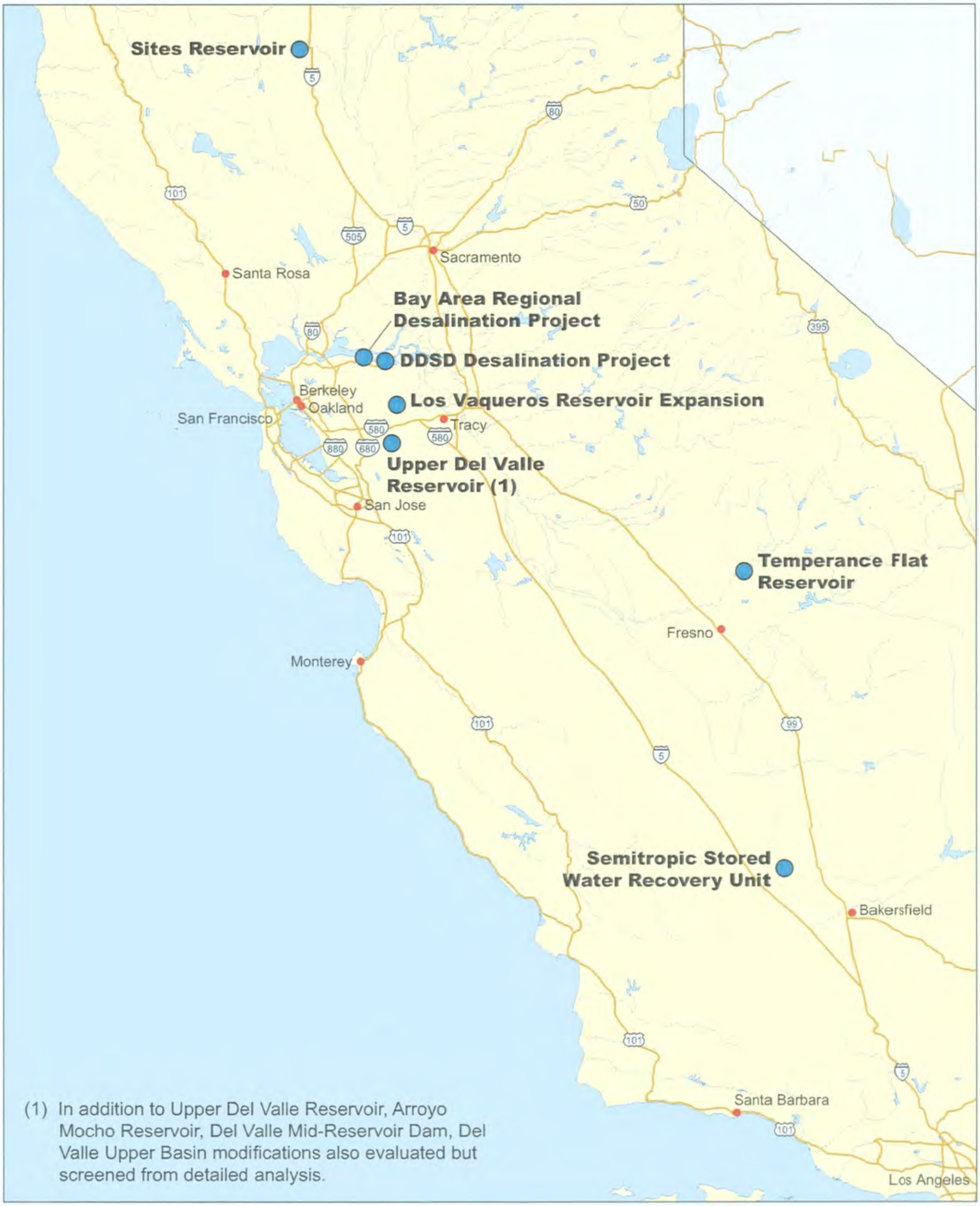


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Figure 1-1
Locations of Projects Evaluated in Comparative Analysis

Section 2
Water Supply Impacts of Delta Restrictions and Climate Change

This section estimates the range of water supply loss for South Bay Aqueduct (SBA) Contractors from (a) possible changes in the biological opinion on the long-term operation of the State Water Project (SWP)/Central Valley Project (CVP) given recent court decisions, and (b) climate change. The losses are estimated for five different hydrologic scenarios.

2.1 Summary

Changes in deliveries are estimated from *The State Water Project Delivery Reliability Report* (Department of Water Resources, Bay Delta Office, 2006 and 2008a). The 2005 report was used to establish baseline deliveries, and the 2008 report to estimate delivery reductions.

Three major scenarios were evaluated. The findings include:

- *Restrictions Due to Biological Opinion.* A court-issued Interim Remedial Order to protect delta smelt was in place prior to the issuance of U.S. Fish and Wildlife Service's (USFWS) December 2008 biological opinion. The remedial order affected SWP Harvey O. Banks (Banks) pumping operations, and therefore deliveries to SWP contractors downstream of the Banks pumps. Analysis by California Department of Water Resources (DWR) indicates that the Delta restrictions, based on simulations to assess impacts of the remedial order, would reduce SBA Contractors' SWP Table A deliveries by 6 to 11 percent on a long-term average basis, and 11 to 16 percent in dry years. Article 21 deliveries would be significantly reduced in all hydrologic year types. The biological opinion will have a further impact on deliveries, since it includes additional restrictions beyond those imposed in the remedial order.

  These losses are deemed to be significant by each of the agencies.

- *Restrictions Due to Climate Change.* Climate change could impact SWP deliveries because of altered hydrologic conditions. DWR's CalSim II simulations evaluate the effects of four climate change scenarios on SWP deliveries using historical hydrology from 1922 through 2003. The impact on SBA Contractors SWP deliveries over the simulation period are small compared with those that would occur with Delta restrictions only. Climate change could also result in sea level rise and impact local operations at Del Valle Reservoir. This would affect SBA Contractor water supply. These changes are not currently included in the CalSim modeling.

- *Effects of a South Bay Pumping Plant Outage* An outage of the South Bay Pumping Plant could significantly impact deliveries to all three SBA Contractors Both Alameda County Water District (ACWD) and Santa Clara Valley Water District (SCVWD) take delivery of SBA water downstream of Del Valle Reservoir, and could take emergency storage from the reservoir during a South Bay Pumping Plant outage While Zone 7 Water Agency (Zone 7) could deliver Del Valle water to its Del Valle water treatment plant (WTP), it would need to shift to groundwater supply to supplement its emergency use of Del Valle Reservoir The delivery capacity from Del Valle Reservoir to all three agencies is significantly reduced during an outage -- approximately 120 cubic feet per second (cfs), compared with 300 cfs when the pumping plant is in service

2.2 Agency Supplies

This section describes supply sources for Zone 7, ACWD, and SCVWD, as reported in agency planning documents[1], and DWR's 2005 *State Water Project Delivery Reliability Report* These supply projections represent the basis for water supply planning for each of the agencies prior to implementation of regulatory restrictions in the Delta

2.2.1 Zone 7 Water Agency

Water sources for Zone 7 include the Livermore-Amador Valley Groundwater Basin, water transfers, imported supplies, locally conserved water in Lake Del Valle, and recycled water Table 2-1 shows the annual average supply (projected for 2010 and 2030), as reported in Zone 7's 2005 Urban Water Management Plan Zone 7 imports SWP water through the SBA, Zone 7's maximum annual SWP Table A amount is 80,619 acre-feet (AF) Based on hydrologic conditions, requests by other SWP contractors, SWP facility capacity, and environmental and regulatory requirements, the average yield of the SWP is less than the maximum contract amount and will decline in the future (Zone 7 Water Agency, 2005)

Table 2-1
Zone 7 Total Annual Average Supply

Source (1)	AF Annually Long-term Average
Safe Groundwater Yield from Main Basin	13 400
SWP	62 100
Lake Del Valle future average yield(2)	9 300
Recycled Water	3,300
Byron Bethany Irrigation District	2 000
Total AF Supply	90,100

(1) Source Zone 7 Water Agency 2008 except State Water Project Numbers that are taken from DWR 2005 SWP supply quantities are estimates of deliveries prior to estimating reductions due to climate change or regulatory restrictions

(2) Locally conserved water from the Del Valle Watershed

[1] ACWD and SCVWD information from 2005 Urban Water Management Plans Zone 7 information from 2008 Annual Review of the Sustainable Supply

2.2.2 Alameda County Water District

ACWD has three primary sources of water supply: 1) the SWP; 2) San Francisco's Regional Water System; and 3) local supplies. The SBA brings SWP water into the District's service area; ACWD's maximum annual SWP Table A amount is 42,000 AF. Local supplies include fresh groundwater from the Niles Cone Groundwater Basin (underlying the District service area), desalinated brackish groundwater, and surface water from the Del Valle Reservoir. Table 2-2 summarizes ACWD's long-term average supply.

Table 2-2
ACWD Total Annual Average Supply

Source	AF Annually Long-Term Average[1]
SWP [2]	28,800
San Francisco Regional	15,000
Groundwater Recharge	21,400
Del Valle Release	7,100
Desalination	5,100
Total AF Supply	77,400

Source: ACWD 2006

[1] Long-term average values represent the average water supply availability based on the 1922 – 1994 historical hydrologic conditions.

[2] SWP Numbers that are taken from DWR 2005. SWP supply quantities are estimates of deliveries prior to estimating reductions due to climate change or regulatory restrictions.

2.2.3 Santa Clara Valley Water District

SCVWD's main sources of supply are imported water from the SWP and CVP, San Francisco Public Utilities Commission (SFPUC) supplies from the San Francisco Regional Water System, local surface supplies, and groundwater. Table 2-3 lists the average annual supply in a normal year for each supply source. The SBA delivers SWP water (SCVWD's maximum annual SWP Table A amount is 100,000 AF); the Pacheco Conduit and Santa Clara Conduit bring CVP water from San Luis Reservoir (CVP contract amount is 152,500). Actual deliveries of SWP and CVP water depend on hydrology, regulatory constraints, and other factors.

Table 2-3 SCVWD Total Annual Average Supply – Normal Year		
Source	AF Annually	
	2010	2030
SWP	68,000	77,000
CVP	114 400	114 400
Local Supplies	115,500	115,500
Recycled Water	16 800	31 200
SF Regional	64 600	73,000
Total AF Supply	379 300	411,100

Source SCVWD 2005 except SWP deliveries which are from DWR 2005 SWP supply quantities are estimates of deliveries prior to estimating reductions due to climate change or regulatory restrictions Normal year is based on 1985 hydrology

2.3 Baseline Current and Future State Water Project Deliveries

The DWR 2005 Reliability Report estimates current and future SWP Table A and Article 21 deliveries based on assumptions pertaining to precipitation, water rights and uses, SWP storage and conveyance facilities, including diversion facilities in the Delta, SWP service area demand, and regulations that govern the SWP, including coordinating operation with the CVP Deliveries are estimated using CalSim II, the joint planning model of the U S Bureau of Reclamation's (USBR's) CVP and DWR's SWP operations CalSim II simulates operation of the CVP and SWP and associated changes river flow and reservoir levels on a month-to-month basis SWP demands are based on agricultural land-use-based demands that are calculated from assumed cropping patterns and soil moisture budget These demands are input into CalSim II as an upper limit on deliveries Deliveries are determined based on the following water use prioritization

- First priority – Prior-right water users, minimum instream flow requirement, water quality requirements
- Second priority – SWP Table A contractors, CVP contractors
- Third priority – Reservoir storage for the next year (carryover)
- Fourth priority – SWP Article 21 deliveries

CalSim II has been used for several modeling efforts, including modeling in the 2004 Operations Criteria and Plan (OCAP) for the CVP and SWP Table 2-4 lists key assumptions Appendix A presents a detailed list of assumptions

Table 2-4
Key Study Assumptions
(DWR 2005 Project Delivery Reliability Report)

Scenario	Level of Development (year)	SWP Table A Demand (maf/year)	SWP Article 21 Demand (TAF/month)	Model Version
2005 Scenario	2005	2 3 – 3 9	0-84, Apr-Nov 100-184, Dec-Mar	2004 OCAP
2025 Scenario	2020	3 9 – 4 1	0-84, Apr-Nov 100-184, Dec-Mar	2004 OCAP

TAF = thousand acre-feet

Data included in Tables 2-5 and 2-6 are from DWR's 2005 Water Supply Reliability Report The average year is over the modeled period of record (1922 – 1994), wet, dry and critical years show the average deliveries of all years characterized as these hydrologic year types Hydrologic year types are summarized using the DWR Sacramento Valley Index, which characterizes years based on the total unimpaired inflow at four locations in the Sacramento Valley These were used to characterize deliveries in different hydrologic years, and for comparison with other projects (e g Los Vaqueros Expansion project, discussed in Section 3) See Appendix H for a summary of hydrologic year classifications and Table A allocations estimated from DWR studies

2.3.1 SWP Table A Deliveries

SWP contract Article 7b defines the maximum annual entitlement of a SWP contractor, with the maximum delivery amount defined in Table A of the contract Table 2-5 lists the current and future Table A baseline deliveries and associated percentages of agency demand for different hydrologic conditions These baseline deliveries are estimated from 2005 studies that did not consider Delta regulatory restrictions or climate change effects on SWP deliveries

Table 2-5
Baseline Current (2005) and Future (2025) SWP Deliveries
for South Bay Aqueduct Water Users

		Current (2005)			Future (2025)			
Agency		Zone 7	ACWD	SCVWD		Zone 7	ACWD	SCVWD
Table A Amount (AF)		80,619	42,000	100,000		80,619	42,000	100,000
Year Type	Table A %	Delivery (AF)			Table A %	Delivery (AF)		
Long-Term Average (1922~1994)	68	54,800	28,600	68,000	77	62,100	32,300	77,000
6-Year Drought (1987~1992)	43	34,700	18,100	43,000	42	33,900	17,600	42,000
Wet	74	59,700	31,100	74,000	96	77,400	40,300	96,000
Dry	66	53,200	27,700	66,000	65	52,400	27,300	65,000
Critical	35	28,200	14,700	35,000	31	25,000	13,000	31,000

2.3.2 Article 21 Deliveries

Article 21 of the SWP provides for the sale of surplus water to SWP contractors when available. Article 21 water is apportioned to contractors requesting it based on their proportional share of Table A allocations. Table 2-6 lists the current and future Article 21 baseline deliveries for different hydrologic conditions. These baseline deliveries are estimated from 2005 studies that did not consider Delta regulatory restrictions or climate change effects on SWP deliveries. The Article 21 deliveries are total annual deliveries to all contractors; contractor-specific delivery information is not available.

Table 2-6
Baseline Current (2005) and Future (2025) Article 21 SWP System-wide Deliveries

Year Type	Current Delivery (AF)	Future Delivery (AF)
Long-Term Average (1922~1994)	262,000	124,000
6-Year Drought (1987~1992)	91,000	63,000
Wet	509,000	201,000
Dry	122,000	85,000
Critical	76,000	74,000

2.4 Revised SWP Deliveries Due to Delta Restrictions and Climate Change

Several factors have begun to influence (and will likely continue influencing) SWP supply reliability: emergency regulations regarding longfin smelt (now a candidate species), USFWS biological opinion on the long-term operations of the SWP/CVP, issued in December 2008, National Marine Fisheries Service's (NMFS) biological opinion on salmon, expected in June 2009, and climate change including sea level rise. Sections 2.4.1 through 2.4.4 describe these factors and the potential effects on the SBA Contractors from changes in SWP and local deliveries.

DWR's 2007 Reliability Report, similar to the 2005 report, estimated current and future SWP Table A and Article 21 deliveries based on several assumptions. Table 2-7 lists key assumptions; see Appendix B for a detailed list of assumptions.

Table 2-7
Key Study Assumptions (2007 Report)

Scenario	Level of Development (year)	SWP Table A Demand (maf/year)	SWP Article 21 Demand (TAF/month)	Model Version
2007 Scenario	2005	2.3 – 3.9	MWD [1] up to 100 Dec-Mar, others up to 84	2004 OCAP with modifications
2027 Scenario	2020	3.9 – 4.1	MWD up to 100 Dec-Mar, others up to 84	2004 OCAP with modifications

(1) MWD = Metropolitan Water District of Southern California

2.4.1 Delta Smelt

In *Natural Resources Defense Council v Kempthorne,* the USFWS's biological opinion for delta smelt was successfully challenged as failing to meet Endangered Species Act requirements The court issued a ruling to protect delta smelt until a new biological opinion was issued, in December 2008 The remedial order contained restrictions on export pumping based on the combined flow in Old and Middle Rivers (OMR) These restrictions affected SWP Banks pumping operations, and therefore deliveries to SWP contractors downstream of the Banks pumps

In its 2007 State Water Project Delivery Reliability study, DWR used two CalSim II simulations to bracket a range of potential flow restrictions to identify a range of SWP deliveries, based on the ruling Table 2-8 shows that the actions would be the same for December 25 through February 20 and April 15 through May 15 The actions differ during February 21 through April 14 and May 16 through June 30 Appendix B contains additional information regarding the characterization of the 2007 federal court decision on remedy actions for delta smelt

Table 2-8
Old and Middle River Flow Target Scenarios Assumed in CalSim II Studies

Time Period	***Combined Average Old River and Middle River Flow***	
	Less Restrictive Actions	***More Restrictive Actions***
Dec 25 – Jan 3	Less than 2,000 cfs flow in upstream direction	No change
Jan 4 – Feb 20	Less than 5,000 cfs flow in upstream direction	No change
Feb 21 – Apr 14	Less than 5 000 cfs flow in upstream direction	Less than 750 cfs flow in upstream direction
Apr 15 – May 15	No Old and Middle River flow constraint, VAMP controls exports	No change
May 16 – May 31	Less than 5,000 cfs flow in upstream direction	Less than 750 cfs flow in upstream direction
Jun 1 – Jun 30	Less than 5 000 cfs flow in upstream direction	Less than 750 cfs flow in upstream direction

In December 2008, USFWS published its biological opinion for long-term operation of the SWP and CVP Requirements during the periods outlined in the court ruling are similar in the biological opinion The opinion also includes additional flow restrictions from December 1st through December 20th, if warranted by monitoring, and new outflow requirements in September, October and November of wet and above normal years to improve fall habitat

Tables 2-9 and 2-10 compare the baseline deliveries (2005 and 2025) with revised deliveries based on Delta export restrictions, as modeled based on the court ruling

Table 2-9
Comparison of Current (2005/2007) Modeled Deliveries
Baseline and Revised with Delta Restrictions

Description	Table A %	Deliveries (AFY)			
		Zone 7	ACWD	SCVWD	Total
Long-Term Average (1922~1994)					
Baseline Delivery	68	55,200	28,800	68,500	
Revised with Delta Restrictions	61 ~ 64	49,400 ~ 51,900	25,700 ~ 27,000	61,200 ~ 64,300	
Difference	7 ~ 4	-5,800 ~ -3,300	-3,100 ~ -1,800	-7,300 ~ -4,200	-16,200 ~ -9,300
6-Year Drought (1987~1992)					
Baseline Delivery	43	34,400	17,900	42,700	
Revised with Delta Restrictions	33 ~ 36	26,900 ~ 29,100	14,000 ~ 15,200	33,300 ~ 36,100	
Difference	10 ~ 7	-7,500 ~ -5,300	-3,900 ~ -2,700	-9,400 ~ -6,600	-20,800 ~ -14,600
Wet Years					
Baseline Delivery	74	60,000	31,300	74,400	
Revised with Delta Restrictions	74 ~ 75	59,800 ~ 60,600	31,200 ~ 31,600	74,200 ~ 75,200	
Difference	0 ~ 1	-200 ~ 600	-100 ~ 300	-200 ~ 700	-500 ~ 1,700
Dry Years					
Baseline Delivery	66	53,500	27,900	66,300	
Revised with Delta Restrictions	51 ~ 56	41,100 ~ 45,000	21,400 ~ 23,400	51,000 ~ 55,800	
Difference	15 ~ 10	-12,400 ~ -8,500	-6,500 ~ -4,500	-15,300 ~ -10,600	-34,200 ~ -23,500
Critical Years					
Baseline Delivery	35	28,400	14,800	35,300	
Revised with Delta Restrictions	24 ~ 29	19,700 ~ 23,100	10,200 ~ 12,000	24,400 ~ 28,700	
Difference	9 ~ 6	-8,700 ~ -5,300	-4,600 ~ -2,800	-10,900 ~ -6,600	-24,200 ~ -14,700

Table 2-10
Comparison of Future (2025/2027) Modeled Deliveries
Baseline and Revised with Delta Restrictions

Description	Table A %	Deliveries (AFY)			
		Zone 7	ACWD	SCVWD	Total
Long-Term Average (1922~1994)					
Baseline Delivery	77	62,000	32,300	76,900	
Revised with Delta Restrictions	66 ~ 71	53,300 ~ 57,500	27,800 ~ 29,900	66,200 ~ 71,300	
Difference	11~6	-8,700 ~ -4,500	-4,500 ~ -2,400	-10,700 ~ -5,600	-23,900 ~ -12,500
6-Year Drought (1987~1992)					
Baseline Delivery	42	33,900	17,600	42,000	
Revised with Delta Restrictions	32~ 36	25,800 ~ 29,000	13,400 ~ 15,100	32,000 ~ 36,000	
Difference	10 ~ 6	-8,100 ~ -4,900	-4,200 ~ -2,500	-10,000 ~ -6,000	-22,300 ~ -13,400
Wet Years					
Baseline Delivery	96	77,700	40,500	96,400	
Revised with Delta Restrictions	90 ~ 95	72,200 ~ 76,300	37,600 ~ 39,800	89,500 ~ 94,700	
Difference	6 ~ 1	-5,500 ~ -1,400	-2,900 ~ -700	-6,900 ~ -1,800	-15,300 ~ -3,800
Dry Years					
Baseline Delivery	65	52,500	27,400	65,100	
Revised with Delta Restrictions	49 ~ 54	39,500 ~ 43,200	20,600 ~ 22,500	49,000 ~ 53,600	
Difference	16~11	-13,000 ~ -9,300	-6,800 ~ -4,900	-16,100 ~ -11,500	-35,900 ~ -25,700
Critical Years					
Baseline Delivery	31	25,100	13,100	31,200	
Revised with Delta Restrictions	24~ 26	19,200 ~ 21,200	10,000 ~ 11,100	23,800 ~ 26,300	
Difference	7 ~ 5	-5,900 ~ -3,900	-3,100 ~ -2000	-7,400 ~ -4,800	-16,400 ~ 10,800

Long-term average Table A delivery reductions range from 4 to 7 percent for 2005/2007 conditions and from 6 to 11 percent for 2025/2030 conditions. The largest delivery reductions are in dry years. There are smaller reductions in critically dry years, because deliveries amounts are small.

SWP supplies comprise approximately two-thirds of the total water supply for Zone 7, while they account for 40 percent for ACWD and 20 percent for SCVWD. However, it should be noted that SCVWD has a CVP supply contract as well as an SWP supply contract. Although not within the scope of this study to evaluate changes to CVP supply, Delta restrictions would also affect south of Delta CVP deliveries. SCVWD's combined CVP and SWP supply constitute about half of the agency's supply.

Table 2-11 compares the baseline Article 21 deliveries (2005 and 2025) with revised Article 21 deliveries based on Delta export restrictions. Delta restrictions have the largest effect on Article 21 deliveries in multiple dry years, during which deliveries are reduced 100 percent.

Table 2-11
Comparison of Current and Future Article 21 SWP System-wide Deliveries
Baseline and Revised with Delta Restrictions

Delivery Conditions	*Current Scenario (AF)*	*Future Scenario (AF)*
Long-Term Average (1922~1994)		
Baseline Delivery	262,000	124,100
Revised with Delta Restrictions	63,000 ~ 106,500	17,400 ~ 35,900
Difference	-199,000 ~ -155,500	-106,700 ~ -88,200
6-Year Drought (1987~1992)		
Baseline Delivery	91,000	62,700
Revised with Delta Restrictions	0 ~ 0	0 ~ 0
Difference	-91,000 ~ -91,000	-62,700 ~ -62,700
Wet Years		
Baseline Delivery	509,100	200,600
Revised with Delta Restrictions	182,300 ~ 29,2700	47,200 ~ 93,900
Difference	-326,800 ~ -216,400	-153,400 ~ -106,700
Dry Years		
Baseline Delivery	121,900	85,400
Revised with Delta Restrictions	3,300 ~ 6,900	1,200 ~ 300
Difference	-118,600 ~ -115,000	-84,200 ~ -85,100
Critical Years		
Baseline Delivery	75,600	74,300
Revised with Delta Restrictions	0 ~ 7,300	0 ~ 7,300
Difference	-75,600 ~ -68,300	-74,300 ~ -67,000

2.4.2 Longfin Smelt

On February 7, 2008, the California Fish and Game Commission accepted for consideration the petition submitted by The Bay Institute, Center for Biological Diversity, and Natural Resources Defense Council to list longfin smelt as an endangered species. On February 19, 2008 in a notice of findings, the California Fish and Game Commission declared longfin smelt a candidate species for listing under the California Endangered Species Act. Within one year from the findings, the Department of Fish and Game (DFG) will indicate whether the petitioned action is warranted. During the 12-month review, the DFG has adopted an emergency regulation [Special Order Relating to the Incidental Take of Longfin Smelt (*Spirinchus thaleichthys*) During Candidacy Period] that will allow the continued export of water for agricultural, municipal and industrial use along with the other specified scientific and commercial activities, while ensuring appropriate interim protections for longfin smelt. The emergency regulation was adopted in February 2008, and was re-adopted in August 2008 and November 2008 (CA Fish and Game Commission, 2008a, 2008b).

Included in the emergency regulation are guidelines for SWP and CVP exports. It was recognized that pursuant to *Natural Resources Defense Council v. Kempthorne*, the court issued an Interim Remedial Order that required limitations on the SWP and CVP to protect the delta smelt until the USFWS issued a new biological opinion. While there is overlap in the sensitive periods for the delta smelt and longfin smelt, the existing protections for delta smelt are not sufficient to fully protect longfin smelt. Adult and juvenile longfin smelt can be taken by the SWP/CVP pumps a month or more earlier than delta smelt (potentially in late November or early December compared to late December) Additionally, because longfin smelt spawn earlier, the larvae could be present earlier (potentially in January compared to March) (DFG, 2008) Therefore, the Commission authorized take of longfin smelt incidental to SWP/CVP export operations with new OMR flow limits, or the limits set in *Kempthorne,* whichever are more protective

Under *Kempthorne,* Delta export restrictions can be imposed starting February 21st, based on monitoring conditions and if OMR reverse flows range from 750 cfs to 5,000 cfs Longfin smelt flow restrictions use the same range for OMR reverse flows, starting January 1st, and can impose restrictions as early as December 1st, using only the OMR 5,000 cfs reverse flow criterion, based on monitoring conditions, since adults at spawning stage can be present at this time

These new limits were not included in DWR's 2007 Reliability Report and have not been modeled to determine potential SWP water supply effects However, the SWP/CVP export restrictions based on OMR flow limits could affect supplies to SBA water users beyond the effects described in Section 2 4 1 because OMR limits may be in place to protect longfin smelt when not needed for delta smelt

2.4.3 Salmon

In *Pacific Coast Federation of Fishermen's Associates et al, v Gutierrez,* the NMFS biological opinion for several salmon species was successfully challenged as failing to meet Endangered Species Act requirements In April 2008, a federal judge ordered NFMS to enter into new consultations with USBR and issue a new biological opinion for salmon The biological opinion is due to be issued in June 2009

Potential export restrictions to protect salmon were not included in DWR's 2007 Reliability Report and have not been modeled to determine potential SWP water supply effects

2.4.4 Climate Change

Climate change has the potential to change SWP deliveries because of altered hydrologic conditions The California Climate Change Center predicts slightly warmer winters with less winter snowpack, resulting in average winter flood flows to the Delta becoming larger More precipitation occurring as rain instead of snow would shift the timing of peak runoff from the spring and summer toward the winter

DWR's 2006 report, *"Progress on Incorporating Climate Change into Management of California's Water Resources"* accounts for the uncertainty in future climate change by examining four scenarios through CalSim II simulations The four scenarios are depicted by two different models, which bracket the uncertainty the Geophysical Fluid Dynamic Lab (GFDL) model and Parallel Climate Model (PCM) The GFDL model indicates a greater warming trend than the PCM Each model includes two emissions scenarios The A2 emissions scenario assumes high growth in population, regional based economic growth, and slow technological changes, which results in significantly higher greenhouse gas emissions. The B1 emissions scenario represents low growth in population, global based economic growth and sustainable development that results in a low increase in greenhouse gas emissions. Therefore, the four scenarios can be summarized as follows:

Climate Change Scenario	***Description***
GFDL, A2	Modest warming and modest drying, using model GFCL
PCM, A2	Modest warming and modest drying using model PCM;
GFDL, B1	Relatively strong temperature warming and modest drying using model GFDL
PCM-B1	Weak temperature warming and weak precipitation increase, using model PCM

SWP - Hydrologic Impacts

Table 2-12 compares the SWP Table A percentages for different hydrologic years for Delta restrictions only and Delta restrictions plus climate change, using the range of predictions from the different climate models. Figures 2-1 through 2-3 graphically represent the delivery data for all four climate scenarios. The colored bars correspond to the delivery amount with the Delta restrictions averaged for each climate change scenario; the "error bars" indicate the range of the lower and higher Delta restrictions. As the table and figures show, differences are small between the scenario with only Delta restrictions, and with Delta restrictions plus climate change.

Table 2-12
Comparison of Future (2025/2027) Deliveries
Baseline and Revised with Delta Restrictions and Climate Change

		Delivery (AFY)		
Scenario	***Table A %***	***Zone 7***	***ACWD***	***SCVWD***
Long-Term Average (1922~1994)				
Delta Restrictions	66 ~ 71	53300 ~ 57500	27800 ~ 29900	66200 ~ 71300
Delta Restrictions + Climate Change	63 ~ 71	51000 ~ 57600	26600 ~ 30000	63300 ~ 71500
Difference	***-3 ~ 0***	***-2300 ~ 100***	***-1200 ~ 100***	***-2900 ~ 200***
6-Year Drought (1987~1992)				
Delta Restrictions	32 ~ 36	25800 ~ 29000	13400 ~ 15100	32000 ~ 36000
Delta Restrictions + Climate Change	31 ~ 37	25100 ~ 29800	13100 ~ 15500	31200 ~ 37000
Difference	***-1 ~ 1***	***-700 ~ 800***	***-300 ~ 400***	***-800 ~ 1000***
Wet Years				
Delta Restrictions	90 ~ 95	72200 ~ 76300	37600 ~ 39800	89500 ~ 94700
Delta Restrictions + Climate Change	88 ~ 94	70600 ~ 75800	36800 ~ 39500	87500 ~ 94000
Difference	-2 ~ -1	-1600 ~ -500	-800 ~ -300	-2000 ~ -700
Dry Years				
Delta Restrictions	49 ~ 54	39500 ~ 43200	20600 ~ 22500	49000 ~ 53600
Delta Restrictions + Climate Change	45 ~ 54	36500 ~ 43700	19000 ~ 22800	45300 ~ 54200
Difference	***-4 ~ 0***	***-3000 ~ 500***	***-1600 ~ 300***	***-2700 ~ 600***
Critical Years				
Delta Restrictions	24 ~ 26	19200 ~ 21200	10000 ~ 11100	23800 ~ 26300
Delta Restrictions + Climate Change	22 ~ 27	17900 ~ 22000	9300 ~ 11500	22300 ~ 27300
Difference	***-2 ~ 1***	***-1300 ~ 800***	***-700 ~ 400***	***-1500 ~ 1000***

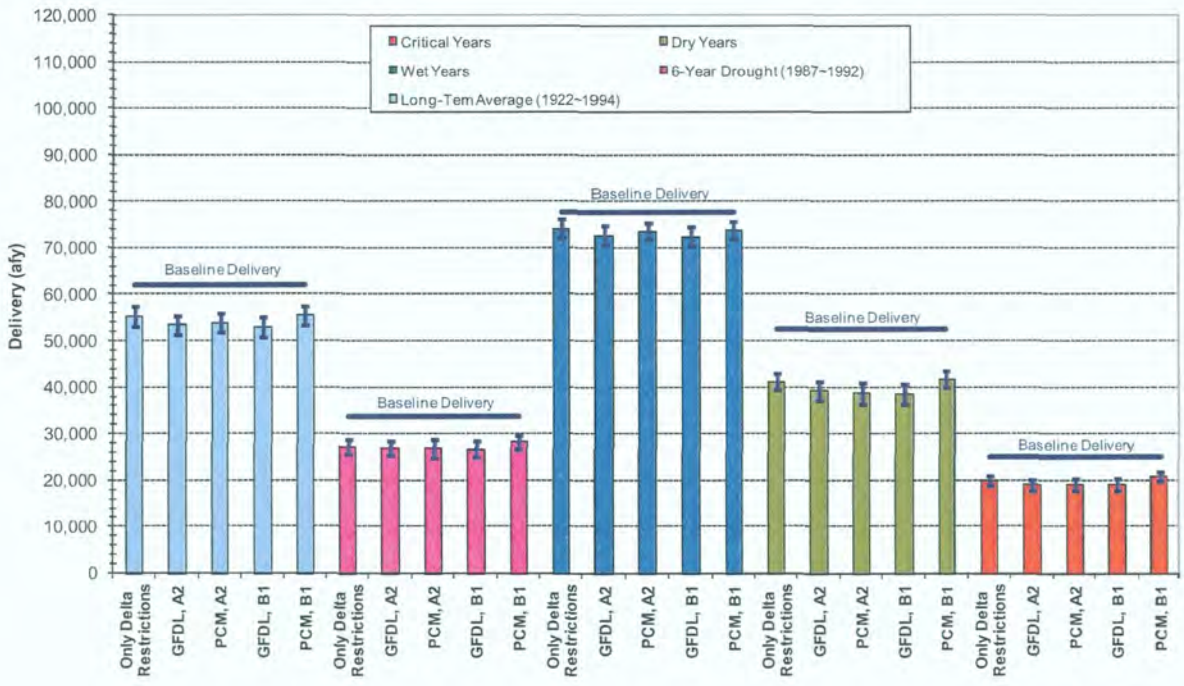

Figure 2-1
Impact of Delta Restrictions and Climate Change to Zone 7

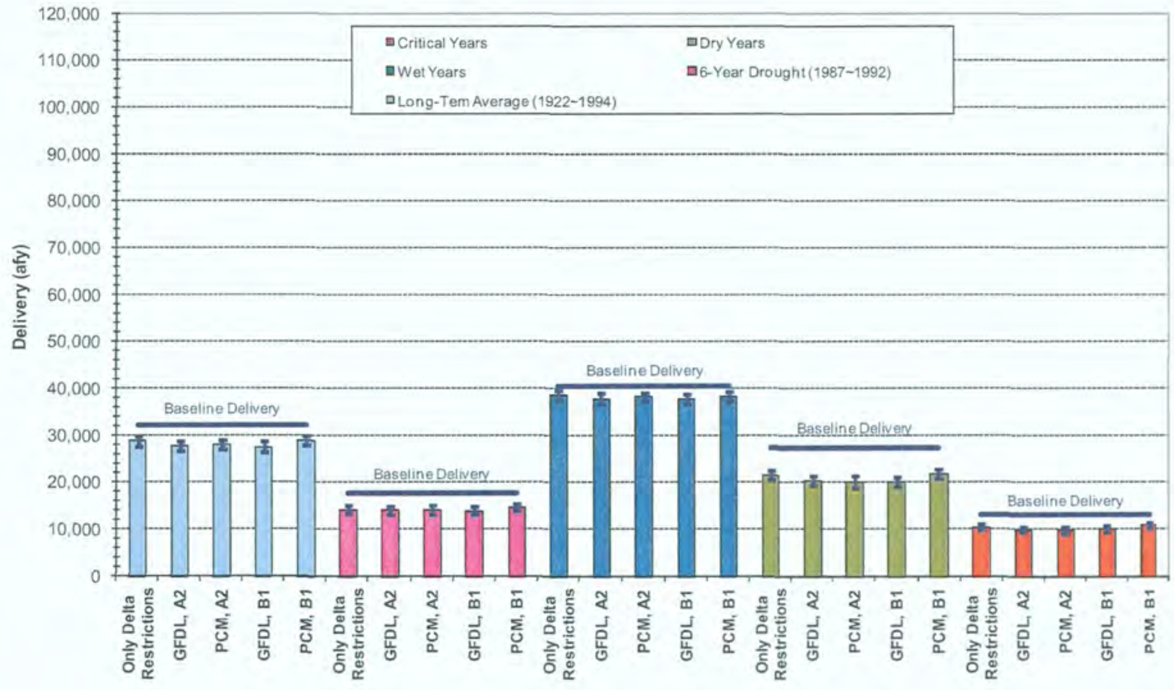

Figure 2-2
Impact of Delta Restrictions and Climate Change to ACWD

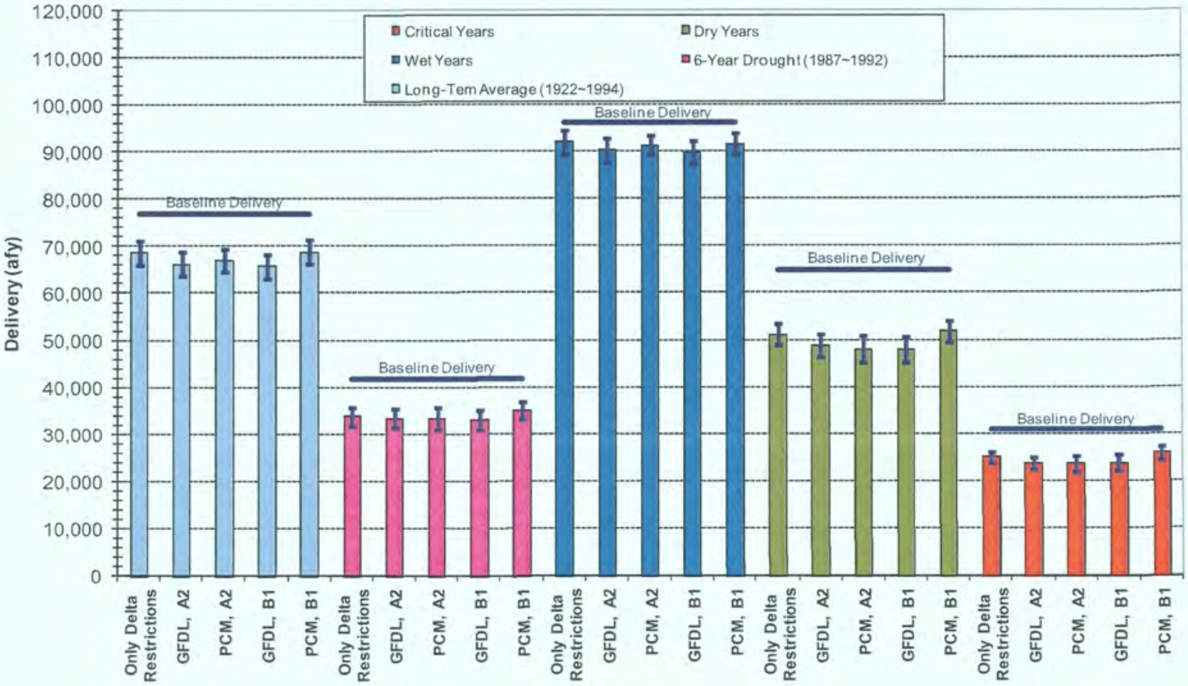

Figure 2-3
Impact of Delta Restrictions and Climate Change to SCVWD

Table 2-13 lists the Article 21 deliveries for different hydrologic years. In all year types, the Article 21 deliveries with the climate change scenarios do not differ much compared with Delta restrictions only.

Table 2-13
Comparison of Future (2025/2027) Article 21 Deliveries with Delta Restrictions and Delta Restrictions Plus Climate Change

	Future Delivery (AF)	*Difference in Delivery (AF)*
Long-Term Average (1922~1994)		
Delta Restrictions	17400 ~ 35900	
Delta Restrictions + Climate Change	16800 ~ 42800	-600 ~ 6900
6-Year Drought (1987~1992)		
Delta Restrictions	0 ~ 0	
Delta Restrictions + Climate Change	0 ~ 0	0
Wet Years		
Delta Restrictions	47200 ~ 93900	
Delta Restrictions + Climate Change	46800 ~ 97200	-400 ~ 3700
Dry Years		
Delta Restrictions	1200 ~ 300	
Delta Restrictions + Climate Change	1400 ~ 7100	-200 ~ 6800
Critical Years		
Delta Restrictions	0 ~ 7300	
Delta Restrictions + Climate Change	0 ~ 16700	0 ~ 9400

SWP– Sea Level Rise Impacts

In response to a request from the CALFED Bay-Delta Program, the CALFED Independent Science Board (ISB) examined various sea level rise projections available in published reports and prepared a memo advising the Science Program about which projections are most appropriate for incorporating into planning for the Delta. The ISB concluded in part, "First, given the inability of current physical models to accurately simulate historic and future sea level rise, until future model refinements are available, it is prudent to use existing empirically-based models for short to medium term planning purposes. The most recent empirical models project a mid-range rise this century of 70-100 centimeters (cm) (28-39 inches) with a full range of variability of 50-140 cm (20-55 inches). It is important to acknowledge that these empirical models also do not include dynamical instability of ice sheets and likely underestimate long-term sea level rise (CALFED ISB, 2007).

While the ISB memo gives direction for future Delta planning, the connection between model projections that have estimated sea level rise and the implications of those values for water supply have not yet been made. On a theoretical basis, sea level rise could result in increased salinity intrusion in the Delta, which could affect water supply either due to higher treatment costs or unsuitability of the supply. If the existing Delta water quality standards were maintained, the SWP and CVP would need to reoperate upstream reservoirs to provide more water to manage salinity intrusion in the Delta. This would likely create lower reservoir levels and carryover storage, which could reduce supplies especially during dry years (DWR, 2008a). Sea level rise would also increase the hydraulic pressure on already fragile Delta island levees, increasing the probability of catastrophic flooding. The quantitative effects of sea level rise on SWP operations have not been evaluated because of the lack of tools available necessary to complete such an analysis.

Lake Del Valle

Approximately 13 percent of Zone 7's 2030 water supply is projected to come from local runoff from the surrounding watershed that is stored in Lake Del Valle Reservoir. ACWD projects that nine percent of its 2030 supplies would come from Lake Del Valle releases. Operation of Lake Del Valle could be affected by the need to change flood control operations based on an anticipated increase in frequency and intensity of winter storms. Lowered reservoir levels during the winter to accommodate flood flows may not rebound in the spring because of decreased spring precipitation. Therefore, water supply from Lake Del Valle would likely be less in the future considering climate change. Additionally, the water supply would be less reliable and more difficult to forecast because the supply could not be determined until the magnitude of spring precipitation was known.

