2011 Water Supply Evaluation

A Risk-Based Approach To Evaluating
Zone 7 Water Agency's
Water Supply System

July 2011

Zone 7 Water Agency

Mission Statement

Zone 7 Water Agency is committed to providing a reliable supply of high quality water and an effective flood control system to the Livermore-Amador Valley. In fulfilling our present and future commitments to the community, we will develop and manage the water resources in a fiscally responsible, innovative, proactive and environmentally sensitive way.

2011 WATER SUPPLY EVALUATION

A RISK-BASED APPROACH TO EVALUATING ZONE 7 WATER AGENCY'S WATER SUPPLY SYSTEM

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ZONE 7 WATER AGENCY

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ACRONYMS AND DEFINITIONS

The following terms and acronyms have been used throughout this Water Supply Evaluation to improve document clarity and readability.

ACWD	Alameda County Water District
AF	Acre-Feet
AFA	Acre-Feet Annually
APL	Altamont Pipeline
ASR	Aquifer Storage Recovery
AWTP	Altamont Water Treatment Plant
B.O.	Biological Opinion
BARDP	Bay Area Regional Desalination Project
BBID	Byron-Bethany Irrigation District
BDCP	Bay Delta Conservation Plan
Board	Zone 7 Board of Directors
Cal Water	California Water Service Company
CalSIM	California Statewide Integrated Model
Cawelo	Cawelo Water District
CCWD	Contra Costa Water District
CEQA	California Environmental Quality Act
CFS	Cubic Feet Per Second
CIP	Capital Improvement Program
Conservation Act	Water Conservation Act of 2009 (SBX 7-7 or 20 by 2020)
DAF	Dissolved Air Flotation
Delta	Sacramento-San Joaquin Delta
DHA	Dublin Housing Authority
DHCCP	Delta Habitat Conservation and Conveyance Plan
District	Alameda County Flood Protection and Water Conservation District
DSRSD	Dublin San Ramon Services District
DSS	Decision Support System
DVWTP	Del Valle Water Treatment Plant
DWR	Department of Water Resources
EBMUD	East Bay Municipal Utility District

EBRPD	East Bay Regional Parks District
EIR	Environmental Impact Report
EIS	Environmental Impact Study
Eto	Evapotranspiration
ExtendSIM	Extended Simulation Model
GIS	Geographic Information System
GPCD	Gallons Per Capita Per Day
GPQ	Groundwater Pumping Quota
GUI	Graphic User Interface
GWMP	Groundwater Management Plan
LARPD	Livermore Area Recreation and Parks District
Livermore	City of Livermore
LLNL	Lawrence-Livermore National Laboratory
M&I	Municipal and Industrial
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
Mg/L	Milligrams per Liter
MGD	Million Gallons Per Day
MGDP	Mocho Groundwater Demineralizaton Plant
Msl	Mean sea level
O&M	Operation and Maintenance
PHG	Public Health Goal
Pleasanton	City of Pleasanton
PPWTP	Patterson Pass Water Treatment Plant
Retailers	Cal Water, DSRSD, Livermore, Pleasanton or local water supply retailers
RO	Reverse Osmosis
RWQCB	Regional Water Quality Control Board
SBA	South Bay Aqueduct
SBPP	South Bay Pumping Plant
SCVWD	Santa Clara Valley Water District
SEI	Stockholm Environment Institute
Semitropic	Semitropic Water Storage District

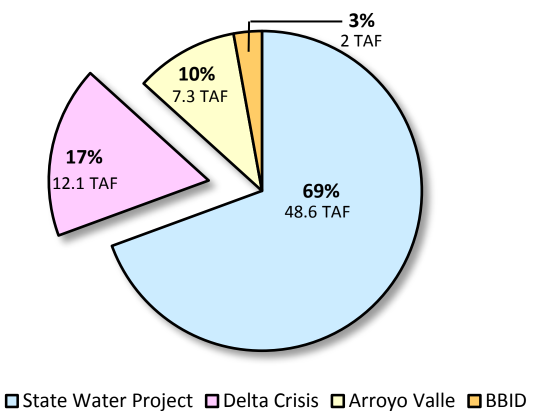
SFPUC	San Francisco Public Utilities Commission
SLR	San Luis Reservoir
SMP	Salt Management Plan
SWAN	Statewide Water Analysis Network
SWP	State Water Project
TAF	Thousand Acre-Feet
TDS	Total Dissolved Solids
UAFW	Unaccounted-For Water
UF	Ultrafiltration
VA	Veterans Association
Valley	Livermore-Amador Valley
WEAP	Water Evaluating and Planning
WQMP	Water Quality Management Program
WSE	Water Supply Evaluation
Yuba Accord	Lower Yuba River Accord
Zone 7	Zone 7 Water Agency

EXECUTIVE SUMMARY

PURPOSE AND OBJECTIVES

Over the past few decades, Zone 7 Water Agency (Zone 7) has developed a robust system that provides a reliable and sustainable treated and untreated water supply for the Livermore-Amador Valley (Valley). However, 80% of Zone 7's long-term average water supply – State Water Project (SWP) water – is currently subject to a very uncertain future due to legal and environmental constraints in the Sacramento-San Joaquin Delta (Delta). In fact, over the past few years, Zone 7's long-term average yield from the SWP has been reduced by over 12 thousand acre-feet (TAF), or about 17% of total supplies.

Figure ES-1. Water Supply Reduced from SWP



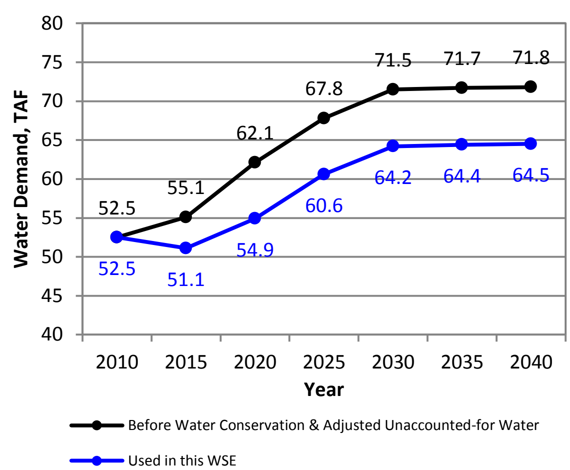
Consequently, Zone 7 staff developed a probability-based water supply model to help assess near-term and long-term risks of a water supply shortage. A preliminary analysis completed in November 2009 indicated that the chance of water supply shortages increased dramatically beyond 2015 as projected water demands began to exceed long-term average water supplies sometime between 2015 and 2020.[1] In light of this analysis, Zone 7 completed this Water Supply Evaluation (WSE) to help identify operational improvements and additional studies that will minimize near-term risks of water supply shortages and maximize long-term flexibility by evaluating potential new supply sources.

Due to the future uncertainty of the Delta, Zone 7 staff also evaluated the ability of various mixes of water supplies to meet different reliability targets to facilitate future discussions with the Zone 7 Board of Directors.

PROJECTED WATER DEMANDS

Zone 7 staff – in close coordination with its four Retailers – developed projected water demands for the Valley through buildout of adopted general plans. Zone 7 staff also estimated potential Valley-wide water conservation requirements associated with the Water Conservation Act of 2009 (Conservation Act), which was approximately 6 TAF. Of this amount, Zone 7 staff assumed that approximately 4 TAF was associated with traditional conservation measures (e.g., low-flow toilets) and that about 2 TAF was associated with additional recycled water. The demand projections also assume that Zone 7 can reduce its unaccounted-for water by approximately 1.3 TAF.

Figure ES-2. Projected Zone 7 Water Demands[2]



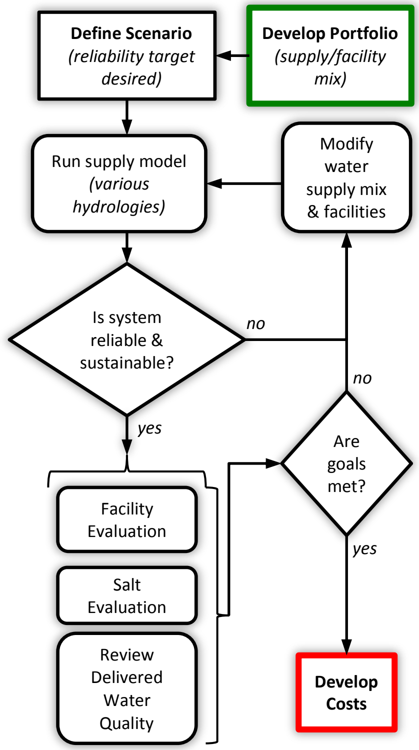
[1] Zone 7 Water Agency, 2009. Interoffice Memo – Water Supply Update. November 18.

[2] Figure ES-2 does not include additional demands associated with storage and demineralization losses, or artificial recharge.

METHODOLOGY FOR EVALUATION

Zone 7 staff considered water supply, facility needs, salt balance, and delivered water quality while evaluating the Current Plan and two backup portfolios under various scenarios (see Figure ES-3). Portfolios are mixes of different water supplies and facilities, while scenarios refer to different reliability targets.

Figure ES-3. Methodology



Water Supply Methodology

Zone 7 used Microsoft Excel, along with Frontline System's Risk Solver, to develop a new water balance model. Unlike typical water balance models, key water supplies were modeled as uncertain variables – their value was determined through Monte Carlo methods.

Climate Change

The SWP provides Zone 7 over 80% of its long-term average water supplies; hence, climate changes that reduce SWP allocations likely dominate the potential impacts of climate change on Zone 7's overall water supplies. Consequently, this analysis used DWR projections of SWP allocations that incorporated climate change.[3]

Definition of Reliability and Sustainability

Zone 7 staff used two criteria to evaluate the effectiveness of various water supply portfolios: reliability and sustainability. Zone 7 defined reliability based on the maximum shortage possible, but for completeness, also provided two additional pieces of information based on a risk curve developed for each scenario: (1) a mid-point shortage and (2) the percent of time no shortages are expected.

Zone 7 staff used the term sustainability to describe the trend of median storage levels. A decreasing median storage level would indicate that a particular water supply portfolio is relying on drought and emergency storage during normal hydrologic conditions, ultimately an unsustainable condition.

Water Facility Methodology

The portfolios involved different water supplies that drove facility needs. Therefore, Zone 7 staff compared and recommended facility production capacities necessary to meet current policies—both peak day and outage scenarios.

Salt Balance Methodology

One of Zone 7's goals is to balance long-term salt loading and removal within the Main Basin. Different water supply sources have different water quality characteristics, which could change salt loading. Consequently, Zone 7 staff conducted a preliminary analysis using updated salt balance models previously developed as part of the original Salt Management Plan (SMP). However, Zone 7 staff is recommending further evaluation as part of the planned Groundwater Management Plan update, which will include an SMP Update.

Delivered Water Quality Methodology

Zone 7 staff completed a qualitative review to determine potential positive or negative water quality impacts on Zone 7's system using the goals established in Zone 7's Water Quality Management Plan.

Cost Estimating Methodology

Zone 7 staff divided portfolio costs for each scenario evaluated into three categories: (1) water supplies, (2) water facilities, and (3) water quality. This allowed for a more refined comparison of portfolio and scenario costs.

[3] Allocations based on DWR's 2009 Reliability Report for the SWP.

EVALUATION OF THE CURRENT PLAN

The Current Plan assumes that the State of California implements a Delta Fix that restores the reliability of the SWP and that Zone 7 successfully implements its existing Capital Improvement Program (CIP). This portfolio also assumes Zone 7 can reduce unaccounted-for water, reduce demineralization losses, confirm the minimum yield of the Byron Bethany Irrigation District (BBID) contract, implement an enhanced in-lieu recharge program, and perfect its existing local water right permit.

Delta Fix Assumptions

The following assumptions for a fix in the Delta were used to evaluate the Current Plan:

- Long-term Average Yield: 75% of Table A
- Water Quality: ~20% Avg. Reduction in TDS
- Online between 2020 & 2030: assumed 2025
- Cost: $12 Billion ($140 Million to Zone 7)

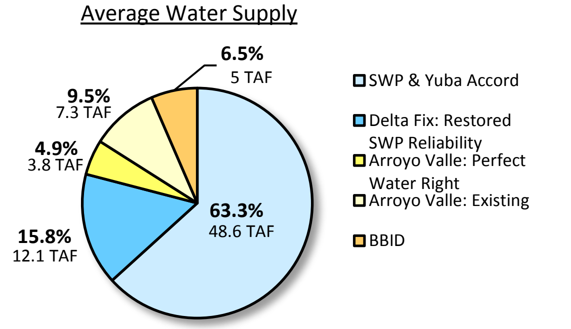
Reliability: 85 to 99%

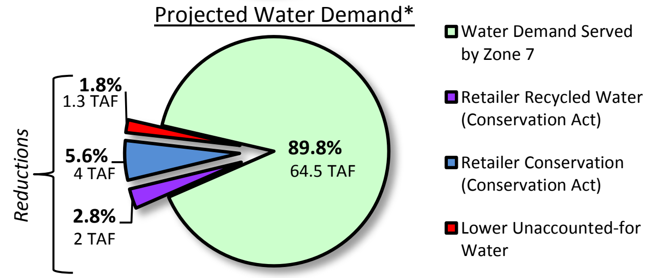
Based on the analysis completed, Zone 7 staff found that the Current Plan provides a minimum reliability of 85%. More specifically, there is a less than 1% chance of a shortage larger than 15%, there is only about a 2% chance of a 10% shortage, and there will not likely be any shortages 96% of the time. Storage levels were found to be sustainable. Zone 7 staff identified two options for increasing reliability above 85%: (1) Chain of Lakes (COL) pipeline and (2) spot-market water for drought.

Facilities, Salt Balance, and Water Quality

The current facility policies can be met once new treated-water capacity (~20 MGD by 2023) was constructed to meet maximum day demand. However, the construction schedule of new capacity influences the ability to meet facility outages. At least one more phase of demineralization is required to achieve salt balance, but staff recommends further evaluation as part of the GWMP/SMP Update. No potential negative delivered water quality impacts were identified as long as the Delta Fix reduces average TDS concentrations by ~20%.

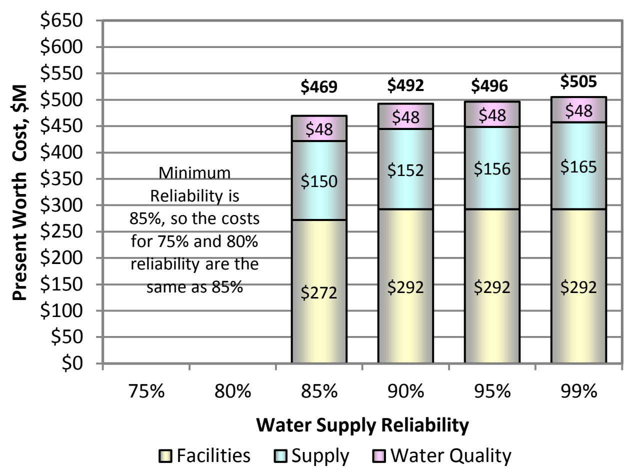
Figure ES-4. Supply & Demand Mix: Current Plan





** Demands in this figure do not include water supply required for groundwater recharge or storage losses.*

Figure ES-5. Estimated Costs: Current Plan



Current Plan Results

- Minimum reliability is 85%
- COL Pipeline & Spot Market water required to increase reliability above 85%
- Still requires additional surface water treatment plant capacity: 20 MGD by 2023
- Still requires Well Master Plan wells & Chain of Lakes recharge
- With additional demineralization, no water quality impacts identified *(requires verification)*
- Cost Increase from 85 to 99%: < 10% *($469 to $505M)*

POTENTIAL BACKUP SUPPLY SOURCES

Starting in early 2010, Zone 7 staff began developing a comprehensive list of potential water supply options to help create backup portfolios in case the Current Plan assumptions change. The options ranged from the obvious to the unlikely, but the entire list was vetted internally, with the Retailers, and with the Zone 7 Board of Directors. Based on input received, Zone 7 staff then screened the options to develop two backup portfolios.

Supply Options Divided into Categories

For comparative purposes, the original 24 water supply options identified were divided into six different categories:

- Increased yield from existing supplies,
- New or additional water supplies,
- Stormwater runoff and rainfall capture,
- Recycled water,
- Desalination and demineralization, and
- Operational improvements.

The supply options ranged from simple operational improvements (e.g., reducing unaccounted-for water) to complex multi-partner arrangements (e.g., regional desalination).

Supply Options Screened Down to 12

Zone 7 staff then screened the 24 water supply options based on potential water supply yield, the associated technical and institutional barriers, and any unique contributions any particular supply added to Zone 7's water system. The remaining 12 water supply options (see Table ES-1) were then used to create two backup portfolios to augment the Current Plan.

Two Backup Portfolios: In-Valley and Intertie

The first backup portfolio focused only on those local supply options available to the Livermore-Amador Valley and eliminated imported sources; this group of supplies was called the "In-Valley" Portfolio. The second backup portfolio focused on the lowest unit cost options that also provided the highest water quality benefit; this option was called the "Intertie" Portfolio.

Table ES-1. Options Used to Develop Portfolios

Option	Average Yield, acre-feet annually	Amortized Cost, $/acre-foot[(a)]
Arroyo Valle – Perfection of Existing Permit	3,800	$20
Reduce Mocho Demineralization Losses	260	$30
Reduce Unaccounted-for Water Losses	1,300	$100
Enhance Existing In-Lieu Recharge	500 to 830	$110
Arroyo Las Positas Water Rights	750	$200
Arroyo Mocho Water Rights	900	$200
Confirm BBID Yield	3,000	$285
Intertie Supply: Long-term Leases	up to 10,900	$1,400
Recycled Water – Direct	up to 3,700	$1,500
Groundwater Injection: Recycled Water	2,800	$1,600
Intertie Supply: Regional Desalination	up to 9,300	$2,000
Recycled Water - Storage	up to 17,300	$2,400

(a) Based on 2010 ENR SF CCI. Amortized costs assume a 6% interest rate for 30 years.

In-Valley Portfolio: This portfolio focused mainly on recycled water supplies and acquisition of other local water rights.

Intertie Portfolio: This portfolio focused mainly on the lowest unit cost and highest quality water supplies.

EVALUATION OF BACKUP PORTFOLIO: IN-VALLEY

The In-Valley Portfolio assumes Zone 7 is able to work with the Retailers to develop new recycled water supplies. This portfolio also assumes acquisition of additional local water rights.

In-Valley Portfolio Assumptions

The following assumptions were used to evaluate the In-Valley Portfolio:

- Assumes SWP Yield: 60% of Table A Amount
- Potable demand reduction is available
- Recycled Supply Sources: Dublin San Ramon Services District (DSRSD), Livermore, and Pleasanton

Reliability: 75 to 99%

Based on the analysis completed, Zone 7 staff found that the In-Valley Portfolio could provide reliabilities ranging from 75 to 99% while also maintaining sustainable storage levels. The additional recycled water required, beyond existing programs and assumed conservation, ranges from 1,000 to 5,600 AF, and must be online by 2025.

Key Issue: Salt Balance

Based on the preliminary salt balance analysis, only a portion of the additional recycled water can be applied over the Main Basin without triggering more than one additional phase of demineralization. Zone 7 staff recommends re-evaluating as part of the GWMP/SMP Update.

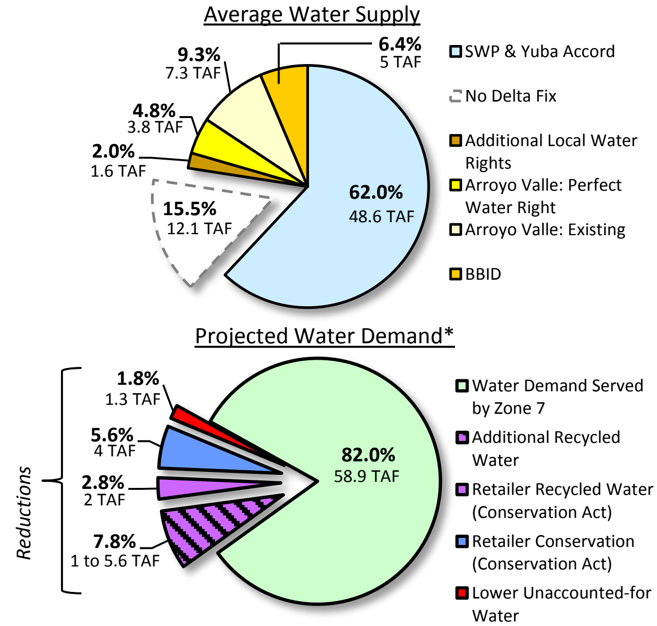
Key Issue: Potable Demand Reduction Required

The analysis in this WSE identified the potable demand reduction required. Zone 7 staff strongly recommends that the Retailers and Zone 7 work together to verify costs and potential recycled water demands in a separate study.

Facilities and Water Quality

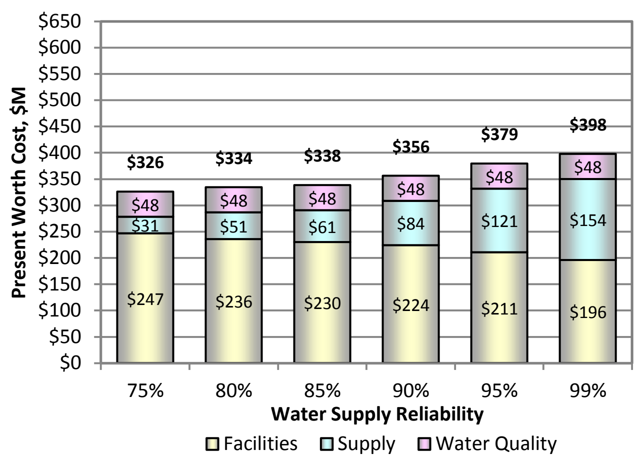
Zone 7 found that the current facility policies could be met by providing enough treated-water capacity (~7 to 15 MGD by 2024 to 2030) to meet maximum day demand. No potential negative delivered water quality impacts were identified as long as the amount of recycled water applied over the Main Basin is limited.

Figure ES-6. Supply & Demand Mix: In-Valley



** Demands in this figure do not include water supply required for groundwater recharge or storage losses.*

Figure ES-7. Estimated Costs: In-Valley



Backup Portfolio Results: In-Valley

- Minimum reliability is 75%
- Still requires additional surface water treatment plant capacity: 7 to 15 MGD between 2024 and 2030
- Still requires Well Master Plan wells & Chain of Lakes recharge
- With additional demineralization, no water quality impacts were identified *(requires verification)*
- Cost Increase from 75 to 99%: ~ 20% *($326 to $398M)*

EVALUATION OF BACKUP PORTFOLIO: INTERTIE

The Intertie Portfolio assumes Zone 7 constructs a new intertie with another water agency (e.g., EBMUD or SFPUC) and wheels new high quality water supply into Zone 7's water system. The Intertie Portfolio also assumes Zone 7 acquires additional local water rights.

Intertie Portfolio Assumptions

The following assumptions were used to evaluate the Intertie Portfolio:

- Assumes SWP Yield: 60 percent
- Water Quality Similar to EBMUD supply
- No added capacity for meeting peak demands

Reliability: 90 to 99%

If Zone 7 acquired at least 5,100 AF of normal/wet year supply, then the Intertie Portfolio provided a minimum reliability of 90%. Dry year supply needs were up to 5,600 AF depending on the reliability target evaluated. The new supplies would need to be online between 2020 and 2030. The analysis indicated that long-term storage levels were unsustainable if new normal/wet year water supplies were not continued beyond 2038.

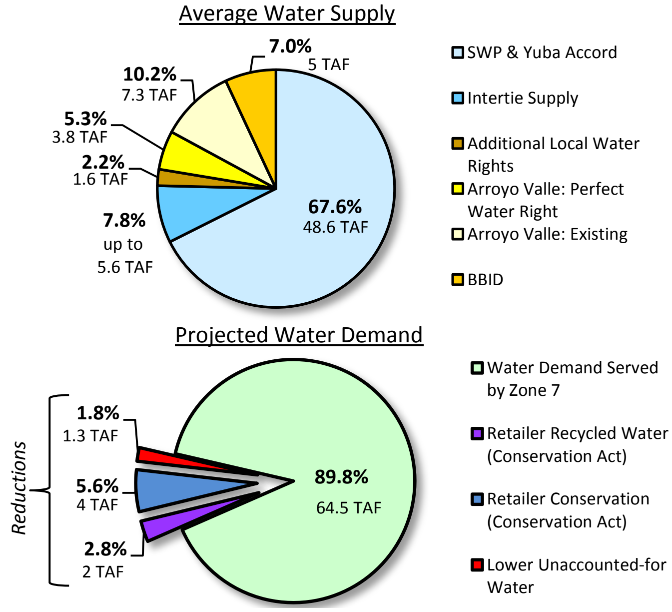
Key Issue: Uncertainty of Supply Source

Preliminary discussions with EBMUD staff indicate that normal/wet year water cannot be wheeled to Zone 7 via EBMUD's Freeport project because it is only used during dry years. Additional discussions with EBMUD indicate that there are no normal/wet year water supplies available in the Mokelumne watershed, and due to source water constraints, EBMUD may not currently have a source of supply they can use to participate in a groundwater-banking program with Zone 7. The most likely source of normal/wet year water is regional desalination *(requires additional study)*.