2.5 Effects of South Bay Pumping Plant Outages

Zone 7 has two existing WTPs on the SBA Patterson WTP and Del Valle WTP (DVWTP) With an outage of the South Bay Pumping Plant, only Del Valle WTP, which has a connection to Del Valle Reservoir, could receive surface water Zone 7 has a policy goal of providing up to 75% of its contractual maximum day municipal and industrial demands from all wells (including retailer wells), in the event of an outage that disrupts SBA supply With an SBA outage, Zone 7 could use DVWTP and wells, although capacity restrictions from Del Valle Reservoir to DVWTP may limit the use of the WTP Zone 7 also has plans to develop supplemental groundwater capacity to provide well production capacity (including retail supplier wells) equal to 75% of maximum day demand (Zone 7 Water Agency, 2005)

Both ACWD and SCVWD receive SBA deliveries downstream of Del Valle Reservoir, and could receive water delivered from Del Valle emergency storage during a South Bay Pumping Plant outage, though at a reduced rate of 120 cfs[2], compared with the full capacity of 300 cfs with the South Bay Pumping Plant in service A 2004 ACWD study found that following a catastrophic event disrupting its SWP supply, ACWD could continue to provide full deliveries to customers for over 12 months by shifting to local supplies (groundwater and desalination), use of emergency storage from Del Valle Reservoir, and continued purchase from San Francisco's Regional Water System (Alameda County Water District, 2006a)

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[2] Based on capacity of Reach 5, which connects Del Valle Reservoir to the SBA

Section 3
Los Vaqueros Reservoir Expansion Evaluation

One option being evaluated in the Delta Water Supply Reliability Study is the expansion of Los Vaqueros Reservoir This section summarizes information on the Los Vaqueros Expansion (LVE) alternative, using information provided by the Contra Costa Water District's (CCWD) LVE study team The section summarizes Alternative 1 from the LVE studies, the expansion of LVE from its existing capacity of 100 thousand acre-feet (TAF) to 275 TAF

In December 2008, CCWD presented a modified concept of expansion to 160 TAF to Zone 7 This section focuses on the 275 TAF expansion, but also briefly discusses the 160 TAF expansion (see Section 3 2 6) Information presented in this section includes

- Summary
- Los Vaqueros Expansion Project Description
- Deliveries
- Project Costs

In Section 6, Comparison of Water Supply Alternatives, the Los Vaqueros Reservoir Expansion is compared with other potential supply alternatives being evaluated in this study

3.1 Summary

3.1.1 LVE Project Overview

The LVE study team has identified four alternatives in its Environmental Impact Statement/Environmental Impact Report (EIS/EIR) evaluating potential expansion options for Los Vaqueros Reservoir (USBR and CCWD, 2008) Alternative 1, identified as the Proposed Action, includes environmental water for State Water Project (SWP) and federal Central Valley Project (CVP) operations, and supply reliability deliveries to South Bay Aqueduct (SBA) Contractors Environmental benefits are derived by shifting pumping from the Harvey O Banks (Banks) Pumping Plant (PP) or Jones PP to CCWD diversion facilities Supply reliability amounts are intended to make up delivery reductions due to Delta fishery restrictions

Alternative 1 would increase Los Vaqueros Reservoir storage from 100 TAF to 275 TAF It includes expansion of Delta intake facilities, and construction of a new 470 cubic feet per second (cfs) pipeline from LVE diversion facilities to Bethany Reservoir

LVE long-term average annual environmental deliveries (i e shifted pumping) range from 191 TAF per year (TAF/yr) to 205 TAF/yr Supply reliability deliveries are estimated to range from 18 TAF/yr to 25 TAF/yr for the SBA and 7 TAF/yr for Santa

Clara Valley Water District's (SCVWD) CVP supply The water source for supply reliability deliveries could be unappropriated Delta water[1], transfer water conveyed on behalf of SBA Contractors when capacity is unavailable at Banks PP, or water available under existing water rights permits

Alternative 1 has an estimated conceptual-level capital cost of $793 million in 2008 dollars [2] CCWD is currently envisioning that it would finance an enlargement project and become a wholesale water provider to SBA Contractors Uncertainties about the cost of water remain Better definition of costs depends on several issues including project financing, potential State or Federal cost-sharing, analysis of annual costs, identifying potential "buy-in" fees for use of existing Los Vaqueros capacity, actual supply yield, etc

LVE studies are using an implementation time-frame of having the reservoir online by 2015

3.1.2 Review of Technical Analysis

Key findings from the analysis are

- Discrepancies exist in SBA Shortfalls between LVE and California Department of Water Resources (DWR) Studies LVE studies project greater long-term average shortfalls due to fishery restrictions than DWR's SWP Delivery Reliability Studies (37 to 50 TAF/yr versus 13 to 24 TAF/yr) Rules relating to fishery restrictions can only be approximated in the modeling studies, and DWR and LVE studies have used different assumptions The December 2008 publication of the biological opinion for Delta smelt indicates that Delta exports are facing increasing restrictions Estimates of impacts to SBA Contractors will continue to be a moving target, pending future regulatory actions regarding salmon and long-fin smelt

- Uncertainties remain as to whether LVE Deliveries will resolve SBA Contractors Shortfall LVE long-term average supply reliability deliveries are estimated to range from 18 TAF/yr to 25 TAF/yr for the SBA and 7 TAF/yr for SCVWD's CVP supply Although there are significant differences in modeling assumptions, the SBA supply amounts are similar to estimated SWP delivery shortfalls due to fishery restrictions from DWR studies, which range from 13 TAF/yr to 24 TAF/yr However, the LVE studies estimate a greater reduction in SBA deliveries due to fishery restrictions (37 TAF to 50 TAF) Supply reliability deliveries make up about 50 percent of the shortfall, using the LVE estimates Differences between DWR studies and LVE studies need to be investigated Collaboration is needed between the LVE studies team and the SBA Contractors' technical staff to examine the assumptions on demand and timing for each of the agencies

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1 Assuming unappropriated water is available

2 The Alternative 1 capital cost presented in the project EIS/EIR is $985M, which includes escalation to the mid-point of construction The un-escalated cost is used in this study for comparison with other water supply alternatives

- Would a Delta Isolated Conveyance Facility/Dual Conveyance Facility Impact Value of LVE? How LVE would work with an isolated conveyance facility has not yet been defined LVE and an isolated conveyance facility would achieve similar objectives Some of the benefits of LVE are based on shifting pumping from Banks and Jones PP to diversion facilities with state-of-the-art fish screens An isolated conveyance facility would have similar benefits LVE supply reliability deliveries to SBA contractors are intended to make up delivery shortfalls due to fishery restrictions DWR studies for the Bay-Delta Conservation Plan show that overall CVP and SWP deliveries could more than make up anticipated shortfalls due to fisheries actions Therefore, it is plausible that LVE benefits, as the project is currently conceptualized, would be reduced if Delta Conveyance were implemented CCWD could explore whether there are ways of using the LVE project in conjunction with Delta facilities to increase overall deliveries

- Costs of LVE Water are Dependent on State-Federal Participation As noted above, the potential cost of LVE water for SBA contractors has not been defined and would depend on several issues, including potential State or Federal cost-sharing, and project financing To compare LVE with other projects being evaluated in this study, CDM evaluated potential annualized costs and unit costs of water, using generalized costing assumptions For a 90 percent project cost share by State or Federal partners, the unit cost is about $300/AF for all participants This assumes environmental water and supply reliability deliveries contribute proportionally to the costs, i e the cost is the total cost divided by the sum of the reliability and environmental water benefits

As the above findings indicate, a number of issues are yet to be resolved at this point in time The CCWD LVE study team has requested input on the reasonableness of initial assumptions for SBA supply reliability deliveries for the EIS/EIR analysis, primarily to assess whether the EIS/EIR impacts analysis is sufficiently comprehensive The study team has also indicated a willingness to work with SBA Contractors to refine supply reliability estimates

3.1.3 Next Steps

There are several uncertainties associated with the LVE project, including potential supply reliability yields, how those will be affected by ongoing actions to protect Delta fisheries, and costs, which will depend on potential project participants Since a decision to proceed depends on some resolution of these uncertainties, CDM recommends that the SBA Contractors clarify the costs and benefits of the LVE project by working with CCWD

- *Refining water supply sources, amounts and timing of water* CCWD has requested input from the SBA Contractors regarding specific operational needs, and has indicated a willingness to refine modeling analyses completed to date to evaluate differences in modeling assumptions and identify alternative delivery scenarios/assumptions In addition to modeling analysis, the SBA Contractors should also work with CCWD to better understand the types of water available (e g unappropriated Delta Water, transfer water, or water under existing water rights permits) as this will be critical to state and federal agencies (i e , how amounts can be further quantified, and the permitting and other institutional issues that would need to be addressed to obtain supply) Uncertainty remains as to who would obtain/purchase additional supplies Similarly, the SBA Contractors would need to evaluate potential LVE deliveries and how they integrate with existing supplies to specifically address usability of LVE supplies

- *Expanding analysis to include SBA capacity constraints* The effectiveness of LVE, as well as some alternatives such as an isolated conveyance facility and groundwater banking, depends on capacity availability in the SBA A detailed study of the seasonal capacity availability by reach would help refine these discussions

- *Developing potential participation costs to SBA Contractors* To date, CCWD has not completed cost analysis to determine potential participation costs for SBA Contractors Participation in the 275 TAF LVE would be contingent on state and federal participation Potential state and federal cost sharing will be examined in the federal and state feasibility studies SBA Contractors will need more information on cost sharing and buy-in costs from CCWD

- *Further developing the 160 TAF Expansion Option* In December 2008, CCWD identified a potential variant of the 160 TAF CCWD-only project, with up to 30 TAF storage available to other participating partners Offering significant cost savings, this project may be implemented with existing conveyance facilities, and delivery to the SBA Contractors through exchanges The SBA Contractors should continue to work with CCWD to refine this potential option to quantify potential supply reliability benefits and costs

3.2 Los Vaqueros Expansion Project Description

The LVE Study team is evaluating several options for expansion of the reservoir This section summarizes features of Alternative 1 of the LVE study, which would expand the reservoir to 275 TAF, and provide supply reliability to SBA customers, as well as environmental supply for the SWP and/or CVP as a whole Alternative 1 is presented as the proposed action (preferred alternative) in the Los Vaqueros Reservoir EIS/EIR

3.2.1 Existing and Proposed Facilities

Figure 3-1 shows existing Los Vaqueros Reservoir facilities The project has intake facilities on Old River and the Victoria Canal Up to 320 cfs can be conveyed to the Los Vaqueros Transfer facility, where water can either be used to fill Los Vaqueros Reservoir, or delivered to the Contra Costa Canal The transfer pipeline to Los Vaqueros Reservoir has a 200 cfs filling capacity, and 400 cfs release capacity The existing Los Vaqueros Reservoir has a capacity of 100 TAF

Table 3-1 and Figure 3-2 summarize existing and proposed facilities for LVE Alternative 1 This alternative would expand Los Vaqueros Reservoir from 100 TAF to 275 TAF by raising the existing dam, building on the existing dam to raise and

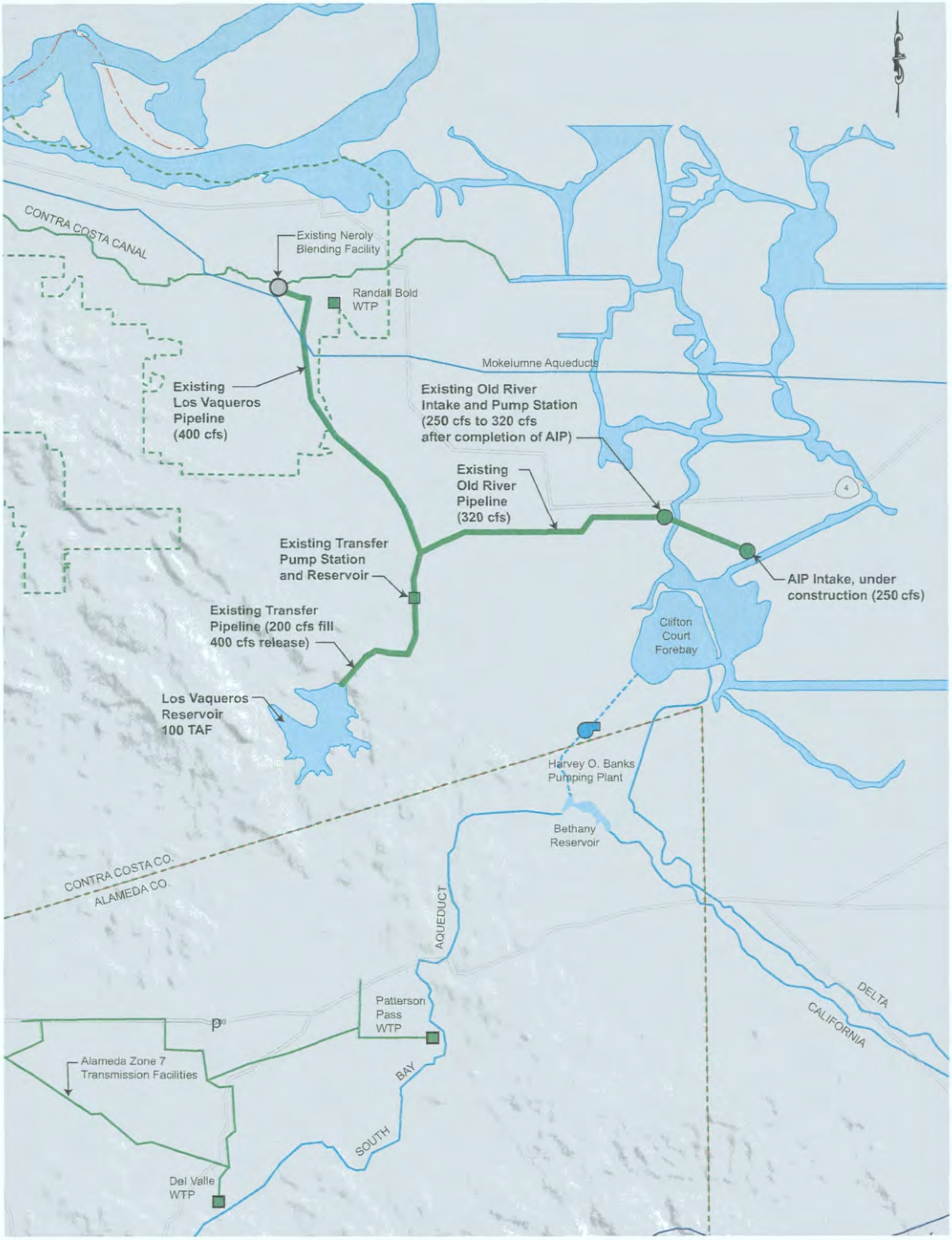

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Figure 3-1
Los Vaqueros Reservoir
Existing Project Facilities

CDM

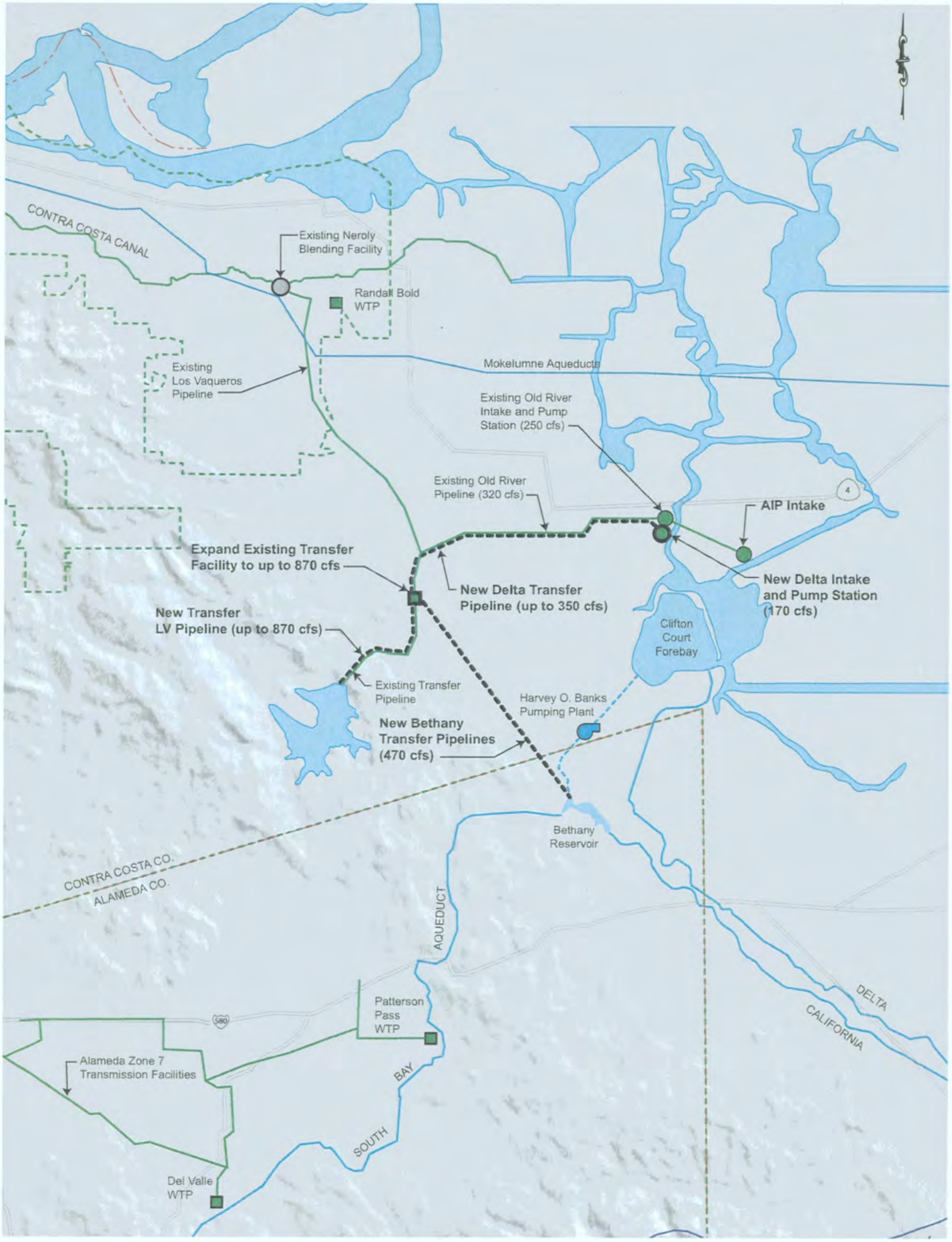

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Figure 3-2
Los Vaqueros Reservoir Expansion
Alternative 1 - SBA/Environmental Water

CDM

strengthen it New conveyance would be constructed to increase the intake and conveyance capacity to the reservoir to 670 cfs A new 470 cfs connection would also be constructed from the transfer facility to Bethany Reservoir

Table 3-1
Major Facility Components Alternative 1

Objective	No Action/ No Project	Alternative 1
Reservoir Facilities		
Los Vaqueros Reservoir – Storage Capacity	100 TAF	275 TAF
Dam Raise	No	Yes
Maximum Water Surface Elevation	472 feet	560 feet
Intake Facilities		
Old River Intake and Pump Station (*existing facility*)	250 cfs	250 cfs
Delta Intake and Pump Station (*new facility*)	–	Up to 170 cfs
Alternative Intake Projects (AIP) (*existing facility*)	250 cfs	250 cfs
Conveyance Pipelines and Facilities		
Old River Pipeline (*existing facility*)	320 cfs	320 cfs
Delta-Transfer Pipeline (*new facility*)	–	Up to 350 cfs
Transfer Facility (*existing facility, expanded*)	200 cfs/4 million gallon (MG) Reservoir	200 cfs/4 MG Reservoir
Expanded Transfer Facility (*new facility*)	–	470 cfs/8 MG Reservoir
Transfer Pipeline (*existing facility*)	200 cfs to/400 cfs from Reservoir	430 cfs from Reservoir
Transfer-LV Pipeline (*new facility*)	–	Up to 870 cfs
Transfer-Bethany Pipeline (*new facility*)	–	470 cfs
Electrical Power Facilities (Two Options)		
Option 1 Extend new supply facilities from and upgrades to existing Western Area Power Association facilities *OR* Option 2 Extend new supply facilities from and upgrades to existing Western and PG&E facilities	–	Needed

3.2.2 Project Operations

A key assumption for the project is the ability to move the SWP water through LVE facilities, which may require modification of existing water rights (an assumption that requires verification), otherwise new sources of supply would be needed [3]

[3] Likelihood projections of availability and yields have not yet been performed

For Alternative 1, SBA deliveries would be made through LVE diversion facilities whenever possible[4] SBA deliveries include two components

- *Environmental water* SWP or CVP contract water that is delivered via LVE diversion facilities ("wheeled") rather than via Banks or Jones PP
- *Reliability supply* Supply above and beyond SWP current year allocations that is delivered when there is excess Delta supply, or from water stored in LVE

In this alternative, SCVWD deliveries also include both CVP contract water and reliability supply above and beyond CVP contract allocations The alternative does not explicitly address re-operation of San Luis Reservoir to address potential curtailment of deliveries to SCVWD during a low point event[5] However, there may be some benefits to SCVWD during years when low point occurs, due to increased water supply delivery from the project

The environmental component of this alternative is based on reduced impacts to Delta aquatic species by pumping at LVE diversion facilities, which would have state-of-the-art fish screens The alternative also includes a 30-day no diversion period when no pumping occurs at LVE diversion facilities, to avoid impingement/entrainment of larvae in pumps During this period, assumed to occur in April for the studies supporting the alternative, deliveries to SBA Contractors are made through releases from Los Vaqueros Reservoir

Reliability supply to SBA Contractors was assumed to replace deliveries lost because of actions to protect endangered fish species These fish actions will not be defined until the Biological Opinions for the Long-Term Operations of the Projects are completed The modeling uses the Interim Remedial Order associated with the implementation of *NRDC vs Kempthorne* decision to bracket a potential range of fish actions The difference in deliveries from Cal Sim II simulations with and without delta smelt protections were used to establish reliability supply targets Dry and critically dry year reliability demands were increased above initial target amounts an additional 50 and 200 percent, respectively, to provide additional supplies to the SBA Contractors in years when SWP contract allocations are low Supply reliability water for dry and critically dry year deliveries would be provided from LVE storage

Reliability supply targets were assumed to have the same delivery pattern as contract water Modeled reliability deliveries were much lower than reliability supply targets, due to various constraints in water availability, or conveyance to SBA Contractors Long-term average reliability targets from the LVE CalSim II modeling ranged from

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[4] CCWD has not evaluated costs in detail, but has noted that the cost for moving water through CCWD facilities to Bethany Reservoir would be slightly more expensive, due to the increased pumping head moving water through LVE facilities A more complete cost analysis will be done as part of the Feasibility Study

[5] A low point event occurs when San Luis Reservoir storage drops to or below 300 TAF, forcing SCVWD to rely on other supplies to avoid delivery of poor quality water from the reservoir

about 37 TAF/yr to 50 TAF/yr, depending on fishery restriction assumptions used Actual long-term reliability supply deliveries estimated in the model simulation ranged from 18 TAF/yr to 25 TAF/yr

Both environmental and reliability supply to SBA Contractors provided by LVE would require modification of existing water rights CCWD envisions that CCWD, the U S Bureau of Reclamation (USBR) or DWR water rights would be modified Although CCWD has had preliminary discussions with USBR, DWR, and the State Water Resources Control Board (SWRCB) regarding water rights, water rights issues would not be addressed in more detail until a preferred project is selected Application for new water rights is not anticipated to be necessary

CCWD currently operates Los Vaqueros Reservoir to meet water quality objectives, limiting reservoir filling to periods when chlorides are below a certain threshold Operational studies for this alternative assume SWP and CVP contract water wheeled through project facilities would be directly delivered to Bethany Reservoir via a new pipeline connecting LVE diversion facilities and Bethany Reservoir Therefore, if water quality does not meet the LVE required thresholds, deliveries could still be made through project facilities to the SBA Deliveries to the SBA through project facilities would only be precluded when the full conveyance capacity of LVE diversion facilities is being used to re-fill LVE reservoir During these periods, the SBA would be supplied via Banks Pumping Plant

3.2.3 LVE and Isolated Delta Facility

To date, the LVE study team has not assessed potential LVE operations with an isolated Delta facility, or with future sea-level rise Because an isolated Delta facility could have a significant impact on LVE operations, this section includes a qualitative assessment of LVE operation with an isolated-Delta facility, using information from available reports *Conservation Strategy Options Evaluation Report* (Bay-Delta Conservation Plan [BDCP], 2007) and *An Initial Assessment of Dual Delta Water Conveyance – Final Draft* (Department of Water Resources, 2008b) The impacts of sea-level rise could also be significant However, no available information was identified to evaluate this issue

Both the concepts of a Delta isolated conveyance facility and Delta dual conveyance facilities are conservation strategy options under consideration to be carried forward into a detailed conservation planning process of the BDCP The BDCP's purpose is to provide for the conservation of at-risk species in the Delta and improve the reliability of the water supply system within a stable regulatory framework Per BDCP's 2007 Conservation Strategy Options Evaluation Report, options include physical and operational habitat restoration and enhancement with modified conveyance

- A Delta isolated conveyance facility would involve construction of a peripheral aqueduct with an intake on the Sacramento River (near Hood or Clarksburg) and isolated connection at the SWP and CVP pump facilities

- Delta dual conveyance facilities would involve dual conveyance facilities and physical and operational habitat restoration and enhancement Conveyance would be via (1) a peripheral aqueduct with an intake on the Sacramento River and isolated connection at the SWP/CVP pump facilities, and (2) an improved through-Delta conveyance with operable barriers along Middle River and separated water supply flows from San Joaquin River flows by a siphon

Appendix I shows conceptual alignments from the 2008 DWR study The operations of either of these conveyance options are still the subject of debate and will impact the effectiveness of these options for habitat restoration and water supply reliability The reports indicate that local agencies, such as CCWD, may wish to connect diversion facilities to the isolated conveyance facility

Water Supply Reliability

An isolated conveyance facility has some similar objectives to LVE because both would work to improve water supply reliability for SBA Contractors DWR has examined a range of operational scenarios for a potential dual conveyance facility, all scenarios include an isolated conveyance facility and improvements to through-Delta conveyance The operational scenarios vary the size of the isolated conveyance facility (5,000 cfs to 15,000 cfs) and the preference for diversion location (if the SWP and CVP use isolated conveyance or through-Delta conveyance as the preferred diversion location) Table 3-2 includes a summary of the total exports (combined SWP and CVP) under a range of operational scenarios The "Reference Case" includes current operational requirements (including D-1641), the "Reference Case with Fish Actions" includes fish actions associated with Old and Middle River flows (similar to those in the Interim Remedial Order regarding delta smelt)

Table 3-2
Total Exports for Dual Conveyance Facilities (TAF/yr)

			Isolated Conveyance First			Through-Delta First	
Total Exports (Annual Average)	**Reference Case**	**Reference Case with Fish Actions**	**5,000 cfs Isolated Facility**	**10,000 cfs Isolated Facility**	**15,000 cfs Isolated Facility**	**5,000 cfs Isolated Facility**	**10,000 cfs Isolated Facility**
Long-term Average (1922-2003)	6,020	5,300	6,440	6,500	6,530	6,470	6,500
Drought Average (1928-34, 1976-77, 1986-92)	3,620	3,120	3,850	3,890	3,840[6]	3,740	3,770

Source DWR 2008

6 The reason for a slight decrease between the 10,000 cfs and 15,000 cfs facility options is not discussed in the study

CDM

While this report does not separate the deliveries for the SBA, it does indicate that for all operational scenarios, an isolated conveyance or dual conveyance facility would result in a small increase in exports compared to Reference Case conditions without Fish Actions

How LVE would work with an isolated conveyance facility or dual conveyance facility is not yet defined Currently, LVE's environmental benefits are derived from shifting pumping from Banks and Jones PP to LVE's diversion facilities Isolated or dual conveyance facilities would likely eliminate the need for this action because the Projects would own an alternate facility with state-of-the-art fish screens Additionally, some of the reliability benefits of LVE are based on the concept that Banks and Jones PP have environmental restrictions during the winter when flows are higher LVE is not subject to similar restrictions and can therefore capture some of the flows surplus to in-Delta needs An isolated or dual conveyance facility, however, would also work to capture these flows by shifting pumping to the northern Delta to a facility with state-of-the-art fish screens Diversions to LVE would likely be limited to periods when flows are in excess of SWP and CVP water rights (approximately 15,000 cfs combined) or when the SWP and CVP do not need to divert full amounts because San Luis Reservoir is full and Article 21 demands are being met

Increased south-of-Delta storage in LVE would likely still provide water supply benefits, although they may be smaller than those without new conveyance New conveyance would likely allow more diversions during the winter that would fill San Luis Reservoir and meet Article 21 demands earlier in the year Therefore, surplus water may still be available later in the wet season Additionally, an isolated conveyance facility will have requirements regarding the amount of flow that must pass by the facility to make the fish screens work properly and meet downstream requirements, diversion of some of this flow in the Delta may be possible The operation of any project involving Los Vaqueros would be reviewed and optimized for water quality and supply reliability benefits if significant changes to current Delta operations were implemented

Water Quality

Use of an isolated conveyance facility would change flow patterns in the Delta Export facilities in the south Delta and the Delta Cross Channel route some Sacramento River water through the central Delta and into the south Delta This routing of water through the Delta generally improves water quality in these areas by diluting San Joaquin River water As a result, SWP contractor operations unintentionally improve the water quality for non-contractors in this region of the Delta and specifically at the LVE point(s) of diversion An isolated conveyance facility would curtail this in-situ dilution benefit

Modeling efforts have used CCWD's diversion at Rock Slough as an indicator for water quality in the central Delta These efforts have found that use of an isolated conveyance facility would increase electrical conductivity (a measure of salinity) at this site in the winter, summer, and spring For the operational scenario with a 15,000 cfs facility where the isolated facility is used first, electrical conductivity would be approximately 650 to 850 in the winter and 450 to 650 in the spring, an increase ranging from 100 to 300 over the reference cases (Department of Water Resources, 2008b)

LVE would withdraw water from CCWD's existing and planned diversion points in the south Delta (Rock Slough, Old River and Victoria Canal) DWR modeling efforts have not evaluated simulated changes in water quality at these locations DWR modeled changes in Old River at Tracy Road (a water quality compliance location), but this site is not very close to CCWD's diversions Modeling results indicate an increase in electrical conductivity, however, the results are heavily affected by the operations of the projected future permanent operable gates in the vicinity (DWR, 2008) While these results are not necessarily indicative of changes at CCWD's diversions, DWR does indicate that water quality would degrade throughout the south Delta (Department of Water Resources, 2008b)

CCWD currently operates Los Vaqueros Reservoir to improve drinking water quality, therefore, it diverts water during the winter and spring during periods of high flow and low salinity LVE studies assume similar water quality operational strategies as currently employed Modeling by the LVE team assumes that LVE would be filled when surplus water is available or when the Delta is in balanced conditions, and chloride levels are less than 65 milligrams per liter With the proposed configuration for LVE, direct diversions to Bethany Reservoir could still be made when Delta water quality does not meet targets for filling LVE Operation of LVE in conjunction with an isolated facility or dual conveyance facility would likely result in less frequent diversions, unless a higher chloride level is used as a threshold for diversions or CCWD connects its diversions to an isolated conveyance facility

3.2.4 LVE and Existing Groundwater Banking Programs

LVE supply could be used with the existing Semitropic Water Storage District (Semitropic) Groundwater Bank to enhance supply reliability All three SBA Contractors participate in the Semitropic Groundwater Bank

Through the banking program, SBA Contractors can divert water to storage in wetter years and receive a portion of their banked water in dry years Together the SBA Contractors have a storage allocation of 565,000 AF, 56 5 percent of the original banking capacity

In any year, the SBA Contractors can receive their banked supply through an in-lieu program, direct pumping, or both In the in-lieu program, the SBA Contractors receive a portion of Semitropic's SWP Table A entitlement while Semitropic meets its water needs by increased groundwater pumping Called "program entitlement exchange rights," the maximum amount available to the SBA Contractors would be 75,145 AF in any year, based on a 100% SWP allocation to Semitropic The maximum program entitlement exchange right for all banking partners is 133,000 AF, based on

Semitropic's total SWP entitlement of 158,000 AF less 22,000 AF[7] The SBA Contractors' portion of that amount is based upon their total capacity in the groundwater bank, 56 5% The SBA Contractors' ability to take water is proportional to Table A allocations for that year This method of withdrawing banked supply is limited in dry years, when Semitropic's Table A allocations are low

Through the "pumpback" program, Semitropic pumps stored groundwater into the California Aqueduct for delivery to SWP contractors downstream of Semitropic's pump back location This groundwater offsets SWP supplies from the Delta or San Luis Reservoir SBA Contractors would take delivery of an equal amount of water at their regular SWP diversion location The SBA Contractors' portion of Semitropic's total pumpback delivery capacity of 90,000 AFY is 50,850 AFY

With these two supply options, the maximum supply available from Semitropic in any year is 125,995 AFY However, the SBA Contractors would be more likely to utilize banked water in drier years, when in-lieu deliveries are limited

SBA Contractors could potentially utilize LVE supply reliability deliveries and Semitropic deliveries in two ways

1 Take delivery of both LVE supply reliability water and Semitropic stored water (either through in-lieu SWP water or through stored groundwater) in dry years, to the extent that there is adequate SBA pumping and reach capacity

2 Deliver LVE reliability supply to Semitropic to bank during wet years, provided that there is California Aqueduct capacity to do so This does not appear to require a change to existing banking contracts as the contract language states water delivered to Semitropic can be "a portion of [its] SWP or other water " If this were to present contractual issues, LVE reliability supply could be used to meet local SBA demand, making entitlement water available for banking The SBA Contractors can deliver 51,133 AFY to the Semitropic program in wet years, 56 5% of the assumed total delivery capacity of 90,500 AFY

Timing and quantities of LVE reliability supply would need to be further assessed to determine the feasibility of using LVE in conjunction with banking programs

Zone 7 and SCVWD also participate in other banking programs – Zone 7 in a planned program with Cawelo Water District, and SCVWD with San Benito County Water District (SBCWD) LVE reliability supply could be used in conjunction with these banking programs in similar ways

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[7] The SBA Contractors' contracts with Semitropic specify the amount of program entitlement exchange rights available, ranging from 40,000 AFY to 133,000 AFY, based upon the total vested storage in the groundwater bank and the year's percentage of SWP allocation Semitropic retains the first 22,000 AF of their SWP entitlement allocation

While groundwater banking in Semitropic could produce 50,850 AF in dry or critically dry years, this amount must first be stored in the bank Semitropic has guaranteed recharge capability of 90,500 AF, and the SBA Contractors have 56 5 percent of that capability (51,133 AF) Groundwater banking using these existing facilities has the capability to produce more water in a single dry year than LVE, but the utility would decrease in a series of dry years because the SBA Contractors would not have an opportunity to recharge the bank

The Semitropic Stored Water Recovery Unit (SWRU) may provide an opportunity for SBA Contractors to further expand their banking programs This project is discussed in Section 5 6

3.2.5 LVE and South Bay PP Outages

As conceptualized in Alternative 1, the LVE project could provide SWP wheeled water or reliability supply to the SBA through direct diversions from project Delta intakes to Bethany Reservoir, or through releases from LVE to Bethany Reservoir All LVE project facilities are upstream of the South Bay PP Therefore, LVE would not provide any benefits during a South Bay PP outage

3.2.6 Smaller LVE Reliability Project

In December 2008, CCWD presented potential partnership concepts to Zone 7 Water Agency In addition to the 275 TAF LVE expansion project, a smaller 160 TAF LVE expansion project was presented This is a variant of Alternative 4 presented in the Administrative Draft EIR/EIS In the EIR/EIS, this project was evaluated as a CCWD only project, with the additional 60 TAF of storage designated as emergency and reliability storage for CCWD CCWD envisions a need for a minimum of 20 TAF of storage with up to 40 TAF of storage available for other partners For this alternative, no new Delta intake facility or increased conveyance capacity would be needed, and no new pipeline connecting to Bethany Reservoir would be constructed

Water would be delivered to the SBA via exchange Two possible options were identified

- <u>Direct exchange between CCWD and SBA Contractors</u> CCWD would curtail pumping and draw from storage, so that additional water could be delivered to the SBA through Banks PP and/or to SCVWD through Jones PP The operation would use expanded storage to provide water supply reliability for SBA Contractors under a variety of conditions, including
  - Dry-year transfers using excess pumping capacity at Banks or Jones at times when Delta exports are not limited by flow restrictions, but water supply is limited and SWP and CVP contract allocations are low,
  - Transfers at times when minimum required outflow, Delta salinity standards, or other regulatory factors are controlling Delta export operations, and,

CDM

- Transfers when Old and Middle River (OMR) flow standard is controlling Delta exports (the operation described here would not alter compliance with an OMR flow standard, because total exports from south of the Delta would not change)

- **Indirect exchange between CCWD and SBA Contractors through Byron Bethany Irrigation District (BBID)** As an extension of the above option, CCWD could also meet BBID demands from storage at times when Delta diversions are restricted BBID is situated between CCWD raw water diversion facilities and SWP facilities, and has a canal intake on the channel upstream of Banks PP It may be possible for CCWD to develop a connection to deliver water to BBID from Los Vaqueros Reservoir, which would allow
  - Additional water supply to be available for transfers in dry years, and,
  - A larger share of Banks or Jones exports to be available to the SBA Contractors without increasing total south Delta diversions when Delta exports are restricted by regulatory standards

There is also the possibility to deliver water via exchange with existing facilities, including treated water exchange through the East Bay Municipal Utility District system Further analysis would be necessary to determine the available capacity of these existing connections

These mechanisms for water exchange could also be used without increased storage to facilitate reliable delivery of existing supplies in the face of conveyance restrictions in the Delta By using one or more of these mechanisms, CCWD estimates that up to 5,000 AF could be available in 2009, and up to 15,000 AF could be available by 2010, once the Alternative Intake Project is online In the near term, the proposed source of water for these deliveries would be transfers or other deliveries arranged by SBA Contractors As noted in Chapter 3 of the EIS/EIR, modifications to existing water rights held by CCWD, DWR, or USBR may also be investigated by the project team to allow water supply reliability improvements without diverting more water from the Delta than allowed under the existing water rights

These concepts are at the initial planning stages The SBA Contractors would need to work with CCWD to refine concepts and quantify delivery amounts, timing, costs and water sources

3.3 Deliveries

This section summarizes the LVE study potential water delivery benefits to the SBA The LVE study uses a customized version of CalSim II, the joint planning model of the USBR's CVP and State DWR's SWP operations

3.3.1 Key Modeling Assumptions

The CalSim II model for the LVE study was developed based on the CalSim II, version 8D, of the CALFED Program Common Assumptions Common Model Packages, with modifications to include new facilities and operations for LVE Key modeling assumptions are included in Table 3-3 Detailed modeling assumptions for Common Assumptions version 8D for future conditions are included as Appendix C

Table 3-3   ***Key Modeling Assumptions for LVE Studies***
<u>CalSim II Model Version</u>   8D, Common Assumptions Model Package
<u>Level of Development</u>   • 2020 level-of-development for Sacramento Valley   • 2030 level-of-development for San Joaquin Valley
<u>Demand of LVE Reliability Water Supply</u>   • Assumed demand is equal to the difference between SBA deliveries in a "pre-Wanger decision" model run and "with-Wanger decision" model run   • The demands are increased for dry and critical years by 50% and 200%, respectively, to encourage additional reliability delivery when SWP allocations are low
<u>Delta Export Restrictions</u>   • High Export and Low Export scenarios, based on Interim Remedial Order   • Scenarios used to bookend the potential effects of implementing the remedy actions
<u>Climate Change Considerations</u>   • Not applied in model simulations provided by LVE study team
<u>Operational Strategies</u>   • Make SWP contract deliveries and SCVWD CVP contract deliveries through CCWD diversion facilities rather than State and Federal pumps when possible, to reduce impacts on Delta aquatic species   • Curtail Delta pumping in April to simulate 30-day no diversion period to protect larval-stage smelt   • Make SBA and SCVWD CVP reliability deliveries when excess Delta supply available Reliability targets based on replacement of supply reductions due to fishery restrictions

Table 3-4 summarizes the low and high Delta export assumptions used for LVE studies, which are restrictions on combined OMR reverse flows

<table>
<tr><th colspan="5">Table 3-4
LVE High and Low Delta Export Assumptions</th></tr>
<tr><th rowspan="2">Month</th><th rowspan="2">Trigger</th><th rowspan="2">Condition</th><th colspan="2">Minimum OMR Reverse Flow</th></tr>
<tr><th>High Export</th><th>Low Export</th></tr>
<tr><td>October to November</td><td>N/A</td><td>N/A</td><td colspan="2">No Action</td></tr>
<tr><td rowspan="3">December</td><td rowspan="3">Turbidity</td><td>Sacramento Inflow - Sacramento Inflow (previous month) <= 6,000 cfs
OR
Sacramento plus Yolo Inflow > 80,000 cfs</td><td colspan="2">No Action</td></tr>
<tr><td>6,000 cfs < Sacramento Inflow – Sacramento Inflow (previous month) <= 10,000 cfs</td><td colspan="2">Dec 1-15 No Action
Dec 16-25 2,000 cfs
Dec 26 31 5,000 cfs</td></tr>
<tr><td>Sacramento Inflow Sacramento Inflow (previous month) > 10,000 cfs</td><td colspan="2">Dec 1 10 2,000 cfs
Dec 11-31 5,000 cfs</td></tr>
<tr><td rowspan="6">January</td><td rowspan="6">Turbidity</td><td>Action taken in December</td><td colspan="2">-5000 cfs</td></tr>
<tr><td>Sacramento plus Yolo Inflow <= 50,000 cfs
AND
Sacramento Inflow Sacramento Inflow (previous month) <= 6,000 cfs</td><td colspan="2">Jan 1-14 No Action
Jan 15 31 -5 000 cfs</td></tr>
<tr><td>Sacramento plus Yolo Inflow <= 50,000 cfs
AND
6 000 cfs < Sacramento Inflow – Sacramento Inflow (previous month) <= 10 000 cfs</td><td colspan="2">Jan 1-9 No Action
Jan 10 14 -2,000 cfs
Jan 15 31 -5,000 cfs</td></tr>
<tr><td>Sacramento plus Yolo Inflow <= 50,000 cfs
AND
Sacramento Inflow - Sacramento Inflow (previous month) > 10,000 cfs</td><td colspan="2">Jan 1 10 2 000 cfs
Jan 11 31 -5 000 cfs</td></tr>
<tr><td>50,000 cfs < Sacramento plus Yolo Inflow <= 80 000 cfs</td><td colspan="2">Jan 1-10 -2 000 cfs
Jan 11-31 -5 000 cfs</td></tr>
<tr><td>Sacramento plus Yolo Inflow > 80 000 cfs</td><td colspan="2">No Action</td></tr>
<tr><td rowspan="2">February</td><td rowspan="2">Spawning (12 deg C)</td><td>Sacramento plus Yolo Inflow > 30 000 cfs</td><td>Feb 1-15 5,000 cfs
Feb 16-28 -4 500 cfs</td><td>Feb 1-15 5 000 cfs
Feb 16-28 2 500 cfs</td></tr>
<tr><td>Sacramento plus Yolo Inflow <= 30,000 cfs</td><td>Feb 1 15 5,000 cfs
Feb 16 28 3 500 cfs</td><td>Feb 1-15 -5 000 cfs
Feb 16-28 1,500 cfs</td></tr>
<tr><td rowspan="2">March to June</td><td rowspan="2">Proximity of smelt to export pumps</td><td>Sacramento plus Yolo Inflow > 30,000 cfs</td><td>-4 500 cfs</td><td>-2,500 cfs</td></tr>
<tr><td>Sacramento plus Yolo Inflow <= 30 000 cfs</td><td>-3,500 cfs</td><td>1,500 cfs</td></tr>
<tr><td>July to September</td><td>N/A</td><td>N/A</td><td colspan="2">No Action</td></tr>
</table>

3.3.2 Deliveries

LVE modeling results for Alternative 1 are compared to the future No Action scenario to assess the potential water delivery benefits to SBA Contractors. Results are based on model runs received from CCWD in July 2008 that are being used for impacts analysis in the LVE EIS/EIR. CCWD provided model runs for both the high export and low export scenarios.

CCWD has noted that these simulations are based on initial assumptions about how supply reliability deliveries could be made. They indicated a willingness to work with SBA Contractors to refine operational assumptions and amounts, based on SBA Contractor needs.

Total SBA Deliveries

Table 3-5 and Figure 3-3 show the annual average total SBA deliveries, in acre-feet per year, for different water year types. Results are presented for long-term average conditions (average of 1922 through 2003), 6-year drought (1987 through 1992), and for different water year types (wet, above normal, below normal, dry and critical years). Water year types are defined based on the Sacramento Valley Index stipulated in SWRCB's 1995 Bay-Delta Water Quality Control Plan. Figure 3-4 graphically shows the differences between Alternative 1 and the No Action scenario for the Low Delta Export and High Delta Export scenarios. Figure 3-5 shows the exceedance probability of the annual total SBA delivery.

Total deliveries include Table A entitlement, Article 21 water, Article 56 carryover storage water and LVE Reliability Supply. For the low export (severe restrictions) scenario, total SBA deliveries are 132 TAF/yr, and include 121 TAF/yr Table A deliveries, 2 TAF Article 21 deliveries and 9 TAF/yr Article 56 water.

Long-term average total SBA reliability deliveries range from about 18 TAF/yr to 25 TAF/yr, depending on Delta export restrictions. Reliability deliveries are made in all years, though dry and critically dry years are targeted for higher reliability deliveries, since SWP deliveries would be lower in these years. Reliability deliveries for the 1987 through 1992 drought range from 20 TAF/yr to 22 TAF/yr.

The focus of the LVE evaluation was to examine the net delivery of reliability supply to the three agencies, and to represent a reasonable "high end" level of combined water supply reliability deliveries to the three agencies, in order to complete a comprehensive impacts analysis. The LVE studies made no attempt to evaluate reliability deliveries to individual agencies. SBA total deliveries include Table A, Article 21 deliveries and carryover storage. Assuming that benefits would be generally proportional to the SBA Contractors' Table A deliveries, Zone 7 Water Agency would receive 36 percent of reliability deliveries, Alameda County Water District 19 percent, and SCVWD 45 percent.