Facilities, Salt Balance, and Water Quality

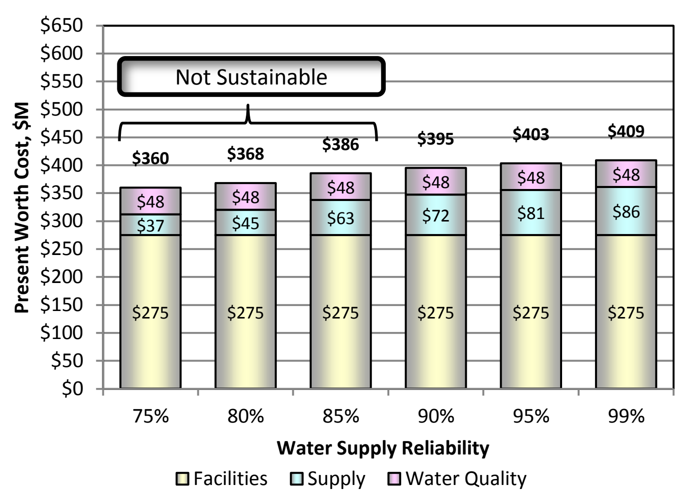
The analysis completed for the Intertie Portfolio yielded similar results to the Current Plan: (1) ~20 MGD of additional treated-water capacity by 2023, (2) Zone 7 staff recommends verifying salt balance results as part of the GWMP/SMP Update, and (3) no potential negative delivered water quality impacts were identified.

Figure ES-8. Supply & Demand Mix: Intertie



** Demands do not include water supply required for groundwater recharge or storage losses.*

Figure ES-9. Estimated Costs: Intertie



Backup Portfolio Results: Intertie

- Minimum reliability to achieve sustainability is 90%
- Still requires additional surface water treatment plant capacity: 20 MGD by 2023
- Still requires Well Master Plan wells & Chain of Lakes recharge
- No water quality impacts anticipated
- Cost Increase from 75 to 99%: ~ 14% *($360 to $409M)*

RECOMMENDED NEAR-TERM ACTIONS

Based on the analysis completed as part of this WSE, Zone 7 staff recommends a series of "no regret" actions that will help minimize near-term risks of water supply shortages, and several additional studies necessary to confirm key assumptions made for both the In-Valley and Intertie Portfolios. Figure ES-11 provides a preliminary schedule for key actions and studies.

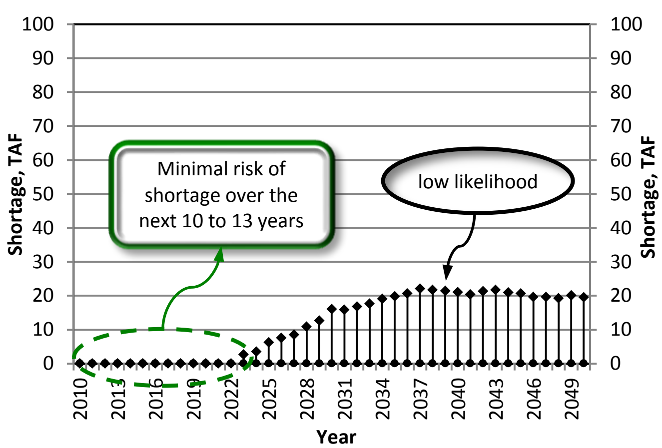
"No Regret" Actions

All of the following activities are lowest-cost alternatives and within local control (i.e., either Zone 7 or the Retailers):

- Reducing Unaccounted-for Water,
- Minimizing demineralization brine losses,
- Confirming available supply under existing contract with BBID,
- Enhancing existing in-lieu recharge program,
- Continued support of the Conservation Act,
- Working with Retailers to develop a water conservation tracking methodology, and
- Continuing to implement the Well Master Plan and Chain of Lakes projects.

These no regret actions will help Zone 7 minimize the risk of shortages larger than 1% for the next 10 to 13 years, until completion of a major new water supply project, which can take over 10 years to complete.

Figure ES-10. Benefits of No Regret Actions



Recommended Studies: Current Plan

The key to improving reliability under the Current Plan is to work with the other SWP contractors and other stakeholders to increase the reliability of the SWP; consequently, Zone 7 staff recommends continued participation in any studies and other efforts potentially leading toward increased reliability of the SWP and sustainability of the Delta.

Recommended Studies: In-Valley Portfolio

Zone 7 and the Retailers may need to develop as much as 7,600 AF of additional recycled water supply—above the 5,900 AF already planned by the Retailers—to meet various reliability targets under the In-Valley Portfolio. This is a significant amount of recycled water; Zone 7 staff therefore recommends:

- Refining potential water quality assumptions as part of the GWMP/SMP update,
- Identifying or linking feasible potable demand reduction using recycled water irrigation, and
- Identifying feasible recycled water storage options – both local and non-local.

Recommended Studies: Intertie Portfolio

The water supply yields and costs for each potential supply source under the Intertie Portfolio are still uncertain at this time; consequently, Zone 7 staff recommends:

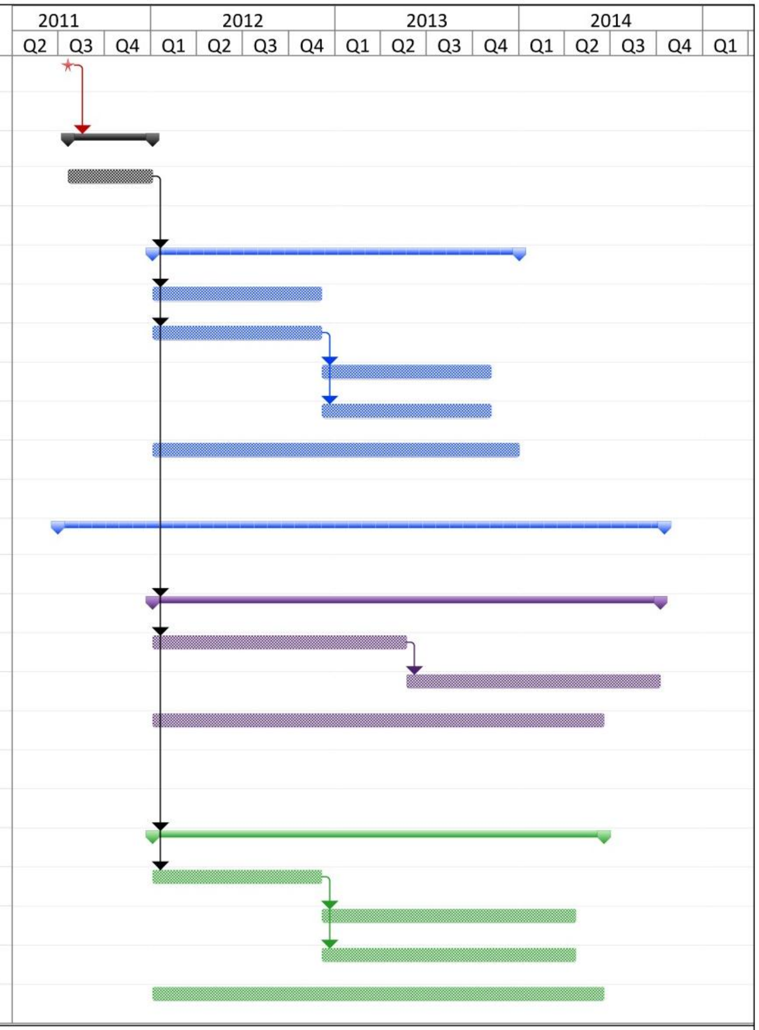
- Identifying feasible options for a new intertie with another water agency,
- Continuing to participate in studies for the Bay Area Regional Desalination Project, and
- Confirming available water supplies.

Recommend Reviewing Reliability Policy

This analysis indicated that costs and individual portfolios are not strong drivers, but that other factors (e.g., demand hardening and uncertainty) could drive changes in the reliability policy. Zone 7 staff recommends working with the Retailers to develop several proposals for changing the existing reliability policy for the Zone 7's Board of Directors to consider.

Figure ES-11. Measures of Success: Preliminary Schedule of Next Steps

ID	Task Name
1	**Finalize Water Supply Evaluation**
2	
3	**Review Reliability Policy**
4	Develop Proposals with Retailer Input
5	
6	**No Regret Actions**
7	Unaccounted-for Water Study
8	Brine Loss Study
9	Confirm BBID Yield
10	Formalize Enhanced In-Lieu Recharge Program
11	Water Conservation Tracking Methdology
12	
13	**On-Going Studies for the Delta and SWP**
14	
15	**Activities for the In-Valley Portfolio**
16	Link Potable Reductions Required to Potential Recycled Water Demand
17	Investigate Feasible Recycled Water Storage Options
18	Understand Water Quality Implications Associated with Recycled Water
19	*(in coordination with the Groundwater Management Plan Update)*
20	
21	**Activities for the Intertie Portfolio**
22	Identify Feasible Intertie Options
23	Investigate Potential Normal/Wet Year Supply Sources
24	Investigate Potential Dry Year Supplies with EBMUD
25	Bay Area Regional Desalination Project Studies



LEGEND

Completion of WSE ★ | Task | In-Valley
Summary | Current Plan | Intertie

1. PURPOSE AND OBJECTIVES

Over the past few decades, Zone 7 Water Agency (Zone 7) has developed a robust water supply system that allowed Zone 7 to store excess water in the wet years and draw on these reserves during dry years to provide a reliable and sustainable water supply for the Livermore-Amador Valley (Valley). However, approximately 80% of Zone 7's water supply is Table A water purchased from the Department of Water Resources (DWR) – the reliability of Table A water is subject to a very uncertain future due to legal and environmental constraints in the Sacramento-San Joaquin Delta.

In response to this challenge, Zone 7 staff developed a probability-based water supply model that uses Monte Carlo methods to help assess near-term and long-term risks of water supply shortages within its water supply system. In November 2009, Zone 7 staff completed a preliminary evaluation of the existing system. This analysis indicated that the reliability of Zone 7's existing water supply system (both supplies and drought storage combined) could decrease from 100 percent to approximately 97 percent in the next five years, 91 percent in the next 10 years, and to 65 percent over the next 20 years.[4] The risk and magnitude of potential shortages increased dramatically beyond 2015 as projected demands exceeded long-term average supplies, and the likelihood of having sufficient stored water during drought periods was significantly lower.[4]

In light of these results, Zone 7 completed this Water Supply Evaluation (WSE) to:

(1) Develop a diverse set of water supply options and corresponding portfolios to help identify supplemental studies necessary to assist Zone 7 in refining associated yields and limits,

(2) Evaluate the ability for various water supply portfolios to meet future reliability targets, and

(3) Identify low-cost, zero-impact actions that will minimize near-term risks of water supply shortages, while maximizing flexibility.

This WSE presents the work plan that outlines minor operational improvements and additional studies necessary to minimize risk until more is known regarding a Delta fix and does not layout a roadmap of major water supply acquisitions and facility improvements over the next 30 years. Therefore, this WSE is not a master planning document that provides a "blueprint" for major water supply investments. Many of the portfolios still have supply ranges and costs that require further analysis before an actual project or program can be developed. Consequently, based on an initial evaluation completed by Zone 7 environmental staff,[5] Zone 7 filed an exemption to the California Environmental Quality Act (CEQA) for this WSE.

[4] Zone 7 Water Agency, 2009. Interoffice Memo – Water Supply Update. November 18.

[5] Appendix H provides the CEQA exemption filed.

2. DESCRIPTION OF ZONE 7 WATER AGENCY AND ITS SERVICE AREA

Zone 7 Water Agency (Zone 7) is a public agency that supplies water, manages the local groundwater basin, and provides flood control services for the Livermore-Amador Valley. This section provides an overview of the history and primary functions of Zone 7, along with a description of the area served.

2.1 ZONE 7 WATER AGENCY: HISTORY AND PRIMARY FUNCTION

The Alameda County Flood Control and Water Conservation District (District) was created in 1949 by the California State Legislature to provide control of flood and storm waters and to conserve water for beneficial uses in ten zones in Alameda County. The District is also vested with the power to store water in surface or underground reservoirs within or outside of the District for the common benefit of the District; conserve and reclaim water for present and future use within the District; appropriate and acquire water and water rights; and import water into the District.

The District is further authorized by the District Act to prevent interference with or diminution of, or to declare rights, in the natural flow of any stream or surface or subterranean supply of waters used or useful for any purpose of the District. Additionally, the District has the authority to prevent contamination that would render surface or subsurface water unfit for beneficial use in the District and to levy replenishment assessments upon the production of groundwater from all water-producing facilities, whether public or private, within the District.

In the mid-1950s, the Livermore-Amador Valley—designated as Zone 7 of the District—was primarily rural in character, with a population of approximately 30,000 people. The area faced a number of problems, including groundwater overdraft, poor drainage and flood hazards, and uncertainty over the status of future water supplies. It was against this backdrop that the residents of the Livermore-Amador Valley voted, in 1957, to create Zone 7 as a separate agency governed by a seven-member board of directors (Zone 7 Board). Each director is elected at-large by residents within Zone 7's service area to a four-year term. The Zone 7 Board sets policy and provides direction to agency management and staff.

In 2003, the legislature passed Assembly Bill 1125 and gave the Zone 7 Board full authority and autonomy to govern matters solely affecting Zone 7 independently of the District's governing body, the Alameda County Board of Supervisors, which governs the other nine zones of the District.