Table 3-5
LVE Study Results - Annual Average Total SBA Delivery for Future (2020) Level of Development (AFY)

Water Year Type	Low Delta Export Assumptions (Severe Fishery Restrictions)			High Delta Export Assumptions (Moderate Fishery Restrictions)		
	No Action	Alternative 1	Difference	No Action	Alternative 1	Difference
Long-Term (1922~2003)	138,244	162,889	24,645	151,658	169,519	17,861
6-Year Drought (1987~1992)	79,523	99,351	19,828	89,616	112,094	22,478
Hydrologic Year Types						
Wet	181,379	197,270	15,891	194,579	205,071	10,492
Above Normal	142,959	161,565	18,606	160,597	172,329	11,733
Below Normal	132,277	151,839	19,562	153,272	167,345	14,073
Dry	114,399	153,534	39,136	124,754	151,501	26,747
Critical	82,800	116,644	33,843	88,196	119,240	31,044

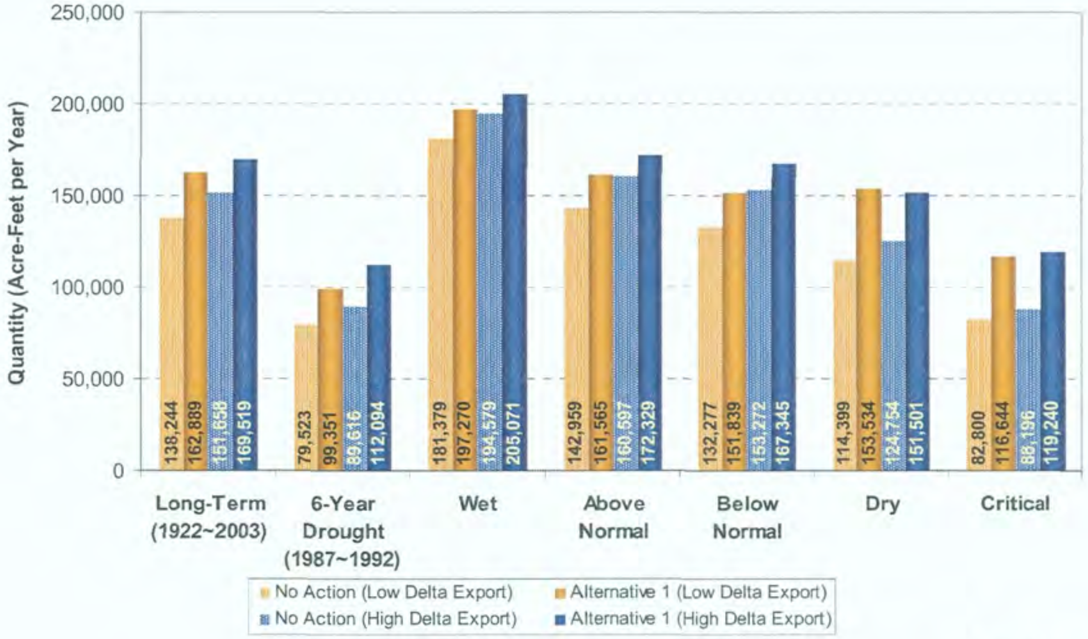


Figure 3-3
LVE Study Results - Annual Average Total SBA Delivery

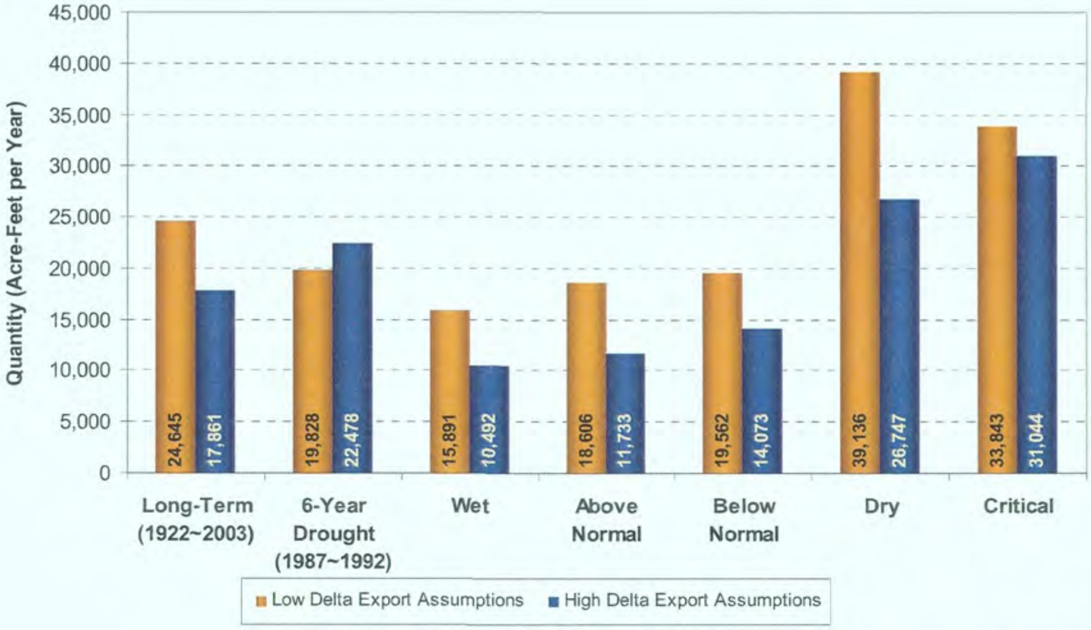


Figure 3-4
LVE Study Results - Additional Annual Average Total SBA Delivery (Difference between No Action and Alternative 1)

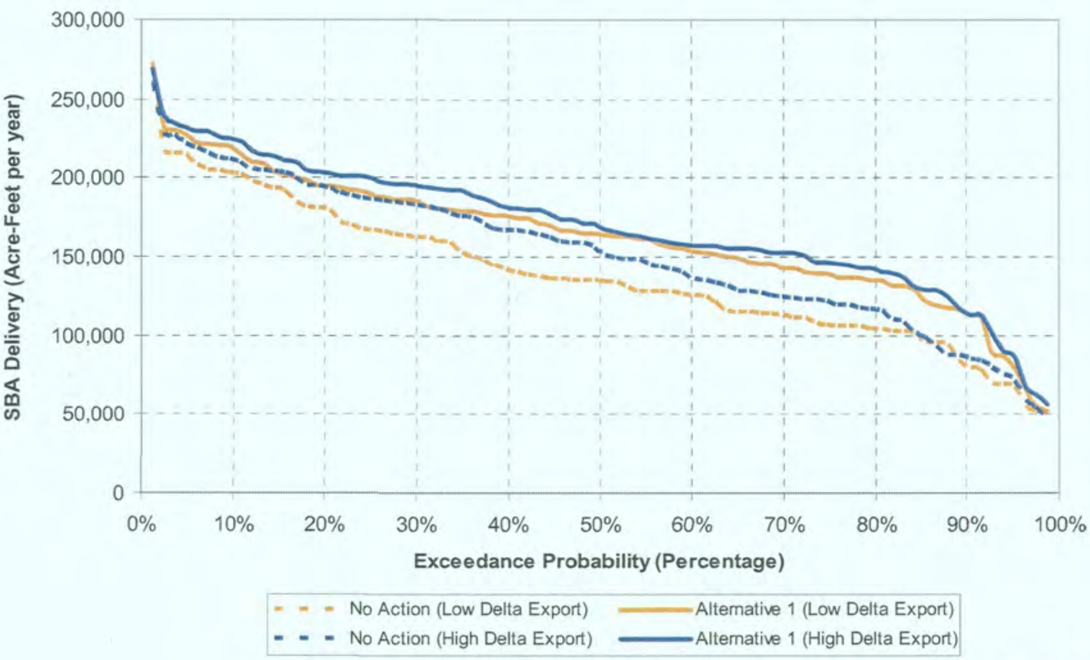


Figure 3-5
LVE Study Results - Exceedance Probability of Annual Total SBA Delivery

Delivery to CVP San Felipe Municipal and Industrial Use

The LVE studies also evaluate potential supply reliability deliveries to SCVWD through its CVP contract, delivered from San Luis Reservoir The CVP San Felipe Division provides both irrigation and municipal and irrigation (M&I) water supply to SCVWD and SBCWD In CalSim II, the total M&I water delivery to SCVWD and SBCWD are considered together as one M&I delivery Although the model does not disaggregate the M&I delivery to SCVWD and SBCWD separately, the CVP San Felipe M&I delivery result could provide a general idea regarding delivery to SCVWD, since SCVWD's CVP M&I contract amount (119,400 AFY) is much bigger than SBCWD's contract amount (8,250 AFY)

Table 3-6 and Figure 3-6 show the annual average deliveries to CVP San Felipe M&I use, in acre-feet per year, for different water year types Figure 3-7 graphically shows the differences between Alternative 1 and the No Action scenario for the Low Delta Export and High Delta Export scenarios Figure 3-8 shows the exceedance probability of the annual total SBA delivery

Long-term average reliability deliveries to CVP San Felipe M&I use range from about 4 TAF/yr to 7 TAF/yr, depending on Delta export restrictions Reliability deliveries for the 1987 through 1992 drought range from 5 TAF/yr to 8 TAF/yr

Table 3-6
LVE Study Results - Annual Average Delivery to CVP San Felipe Division M&I Use (AFY)

Water Year Type	Low Delta Export Assumptions			High Delta Export Assumptions		
	No Action	Alternative 1	Difference	No Action	Alternative 1	Difference
Long-Term (1922~2003)	99 857	106,924	7 067	103,953	108,023	4,069
6-Year Drought (1987~1992)	82,518	90,377	7,859	85 280	90,974	5,694
Comparisons for Different Hydrologic Year Types						
Wet	113,438	118,944	5,507	117,467	120,397	2 930
Above Normal	99,917	106,190	6,273	106,299	109,055	2,756
Below Normal	98,317	103,404	5,088	103,840	106,104	2,264
Dry	94,188	103,287	9,099	96 857	101,934	5,077
Critical	80 671	91,174	10,503	83,106	91,553	8,447

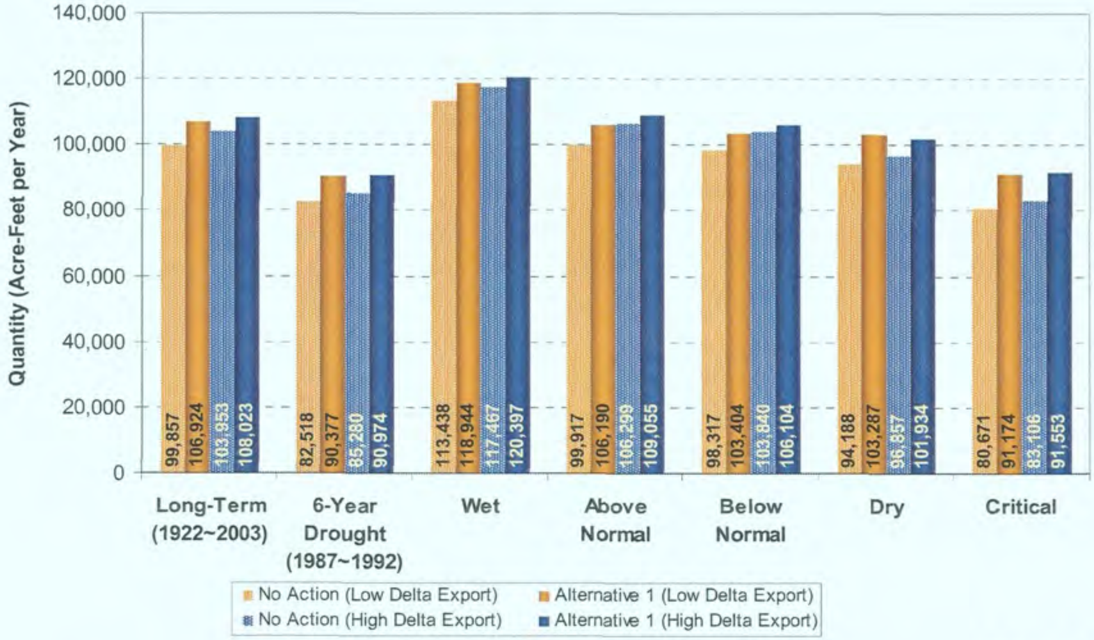


Figure 3-6
LVE Study Results - Annual Average Delivery to CVP San Felipe Division M&I Use

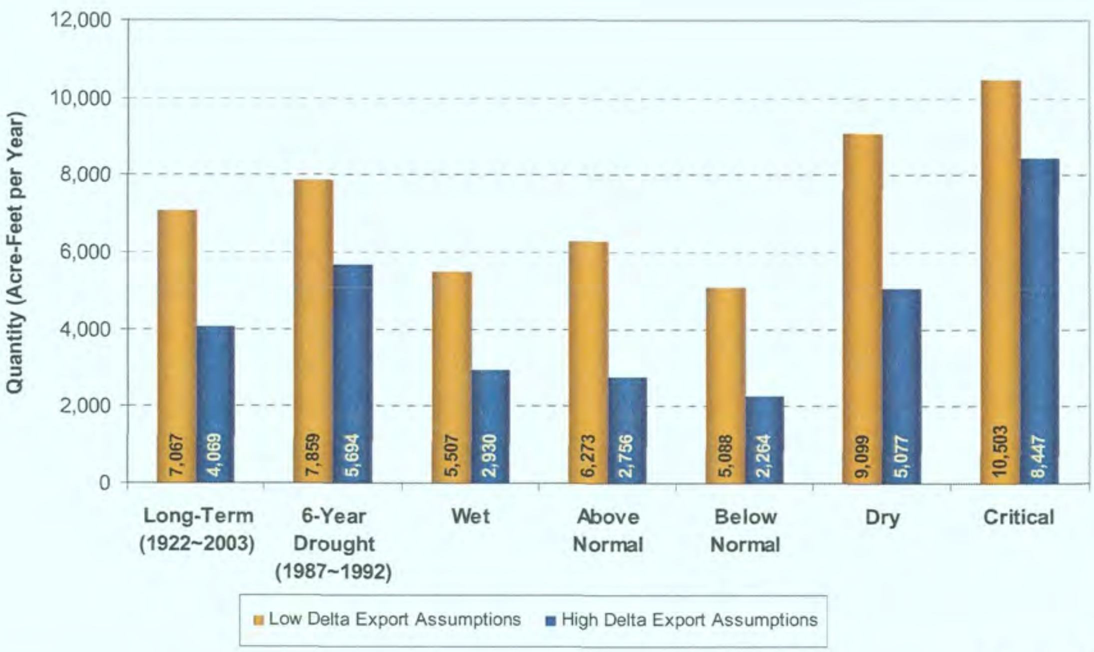


Figure 3-7
LVE Study Results - Additional Annual Average Delivery to CVP San Felipe Division M&I Use (Difference between No Action and Alternative 1)

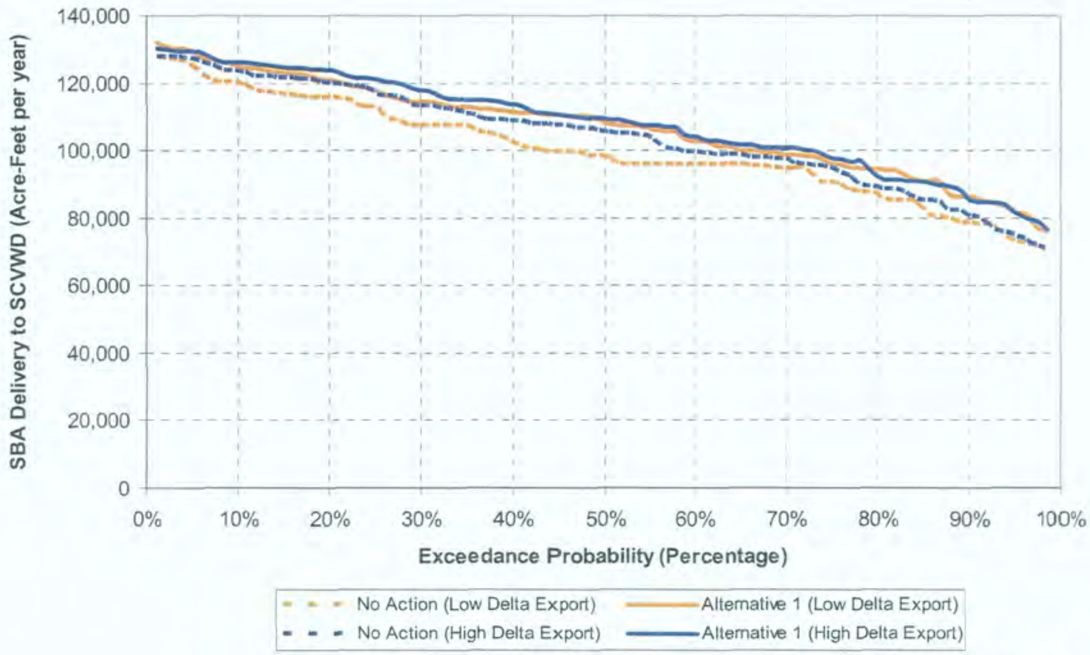


Figure 3-8
LVE Study Results - Exceedance Probability of Annual Delivery to CVP San Felipe Division M&I Use

3.3.3 Comparisons to 2007 SWP Study

Section 2 of this report presents potential changes to SWP deliveries using information from DWR's SWP Delivery Reliability studies from 2005 and 2007. The 2005 studies are the current basis of planning for SWP deliveries for the SBA contractors. The 2007 studies incorporate potential effects of delta smelt restrictions and climate change. The differences in SWP deliveries in the two reports were used to establish estimates of the potential magnitude of delivery reductions to SBA contractors.

Similarly, LVE studies evaluated baseline conditions with and without implementing potential pumping restrictions due to delta smelt. Delivery differences between the simulations with delta smelt restrictions and without restrictions were used to establish delivery targets.

This section compares LVE studies with DWR studies.

Comparisons to 2007 SWP Baseline

LVE Future No Action scenarios were compared with DWR 2007 studies to assess differences. Since the LVE study models did not consider the climate change effects, the two future scenarios (high and low Delta export assumptions) are compared with DWR results without climate change effects.

DWR 2007 studies use an updated version of the CalSim II model developed for the 2004 Long-Term CVP Operations Criteria and Plan (OCAP) The studies use SWP 2027 demands, though land-use assumptions are based on a 2020 level of development LVE studies are based on model version 8D of the Common Assumptions package, which has incorporated multiple changes to the OCAP version of CalSim II As a result, there are some key differences in modeling assumptions between the two studies Three major differences are

- **Regulation rules** The DWR 2007 study considered constraints stipulated in the SWRCB's Decision 1641, the LVE study considered SWRCB's Decision 1641 and Decision 1485, and CVPIA b(2) rules
- **CCWD's Delta diversions** Compared to the DWR 2007 study, LVE study assumes greater CCWD Delta diversions The long-term average of CCWD's Delta diversions difference between these two studies is approximately between 14,301 to 14,412 AFY
- **Fish Actions** The two efforts included different assumptions regarding fish actions Table 3-7 includes fish action assumptions in the SWP Reliability Report, which are generally less restrictive in December and January and more restrictive in February, March, and June than the LVE assumptions (Table 3-7)

Table 3-7
Fish Actions Assumed for SWP Delivery Reliability Studies

Dates	***Minimum OMR Reverse Flow***	
	High Export	***Low Export***
December 25 – January 3	-2 000 cfs	
January 4 – February 20	-5,000 cfs	
February 21 – April 14	-2,000 cfs	-750 cfs
April 15 – May 15	No OMR standard VAMP controls export	
May 16 – June 30	-5 000 cfs	-750 cfs

Source DWR 2007

A comparison of detailed assumptions for the 2004 OCAP studies and Common Assumptions v8D studies is included as Appendix C

Table 3-8 summarizes the model comparisons for the DWR and LVE studies The comparison includes total SBA delivery, in terms of water year types, long-term (water year 1922-2003), and 6-year drought periods (water year 1987-1992) In addition, CCWD's Delta diversions are compared to show the difference in modeling assumptions

Table 3-8
Modeling Results Comparison between DWR 2007 Study and LVE Study (AFY)

Water Year Types	Low Delta Export Assumptions				High Delta Export Assumptions			
	DWR 2007	LVE No Action	Difference	Difference (%)	DWR 2007	LVE No Action	Difference	Difference (%)
Total SBA Delivery								
Wet	188,588	181,379	-7,209	-4%	194,532	194,579	47	0%
Above Normal	157,107	142,959	-14,149	-9%	169,006	160,597	-8,409	-5%
Below Normal	159,049	132,277	-26,772	-17%	164,088	153,272	-10,816	-7%
Dry	126,986	114,399	-12,587	-10%	139,754	124,754	-15,000	-11%
Critical	88,321	82,800	-5,520	-6%	90,825	88,196	-2,628	-3%
Long-Term (1922~2003)	150,742	138,244	-12,498	-8%	158,398	151,658	-6,740	-4%
6-Year Drought (1987~1992)	82,285	79,523	-2,762	-3%	89,927	89,616	-312	0%
CCWD's Delta Diversions								
Wet	145,804	160,855	15,051	10%	145,804	159,647	13,843	9%
Above Normal	155,258	172,804	17,545	11%	155,258	170,721	15,462	10%
Below Normal	156,421	172,253	15,831	10%	156,421	170,909	14,488	9%
Dry	151,567	157,207	5,640	4%	151,567	161,731	10,165	7%
Critical	134,308	154,944	20,636	15%	134,308	155,183	20,874	16%
Long-Term (1922~2003)	148,583	162,884	14,301	10%	148,583	162,994	14,412	10%
6-Year Drought (1987~1992)	145,183	169,441	24,257	17%	145,183	169,894	24,710	17%

The comparison generally shows that the average annual amount of total SBA delivery is smaller under both low and high Delta export assumptions for the LVE studies. The comparison also shows the CCWD deliveries are greater in the LVE studies. The impact of these differences is uncertain. Underestimation of total SBA deliveries could potentially over-estimate LVE supply reliability deliveries, since SBA delivery capacity would be assumed to be available when it may not be. As part of future studies, CCWD could investigate these differences and refine delivery estimates.

Comparisons of Reliability Shortfalls due to Fishery Restrictions

As noted above, CDM compared results from Cal Sim II simulations for SWP Delivery Reliability studies from 2005 and 2007 to estimate potential reductions in deliveries due to potential pumping restrictions in the Delta. LVE studies used a similar approach, comparing results from Cal Sim II simulations with and without fisheries restrictions.

SWP reliability studies estimate that long-term annual average Table A deliveries to SWP contractors would decrease from 171 TAF (2005 studies) to 147 to 158 TAF (2007 studies). This translates to estimated long-term average SBA delivery reductions of 13 TAF/yr to 24 TAF/yr.

By comparison, LVE studies show that long-term annual average SBA deliveries would be reduced from about 182 TAF with no fishery restrictions to 132 TAF to 145 TAF, with fishery restrictions Deliveries prior to court-ordered fishery restrictions are estimated to be higher than DWR studies, and deliveries with court-ordered fishery restrictions are estimated to be lower than DWR studies, so the overall reduction is more 37 TAF/yr to 50 TAF/yr, compared with 13 TAF/yr to 24 TAF/yr Actual reliability deliveries to SBA Contractors range from 18 TAF/yr to 25 TAF/yr, about 50% of the estimated shortfall, due to diversion and delivery constraints

Summary of Comparisons

There are differences in estimates of total deliveries and delivery reductions in LVE studies and DWR studies, due to the use of different CalSim II versions, with different modeling assumptions, in particular as they relate to potential fishery restrictions, and fundamental assumptions about Delta regulatory operations It is uncertain what impact these differences would have on estimates of supply reliability deliveries for SBA Contractors These differences should be explored Estimates of supply reliability deliveries would also be able to be refined based on the USFWS's December 2008 OCAP biological opinion

3.4 Project Costs

Capital costs for the alternatives under consideration in the LVE EIR/EIS have been developed by the LVE team Annual operating and maintenance and power costs have not yet been developed for alternatives This analysis is planned as part of subsequent State and Federal feasibility studies that will be undertaken in late 2008 and 2009

In discussions with the LVE planning team, the following key items were noted about costs

- Alternative 1, which includes an environmental water component would have a State or Federal cost share if DWR or USBR determines that there is a State or Federal interest in participating in the project Potential Federal cost sharing will be examined as part of the Federal feasibility studies, which are slated to have a draft study available by July 2009, and final study by 2010 Federal feasibility studies, including cost sharing are guided by policies set forth in the *Federal Economic and Environmental Principals and Guidelines for Water and Related Land Resources Implementation Studies* (U S Department of Interior, 1983) It is uncertain at this point whether the State feasibility study will address State cost-sharing According to CCWD, there is no similar framework for cost analysis for State feasibility studies as there is for the Federal feasibility studies

- CCWD is envisioning financing the project and becoming a wholesale water provider to sell reliability supply to SBA Contractors Financial analysis to determine water pricing has not yet been evaluated by CCWD

- CCWD would have a buy-in fee to reimburse CCWD for sunk costs invested in the initial project The buy-in fee would need to be determined A placeholder value of $100M buy-in for SBA Contractors was provided

3.4.1 Capital Costs

Table 3-9 presents conceptual-level project capital costs for Alternative 1 Capital costs were developed by the LVE study team and provided to CDM for this analysis Costs are in August 2008 dollars The only adjustment to the LVE study team costs made for this analysis was to remove escalation to midpoint of construction and present capital costs in August 2008 dollars This adjustment was made so that capital costs could be compared to other alternatives being evaluated in this study The total capital cost is $793 million

Table 3-9
Alternative 1 Conceptual-Level Capital Cost Estimate ($1000)

Conveyance	***Cost ($1000)***
Transfer Facility Reservoir	$ 9,630
Expanded Transfer Pump Station (670 cfs)	$ 30,350
Delta Pump Station (170 cfs)	$ 20,522
Raw Water Conveyance	$ 226,717
Power Supply	$ 40,100
Mobilization (General Requirements/Indirect costs)	$ 32,732
Subtotal – Conveyance	$ 360,051
275 TAF Dam	
Site Preparation	$ 1,015
Dam Foundation	$ 14,014
Embankment	$ 50,717
RCC Abutment	$ 15,794
Inflow Conduit	$ 19,306
Spillway	$ 724
Intake Structure and Outlet Works	$ 7,090
Dam Roads	$ 612
Mobilization (General Requirements/Indirect costs)	$ 10,927
Subtotal Dam	$ 120,199
Subtotal	$ 480,250
Contingency (30%)	$ 144,075
Subtotal	$ 624,325
Design Services (10%)	$ 62,433
Design Services During Construction (4%/)	$ 24,973
Construction Management (8%)	$ 49,946
Miscellaneous (1%)	$ 6,243
Land/Recreation	$ 25,000
Total	$ 792,920

3.4.2 Lifecycle Cost Analysis

For the purpose of comparison with other alternatives under consideration in this study, life-cycle and unit cost estimates were prepared by CDM, with review and input by the CCWD LVE studies team These estimates were prepared using the following assumptions

- Annual capital recovery cost for project financing estimated using interest rate of 5 percent and 30-year payback period
- Energy costs computed from anticipated annual energy usage for project facilities, as reported in LVE EIR/EIS, and unit energy costs provided by CCWD CCWD uses a blended power rate for Old River, Rock Slough and AIP pump stations assuming power purchase from CVP ($0 03/kilowatt-hour [kWh]) and Modesto Irrigation District ($0 085) The Transfer PS assumes purchase from PG&E at $0 10/kWh Energy costs are the incremental costs between the No Action/No Project condition and Alternative 1
- Annual operating and maintenance costs assumed to be 1 percent of capital cost
- Unit costs computed for long-term average deliveries for low export (severe fishery restrictions) scenario, using average annual deliveries for two components
  - Pumping reductions through Banks PP (191 TAF/yr) representing environmental component of alternative,
  - Supply reliability delivery to SBA Contractors (32 TAF/yr)
- Costs are presented with and without a placeholder buy-in cost of $100M to reimburse CCWD for portion of sunk costs from construction of existing Los Vaqueros facilities

Table 3-10 summarizes estimated annual costs and unit costs Annual costs range from $63M to $70M, depending on the inclusion of buy-in costs Unit water costs are $280/AF without buy-in costs, and $309/AF with estimated buy-in costs Computation of unit costs treats environmental water, supply reliability water and emergency water equally (i e amount delivered is proportional to project cost) To realize these unit costs for supply reliability water would require 85 percent of the project costs to be borne by State or Federal partners Analysis of the moderate fishery restriction scenario indicates similar unit costs, with 89 percent of the project costs to be borne by State or Federal partners As noted above, numerous factors will influence ultimate pricing of water for SBA Contractors

Table 3-10 Example Life-Cycle Cost Analysis for LVE Alternative 1 ($M)				
	Without $100M Buy-In		***With $100M Buy-In***	
Total Capital Cost	$793		$893	
Annualized Capital Cost (5%, 30 years)	$51 6		$58 1	
Energy Cost	$3 8		$3 8	
O&M Cost (1%)	$7 9	-	$7 9	
Total Annual Cost	$63 3		$69 8	
Reliability Supply	32	TAF	32	TAF
State/Federal Environmental Supply	191	TAF	191	TAF
CCWD Emergency Supply	3	TAF	3	TAF
Total Supply	226	TAF	226	TAF
Unit Cost[1]	$280	/AF	$309	/AF

[1] Unit cost with no State or Federal cost share is $1 800/AF

Section 4
Del Valle Reservoir Expansion Alternatives

4.1 Introduction and Summary

In 1999, Zone 7 Water Agency (Zone 7) identified the need to obtain additional supply and build additional conveyance capacity to meet future demands The *Water Conveyance Study* (CDM, 2001) (2001 Study) evaluated and recommended conveyance, storage, and treatment options to meet the future demand requirements The 2001 Study assessed several new surface water reservoir sites and re-operation of the Del Valle Reservoir as alternatives to enlargement of the South Bay Aqueduct (SBA) to help meet peak demands, providing more flexibility in reservoir operations for Zone 7's increased State Water Project (SWP) entitlement and increased SBA capacity allotment None of these storage alternatives were implemented through Zone 7's Capital Improvement Program

As part of the Delta Water Supply Reliability Study, the SBA Contractors (Zone 7, Alameda County Water District [ACWD], and Santa Clara Valley Water District [SCVWD]) decided to examine a joint water supply strategy and review the 2001 Study alternatives that considered increased use of storage at Del Valle Reservoir In this section, CDM updates and summarizes the information on the Del Valle Reservoir alternatives, their costs and benefits

This section presents

- Expansion and re-operation alternatives,
- Updated cost estimates,
- Significant geotechnical, environmental, and recreation issues, and
- Next steps necessary to resolve the implementation issues for each alternative

Table 4-1 summarizes the findings from the analysis for the five Del Valle Reservoir alternatives Further detail is presented in this section for each of the alternatives In Section 6 of this report, these alternatives are compared to the Los Vaqueros Reservoir Expansion and other potential supply programs to compare alternatives and develop a recommended action plan for the SBA Contractors

Table 4-1
Summary of Evaluation of Del Valle Alternatives [1]

Alternative	Description	Storage Capacity (AF)	Annual Yield (AFY)	Capital Cost ($M)	Unit Cost ($/AFY)[2]	Implementation Issues: Geotechnical	Implementation Issues: Environmental	Implementation Issues: Recreation	Next Steps for Implementation
Upper Del Valle Reservoir	Creates two separate reservoirs in Del Valle area	10 500	150	$81 - $87	$40,000 - $44,000	Significant seismic hazard within 1 mile, however, peak ground acceleration within allowable limits	Inundates up to 259 acres, special status species habitat significant adverse visual impact, extensive permitting for resources issues and earthwork	Relocation of Arroyo Valle campground	Further evaluate supply source options (Arroyo Valle, Article 21 water, and additional purchases) Evaluate dam foundations, borrow materials, and slope stability/erosion/seepage Assess environmental costs and schedule
		15,000	700	$108 - $115	$11,500 - $12,300				
Del Valle Mid-Reservoir Dam	Constructs new dam bisecting existing Del Valle Reservoir	< 5 000	<75	$105	$105 000	Significant seismic hazard within 1 mile, however, peak ground acceleration within allowable limits	Special status species habitat, significant adverse visual impact extensive permitting for resources issues and earthwork	Divides Lake Del Valle, potentially significant adverse impact to recreation on existing reservoir	Evaluate amount of supply that could be used in the existing reservoir, and potential source storage capacity, hydraulic and geotechnical studies of river diversion, evaluate dam foundations borrow materials, slope stability/erosion/seepage
Upper Basin Modifications	Targets excavation in upstream end of Del Valle Reservoir	375	--	$11	--	Requires suitable spoils disposal location	Dredging disturbances, streambed alteration, special status species habitat less extensive permitting for resources issues and earthwork	Improves boating access	Further evaluate supply source options (Arroyo Valle, Article 21 water, and additional purchases) Survey basin, drill and sample lake bed
Arroyo Mocho Reservoir	Constructs new reservoir on Arroyo Mocho	9,000	800	$123	$11 500	Significant seismic hazards unstable sediments prone to landslides, slopes prone to cracking and settlement	Inundates up to 240 acres special status species habitat, significant visual impact, extensive permitting	Relocation of access roads to Lake Del Valle	Investigate water rights on Arroyo Mocho and other water source options Evaluate dam foundations borrow materials, and slope stability/erosion/seepage, hydraulic study of spillway
		15,000	1,300	$153	$8 800				
Re-Operation of Del Valle Reservoir	Changes operations to allow summer storage up to 710 feet for additional water supply	5,000	75	$21	$21,000	None	Special status species habitat, potential for cultural resource mitigation reduction in flood control capacity that need Federal agency oversight, moderate permitting for resources and earthwork	Reduced access to recreation facilities during summer require construction of new facilities	Further evaluate supply source options (Arroyo Valle, Article 21 water, and additional purchases) Evaluate impact of additional storage on flood control needs Assess range of impacts associated with reduced flood control and potential mitigation alternatives

AF = acre-feet AFY = acre feet per year $M = million dollars $/AFY = dollars per acre-foot per year

(1) Source for information CDM, 2001

(2) Annual recovery costs for project financing computed using interest rate of 5% and 30 year payback period

The 2001 Study also considered a new dam and surface storage in the Doolan Canyon area, north of Livermore The Doolan Canyon Reservoir was excluded from evaluation in this study because the area is now being considered for habitat conservation

4.2 Potential Alternatives

4.2.1 Overview

Under current operations, California Department of Water Resources (DWR) has imposed operating restrictions to maintain Del Valle Reservoir at a water surface elevation of 703 feet, about 40,000 AF, from the end of May through the first week of September A two-foot elevation decrease during that time is allowed for operations and evaporative losses This restriction is in place to maintain lake levels for continued access to the recreation facilities that exist between about elevation 700 feet and 710 feet The operating rules currently mean that Del Valle Reservoir cannot be filled to a higher volume at the beginning of the summer and drawn down for water supply through the high demand season

The 2001 Study identified five alternatives for expanding the storage available at Del Valle Reservoir Three alternatives involved construction of new dams, in Del Valle Reservoir and the surrounding area, and one alternative involved limited excavation of a portion of the existing reservoir Another alternative assessed re-operation of Del Valle Reservoir

Description of Alternatives

To assess the construction alternatives during the 2001 Study, CDM and its subconsultants reviewed available data from previous planning and engineering studies, conducted field visits and aerial reconnaissance, studied aerial photographs of all reservoir sites (including pre-dam photographs for the Del Valle Reservoir), reviewed Del Valle dam construction data, consulted with regulatory agency engineers concerning site conditions, prepared construction cost estimates and site layouts, and evaluated geologic conditions to screen out infeasible sites The storage volumes for new reservoirs were based Zone 7's acquisition of the fourth SBA contractor share (CDM, 2001) Figure 4-1 shows the reservoir sites

The 2001 Study also evaluated the re-operation of Del Valle Reservoir to a higher water level to allow a portion of the flood control storage in the reservoir to be used for water supply The re-operation would require relocation of existing recreation facilities In the 2001 Study, CDM evaluated the potential impacts on the Del Valle Reservoir water levels based on different types of system operations and identified potential cost impacts of these changes to the recreational facilities at Del Valle Reservoir (CDM, 2001) For the Delta Water Supply Reliability Study, CDM has assessed whether relocating recreational facilities and reducing existing operational constraints could provide additional reservoir yield without changing the size or location of the existing dam

The sections below summarize information for each alternative on the project configuration, operation, and potential yield

Potential Sources of Supply

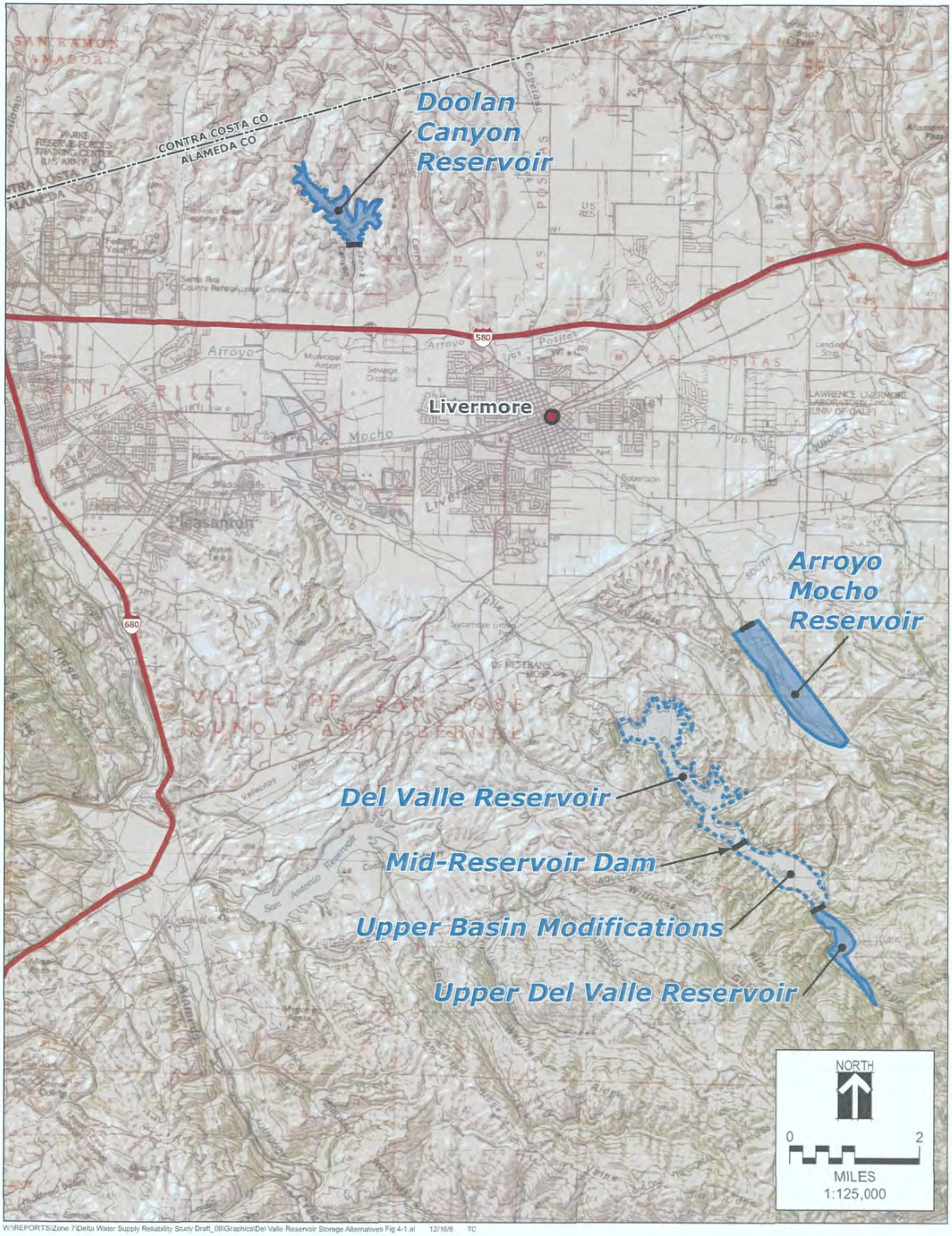
Several potential sources of supply to fill the additional storage were identified in past studies The 2001 Study assumed the reservoirs would be filled using the future fourth SBA contractor share Since Zone 7 subsequently purchased that additional capacity allotment, it has been treated like the rest of Zone 7's SWP entitlement and is no longer specifically available as a supply source for the storage alternatives

A 1992 report by Bookman-Edmonston Engineering, Inc , *Report on Supplemental Water and Storage for SBA Contractors,* identified possible sources additional runoff from Arroyo Valle, surplus Delta water, and water purchases Each is described below and could be used as a supply for the alternatives involving Del Valle Reservoir Runoff from Arroyo Mocho is also considered as a supply for the Arroyo Mocho Reservoir

Arroyo Valle Runoff

Zone 7 and ACWD each have rights to 60,000 AFY of water from Arroyo Valle There are restrictions on their use of Del Valle Reservoir that limit storage of this runoff to the portion of the total water supply storage allowed in the reservoir that is not already in use by SWP water While Zone 7 and ACWD have substantial rights to this water, their combined active storage is limited to 15,000 AF

Monthly data on total runoff in Arroyo Valle is available from 1912 to 1998 To evaluate the yield of a project that adds storage to the existing Del Valle Reservoir, either with a change in the operation of Del Valle Reservoir or by the addition of surface storage in the watershed, runoff utilized by Del Valle Reservoir must be subtracted from total runoff to calculate available runoff The 1992 Bookman-Edmonston study estimated the amount of natural runoff in Arroyo Valle captured and stored in Del Valle Reservoir using a mass balance model simulating normal reservoir operations under full entitlement deliveries for a monthly time step from 1922 to 1978 Long-term operation schedules supplied by DWR were utilized to provide a realistic simulation of reservoir filling during the winter and deliveries during the summer months The monthly record of runoff captured in the reservoir, or regulated runoff, was then subtracted from the observed monthly streamflow of Arroyo Valle, to estimate the amount of "unregulated" runoff available for capture in new storage projects (Bookman-Edmonston, 1992) The time period of 1922 to 1978 is hydrologically similar to the more recent period of 1979 to 2003 Based on the predictions of SWP deliveries specified in the 2007 SWP Delivery Reliability report, the long term averages for SWP deliveries as a percentage of the maximum Table A allocations is identical for both time periods 1992 to 1978 and 1979 to 2003, approximately 69% One difference, as further discussed below, is that the 1979 through 2003 period includes the 1987 through 1991 drought, which is usually the defining historical drought period for estimating water supply yield



W:\REPORTS\Zone 7\Delta Water Supply Reliability Study Draft_09\Graphics\Del Valle Reservoir Storage Alternatives Fig 4-1.ai 12/16/8 TC

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Figure 4-1
Del Valle Reservoir Storage Alternatives

Figure 4-2 presents a summary of the unregulated runoff calculations - the exceedance probability of a volume of total annual unregulated runoff being available over the course of the historical analysis period For example, there will be some amount of unregulated runoff in about 55 percent of the years During relatively wetter years, the available runoff could be captured by additional storage in Del Valle Reservoir or in new storage projects such as Upper Del Valle Reservoir The reliable yield resulting from the utilization of the unregulated runoff would depend on the project's storage volume and timing of runoff/delivery operations The estimated yields for proposed projects are discussed in Section 4 3 Given the annual variation in runoff, the additional reservoir storage could also be used to store smaller amounts of surplus runoff over a number of years

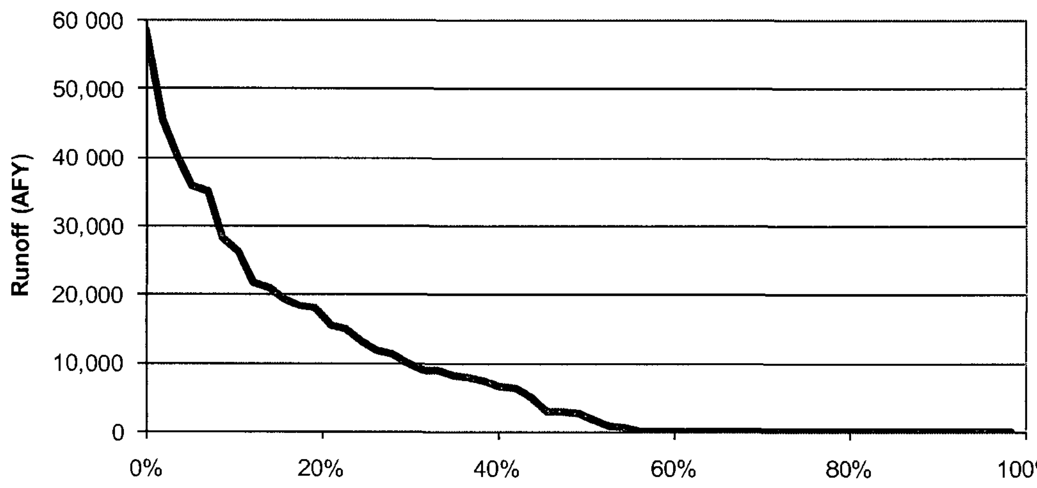

Figure 4-2
Exceedance Probability of Total Annual Unregulated Runoff in Arroyo Valle

Arroyo Mocho Runoff
Runoff from the Arroyo Mocho valley, located adjacent to the Arroyo Valle valley, would serve as a source of water supply for the Arroyo Mocho Reservoir alternative Due to their close proximity and similar climatology, the amount of natural runoff available in the Arroyo Mocho valley can be roughly estimated from runoff estimates in the Arroyo Valle valley using an area transformation of the runoff time series based on the ratio of the watershed areas [1] As specified by the San Francisco Bay Regional

[1] Hyetographs for the east Alameda Creek watershed, not available in this study, indicate that Arroyo Mocho sub-basin has about 20 percent less precipitation than Arroyo Valle, so the method used in this study is conservative

Water Quality Control Board, the watershed areas for Arroyo Mocho and Arroyo Del Valle are 28 0 and 172 7 square miles, respectively Natural runoff was calculated for the Arroyo Mocho watershed for the time period 1912 to 1998 using the following equation for each month, "t"

$$\text{Runoff}_t\ (\text{Arroyo Mocho}) = \frac{\text{Watershed Area (Arroyo Mocho)}}{\text{Watershed Area (Arroyo Del Valle)}} * \text{Runoff}_t\ (\text{Arroyo Del Valle})$$

Figure 4-3 presents a summary of the natural runoff calculations for Arroyo Mocho using the exceedance probability of a volume of total annual natural runoff being available over the course of the historical analysis period Based on these results, multiple years of runoff collection would likely be necessary to fill either the 9,000-AF or 15,000-AF Arroyo Mocho Reservoir options

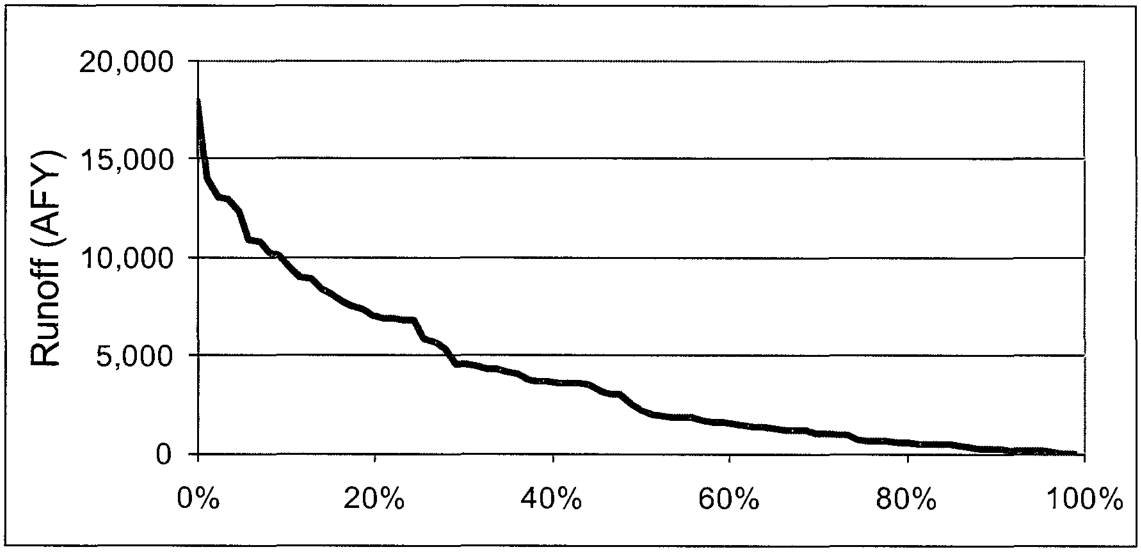

Figure 4-3
Exceedance Probability of Estimated Total Annual Runoff in Arroyo Mocho (AF)

Surplus Delta Water

Surplus Delta water is available from the SWP and Central Valley Project (CVP) when all diversion and Delta outflow requirements have been met The SWP surplus program is called Article 21 and it makes water available in addition to contractors' Table A allocations This water is made available when San Luis Reservoir is full (or projected to be full in the near future), other south-of-Delta storage is full (or conveyance to fill facilities is at capacity), DWR is able to meet all other demands south of the Delta, the Delta is in excess conditions, and the SWP has available pumping and conveyance capacity Due to these restrictions, Article 21 water is available on an erratic schedule, may be cut off at any time, and must be requested in advance (and receiving the full request is not guaranteed) Also, Article 21 water has the fourth priority for capacity in the SWP system, following prior rights and instream flow requirements, Table A entitlements, and carryover storage

If the demand for Article 21 exceeds the available water, DWR may allocate Article 21 water in proportion to those contractors' SWP Table A allocations The SBA Contractors' Table A allocation of 222,619 AFY is only 5 3% of the total Table A supply, therefore, the SBA Contractors could only rely on 5 3% of the available water in a year with many Article 21 requests

As discussed in Section 2, future (2027) Article 21 deliveries to all SWP Contractors in an average year are projected to range from 17,000 AF to 43,000 AF

Article 21 supplies are likely to be much more limited in the future because of Delta export restrictions associated with protection of delta smelt and salmon Judge Wanger's interim remedies from *NRDC vs Kempthorne* include export reductions from December through June, and these months are also when Article 21 supplies have historically been available As discussed in Section 2, DWR estimates of Article 21availability, with consideration of Delta restrictions using the interim remedies, range from 17,000 AFY to 36,000 AFY, compared with a pre-regulatory baseline of 124,000 AFY The revised biological opinion for delta smelt for the long-term operations of the CVP and SWP contain similar provisions as the interim remedies in December through June, and also restrict fall exports

Based on the SBA Contractors' Table A share of the overall SWP Table A allocations, the SBA Contractors could receive about 900 AF to 1,900 AF in an average year In critically dry and multiple dry years, no Article 21 water is projected to be available For wet years, about 2,500 AF to 5,000 AF of Article 21 water could be available to the SBA Contractors

The uncertainties associated with receiving Article 21 water make it a less reliable supply for the Del Valle Reservoir alternatives

Purchased Supply

The SBA Contractors could also purchase additional water to supply the Del Valle Reservoir alternatives These purchases could be from willing sellers through the water transfer market, most water transfers are typically made available north of the Delta Water transfer availability is limited by conveyance capacity through the Delta and SBA capacity

Conveyance capacity through the Delta will be likely be limited, based on the biological opinion for delta smelt, which has similar provisions to the interim remedies, and additional restrictions in the fall Export restrictions to protect fish during the winter months would cause the SWP and CVP to shift export pumping from the winter and spring into the summer Historically, Jones Pumping Plant had capacity available in the late summer (July, August, and September) to move water for SWP Contractors, however, the SWP may need more of that capacity to move water associated with SWP supplies Most transfers would be made available based on the irrigation schedule – April through September

The amount of water that could be transferred through the SBA is limited by the SBA capacity in Reaches 1 through 4 (430 cubic feet per second [cfs] after expansion - see Figure 4-4 for reach locations and capacities) less the SBA Contractors' entitlement capacity (267 cfs to 290 cfs) and some amount of SWP losses During years of reduced Table A deliveries, more capacity may be available if Semitropic Water Storage District returns are not at capacity

4.2.2 New Upper Del Valle Reservoir

The New Upper Del Valle Reservoir alternative would construct a new dam at the upper end of Del Valle Reservoir starting in the area of the existing East Bay Regional Park District (EBRPD) bridge, as shown on Figure 4-1 This configuration would create two separate reservoirs in the Arroyo Valle area The upstream reservoir would have fluctuating lake levels and be used for water supply, while the downstream reservoir elevations would be maintained during the summer for facility access Sites upstream of the bridge location were initially considered, but were deemed infeasible due to unstable ground and landslide potential and were not analyzed further Construction was assumed to last three seasons (CDM, 2001)

Two reservoir sizes were considered

- 10,500 AF 7,500 AF of available storage, 1,500 AF of emergency and dead storage, and 1,500 AF to replace a portion of the existing flood control pool for Del Valle Reservoir, and

- 15,000 AF 11,000 AF of available storage and up to 4,000 AF of emergency and dead storage

The New Upper Del Valle Reservoir was analyzed under two operational scenarios using its capacity for water supply or to offset flood control storage These operations would require different facilities for piping water, affecting the total alternative costs (see Section 4 3 1) If the reservoir is used for water supply, a pump station and pipelines would be required to move water from the existing Del Valle Reservoir into the new Upper Del Valle Reservoir Water would be released back into the existing reservoir during the summer as the supply is needed There would be no adverse effects on existing recreational facilities during the summer If the reservoir was filled with unregulated runoff from Arroyo Valle, ACWD and Zone 7 would be the water rights holders These agencies could potentially exchange water with or provide storage for SCVWD, as well, so that all three SBA Contractors could benefit from the new water supply

A new reservoir operated for flood control storage would allow Del Valle Reservoir to be maintained at a higher water level at the beginning of the summer, and then gradually drawn down during the later summer months No additional pumping or

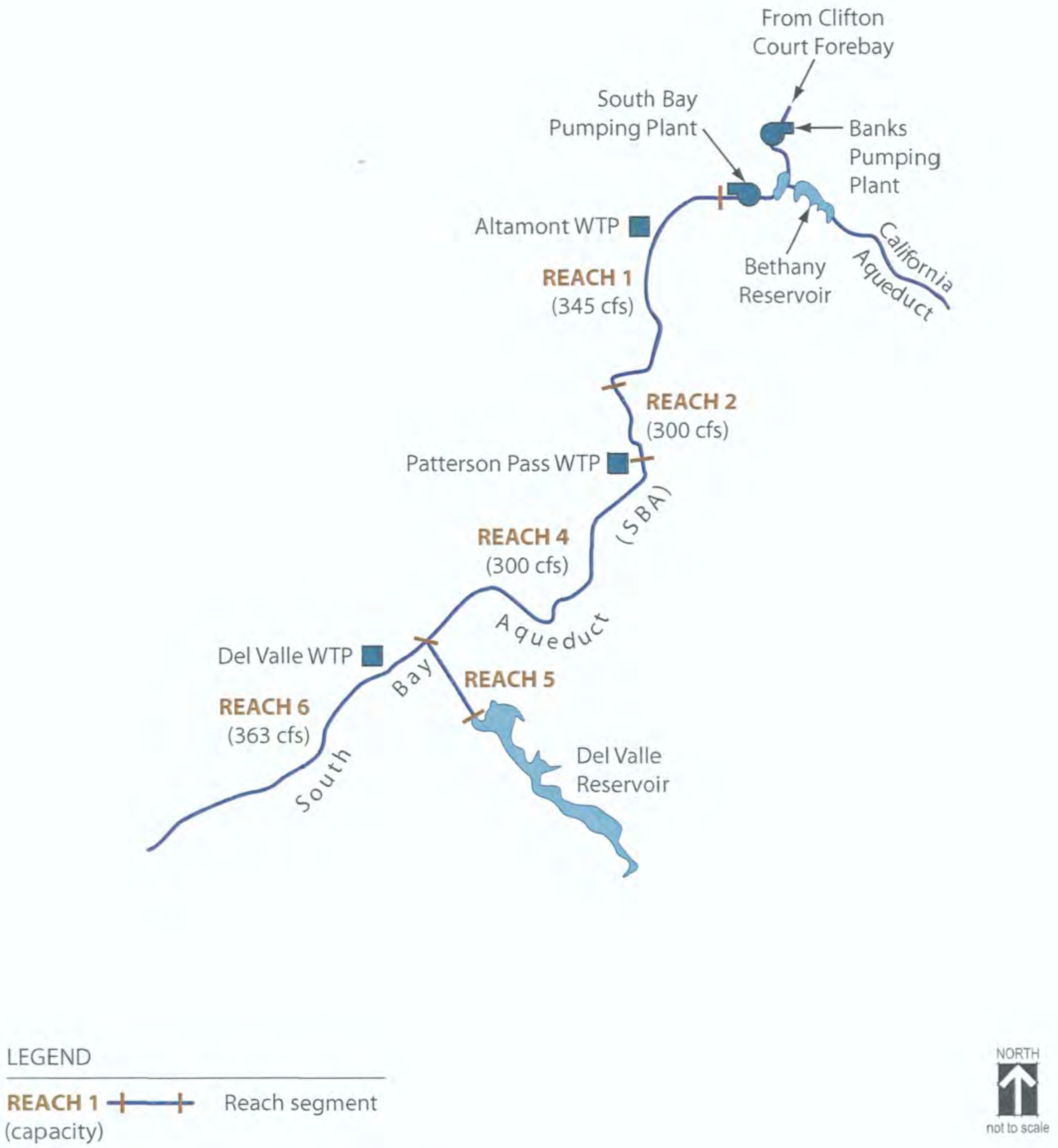

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Figure 4-4
South Bay Aqueduct Reach Capacities

piping would be required, but this operation would inundate existing recreational facilities.

Table 4-2 provides key information on the Upper Del Valle Reservoir alternatives.

Table 4-2
Upper Del Valle Reservoir Information

Item/Facility	10,500-AF Alternative	15,000-AF Alternative
Available Storage (AF)	7,500	11,000
Long-Term Yield (AFY)	150	700
Streambed Elevation (ft)	685	685
Height of Dam (ft)	142	160
Dam Crest Elevation (ft)	827	845
Spillway Crest Elevation (ft)	802	820
Type of Dam	Roller Compacted Concrete	Roller Compacted Concrete
New Pipeline	• Not required for use in flood control storage option. • 30-inch diameter, 6,000 feet, 32 cfs for storage option.	• Not required for use in flood control storage option. • 36-inch diameter, 6,000 feet, 46 cfs for storage option.
New Pump Station	• Not required for use in flood control storage option. • 550 horsepower (HP) for storage option.	• Not required for use in flood control storage option. • 800 HP for storage option.

To estimate the long-term yield for the two proposed Upper Del Valle Reservoir alternatives, a water balance model tracking reservoir inflow (the unregulated runoff from Arroyo Valle available from 1922 to 1978 and estimated in Section 4.1.1), evaporation loss, and withdrawals was constructed. The available storage used in the analysis was 7,500 AF for the 10,500-AF alternative and 11,000 AF for the 15,000-AF alternative. An example time history of the proposed Upper Del Valle Reservoir (for the 15,000-AF alternative) is presented in Figure 4-5 below. The simulated time

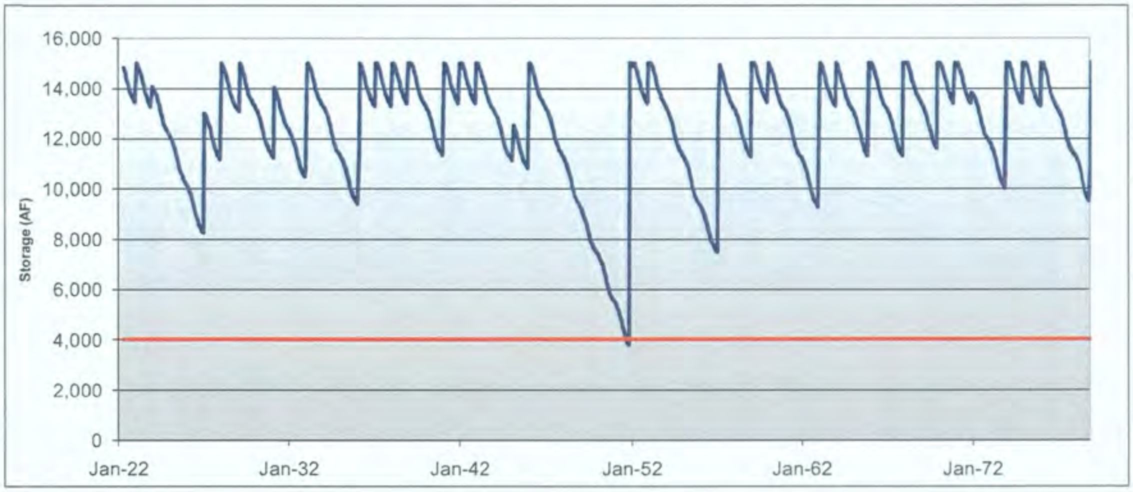

Figure 4-5
Storage Volume Time History of Proposed Upper Del Valle Reservoir Under Long Term Yield Withdrawal

history of reservoir volume shows a period of decline in the early 1950s triggered by a period of low inflow

Although unregulated flows were available from 1922 through 1998 for Arroyo Valle, estimates of available streamflow taking into account the existing reservoir operation were only available from 1922 to 1978 In the yield analysis for the Arroyo Mocho Reservoir site, which had streamflow estimates for the longer 1922 through 1998 period, the defining drought for the area was found to occur in the early 1990s, from approximately 1986 to 1995 To provide a conservative estimate for the yield of the Upper Del Valle Reservoir option, the yield calculated during the 1950s drought was adjusted based on the yields calculated for the Arroyo Mocho Reservoir for the 1950s and 1990s drought The adjustment took the form of a ratio of yield results

$$\text{Yield of Upper Del Valle based on 1990s drought} =$$

$$\frac{\text{Yield of Arroyo Mocho (1990s)}}{\text{Yield of Arroyo Mocho (1950s)}} * \text{Yield of Upper Del Valle (1950s)}$$

The long term yield, which is equal to the constant withdrawal rate that the proposed reservoir can sustain based on its available storage and inflow, was equal to 150 AFY and 700 AFY for the 10,500 AF and 15,000 AF alternatives, respectively All yield estimates provided in this report are based on the defining drought of the 1990s

4.2.3 Del Valle Mid-Reservoir Dam

Under the Del Valle Mid-Reservoir Dam alternative, a new dam would be constructed about three miles upstream of the existing dam to maintain higher water levels upstream for recreational purposes during the summer The proposed location is shown on Figure 4-1 This alternative would allow for more drawdown of the existing reservoir, but would eliminate access to the lower reaches of Del Valle Reservoir downstream of the new dam In the 2001 Study, the reservoir capacity between the new dam's spillway crest and the approximate lake bottom was estimated in the range of 5,000 to 7,000 AF The mid-reservoir dam would not create additional storage in the reservoir, but would allow for increased use of the existing (downstream) reservoir's storage, which is not currently available during the summer months (estimated to be less than 5,000 AF) Construction was assumed to last three seasons (CDM, 2001) No yield analysis was prepared for the Mid-Reservoir option Yields were assumed to be ½ of the Upper Del Valle 10,500 AF reservoir

Table 4-3 provides key information on the Del Valle Mid-Reservoir alternative

Table 4-3 Del Valle Mid-Reservoir Information	
Item/Facility	
Streambed Elevation (ft)	638
Height of Dam (ft)	65/135 (1)
Dam Crest Elevation (ft)	773 (2)
Spillway Crest Elevation (ft)	703
Type of Dam	Roller Compacted Concrete
New Pipeline	N/A
New Pump Station	N/A

(1) 65 feet high at center of streambed 135 feet at abutments
(2) Same as Del Valle Reservoir

4.2.4 Upper Basin Modifications to Del Valle Reservoir

Upper Basin Modifications would serve two purposes to improve boating access to the dock facilities during reservoir drawdown during later summer and early fall, and to provide some additional storage capacity to the reservoir Excavating the basin at the upper end of Del Valle Reservoir would assist with mitigation of reservoir drawdown from the use of Zone 7's additional SWP entitlement

Excavation would primarily occur in the upper 2,500 feet of the reservoir, where the rock floor beneath the bridge is at an elevation of 690 feet and deepens to 680 feet about 2,500 feet downstream Approximately 446,500 cubic yards (cy) of fine-grained material would be removed under these operations An additional 37,000 cy could be removed through dredging to create a low water access channel to the boat dock In the 2001 Study, this alternative was estimated to initially add about 375 AF of additional storage, however, that amount would decrease with time from gradual resedimentation of the basin (CDM, 2001) Yields were not estimated for this project due to the small storage volume of the project

4.2.5 New Arroyo Mocho Reservoir

The Arroyo Mocho Reservoir alternative would construct a new dam on Arroyo Mocho in a valley about two miles east of the downstream end of Del Valle Reservoir (see Figure 4-1) Three sites were initially considered for the Arroyo Mocho, but two were deemed infeasible due to poor geologic conditions The site chosen is just north of the junction of Mines Road and Del Valle Road A portion of Mines Road would be relocated around the eastern side of the reservoir, and access to Del Valle Reservoir would be provided by a road across the dam Construction was assumed to require three construction seasons (CDM, 2001)

Two reservoir sizes were considered

- 9,000 AF 7,500 AF of available storage and 1,500 AF of emergency and dead storage, and

- 15,000 AF 11,000 AF of available storage and up to 4,000 AF of emergency and dead storage

The Arroyo Mocho Reservoir was designed to receive and store water from the SBA during the winter, and then meet peak summer demands by releasing water in to the SBA or Zone 7's proposed In-Valley Conveyance facilities A new pipeline would be required from SBA south to the reservoir, and could be extended north to the In-Valley Conveyance system Because of an elevation difference of 145 to 170 feet (depending on the size of the reservoir), pumping would be required to move the water from the SBA to the reservoir During the summer releases, the stored water would flow by gravity to the SBA or In-Valley Conveyance system Since the 2001 Study, the proposed In-Valley Conveyance system was removed from Zone 7's CIP and is no longer planned for completion Therefore, the Arroyo Mocho Reservoir would be considered only with a connection to the SBA

Table 4-4 provides key information on the Arroyo Mocho Reservoir alternatives

Table 4-4
Arroyo Mocho Reservoir Information

Item/Facility	9,000-AF Alternative	15,000-AF Alternative
Available Storage (AF)	7 500	11,000
Long-Term Yield (AFY)	800	1,300
Streambed Elevation (ft)	740	740
Height of Dam (ft)	140	180
Dam Crest Elevation (ft)	880	920
Spillway Crest Elevation (ft)	850	890
Type of Dam	Earth fill	Earth fill
New Pipeline	30-inch diameter 7 500 feet, 32 cfs	36-inch diameter, 7,500 feet, 46 cfs
New Pump Station	650 HP	1 100 HP

A reservoir water balance model was prepared for the proposed Arroyo Mocho Reservoirs similar to the Upper Del Valle analysis to estimate the long-term yield for the two alternative reservoir sizes The water balance model tracks reservoir inflow (the Arroyo Mocho monthly runoff estimated in Section 4 2 1 was used as reservoir inflow), evaporation loss, and withdrawals In-stream releases were not included in the reservoir water balance, so the resulting yield should be considered an upper bound estimate Any required releases will reduce the yield available from the reservoir The available storage used in the analysis was 7,500 AF for the 9,000-AF alternative and 11,000 AF for the 15,000-AF alternative The long term yield, which is equal to the constant withdrawal rate that the proposed reservoir can sustain based on its available storage and inflow, was equal to 800 AFY and 1,300 AFY for the 9,000-AF and 15,000-AF Arroyo Mocho Reservoir alternatives, respectively The larger yields from these proposed reservoirs compared to Upper Del Valle is primarily due to the more consistent inflow available in Arroyo Mocho compared to the intermittent unregulated runoff available to Upper Del Valle Reservoir An example time history of the proposed Arroyo Mocho Reservoir (for the 15,000-AF alternative) is presented in Figure 4-6 below. The simulated time history of reservoir storage shows the defining drought occurred in the early 1990s. The yield analysis for Arroyo Mocho Reservoir based on the 1950s and 1990s drought was used to adjust the yield for the Upper Del Valle Reservoir option, which was characterized using the 1950s drought. This adjustment is discussed in Section 4.2.2 above.

Figure 4-6
Storage Volume Time History of Proposed Arroyo Mocho Reservoir Under Long Term Yield Withdrawal

4.2.6 Re-operation of Del Valle Reservoir

Del Valle Reservoir was designed to store local runoff and transfers from the SBA during the winter and spring, and release water to the SBA in the summer to help meet peak summer demands. The reservoir is currently drawn down to 680 feet during the winter and spring months to create space for collecting local runoff, SBA transfers, and flood control. During the summer months, the reservoir elevation is currently maintained at 703 feet for recreational purposes. The re-operation of Del Valle Reservoir would involve an increase in the allowable operating range of the reservoir. Increasing the allowable summer reservoir levels would increase the volume available to capture spring runoff (CDM, 2001).

Maintaining a summer reservoir level higher than the current 703 feet would necessitate the relocation of recreational facilities. Details on the impacted facilities and the cost of site relocation are discussed in Section 4.2.2. By increasing the allowable reservoir elevation during the summer months to 710 feet, the SBA Contractors would have 5,000 AF of additional water supply storage, for a total of 45,000 AF, to offset summer demands (see Figure 4-7).

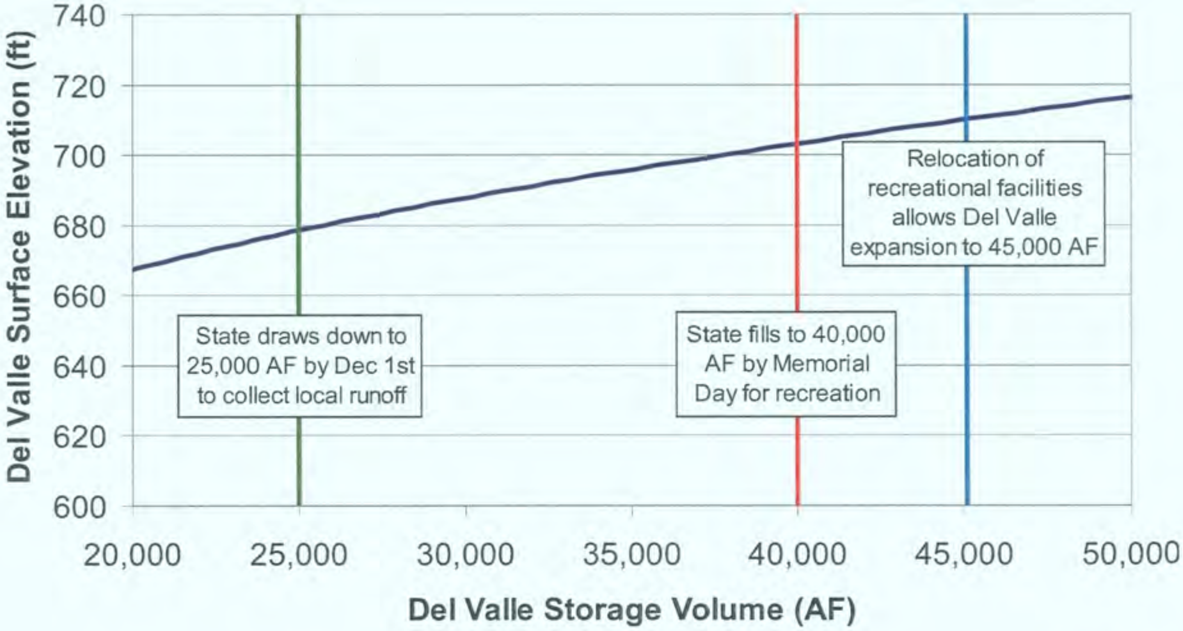

Figure 4-7
Storage-Elevation Curve for Del Valle Reservoir

The value of the additional 5,000 AF of storage in Del Valle Reservoir is dependent on the availability of water to fill the reservoir, either with natural runoff into Del Valle Reservoir or from the other potential sources discussed in Section 4.2.1. As shown on Figure 4-1, the possibility of having greater than 5,000 AF per year of runoff is predicted more than 40% of the time. Given the annual variation in runoff, the additional reservoir storage could also be used to store smaller amounts of surplus runoff over a number of years. Yield was not directly estimated for this alternative, but was estimated to be ½ of the 10,500 AF Upper Del Valle Reservoir alternative.

4.3 Evaluation

Updated cost estimates for each of the Del Valle Reservoir alternatives were developed based on details from the 2001 Study for reservoir construction, environmental mitigation, and necessary pipelines and pump stations. Significant implementation issues (geotechnical, environmental, and recreation) and the next steps necessary to resolve the issues for each alternative were also analyzed. Table 4-1 summarizes this evaluation for each alternative.

4.3.1 Alternative Costs

Each alternative includes conceptual-level capital costs for reservoir construction, environmental mitigation, pipelines, and pump stations. Detailed cost estimates for these alternatives were prepared in the 2001 Study, and have been updated to year

CDM

2008 costs Cost and facility information is summarized in Table 4-4, and detailed tables are found in Appendices D through G

The capital costs for the reservoirs includes mobilization/demobilization, care and diversion of water, dewatering of foundations, reservoir clearing, dam embankment, spillway, outlet works, allowance for lands, and land purchase costs for environmental mitigation CDM's construction cost estimators updated the unit costs to 2008 dollars The reservoir capital costs include engineering, legal and client administration costs at 27% of construction costs, plus a 35% contingency The detailed capital costs are included in Appendix D

Preliminary pipe and pump station sizing was based on the total storage utilized, the duration of seasonal use, calculated flow, and required horsepower to move water to the reservoir facilities (as presented in the 2001 report) The detailed pipeline and pump station information, including unit costs, is included in Appendix E

The environmental mitigation costs were initially prepared in the 2001 Study and this study uses the same assumptions Appendix F includes backup for the environmental mitigation costs

Table 4-5 presents conceptual-level capital costs and unit costs for the Del Valle Reservoir storage alternatives, in 2008 dollars Unit costs assume 5 percent cost of money for financing the project capital costs, operating and maintenance costs of 1 percent of total capital costs, and yields as discussed in Section 4 2

Table 4-5
Capital Costs for Del Valle Reservoir Alternatives

Alternative	Reservoir Capacity (AF)	Operational Option	Reservoir ($m)	Pipeline ($m)	Pump Station ($m)	Environmental Mitigation ($m)	Total [1] ($m)	Unit Cost ($/AFY)[2]
Upper Del Valle Reservoir	10 500	Water Supply	$77 2	$4 0	$2 3	$3 4	$86 9	$44,000
		Flood Control Storage	$77 2	$0 0	$0 0	$3 4	$80 6	$40,000
	15 000	Water Supply	$104 1	$4 9	$2 9	$3 4	$115 3	$12 300
		Flood Control Storage	$104 1	$0 0	$0 0	$3 4	$107 5	$11 500
Del Valle Mid-Reservoir Dam	less than 5 000	--	$104 6	$0 0	$0 0	$0 0	$104 6	$105 000
Upper Basin Modifications	375	--	$10 8	$0 0	$0 0	$0 0	$10 8	--
Arroyo Mocho Reservoir	9 000	--	$110 0	$5 0	$2 5	$5 1	$122 6	$11 500
	15 000		$136 9	$6 1	$3 5	$6 1	$152 6	$8 800
Re-operation of Del Valle Reservoir	5 000	--	--	--	--	--	$20 9	$21 000

(1) For details of capital cost estimates see Appendices D E F and G
(2) Annual recovery costs for project financing computed using interest rate of 5% and 30-year payback period

In the 2001 Study, the Arroyo Mocho Reservoir alternative was screened out of analysis because of its expense and because it provided no additional supply benefits over the less expensive Upper Del Valle Reservoir alternative In 2008, Arroyo Mocho Reservoir remains more expensive than Upper Del Valle Reservoir, and the most expensive of all alternatives at about $123 million to $153 million, depending on size The 9,000-AF Arroyo Mocho reservoir is 41% to 52% more expensive than the Upper Del Valle 10,500-AF alternatives, depending upon operational option The 15,000-AF Arroyo Mocho option is 33% to 42% more expensive, depending upon operational option, than the same size reservoir at Upper Del Valle While the unit cost for storage on Arroyo Mocho is less than projects at Upper Del Valle site, in-stream releases have not been accounted for in yield estimates, so the unit costs are estimated to be a lower-bound value

In 2001 Study, the Mid-Reservoir alternative cost was nearly as expensive as the Upper Del Valle Reservoir alternative In 2008, the Mid-Reservoir cost is consistent with the low range for the Upper Del Valle Reservoir 15,000-AF option (about $105 million), however, this alternative has the highest unit cost per AF of yield at over $100,000/AFY

The smaller Upper Del Valle Reservoir has the lowest costs of any of the new reservoir options, ranging from about $81 million to $87 million However, the unit cost is high, due to the low yield The Upper Basin Modifications are the least costly of all at only $11 million However, this project only provides 375 AF of storage capacity (a yield was not estimated) The storage volume would likely decrease with time due to sedimentation

Increasing the operational range of Del Valle Reservoir will necessitate relocation of multiple recreational facilities Raising the maximum operational reservoir elevation to 710 feet, representing a storage volume increase of 5,000 AF, is expected to cost about $21 million to address impacts to the Arroyo Mocho and Rocky Ridge areas of the Del Valle Reservoir A detailed cost breakdown is included in Appendix G

4.3.2 Implementation Issues

In the 2001 Study, environmental issues were evaluated by Environmental Science Associates and geotechnical issues were evaluated by Doug Hamilton and Kenneth King This information has been summarized below

Geotechnical Issues

Upper Del Valle Reservoir

There is a significant seismic hazard at the Upper Del Valle Reservoir dam site due to the presence of the Williams Fault less than one mile away This fault has a median peak ground acceleration (pga) of 0 5 g However, Hamilton & King's 2001 review found that previous analysis of other similarly constructed dams with downstream slopes comparable to the conceptual design for this damn showed that stresses due to pga in the range of 0 4 to 0 7 g in the dams would not exceed currently allowable limits

Del Valle Mid-Reservoir Dam

The Del Valle Mid-Reservoir Dam has the same geotechnical issues as described for the Upper Del Valle Reservoir

Upper Del Valle Reservoir

Upper Basin Modifications to Del Valle Reservoir would not be affected by the seismic hazards described above for the Del Valle dam alternatives Construction implementation issues primarily consist of spoils disposal Opportunities for either temporary or permanent disposal of fine-grained sediment removed from the upper basin are limited within the immediate Del Valle Reservoir area However, there could be suitable space identified within the boundary of the Del Valle Regional Park or in an adjacent ranch

Arroyo Mocho Reservoir

Sediments in the valley slopes upstream of the Arroyo Mocho Reservoir are unstable and prone to landslides The entire southernmost slope of the valley extending upstream from the dam site consists of a landslide complex The potential effect of flooding the lower margins of the slide complex will have to be carefully evaluated if the reservoir alternatives move forward

The seismic hazards at the Arroyo Mocho dam sites are significant For the 2001 conceptual design, the materials in the dam foundation were assumed to be excavated primarily to reduce the potential for liquefaction The dam embankment is susceptible to both transverse and longitudinal cracking and settlement Seiches could occur with the reservoir Slumping of the Arroyo Mocho reservoir slopes could also occur

Re-operation of Del Valle Reservoir

There are no geotechnical implementation issues with the re-operation of Del Valle Reservoir

Environmental Issues

Upper Del Valle Reservoir

The Upper Del Valle Reservoir alternatives would inundate up to 259 acres, including some private parcels, state park land, and agriculture under the Williamson Act There would be significant riparian habitat loss through the 2 5 miles of riparian corridor affected The reservoir area is habitat for the California red-legged frog, California tiger salamander, San Joaquin kit fox, and potentially the Alameda whipsnake There would be low to moderate potential for disturbance to cultural resources in the area A site-specific cultural resource survey and monitoring would likely be needed The 140- to 160-foot dam would be a significant visual impact from adjacent recreational areas and trails

The upper reaches of the existing Del Valle Reservoir were identified as having siltation issues, more so than towards the middle of the reservoir An Upper Del Valle Reservoir would likely have similar issues given it extends further upstream

DWR would be the lead agency on acquiring additional land and approving the Upper Del Valle Reservoir and Arroyo Mocho Reservoir These alternatives would require permits or authorizations from the U S Corps of Engineers (individual permit), U S Fish and Wildlife (Section 7 consultation for the Endangered Species Act), California Department of Safety of Dams (DSOD), and potentially a Habitat Conservation Plan A lengthy environmental process would be expected

Del Valle Mid-Reservoir Dam

The Del Valle Mid-Reservoir area is habitat for the California red-legged frog, California tiger salamander, and various raptors Similar to the Upper Del Valle Reservoir, there would be low to moderate potential for disturbance to cultural resources in the area Although somewhat lower than the Upper Del Valle dam, the 65- to 135-foot dam would have a significant visual impact to downstream users The same permitting issues would apply to the Mid-Reservoir Dam as apply to the Upper Del Valle Reservoir

Upper Basin Modifications to Del Valle Reservoir

The Upper Basin Modifications to Del Valle Reservoir would result in dredging disturbances during construction, including excavation, hauling, possible sand and gravel processing, and spoils placement The construction would alter the bathymetry of the lake bed, channel transition, and vegetation The same habitat and cultural resources effects as for the Mid-Reservoir dam could be expected for the basin modifications alternative This alternative would require all the same permits as the Upper Del Valle Reservoir except for the DSOD permit

New Arroyo Mocho Reservoir

The Arroyo Mocho Reservoir alternatives would inundate about 240 acres, including private parcels and agriculture under the Williamson Act There would be significant upland habitat loss for the California red-legged frog, California tiger salamander, San Joaquin kit fox, burrowing owl, and various raptors Arroyo Mocho is also one of the best potential steelhead, a federally listed (threatened) species, spawning and rearing habitats in the Alameda Creek Watershed, if migration barriers are removed in lower reaches of the watershed Zone 7's 2006 Stream Management Master Plan identifies Arroyo Mocho as part of the primary steelhead migration corridor for plan's study area The National Marine Fisheries Service would be involved in the Section 7 consultation on endangered species (Zone 7, 2006)

The cultural resources and visual effects would be similar to that of the Upper Del Valle Alternative This alternative would require all the same permits as the Upper Del Valle Reservoir

Re-operation of Del Valle Reservoir
Re-operation of Del Valle Reservoir would result in loss of fringe riparian habitat for the California red-legged frog and California tiger salamander There would be potential for inundation of additional cultural resources in the reservoir area, which may require mitigation With the increased use of available supply in the reservoir, there would be periodic reductions in flood control capacity This alternative would require permits or authorizations from the U S Corps of Engineers (Re-Operation Study and Authorization) and DWR

Recreation

New Upper Del Valle Reservoir
This alternative requires relocation of the Arroyo Valle Campground facilities presently located upstream of the proposed dam, and rerouting of Del Valle Road

Del Valle Mid-Reservoir Dam
This alternative would divide the existing Del Valle Reservoir, limiting access to the northern end of the lake There could be potentially significant impacts on boating and water recreation

Upper Basin Modifications to Del Valle Reservoir
This alternative improves boating access to the dock facilities during reservoir drawdown during late summer and early fall

New Arroyo Mocho Reservoir
This alternative requires relocation of a portion of Mines Road, the access road to Del Valle recreation area, and utilities

Re-operation of Del Valle Reservoir
Re-operation of Del Valle Reservoir area would have temporary impacts to recreation with the increase in reservoir elevation expected in the spring and early summer months This alternative may require construction of new recreation facilities in the northern part of the reservoir, intensifying recreational uses and altering the undeveloped nature of the north shore area

The following paragraphs indicate the resulting impacts on recreational facilities located near the reservoir waterline when the reservoir is maintained at elevations greater than 703 feet

Reservoir WSE 705 feet (Increase of 1,300 AF)
As the reservoir level increases to 705 feet, the beach at Rocky Ridge is inundated with water

Reservoir WSE 706 feet (Additional Increase of 700 AF)
Arroyo Mocho is impacted by the increasing water level when the reservoir reaches 706 feet At this point, the water covers approximately 500 feet of pathway and portions of the irrigated lawn northwest of cabanas 17 and 18 At the Rocky Ridge

beach area, the water has completely covered the beach and has begun to cover the some of the curb and part of the lawn

Reservoir WSE 707 feet (Additional Increase of 800 AF)
At a water surface elevation of 707 feet, more of the Arroyo Mocho pathway and irrigated lawn are under water with the cabana 17/18 pads under water In addition, the Arroyo Mocho sewer manhole rim elevation is located at 707 94 feet At Rocky Ridge, the curb separating the sand from the lawn is completely covered while the lawn continues to be inundated with water

Reservoir WSE 708 feet (Additional Increase of 700 AF)
At 708 feet, the cabanas at Arroyo Mocho are under water, the pathway and irrigated lawn continue to be flooded, and the some of the picnic area is under water At Rocky Ridge, water continues to cover the lawn In addition, the drainage swale at the Family Campground is beginning to pond at expansion site 3

Reservoir WSE 709 feet (Additional Increase of 800 AF)
Increasing storage to 709 feet will completely flood the Arroyo Mocho picnic area and soak the Rocky Ridge area In addition, one of the manholes at Rocky Ridge has a rim elevation of 709 51 feet

Reservoir WSE 710 feet (Additional Increase of 700 AF)
At 710 feet, the cabanas at Arroyo Mocho are under two feet of water and approximately 50 percent of the irrigated lawn is under water The lawn area at Rocky Ridge also continues to go under water with almost full inundation at 710 feet The rim elevations for the manholes are slightly above 710 feet More ponding occurs at this elevation at the Family Campground, specifically in the North Expansion Area and the Phase 2 area

Other miscellaneous facilities are affected by increasing the water elevation from 705 to 710 feet These impacts included water covering

- 1500 to 2500 feet of Service Trail from the boat ramp toward the dam
- 500 feet of the Tunnel Service Trail
- Two sewer lift stations and underground utilities
- Sewer lift station and holding tank by the amphitheater

4.3.3 Next Steps

New Upper Del Valle Reservoir

If the Upper Del Valle Reservoir is chosen for further consideration, the SBA Contractors should investigate the feasibility of gaining additional water rights to Arroyo Valle, conduct more detailed study into the potential availability of Article 21 water, and investigate opportunities for purchasing additional water, or making use of existing contracts, as options for the supply source for the reservoir In additional, the following geotechnical investigations should be performed to obtain a greater level of detail than was prepared for the conceptual assessment

1 Evaluate the depth of necessary excavations (especially in the right abutment ridge), grouting requirements, and seepage at the dam foundations and foundations for the river diversion cofferdams The depth of dam foundation excavations will greatly affect the construction cost This information can also be used to evaluate the selection of an earthfill or roller-compacted concrete (RCC) dam

2 Investigate location, available volume, and suitability of the local borrow materials to be used for RCC materials or embankment materials

3 Evaluate excavations in the reservoir for slope stability, erosion, and seepage The sand and gravel in the arroyo and in the reservoir near the site will be particularly useful to the alternative regardless of the type of dam that is selected

Del Valle Mid-Reservoir Dam

In future studies, the capacity of the reservoir should be evaluated in detail, and modifications of the capacity and elevations could be required to meet alternative objectives or regulatory requirements Also, further calculation should be performed to determine the amount of supply that could be used in the existing reservoir under the new operation scenario, and also the potential source of supply

If the Del Valle Mid-Reservoir Dam is chosen for further consideration, the following geotechnical investigations should be performed, along with those listed above for Upper Del Valle Reservoir

- For the river diversion, 1) perform geotechnical investigations to characterize the depth and type of alluvium materials and underlying Panoche Formation, 2) topographic mapping, 3) develop alternatives for dewatering foundations and selection of optimum alternative, 4) coordinate with EBRPD to provide for lowered reservoir water levels during the investigation and during construction

- Perform hydrologic and hydraulic studies for the spillway, outlet works, and river diversion

Upper Basin Modifications to Del Valle Reservoir

If the Upper Basin Modifications is chosen for further consideration, the SBA Contractors should investigate the supply source options discussed for Upper Del Valle Reservoir (Section 4 2 1), though the supply needs would be much less In additional, the following the following geotechnical investigations should be performed to obtain a greater level of detail than was prepared for the conceptual assessment

- Survey the basin form
- Conduct a drilling and sampling exploration program to establish the thickness, volume, material characteristics, and internal makeup of the surficial deposits subject to removal

New Arroyo Mocho Reservoir

If Arroyo Mocho is considered for further evaluation, the SBA Contractors should investigate opportunities for water rights to Arroyo Mocho as the source of supply for the reservoir, along with the supply options considered for Upper Del Valle Reservoir (see Section 4 2 1) The following geotechnical investigations should also be conducted, along with numbers 2 and 3 identified for the Upper Del Valle Reservoir

- Investigate depth and character of the dam embankment foundations and other hydraulic structures for bearing capacity, stability, liquefaction potential, and seepage conditions
- Evaluate slope stability and erosion potential to determine need for mitigation measures such as blanketing of the reservoir slopes The potential for destabilizing the large slide complex along the southwest slope of Arroyo Mocho will require special evaluation, both with regards to reservoir stability and because the access road to Del Valle Regional Park crosses the slide
- Perform hydrologic and hydraulic studies for the spillway and outlet works