2.1.1 Key Management and Administrative Activities

Zone 7's key functions include:

- providing treated and untreated water supply;
- monitoring and protecting surface water and groundwater quality;
- operating and maintaining a water treatment and transmission system; and
- managing regional flood and storm water for public safety and protection of property.

Under Zone 7's Groundwater Management Program, Zone 7 also administers oversight of the local groundwater basin, the Livermore Valley Groundwater Basin, and prevents groundwater overdraft. The Main Basin is the portion of the Livermore Valley Groundwater Basin that contains high-yielding aquifers and good quality groundwater. Within this capacity, Zone 7 monitors groundwater extractions and imports water to both artificially recharge the Main Basin (thereby supplementing natural recharge) and to provide water to Retailers and other users (thereby reducing pumping demands on the Main Basin). Zone 7's groundwater management policies and programs are described in the Groundwater Management Plan[6]. Every year Zone 7 completes an annual report for its Groundwater Management Program. The most recent report was completed in May 2010 for the 2009 water year[7].

2.1.2 Wholesale Water Supply

This Water Supply Evaluation (WSE) focuses on Zone 7's key function as a water wholesaler for the Livermore-Amador Valley, also known as the Tri-Valley Area[8]. Zone 7 supplies untreated water for agriculture and golf courses, and treated drinking water to four retail water supply agencies (Retailers):

- California Water Service Company (Cal Water),
- Dublin San Ramon Services District (DSRSD),
- City of Livermore (Livermore), and
- City of Pleasanton (Pleasanton).

These Retailers deliver water for municipal and industrial (M&I) purposes within their individual service areas. While the Retailers represent most of the demand on Zone 7's system, Zone 7 does also sell treated water directly to several commercial/institutional customers.[9]

2.2 SERVICE AREA

Zone 7's water service area is located about 40 miles south-east of San Francisco, and encompasses an area of approximately 425 square miles of the eastern portion of Alameda County, including the Livermore-Amador Valley, Sunol Valley, and portions of the Diablo Range. Zone 7's service area also overlies the Alameda Creek Watershed. This watershed encompasses almost 700 square miles, and extends from Altamont Pass to the east, San Francisco Bay to the west, Mount Diablo to the north, and Mount Hamilton to the south. Figure 2-1 illustrates the location of Zone 7's service area.

2.2.1 Major Streams and Arroyos in the Service Area

Major streams in Zone 7's service area include the Arroyo del Valle, Arroyo Mocho, Arroyo Las Positas, Alamo Canal, South San Ramon Creek, and Tassajara Creek (see Figure 2-1). Both the Arroyo del Valle and Arroyo Mocho originate in the woodland forests of the Burnt Hills region in Santa Clara County, in the sub-watershed above Lake Del Valle. The Arroyo del Valle and Arroyo Mocho have the largest drainage areas within the Zone 7 service area.

The Arroyo del Valle flows into Lake Del Valle above Lang Canyon, and then continues its journey below the Del Valle Dam and flows westerly through a regional park on the southern border of Livermore and reaches Pleasanton. The Arroyo del Valle then flows southwesterly through the historical downtown area of Pleasanton and joins the Arroyo de la Laguna. It is used by Zone 7 for groundwater recharge.

The Arroyo Mocho remains a natural waterway as it flows southwest through the oak woodlands east of Livermore, and then flows through the southern portion of Livermore; from there, it becomes an improved channel and proceeds through the gravel mining area west of Livermore and meets the Arroyo

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[6] Jones and Stokes, 2005. Groundwater Management Plan for the Livermore-Amador Valley Groundwater Basin.

[7] Zone 7 Water Agency, 2010. Annual Report for the Groundwater Management Program: 2009 Water Year.

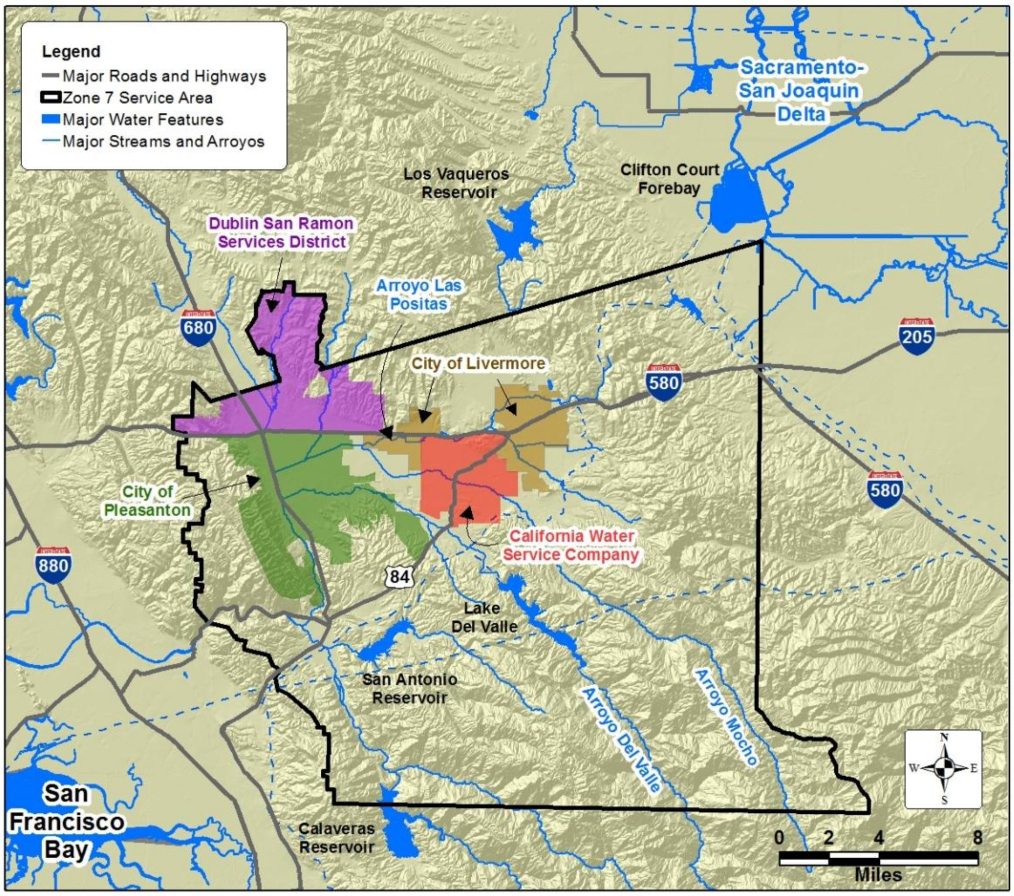
[8] The Tri-Valley Area includes the City of Dublin, City of Livermore, City of Pleasanton, and part of the City of San Ramon.

[9] These customers are described in more detail in Section 3.

Las Positas in Pleasanton. This stream is also a major component of Zone 7's groundwater recharge program. At the request of Zone 7, the Department of Water Resources (DWR) releases water into both Arroyo Mocho and Arroyo del Valle for groundwater recharge purposes that also provide secondary aesthetic and environmental benefits.

The Arroyo Las Positas mainly flows westerly along I-580, and is fed by the Arroyo Seco, Altamont Creek, Cayetano Creek, Collier Canyon Creek, and Cottonwood Creek. In northeast Pleasanton, the Arroyo Las Positas joins the Arroyo Mocho, where the streambed becomes a wide, trapezoidal-shaped flood control channel. The Arroyo Mocho then flows into the Arroyo de la Laguna, which is a tributary of Alameda Creek.

Figure 2-1. Location of Service Area and Major Streams and Arroyos



2.3 EXISTING WATER USE SECTORS

Zone 7's service area is home to a diverse, vibrant, and rapidly growing community that supports a population of approximately 220,000 people and a myriad of vital and dynamic commercial, agricultural, and industrial enterprises. The eastern reaches of Zone 7's service area include oil wells and acres of energy generating windmills, while other areas include large employers such as AT&T, Oracle, Providian Financial, SAP, and Lawrence Livermore National Laboratory. This area also supports a number of award-winning wineries. Examples of industrial water users include: Applied Biosystems (biotech), Clorox

Services Company (chemical company), Roche Molecular Systems (medical research and development), and A-1 Enterprise (waste hauler).

As discussed previously, Zone 7 provides wholesale treated water to the Retailers, who use this water for M&I purposes within their service areas; through this arrangement, Zone 7 indirectly serves approximately 66,000 residential, commercial, industrial, institutional, and landscape water use accounts. Two of the Retailers—DSRSD and Livermore—also provide recycled water for landscape irrigation to supplement treated water supply. In addition to supplying treated water, Zone 7 also supplies raw or untreated water to agricultural uses and golf courses in the service area; agricultural uses primarily consist of vineyards in the southern portion of the Livermore Valley, but also produces olives, pistachios, and prime beef.

As shown in Table 2-1, water accounts within Zone 7's service area are primarily residential (90%).[10]

Table 2-1. 2009 Accounts by Water Use Sectors Directly and Indirectly Served by Zone 7[(a)]

Water Use Sector	Accounts	% of Total
Single-Family Residential	57,198	86%
Multi-Family Residential	2,327	4%
Commercial/Institutional	3,807	6%
Industrial	175	0.3%
Landscape	1,844	3%
Agriculture	14	0.02%
Other	868	1%
Total	66,233	100%

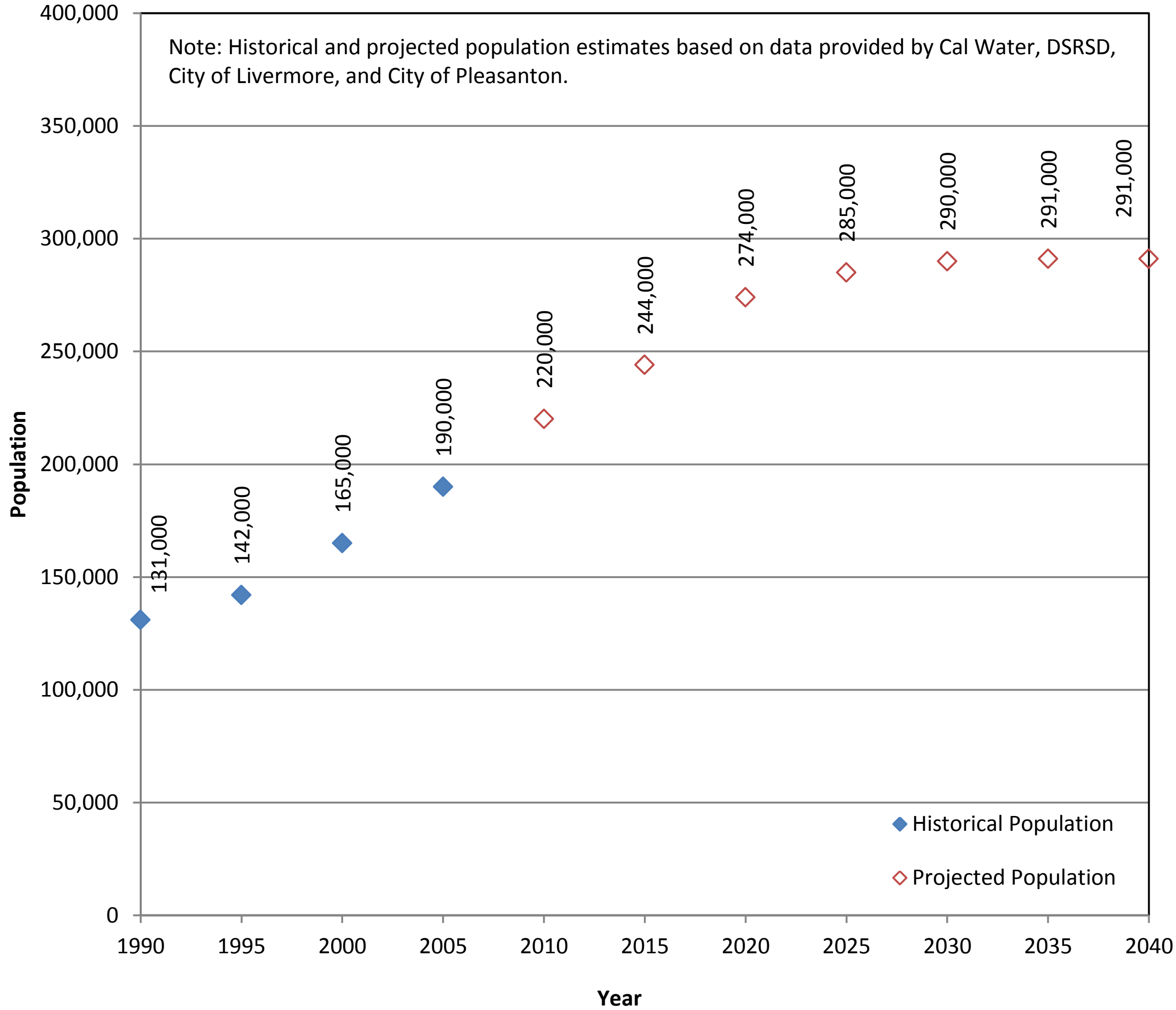
[(a)] Based on data provided by the Retailers and data from Zone 7's annual water supply reports. These values do not include recycled water, but do include untreated surface water provided to agriculture.