Re-operation of Del Valle Reservoir

The supply source issues discussed under Section 4 2 1 would also need evaluation for the re-operation of Del Valle Reservoir The extent of modification of Del Valle Reservoir operation will depend on the acceptable costs for recreation mitigation Recreational needs and the feasibility of moving specific recreational areas should be further evaluated if this alternative is moved forward Also, the SBA Contractors would need to evaluate whether re-operation would have an adverse affect on the flood control capabilities of the reservoir If the unregulated runoff is used as the source of supply, that additional water would accumulate in the reservoir during the typical flood control season, thereby reducing the flood control capacity of the reservoir This issue would need to be discussed and evaluated with DWR

Section 5
Other Alternatives

This section presents information on a number of other water supply projects that the South Bay Aqueduct (SBA) Contractors (Zone 7 Water Agency [Zone 7], Alameda County Water District [ACWD], and Santa Clara Valley Water District [SCVWD]) may consider as part of their supply strategy

5.1 Introduction

The alternatives include surface storage projects, desalination, and groundwater banking Figure 1-1 shows the locations of these projects The information presented is based on existing, available documentation, with updates of project costs to 2008 dollars performed by CDM

The projects include the following

- Bay Area Regional Desalination Project (BARDP)
- Delta Diablo Sanitation District (DDSD) Desalination Project
- Sites Reservoir
- Temperance Flat Reservoir
- Semitropic Stored Water Recovery Unit (SWRU)

Several of the projects involve the use of existing or new connections or exchanges with other agencies to deliver water to the SBA Contractors These potential interconnection locations are shown on Figure 5-1 and discussed in more detail in the project descriptions

Potential delivery options include

- Exchange with Contra Costa Water District (CCWD) or with CCWD through Byron-Bethany Irrigation District (BBID),
- Existing interconnections between East Bay Municipal Utility District (EBMUD) and Dublin-San Ramon Services District (DSRSD),
- New interconnection between EBMUD and Zone 7 transmission facilities,
- Existing EBMUD/San Francisco Public Utilities Commission (SFPUC) and SFPUC/SCVWD emergency interties

Several additional projects are discussed in Section 5 7 These are projects for which there was insufficient detail to include in the Delta Water Supply Reliability Study, but that the SBA Contractors may want to track in the future

5.2 Bay Area Regional Desalination Project

CCWD, EBMUD, SFPUC, and SCVWD are jointly evaluating the BARDP to provide an additional water supply to their customers in the Bay Area Information was obtained from the *Bay Area Regional Desalination Project Feasibility Study* (URS, 2007)

5.2.1 Project Description

The BARDP will develop one or two desalination plants to produce reliable potable water The participating agencies would either directly receive desalinated water or exchange other water between them As originally planned, the BARDP would deliver up to 65 million gallons per day (mgd) to the agencies during dry years, emergencies, or maintenance periods The total plant treatment capacity was based on the agencies' annual dry year water needs, of which SCVWD's share was 10 mgd SCVWD's dry year supply would be 10,640 acre-feet per year (AFY) Under an emergency scenario, the project could provide all of its supply to any one of the agencies; up to a total of 69,200 AFY The plant could produce 25 mgd (up to 26,600 AFY) during wet years to supply other customers and reduce the plant's unit costs Annual supply estimates assume a 95 percent plant production factor Conveyance through adjacent systems would likely be limited to winter, or 11,000 AFY, assuming a 5-month window

During the 2007 feasibility study process, SFPUC re-evaluated its need for desalination water and increased its demand by 6 mgd, bringing the total project capacity to 71 mgd The feasibility study operation and conveyance studies have not been updated to reflect a total capacity of 71 mgd, but will be revised in the future

The BARDP evaluation process started in 2003 with the screening of 22 potential sites, narrowing those down to three sites The 2007 feasibility study screened and ranked combinations of location, operation, and conveyance scenarios according to six issues environmental, permitting, institutional/legal, cost, public perception, and reliability The highest performing configuration was a 65 mgd facility in the city of Pittsburg The plant would be co-located with the existing Mirant Power Plant, along the confluence of the Sacramento River, New York Slough, and the San Joaquin River The power plant has a permitted annual average daily flow of 658 mgd

Under the dry year operational scenarios, SCVWD would not receive desalinated water directly from the plant, but would take 10 mgd through the EBMUD/SFPUC intertie[1] and SFPUC/SCVWD emergency intertie[2] (after wheeling through EBMUD's

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[1] The EBMUD/SFPUC intertie includes a pump station located at the Hayward Executive Airport, along with valving and piping allowing up to 30 mgd to be conveyed in either direction between EBMUD and SFPUC Water is delivered to the SFPUC system at Newark Valve Lot on the Bay Division Pipelines 1 and 2 that convey water across San Francisco Bay

W:\REPORTS\Zone 7\Delta Water Supply Reliability Study Draft_09\Graphics\Interconnection Locations Fig 5-1.ai 04/01/09 JJT

CDM

Figure 5-1
Interconnection Locations

Mokelumne Aqueduct and distribution system) or through a Delta transfer with CCWD Under the emergency operational scenario, SCVWD could receive 35 to 65 mgd through Delta transfers with CCWD (CCWD would receive water directly from the desalination plant) Without a Delta transfer, SCVWD would be limited to 30 mgd, based on the hydraulic capacity of the EBMUD/SFPUC and SFPUC/SCVWD interties

Zone 7 and ACWD were identified as potential customers for wet years, when the plant could be operated to bring down overall product water costs At the time of the 2007 BARDP feasibility study, Zone 7 did not have a need for additional supplies, but indicated it was open to economical methods to achieving greater supply reliability and improving water quality ACWD evaluated the possibility of using BARDP water during wet years and determined it was not necessary at the time ACWD's brackish groundwater desalination plant is contributing to their supply reliability needs (see Section 5 7 3)

Zone 7 and ACWD could potentially receive water from BARDP in the following ways

- *Delta transfer with CCWD* CCWD would take delivery of desalinated water, CCWD would reduce Delta pumping, and the State Water Project (SWP) could increase pumping by commensurate amounts The SBA Contractors would receive CCWD water via the SWP This would provide a way of increasing deliveries to the SBA Contractors without increasing net pumping in the Delta

- *Exchange of SBA supply with SCVWD* SCVWD would take delivery of BARDP supply rather than SBA supply via the existing EBMUD/SFPUC and SFPUC/SCVWD interties

- *EBMUD and DSRSD Interconnections* EBMUD has two emergency interconnections with DSRSD, a Zone 7 retail customer, both located on Alcosta Boulevard in Dublin One interconnection, located west of I-680, is supplied from EBMUD's San Ramon pressure zone, and has a hydraulic capacity of about 1 mgd The other, located east of I-680, is supplied from EBMUD's Amador pressure zone, and has a hydraulic capacity of about 2 to 3 mgd

  During an emergency, stub-outs to each purveyor are connected to interim above-grade piping and pumps for transferring water Both interconnections are limited by the hydraulic capacity of the EBMUD distribution system, being located in the vicinity of generally smaller-diameter piping at the southern extremity of the EBMUD system (CDM, 2003, WYA, 2005)

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[2] SFPUC and SCVWD have an intertie in Milpitas Water can be delivered to the SCVWD system to pipelines that serve Penitencia Water Treatment Plant from SFPUC's Bay Division Pipelines 3 and 4 The hydraulic capacity of the intertie is 40 mgd

- *New Zone 7 interconnection with EBMUD* This would require new conveyance facilities to connect Zone 7 transmission with EBMUD piping in the San Ramon pressure zone As part of a previous study (CDM, 2003), a potential interconnection between EBMUD and Zone 7 was evaluated The intertie was evaluated both for emergency use and as part of a potential conjunctive use project using the Zone 7 groundwater basin for storage Two potential intertie sizes were evaluated 14 mgd and 25 mgd Transfers could be made only when there is excess capacity in the EBMUD system, typically the winter and spring months from November through May

  For the project involving only an intertie for emergency use, a new pumping plant along with either a 27-inch (14 mgd) or 39-inch (25 mgd) pipeline would be constructed, connecting to large-diameter transmission in EBMUD's system in San Ramon Valley Boulevard, north of Bollinger Canyon Road Pipelines would connect to Zone 7's system in the vicinity of the Hopyard Pipeline and the Dougherty Pipeline Capital costs for the project were estimated at $18 million to $32 million in 2003 dollars

  A project incorporating conjunctive use included additional pipelines parallel to the Hopyard and Mocho Pipelines to deliver water to/from the Hopyard and Mocho wellfields, plus the installation of new wells for aquifer storage and recovery

For BARDP water received during normal and wet years to be usable, the SBA Contractors would need to bank water for subsequent extraction during dry years

5.2.2 Project Costs

CDM updated the costs for the BARDP's 65 mgd East Contra Costa site in 2008, based on project information presented in the 2007 feasibility study The total capital cost is $340 million in 2008 dollars Operations and maintenance (O&M) costs total $29 million per year The BARDP analysis assumed dry-year operation (1 out of 3 years), with a 95 percent plant factor, with O&M costs in wet years equal to 20% of dry year O&M costs, to maintain membranes Based on these assumptions, the unit cost would be $1,600/AFY, reflecting operation during dry years only Note that these costs do not include conveyance improvements, wheeling, and post-treatment These can be significant and will vary for each BARDP partner The unit cost for operation in all years would drop to $1,300/AFY

5.2.3 Implementation Issues

CCWD, EBMUD, SFPUC, and SCVWD would have to enter into a number of institutional agreements to implement the BARDP Key issues requiring agreements include facility ownership, operations, and maintenance, water supply distribution, water supply rights and entitlements, water banking, water capacity constraints, and pipeline design constraints The BARDP would require construction of interconnected pipelines and pump stations between partner agencies Water delivery through treated water pipelines from the East Contra Costa site would be limited to about 25 mgd, based on capacity of CCWD's Multi-Purpose Pipeline Hydraulic capacity is adequate for delivery through raw water pipelines

Should Zone 7 or ACWD participate, institutional agreements would likely be required with all of the partnering agencies

Recent desalination projects have had difficulty with permitting in California The BARDP would require a National Pollutant Discharge Elimination System (NPDES) permit and appropriative water right permit The East Contra Costa site may have more difficulty receiving an NPDES permit than the other considered sites Its interior San Francisco Bay location reduces water mixing, which could mean the plant's effluent may not be diluted as quickly as at other sites CCWD's existing water rights could be extended or transferred for a plant with a capacity less than 25 mgd Over that amount, additional water rights would be needed which would be difficult to obtain due to limited availability and large number of water uses that depend on San Francisco Bay water

5.2.4 Potential Operational Benefits with Existing Programs and Facilities

Semitropic Groundwater Banking Program

This project could potentially provide a supply source for replenishment of SBA Contractors' existing Semitropic Water Storage District (Semitropic) groundwater bank, or be used as a supply source in conjunction with a new banking program with the Semitropic SWRU

Water could be supplied to SBA Contractors during low seasonal demand periods in normal and wet years, when the project is not planned for use by current project sponsors, and capacity is more likely to be available to wheel through adjacent agency systems This would free SWP supply for delivery and storage in the groundwater bank

South Bay Pumping Plant Outage

This project could potentially provide supply to all three SBA Contractors during a South Bay pumping plant outage However, delivery would rely on exchange/use of intertie facilities with other agencies

Zone 7 Zone 7 could receive water from EBMUD via existing interties with DSRSD (3 mgd), or if an intertie is constructed between EBMUD and Zone 7 facilities (up to 25 mgd previously evaluated)

ACWD/SCVWD Both agencies could take delivery of up to 30 mgd via the EBMUD/SFPUC intertie - ACWD through exchange with SFPUC, and SCVWD through the SFPUC/SCVWD intertie

5.2.5 Next Steps

The BARDP is currently conducting a pilot study at the East Contra Costa site to test different pretreatment and treatment technologies, brine discharge quality, and entrainment avoidance technologies, and to develop design criteria After the pilot study is complete, a detailed site selection study is needed to identify a proposed site, preliminary layout, and conceptual engineering design for the facilities Additionally, hazardous waste and geotechnical investigations would be required for the selected site or sites, and a blending study would be needed to evaluate the potential water sources and water quality of any transfer waters

After organizational structure issues and contractual mechanisms are decided upon, the BARDP agencies would move on to environmental impact studies, permitting, and construction The 2007 feasibility study assumes the pilot program and site selection study will be completed in 2009, and construction could be completed in 2012 Given the time since the feasibility study was completed, CDM modified this estimate to 2013

5.3 Delta Diablo Sanitation District Desalination Project

The DDSD is developing a demonstration scale desalination plant, of 5 to 7 5 mgd (5,000 to 7,600 AFY assuming a 90 percent plant factor), to study the feasibility of a larger size plant of up to 50 mgd Information was obtained from the 2005 report, *Northern Contra Costa County Feasibility Level Desalination Facility Cost* (Delta Diablo Sanitation District, 2005)

5.3.1 Project Description

The DDSD desalination plant would be located at the DDSD treatment facility in Antioch and utilize either the City of Antioch or CCWD Mallard Slough intake Raw water would be delivered to the plant through existing unused pipelines which run between the Mirant Pittsburg and Mirant Antioch power plants Brine from the desalination process would be mixed with the DDSD treatment plant effluent and discharged through the existing DDSD outfall

The plant would be designed for brackish raw water and have a recovery rate of about 53 percent Plant output would depend on the level of total dissolved solids (TDS) in the raw water The recommended plant design will process TDS of 5,000 milligrams per liter (mg/L) When the TDS level is less than 1,500 mg/L, plant output would be about 7 5 mgd

Potential partners currently include CCWD and EBMUD, due to their proximity to the plant site and accessible infrastructure, however, DDSD is looking for other interested agencies The DDSD facility would require a connection to the 20-inch diameter Dow Chemical water supply line which connects to CCWD's Contra Costa Canal Through the Dow line, product water could be delivered to CCWD, and to the

EBMUD's Mokelumne Aqueduct, with the addition of a diversion structure and pump station Costs of the EBMUD connection have not been developed by DDSD

Water could be delivered to the SBA Contractors through exchange with CCWD or EBMUD, through the same interconnection options as outlined in Section 5 2 1 for the BARDP

5.3.2 Project Costs

DDSD's pilot plant would consist of three stages of treatment 9 4 mgd of microfiltration, 7 5 mgd of nanofiltration, and 5 0 mgd of reverse osmosis (RO) Based on this treatment and facility information presented in 2005 (R W Beck, 2005), CDM prepared a capital cost estimate using current unit rates for each stage of treatment The total capital cost estimate (in 2008 dollars) is $57 million

O&M costs are about $3 9 million per year, based on CDM's escalation of 2005 O&M costs The unit costs in 2008 dollars are about $1,300 to $1,900/AF with an initial 8 percent interest rate, and $1,000 to $1,500/AF with a 3 percent interest rate (discounted interest rate sited in R W Beck study), depending on the plant output (5 to 7 5 mgd) and assuming a 90 percent plant factor The plant would be able operate year-round in all years Note that these costs do not include conveyance improvements, wheeling, and post-treatment These can be significant, depending on final capacity and which agencies participate

When raw water has a TDS concentration of less than 1,500 mg/L, treated water suitable for municipal use could be produced without the RO process This would reduce costs by the energy and O&M expenses for RO treatment The amount of time this situation is exists is dependent upon which intake location is used

DDSD expects to pursue state grants and federal funding which could lower capital costs Also, if DDSD is able to negotiate an agreement to use excess heat from the adjacent Delta Calpine power plant, this could further reduce costs

5.3.3 Implementation Issues

The yield from the pilot project is relatively small, up to 7,600 AFY for all users This is about one third to one half of the estimated SBA shortfall of 13,000 to 24,000 AFY Wheeling agreements and construction of a new intertie would be required with EBMUD for water delivery to Zone 7 Wheeling agreements would be required with EBMUD and SFPUC for SCVWD and ACWD

No new water rights would be needed for the DDSD pilot plant Both proposed intake locations already have permitted water rights, including pre-1914 rights for the City of Antioch

It would be valuable for DDSD to coordinate with the Calpine power plant for either preheating of the RO feedwater through energy recovery in Calpine's cooling process, or for direct electrical service to the plant The latter would reduce RO treatment and facility energy costs

Given the location of the potential intakes, there is the potential for impingement and/or entrainment of larval and juvenile marine life, particularly for sensitive species in the Bay-Delta The plant would be designed with a positive barrier fish screen to reduce and avoid entrainment, but would likely require a high level of fisheries and water quality monitoring This could be reduced over time as concentrations of brine at the outfall are presented

5.3.4 Potential Operational Benefits with Existing Programs and Facilities

Semitropic Groundwater Banking Program

This project could potentially provide a supply source for replenishment of SBA Contractors' existing Semitropic groundwater bank, or be used as a supply source in conjunction with a new banking program with the Semitropic SWRU

Water could be supplied to SBA Contractors during lower seasonal demand periods in normal and wet years, when capacity is more likely to be available in adjacent agency systems This would free SWP supply for delivery and storage in the groundwater bank

South Bay Pumping Plant Outage

This project could potentially provide a small amount of supply to all three SBA Contractors during a South Bay pumping plant outage However, delivery would rely on exchange/use of intertie facilities with other agencies With the exception of the existing EBMUD/DSRSD 3 mgd connections, supply capacity, estimated at 6 to 7 5 mgd, would be the limiting factor for delivery during an outage

5.3.5 Next Steps

The 2005 Study had a project completion timeframe of three to five years Based on this previous estimate, CDM estimates construction could be completed as early as 2014

5.4 Sites Reservoir

Sites Reservoir is one component of the North-of-Delta Offstream Storage (NODOS) Investigation being conducted by the U S Bureau of Reclamation (USBR) and the California Department of Water Resources (DWR) The investigation is studying offstream surface water storage projects in the Upper Sacramento River Basin that could meet three goals improve water supply and reliability, enhance anadromous fish survival, and provide high quality water for municipal and industrial, agricultural, and environmental uses The 2006 Initial Alternatives Information Report (IAIR) identified three focus areas for alternative development environmental, water quality, and water supply The upcoming Plan Formulation Report will study alternatives which combine Sites Reservoir with conveyance options, groundwater storage, anadromous fish survival measures, and different operational benefits (U S Bureau of Reclamation and California Department of Water Resources, 2006)

The study is one of five surface studies recommended in the CALFED Programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) Record of Decision, which also includes the Los Vaqueros Expansion and the Upper San Joaquin River Basin Storage Investigation Sites Reservoir is part of Governor Schwarzenegger's comprehensive water infrastructure proposal for California

5.4.1 Project Description

Sites Reservoir would be located in Colusa County, near the town of Maxwell, and would store up to 1 8 million AF The largest reservoir size would require construction of two 300-foot dams and nine saddle dams along the southern edge of the Hunters Creek watershed Potential supply sources include diversion from the Colusa Basin Drain, the Sacramento River, and local tributaries Conveyance options for the reservoir include using existing canals and infrastructure, building a new pipeline and intake on the Sacramento River, or a combination of the two (U S Bureau of Reclamation and California Department of Water Resources, 2006)

The overall NODOS program could be managed with an emphasis on water quality, environmental benefits, and/or water supply Depending on the operational focus, the yield for water supply would vary In September 2008, DWR staff indicated the estimated yields for water supply had been refined since the IAIR was completed in 2006 DWR assumes that the Metropolitan Water District of Southern California (MWD) will take some of the project's water, though MWD has been hesitant to discuss supply needs DWR has had difficulty getting other agencies involved in the project to this point, likely because the costs are so high This has made quantifying supply benefits difficult (Rasmussen, 2008a)

DWR provided data from preliminary Calsim II operation studies for the reservoir[3] The average annual yield for water supply ranges from 189,000 AFY to 368,000 AFY depending on the NODOS scenario (water supply focus, water quality focus, ecosystem restoration focus, or multi-purpose focus) Supply yield includes supply for local, SWP and Central Valley Project (CVP) users The yield for SWP contractors ranges from 75,000 AFY under the ecosystem focused scenario to 163,000 AFY under the multi-purpose scenario The average annual yield for water supply under the driest periods of the hydrologic record ranges from 142,000 AFY (ecosystem focus) to 317,000 AFY (water supply focus) The dry year yield for SWP contractors ranges from 55,000 AFY under the ecosystem focused scenario to 168,000 AFY under the multi-purpose scenario Other water supply beneficiaries include the CVP, local users (Tehama-Colusa Canal Authority), level 4 water supplies for wildlife refuges, and the Environmental Water Account (EWA) or an equivalent program If the SBA Contractors share the SWP portion of water supply based on their Table A portion

[3] DWR has not yet performed modeling to incorporate potential flow restrictions due to the Wanger decision into estimates of annual average yield

(5 3%), they could receive an annual average supply of 4,000 to 8,600 AFY, and a dry yield supply of 2,900 to 8,900 AFY (Rasmussen, 2008b)

5.4.2 Project Costs

Costs for the Sites Reservoir have been increasing as the project has moved through the feasibility study process In a DWR Frequently Asked Questions (FAQ) brochure available in September 2007, the costs were estimated at $2 3 to $3 2 billion This cost includes reservoir and other improvements in upstream facilities, depends upon conveyance options, includes capital costs for construction, engineering, administration, environmental compliance and mitigation, legal, real estate, and contingencies (Department of Water Resources, 2007a)

In September 2008, DWR provided CDM its cost estimate for the Sites Reservoir of $2 6 to $3 6 billion The cost range represents two options for conveyance The lower estimate does not include a pipeline that would divert water and allow DWR to deliver water back to the Sacramento River In this case, the project would rely on existing canals and reoperating Lake Oroville and Shasta Lake Without this pipeline, there would be fewer overall project benefits (Rasmussen, 2008b)

O&M costs for operations, maintenance, and power would range from $11 to $22 million per year, based on an escalation of costs provided in DWR's September 2007 FAQ (Department of Water Resources, 2007a) Using the range of capital and O&M costs and total average annual yield (for water supply, water quality, and ecosystem benefits), unit costs are estimated to be $230 to $430/AFY, for an average of $330/AFY This assumes that all project uses (water supply, water quality, and ecosystem restoration) share the total costs proportionally, where water supply is approximately 40 to 45 percent of the long-term average yield If water supply users were to pay 90 percent of the project costs, the unit costs would rise to $350/AFY to $1,000/AFY for the water supply yield

5.4.3 Implementation Issues

Besides providing additional water supply, the overall NODOS project objectives include anadromous fish survival, water quality improvement for ecosystem restoration, hydropower generation, recreation opportunities, and flood control under all scenarios These multiple project objectives could complicate water supply delivery Other supply reliability options exist for the SBA Contractors with projects that are in the local area, where the agencies could have more control and input into operations

Due to the involvement of both USBR and DWR, and the size of the project, Sites Reservoir would be more of a long-term water supply option for the SBA Contractors

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5.4.4 Potential Operational Benefits with Existing Programs and Facilities

Semitropic Groundwater Banking Program

This project could potentially provide a supply source for replenishment of SBA Contractors' existing Semitropic groundwater bank, or be used as a supply source in conjunction with a new banking program with the Semitropic SWRU

South Bay Pumping Plant Outage

This project would provide no benefit for a South Bay Pumping Plant outage, since storage facilities are upstream of the pumping plant

5.4.5 Next Steps

DWR's 2007 FAQ suggested the reservoir could be operational in 2019 (Department of Water Resources, 2007a) Given the amount of time since that document, CDM modified this estimate to 2020 There is still significant engineering and environmental study and evaluation that remain The Plan Formulation Report, which should lay out project alternatives, was expected in the summer of 2008, but has not yet been published, as of December 2008 The complete feasibility study and EIS/EIR are currently expected in the winter of 2010

5.5 Temperance Flat Reservoir

Temperance Flat Reservoir is one component of the Upper San Joaquin River Basin Storage Investigation being conducted by the USBR and DWR The goal of the feasibility study is to evaluate options to develop water supplies from the San Joaquin River that can benefit water quality and ecosystem restoration for the river The 2005 IAIR identified overall program objectives including restoring the San Joaquin River, improving water quality in the San Joaquin River, and facilitating conjunctive water management and water exchanges that improve water quality in deliveries to in eastern San Joaquin Valley Secondary objectives include flood control, supply for the EWA or an equivalent, hydropower, and recreation The study identified six water storage measures and six operational scenarios, combinations of which will be studied as alternatives in the upcoming Plan Formulation Report (U S Bureau of Reclamation and Department of Water Resources, 2005)

The study is one of five surface studies recommended in the CALFED Programmatic EIS/EIR Record of Decision, which also includes the Los Vaqueros Reservoir Expansion and the NODOS Investigation Temperance Flat Reservoir is part of Governor Schwarzenegger's comprehensive water infrastructure proposal for California

5.5.1 Project Description

Temperance Flat Reservoir would be located in Fresno County at one of two sites along the San Joaquin River near Fresno, between Friant and Kerckhoff Dams The joint USBR/DWR 2005 IAIR identified a site at River Mile 279 which could have two potential reservoir sizes 450,000 AF or 725,0000 AF A site at River Mile 274 would have 1,310,000 AF of storage Each dam configuration would include a powerhouse at the base of the dam (U S Bureau of Reclamation and Department of Water Resources, 2005)

At the time of the IAIR, the project was not designed with any water supply benefit, only ecosystem benefits The total estimated average annual yield ranged from 86,000 AFY to 165,000 AFY The project was developed to contribute to habitat and water quality restoration of the San Joaquin River and to facilitate conjunctive water management and exchanges to improve water quality (U S Bureau of Reclamation and Department of Water Resources, 2005) Since the completion of the IAIR, the San Joaquin River Settlement Agreement was completed and will provide for fisheries flows in the river This removed many of the environmental benefits that were included for Temperance Flat Reservoir A water supply benefit is now being evaluated for SWP and CVP contractors In September 2008, DWR staff indicated additional modeling was being conducted by USBR and the Plan Formulation Report would be completed within several months (Rasmussen, 2008a)

USBR is evaluating the benefits to SWP contractors, depending on the construction a trans-valley canal connecting areas of the Friant Division to the California Aqueduct This canal would cost an additional $400 million There are other methods of providing this connection with existing southern canals (Rasmussen, 2008a)

In September 2008, DWR staff indicated USBR is evaluating two operations scenarios that would provide a 35,000 to 53,000 AFY average annual yield for SWP Contractors, and a 41,000 to 68,000 AFY annual yield in dry and critically dry years If the SBA Contractors share the SWP portion of water supply based on their Table A portion (5 3%), they could receive an annual average supply of 1,900 to 2,800 AFY, and a dry yield supply of 2,200 to 3,600 AFY Future changes in SWP and CVP operations would affect these yield estimates Additional operational scenarios will be analyzed in the feasibility report (Rasmussen, 2008b)

5.5.2 Project Costs

DWR's 2007 FAQ for Temperance Flat Reservoir stated capital costs would be about $2 billion (Department of Water Resources, 2007b) In September 2008, DWR provide CDM with information from USBR which stated capital costs at $3 2 billion This includes mobilization, design and contingency factors, non-contract costs, and interest during construction More detailed costs will be available in the forthcoming Plan Formulation Report and Draft Feasibility Report (Rasmussen, 2008b)

O&M costs have not been made available by DWR or USBR Using most recent total average annual yield value of 183,000 AFY (from DWR's 2007 FAQ, before project reconfiguration after the San Joaquin River Settlement Agreement), the unit cost (without O&M) would be about $900/AF Assuming O&M costs at 0 5% of capital costs (similar to the ratio for the Sites Reservoir and Los Vaqueros Reservoir

Expansion) and that all project uses share the costs proportionally, CDM estimated unit costs would be about $1,000/AF

5.5.3 Implementation Issues

As with Sites Reservoir, the Upper San Joaquin River Basin Storage Investigation has multiple project objectives, which could complicate water supply delivery Other supply reliability options exist for the SBA Contractors with projects that are in the local area, where the agencies could have more control and input into operations Due to the involvement of both USBR and DWR, and the size of the project, Temperance Flat Reservoir is anticipated to only be a long-term supply option for the SBA Contractors

Also, the water supply benefits to all potential contractors, including the SWP, are still being evaluated after the overall change in focus for the project away from ecosystem restoration The yields described above could change based on redefined alternatives The SBA Contractors should remain aware of the status of the trans-valley conveyance which, while more expensive, could facilitate easier delivery of water to the SWP

5.5.4 Potential Operational Benefits with Existing Programs and Facilities

Semitropic Groundwater Banking Program

This project could potentially provide a supply source for replenishment of SBA Contractors' existing Semitropic groundwater bank, or be used as a supply source in conjunction with a new banking program with the Semitropic SWRU

South Bay Pumping Plant Outage

This project would provide no benefit for a South Bay Pumping Plant outage, since storage facilities are upstream of the pumping plant

5.5.5 Next Steps

DWR's 2007 FAQ suggested the reservoir could be operational in 2017 to 2019 (Department of Water Resources, 2007b) Given the time since that publication, CDM modified this estimate to 2018 to 2020 There is still significant study and evaluation that remain The Plan Formulation Report, Draft Feasibility Study, and Draft EIR/EIS were expected in the summer of 2008 The complete feasibility study and EIS/EIR are due in summer 2010

5.6 Semitropic Stored Water Recovery Unit

The SBA Contractors' existing agreements with the Semitropic's groundwater banking program are summarized in Section 3 2 4 The SBA Contractors hold 56 5 percent of the original Semitropic storage allotment of 1 million AF The remaining partners are MWD (35%), Newhall Land and Farming Company (5 5%), and Vidler Water Company (3%) Semitropic is instituting an expansion of the banking program by increasing recharge capacity in the existing program area and adding new recharge areas

5.6.1 Project Description

Semitropic is currently looking for partners (existing or new) for its expanded groundwater banking program The SWRU will add 12,000 acres of in-lieu recharge and 65 new wells The project will increase pumpback capacity by 200,000 AFY and increase storage by 650,000 AF, to a total of 1 65 million AF Total pumpback capacity for the existing and new banking programs will be 290,000 AFY Combined with Semitropic's SWP entitlement, the district could deliver 423,000 AFY to project partners through the banking program The SWRU is not a new source of water with additional yield, but a method for storing and using the SBA Contractors' water

In 2004, Semitropic offered the first phase of the SWRU, 50,000 AF of storage and recovery, to the original banking partners These shares had a one-to-one ratio of storage to pumpback capacity In 2004, Semitropic solicited interest from existing partners in these shares and provided a date by which they had to respond or the first phase capacity would be allocated to new partners in the program (Semitropic, 2004) According to the USBR *Special Study Report*, Zone 7 purchased 3,250 shares of the SWRU's first phase, or 6 5 percent of the shares Semitropic offered the existing partners a portion of the first phase in proportion to their participation in the original banking program Vidler Water Company and Westlands Water District either purchased or committed to 21,500 shares, leaving 25,250 shares uncommitted (U S Bureau of Reclamation, 2007) Due to the amount of outstanding shares, it is possible other original banking partners may still be able to participate in the first phase Confirmation with Semitropic would be needed

New partners are being sought for the subsequent phases of the SWRU Partners in the existing banking program, who either did not commit to the first phase or want to purchase additional capacity, can still participate, though at different terms than those offered for the first phase There is 450,000 AF of firm storage available, with an additional 200,000 AF of storage when available Partners could recharge 50,000 AFY on a firm basis, plus an additional 420,000 AFY when available Pumpback capacity would be 150,000 AFY on a firm basis, plus an additional 276,000 AFY when available on a lower priority basis In this phase of the SWRU project, for every 3 AF of water stored, 1 AFY can be withdrawn Shares can be purchased as high or low priority – high priority shares have a guaranteed recovery rate while low priority shares are able to use pumpback capacity when it is available

5.6.2 Project Costs

Semitropic provided rate structure information for the SWRU to the original banking partners and indicated the total capital costs of the SWRU project was $150 million (in 2003 dollars) Semitropic assumed $10 million of that cost would be paid for by the original partners through the Phase 1 project shares (Semitropic Water Storage District, 2004) When escalated to 2008 dollars, the total capital costs are estimated at

 CDM

about $187 million. Semitropic's 2004 rate structure provided information on capital costs per share and maintenance, management, recharge, and recovery fees per AF for both high and low priority shares. The 2007 *Special Study Report* used that cost information to develop a total cost per AF for high and low priority shares that accounts for the time period of the contract (through 2035) and assumes the groundwater banking will be used for two storage and recovery cycles. Using the same methodology, escalated unit costs in 2008 dollars are $480 to $530 per AF for high priority shares, and $300 to $350 per AF for low priority shares. The cost range for each type of share reflects a cost reduction when purchasing more than 15,000 shares. Costs do not include purchase of water and conveyance to Semitropic.

5.6.3 Implementation Issues

The USBR *Special Study Report* identified several planning constraints associated with the project that could potentially affect the timing and cost of implementation. These fall into three areas, each of which will require further study.

1) *Potential Groundwater Quality Impacts to Extracted Water.* The SWRU increases the number of wells in the overall groundwater banking program. That increase in wells could potentially affect groundwater quality by drawing up saline groundwater that lies in the deepest groundwater storage areas, or by drawing saline groundwater from the west to the well extraction zone.

2) *Need for Arsenic Treatment.* A number of Semitropic's supply and monitoring wells have reported arsenic concentrations exceeding the U.S. Environmental Protection Agency's 50 parts per billion (ppb) maximum contaminant limit (MCL) (U.S. Bureau of Reclamation, 2007). The California Department of Public Health lowered the State's MCL to 10 ppb. The groundwater may require treatment before it can be pumped back to the California Aqueduct. Semitropic's capital costs include about $12 million (2008 dollars) for arsenic treatment. This issue will require additional study by Semitropic for regulatory, treatment, and cost effectiveness issues.

3) *Potential Exacerbation of Groundwater Overdraft.* According to the *Special Study Report*, the current status of groundwater overdraft in the Semitropic area has not been quantified. Overall, the banking program has improved groundwater levels in the area, however, the banking partners have not removed significant quantities of water over several consecutive years. During an extended drought, extraction from original and expanded bank could be 290,000 AFY for four to five years. Semitropic has established measures to prevent subsidence and overdraft (U.S. Bureau of Reclamation, 2007).

5.6.4 Potential Operational Benefits with Existing Programs and Facilities

Semitropic Groundwater Banking Program

This project, which is an expansion of the existing Semitropic groundwater banking program, requires a supply source for replenishment

South Bay Pumping Plant Outage

This project would provide no benefit for a South Bay PP outage, since storage facilities are upstream of the pumping plant

5.6.5 Next Steps

As of November 2007 *Special Study Report,* all Phase 1 facilities were either constructed or under construction Semitropic's website indicates the expanded program is permitted and ready for construction USBR is currently conducting a study to fill the data gaps identified in the *Special Study Report,* and is still considering purchasing shares of the expanded bank up to $50 million

If the SBA Contractors are interested in participating (or increasing participation, for Zone 7) in the expanded program, they should investigate whether it is still possible to purchase shares in Phase 1 of the SWRU, because of the more favorable storage and recovery ratio for each share

5.7 Projects Not Included for Comparative Analysis

This section presents information on several other water supply projects whose progress the SBA Contractors may want to follow in the future These projects are not considered for evaluation in this study, but included for informational purposes

5.7.1 Northeastern San Joaquin Groundwater Banking Authority

In 2001, ten agencies in San Joaquin County formed a joint powers authority, the Northeastern San Joaquin County Groundwater Banking Authority (GBA), to collaboratively develop locally supported projects to improve water supply reliability in the eastern portions of the county These agencies include

- San Joaquin County/San Joaquin County Flood Control and Water Conservation District
- City of Stockton
- City of Lodi
- Woodbridge Irrigation District
- North San Joaquin Water Conservation District
- South Delta Water Agency
- Central Delta Water Agency

- Stockton East Water District
- Central San Joaquin Water Conservation District
- California Water Service Company

Several GBA agencies have small groundwater recharge projects currently underway, but there is no groundwater banking program in effect at this time There are a few projects being studied now that could involve groundwater banking for the GBA agencies Freeport Connection Project, Mokelumne Water Forum, and Mokelumne River Water Storage and Conjunctive Use Project

The GBA completed an Integrated Regional Water Management Plan (IRWMP) in July 2007 which included options for a groundwater banking program involving SWP contractors No particular SWP contractors were identified SWP water could be sent to the GBA bank through the Freeport pipeline, the future Stockton Delta Water Supply Project, or other means Recovered groundwater could be pumped into the Calaveras or Mokelumne Rivers upstream from the Delta There could be environmental benefits from increased stream flows, however, wheeling water through the Delta in dry or critical years could be difficult The GBA agencies are opposed to the proposed Delta Conveyance Facility (Williamson, 2008)

The IRWMP's Draft Programmatic Environmental Impact Report should be available by the spring of 2009 A project of this type would likely take more than five years for design, project-level environmental documentation, financing, and construction

5.7.2 Stockton East Water District Groundwater Banking Program

Stockton East Water District (SEWD) is developing a banking program for its urban contractors (the City of Stockton and the California Water Service Company) and other interested parties The district has secured a purchase option on a 230-acre site for its recharge facilities The technical feasibility of the program, including geotechnical and water quality assessments (including an arsenic study) and a preliminary design, is currently under evaluation by SEWD The bank would store at least 45,000 AF, and be able to recover 15,000 AFY for three consecutive years Participants could recharge a minimum of 13,400 AFY in wet or average hydrologic years (Stockton East Water District, 2008a)

SEWD provided capital cost and maintenance, management, recharge, and recovery fee information to their urban contractors The capital cost of the project is estimated at $30 million (Stockton East Water District, 2008a) Assuming three storage and recovery cycles over a 21-year period, the unit cost of water is approximately $1,250/AF These costs do not include pumping costs and costs to acquire water SEWD's proposal includes an option for SEWD to acquire the banked surface water for participants, for additional cost

For SEWD's urban contractors, water recovered from the bank would be pumped directly to SEWD's water treatment plant for treatment and distribution The conveyance for distributing recovered water to other participants is not yet clear SEWD contacted EBMUD about potential interest in the banking program and indicated there are many options for recharge and delivery that would need to be discussed (Stockton East Water District, 2008b) SEWD expects to be able to begin accepting water within one year of signing user agreements (Stockton East Water District, 2008a)

5.7.3 ACWD Desalination Facility

ACWD's Newark Desalination Facility is a 5 mgd plant that treats brackish groundwater from the Niles Cone Groundwater Basin for potable use According to ACWD's *Urban Water Management Plan*, the plant can provide 5,100 AFY under median and long term conditions The maximum supply available from the plant is 5,600 AFY (Alameda County Water District, 2006a)

ACWD is currently expanding the plant's capacity to 10 mgd The need for the second phase of the desalination facility was identified in ACWD's *Integrated Resources Planning Study* to help meet future water production needs (Alameda County Water District, 2006b) The expanded plant could be operated at 5 mgd in normal and dry years and 10 mgd during above normal and wet years (Alameda County Water District, 2006a) According to ACWD staff, the plant cannot be further expanded beyond 10 mgd because it is using as much brackish groundwater as the basin can accommodate without increasing salt water intrusion (Niesar, 2008)

5.7.4 Zone 7 Demineralization Program

Zone 7 is currently implementing wellhead demineralization facilities using reverse osmosis treatment The purpose of the project is to offset increased salt loading to the groundwater basin, and provide lower hardness water to its retail customers The project does not include a water supply element

5.7.5 South Bay Desalination Concepts

The 2004 *Bay Area Water Quality and Supply Reliability Program* evaluated the development of up to three small desalination plants in Santa Clara County, each producing up to 4 3 mgd each (5 mgd design) These plants would treat brackish groundwater for either potable or industrial and/or cooling uses Plants designed for industrial or cooling applications would have a capacity of 1 mgd The concepts were originally studied in the early stages of the BARDP and were not carried forward because of their small size

The potential sites were the Pico Power Plant in Santa Clara, Los Esteros Power Plant in San Jose, and the Palo Alto Regional Water Quality Control Plant in Palo Alto The potential participants identified were the common SFPUC and SCVWD customers of the Cities of Palo Alto, Santa Clara, and San Jose The average dry year supply from the three plants would be 13,000 AFY for potable supply, or up to 3,200 AFY of irrigation/cooling supply, where plant demands are the limiting factor and assuming a 95 percent plant factor The plants' supply would free up SCVWD or SFPUC potable water for delivery to other customers (CDM, 2005) Although only SCVWD would benefit directly from the supply, there would be opportunity for SCVWD to provide water to ACWD and Zone 7 through exchange, by reducing its SBA supply

The 2004 study included a cost estimate for the plants for both potable and irrigation/industrial water supply operation (CDM, 2005) Escalating those costs to 2008 dollars, the capital cost per plant for the potable water supply option is $17 to $54 million O&M costs are estimated at $3 to $4 million per year per plant The unit costs for potable water are estimated to be $1,100 to $1,700 per AF

Section 6
Comparison of Water Supply Alternatives

6.1 Summary

This section presents a comparison of the Los Vaqueros Reservoir Expansion (LVE) and Upper Del Valle Reservoir with the additional water supply projects discussed in detail in Section 5 to assess their ability to replace lost Sacramento-San Joaquin Delta (Delta) supply for Zone 7 Water Agency (Zone 7), Alameda County Water District (ACWD), and Santa Clara Valley Water District (SCVWD) (collectively, the South Bay Aqueduct [SBA] Contractors) The conceptual evaluation compares the projects based on the following factors

- costs and financing,
- environmental impacts,
- regulatory requirements,
- dependence on others, and
- operational benefits

Table 6-1 summarizes the seven potential projects that were evaluated in the study The table summarizes information on project capacity, yield, capital costs and unit costs of water Cost information was developed from available information for each project, updated to 2008 dollars The table also summarizes the principal benefits of projects, key issues, and approximate timing Upper Del Valle Reservoir is one of several local options that were evaluated for storage, and was selected for comparison with other projects as the best local option

6.1.1 Storage Projects

Four reservoir projects were evaluated in the study expansion of Upper Del Valle (several configurations initially evaluated), LVE Project, Sites Reservoir, and Temperance Flats Reservoir Of the reservoir projects, only the regional-scale projects (LVE, Sites, and Temperance Flats) have the potential to provide significant supply reliability benefits to the SBA Contractors Other Del Valle Reservoir expansion alternatives provide only small storage volumes and were screened from further consideration due to their small yields The remaining projects all have considerable uncertainty in implementation time-frame, yields due to uncertainty of unfolding Delta regulations, potential project partners, and costs

LVE, sponsored by Contra Costa Water District (CCWD), is the furthest along in the planning process and, at this point in time, has the shortest projected implementation time frame The 275 thousand acre-feet (TAF) LVE expansion project evaluated in this study is seeking State or Federal partners for project environmental benefits, and SBA partners for reliability supply LVE may provide a means of maintaining deliveries that would normally come through the SWP when it would otherwise be restricted

Table 6-1
Summary of Alternatives

Alternative	Capacity (1)	Average Annual Yield (TAF/yr)	Capital Cost ($M, June 2008)	Unit Cost ($/AFY)	Principal Benefits	Key Issues	Approximate Timing (2)
Los Vaqueros Reservoir Expansion	275 TAF (total capacity)	18 to 25 for SBA Contractors	$793	Ranges from $280 to $1,800 depending whether obtain 90% Federal/State Cost Share (low end of cost range) or no State/Federal cost share (high end of cost range) Does not include $100M buy-in fee	• Potentially meets a significant portion of projected shortfall	• State or Federal cost share required for lower cost for SBA Contractors No established procedures to determine potential State cost share • 1,000 acres of new inundation area	Construction completed by 2015
Upper Del Valle Reservoir	15 TAF	0 9 (unregulated runoff only)	$108-$115	$11,500 - $12 300 with local runoff only	• Locally controlled project • Would make use of Zone 7 and ACWD prior water rights	• Small reservoir capacity limits ability to meet projected needs	Construction completed by 2015
Sites Reservoir (3)	1,800 TAF	75 to 163 (all SWP contractors), 4 to 9 to SBA Contractors (assuming 5 3% of SWP yield)	$2,600-$3,600	$230-$430 when costs shared proportionally by all users, $350-$1,000 when water supply users pay 90% of project costs	• Potential for increased SWP supplies in dry years • Project has State interest, so costs could be reduced by State participation	• Low potential supply benefits • State and Federal approval needed • 14 000-acre inundation area • Requires moving water through the Delta • Long-term project	Operation in 2020 (based on timing in DWR's 2007 FAQ)
Temperance Flat Reservoir	450 TAF – 1 300 TAF	35 to 53 (all SWP contractors), 2 to 3 to SBA Contractors (assuming 5 3% of SWP yield)	$3,200	$900 (without O&M costs), $1 000 when O&M costs estimated at 0 5% of capital costs	• Potential for increased SWP supplies in dry years • Project has State interest so costs could be reduced by State participation	• Low potential supply benefits • State and Federal approval needed • 6,000-acre inundation area • Requires moving water through the Delta • Long-term project	Operation in 2018-2020 (based on timing in DWR's 2007 FAQ)
Bay Area Regional Desalination Project (BARDP)	65 mgd (total capacity) 10 mgd (SCVWD-alone capacity, or SBA Contractors capacity if SCVWD partners with other contractors)	11-27 total normal/wet year supply for SCVWD/SBA Contractors assuming 95% plant factor 5-month to year-round operation	$52 (based on 10 mgd SCVWD capacity)	$1,300 + wheeling/ conveyance (for operation in all years)	• Potential opportunities for average/wet year deliveries for SBA Contractors when capacity not planned by partners	• Could require wheeling agreements/ interties thru EBMUD for use by Zone 7 City of Hayward for SCVWD/ACWD, or exchange with CCWD • Potential impingement/ entrainment of larval and juvenile fish species	Construction completed in 2013 (current BARDP schedule)

Table 6-1
Summary of Alternatives

Alternative	Capacity (1)	Average Annual Yield (TAF/yr)	Capital Cost ($M, June 2008)	Unit Cost ($/AFY)	Principal Benefits	Key Issues	Approximate Timing (2)
Delta Diablo Desalination Project	5-7 5 mgd pilot, potentially up to 50 mgd	5 to 8 total assuming 90% plant factor (pilot project total for all participants)	$57 for the pilot plant	$1,500 - $1 900 for 5 mgd output $1,000-$1,300 for 7 5 mgd output Does not include wheeling/conveyance	• Potentially shorter implementation time frame for pilot project rather than reservoir projects	• Small project • Could require wheeling agreements/interties thru EBMUD for use by Zone 7, City of Hayward for SCVWD/ACWD • Potential impingement/ entrainment of larval and juvenile fish species	Construction completed in 2014 (based on DDSD study)
Semitropic Stored Water Recovery Unit (Phase 2) (4)	450 TAF firm, plus 200 TAF when available	150 firm plus up to 276 when available (total for all participants)	$187 (of which $12 is to be paid by Phase 1 partners)	$480 to $530 for high priority shares, $300 to $350 for low priority shares Does not include cost of water banked and conveyance to Semitropic	• Extension of existing program in which SBA Contractors participate • Provides operational flexibility in dry years • Can significant increase return capacity from original (existing) Semitropic stored supplies • CEQA and permitting work is completed • Available immediately	• Project would need to be developed in conjunction with a supply project to obtain water to store in the bank • Recovered groundwater may need arsenic treatment • Requires exchange of California Aqueduct water for delivery to SBA	As of February 2007, 25% of facilities were constructed

Notes $/AFY = dollars per acre-foot per year, $M = millions of dollars, CCWD = Contra Costa Water District CEQA = California Environmental Quality Act, DDSD = Delta Diablo Sanitation District EBMUD = East Bay Municipal Utility District FAQ = Frequently Asked Questions O&M = operations and maintenance TAF/yr = thousand acre-feet per year

(1) Capacity represents total capacity of project except where explicitly noted for BARDP

(2) Timing in contingent upon a number of factors including completion of feasibility studies financing, environmental documentation permitting and project approval

(3) DWR has not yet performed modeling to incorporate potential flow restrictions due to the Wanger decision into estimates of annual average yield

(4) Semitropic Stored Water Recovery Unit (Phase 2) is not a new source of water with additional yield but rather a method for storing and using the SBA Contractors water Unit costs shown in this table represent costs for Semitropic SWRU participation only Additional costs would be incurred to acquire water supply for groundwater banking

due to environmental or other constraints through those SWP facilities This assumes an ability to move the SWP water through LVE facilities, which may require modification of existing water rights (an assumption that requires verification), otherwise new sources of supply would be needed It may be possible to move new sources of supply through LVE facilities These sources could be unappropriated Delta water , transfer water conveyed on behalf of SBA Contractors when capacity is unavailable at Banks, or water available under existing water rights permits Uncertainty remains as to who would obtain/purchase additional supplies Assessments by the State of California may affect the extent to which existing and future supply will be able to conveyed through LVE This project would likely require State or Federal cost sharing to move forward In addition to the 275 TAF LVE expansion project evaluated in this study, CCWD is also evaluating a smaller reservoir expansion of 160 TAF, with the potential to provide 30 TAF of storage to other interested partners The smaller project could be developed as a CCWD-only project, or with local partners, and would not require State or Federal cost sharing partners While the reliability supply would be much smaller than for the 275 TAF reservoir expansion, the smaller project does not require costly conveyance pipelines, so could potentially be implemented more quickly and at considerably lower cost

The LVE studies team has completed analysis to assess project impacts for the project environmental impact statement/environmental impact report (EIS/EIR), currently scheduled to be released in early 2009 State and Federal Feasibility studies to assess State and Federal interest in the project and potential cost sharing will be completed in 2009 and 2010

Sites and Temperance Flat Reservoirs are undergoing joint study by the U S Bureau of Reclamation and the California Department of Water Resources (DWR) A Project Formulation Report, Feasibility Study, and EIS/EIR are due for each project over the next few years These projects will have a longer time frame for implementation (operation in 2018-2020) due to the significant size of each reservoir and the joint state and federal involvement in environmental documentation, design, permitting, construction, and funding

6.1.2 Desalination Projects

Two desalination projects were evaluated in the study the Bay Area Regional Desalination Project (BARDP) and the Delta Diablo Desalination Project The BARDP project is being sponsored by four Bay Area agencies East Bay Municipal Utility District (EBMUD), San Francisco Public Utilities Commission (SFPUC), SCVWD, and CCWD The project is planned to provide dry-year and emergency supply to participating agencies at one or two locations There is an opportunity to seek additional partners who would be interested in average and wet year supply BARDP sponsors are currently conducting a pilot study at the preferred plant location, adjacent to the Mirant Power Plant in Pittsburg Thus far, studies for the BARDP project have been conducted using grant funding Funding has not been secured beyond the current pilot phase Delta Diablo Sanitation District (DDSD) is developing a 5 to 7 5 million gallon per day (mgd) demonstration-scale project that would treat brackish bay water for delivery to other agencies Depending on the outcome of the demonstration project, the project has the potential to be expanded to 50 mgd

Both desalination projects have similar unit costs and similar implementation time frames, which are slightly shorter than the LVE implementation time frame Environmental impacts for the two projects would also be similar, based on their construction on previously disturbed sites and siting of intake facilities along the Delta, where fisheries impacts would be the greatest challenge Given their location in Pittsburg and Antioch adjacent to the Delta, both projects would also require partnerships/exchange agreements with other agencies (potentially EBMUD, CCWD, and/or SFPUC) to convey water to SBA Contractors While these projects potentially have less supply reliability uncertainty than storage projects that are subject to Delta conveyance limitations, the amount that could be delivered to SBA Contractors is highly dependent on conveyance capacity in adjacent utility systems, as well as the ability of SBA Contractors to receive water at interconnection locations, and distribute water effectively Since water would be more likely available during winter season months, these projects could potentially be paired with existing groundwater banking programs or the Semitropic Water Storage District (Semitropic) Stored Water Recovery Unit (SWRU) either to meet demand directly from projects, and bank State Water Project (SWP) water normally delivered through the SBA, or to exchange water through other agencies for delivery to Semitropic groundwater bank

6.1.3 Groundwater Banking

The SBA Contractors participate in the current Semitropic Groundwater Banking program, with a 57 percent share of the 1 million AF of storage Semitropic is currently seeking partners for Phase 2 of the SWRU, which is currently under construction SWRU is not a new source of water with additional yield, but rather a method for storing and using SBA Contractors' water Zone 7 has already purchased shares in the first phase of the program The SWRU provides an additional storage amount of 650 TAF, and 200,000 acre-feet per year (AFY) of additional pumpback capacity Arsenic, in concentrations exceeding State maximum contaminant levels, has been found in some supply and monitoring wells and Semitropic is currently evaluating the need and best approach for arsenic treatment Cost of the banking program is estimated at $280 to $430/AF, including treatment[1] Participation in the SWRU could provide additional dry-year operational flexibility to the SBA Contractors, but only if a banking source of water can be identified For example, Article 21 water, which might have been a source, is not expected to be as readily available

6.1.4 Conclusions

All of the potential alternatives analyzed have limitations in their ability to meet SBA Contractors' needs None of the alternatives are without significant costs, even the alternatives with lower apparent costs (LVE and Sites) include assumptions that may

[1] Unit costs are for participation in the banking program only Additional costs would be incurred to acquire water supply for groundwater banking

not be accurate [2] While the study found that all of the alternatives have significant limitations, some of the alternatives merit continued investigation

- *LVE* This alternative has made substantial progress towards implementation, and appears to be on a faster track than other Regional storage projects While the expansion from 100 TAF to 275 TAF has considerable uncertainty, associated with both benefits and costs, CCWD proposed an intermediate alternative - a 160 TAF expansion project - that would reduce the capital costs by elimination of costly conveyance It would also obviate the need for state or federal partnerships, but would have more limited supply benefits At the current time, there is little additional information available on this option SBA Contractors should continue to work with CCWD to refine both projects to assess benefits and costs of the LVE projects

- *Desalination* Two projects currently appear to be proceeding BARDP and the DDSD Desalination Project Both are in early phases of implementation The primary benefits of desalination projects are that they provide a new, and therefore more reliable, water supply regardless of hydrologic conditions The DDSD project may also have fewer implementation hurdles because SBA Contractors would be dealing with a single project sponsor, and may be an attractive alternative for individual agencies depending on the comparison of agency supply and demand Both desalination projects would require agreements with neighboring agencies (EBMUD and potentially SFPUC) to wheel water through their systems, so conveyance issues would need to be explored

- *Semitropic SWRU* Although not a new source of supply, groundwater storage has the potential to improve the performance of either LVE or desalination water supply options by storing water when it is available for later use SBA Contractors would need to assess how reductions in Article 21 water and LVE or desalination would work with existing banking programs, to determine whether there would be benefits to pursuing additional storage in the SWRU Timing of supply would be a key issue for the SWRU, since most of the recharge is in-lieu, and winter recharge is limited

These three alternatives are selected because of a combination of characteristics costs that may be feasible, decreased reliance on Delta diversions through Harvey O Banks pumping plant, and a schedule for implementation within the study period (10-15 years)

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[2] LVE assumes that State and Federal funding will pay for 90 percent of the project, but this funding may be difficult to obtain The cost per acre-foot for Sites and Temperance Flat Reservoirs may also be understated because they are based on reservoir yield, but that yield may not be able to be moved through the Delta to reach the SBA

Figure 6-1 compares the potential supply shortfall with potential yields for the alternatives, and also shows unit costs.

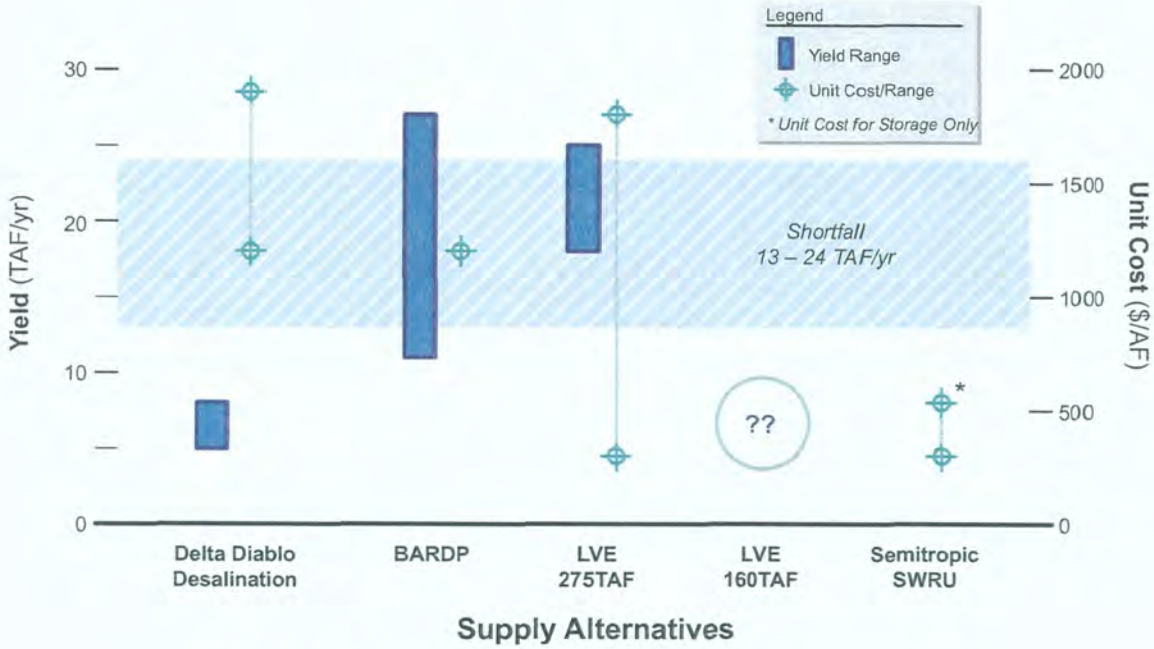


Figure 6-1 *Yields and Unit Costs for Supply Alternatives*

The remaining alternatives were screened out for the following reasons:

- *Upper Del Valle Reservoir*: high cost per acre-foot.
- *Sites and Temperance Flat Reservoirs*: extended timeline for implementation and dependence on multiple other partners.

The larger alternatives are, generally, more expensive, more complex to implement and therefore are expected to be on-line later.

6.2 Costs and Financing

Table 6-2 presents information on the costs for each project, including capital, operations and maintenance (O&M), and unit costs. CDM reviewed the most recent cost estimates and yield information available on each project and updated costs to 2008 dollars.

The projects have a wide range of unit costs, from several hundred dollars per AF to over $10,000/AF. The projects with estimated unit costs of $1,000/AF or less are LVE, Sites Reservoir, Temperance Flat Reservoir, and Semitropic SWRU. The Los Vaqueros unit cost was prepared with input and review from the LVE team of CCWD staff. The LVE team's working assumption is that the project will have a 90 percent cost share from state and federal sources. Based on that assumption, unit costs for the project are

$300/AF, however, the level of state and/or federal participation is unknown given the current economic climate With no state or federal participation, the unit cost rises to $1,800/AF Unit costs do not include a buy-in fee, estimated by CCWD at $100 million (Naillon, 2008)

Sites Reservoir's unit costs for water supply will depend on (1) how costs are shared by the different classes of users (water supply, water quality, and ecosystem benefits), and (2) on the portion of its annual yield dedicated to water supply DWR and U S Bureau of Reclamation (USBR) are still evaluating operating scenarios for the reservoir The same issues are true for the Temperance Flat Reservoir USBR is currently re-evaluating the project's yield and potential beneficiaries Temperance Flat Reservoir's unit costs are estimated at $1,000/AF, based on O&M costs of 0 5 percent of capital costs DWR and USBR have not developed O&M estimates at the time of this report The unit costs shown in Table 6-2 reflect the most recent total project yield available (DWR, 2007b) and the yield for water supply provided by DWR (Rasmussen, 2008b)

The Semitropic SWRU appears to have the most favorable costs, with unit costs below $530/AF However, this cost is for storage only and does not factor in the supply source Costs vary for Phase 2 depending upon the priority and number of shares purchased High priority shares have guaranteed storage, recharge, and recovery rates, while the less expensive, low priority shares have access to Semitropic facilities when capacity is available

The two desalination projects have unit costs between $1,000 and $2,000/AF The DDSD pilot project and SCVWD's portion of the BARDP have similar capital costs and similarly sized output The DDSD plant's unit costs could be reduced through the use of energy from the nearby Calpine power plant State funding is also a possibility for these projects

Upper Del Valle Reservoir's high unit cost is due to the project's very low supply benefit, less than 1,000 AFY using local unallocated runoff only

Table 6-2
Comparison of Costs and Financing

Project	Capital Cost ($2008)	O&M Cost ($2008)	Unit Cost ($2008)
Los Vaqueros Reservoir Expansion [1]	$790 million for Alternative 1 Cost shown is for entire Alternative 1 project not SBA supply portion Alternative 1 capital costs were originally developed by the LVE team and adjusted by CDM to current dollars CCWD plans to finance the project and become wholesale provider of water to SBA contractors	O&M costs not yet developed by LVE team	With 90% state/federal cost share, $300/AF CDM prepared estimate of unit costs with input from LVE team No established procedures to determine potential State cost share Numerous factors will influence ultimate pricing of water for SBA contractors With no cost share, unit cost is $1,800/AF Unit costs do not include buy-in fee estimated at $100M
Upper Del Valle Reservoir [2]	$108 - $115 million for 15,000-AF reservoir Total capital cost depends upon operational scenario (water supply or flood control) Low estimate reflects operation to offset flood control storage, with no pumping or piping costs The high estimate reflects operation for seasonal storage, which requires pumping and piping to move water from existing Del Valle Reservoir into Upper Del Valle	$0 8 -$1 1 million/year Assumes O&M costs are 1% of total capital costs Energy costs are not included	$11 500 to $12 300/AF with local runoff only
Sites Reservoir [3]	$2 6 - $3 6 billion for 1 8 MAF-reservoir depending upon conveyance options	$11 - $22 million/year for operations, maintenance, and power	$230 - $430/AF, when all water users share costs proportionally to supply, $350-$1 000/AF when water supply users pay 90% of project costs Range based on low and high capital and O&M costs and span of long-term average yield from different operational scenarios
Temperance Flat Reservoir [4]	$3 2 billion for 1 3 MAF-reservoir	O&M costs have not been developed by DWR/Reclamation	$900/AF without O&M costs, and assuming 183 000 AFY average yield (pre-San Joaquin River Settlement Agreement) $1 000/AF when O&M costs estimated at 0 5% of capital costs
Bay Area Regional Desalination Project [5]	$52 million for 10 mgd (10,640 AFY with 95% plant factor) during dry years (represents SCVWD s share of total 65 mgd capacity) Total project capital costs are $340 million	$4 3 million/year for SCVWD s share Total project O&M costs are $29 million/year	$1,600/AF for dry year operation, $1 300/AF for operation in all years assumes 95% plant factor Does not include wheeling conveyance improvements, and post-treatment
Delta Diablo Desalination Project [6]	$57 million for 5-7 5 mgd, 3-stage pilot plant based on CDM estimate of 2008 unit cost for each phase of treatment	$3 9 million/year, based on escalation of costs reported in 2005 study	$1,500 - $1,900/AF for 5 mgd output, $1,000-$1 300/AF for 7 5 mgd output assumes 90% plant factor Range depends upon interest rate (3% vs 8%, provided in 2005 study)
Semitropic SWRU (Phase 2) [7]	$187 million, of which $12 million Semitropic expects to be paid by Phase 1 users	$200 to $280/AF, depending upon share priority for put/take pumping, management and maintenance	$480 to $530/AF for high priority shares $300 to $350/AF for low priority shares Does not include cost of water banked and conveyance to Semitropic

(1) EWA, 2008 Naillon, 2008
(2) CDM 2001
(3) Rasmussen, 2008b, DWR, 2007a
(4) Rasmussen 2008b DWR 2007b
(5) URS 2007
(6) DDSD, 2005
(7) USBR, 2007, Semitropic, 2004

6.3 Environmental Impacts

Table 6-3 presents information on environmental impacts for each project, focusing on aquatic and terrestrial effects

The storage projects would have the greatest terrestrial impacts Upper Del Valle and LVE have smaller inundation areas of several hundred acres to 1,000 acres, while Temperance Flat and Sites Reservoirs cover 6,000 and 14,000 acres, respectively Each would affect state and/or federal listed terrestrial species Both the BARDP and the DDSD desalination project would be constructed at previously disturbed sites, with minimal terrestrial impacts The Semitropic SWRU could affect land subsidence in the Kern National Wildlife Refuge and listed species habitat on California Department of Fish and Game (DFG)-owned parcels in the recharge area Semitropic has developed a land subsidence mitigation plan and is proceeding with Section 7 consultation with the U S Fish and Wildlife Service (USFWS) for habitat issues

Potential aquatic impacts differ for the storage projects Streams in the Sites Reservoir area do not support anadromous fisheries, but the reservoir's operation could have some beneficial impacts on fisheries in the Sacramento River (USBR and DWR, 2006) Temperance Flat Reservoir would add another dam on the San Joaquin River affecting fisheries, though specific impacts are currently unknown More information should be available in the EIS/EIR (USBR and DWR, 2005) LVE has fewer fisheries impacts than future no project conditions According to the EIR/EIS, the project's diversion facilities would have state-of-the-art fish screens, an improvement to current SWP and Central Valley Project (CVP) intake structures, and provide better flexibility in responding to fisheries conditions Most construction impacts could be mitigated to a less than significant level (USBR and CCWD, 2008) Upper Del Valle Reservoir would also affect habitat for listed aquatic species, through inundation of 2 5 miles of riparian corridor (CDM, 2001)

Both BARDP and the DDSD project would be constructed with intake systems designed to minimize impingement and entrainment of marine life, particularly sensitive species in the Delta The BARDP pilot plant is currently testing intake structures and effects on entrainment Monitoring would likely be required at both plants at the intake and brine disposal for effects on marine species

Arsenic, in concentrations exceeding State maximum contaminant levels, has been found in some supply and monitoring wells for the existing Semitropic groundwater banking system For the SWRU, Semitropic is evaluating the need for arsenic treatment The potential effect on water quality from the SWRU is currently unknown

Table 6-3
Comparison of Potential Environmental Impacts

Project	Aquatic Impacts	Terrestrial Impacts
Los Vaqueros Reservoir Expansion [1]	• Water could be diverted to LVE from several different intake locations allowing for increased flexibility to respond to changing fishery conditions in the Delta All water diverted through LVE facilities would use intakes equipped with state-of-the-art, positive barrier fish screens designed and operated to meet federal, state, and local environmental protection requirements (SWP and CVP pumps are not screened) According to the EIR/EIS, impacts to fish would be reduced compared to diverting the same amount of water through SWP and CVP pumps Overall impacts to fisheries from diversions through LVE facilities would be less than significant • Impacts to fisheries during construction would be less than significant with the use of a cofferdam and other mitigation measures • Modeling of Delta hydraulic conditions with and without LVE showed a less than significant impact to parameters affecting fisheries habitat (e g , X2 location net Delta outflow net flow on lower San Joaquin River, salinity in the interior Delta, circulation in the Delta, and river flows upstream of the Delta)	• LVE would increase reservoir inundation area by 1,000 acres and require several new or expanded pipelines (over 18 miles) through the project area • Most project construction impacts would be less than significant with mitigation for affected habitats, including special status plants and animals • Project construction would have a significant and unavoidable impact on one listed species (San Joaquin kit fox) by permanently reducing regional movement opportunities in one location
Upper Del Valle Reservoir [2]	• There would be significant riparian habitat loss along the 2 5 miles of riparian corridor to construct a new reservoir upstream of existing dam The area is habitat for several aquatic special status species	• Reservoir would inundate up to 259 acres, including private land state park land, and agriculture There would be significant riparian habitat loss The area is habitat for several terrestrial special status species • There would be a significant adverse visual impact with the new upstream reservoir and potential for cultural resources disturbance • The Arroyo Valley Campground facilities would be relocated and Del Valle Road rerouted
Sites Reservoir [3]	• The streams flowing through the Sites Reservoir area do not support anadromous fish and the streams are intermittent in nature No special status species were found in preliminary stream surveys • Reservoir would allow changes in the timing, magnitude, and duration of diversions, which could help reduce diversion effects on fisheries and help assure appropriate flows necessary for critical life states of anadromous fish and riparian habitat in the Delta Reservoir improves fish passage in the Sacramento River by replacing the Red Bluff Diversion Dam with state of the art fish screens and pumps Also increases cold water conveyance to provide a cooler environment for anadromous fish, and improves conditions for spawning fall-run Chinook salmon	• Reservoir would have 14 000-acre inundation area, and 85 square mile drainage area Preliminary site surveys have identified 250 acres of wetlands 75 acres of riparian habitat over 900 acres of woodland affected by the reservoir, 25 bird and 1 reptile species of state and federal concern 45 prehistoric cultural resources and 27 historic cultural resources The reservoir could have significant impacts upon biological resources stemming from habitat loss
Temperance Flat Reservoir [4]	• Existing fisheries in Millerton Lake and the Big Bend reach of the San Joaquin River would be affected by the reservoir, primarily by the division of Millerton Lake into two portions Allows cold water from Millerton Lake to be diverted, without negative effect on the lake, to the San Joaquin River in order to maintain fish ecosystems Specific impacts are unknown at this time	• Inundation area of up to 6,000 acres Preliminary site surveys have identified 24 potentially impacted listed species

Table 6-3
Comparison of Potential Environmental Impacts

Project	Aquatic Impacts	Terrestrial Impacts
Bay Area Regional Desalination Project [5]	• Potential for impingement/ entrainment of larval and juvenile fish species Final plant site and design has not been selected Intake system will be designed to minimize impingement and entrainment of marine life Entrainment of larval fish and juvenile delta smelt would be a concern Pilot plant is testing intake structure and effects on entrainment Effects could be significant	• Final plant site has not been selected Pilot plant at East Contra Costa site is located at the Mirant Pittsburg Plant, a previously disturbed site • Pumping facilities and pipelines would likely be located along road rights-of-way and other disturbed areas • Temporary construction-related effects to terrestrial resources may occur if new facilities are located on or adjacent to sensitive terrestrial habitats Effects likely to be less than significant after mitigation
Delta Diablo Desalination Project [6]	• Issues include potential impingement/entrainment of larval and juvenile marine life (particularly sensitive species in the Bay-Delta) and brine disposal Plant will be designed with a positive barrier fish screen to reduce and avoid entrainment of larger juvenile, subadult and adult fish species at intake locations Plant would also be operated with seasonal variations to reduce and avoid entrainment Monitoring for effectiveness of the fish screen will likely be required Final plant site and design has not been selected • Brine would be mixed with wastewater treatment effluent to reduce salinity Brine disposal would be designed to avoid and minimize potential adverse impacts by locating discharge deep within channel for effective mixing with currents Effects to aquatic resources from brine disposal likely to be less than significant	• Likely plant location is DDSD's facilities in Antioch, a previously disturbed site • Pumping facilities and pipelines would likely be located along road rights-of-way and other disturbed areas • Temporary construction-related effects to terrestrial resources may occur if new facilities are located on or adjacent to sensitive terrestrial habitats Effects likely to be less than significant after mitigation
Semitropic SWRU [7]	• Effects of arsenic on water quality and operation of SWRU are unknown no analysis available of potential water quality effects from arsenic • Operation of existing bank and SWRU expansion would improve groundwater levels more than from only surface water deliveries • Effect of extended pumping has not been studied, during an extended drought extraction could be 290,000 AFY for 4-5 years, Semitropic has established measures to prevent overdraft and subsidence	• Adds 12,000 acres of in-lieu recharge • Potential for land subsidence of about 8 inches in the Kern National Wildlife Refuge could change Kern s ability to distribute water through its gravity flow canal system, Semitropic has developed mitigation plan • Could improve viability of agriculture in Semitropic area • Well field construction requires habitat conservation plan, listed species in well field for DFG-owned parcels

[1] USBR and CCWD 2008
[2] CDM, 2001
[3] USBR and DWR 2006
[4] USBR and DWR, 2005
[5] URS, 2007
[6] Jones & Stokes, 2005, Hanson Environmental 2008
[7] USBR 2007

6.4 Regulatory Requirements

Table 6-4 lists permits and other regulatory requirement measures necessary for each project, based on information in the available documentation Sites and Temperance Flat Reservoirs and LVE have the greatest number of requirements due to their nature as surface storage projects BARDP and the DDSD project could face substantial permitting issues for intake design, brine disposal, and fisheries mitigation Semitropic's website indicates the SWRU is fully permitted If the USBR decides to participate in the project, an EIS will need to be completed for compliance with the National Environmental Policy Act

6.5 Dependence on Others

Table 6-5 discusses each project's potential relationships to other agencies, local, state, and federal Participation in the Semitropic SWRU would be easiest for the SBA Contractors to implement as they each have an existing contract with Semitropic for the current groundwater banking program These agreements could be amended to include participation in the SWRU Zone 7 has already purchased shares in the first phase of the SWRU

In general, the local projects (LVE, BARDP, and DDSD desalination) would have fewer dependencies upon state or federal involvement for project approvals, though the State and Federal governments could be potential funding sources These three projects would require agreements between partner agencies for water transfers or wheeling of water through interties Although Upper Del Valle Reservoir is a local project, DWR would be the lead agency for project development because Del Valle Reservoir is part of the SWP

Sites and Temperance Flat Reservoirs would require the most involvement with other agencies because DWR and USBR the project sponsors and because of the size and scope of the surface storage projects Each of reservoirs would also have other project beneficiaries would need to be consulted during operations and planning

Table 6-4
Comparison of Regulatory Requirements

Agency	*Permitting Required*	*Project:* Los Vaqueros Expansion	Upper Del Valle Reservoir	Sites Reservoir	Temperance Flat Reservoir	Bay Area Regional Desalination Project	Delta Diablo Sanitation District Project	Semitropic Stored Water Recovery Unit [4]
Bay Area Air Quality Management District	Authority to Construct Permit Permit to Operate						✓	
U S Army Corps of Engineers	Clean Water Action Section 404 Permit	✓	✓	✓	✓	✓	✓	
	Rivers and Harbor Act Section 10 Permit	✓	✓	✓	✓			
USFWS and National Oceanic and Atmospheric Administration (NOAA) Fisheries	Section 7 consultation required to comply with Federal Endangered Species Act (ESA), Magnuson Stevens Fisheries Conservation & Management Act	✓	✓	✓	✓	✓	✓	✓ [4]
Federal Energy Regulatory Commission (FERC)	Hydropower generation permit			✓	✓			
US Coast Guard - Private Aids to Navigation Permit	Private Aids to Navigation Permit	✓						
U S Environmental Protection Agency (USEPA)	Clean Air Act compliance, Farmland Protection Act compliance			✓	✓			
Western Power Authority Administration	Transmission Service Request Permit and Open Access Transmission Service Tariff Process	✓						
State Water Resources Control Board (SWRCB)	Modification of existing water rights or new water rights permit	✓	✓	✓	✓	✓ [1]		
California Department of Fish and Game	DFG - California ESA Compliance, Section 1601 Streambed Alteration Agreement	✓	✓	✓	✓			
California Department of Water Resources	Encroachment Permit	✓	✓					
California Division of Safety of Dams (DSOD)	Dam Design Approval	✓	✓	✓	✓			
California Reclamation Board	Encroachment Permit	✓						
California Department of Transportation (Caltrans)	Encroachment Permit	✓						
Regional Water Quality Control Board (RWQCB)	Clean Water Action Section 401 Water Quality Certification, National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit	✓	✓	✓	✓	✓ [2]		
State Lands Commission	General Permit	✓	✓ [3]	✓	✓	✓ [3]	✓ [3]	
State Historic Preservation Office (SHPO)	National Historic Preservation Act Section 106 Compliance	✓	✓	✓	✓			
Alameda/Contra Costa Counties, cities	Encroachment Permit	✓	✓					
U S Bureau of Reclamation	Executive Order 11988 Floodplain Management compliance Executive Order 11990 Protection of Wetlands			✓	✓			
California Department of Conservation	Surface Mining Reclamation Act compliance			✓	✓			
San Francisco Bay Conservation and Development Commission (BCDC)	Major Permit (if facility is within jurisdictional boundaries)					✓		
	Regionwide permit (if new pipeline needed to use CCWD intake)						✓	

(1) Existing CCWD water rights permits could cover a plant under 25 mgd at the Mirant site For plants > 25 mgd, additional water rights would be required
(2) The East Contra Costa site may have more difficulty receiving NPDES permit than other locations due to lower mixing and les s dilution
(3) Required if constructed on State land
(4) Already permitted USFWS Section 7 consultation underway Federal Participation would require EIS

Table 6-5
Comparison of Dependence Upon Other Organizations

Project	Summary
Los Vaqueros Reservoir Expansion [1]	• CCWD currently plans to finance project and act as water wholesaler SBA contractors may have reduced operational flexibility/management as purchasers compared to participating as project partners
Upper Del Valle Reservoir [2]	• DWR would be lead agency on acquiring additional land, environmental documentation, and approving reservoir
Sites Reservoir [3]	• DWR and Reclamation are partners for the studies, along with participation from a wide variety of other state and federal agencies providing input Federal and State involvement adds layer of complexity to contracts and agreements Future changes to operations of SWP and CVP could affect supply yields
Temperance Flat Reservoir [4]	• DWR and Reclamation are partners for the studies, along with participation from a wide variety of other state and federal agencies providing input Federal and State involvement adds layer of complexity to contracts and agreements Future changes to operations of SWP and CVP could affect supply yields
Bay Area Regional Desalination Project [5]	• BARDP would be a locally controlled project Besides SCVWD, BARDP partners include EBMUD, CCWD, and SFPUC These agencies have yet to work out institutional agreements regarding facility ownership, operations, maintenance, water supply distribution, water supply rights and entitlements, water banking, water capacity constraints, and pipeline design constraints Amount of water available in any given year could be affected by a partner agency emergency situation • Requires revision to partner agencies' Memoranda of Understanding for use of existing interties Could require wheeling agreements/ interties through EBMUD for use by Zone 7, and through City of Hayward for SCVWD/ACWD • Water transfers that affect the point of diversion or place of use would likely be subject to review/approval by SWRCB
Delta Diablo Desalination Project [6]	• Besides SBA Contractors, partners include DDSD and potentially EBMUD, CCWD, and others Portion of plant's supply available to SBA Contractors is unknown at this time • DDSD will likely pursue state and/or federal funds for project, adding another layer(s) of project approval • Could require wheeling agreements/ interties through EBMUD for use by Zone 7, and through City of Hayward for SCVWD/ACWD
Semitropic SWRU	• SBA Contractors have established relationship/agreements with Semitropic Participation in the SWRU would require amendment to current individual agreements

[1] U S Bureau of Reclamation and CCWD 2008
[2] CDM, 2001
[3] DWR, 2000 U S Bureau of Reclamation and DWR 2006
[4] U S Bureau of Reclamation and DWR, 2005, DWR, 2007b
[5] URS 2007
[6] DDSD 2005, Jones & Stokes 2005, Hanson Environmental 2008

6.6 Operational Benefits

Table 6-6 describes the operational benefits for the SBA Contractors from each project The SBA Contractors are already familiar with the benefits of the Semitropic SWRU through the operation of their existing groundwater banking programs The SWRU would be operated as an extension of the existing Semitropic program, receiving and supplying water through established procedures The SBA Contractors could most benefit from the SWRU when implemented in conjunction with a water supply project However, timing may be a significant issue Recharge is in-lieu and wintertime recharge, when water is more likely to be available from supply projects, is small

LVE would provide additional water supply reliability, improved water quality, decreased fisheries impacts (through improved intake design), operational flexibility for future Delta conveyance facilities, and a potential source of water for banking Sites and Temperance Flat Reservoirs would also provide additional water supply for SWP contractors (based on currently information on project beneficiaries) This water would need to be moved through the Delta, which could be difficult in summer under pumping restrictions or could be done in the winter and banked in a groundwater storage program

BARDP and the DDSD desalination projects would both provide a supply of water under local control Each could improve the SBA Contractors' dry year supply reliability by providing water in wet years for banking in the Semitropic SWRU, with the water returned in dry years when SWP cutbacks may be likely

Table 6-6
Comparison of Operational Benefits

Project	Summary

Los Vaqueros Reservoir Expansion [(1)]	• LVE would provide a reliability supply above and beyond current SWP allocations for SBA contractors that is delivered when there is excess supply or delivered from water stored in LVE This supply is designed to replace deliveries lost with the implementation of the NRDC vs Kempthorne decision Reliability supply targets were established as the difference between modeled deliveries with and without delta smelt protections
	• SBA deliveries would be made through LVE diversion facilities This allows for supply reliability water to be delivered to the SBA even when the water quality is too poor for storage in LVE Delivery of water in this method would only be precluded when full capacity of LVE diversion facilities is being used to fill LVE The new intake location would allow for operational flexibility in providing water to LVE during sensitive fisheries periods, and would likely not be subject to the SWP and CVP pumping restrictions because of fish screens
	• Increased regional storage could provide stored water to SBA contractors during an emergency, particularly as interties between LVE and SBA contractors would not be dependent upon federal and state Delta pumps
	• LVE could help improve the system operational flexibility to maintain Delta export water supply reliability and water quality If the operation of an isolated Delta conveyance facility (or Delta dual conveyance facilities) is restricted due to emergencies, LVE could serve as an alternative source to provide Delta water exports to the SBA, and thus reduce the frequency and duration of a water export shortage Also, with the existence of an isolated Delta facility, LVE could store SWP water in the winter and spring for release in the summer when conveyance capacity in the isolated facility is limited for south of Delta exports, or store excess water released from upstream facilities after environmental requirements in the Delta are met, and release water to supplement Delta exports
	• SBA contractors could see some improvement in Delta water quality through the use of deliveries from LVE The reservoir would pump and store Delta water during periods of high water quality, and provide that water to SBA contractors during dry periods when salinity, algae, organic carbon, taste, and odor levels from direct Delta diversions or Clifton Court Forebay deliveries are usually high
	• LVE supply reliability deliveries could be used with existing or new groundwater banking programs (Semitropic, Cawelo Water District, and San Benito County Water District) in a number of ways
	  o Take delivery of both LVE supply reliability water and Semitropic stored water (either through in-lieu SWP water or through stored groundwater) in dry years to the extent that there is adequate SBA pumping and reach capacity
	  o Deliver LVE reliability supply to Semitropic to bank during wet years, provided that there is California Aqueduct capacity to do so This does not appear to require a change to existing banking contracts as the contract language states water delivered to Semitropic can be "a portion of [its] SWP or other water " If this were to present contractual issues, LVE reliability supply could be used to meet local SBA demand, making entitlement water available for banking

Upper Del Valle Reservoir [(2)]	• Upper Del Valle Reservoir would be operated in concert with the existing Del Valle Reservoir SBA contractors would share benefits
	• Two operation scenarios were considered
	  o Water supply storage Upper Del Valle would store additional water during the winter, pumped from the existing Del Valle Reservoir Water would be released back into the existing reservoir during the summer as supply is needed Potential water supply sources include runoff from Arroyo Valle, Article 21 water (less reliable in dry years), or purchased supplies
	  o Flood control storage Upper Del Valle would provide the flood control storage that currently exists in Del Valle Reservoir, allowing the existing Del Valle Reservoir to be maintained at a higher water level at the beginning of the summer and then gradually drawn down during the later summer months
	• Small reservoir capacity limits the ability to meet projected supply needs

Table 6-6
Comparison of Operational Benefits

Project	Summary
Sites Reservoir [3]	• Diversions to Sites Reservoir would be taken and stored during winter months when more flow is available in the Sacramento River. Water would be released during the summer to meet contractor needs when river flows are less available, while keeping water in Shasta Reservoir for later contractor delivery to assist in river temperature needs. • Releases from Sites Reservoir could improve water quality to SBA contractors by providing increased flows during critical times to help reduce salinity for Delta diversions, however, the project would require moving water through the Delta.
Temperance Flat Reservoir [4]	• Provides nominal increase in SWP supplies, however, the project would require moving water through the Delta. Exchange through the Friant system may be possible, but the exchange capacity would be limited. • Little information is available on how Temperance Flat Reservoir would operate under new scenarios considered by DWR/USBR. Reservoir was initially conceived and evaluated for ecosystem restoration purposes. See Section 5.5 for information on potential water supply benefits.
Bay Area Regional Desalination Project [5]	• BARDP provides local control of water supply. Potential opportunities for average/wet year deliveries for SBA Contractors when capacity not planned by partners. • SCVWD would receive project water through a series of interties with EBMUD and SFPUC or transfers with CCWD. If the plant is located at the East Contra Costa site, a Delta water transfer would not be required to share water between partner agencies. • Zone 7 and ACWD could receive project water during wet years, or under contract with SCVWD, through transfers with SCVWD. Project could be used in conjunction with existing or new groundwater banking programs. BARDP could bank water when supply from the plant exceeds the partners' needs through a new banking program, or partners/agencies could bank the water through existing or new agreements. The SBA Contractors could take delivery of BARDP water through transfers in the Delta, and send that water to Semitropic for storage. • Project could be viable supply option if other major water supplies are disrupted by saltwater intrusion (from sea level rise) or Delta levee failures. If Oceanside or Bay Bridge site is chosen, project could provide reliable supply in years with decreased runoff because the raw water would not be a Delta source.
Delta Diablo Desalination Project [6]	• DDSD project provides local control of water supply. SBA Contractors would receive project water through exchanges with CCWD or wheeling through EBMUD facilities. • Supply of desalinated water during drought periods could replace a portion of agencies' use of surface water reservoirs, saving that reservoir supply for emergency use. Project could be viable supply option if other major water supplies are disrupted by saltwater intrusion (from sea level rise) or Delta levee failures. • The project would provide better quality water when taking transfer from CCWD from the desalination plant than when transfers originate from Delta export pumps. • Project could be used in conjunction with existing or new groundwater banking programs. SBA Contractors could bank the water through existing or new agreements. The SBA Contractors could take delivery of DDSD water through transfers in the Delta (through CCWD), and send that water to Semitropic for storage. • Potentially shorter implementation time frame for pilot project rather than reservoir projects, however, project supply is small.
Semitropic SWRU [7]	• Would improve Semitropic's water delivery flexibility, can help make up supply from SWP reduced deliveries. • Could receive water through already established procedures. • Project would work well in coordination with a water supply project to provide water to bank.

[1] U.S. Bureau of Reclamation and CCWD, 2008
[2] CDM. 2001
[3] DWR. 2000. U.S. Bureau of Reclamation and DWR. 2006
[4] Rasmussen. 2008b
[5] URS, 2007
[6] DDSD, 2005. Jones & Stokes, 2005. Hanson Environmental. 2008
[7] U.S. Bureau of Reclamation, 2007

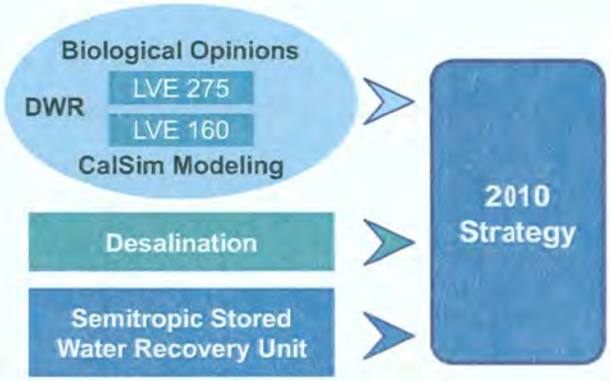
CDM

Section 7
Recommended Action Plan

CDM recommends that the South Bay Aqueduct (SBA) Contractors continue to track and take next steps to explore participation in three supply projects: 1) Los Vaqueros Reservoir Expansion (LVE) Project; 2) Delta Diablo Sanitation District (DDSD) or Bay Area Regional Desalination Project (BARDP) project; and 3) Semitropic Water Storage District (Semitropic) Stored Water Recovery Unit (SWRU). While these alternatives have significant uncertainties, in terms of costs and potential yields, the alternatives merit continued investigation.

CDM recommends that the SBA Contractors:

1. Assess impacts of regulatory decisions on SBA deliveries and anticipated LVE yields.
2. Assess how new supplies could be coupled with existing banking programs to determine whether increased banking participation through the Semitropic SWRU would be beneficial.
3. Further refine the costs and benefits of the LVE and desalination alternatives during 2009 and early 2010.



Further evaluation of best alternatives necessary prior to formulating water supply strategy

4. In mid-2010, based on the above findings, formulate a supply strategy based on the optimal combination of the 1) LVE Project (either 275 or 160 TAF); 2) DDSD or BARDP project; and/or 3) Semitropic SWRU.

SBA Contractors may more efficiently and reliably meet their objectives by focusing on multiple smaller projects than a single larger project. This approach may reduce the SBA Contractors' risk since they will not be relying on any single alternative to address future water supply shortfalls.

Potential general next steps and specific actions for the projects are outlined below:

7.1 General

- Evaluate impacts of upcoming regulatory changes pertaining to Delta fisheries, in particular biological opinions for longfin smelt and salmon, and work with California Department of Water Resources (DWR) to assess potential supply ramifications for State Water Project (SWP) supply reliability.