2.4 POPULATION GROWTH

As shown on Figure 2-2, the population within Zone 7's service area increased 65% between 1990 and 2009, and is projected to grow by another 35% by 2040, from 216,000 in 2009 to 291,000; a majority of the projected growth occurs within the next 10 years.

[10] Water demands in the service area are discussed in detail in Section 3.

Figure 2-2. Historical and Projected Population within Zone 7's Service Area

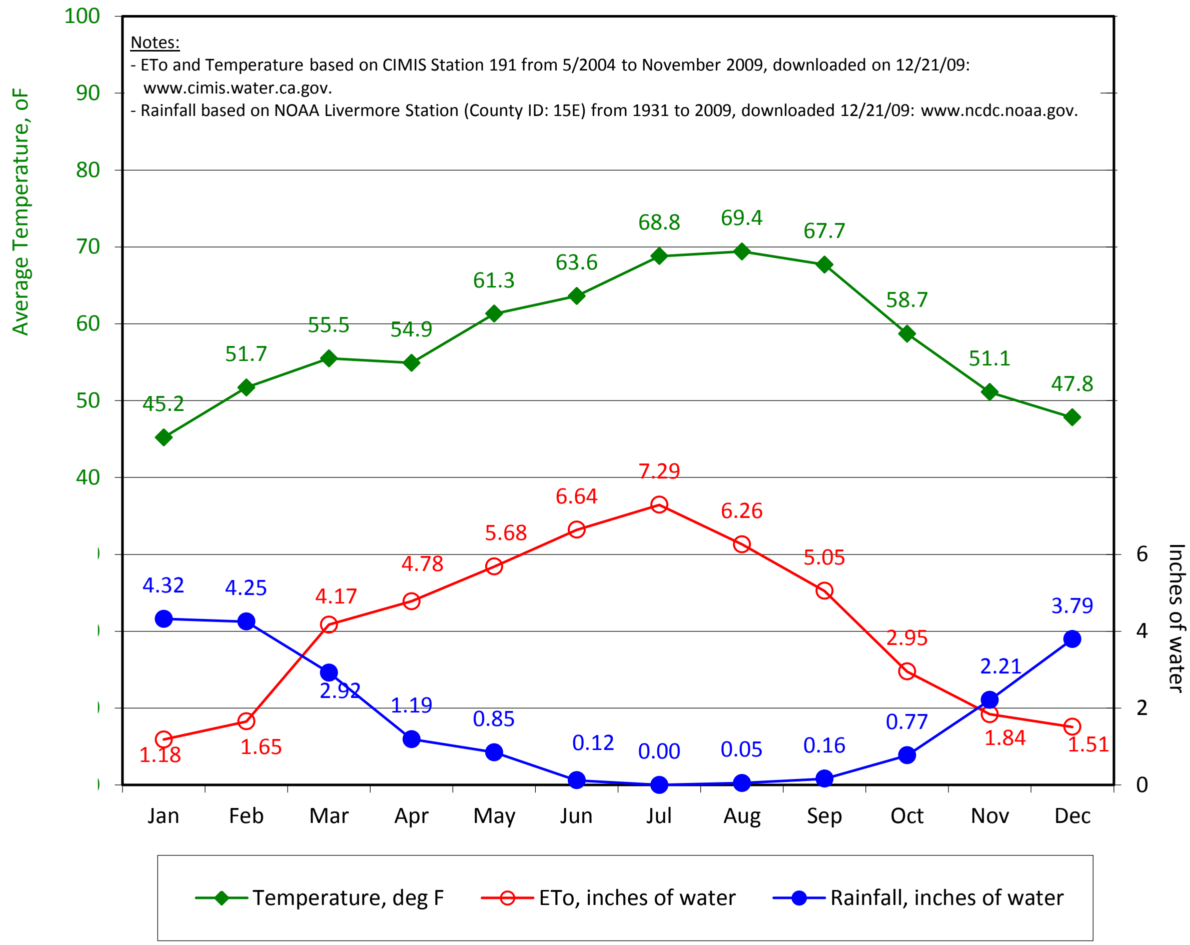


2.5 CLIMATE

The climate within Zone 7's service area is best described as Mediterranean, characterized by hot, dry summers and cool, moist winters. Figure 2-3 provides data for average temperatures, rainfall, and evapotranspiration rates (ETo)[11] within Zone 7's service area over the year. Average annual precipitation is approximately 14.6 inches of water, while total evapotranspiration is approximately 49 inches of water; average monthly temperatures vary from 45 to 69 degrees Fahrenheit throughout the year.

[11] Evapotranspiration based on standard grass as reference.

Figure 2-3. Climate Data for the Zone 7 Service Area



3. HISTORICAL AND PROJECTED WATER DEMANDS

The purpose of this section is to describe the historical and projected water demands used for the analysis completed in this Water Supply Evaluation (WSE), including assumptions regarding water conservation and other forms of demand reduction, for Zone 7 Water Agency (Zone 7).

3.1 HISTORICAL WATER DEMANDS SERVED BY ZONE 7

Historically, treated water provided to water supply retailers (California Water Service Company [Cal Water], Dublin San Ramon Services District [DSRSD], City of Livermore [Livermore], and City of Pleasanton [Pleasanton]; collectively referred to as the "Retailers") have represented nearly 90% of the demand on Zone 7's water supply system. Raw or untreated water served to agricultural customers make up most of the remaining 8-10% of demand; treated water served directly to retail commercial/institutional customers represents a minor fraction. Water losses through Zone 7's treated water transmission system also exert a small but significant demand (2-4%) on Zone 7's water supplies; these system losses are referred to as "unaccounted-for water".

Table 3-1 presents historical water demands met by Zone 7 within its service area between 1990 and 2009. As shown, water use currently served by Zone 7 has approximately doubled since the early 1990s. A majority of this increase is associated with water served to the Retailers. Table 3-1 also indicates that unaccounted-for water increased by 1,000 to 2,000 acre-feet (AF) after 2003; potential reasons for this increase are discussed in Section 3.3.4. Including water pumped directly by three of the four retailers from the Main Basin as part of their groundwater pumping quotas (GPQs), the total demand in the Livermore-Amador Valley has averaged approximately 44,000 and 53,000 acre-feet annually (AFA) over the last 20 and last 5 years, respectively.[12]

Table 3-2 presents the historical Municipal and Industrial (M&I) per capita demand served by Zone 7 and the Retailers (includes all groundwater pumping). M&I demand is derived by subtracting untreated surface water demand from the total water demand listed in Table 3-1. As shown in Table 3-2, per capita demands have stayed above the historical average of 213 gallons per capita per day (gpcd) over the last ten years; however, more recently, there has been a downward trend and the five-year average of 215 gpcd is now very close to the historical average.[13]

Figure 3-1 compares historical M&I per capita demand to precipitation, which is used as an inverse indicator of outdoor water demands. As shown, the demand pattern is generally responsive to the pattern of precipitation: that is, with an increasing rainfall trend, there is a decreasing trend in water demand.

[12] Note that recycled water used for irrigation is not included in these demands; recycled water is discussed in Section 6.2.2.

[13] As discussed in Section 6.21, future reduction of daily per capita consumption has been mandated statewide by state legislation passed in 2009.

Table 3-1. Historical Water Demand in the Zone 7 Service Area, acre-feet

Year	Total Municipal and Industrial Water Use Served by Zone 7				Untreated Water for Agriculture[d]	Total Demand on Zone 7	Retailer Pumping (GPQs)	Total Water Demand
	Retailers[a]	Zone 7 Retail[b]	UAFW[c]	Total				
1990	23,869	1,070	1,876	26,815	3,170	29,985	5,882	35,867
1991	14,831	500	754	16,085	1,845	17,930	9,730	27,660
1992	20,714	1,010	1	21,725	2,344	24,069	6,447	30,516
1993	23,926	1,200	59	25,185	1,782	26,967	4,146	31,113
1994	22,734	680	691	24,105	1,985	26,090	6,598	32,688
1995	28,519	1,190	316	30,025	3,481	33,506	1,819	35,325
1996	29,901	790	4	30,695	4,329	35,024	2,920	37,944
1997	28,802	780	63	29,645	6,287	35,932	7,602	43,534
1998	26,640	510	5	27,155	4,370	31,525	7,573	39,098
1999	32,292	240	3	32,535	5,607	38,142	6,934	45,076
2000	34,632	270	423	35,325	5,899	41,224	6,826	48,050
2001	36,601	320	24	36,945	4,845	41,790	7,237	49,027
2002	38,176	260	4	38,440	3,523	41,963	6,981	48,944
2003	38,169	370	1,321	39,860	3,359	43,219	6,911	50,130
2004	42,371	770	819	43,960	3,422	47,382	6,573	53,955
2005	38,912	282	1,676	40,870	3,309	44,179	6,583	50,762
2006	40,414	316	1,064	41,794	3,488	45,282	6,581	51,863
2007	43,132	312	1,940	45,384	3,642	49,026	6,434	55,461
2008	42,982	270	1,649	44,901	4,164	49,065	6,026	55,091
2009	38,083	233	1,900	40,216	4,920	45,136	6,569	51,705
Historical Average	32,285	569	730	33,583	3,789	37,372	6,319	43,691
10-Year Average	39,347	340	1,082	40,770	4,057	44,827	6,672	51,499
5-Year Average	40,700	300	1,600	42,600	3,900	46,500	6,400	53,000

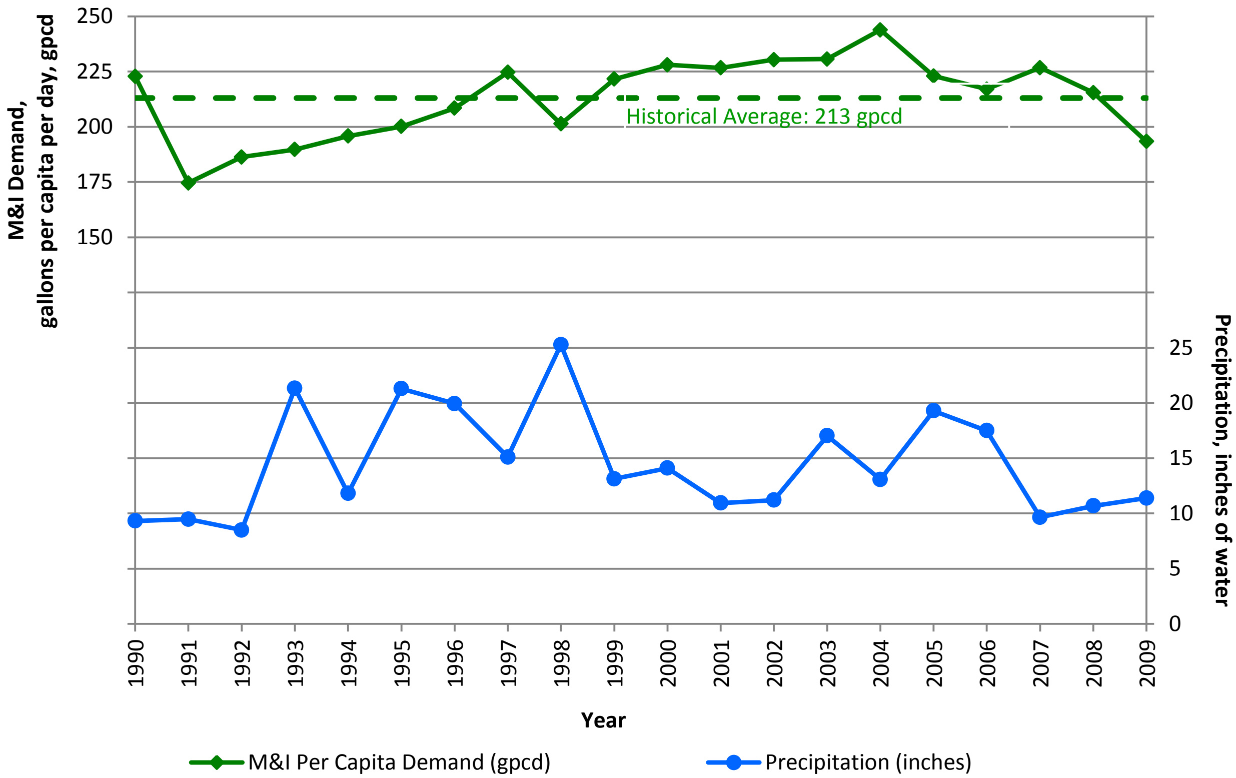
[a] Data collected from the Retailers and from the Zone 7 Annual Supply Reports (WR OM1 and WR OM3). Includes groundwater pumping quota for DSRSD (but not for the other retailers).
[b] Zone 7 directly serves six customers with potable water - data based on historical records.
[c] Unaccounted-for water (UAFW) is based on the difference between total production and actual deliveries. Production is water purchased from the State Water Project plus Zone 7 groundwater pumping minus brine concentrate losses (beginning in 2009 when the demineralization facility started operating).
[d] Zone 7 serves 74 customers through 7 accounts with untreated surface water.