- As alternatives are more fully developed, each agency should re-evaluate their supply reliability policies with respect to costs

7.2 LVE Project

There are a number of uncertainties associated with LVE project, including potential supply reliability yields, how those will be affected by ongoing actions to protect Delta fisheries, and costs, which will depend on potential project participants Since a decision to proceed is difficult at present due to the uncertainties, CDM recommends that the SBA Contractors clarify the costs and benefits of the LVE project by working with CCWD

- *Refining water supply sources, amounts and timing of water* CCWD has requested input from the SBA Contractors regarding specific operational needs, and has indicated a willingness to refine modeling analyses completed to date to evaluate differences in modeling assumptions and identify alternative delivery scenarios/assumptions In addition to modeling analysis, the SBA Contractors should also work with CCWD to better understand the types of water available (e g unappropriated Delta Water, transfer water, or water under existing water rights permits) as this will be critical to state and federal agencies (i e , how amounts can be further quantified, and the permitting and other institutional issues that would need to be addressed to obtain supply) Uncertainty remains as to who obtains/purchases these supplies Similarly, the SBA Contractors would need to evaluate potential LVE deliveries and how they integrate with existing supplies to specifically address usability of LVE supplies

- *Expanding analysis to include SBA capacity constraints* The effectiveness of LVE, as well as some alternatives such as an isolated conveyance facility and groundwater banking, depends on capacity availability in the SBA A detailed study of the seasonal capacity availability by reach would help refine these discussions

- *Developing potential participation costs to SBA Contractors* To date, CCWD has not completed cost analysis to determine potential participation costs for SBA Contractors Participation in the 275 TAF LVE would be contingent on state and federal participation Potential state and federal cost sharing will be examined in the federal and state feasibility studies SBA Contractors will need more information on cost sharing and buy-in costs from CCWD

- *Further developing the 160 TAF Expansion Option* In December 2008, CCWD identified a potential variant of the 160 TAF CCWD-only project, with up to 30 TAF storage available to other participating partners Offering significant cost savings, this project may be implemented with existing conveyance facilities, and delivery to the SBA Contractors through exchanges The SBA Contractors should continue to work with CCWD to refine this potential option to quantify potential supply reliability benefits and costs

7.3 DDSD (or BARDP) Desalination Project

Pursue desalination projects to determine if they are financially and institutionally viable

- Continue to work with DDSD to explore participation in pilot project, and timing of supply
- Track progress of BARDP pilot studies
- Discuss the potential for wheeling desalinated water through adjacent systems with East Bay Municipal Utility District (EBMUD) (all SBA Contractors) and San Francisco Public Utilities Commission (Alameda County Water District and Santa Clara Valley Water District), and identify steps necessary to refine available capacity and timing for transfers
- Revisit potential new intertie between Zone 7 Water Agency (Zone 7) and EBMUD to increase delivery capacity to Zone 7
- Perform system operational studies to assess ability to integrate supply source with local resources and groundwater banking programs

7.4 Semitropic Stored Water Recovery Unit

The Semitropic SWRU may be an option to supplement new supply projects and existing banking programs Zone 7 has already purchased shares in the SWRU, and should assess purchasing additional shares ACWD and SCVWD should assess participation

- Investigate whether it is still possible to purchase shares in Phase 1 of the SWRU, because of the more favorable storage and recovery ratio for each share
- As supply quantities and timing are refined for LVE and/or desalination projects, perform system operational studies to assess use of new supplies with existing banking program and need for additional banking capacity

Section 8
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Appendix A
2005 Delivery Reliability Report
CalSim II Modeling Assumptions

(Taken from Appendix A of "*The State Water Project Delivery Reliability Report 2005*" dated April 2006 by the Department of Water Resources)

Appendix A. 2005 Delivery Reliability Report CalSim II Modeling Assumptions

Two versions of the model are used for this report Studies 1, 2 and 3 are based on the May 2002 benchmark study version The updated studies (4 and 5) use the most recent version, which was developed for the 2004 Long-Term Central Valley Project Operations Criteria and Plan (OCAP) The key assumption differences between the May 2002 benchmark version and the 2004 OCAP version are listed below

1 Temperature flow below Keswick Dam was changed from a fixed time series flow to a dynamic storage dependent flow

2 Relaxation of criteria for flow below Nimbus Dam when Folsom Lake storage drops below 300 thousand acre-feet

3 Navigation control point flow criteria were modified from being dependent on water year type to being dependent on CVP agricultural allocation levels Criteria were also relaxed for very low allocation years

4 Clear Creek Tunnel target flows were modified to match the latest Trinity EIR analysis

5 Addition of a minimum pumping level at Banks Pumping Plant of 300 cubic feet per second

6 Addition of a minimum pumping level at Tracy Pumping Plant of 600 cubic feet per second

7 Addition of flow requirements for flow at the mouth of the Feather River for Settlement Contractors

8 Delivery-carryover relationship was adjusted to reduce delivery targets and increase carryover in critically dry years

9 Addition of Lake Oroville end-of-September carryover target storage rule

10 Five-step study setup modified to isolate (b)(2) accounting from "with Project" conditions

11 Modification of American River demands as described in Tables A-2 and A-3

12 Modification of Contra Costa Water District demands to include the effect of Los Vaqueros Reservoir operations

13 The minimum flow of the Trinity River below Lewiston Dam in study 4 ranges from 369 to 453 thousand acre-feet per year depending on water year type All other studies used in this report assume the Trinity River minimum flow has a greater range from 369 to 815 thousand acre-feet per year This greater range of Trinity River minimum flows represents the Trinity Environmental Impact Statement Preferred Alternative

14 Study 5 assumes the implementation of Freeport Regional Water Project, including modified East Bay Municipal Utility District operations on the Mokelumne River

15 Implementation of May 2003 CVPIA 3406 (b)(2) decision and other changes
  a Streamlining actions to simplify analysis of the results

- b Anadromous Fish Restoration Program table updates to better represent management of (b)(2) water under the May 2003 (b)(2) decision
- c Action triggering modifications to attempt to meet 200 thousand-acre feet target during October through January period

16 Environmental Water Account (EWA) changes include

- a Streamlining actions and coordination with (b)(2) actions
- b EWA purchase amount increase to a maximum of 250 thousand acre-feet per year
- c Addition of storage debt carryover accounting, including debt spill at San Luis Reservoir
- d Addition of EWA asset takeover by SWP and CVP at San Luis Reservoir when reservoir space utilized by EWA is needed for project operations

All studies assume current Banks Pumping Plant capacity, existing conveyance capacity of the upper Delta-Mendota Canal/California Aqueduct system, and current SWP/CVP operations agreements

The following table is a complete list of the study assumptions

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions

	Study 1 2001 Study, 2003 Report	Study 4 2005 Study, Updated Studies	Study 2 2021A Study, 2003 Report	Study 3 2021B Study, 2003 Report	Study 5 2025 Study, Updated Studies
Period of Simulation	73 years (1922-1994)	Same	Same	Same	Same
HYDROLOGY					
Level of Development (Land Use)	2001 Level, DWR Bulletin 160-98[1]	Same as Study 1	2020 Level, DWR Bulletin 160-98	Same as Study 2	Same as Study 2
Demands					
North of Delta (except American River)					
CVP	Land Use based, limited by Full Contract	Same	Same	Same	Same
SWP (FRSA)	Land Use based, limited by Full Contract	Same	Same	Same	Same
Non-Project	Land Use based	Same	Same	Same	Same
CVP Refuges	Firm Level 2	Same	Same	Same	Same
American River Basin					
Water rights	2001[2]	2001[3]	2020[4]	Same as Study 2	2020, as projected by Water Forum Analysis[5]
CVP	2001[2]	2001[3]	2020[6]	Same as Study 2	202 0, as projected by Water Forum Analysis[7]
San Joaquin River Basin					
Friant Unit	Regression of historical	Same	Same	Same	Same
Lower Basin	Fixed annual demands	Same	Same	Same	Same
Stanislaus River Basin	New Melones Interim Operations Plan	Same	Same	Same	Same
South of Delta					
CVP	Full Contract	Same	Same	Same	Same
CCWD	143 TAF/YR[8]	124 TAF/YR[8]	151 TAF/YR[8]	Same as Study 2	158 TAF/YR[8]

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions (cont)

	Study 1 2001 Study, 2003 Report	Study 4 2005 Study Updated Studies	Study 2 2021A Study, 2003 Report	Study 3 2021B Study, 2003 Report	Study 5 2025 Study, Updated Studies
SWP (w/ North Bay Aqueduct)	3 0 4 1 MAF/YR	2 3 3 9 MAF/YR	3 3 4 1 MAF/YR	4 1 MAF/YR	3 9 4 1 MAF/YR
SWP Article 21 Demand	MWDSC up to 50 TAF/month Dec Mar others up to 84 TAF/month	MWDSC up to 100 TAF/ month Dec Mar others up to 84 TAF/month	Same as Study 1	Same as Study 1	Same as Study 4
FACILITIES					
Freeport Regional Water Project	None	Same as Study 1	Same as Study 1	Same as Study 1	Included[9]
Banks Pumping Capacity	6680 cfs	Same	Same	Same	Same
Tracy Pumping Capacity	4200 cfs + deliveries upstream of DMC constriction	Same	Same	Same	Same
REGULATORY STANDARDS					
Trinity River					
Minimum Flow below Lewiston Dam	Trinity EIS Preferred Alternative (369 815 TAF/YR)	369 453 TAF/YR	Same as Study 1	Same as Study 1	Same as Study 1
Trinity Reservoir End of September Minimum Storage	Trinity EIS Preferred Alternative (600 TAF as able)	Same	Same	Same	Same
Clear Creek					
Minimum Flow below Whiskeytown Dam	Downstream water rights 1963 USBR Proposal to FWS and NPS and FWS use of CVPIA 3406(b)(2) water	Same	Same	Same	Same
Upper Sacramento River					
Shasta Lake End of September Minimum Storage	SWRCB WR 1993 Winter run Biological Opinion (1900 TAF)	Same	Same	Same	Same

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions (cont.)

	Study 1 2001 Study, 2003 Report	Study 4 2005 Study, Updated Studies	Study 2 2021A Study, 2003 Report	Study 3 2021B Study, 2003 Report	Study 5 2025 Study, Updated Studies
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90-5 and 1993 Winter-run Biological Opinion temperature control, and FWS use of CVPIA 3406(b)(2) water	Same	Same	Same	Same
Feather River					
Minimum Flow below Thermalito Diversion Dam	1983 DWR, DFG Agreement (600 CFS)	Same	Same	Same	Same
Minimum Flow below Thermalito Afterbay outlet	1983 DWR, DFG Agreement (750-1700 CFS)	Same	Same	Same	Same
American River					
Minimum Flow below Nimbus Dam	SWRCB D-893 (see accompanying Operations Criteria), and FWS use of CVPIA 3406(b)(2) water	Same	Same	Same	Same
Minimum Flow at H Street Bridge	SWRCB D-893	Same	Same	Same	Same
Lower Sacramento River					
Minimum Flow near Rio Vista	SWRCB D-1641	Same	Same	Same	Same
Mokelumne River					
Minimum Flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (100-325 CFS)	Same	Same	Same	Same
Minimum Flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (25-300 CFS)	Same	Same	Same	Same
Stanislaus River					
Minimum Flow below Goodwin Dam	1987 USBR, DFG agreement, and FWS use of CVPIA 3406(b)(2) water	Same	Same	Same	Same

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions (cont.)

	Study 1 2001 Study, 2003 Report	Study 4 2005 Study, Updated Studies	Study 2 2021A Study, 2003 Report	Study 3 2021B Study, 2003 Report	Study 5 2025 Study, Updated Studies
Minimum Dissolved Oxygen	SWRCB D-1422	Same	Same	Same	Same
Merced River					
Minimum Flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180-220 CFS, Nov-Mar), and Cowell Agreement	Same	Same	Same	Same
Minimum Flow at Shaffer Bridge	FERC 2179 (25-100 CFS)	Same	Same	Same	Same
Tuolumne River					
Minimum Flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94-301 TAF/YR)	Same	Same	Same	Same
San Joaquin River					
Maximum Salinity near Vernalis	SWRCB D-1641	Same	Same	Same	Same
Minimum Flow near Vernalis	SWRCB D-1641, and Vernalis Adaptive Management Program per San Joaquin River Agreement	Same	Same	Same	Same
Sacramento River-San Joaquin River Delta					
Delta Outflow Index (Flow and Salinity)	SWRCB D-1641	Same	Same	Same	Same
Delta Cross Channel Gate Operation	SWRCB D-1641	Same	Same	Same	Same
Delta Exports	SWRCB D-1641, FWS use of CVPIA 3406(b)(2) water and CALFED Fisheries Agencies use of EWA assets	Same	Same	Same	Same
OPERATIONS CRITERIA					
Subsystem					
Upper Sacramento River					
Flow Objective for Navigation (Wilkins Slough)	3,500-5,000 CFS based on Lake Shasta storage condition	3,250-5,000 CFS based on CVP Ag allocation levels	Same as Study 1	Same as Study 1	Same as Study 4

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions (cont)

	Study 1 2001 Study 2003 Report	Study 4 2005 Study, Updated Studies	Study 2 2021A Study 2003 Report	Study 3 2021B Study 2003 Report	Study 5 2025 Study, Updated Studies
American River					
Folsom Dam Flood Control	SAFCA Interim re operation of Folsom Dam Variable 400/670 (without outlet modifications)	Same	Same	Same	Same
Flow below Nimbus Dam	Operations criteria corresponding to SWRCB D 893 required minimum flow	Same	Same	Same	Same
Sacramento Water Forum Mitigation Water	None	Same as Study 1	Sacramento Water Forum (up to 47 TAF/YR in dry years)[10]	Same as Study 2	Same as Study 2
Feather River					
Flow at Mouth	No criteria	Maintain the DFG/DWR flow target above Verona or 2800 cfs for Apr Sep dependent on Oroville inflow and FRSA allocation	Same as Study 1	Same as Study 1	Same as Study 4
Stanislaus River					
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan	Same	Same	Same	Same
San Joaquin River					
Flow near Vernalis	San Joaquin River Agreement in support of the Vernalis Adaptive Management Program	Same	Same	Same	Same
System wide					
CVP Water Allocation					
CVP Settlement and Exchange	100% (75% in Shasta Critical years)	Same	Same	Same	Same
CVP Refuges	100% (75% in Shasta Critical years)	Same	Same	Same	Same

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions (cont)

	Study 1 2001 Study 2003 Report	Study 4 2005 Study, Updated Studies	Study 2 2021A Study, 2003 Report	Study 3 2021B Study 2003 Report	Study 5 2025 Study Updated Studies
CVP Agriculture	100% 0% based on supply (reduced by 3406(b)(2) allocation)	Same	Same	Same	Same
CVP Municipal & Industrial	100% 50% based on supply (reduced by 3406(b)(2) allocation)	Same	Same	Same	Same
SWP Water Allocation					
North of Delta (FRSA)	Contract specific	Same	Same	Same	Same
South of Delta	Based on supply Monterey Agreement	Same	Same	Same	Same
CVP/SWP Coordinated Operations					
Sharing of Responsibility for In Basin Use	1986 Coordinated Operations Agreement	Same	Same	Same	Same
Sharing of Surplus Flows	1986 Coordinated Operations Agreement	Same	Same	Same	Same
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D 1641 use of CVPIA 3406(b)(2) only restricts CVP exports EWA use restricts CVP and/or SWP exports as directed by CALFED Fisheries Agencies	Same	Same	Same	Same
Transfers					
Dry Year Program	None	Same	Same	Same	Same
Phase 8	None	Same	Same	Same	Same
MWDSC/CVP Settlement Contractors	None	Same	Same	Same	Same

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions (cont.)

	Study 1 2001 Study, 2003 Report	Study 4 2005 Study, Updated Studies	Study 2 2021A Study, 2003 Report	Study 3 2021B Study, 2003 Report	Study 5 2025 Study, Updated Studies
CVP/SWP Integration					
Dedicated Conveyance at Banks	None	Same	Same	Same	Same
NOD Accounting Adjustments	None	Same	Same	Same	Same
CVPIA 3406(b)(2)	May 2002 benchmark study assumptions	Dept of Interior 2003 Decision	Same as Study 1	Same as Study 1	Same as Study 4
Allocation	800 TAF/YR (600 TAF/YR in Shasta Critical years)	800 TAF/YR, 700 TAF/YR in 40-30-30 Dry Years, and 600 TAF/YR in 40-30-30 Critical years	Same as Study 1	Same as Study 1	Same as Study 4
Actions	AFRP flow objectives (Oct-Jan), CVP export reduction (Dec-Jan), 1995 WQCP (up to 450 TAF/YR), VAMP (Apr 15- May 16) CVP export restriction, Post (May 16-31) VAMP CVP export restriction, Ramping of CVP export (Jun), Pre (Apr 1-15) VAMP CVP export restriction, CVP export reduction (Feb-Mar), Additional Upstream Releases (Feb-Sep)	1995 WQCP, Fish flow objectives (Oct-Jan), VAMP (Apr 15- May 16) CVP export restriction, 3000 CFS CVP export limit in May and June (D1485 Striped Bass continuation), Post (May 16-31) VAMP CVP export restriction, Ramping of CVP export (Jun), Upstream Releases (Feb-Sep)	Same as Study 1	Same as Study 1	Same as Study 4
Accounting adjustments per May 2003 Interior Decision	None	No limit on responsibility for non-discretionary D1641 requirements no Reset with the Storage metric and no Offset with the Release and Export metrics	Same as Study 1	Same as Study 1	Same as Study 4

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions (cont)

	Study 1 2001 Study 2003 Report	Study 4 2005 Study Updated Studies	Study 2 2021A Study, 2003 Report	Study 3 2021B Study, 2003 Report	Study 5 2025 Study Updated Studies
CALFED Environmental Water Account					
Actions	Total exports restricted to 4 000 cfs 1 wk/mon Dec Mar (wet year 2 wk/mon) VAMP (Apr 15 May 16) export restriction Pre (Apr 1 15) and Post (May 16 31) VAMP export restriction Ramping of export (Jun)	Dec Feb reduce total exports by 50 TAF/month relative to total exports without EWA VAMP (Apr 15 May 16) export restriction on SWP Post (May 16 31) VAMP export restriction on SWP and potentially on CVP if B2 Post VAMP action is not taken Ramping of exports (Jun)	Same as Study 1	Same as Study 1	Same as Study 4
Assets	50% of use of JPOD 50% of any CVPIA 3406(b)(2) or ERP releases pumped by SWP flexing of Delta Export/Inflow Ratio (not explicitly modeled) dedicated 500 CFS increase of Jul Sep Banks PP capacity north of Delta (35 TAF/Yr) and south of Delta purchases (50 200 TAF/Yr) 100 TAF/Yr from south of Delta source shifting agreements and 200 TAF/YR south of Delta groundwater storage capacity	Fixed Water Purchases 250 TAF/yr 230 TAF/yr in 40 30 30 dry years 210 TAF/yr in 40 30 30 critical years The purchases range from 0 TAF in Wet Years to approximately 153 TAF in Critical Years NOD and 57 TAF in Critical Years to 250 TAF in Wet Years SOD Variable assets include the following used of 50% JPOD export capacity acquisition of 50% of any CVPIA 3406(b)(2) releases pumped by SWP flexing of Delta Export/Inflow Ratio (post processed from CalSim II results) dedicated 500 CFS pumping capacity at Banks in Jul Sep	Same as Study 1	Same as Study 1	Same as Study 4

Table A-1 2005 Delivery Reliability Report CalSim II Modeling Assumptions (cont)

	Study 1 2001 Study 2003 Report	Study 4 2005 Study, Updated Studies	Study 2 2021A Study 2003 Report	Study 3 2021B Study 2003 Report	Study 5 2025 Study Updated Studies
Debt restrictions	No planned carryover of debt past Sep no reset of unpaid debt debt carried past Sep paid back by Feb	Delivery debt paid back in full upon assessment Storage debt paid back over time based on asset/action priorities SOD and NOD debt carryover is allowed SOD debt carryover is explicitly managed or spilled NOD debt carryover must be spilled SOD and NOD asset carryover is allowed	Same as Study 1	Same as Study 1	Same as Study 4

[1] 2000 Level of Development defined by linearly interpolated values from the 1995 Level of Development and 2020 Level of Development from DWR Bulletin 160 98

[2] 1998 level demands defined in Sacramento Water Forums EIR with a few updated entries

[3] Presented in attached Table 2001 American River Demand Assumptions

[4] Sacramento Water Forum 2025 level demands defined in Sacramento Water Forums EIR

[5] Presented in attached Table 2020 American River Demand Assumptions

[6] Sacramento Water Forum 2025 level demands defined in Sacramento Water Forums EIR Freeport Alternative defined in EBMUD Supplemental Water Supply Project REIR/SEIS

[7] Same as footnote 5 but modified with PCWA 35 TAF CVP contract supply diverted at the new American River PCWA Pump Station

[8] Delta diversions include operations of Los Vaqueros Reservoir and represents average annual diversion

[9] Includes modified EBMUD operations of the Mokelumne River

[10] This is implemented only in the PCWA Middle Fork Project releases used in defining the CALSIM II inflows to Folsom Lake

Table A-2 2001 American River Demand Assumptions

Location / Purveyor	Allocation Type (maximum acre feet)					
	CVP AG	CVP MI	CVP Settlement / Exchange	Water Rights / Non-CVP / No Cuts	CVP Refuge	Total
Auburn Dam Site (D300)						
Placer County Water Agency	0	0	0	8 500	0	8 500
Total	**0**	**0**	**0**	**8 500**	**0**	**8 500**
Folsom Reservoir (D8)						
Sacramento Suburban	0	0	0	0	0	0
City of Folsom (includes P L 101 514)	0	0	0	20 000	0	20 000
Folsom Prison	0	0	0	2 000	0	2 000
San Juan Water District (Placer County)	0	0	0	10 000	0	10 000
San Juan Water District (Sacramento County) (includes P L 101 514)	0	11 200	0	33 000	0	44 200
El Dorado Irrigation District	0	7 550	0	0	0	7 550
El Dorado Irrigation District (P L 101 514)	0	0	0	0	0	0
City of Roseville	0	32 000	0	0	0	32 000
Placer County Water Agency	0	0	0	0	0	0
Total	**0**	**50 750**	**0**	**65 000**	**0**	**115 750**
Folsom South Canal (D9)						
So Cal WC/ Arden Cordova WC	0	0	0	3 500	0	3 500
California Parks and Recreation	0	100	0	0	0	100
SMUD (export)	0	0	0	15 000	0	15 000
South Sacramento County Agriculture (export SMUD transfer)	0	0	0	0	0	0
Canal Losses	0	0	0	1 000	0	1 000
Total	**0**	**100**	**0**	**19 500**	**0**	**19 600**
Nimbus to Mouth (D302)						
City of Sacramento	0	0	0	63 335	0	63 335
Arcade Water District	0	0	0	2 000	0	2 000
Carmichael Water District	0	0	0	8 000	0	8 000
Total	**0**	**0**	**0**	**73 335**	**0**	**73 335**
Sacramento River (D162)						
Placer County Water Agency	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Sacramento River (D167/D168)						
City of Sacramento	0	0	0	38 665	0	38 665
Sacramento County Water Agency (SMUD transfer)	0	0	0	0	0	0
Sacramento County Water Agency (P L 101 514)	0	0	0	0	0	0
EBMUD (export)	0	0	0	0	0	0
Total	**0**	**0**	**0**	**38 665**	**0**	**38,665**
Total from the American River	**0**	**50 850**	**0**	**166 335**	**0**	**217 185**

Table A-3 2020 American River Demand Assumptions

Location / Purveyor	Allocation Type (maximum acre-feet)						Folsom Unimpaired Inflow (FUI)			Notes
	CVP AG	CVP MI	CVP Settlement / Exchange	Water Rights / Non-CVP / No Cuts	CVP Refuge	Total	FUI = Total TAF (Mar – Sep) + 60 TAF			
Auburn Dam Site (D300)										
Placer County Water Agency	0	35,000	0	35,500	0	70,500	70,500	70,500	70,500	1/2/3/12
Total	**0**	**35,000**	**0**	**35,500**	**0**	**70,500**	**70,500**	**70,500**	**70,500**	
Folsom Reservoir (D8)										
Sacramento Suburban	0	0	0	29,000	0	29,000	29,000	0	0	4/5/11
City of Folsom (includes P.L. 101-514)	0	7,000	0	27,000	0	34,000	34,000	34,000	20,000	1/2/3
Folsom Prison	0	0	0	5,000	0	5,000	5,000	5,000	5,000	
San Juan Water District (Placer County)	0	0	0	25,000	0	25,000	25,000	25,000	10,000	1/2/3/11
San Juan Water District (Sac County) (includes P.L. 101-514)	0	24,200	0	33,000	0	57,200	57,200	57,200	44,200	1/2/3
El Dorado Irrigation District	0	7,550	0	17,000	0	24,550	24,550	24,550	22,550	1/2/3
El Dorado Irrigation District (P.L. 101-514)	0	7,500	0	0	0	7,500	7,500	7,500	0	1/2/3
City of Roseville	0	32,000	0	30,000	0	62,000	54,900	54,900	39,800	1/2/3/11/12
Placer County Water Agency	0	0	0	0	0	0	0	0	0	11
Total	**0**	**78,250**	**0**	**166,000**	**0**	**244,250**	**237,150**	**208,150**	**141,550**	
Folsom South Canal (D9)										
So. Cal WC/ Arden Cordova WC	0	0	0	5,000	0	5,000	5,000	5,000	5,000	
California Parks and Recreation	0	5,000	0	0	0	5,000	5,000	5,000	5,000	
SMUD (export)	0	15,000	0	15,000	0	30,000	30,000	30,000	15,000	1/2/3
South Sacramento County Agriculture (export, SMUD transfer)	0	0	0	0	0	0	0	0	0	1/2/3
Canal Losses	0	0	0	1,000	0	1,000	1,000	1,000	1,000	
Total	**0**	**20,000**	**0**	**21,000**	**0**	**41,000**	**41,000**	**41,000**	**26,000**	
Nimbus to Mouth (D302)										
City of Sacramento	0	0	0	96,300	0	96,300	96,300	96,300	50,000	6/7/8

Table A-3 2020 American River Demand Assumptions (cont)

Location / Purveyor	Allocation Type (maximum acre feet)						Folsom Unimpaired Inflow (FUI)			Notes
	CVP AG	CVP MI	CVP Settlement / Exchange	Water Rights / Non CVP / No Cuts	CVP Refuge	Total	FUI = Total TAF (Mar – Sep) + 60 TAF			
Arcade Water District	0	0	0	11 200	0	11 200	11 200	11 200	3 500	13
Carmichael Water District	0	0	0	12 000	0	12 000	12 000	12 000	12 000	
Total	**0**	**0**	**0**	**119,500**	**0**	**119,500**	**119,500**	**119,500**	**65,500**	
Sacramento River (D162)										
Placer County Water Agency	0	0	0	0	0	0	0	0	0	
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sacramento River (D167/D168)										
City of Sacramento	0	0	0	34 300	0	34 300	34 300	34 300	80 600	8
Sacramento County Water Agency (SMUD transfer)	0	30 000	0	0	0	30 000				10
Sacramento County Water Agency (P L 101 514)	0	15 000	0	0	0	15 000				10
EBMUD (export)	0	133 000	0	0	0	133 000				
Total	**0**	**178,000**	**0**	**34,300**	**0**	**212,300**	**34,300**	**34,300**	**80,600**	
Total demands from the American River	**0**	**133,250**	**0**	**342,000**	**0**	**475,250**	**468,150**	**439,150**	**303,550**	

Notes

[1] Wet/average years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is greater than 950 000 af

[2] Drier years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 950 000 af but greater than 400 000 af

[3] Driest years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 400 000 af

[4] Wet/average years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is greater than 1 600 000 af

[5] Drier years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 1 600 000 af

[6] Wet/average years as it applies to the City of Sacramento are time periods when the flows bypassing the E A Fairbairn Water Treatment Plant diversion exceed the Hodge flows

[7] Drier years are time periods when the flows bypassing the Citys E A. Fairbairn Water Treatment Plant diversion do not exceed the Hodge flows

[8] For modeling purposes it is assumed that the City of Sacramentos total annual diversions from the American and Sacramento River in year 2030 would be 130 600 af

[9] The total demand for Sacramento County Water Agency would be up to 78 000 af The 45 000 af represents firm entitlements the additional 33 000 af of demand is expected to be met by intermittent surplus supply The intermittent supply is subject to Reclamation reduction (50%) in dry years

[11] Water Rights Water provided by releases from PCWAs Middle Fork Project inputs into upper American River model must be consistent with these assumptions

[12] Demand requires Replacement Water as indicated below

[13] Arcade WD demand modeled as step function one demand when FUI > 400 another demand when FUI < 400

Appendix B
2007 Delivery Reliability Report
CalSim II Modeling Assumptions

(Taken from Appendix A of "*The State Water Project Delivery Reliability Report 2007*" dated August 2008 by the Department of Water Resources)

Appendix A. 2007 Delivery Reliability Report

CalSim II Modeling Assumptions

The CalSim II model developed for the 2004 Long-Term Central Valley Project Operations Criteria and Plan (OCAP) was modified specifically for the studies in this report The model for this report assumes a D-1641 regulatory environment and implements the 2007 federal court decision on remedy actions for the Delta smelt Two of the proposed actions in that decision, actions 6 and 8, specify a range in upstream flow targets for Old River and Middle River (OMR) The model studies for this report consider both the high and low remedy actions for actions 6 and 8 to bookend the potential effects The assumptions for the remedy actions are shown in the following table

The remedy actions incorporate the Vernalis Adaptive Management Plan (VAMP) export curtailments for the period April 15 – May 15 with impacts borne by the projects The VAMP criteria applied in the model are as follows

Vernalis flow (cfs)	Combined exports (cfs)
< 5700	< 1500
= 5700	< 2250
> 5700 and = < 8600	< 1500 or < 3000 (alternating standard)
> 8600	< 0 5 * flow at Vernalis

Action	Period	OMR Standard (flow upstream in cfs)	
		Remedy Action High	Remedy Action Low
4	December 25 - January 3	< 2000	< 2000
5	January 4 - February 20	< 5000	< 5000
6	February 21 - April 14	< 750	< 2000
7	April 15 - May 15	No OMR standard VAMP controls export	No OMR standard VAMP controls export
8	May 16 - June 30	< 750	< 5000

Where OMR flow = (0 58 * flow at Vernalis) - (0 913 * total export)

The 2004 OCAP model version was also modified to include the three improvements listed below

1 The previous San Joaquin River Basin representation was replaced by the San Joaquin River Water Quality Module version 1 00 (SJRWQM) developed by U S Bureau of Reclamation Mid-Pacific Region The SJRWQM is an update to previous versions that has gone through extensive agency review and a formal peer review

2 The previous Artificial Neural Network (ANN) used to estimate flow-salinity relationships has been replaced with a newer more accurate version The new ANN, and its accompanying implementation to the CalSim II model, produces salinities that match more closely to Delta Simulation Model 2 (DSM2) salinities

3 The Hydrologic sequence of simulated years has been extended to include the water years 1995 – 2003 The new simulation period spans water years 1922 – 2003 whereas the previous sequence covered water years 1922- 1994

All studies assume current SWP Delta diversion limits (often referred to as "Banks Pumping Plant capacity"), existing conveyance capacity of the upper Delta-Mendota Canal/California Aqueduct system, and current SWP/CVP operations agreements **Table A 1** lists key study assumptions **Table A 2** presents the assumptions behind American River demands

Table A.1 2007 Delivery Reliability Report CalSim II modeling assumptions

	Period of Simulation 82 years (1922-2003)	
	Updated Studies (2007)	**Updated Studies (2027)**
HYDROLOGY		
Level of Development (Land Use)	2005 Level *DWR Bulletin 160 98*[1]	2020 Level *DWR Bulletin 160 98*[2]
North of Delta (except American River) Demands		
CVP	Land Use based limited by Full Contract	
SWP (FRSA)	Land Use based limited by Full Contract	
Non Project	Land Use based	
CVP Refuges	Firm Level 2	
American River Basin Demands		
Water rights	2001 Level[3]	2020 Level[4]
CVP	2001 Level[3]	2020 Level[4]
San Joaquin River Basin Demands		
Friant Unit	Limited by contract amounts based on current allocation policy	
Lower Basin	Land use based based on district level operations and constraints	
Stanislaus River Basin	Land use based based on New Melones Interim Operations Plan	
South of Delta Demands		
CVP	Full Contract	
CCWD	151 taf/yr	
SWP (with North Bay Aqueduct)	2 3 3 9 maf/yr	3 9-4 1 maf/yr
SWP Article 21 Demand	MWDSC up to 100 taf/month Dec Mar others up to 84 taf/month	
FACILITIES		
Freeport Regional Water Project	None	Included
Banks Pumping Capacity	6680 cfs	
Tracy Pumping Capacity	4200 cfs + deliveries upstream of DMC constriction	

	Period of Simulation 82 years (1922 2003)	
	Updated Studies (2007)	Updated Studies (2027)
REGULATORY STANDARDS		
Trinity River		
Minimum Flow below Lewiston Dam	369 453 taf/yr	Trinity EIS Preferred Alternative (369 815 taf/yr)
Trinity Reservoir End of September Minimum Storage	Trinity EIS Preferred Alternative (600 taf as able)	
Clear Creek		
Minimum Flow below Whiskeytown Dam	Downstream water rights 1963 USBR Proposal to FWS and NPS and FWS use of CVPIA 3406(b)(2) water	
Upper Sacramento River		
Shasta Lake End-of September Minimum Storage	SWRCB WR 1993 Winter run Biological Opinion (1900 taf)	
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90 5 and 1993 Winter run Biological Opinion temperature control and FWS use of CVPIA 3406(b)(2) water	
Feather River		
Minimum Flow below Thermalito Diversion Dam	1983 DWR DFG Agreement (600 cfs)	
Minimum Flow below Thermalito Afterbay outlet	1983 DWR DFG Agreement (750 – 1700 cfs)	
Yuba River		
Minimum flow below Daguerre Point Dam	Interim D 1641 operations	Lower Yuba River Accord
American River		
Minimum Flow below Nimbus Dam	SWRCB D 893 (see accompanying Operations Criteria) and FWS use of CVPIA 3406(b)(2) water	
Minimum Flow at H Street Bridge	SWRCB D 893	
Lower Sacramento River		
Minimum Flow near Rio Vista	SWRCB D 1641	
Mokelumne River		
Minimum Flow below Camanche Dam	FERC 2916 029 1996 (Joint Settlement Agreement) (100 – 325 cfs)	
Minimum Flow below Woodbridge Diversion Dam	FERC 2916 029 1996 (Joint Settlement Agreement) (25 – 300 cfs)	
Stanislaus River		
Minimum Flow below Goodwin Dam	1987 USBR DFG agreement and FWS use of CVPIA 3406(b)(2) water	
Minimum Dissolved Oxygen	SWRCB D 1422	
Merced River		
Minimum Flow below Crocker Huffman Diversion Dam	Davis Grunsky (180 – 220 cfs Nov – Mar) and Cowell Agreement	
Minimum Flow at Shaffer Bridge	FERC 2179 (25 – 100 cfs)	
Tuolumne River		
Minimum Flow at Lagrange Bridge	FERC 2299 024 1995 (Settlement Agreement) (94 – 301 taf/yr)	
San Joaquin River		
Maximum Salinity near Vernalis	SWRCB D 1641	
Minimum Flow near Vernalis	SWRCB D 1641 and Vernalis Adaptive Management Program per San Joaquin River Agreement	
Sacramento River San Joaquin River Delta		
Delta Outflow Index (Flow and Salinity)	SWRCB D 1641	
Delta Cross Channel Gate Operation	SWRCB D 1641	
Delta Exports	SWRCB D 1641 FWS use of CVPIA 3406(b)(2) water and CALFED Fisheries Agencies use of EWA assets	

	Period of Simulation. 82 years (1922-2003)	
	Updated Studies (2007)	Updated Studies (2027)
OPERATIONS CRITERIA		
Subsystem		
Upper Sacramento River		
Flow Objective for Navigation (Wilkins Slough)	3 250 - 5 000 cfs based on CVP Ag allocation levels	
American River		
Folsom Dam Flood Control	SAFCA Interim re-operation of Folsom Dam Variable 400/670 (without outlet modifications)	
Flow below Nimbus Dam	Operations criteria corresponding to SWRCB D 893 required minimum flow	
Sacramento Water Forum Mitigation Water	None	Sacramento Water Forum (up to 47 taf/yr in dry years)
Feather River		
Flow at Mouth	Maintain the DFG/DWR flow target above Verona or 2800 cfs for Apr- Sep dependent on Oroville inflow and FRSA allocation	
Stanislaus River		
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan	
San Joaquin River		
Flow near Vernalis	San Joaquin River Agreement in support of the Vernalis Adaptive Management Program	
System wide		
CVP Water Allocation		
CVP Settlement and Exchange	100% (75% in Shasta Critical years)	
CVP Refuges	100% (75% in Shasta Critical years)	
CVP Agriculture	100% 0% based on supply (reduced by 3406(b)(2) allocation)	
CVP Municipal & Industrial	100% 50% based on supply (reduced by 3406(b)(2) allocation)	
SWP Water Allocation		
North of Delta (FRSA)	Contract specific	
South of Delta	Based on supply Monterey Agreement	
CVP/SWP Coordinated Operations		
Sharing of Responsibility for In Basin Use	1986 Coordinated Operations Agreement	
Sharing of Surplus Flows	1986 Coordinated Operations Agreement	
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D 1641	
Transfers		
Dry Year Program	None	
Phase 8	None	
MWDSC/CVP Settlement Contractors	None	
CVP/SWP Integration		
Dedicated Conveyance at Banks	None	
NOD Accounting Adjustments	None	

1/ The 2005 Level of Development for the Sacramento Valley is defined by linearly interpolated values from the 1995 Level of Development and 2020 Level of Development from *DWR Bulletin 160 98* The San Joaquin Valley hydrology reflects 2005 land use assumptions developed by U S Bureau of Reclamation to support its studies
2/ The 2020 Level of Development for the Sacramento Valley is from *DWR Bulletin 160 98* The San Joaquin Valley hydrology reflects draft 2030 land use assumptions developed by U S Bureau of Reclamation to support its studies
3/ Presented in attached table of 2007 Study American River Demand Assumptions
4/ Presented in attached table of 2027 Study American River Demand Assumptions
5/ CalSim II model representation for the Stanislaus River does not necessarily represent U S Bureau of Reclamation s current or future operational policies
6/ Delta diversions include operations of Los Vaqueros Reservoir and represents average annual diversion
7/ Includes modified EBMUD operations of the Mokelumne River
8/ This is implemented only in the PCWA Middle Fork Project releases used in defining the CalSim II inflows to Folsom Lake

Table A.2 2007 Study American River demand assumptions

Location / Purveyor	ALLOCATION TYPE (MAXIMUM)					
	CVP AG	CVP MI	CVP Settlement / Exchange	Water Rights / Non CVP / No Cuts	CVP Refuge	Total
Auburn Dam Site (D300)						
Placer County Water Agency	0	0	0	8 500	0	**8,500**
Total	**0**	**0**	**0**	**8,500**	**0**	**8 500**
Folsom Reservoir (D8)						
Sacramento Suburban	0	0	0	0	0	**0**
City of Folsom (includes P L 101 514)	0	0	0	20 000	0	**20 000**
Folsom Prison	0	0	0	2 000	0	**2 000**
San Juan Water District (Placer County)	0	0	0	10 000	0	**10,000**
San Juan Water District (Sac County) (includes P L 101 514)	0	11 200	0	33 000	0	**44 200**
El Dorado Irrigation District	0	7 550	0	0	0	**7,550**
El Dorado Irrigation District (P L 101 514)	0	0	0	0	0	**0**
City of Roseville	0	32 000	0	0	0	**32 000**
Placer County Water Agency	0	0	0	0	0	**0**
Total	**0**	**50 750**	**0**	**65 000**	**0**	**115 750**
Folsom South Canal (D9)						
So Cal WC/ Arden Cordova WC	0	0	0	3 500	0	**3 500**
California Parks and Recreation	0	100	0	0	0	**100**
SMUD (export)	0	0	0	15 000	0	**15 000**
South Sacramento County Agriculture (export SMUD transfer)	0	0	0	0	0	**0**
Canal Losses	0	0	0	1 000	0	**1 000**
Total	**0**	**100**	**0**	**19,500**	**0**	**19,600**
Nimbus to Mouth (D302)						
City of Sacramento	0	0	0	63 335	0	**63,335**
Arcade Water District	0	0	0	2 000	0	**2,000**
Carmichael Water District	0	0	0	8 000	0	**8,000**
Total	**0**	**0**	**0**	**73 335**	**0**	**73 335**
Sacramento River (D162)						
Placer County Water Agency	0	0	0	0	0	**0**
Total	**0**	**0**	**0**	**0**	**0**	**0**
Sacramento River (D167/D168)						
City of Sacramento	0	0	0	38 665	0	**38,665**
Sacramento County Water Agency (SMUD transfer)	0	0	0	0	0	**0**
Sacramento County Water Agency (P L 101 514)	0	0	0	0	0	**0**
EBMUD (export)	0	0	0	0	0	**0**
Total	**0**	**0**	**0**	**38 665**	**0**	**38 665**
Total from the American River	**0**	**50,850**	**0**	**166,335**	**0**	**217 185**

Table A 3 2027 Study American River demand assumptions

Location / Purveyor	ALLOCATION TYPE (MAXIMUM)					
	CVP AG	CVP MI	CVP Settlement / Exchange	Water Rights / Non CVP / No Cuts	CVP Refuge	Total
Auburn Dam Site (D300)						
Placer County Water Agency	0	0	0	35 500	0	**35,500**
Total	**0**	**0**	**0**	**35,500**	**0**	**35,500**
Folsom Reservoir (D8)						
Sacramento Suburban	0	0	0	29 000	0	**29 000**
City of Folsom (includes P L 101 514)	0	7 000	0	27 000	0	**34,000**
Folsom Prison	0	0	0	2 000	0	**2,000**
San Juan Water District (Placer County)	0	0	0	25 000	0	**25,000**
San Juan Water District (Sac County) (includes P L 101 514)	0	24 200	0	33 000	0	**57,200**
El Dorado Irrigation District	0	7 550	0	0	0	**7,550**
El Dorado Irrigation District (P L 101 514)	0	7 500	0	0	0	**7,500**
City of Roseville	0	32 000	0	30 000	0	**62 000**
Placer County Water Agency	0	0	0	0	0	**0**
Total	**0**	**78 250**	**0**	**146,000**	**0**	**224 250**
Folsom South Canal (D9)						
So Cal WC / Arden Cordova WC	0	0	0	5 000	0	**5 000**
California Parks and Recreation	0	5 000	0	0	0	**5,000**
SMUD (export)	0	15 000	0	15 000	0	**30,000**
South Sacramento County Agriculture (export SMUD transfer)	35 000	0	0	0	0	**35 000**
Canal Losses	0	0	0	1 000	0	**1,000**
Total	**35,000**	**20,000**	**0**	**21,000**	**0**	**76 000**
Nimbus to Mouth (D302)						
City of Sacramento	0	0	0	96 300	0	**96,300**
Arcade Water District	0	0	0	11 200	0	**11 200**
Carmichael Water District	0	0	0	12 000	0	**12,000**
Total	**0**	**0**	**0**	**119,500**	**0**	**119,500**
Sacramento River (D162)						
Sacramento Suburban	0	0	0	29 000	0	**29,000**
Total	**0**	**0**	**0**	**29,000**	**0**	**29,000**
Sacramento River (D167/D168)						
City of Sacramento	0	0	0	34 300	0	**34,300**
Sacramento County Water Agency (SMUD transfer)	0	30 000	0	0	0	**30,000**
Sacramento County Water Agency (P L 101 514)	0	15 000	0	0	0	**15 000**
EBMUD (export)	0	133 000	0	0	0	**133,000**
Total	**0**	**178 000**	**0**	**34,300**	**0**	**212 300**
Total from the American River	**35,000**	**98,250**	**0**	**322 000**	**0**	**455,250**

Folsom Unimpaired Inflow (FUI) FUI = Total taf (Mar – Sep) + 60 taf			Notes
> 1600	> 950	< 400	
35 500	35 500	35 500	
35,500	**35,500**	**35,500**	
29 000	0	0	4 5 10
34 000	34 000	20 000	1 2 3
2 000	2 000	2 000	
25 000	25 000	10 000	
57200	57200	44 200	1 2 3
7550	7550	7550	1 2 3
7500	7500	1 450	1 2 3
54 900	54 900	39 800	
0	0	0	10
217150	**188,150**	**125 000**	
5 000	5 000	5 000	
5 000	5 000	5 000	
30 000	30 000	15 000	1 2 3
35 000	0	0	4 5
1 000	1 000	1 000	
76 000	**41,000**	**26 000**	
96 300	96 300	50 000	6 7 8
11 200	11 200	3 500	12
12 000	12 000	12 000	
119 500	**119 500**	**65 500**	
0	29 000	29 000	4 5
0	**29,000**	**29 000**	
34 300	34 300	80 600	8
0	0	0	9
0	0	0	9
0	0	0	
34 300	**34,300**	**80,600**	
448,150	**384 150**	**252 000**	

1/ Wet/average years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is greater than 950 000 af

2/ Drier years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 950 000 af but greater than 400 000 af

3/ Driest years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 400 000 af

4/ Wet/average years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is greater than 1 600 000 af

5/ Drier years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 1 600 000 af

6/ Wet/average years as it applies to the City of Sacramento are time periods when the flows bypassing the E A Fairbairn Water Treatment Plant diversion exceed the Hodge flows

7/ Drier years are time periods when the flows bypassing the City s E A Fairbairn Water Treatment Plant diversion do not exceed the Hodge flows

8/ For modeling purposes it is assumed that the City of Sacramento s total annual diversions from the American and Sacramento River in year 2030 would be 130 600 af

9/ The total demand for Sacramento County Water Agency would be up to 78 000 af The 45 000 af represents firm entitlements the additional 33 000 af of demand is expected to be met by intermittent surplus supply The intermittent supply is subject to Reclamation reduction (50%) in dry years

10/ Water Rights Water provided by releases from PCWA s Middle Fork Project inputs into upper American River model must be consistent with these assumptions

11/ Demand requires Replacement Water as indicated below

12/ Arcade WD demand modeled as step function one demand when FUI > 400 another demand when FUI < 400

Appendix C
Comparison of Key Modeling Between DWR 2007 Delivery Reliability Report and LVE Study

Appendix C
Comparison of Key Modeling Assumptions between DWR 2007 Delivery Reliability Report and LVE Study

This appendix summarizes the comparison of key CalSim II modeling assumptions between the Department of Water Resources (DWR) 2007 State Water Project (SWP) Delivery Reliability Studies and Los Vaqueros Reservoir Expansion (LVE) studies

Models for DWR 2007 studies are established based on the CalSim II model developed for the 2004 Long-Term Central Valley Project Operations Criteria and Plan (OCAP) with changes for DWR's study purposes LVE studies are based on model version 8D of the Common Assumptions package with changes for LVE's study purposes

Since the LVE study models did not consider the climate change effects, the two future scenarios (high and low Delta export assumptions) are compared with DWR studies without climate change effects

Table C-1 summarizes the key assumption comparison under future conditions

Table C-2 summarizes the fish actions assumed for DWR 2007 SWP Delivery Reliability Studies

Table C-3 summarizes the LVE high and low Delta export assumptions

Table C-1 ***Comparison of Key Modeling Assumptions between DWR 2007 SWP Studies and LVE Studies***			
Items	***Sub-items***	***DWR 2007 Future Conditions***	***LVE Future No Action***
Hydrology			
Level of Development	-	• Sacramento Valley 2020 • San Joaquin Valley 2030	Same
CCWD s demand	-	Average 151 TAF/year	149 ~ 184 TAF/year
South Bay Aqueduct capacity	-	300 cfs	430 cfs
Operation Criteria			
Decision1641	-	Included	Same
CVPIA 3406(b)(2)	-	Not included	Included
EWA	-	Not included	Included as Limited EWA
Court Interim Remedy Actions *(See Table 2 and 3 and Figure 1 for details)*	Timing	December 25 ~ June 30	December 1 ~ June 30
	Possible scenarios of **low** fishery restrictions assumptions	• Dec one • Jan one • Feb one • Mar one • Apr one • May one • Jun one	• Dec three • Jan six • Feb two • Mar two • Apr two • May two • Jun two
	Possible scenarios of **high** fishery restrictions assumptions	• Dec one • Jan one • Feb one • Mar one • Apr one • May one • Jun one	• Dec three • Jan six • Feb two • Mar two • Apr two • May two • Jun two
	Range of fishery restrictions assumptions for bookend analysis	• Dec to Feb 20 same assumptions for both low and high restrictions • Feb 21 to Jun In general a bigger range	• Dec to Feb 20 same assumptions for both low and high restrictions but with various scenarios • Feb 21 to Jun In general a smaller range

CDM

Table C-2 Fish Actions Assumed for DWR 2007 SWP Delivery Reliability Studies		
Dates	**Minimum OMR Reverse Flow**	
	High Export	**Low Export**
December 25 – January 3	-2000 cfs	
January 4 – February 20	-5000 cfs	
February 21 – April 14	-2000 cfs	-750 cfs
April 15 – May 15	No OMR standard VAMP controls export	
May 16 – June 30	-5000 cfs	-750 cfs

Table C-3 LVE High and Low Delta Export Assumptions				
Month	**Trigger**	**Condition**	**Minimum OMR Reverse Flow**	
			High Export	**Low Export**
October to November	N/A	N/A	No Action	
December	Turbidity	Sacramento Inflow Sacramento Inflow (previous month) <= 6 000 cfs OR Sacramento plus Yolo Inflow > 80 000 cfs	No Action	
		6 000 cfs < Sacramento Inflow – Sacramento Inflow (previous month) <= 10 000 cfs	Dec 1 15 No Action Dec 16 25 2 000 cfs Dec 26 31 5 000 cfs	
		Sacramento Inflow Sacramento Inflow (previous month) > 10 000 cfs	Dec 1 10 2 000 cfs Dec 11 31 5 000 cfs	
January	Turbidity	Action taken in December	5000 cfs	
		Sacramento plus Yolo Inflow <= 50 000 cfs AND Sacramento Inflow Sacramento Inflow (previous month) <= 6 000 cfs	Jan 1 14 No Action Jan 15 31 5 000 cfs	
		Sacramento plus Yolo Inflow <= 50 000 cfs AND 6 000 cfs < Sacramento Inflow – Sacramento Inflow (previous month) <= 10 000 cfs	Jan 1 9 No Action Jan 10 14 -2 000 cfs Jan 15 31 -5 000 cfs	
		Sacramento plus Yolo Inflow <= 50 000 cfs AND Sacramento Inflow - Sacramento Inflow (previous month) > 10 000 cfs	Jan 1 10 2 000 cfs Jan 11 31 5 000 cfs	
		50 000 cfs < Sacramento plus Yolo Inflow <= 80 000 cfs	Jan 1 10 2 000 cfs Jan 11 31 -5 000 cfs	
		Sacramento plus Yolo Inflow > 80 000 cfs	No Action	
February	Spawning (12 deg C)	Sacramento plus Yolo Inflow > 30 000 cfs	Feb 1 15 5 000 cfs Feb 16 28 4 500 cfs	Feb 1 15 5 000 cfs Feb 16 28 -2 500 cfs
		Sacramento plus Yolo Inflow <= 30 000 cfs	Feb 1 15 5 000 cfs Feb 16 28 3 500 cfs	Feb 1 15 5 000 cfs Feb 16 28 1 500 cfs
March to June	Proximity of smelt to export pumps	Sacramento plus Yolo Inflow > 30 000 cfs	4 500 cfs	2 500 cfs
		Sacramento plus Yolo Inflow <= 30 000 cfs	3 500 cfs	1 500 cfs
July to September	N/A	N/A	No Action	

Appendix D
Detailed Reservoir Capital Costs

Table D-1
Cost Estimate for Upper Del Valle Alternative - 10,500 AF

Title - Upper Del Valle - 10,500 AF	**Type of Estimate - Prelim/Concept Des**
Client - Zone 7	**Bid Price Level - May 2008**
Job Location - Livermore, CA	**Date - May 2008 PAD**

Item	Description		Quantity	Unit	Unit Cost	Amount
1	Mobilization		1	LS	$817 000	$ 817 000
		Subtotal				$ 817 000
2	Clearing & Grubbing			AC		$ -
		Subtotal				$ -
3	Care and Diversion of Water		1	LS	$3 104 000	$ 3 104 000
		Subtotal				$ 3 104 000
4	Bridge Demolition		1	LS	$164 000	$ 164 000
		Subtotal				$ 164 000
5	Dam & Spillway					
5 1	Excavation Unclassified		198 800	CY	$5	$ 974 120
5 2	Grouting		1	LS	$2 549 000	$ 2 549 000
5 3	Consolidation Grouting		22,500	LF	$57	$ 1 282 500
5 4	Drain Holes		7,800	IF	$41	$ 319 800
5 5	Foundation Preparation		10 000	SY	$16	$ 160 000
5 6	Dental Excavation		2 500	CY	$82	$ 205 000
5 7	Concrete - Dental		1 250	CY	$408	$ 510 000
5 8	Slush Grout		4 500	CF	$41	$ 184 500
5 9	RCC - Test Fill		1	LS	$81 700	$ 81 700
5 10	RCC		184 000	CY	$72	$ 13 248 000
5 11	Concrete - Bedding Mix		4 550	CY	$327	$ 1 487 850
5 12	U/S Face - Conv Concrete		8 450	CY	$572	$ 4 833 400
5 13	Concrete - Spillway		3 600	CY	$572	$ 2 059 200
5 14	RCC Spillway Walls		18 000	CY	$98	$ 1,764 000
5 15	Stilling Basin Concrete		2 340	CY	$572	$ 1 338 480
5 16	Steel Reinforcement		1 134 000	LB	$1	$ 1 134 000
5 17	Rock Anchors		4 650	LF	$65	$ 302 250
5 18	Spillway Bridge		1	LS	$776 000	$ 776 000
5 19	Backfill		47 900	CY	$20	$ 958 000
5 20	Instrumentation		1	LS	$163 000	$ 163 000
		Subtotal				$ 34 330 800
6	Intake					
6 1	Concrete		450	CY	$653	$ 293 850
6 2	Steel Reinforcement		67 500	CY	$1	$ 67 500
6 3	Int Slide Gates 3' x 3'		4	EA	$16 350	$ 65 400
6 4	Int Slide Gates 6' x 6'		1	EA	$49 000	$ 49 000
		Subtotal				$ 475 750
7	Outlet					
7 1	Excavation		300	CY	$82	$ 24 600

Table D-1
Cost Estimate for Upper Del Valle Alternative - 10,500 AF

Title - Upper Del Valle - 10,500 AF
Client - Zone 7
Job Location - Livermore, CA

Type of Estimate - Prelim/Concept Des
Bid Price Level - May 2008
Date - May 2008 PAD

Item	Description	Quantity	Unit	Unit Cost	Amount
7 2	Steel Liner	68 900	LB	$5	$ 344 500
7 3	Cone Spool Biturcation	16,450	LB	$6	$ 98 700
7 4	Concrete	910	CY	$653	$ 594 230
7 5	Reinforcing Steel	136 500	LB	$1	$ 136 500
7 6	Misc Metal	1	LS	$8 170	$ 8 170
7 7	Building	1	LS	$130,700	$ 130 700
7 8	48" x 48" hyd operated slide gate	1	LS	$653 000	$ 653 000
7 9	Electrical	1	LS	$32,700	$ 32 700
	Subtotal				$ 2 023 100
8	Allowance for Access Roads	1	LS	$2 859,000	$ 2,859 000
	Subtotal				$ 2 859 000
	Direct Construction Cost (DCC)				$ 43,773 650
	Contingency (35%)				$ 15 320 778
	Subtotal				$ 59 094 428
	Engineer Legal & Client Admin (27%)				$ 15 955 495
	Total Construction Cost (TCC)				$ 75,049 923
	Allowance for Lands				
	Reservoir Inundated Land				
	Purchase (El 820)	78	AC	$24 500	$ 1,911 000
	Flood Easement	88	AC	$3 250	$ 286 000
	Subtotal				$ 2 197 000
	TCC & Allowance for Land				$ 77 246 923

Table D-2
Cost Estimate for Upper Del Valle Alternative - 15,000 AF

Title - Upper Del Valle - 15,000 AF | **Type of Estimate - Prelim/Concept Des**
Client - Zone 7 | **Bid Price Level - May 2008**
Job Location - Livermore, CA | **Date - May 2008** **PAD**

Item	Description		Quantity	Unit	Unit Cost	Amount
1	Mobilization		1	LS	$ 817 000	$ 817 000
		Subtotal				$ 817 000
2	Clearing & Grubbing			AC		$ -
		Subtotal				$ -
3	Care and Diversion of Water		1	LS	$3 104 000	$ 3 104 000
		Subtotal				$ 3 104 000
4	Bridge Demolition		1	LS	$ 164,000	$ 164 000
		Subtotal				$ 164,000
5	Dam & Spillway					
5 1	Excavation Unclassified		287 300	CY	$5	$ 1 407 770
5 2	Grouting		1	LS	$4 116 000	$ 4 116,000
5 3	Consolidation Grouting		35 800	LF	$57	$ 2 040 600
5 4	Drain Holes		14 000	IF	$41	$ 574 000
5 5	Foundation Preparation		15 900	SY	$16	$ 254 400
5 6	Dental Excavation		4 000	CY	$82	$ 328 000
5 7	Concrete - Dental		2 000	CY	$408	$ 816 000
5 8	Slush Grout		7 100	CF	$41	$ 291 100
5 9	RCC - Test Fill		1	LS	$81,700	$ 81 700
5 10	RCC		302 000	CY	$72	$ 21 744 000
5 11	Concrete - Bedding Mix		8 400	CY	$327	$ 2 746 800
5 12	U/S Face - Conv Concrete		11 500	CY	$572	$ 6 578 000
5 13	Concrete - Spillway		4 200	CY	$572	$ 2 402 400
5 14	RCC Spillway Walls		20 000	CY	$98	$ 1 960 000
5 15	Stilling Basin Concrete		2 800	CY	$572	$ 1 601,600
5 16	Steel Reinforcement		1 400 000	LB	$1 00	$ 1 400 000
5 17	Rock Anchors		5 580	LF	$65	$ 362 700
5 18	Spillway Bridge		1	LS	$776 000	$ 776 000
5 19	Backfill		42 400	CY	$13	$ 551 200
5 20	Instrumentation		1	LS	$163 000	$ 163 000
		Subtotal				$ 50 195 270
6	Intake					
6 1	Concrete		500	CY	$653	$ 326 500
6 2	Steel Reinforcement		75 000	CY	$1	$ 75 000
6 3	Int Slide Gates, 3' x 3'		4	EA	$16,350	$ 65,400
6 4	Int Slide Gates 6' x 6		1	EA	$49 000	$ 49 000
		Subtotal				$ 515,900
7	Outlet					
7 1	Excavation		300	CY	$82	$ 24 600

Table D-2
Cost Estimate for Upper Del Valle Alternative - 15,000 AF

Title - Upper Del Valle - 15,000 AF
Client - Zone 7
Job Location - Livermore, CA

Type of Estimate - Prelim/Concept Des
Bid Price Level - May 2008
Date - May 2008 **PAD**

Item	Description	Quantity	Unit	Unit Cost	Amount
7 2	Steel Liner	68,900	LB	$5	$ 344,500
7 3	Cone Spool Biturcation	16 450	LB	$6	$ 98,700
7 4	Concrete	910	CY	$653	$ 594 230
7 5	Reinforcing Steel	136,500	LB	$1	$ 136 500
7 6	Misc Metal	1	LS	$8 170	$ 8 170
7 7	Building	1	LS	$130 700	$ 130 700
7 8	48" x 48" hyd operated slide gate	1	LS	$653 000	$ 653 000
7 9	Electrical	1	LS	$32 700	$ 32 700
	Subtotal				$ 2 023 100
8	Allowance for Access Roads	1	LS	$2 614 000	$ 2 614 000
	Subtotal				$ 2 614 000
	Direct Construction Cost (DCC)				$ 59,433 270
	Contingency (35%)				$ 20 801 645
	Subtotal				$ 80 234 915
	Engineer Legal & Client Admin (27%)				$ 21 663 427
	Total Construction Cost (TCC)				$ 101 898 341
	Allowance for Lands				
	Reservoir Inundated Land				
	Purchase (El 820)	78	AC	$24 500	$ 1,911 000
	Flood Easement	88	AC	$3 250	$ 286 000
	Subtotal				$ 2,197 000
	TCC & Allowance for Land				$ 104 095 341

Table D-3
Cost Estimate for Mid-Reservoir Alternative

Title - Del Valle Mid-Reservoir Alternatives | **Type of Estimate - Prelim/Concept Des**
Client - Zone 7 | **Bid Price Level - May 2008**
Job Location - Livermore, CA | **Date - May 2008** **PAD**

Item	Description		Quantity	Unit	Unit Cost	Amount
1	Mobilization		1	LS	$817 000	$ 817 000
		Subtotal				$ 817 000
2	Clearing & Grubbing			AC		$
		Subtotal				$
3	Care and Diversion of Water		1	LS	$22 871,000	$ 22 871 000
		Subtotal				$ 22 871 000
4	Dam & Spillway					
4 1	Excavation (above El 710)		25,000	CY	$16	$ 400 000
4 2	Excavation (below El 710)		77 000	CY	$8	$ 616 000
4 3	Grouting		1	LS	$1 960 000	$ 1 960 000
4 4	Consolidation Grouting		23 000	IP	$57	$ 1 311 000
4 5	Drain Holes		6,300	IP	$41	$ 258 300
4 6	Foundation Preparation		10 200	SY	$16	$ 163 200
4 7	Dental Excavation		2 550	CY	$82	$ 209 100
4 8	Concrete - Dental		1 275	CY	$408	$ 520 200
4 9	Slush Grout		1 840	CF	$41	$ 75 440
4 10	RCC - Test Fill		1	LS	$81 700	$ 81 700
4 11	RCC		110 000	CY	$72	$ 7 920 000
4 12	Concrete - Bedding Mix		3 300	CY	$327	$ 1 079 100
4 13	U/S Face - Conv Concrete		6 300	CY	$572	$ 3 603 600
4 14	Concrete - Spillway		9 900	CY	$572	$ 5 662 800
4 15	RCC Spillway Walls		5 300	CY	$98	$ 519 400
4 16	Roller Bucket Concrete		6,850	CY	$572	$ 3 918 200
4 17	Steel Reinforcement		1 816 000	CY	$1	$ 1 816 000
4 18	Rock Anchors		6 000	IF	$65	$ 390 000
4 19	Backfill		2 500	CY	$16	$ 40 000
4 20	Instrumentation		1	LS	$163 400	$ 163 400
		Subtotal				$ 30 707 440
6	Intake					
6 1	Concrete		500	CY	$653	$ 326 500
6 2	Steel Reinforcement		75,000	CY	$1	$ 75 000
6 3	Int Slide Gates 3 x 3		4	EA	$16 300	$ 65 200
6 4	Int Slide Gates 6' x 6'		1	EA	$49,000	$ 49 000
		Subtotal				$ 515,700
7	Outlet					
7 1	Excavation		300	CY	$82	$ 24 600
7 2	Steel Liner		68 900	LB	$5	$ 344 500
7 3	Cone Spool, Biturcation		16,450	LB	$6	$ 98 700
7 4	Concrete		910	CY	$653	$ 594 230

Table D-3
Cost Estimate for Mid-Reservoir Alternative

Title - Del Valle Mid-Reservoir Alternatives
Client - Zone 7
Job Location - Livermore, CA

Type of Estimate - Prelim/Concept Des
Bid Price Level - May 2008
Date - May 2008 **PAD**

Item	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Amount**
7 5	Reinforcing Steel	136 520	LB	$1	$ 136 520
7 6	48" x 48" hyd operated slide gate	1	LS	$653 500	$ 653,500
7 7	Misc Metal	1	LS	$8 200	$ 8 200
7 8	Building	1	LS	$130 700	$ 130 700
7 9	Electrical	1	LS	$32,700	$ 32 700
	Subtotal				$ 2 023 650
8	Allowance for Access Roads	1	LS	$3 431 000	$ 3 431 000
	Subtotal				$ 3,431 000
	Direct Construction Cost (DCC)				$ 60,365 790
	Contingency (35%)				$ 21 128 027
	Subtotal				$ 81 493 817
	Engineer Legal & Client Admin (27%)				$ 22 003 330
	Total Construction Cost (TCC)				$ 103 497 147
	Allowance for Lands				
	Reservoir Inundated Land				
	Land Purchase	43	AC	$24 500	$ 1 053 500
	Subtotal				$ 1 053 500
	TCC & Allowance for Land				$ 104,550 647

Table D-4
Cost Estimate for Upper Del Valle Basin Modifications Alternative

Title - Upper Basin Modifications **Type of Estimate - Prelim/Concept Des**
Client - Zone 7 **Bid Price Level - May 2008**
Job Location - Livermore, CA **Date - May 2008** **PAD**

Item	Description	Quantity	Unit	Unit Cost	Amount
	Dozer & Scraper Excavation "in-the-dry"	320 000	CY	$8	$ 2 560 000
	Dozer Scraper frontend loader excavatio	220 000		$11	$ 2 420,000
	Channel dredging	37 000		$25	$ 925 000
	Subtotal				$ 5 905 000
	Direct Construction Cost (DCC)				$ 5 905 000
	Contingency (35%)				$ 2 066 750
	Subtotal				$ 7 971,750
	Engineer Legal & Client Admin (27%)				$ 2 152 373
	Total Construction Cost (TCC)				$ 10 124 123
	Allowance for Lands				$ 653 500
	TCC & Allowance for Land				$ 10 777 623

Table D-5
Cost Estimate for Arroyo Mocho Alternative - 9,000 AF

Title - Arroyo Mocho Alternative 9,000 AF | **Type of Estimate - Prelim/Concept. Des**
Client - Zone 7 | **Bid Price Level - May 2008**
Job Location - Livermore, CA | **Date - May 2008** **PAD**

Item	Description		Quantity	Unit	Unit Cost	Amount
1	Mobilization/Demobilization		1	LS	$817,000	$ 817,000
		Subtotal				$ 817,000
2	Care and Diversion of Water		1	LS	$980,200	$ 980,200
		Subtotal				$ 980,200
3	Unwatering Foundations		1	LS	$163,400	$ 163,400
		Subtotal				$ 163,400
4	Reservoir Clearing		110	AC	$3,300	$ 363,000
		Subtotal				$ 363,000
5	Dam & Spillway					
5.1	Excavation		850,000	CY	$5	$ 4,250,000
5.2	Foundation Treatment		1	LS	$980,200	$ 980,200
5.3	Foundation Preparation		127,300	SY	$5	$ 636,500
5.4	Zone 1 Impervious Fill		633,000	CY	$7	$ 4,431,000
5.5	2 Filter		158,000	CY	$36	$ 5,688,000
5.6	3 Drain		88,200	CY	$41	$ 3,616,200
5.7	4 Shell		1,690,000	CY	$5	$ 8,450,000
5.8	5 Riprap		68,100	CY	$98	$ 6,673,800
5.9	5a Riprap Base		22,600	CY	$90	$ 2,034,000
5.10	Hydroseeding		20	AC	$2,450	$ 49,000
5.20	Instrumentation		1	LS	$163,400	$ 163,400
		Subtotal				$ 36,972,100
6	Spillway					
6.1	Excavation		62,000	CY	$5	$ 310,000
6.2	Foundation Preparation		7,500	SY	$8	$ 60,000
6.3	Drain Material		2,500	CY	$74	$ 185,000
6.4	Anchor Bars		7,800	LF	$65	$ 507,000
6.5	Concrete - Weir		600	CY	$572	$ 343,200
6.6	Concrete - Approach Wells		1,900	CY	$735	$ 1,396,500
6.7	Concrete - Channel		6,430	CY	$735	$ 4,726,050
6.8	Concrete - Stilling Basin		840	CY	$735	$ 617,400
6.9	Steel Reinforcement		1,420,000	LB	$1	$ 1,420,000
6.10	Backfill		22,700	CY	$16	$ 363,200
6.11	Channel/River Transition		1	LS	$57,200	$ 57,200
		Subtotal				$ 9,985,550
7	Outlet Works					
7.1	Excavation		6,500	CY	$11	$ 71,500
7.2	Foundation Preparation		2,000	LS	$13	$ 26,000
7.3	Concrete		1,750	CY	$735	$ 1,286,250

Table D-5
Cost Estimate for Arroyo Mocho Alternative - 9,000 AF

Title - Arroyo Mocho Alternative 9,000 AF | **Type of Estimate - Prelim/Concept Des**
Client - Zone 7 | **Bid Price Level - May 2008**
Job Location - Livermore, CA | **Date - May 2008** **PAD**

Item	Description	Quantity	Unit	Unit Cost	Amount
7 4	Steel Liner	247 000	LB	$5	$ 1 235 000
7 5	Liner Bifurcation	1	LS	$81,700	$ 81 700
7 6	Steel Reinforcement	262,500	LB	$1	$ 262 500
7 7	Backfill	3 260	CY	$41	$ 133 660
7 8	Hyd Opr Slide Gate 5 5' x 5 5'	2	EA	$326 700	$ 653 400
7 9	Control Valve - 48" Diameter	1	EA	$490 100	$ 490 100
7 10	Stoplogs	1	LS	$49 000	$ 49 000
7 11	Butterfly Valve - 36" Diameter	1	LS	$16 300	$ 16 300
7 12	Metal Building	1	LS	$73 500	$ 73,500
7 13	Electrical	1	LS	$32 700	$ 32 700
7 14	Outlet Channel	1	LS	$49,000	$ 49 000
	Subtotal				$ 4 460 610
8	Allowance for Access Roads	1	LS	$5 718 000	$ 5 718 000
	Subtotal				$ 5 718,000
	Direct Construction Cost (DCC)				$ 59 459 860
	Contingency (35%)				$ 20 810 951
	Subtotal				$ 80 270 811
	Engineer Legal & Client Admin (27%)				$ 21 673 119
	Total Construction Cost (TCC)				$ 101 943 930
	Allowance for Lands	330	AC	$24 500	$ 8 085 000
	TCC & Allowance for Land				$ 110 028 930

Table D-6
Cost Estimate for Arroyo Mocho Alternative - 15,000 AF

Title - Arroyo Mocho Alternative 15,000 AF
Client - Zone 7
Job Location - Livermore, CA

Type of Estimate - Prelim/Concept Des
Bid Price Level - May 2008
Date - May 2008 PAD

Item	Description		Quantity	Unit	Unit Cost	Amount
1	Mobilization/Demobilization		1	LS	$817 000	$ 817 000
		Subtotal				$ 817 000
2	Care and Diversion of Water		1	LS	$980 200	$ 980 200
		Subtotal				$ 980 200
3	Unwatering Foundations		1	LS	$163 400	$ 163 400
		Subtotal				$ 163 400
4	Reservoir Clearing		110	AC	$3 300	$ 363,000
		Subtotal				$ 363 000
5	Dam & Spillway					
5 1	Excavation		1 091 000	CY	$5	$ 5 455,000
5 2	Foundation Treatment		1	LS	$980 200	$ 980 200
5 3	Foundation Preparation		169 000	SY	$5	$ 845,000
5 4	Zone 1 Impervious Fill		962 200	CY	$7	$ 6 735 400
5 5	2 Filter		216 000	CY	$36	$ 7 776 000
5 6	3 Drain		120 700	CY	$41	$ 4 948 700
5 7	4 Shell		2 554 000	CY	$5	$ 12 770 000
5 8	5 Riprap		88,100	CY	$98	$ 8 633 800
5 9	5a Riprap Base		29 600	CY	$90	$ 2 664 000
5 10	Hydroseeding		20	AC	$2 450	$ 49 000
5 20	Instrumentation		1	LS	$163 400	$ 163 400
		Subtotal				$ 51,020 500
6	Spillway					
6 1	Excavation		62 000	CY	$5	$ 310 000
6 2	Foundation Preparation		7 500	SY	$8 00	$ 60 000
6 3	Drain Material		2 500	CY	$74	$ 185 000
6 4	Anchor Bars		7 800	LF	$65	$ 507 000
6 5	Concrete - Weir		600	CY	$572	$ 343 200
6 6	Concrete - Approach Wells		1 900	CY	$735	$ 1 396 500
6 7	Concrete - Channel		6 430	CY	$735	$ 4 726 050
6 8	Concrete - Stilling Basin		840	CY	$735	$ 617 400
6 9	Steel Reinforcement		1 420 000	LB	$1	$ 1 420 000
6 10	Backfill		22 700	CY	$16	$ 363 200
6 11	Channel/River Transition		1	LS	$57 200	$ 57 200
		Subtotal				$ 9 985,550
7	Outlet Works					
7 1	Excavation		6 500	CY	$11	$ 71 500
7 2	Foundation Preparation		2 000	LS	$13	$ 26 000
7 3	Concrete		1 750	CY	$735	$ 1 286 250

Table D-6
Cost Estimate for Arroyo Mocho Alternative - 15,000 AF

Title - Arroyo Mocho Alternative 15,000 AF | **Type of Estimate - Prelim/Concept Des**
Client - Zone 7 | **Bid Price Level - May 2008**
Job Location - Livermore, CA | **Date - May 2008** **PAD**

Item	Description	Quantity	Unit	Unit Cost	Amount
7 4	Steel Liner	247 000	LB	$5	$ 1,235 000
7 5	Liner Bifurcation	1	LS	$81 700	$ 81 700
7 6	Steel Reinforcement	262,500	LB	$1	$ 262 500
7 7	Backfill	3 260	CY	$41	$ 133 660
7 8	Hyd Opr Slide Gate 5 5' x 5 5'	2	EA	$326 700	$ 653 400
7 9	Control Valve - 48" Diameter	1	EA	$490 100	$ 490 100
7 10	Stoplogs	1	LS	$49 000	$ 49 000
7 11	Butterfly Valve - 36" Diameter	1	LS	$16,300	$ 16 300
7 12	Metal Building	1	LS	$73 500	$ 73 500
7 13	Electrical	1	LS	$32,700	$ 32 700
7 14	Outlet Channel	1	LS	$49 000	$ 49,000
	Subtotal				$ 4 460 610
8	Allowance for Access Roads	1	LS	$5,881,000	$ 5 881 000
	Subtotal				$ 5 881 000
	Direct Construction Cost (DCC)				$ 73 671 260
	Contingency (35%)				$ 25 784 941
	Subtotal				$ 99 456 201
	Engineer, Legal & Client Admin (27%)				$ 26 853 174
	Total Construction Cost (TCC)				$ 126 309 375
	Allowance for Lands	434	AC	$24 500	$ 10 633 000
	TCC & Allowance for Land				$ 136 942 375

Appendix E

Detailed Pipeline and Pump Station Information

Appendix E
Basis of Cost Assumptions for Pipelines and Pump Stations

Pipelines

Capital costs for pipelines include the base construction cost plus a 35 percent contingency allowance The capital costs also include an engineering, legal, and administrative allowance of 45 percent times the construction cost The total construction cost prorates equal 80 percent of the construction cost

Table E-1 Capital Costs for Pipelines		
Diameter (in)	In-Pavement ($/ft)	Unpaved/ Open Alignment ($/ft)
10	$210	$160
12	$240	$190
14	$290	$240
16	$340	$280
18	$390	$310
20	$420	$340
24	$520	$410
30	$660	$500
36	$810	$600
42	$960	$710
48	$1 120	$810
54	$1 260	$910
60	$1 440	$1 000
66	$1 600	$1 070
72	$1 780	$1 130
78	$1 960	$1 200
84	$2 140	$1 250
90	$2 330	$1 280
96	$2 530	$1 310
102	$2 720	$1 330

Table E-1 presents the unit capital costs for pipelines installed in-pavement or unpaved areas (in April 2008 dollars) The unit capital costs for the transmission pipelines were updated from the costs provided in the 2001 Conveyance Study The 2001 costs were developed based on review of recent construction contracts for similar sized pipe East Bay Municipal Utility District (EBMUD) had developed contract bid cost curves for various size pipelines to be installed in city streets with traffic This information is current and appears representative of pipeline costs in the San Francisco Bay Area

The EBMUD cost curves were used without modification to estimate the cost of pipeline through paved areas For costs of pipeline through unpaved areas, the cost estimates for paved areas were reduced by 20-50 percent, depending on the pipe diameter

Pumping Plants

Capital costs for pump stations include the base construction cost plus a 35 percent contingency allowance, as shown in Table E-2 The capital costs also include an engineering, legal, and administrative allowance of 45 percent times the construction cost The total construction cost prorates equal 80 percent of the construction cost These costs were updated from the costs provided in the 2001 Study The 2001 costs were based on a review of EBMUD cost curves, and recent bids

Table E-2
Capital Costs for Pump Station

HP	$1,000
50	$710
100	$990
200	$1 440
300	$1 780
400	$2 040
500	$2 270
600	$2 540
700	$2 750
800	$2 900
900	$3 060
1000	$3 200
1500	$4 900
2000	$6 500
2500	$8 100
3000	$9 700
3500	$11 300
4000	$13 000
4500	$14 600
5000	$16 200
5500	$17 800
6000	$19 400

Table E-3
Pipeline and Pump Station Costs for Upper Del Valle Reservoir Alternatives

Reservoir Capacity (AF)	Operational Option	Pipelines				Pump Stations	
		Pipeline Design Flow (cfs)	Pipeline Length (ft)	Design Pipe Diameter (in)	Pipeline Cost ($m)	Design Pump Station Horsepower (HP)	Pump Station Cost ($m)
10 500	Supply Storage	32	6 000	30	$4 0	550	$2 3
	Flood Control Storage	32	0	0	$0 0	0	$0 0
15 000	Supply Storage	46	6 000	36	$4 9	800	$2 9
	Flood Control Storage	46	0	0	$0 0	0	$0 0

Table E-4
Pipeline and Pump Station Costs for Arroyo Mocho Reservoir Alternatives

Reservoir Capacity (AF)	Pipelines				Pump Stations	
	Pipeline Design Flow (cfs)	Pipeline Length (ft)	Design Pipe Diameter (in)	Pipeline Cost ($m)	Design Pump Station Horsepower (HP)	Pump Station Cost ($m)
9 000	32	7 500	30	$5 0	650	$2 5
15 000	46	7 500	36	$6 1	1100	$3 5

Appendix F
Environmental Mitigation Costs

Table F-1
Environmental Mitigation Costs for Del Valle Reservoir Alternatives

Reservoir	Reservoir Capacity (AF)	Mitigaiton Acreage (acres)	Mitigation Ratio	Land Costs ($m) [1]	Startup Costs ($m) [2]	Endowment Cost ($m) [3]	Total ($m)
Upper Del Valle		166	3 1	$2 5	$0 2	$0 6	$3 4
Arroyo Mocho	9 000	250	3 2	$3 8	$0 4	$0 9	$5 1
	15 000	300	3 3	$4 5	$0 5	$1 1	$6 1

(1) Assumes $5 000 per acre
(2) Assumes 10% of land costs
(3) Assumes 25% of land costs

Appendix G

Detailed Recreation Facilities Capital Costs

Table G-1
Preliminary Estimated Costs to Replace Existing Del Valle Recreational Facilities

Elevation (ft)	Additional Reservoir Storage (AF)	Impacted Facility	Impact	Total Cost	Capital Cost (1)
710	5 000	Arroyo Mocho	50% of irrigated lawn under water		
			Fine grading and soil amendments	$204 000	
			Seeded Lawn (over 50 000 sq ft) hydroseed	$16 000	
			Sodded Lawn	$163,000	
			Irrigation (over 50 000 sq ft)	$82 000	
			Water connection (pump connections) add 15% of total	$69 750	
		Rocky Ridge	Beach below water		
			Fine grading for swimming area to ach 5 8% slope	$61 500	
			Imported sand	$151 308	
			Shipping cost for sand	$41	
			Swimming area safety facilities	$41 000	
			Lawn completely covered (additional 20 percent)	$1 252,000	
			1 manhole below water	$1,300	
		Family Campground	Standing water in various areas of camp site	$8 000	***$3,320,800***
705 710	5 000	Misc	1500 to 2500 feet of Service Trail from boat ramp toward dam	$81,500	
			500 feet of Tunnel Cove Service Trail (assume asphalt)	$16 300	
			Sewer lift stations and underground utilities	$262 000	
			Sewer lift stations and holding tank by amphitheatre	$163 000	***$846,900***
709	4 300	Arroyo Mocho	More irrigated lawn under water (assume additional 10%)	$535,445	
			Picnic area under water (assume additional 70%)		
			Picnic tables on concrete pad (quantity assumed)	$420 000	
			Barbecue group (assume 1 per 5 tables)	$34,314	
			Trash containers (assume 1 per 10 tables)	$27 300	
			Shade structure (quantity assumed)	$28,500	
		Rocky Ridge	All of curb and more (assume additional 20%) of lawn under water	$1,252 000	***$3,722,000***
708	3 500	Arroyo Mocho	All (2 additional) cabanas under water	$278 000	
			More pathways under water (assume additional 500 ft of packed earth)	$4 100	
			More irrigated lawn under water (assume additional 10%)	$535,445	
			Some picnic area under water (assume 30%)		
			Picnic tables on concrete pad (quantity assumed)	$180 000	
			Barbecue group (assume 1 per 5 tables)	$14 706	
			Trash containers (assume 1 per 10 tables)	$11 700	
			Shade structure (quantity assumed)	$11 400	
		Rocky Ridge	All of curb and more (assume additional 30%) of lawn under water	$1 878 000	
		Family Campground	Drainage swale		***$4,719,600***
707	2 800	Arroyo Mocho	More pathway under water (assume additional 500 ft of packed earth)	$4,100	
			More irrigated lawn under water (assume additional 15%)	$803 168	
			2 cabana pads under water	$278,000	
			Sewer manhole	$1,300	
		Rocky Ridge	All of curb and more of lawn (assume additional 20%) under water	$1 252 000	***$3,788,500***
706	2 000	Arroyo Mocho	500 ln ft of path (assumed packed earth)	$4,100	
			Irrigated lawn NW of cabanas #17/19 (assume 5%)	$267,723	
		Rocky Ridge	20 25% curb and (assume 10%) lawn under water	$626,000	
			All of beach under water (additional 10%)	$240 871	***$1,844,700***
705	1,300	Rocky Ridge	Most sand under water (assume 90 %)	$1 631,453	***$2,643,000***
703	0	None	Normal Summer recreational pool	NA	NA
				Total Cost	**$20 885 500**

(1) *Capital Cost Adjustment*
Pre Design / Design (10 percent)
Engineering Environmental Administration (8 percent)
Construction Support (9 percent)
Contingency (35 percent)
NA = Not available

Appendix H

Hydrologic Year Types based on Sacramento Valley Index

Appendix H - Hydrologic Year Types and Cal Sim Table A Allocations

Water Year	Year Type (1)	Table A Allocations (percent of maximum) from DWR Delivery Reliability Studies					
		Existing			Future		
		2005	2007		2025	2027	
			Low flow target	High flow target		Low flow target	High flow target
1922	AN	91%	90%	87%	100%	98%	89%
1923	BN	79%	79%	74%	100%	75%	72%
1924	C	30%	13%	7%	9%	11%	3%
1925	D	45%	37%	43%	36%	39%	38%
1926	D	72%	59%	47%	66%	58%	48%
1927	W	93%	92%	87%	100%	100%	90%
1928	AN	82%	52%	47%	82%	51%	46%
1929	C	27%	20%	16%	27%	20%	16%
1930	D	69%	50%	48%	66%	57%	51%
1931	C	25%	28%	25%	26%	27%	25%
1932	D	34%	35%	28%	38%	37%	28%
1933	C	32%	53%	42%	32%	55%	46%
1934	C	37%	31%	33%	36%	32%	35%
1935	BN	92%	88%	74%	98%	90%	75%
1936	BN	87%	83%	68%	90%	86%	72%
1937	BN	82%	78%	78%	82%	85%	91%
1938	W	81%	82%	82%	100%	100%	100%
1939	D	79%	79%	79%	83%	85%	76%
1940	AN	78%	78%	76%	100%	88%	76%
1941	W	61%	61%	61%	95%	95%	92%
1942	W	77%	77%	77%	100%	100%	88%
1943	W	75%	76%	76%	92%	93%	84%
1944	D	75%	72%	70%	86%	71%	62%
1945	BN	75%	75%	75%	94%	82%	80%
1946	BN	78%	78%	77%	93%	92%	83%
1947	D	80%	64%	48%	67%	41%	44%
1948	BN	72%	64%	62%	71%	79%	70%
1949	D	55%	34%	27%	49%	34%	27%
1950	BN	78%	64%	56%	82%	66%	54%
1951	AN	85%	85%	85%	100%	100%	100%
1952	W	63%	63%	63%	95%	95%	95%
1953	W	81%	80%	80%	100%	99%	77%
1954	AN	80%	80%	75%	100%	74%	73%
1955	D	54%	29%	26%	36%	24%	24%
1956	W	87%	87%	87%	100%	100%	100%
1957	AN	79%	65%	59%	86%	60%	48%
1958	W	72%	73%	73%	100%	100%	100%
1959	BN	85%	82%	86%	92%	78%	71%
1960	D	45%	40%	30%	39%	38%	30%
1961	D	65%	61%	53%	66%	66%	60%
1962	BN	79%	70%	73%	80%	73%	76%
1963	W	93%	90%	75%	100%	95%	75%
1964	D	81%	49%	58%	70%	39%	53%
1965	W	74%	73%	65%	84%	81%	72%
1966	BN	80%	79%	79%	100%	84%	82%
1967	W	72%	72%	72%	100%	100%	98%
1968	BN	81%	80%	79%	92%	72%	57%
1969	W	64%	64%	64%	95%	94%	94%
1970	W	79%	79%	79%	100%	100%	100%
1971	W	81%	81%	80%	100%	89%	76%

Appendix H - Hydrologic Year Types and Cal Sim Table A Allocations

Water Year	Year Type [1]	Table A Allocations (percent of maximum) from DWR Delivery Reliability Studies					
		Existing			Future		
		2005	2007		2025	2027	
			Low flow target	High flow target		Low flow target	High flow target
1972	BN	81%	46%	37%	66%	35%	36%
1973	AN	75%	75%	74%	98%	100%	84%
1974	W	77%	77%	77%	100%	100%	91%
1975	W	79%	78%	78%	100%	88%	78%
1976	C	79%	72%	54%	76%	52%	39%
1977	C	4%	5%	6%	5%	7%	7%
1978	AN	88%	87%	87%	94%	94%	94%
1979	BN	85%	79%	73%	91%	80%	74%
1980	AN	66%	66%	66%	85%	91%	94%
1981	D	82%	79%	72%	92%	66%	62%
1982	W	70%	71%	71%	100%	100%	100%
1983	W	61%	60%	60%	95%	94%	94%
1984	W	67%	78%	78%	100%	100%	100%
1985	D	78%	78%	77%	83%	78%	73%
1986	W	56%	56%	56%	69%	69%	69%
1987	D	70%	69%	67%	80%	65%	55%
1988	C	21%	13%	10%	10%	11%	10%
1989	D	77%	76%	76%	85%	84%	77%
1990	C	27%	12%	5%	21%	7%	5%
1991	C	26%	20%	16%	21%	22%	18%
1992	C	35%	27%	26%	35%	27%	27%
1993	AN	94%	93%	87%	100%	98%	85%
1994	C	80%	50%	52%	76%	45%	55%
1995	W	-	72%	72%	-	94%	94%
1996	W	-	83%	83%	-	100%	87%
1997	W	-	73%	77%	-	80%	78%
1998	W	-	73%	73%	-	95%	95%
1999	W	-	83%	83%	-	100%	100%
2000	AN	-	84%	83%	-	96%	80%
2001	D	-	32%	24%	-	19%	24%
2002	D	-	60%	45%	-	63%	50%
2003	AN	-	76%	67%	-	78%	69%
Average		68%	64%	61%	77%	71%	66%
Maximum		94%	5%	5%	100%	7%	3%
Minimum		4%	93%	87%	5%	100%	100%

[1] As defined by the DWR Sacramento Valley Index as published in DWR Bulletin 120 The index is based on the unimpaired runoff for the water year at the following locations Sacramento River above Bend Bridge near Red Bluff Feather River total inflow to Oroville Reservoir Yuba River at Smartville American River total inflow to Folsom Reservoir

Year Type	Abbreviation	Unimpaired Flow (million AF)
Wet	W	Equal to or greater than 9 2
Above Normal	AN	Greater than 7 8 and less than 9 2
Below Normal	BN	Greater than 6 5 and equal to or less than 7 8
Dry	D	Greater than 5 4 and equal to or less than 6 5
Critical	C	Equal to or less than 5 4

Appendix I

Conceptual Alignments for Delta Water Conveyance Facilities

Appendix I
Conceptual Alignments for Delta Conveyance Facilities

Source: California Department of Water Resources, Bay Delta Office. 2008b. "An Initial Assessment of Dual Delta Water Conveyance – Final Draft, 2008". Page 10. Accessed 3/23/09: http://www.water.ca.gov/news/newsreleases/2008/061908assessmentdual.pdf

Source: California Department of Water Resources, Bay Delta Office. 2008b. "An Initial Assessment of Dual Delta Water Conveyance – Final Draft, 2008". Page 12. Accessed 3/23/09: http://www.water.ca.gov/news/newsreleases/2008/061908assessmentdual.pdf