Table 3-2. Historical M&I Per Capita Water Demands in the Zone 7 Service Area

Year	Total Water Demand in the Service Area, gallons per day[(a)]	Total Municipal and Industrial (M&I) Demand in the Service Area, gallons per day[(b)]	Total Population[(c)]	M&I Per Capita Demand, gpcd	Precipitation, inches[(d)]
1990	32,018,113	29,188,313	131,000	223	9
1991	24,692,006	23,045,009	132,000	175	9
1992	27,240,758	25,148,312	135,000	186	8
1993	27,774,133	26,183,375	138,000	190	21
1994	29,180,194	27,408,221	140,000	196	12
1995	31,533,975	28,426,551	142,000	200	21
1996	33,871,819	30,007,400	144,000	208	20
1997	38,862,055	33,249,766	148,000	225	15
1998	34,902,155	31,001,137	154,000	201	25
1999	40,238,273	35,233,007	159,000	222	13
2000	42,893,609	37,627,680	165,000	228	14
2001	43,765,482	39,440,439	174,000	227	11
2002	43,691,729	40,546,812	176,000	230	11
2003	44,750,192	41,751,675	181,000	231	17
2004	48,164,287	45,109,531	185,000	244	13
2005	45,314,135	42,360,252	190,000	223	19
2006	46,297,583	43,183,909	199,000	217	17
2007	49,508,893	46,257,746	204,000	227	10
2008	49,178,982	45,461,856	211,000	215	11
2009	46,156,104	41,764,111	216,000	193	11
Historical Average			166,200	213	15
10-Year Average			190,100	224	13
5-Year Average			204,000	215	14

[(a)] Data collected from the Retailers and from the Zone 7 Annual Supply Reports (WR OM1 and WR OM3). Includes all groundwater pumped for and by the Retailers.
[(b)] Total water demand minus untreated water for agriculture served by Zone 7.
[(c)] Data provided by the Retailers.
[(d)] Source: http://wwwcimis.water.ca.gov/.

Figure 3-1. Comparison of Historical Municipal and Industrial (M&I) Per Capita Demand to Precipitation



3.2 BREAKDOWN OF WATER ACCOUNTS AND USE BY SECTOR IN 2009

As a wholesale water agency, Zone 7 does not track water use by individual water use sectors (e.g., Single Family Residential or Commercial). However, Zone 7 indirectly serves these sectors by supplying water to the Retailers. Tables 3-3a and 3-3b present the breakdowns of water accounts and water use by sector in the service area, including those customers served directly by Zone 7 and including the water produced by the Retailers using their groundwater pumping quotas. Agricultural accounts, which are served untreated surface water by Zone 7, are included, while recycled water accounts are not included in these tables.

As shown in Table 3-3b, three of the top water use sectors by volume are: residential (54%), commercial/institutional (16%), and landscape (13%).

Table 3-3a. Breakdown of Water Accounts by Sector in the Service Area in 2009[a]

Water Use Sector	Cal Water	DSRSD	Livermore[b]	Pleasanton	Zone 7	Total	% of Total
Single-Family Residential	16,466	13,303	7,988	19,441	-	57,198	86%
Multi- Family Residential	82	2,000	20	225	-	2,327	4%
Commercial/Institutional	1,301	432	1,084	984	6	3,807	6%
Industrial	1	168	-	6	-	175	0.3%
Landscape	-	420	440	984	-	1,844	3%
Agriculture	-	-	-	7	7	14	0.02%
Other	19	676	173	-	-	868	1%
Total	17,869	16,999	9,705	21,647	13	66,233	100%

(a) Based on data provided by Cal Water, DSRSD, Livermore, and Pleasanton, and Zone 7's annual water supply reports. These values do not include recycled water, but do include untreated surface water provided to agriculture.

(b) The City of Livermore has developed new estimates that are included in their draft Urban Water Management Plan; these estimates were not available in time to include as part of this evaluation.

Table 3-3b. Breakdown of Water Use by Sector in the Service Area in 2009, acre-feet[a]

Water Use Sector	Cal Water	DSRSD	Livermore[c]	Pleasanton	Zone 7	Total	% of Total
Single-Family Residential	7,597	4,722	3,224	9,484		25,027	49%
Multi-Family Residential[b]	561	1,196	N/A	760		4,726	5%
Commercial/Institutional	2,483	1,423	2,576	1,504	233	6,010	16%
Industrial	-	261	-	73		334	1%
Landscape		1,463	436	4,679		6,577	13%
Agriculture		-	-	-	4,920	4,920	10%
Other	14	6	-	-		20	0%
Unaccounted-for Water	359	457	129	916	1,900	3,762	7%
Total[d]	11,014	9,528	6,365	17,416	7,053	51,375	100%

(a) Based on data provided by Cal Water, DSRSD, Livermore, and Pleasanton, and Zone 7's annual water supply reports. These values do not include recycled water, but do include untreated surface water provided to agriculture. These values include the total potable water supply provided by the Retailers to their customers, and therefore include groundwater-pumping quotas in 2009: DSRSD – 645 AF, Pleasanton – 3,505 AF, and Cal Water – 3,064 AF.

(b) For Livermore, this value is included under commercial/institutional.

(c) The City of Livermore has developed new estimates that are included in their draft Urban Water Management Plan; these estimates were not available in time to include as part of this evaluation.

(d) Note that because of the different accounting methods used by the various agencies, there is a minor discrepancy (<1%) between the total shown here (51,375 AF) and the total shown in Table 3-1 (51,705 AF).

3.3 PROJECTED WATER DEMANDS

Projected water requirements for Zone 7 were estimated by evaluating demands from the Retailers, Zone 7's retail customers, and untreated water customers. Demands were also adjusted to account for potential future water conservation savings, unaccounted-for water and other system losses, and water required to maintain a sustainable groundwater basin. Each of these factors is discussed in more detail below.

3.3.1 Treated Water Retailer Demands

Zone 7 obtained projected water demands from each of the retailers through a series of stakeholder and one-on-one meetings. Zone 7 staff met with and collected water demand and supply information from the four retailers in June, August, and September 2009, and in January 2010, as part of the development of the 2010 Urban Water Management Plan. Additional information was provided by the Retailers throughout 2010. For example, as part of its operational planning, Zone 7 annually collects demand projections ("Delivery Requests") for the next five years; the 2010 Delivery Requests were one of the sources of data used to estimate near-term (2010-2015) demands.

Retailer water demands consist of three components: treated water supplied by Zone 7, groundwater pumped by the Retailers under their groundwater-pumping quotas (GPQ), and recycled water. Table 3-4 presents the amounts of water supply required from Zone 7 by the Retailers. These amounts do not include groundwater pumped by three of the four retailers under their GPQ to meet the rest of their demands: Cal Water (3,069 AF), Pleasanton (3,500 AF), and Livermore (31 AF); Zone 7 pumps DSRSD's GPQ of 645 AF and this amount is included in the table. DSRSD and Livermore currently produce recycled water to supplement their water supplies; recycled water demands are not included in the table.

The water demand projections presented in Table 3-4 do not account for additional water conservation efforts that may be implemented by the Retailers to comply with the Water Conservation Act of 2009; the associated potential future water conservation in the Zone 7 service area is discussed in Section 3.3.5.

Table 3-4. Projected Treated Water Demands from Retailers, acre-feet[(a)]

Year	Demands from Zone 7					GPQs [(a)]	Total Retailer Demands in the Service Area
	Cal Water	DSRSD	Livermore	Pleasanton	TOTAL		
2010	9,160	13,057	7,160	16,400	45,777	6,569	52,346
2011	9,160	13,222	7,160	16,600	46,142	6,569	52,711
2012	9,230	13,351	7,210	16,800	46,591	6,569	53,160
2013	9,290	13,556	7,220	17,020	47,086	6,569	53,655
2014	9,340	13,840	7,310	17,210	47,700	6,569	54,269
2015	9,400	14,076	7,390	17,460	48,326	6,569	54,895
2016	9,840	14,297	7,800	17,820	49,756	6,569	56,325
2017	10,050	14,774	7,900	18,040	50,763	6,569	57,332
2018	10,260	15,187	8,000	18,260	51,707	6,569	58,276
2019	10,490	15,603	8,100	18,480	52,673	6,569	59,242
2020	10,730	16,139	8,200	18,700	53,768	6,569	60,337
2021	10,990	16,552	8,200	18,900	54,642	6,569	61,211
2022	11,270	16,995	8,200	19,100	55,565	6,569	62,134
2023	11,560	17,416	8,200	19,300	56,476	6,569	63,045
2024	11,870	17,836	8,200	19,500	57,406	6,569	63,975
2025	12,210	18,157	8,200	19,700	58,267	6,569	64,836
2026	12,230	18,474	8,200	19,900	58,804	6,569	65,373
2027	12,250	18,714	8,200	20,100	59,264	6,569	65,833
2028	12,280	18,907	8,200	20,300	59,687	6,569	66,256
2029	12,300	19,071	8,200	20,500	60,071	6,569	66,640
2030	12,330	19,169	8,200	20,700	60,399	6,569	66,968
2031	12,350	19,224	8,200	20,700	60,474	6,569	67,043
2032	12,380	19,224	8,200	20,700	60,504	6,569	67,073
2033	12,400	19,224	8,200	20,700	60,524	6,569	67,093
2034	12,420	19,224	8,200	20,700	60,544	6,569	67,113
2035	12,450	19,224	8,200	20,700	60,574	6,569	67,143
2036	12,470	19,224	8,200	20,700	60,594	6,569	67,163
2037	12,500	19,224	8,200	20,700	60,624	6,569	67,193
2038	12,520	19,224	8,200	20,700	60,644	6,569	67,213
2039	12,550	19,224	8,200	20,700	60,674	6,569	67,243
2040	12,570	19,224	8,200	20,700	60,694	6,569	67,263

(a) Groundwater pumping quotas for Cal Water (3,069 AF), Pleasanton (3,500 AF), and Livermore (31 AF). Zone 7 pumps DSRSD's GPQ of 645 AF and this amount is included under DSRSD's Zone 7 demand.

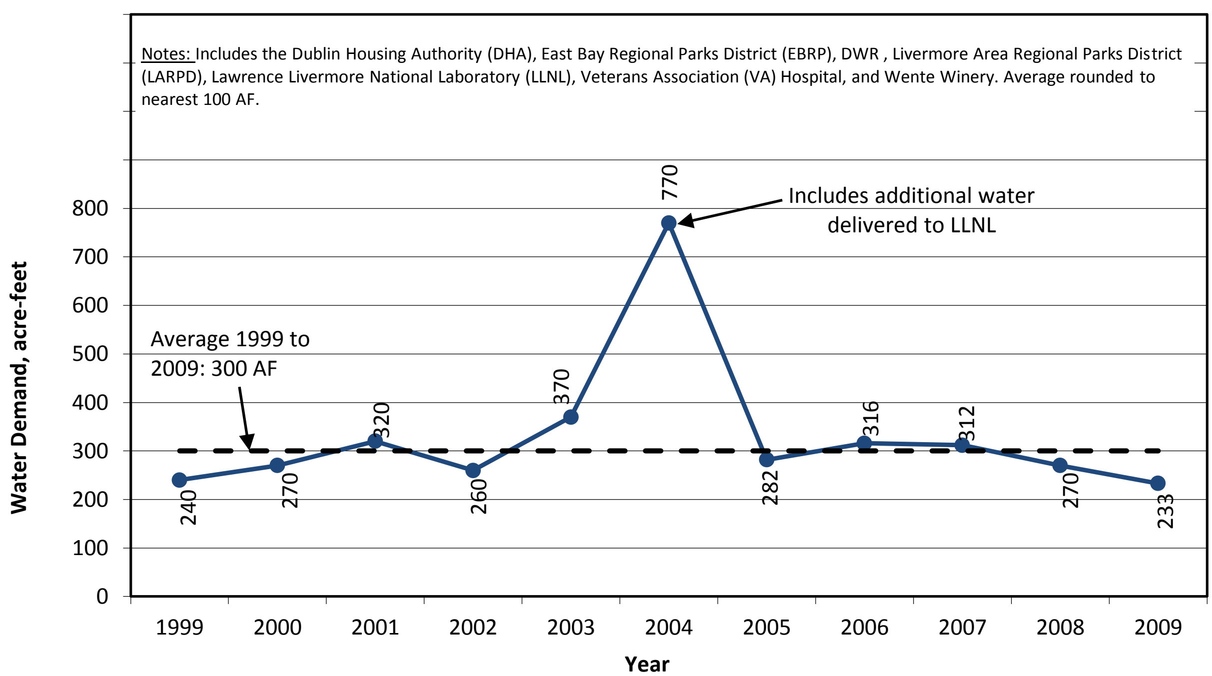
3.3.2 Zone 7 Retail Demands

Zone 7 provides treated water directly to a number of commercial/institutional customers within the service area. These customers currently include the East Bay Regional Parks District (EBRPD), Department of Water Resources (DWR)[14], Livermore Area Regional Parks District (LARPD), Lawrence Livermore National Laboratory (LLNL), Veterans Association (VA) Hospital, and Wente Winery.

Figure 3-2 illustrates the historical water demand from Zone 7's retail customers between 1999 and 2009. As shown on Figure 3-2, water demand for these direct retail customers has been relatively steady for the past 10 years with the exception of 2004. The spike in water demand in 2004 is the result of additional water supplied to LLNL resulting from an interruption in supplies normally provided to LLNL by the San Francisco Public Utilities Commission.

For planning purposes in this analysis, Zone 7 staff assumed that the long-term (2015-2040) water demands for Zone 7's retail customers would be equal to the average demand observed over the past 10 years, which is approximately 300 AF after rounding to the nearest 100 AF. The additional water demand spike resulting from LLNL is relatively infrequent, and can likely be accommodated using existing facilities if necessary. In the near-term (2010-2014), direct retail water demands were based on customers' projections as presented in their 2010 Delivery Requests. Table 3-5 summarizes the projected supply required from Zone 7 for its retail customers.

Figure 3-2. Historical Zone 7 Retail Customer Demand, acre-feet



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[14] DWR has a storage/corporation yard located along the South Bay Aqueduct that requires treated water.

Table 3-5. Projected Demands from Zone 7's Retail Customers, acre-feet[(a)]

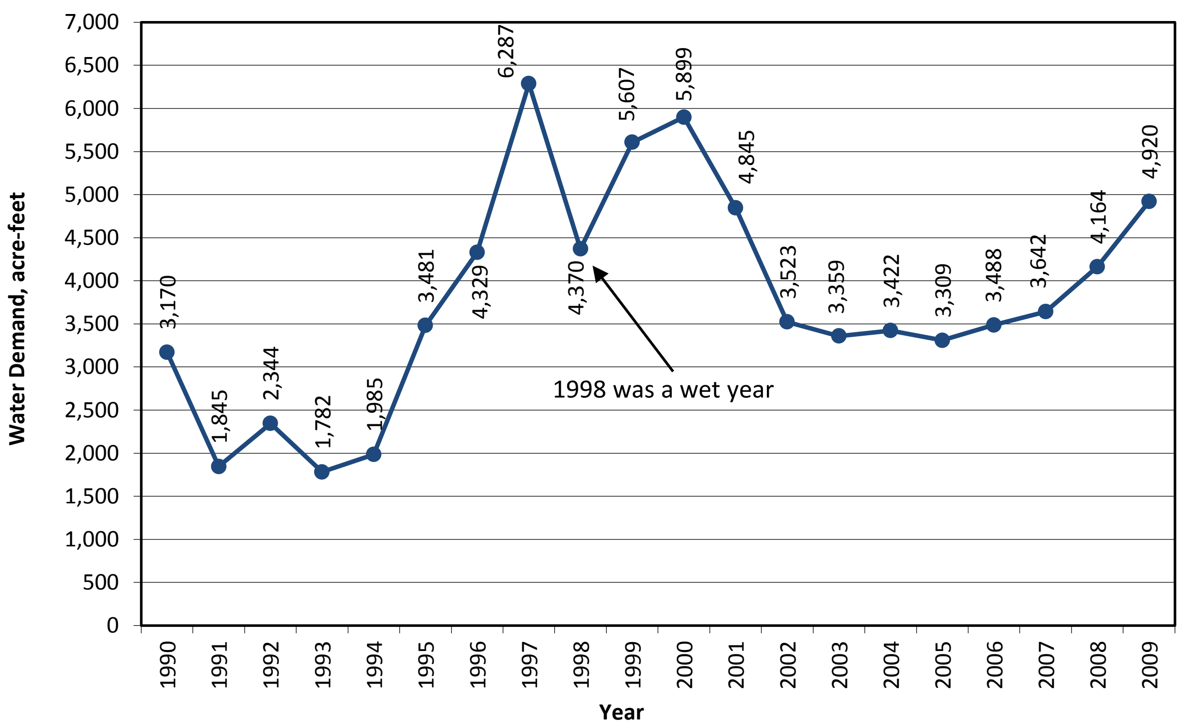
Year	Demand (AF)
2010	285
2011	285
2012	285
2013	235
2014	235
2015-2040	300

3.3.3 Zone 7's Untreated Water Demands

Zone 7 currently supplies untreated surface water to seven turnout customers through eleven South Bay Aqueduct (SBA) turnouts. These seven turnout customers then branch into 74 different untreated water customers.

Figure 3-3 presents historical untreated water demands between 1985 and 2009. As shown on Figure 3-3, untreated water demands significantly increased between 1994 and 1997, and then experienced a significant decrease between 1999 and 2009; 1998 was a wet year (i.e., demands were being partially met by rainfall), while 2008 and 2009 is response to drought conditions. This large decrease is the result of agricultural acreage being taken out of production and water conservation efforts—water conservation has reduced agricultural unit water use from about 1.5 to 0.7 AF/acre (a 50% decrease).

Figure 3-3. Historical Zone 7 Untreated Water Demand



Based on the 2010 Delivery Requests, untreated water demands are expected to remain constant at approximately 4,500 AFA over the next five years. However, Zone 7 has existing contractual obligations up to 8,250 AFA (or 8,300 AFA after rounding to the nearest 100 AFA); it is unknown when untreated water demands could increase to 8,300 AF. Consequently, for planning purposes, it was assumed that untreated water demand would increase linearly from 4,500 AF in 2015 to 8,300 AF in 2030 and remain at that level through 2040. Table 3-6 presents the projected supply required for Zone 7's untreated water customers.

Table 3-6. Projected Demands from Zone 7's Untreated Water Customers, acre-feet[(a)]

Year	Demand
2010	4,500
2011	4,500
2012	4,500
2013	4,500
2014	4,500
2015	4,500
2016	4,738
2017	4,975
2018	5,213
2019	5,450
2020	5,688
2021	5,925
2022	6,163
2023	6,400
2024	6,638
2025	6,875
2026	7,113
2027	7,350
2028	7,588
2029	7,825
2030-2040	8,300

[(a)] Assumes demand increases linearly from 4,500 AF in 2014 to 8,250 AF in 2030; demands rounded to the nearest 100 AF for planning purposes.

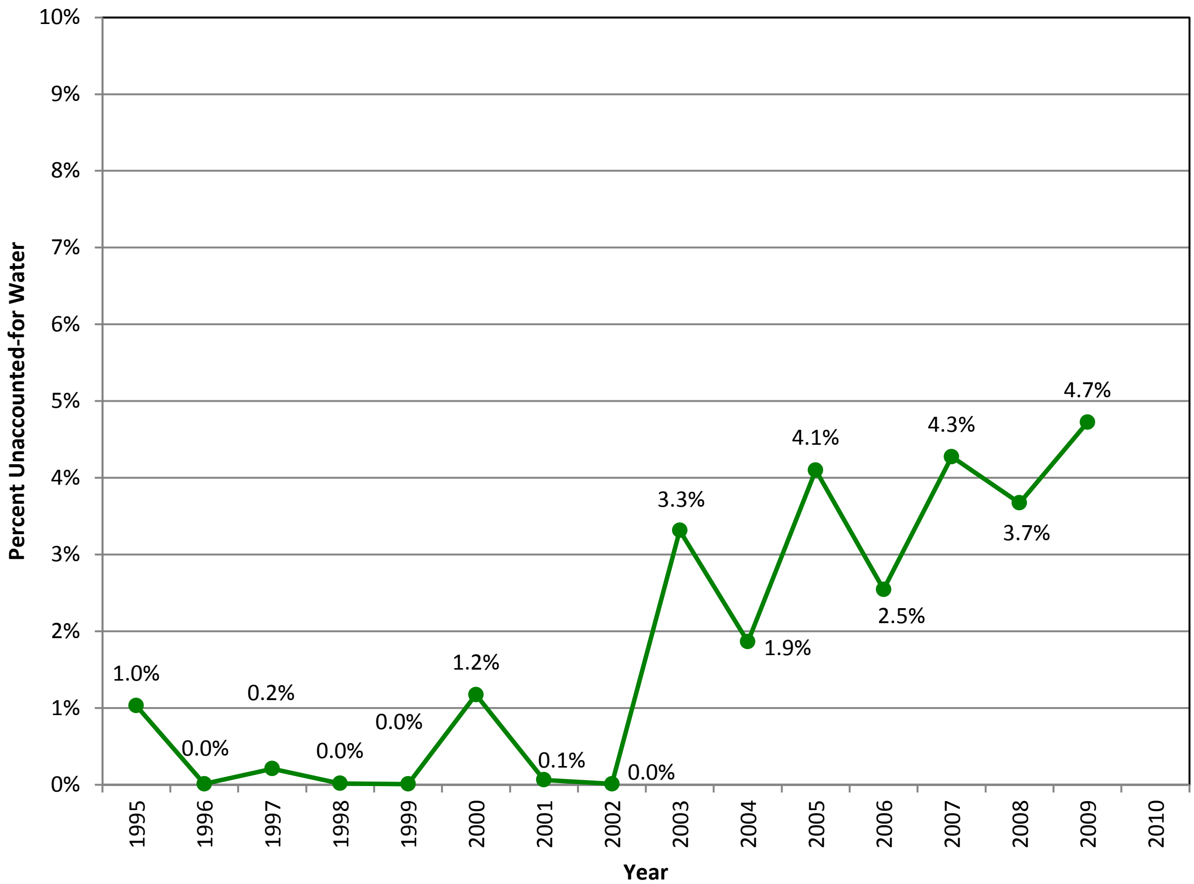
3.3.4 Zone 7's Unaccounted-for Water

Unaccounted-for water is generally defined as the difference between total production (water delivered from the SBA to water treatment plants and groundwater pumped from Zone 7 wells[15]) and the total deliveries made at each of Zone 7's transmission system turnouts. Figure 3-4 illustrates historical unaccounted-for water within Zone 7's system from 1995 to 2009 as a percentage of total production. As shown on Figure 3-4, between 1995 and 2002, unaccounted-for water was typically very low at less

[15] Since 2009, this amount is net of groundwater demineralization losses through brine concentrate disposal.

than 1.2%; however, starting in 2003, it increased significantly, and has averaged approximately 4% between 2003 and 2009.

Figure 3-4. Historical Zone 7 Unaccounted-for Water (Acre-Feet and % of Total Production)



Possible causes for the increase include:

- water losses associated with Zone 7's water treatment plants,
- water losses associated with system flushing,
- meter accuracy and reading errors, and/or
- transmission system leakage.

As described in Section 6.3.2, Zone 7 plans to investigate the cause/s of the upward trend in unaccounted-for water in the next few years and hopes to reduce its percentage down to 2% or less of total water production. Assuming that this improvement occurs starting in 2012, Table 3-7 presents the projected supply lost due to unaccounted-for water.

Note that losses through the disposal of brine concentrate from the demineralization facility are accounted for separately and incorporated into "storage losses" as discussed in Section 3.3.7.

Table 3-7. Supply Required for Zone 7's Unaccounted-for Water, acre-feet[(a)]

Year	Unaccounted-for Water
2010	1,900
2011	1,900
2012	1,000
2013	1,000
2014	1,000
2015	1,000
2016	1,000
2017	1,000
2018	1,100
2019	1,100
2020	1,100
2021	1,100
2022	1,100
2023-2040	1,200

(a) Unaccounted-for water is based on total projected demands and an average unaccounted-for water percentage loss of 2% of total water production starting in 2012.

3.3.5 Projected Demand Reductions Under the Water Conservation Act of 2009

In November 2009, the California legislature passed the Water Conservation Act of 2009 (Conservation Act), also known as Senate Bill SBX7-7. The Conservation Act created a framework for future planning and actions by water supply retailers and agricultural water suppliers to reduce California's water use. More specifically, the Conservation Act requires water supply retailers to reduce their per capita water consumption 20 percent from their baseline by 2020.

Although Zone 7 is not directly subject to the requirements of the Conservation Act because it is a wholesale water agency, Zone 7 fully supports the existing and planned efforts of the Retailers to comply with this new law. To estimate the potential additional water conservation savings (equivalently, demand reductions) that can result from implementation of the Conservation Act, Zone 7 calculated a service area-wide average baseline daily per capita water consumption in accordance with DWR guidelines[16]. The resulting value was 227 gallons per capita per day (gpcd) based on the total potable water demand in the service area over the ten-year period from 1999 to 2008[17]. The total potable water demand included retailer demands from Zone 7, groundwater pumping quotas, direct retail demand, and unaccounted-for water. The period 1999 to 2008 was chosen as it resulted in the highest baseline value and most conservative estimate for water supply planning purposes.

[16] DWR, 2010. Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use.

[17] For water providers using less than 10% recycled water in 2008, any ten-year sequence between 1995 and 2010 can be used for the baseline calculation.

The regional target for daily per capita consumption was subsequently calculated assuming a 20% reduction from the baseline, resulting in a target of 181 gpcd by 2020. Zone 7 adjusted the total projected demands from the Retailers (including GPQs), direct retail customers, and untreated water customers to reflect a reduction of unaccounted-for water (UAFW) from 4% to 2% as discussed in Section 3.3.4. Applying the 181 gpcd target to the population projections (Section 2.4) and the adjusted total projected demands results in an estimated target demand reduction of 6,000 AF in the Livermore-Amador Valley by 2020. The interim demand reduction target for 2015 was assumed to be half of this amount at 3,000 AF in accordance with DWR guidelines. Demand reductions were assumed to increase linearly to the 2015 and 2020 targets.

Note that these water conservation estimates were developed by Zone 7 for planning purposes only; retailers will be calculating their individual targets for compliance with the Conservation Act as presented in their individual 2010 Urban Water Management Plans.

The water conservation or demand reduction calculations are summarized in Table 3-8 below.

Table 3-8. Projected Water Conservation or Demand Reduction Under the Water Conservation Act of 2009, acre-feet[(a)]

Year	Estimated Required Demand Reduction
2010	0
2011	600
2012	1,200
2013	1,800
2014	2,400
2015	3,000
2016	3,600
2017	4,200
2018	4,800
2019	5,400
2020	6,000
2021	6,000
2022	6,000
2023	6,000
2024	6,000
2025	6,000
2026	6,000
2027	6,000
2028	6,000
2029	6,000
2030	6,000
2031	6,000
2032	6,000
2033	6,000
2034	6,000
2035	6,000
2036	6,000
2037	6,000
2038	6,000
2039	6,000
2040	6,000

(a) Projected service area-wide water conservation savings estimated by Zone 7 based on data provided by Cal Water, DSRSD, Livermore, and Pleasanton.

3.3.6 Projected Supply Required for Zone 7's Artificial Recharge Activities

As discussed in more detail in Section 4.2, Zone 7 considers the Livermore Valley Groundwater Basin as a storage facility and not a long-term water supply because Zone 7 only pumps groundwater it has artificially recharged using its surface water supplies. The portion of the Livermore Valley Groundwater Basin that contains high-yielding aquifers and good quality groundwater is used for storage and supply; this portion of the basin is referred to as the Main Basin.

Planning-level analysis completed by Zone 7 staff indicates that Zone 7 could recharge, based on a long-term average, as much as 9,200 AFA via artificial recharge activities in the Arroyo Mocho and Arroyo del Valle.[18] Although Zone 7 will eventually have additional recharge capacity available via the Chain of Lakes (see Section 4.2), existing artificial recharge capacity is limited to the local arroyos.

The amount of water Zone 7 will be using to recharge the Main Basin will vary from year to year depending upon the availability of excess water, storage available in the Main Basin, recharge capacity, available facilities, and other operational factors such as planned extraction of groundwater supply. For planning purposes, the modeling of Zone 7's water supply system, which is described in more detail in Section 5, performs a yearly analysis of artificial recharge activities based on the water supply mix and reliability being analyzed.

3.3.7 Projected Supply Required for Storage and Demineralization Losses

Zone 7's groundwater storage facilities, both local (Main Basin) and non-local (Semitopic Water Storage District [Semitropic] and Cawelo Water District [Cawelo]), are described in detail in Section 4.2. There are different storage losses associated with these facilities: 10% loss for the Main Basin and Semitropic, and 50% loss for Cawelo. The amounts of water placed into storage will vary yearly depending on availability of excess water, storage available in the Main Basin, recharge capacity, available facilities, and other operational factors such as planned extraction of groundwater supply; consequently, storage losses, which are calculated as a percentage of the amount of water placed into storage, will vary yearly. Over time, however, these storage losses will generally decrease as the amounts of water placed into storage decrease (e.g., because the storage facilities are full or there is no excess water available to bank).

Water is also lost through the disposal of brine concentrate from the Mocho Groundwater Demineralization Facility (for more details, see Sections 4.3.4 and 6.3.3) and any future demineralization facilities (see Section 6.5.1). The demineralization losses will vary according to the operation of these facilities.

For planning purposes, the modeling of Zone 7's water supply system performs a yearly analysis of artificial recharge or groundwater banking activities based on the water supply portfolio and reliability policy being analyzed.

3.3.8 Summary of Projected Water Demands

As described in the previous sections, incoming water supplies are used to meet demands from the Retailers, Zone 7's direct retail customers, and untreated water customers. Water supplies are also lost through UAFW, and losses through storage and demineralization activities. The projected demands provided by the Retailers[19] during the data collection for the WSE in 2009 and 2010 (Section 3.3.1) are expected to be lowered as a result of the Water Conservation Act of 2009 (see Section 3.3.5). Furthermore, Zone 7 plans to lower UAFW losses from 4% to 2% of treated water production.

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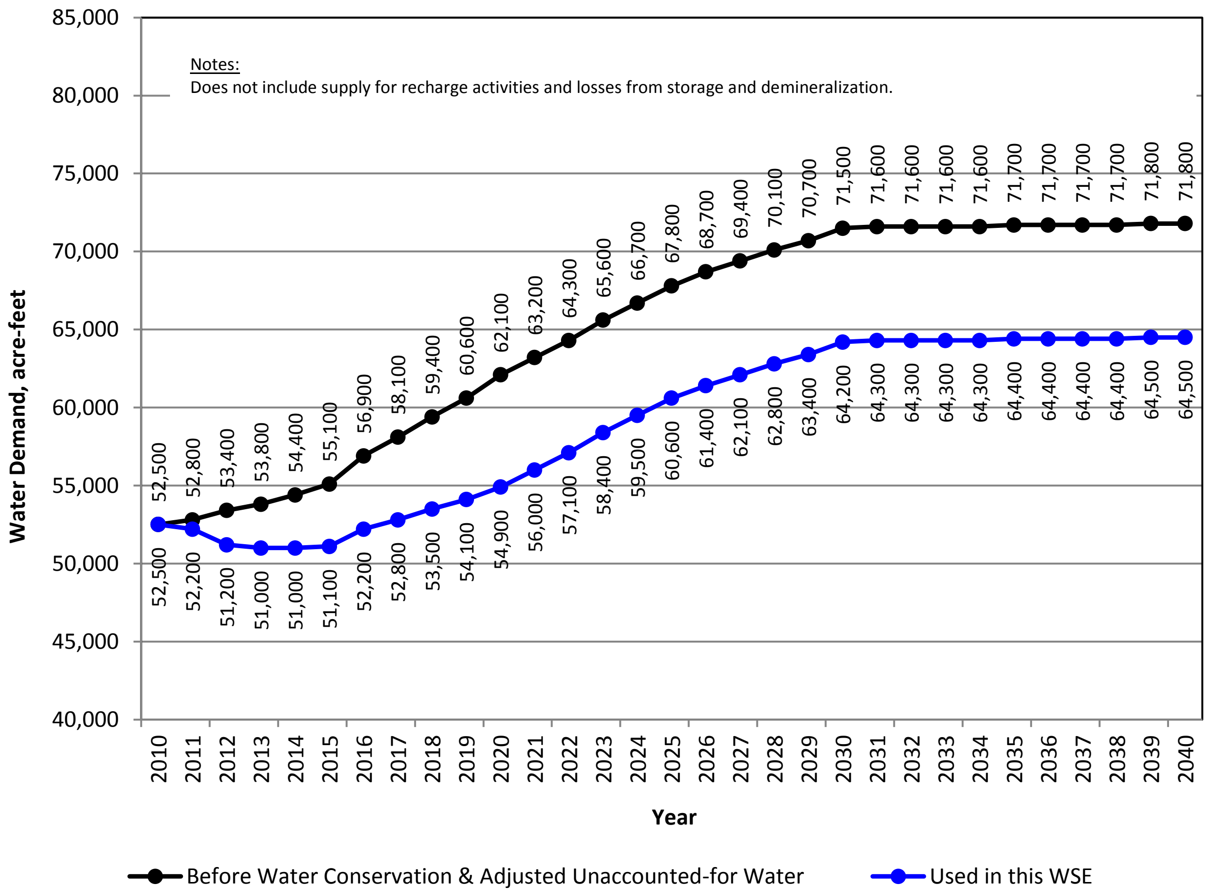
[18] Zone 7 staff used its newly developed water supply model to estimate the average and median recharge capacities along the Arroyo Mocho and Arroyo del Valle. This analysis indicated that the median and average were nearly identical at approximately 9,200 AF. Actual recharge may be significantly more or less than this estimate.

[19] Projections of retailer demands were provided by the Retailers during 2009 and 2010 during the development of the Water Supply Evaluation.

Figure 3-5 shows the projected water demands from the Retailers, retail customers, and untreated water customers with and without the adjustments described above. The Water Supply Evaluation used the lowered projected demands that account for the reductions associated with the Conservation Act and UAFW. At buildout in 2040, the Zone 7 water demand is estimated to be 64,500 AF.

Figure 3-5. Summary of Projected Water Demands from the Retailers, Retail Customers, and Untreated Water Customers



Additionally, the water demand projections presented in Figure 3-5 are planning-level estimates that will likely change in the future. As described in Sections 6 and 8, however, Zone 7 evaluated a myriad of water supply options that have a range of potential water supply yields; Zone 7 staff believes the scope of these options is sufficiently broad and flexible enough to absorb future changes in these estimates.

4. DESCRIPTION OF THE EXISTING WATER SYSTEM

The purpose of this section is to describe the existing water supply system of Zone 7 Water Agency (Zone 7). This system includes three major components: 1) water supplies, 2) water storage facilities, and 3) facilities used to convey, extract, and treat raw water, and facilities used to transmit treated water.

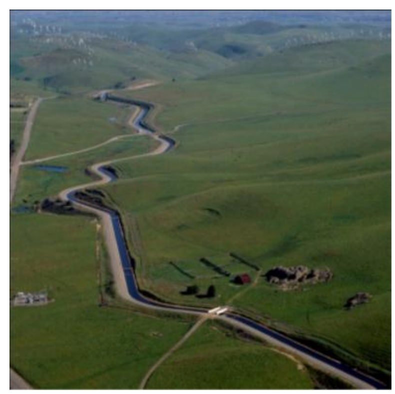
4.1 WATER SUPPLIES

The average yields presented for each water supply below are based on historical data and are therefore representative of historical hydrologic conditions. As part of this Water Supply Evaluation (WSE), Zone 7 developed a new model to incorporate variations in historical hydrologic sequence. Based on this model, Zone 7 analyzed probable water system operations—including water supply availability by source—on a year-by-year basis, resulting in a more rigorous estimate of supply availability. The methodology and criteria used in the WSE are described in detail in Section 5.

4.1.1 Imported Surface Water - State Water Project

Imported surface water is by far Zone 7's largest water source, providing approximately 90% of the treated water supplied to its customers on an annual basis, either directly or after storage. Zone 7 imports surface water from the State Water Project (SWP) and from the Byron Bethany Irrigation District, but the SWP by itself represents approximately 80% of Zone 7's supply.

The SWP is the nation's largest publicly-built water storage and conveyance system and currently serves water to over 25 million people throughout California. It was built and is operated and managed by the California Department of Water Resources (DWR). In addition to delivering water, the SWP also generates power, controls floods, provides recreational facilities, and enhances habitat for fish and wildlife.



Supply from the SWP is delivered via the SBA. Approximately 90% of Zone 7's existing supply is conveyed through the SBA.

SWP water primarily originates within the Feather River watershed, is captured in and released from Lake Oroville, and flows through the Sacramento-San Joaquin Delta (Delta) before it is conveyed by the South Bay Aqueduct (SBA) to Zone 7 or by the California Aqueduct to other south-of-Delta SWP contractors. Zone 7 entered into a 75-year agreement with DWR to receive water from the SWP in November 1961. Including Zone 7, there are 29 SWP contractors spread across California, serving areas as far north as Plumas County and as far south as San Diego County.

Within Zone 7, SWP water is used directly to meet treated water demands from municipal and industrial customers—both wholesale and retail—and untreated water demands from agricultural customers. Water from the SWP can also be stored in Lake Del Valle for later use as described in Section 4.2.1. In addition to aboveground storage, SWP water is used to artificially recharge the local groundwater basin as discussed below in Section 4.2.2, or fill non-local groundwater banks as discussed in Sections 4.2.4 and 4.2.5. Aquifer storage of surface water supplies is a major component of Zone 7's water supply reliability efforts.

4.1.1.1 Table A Allocation and Carryover

The primary allocation agreement between DWR and its SWP contractors is recorded in Articles 12(a) and 18(a) of the agreements and is based on each contractor's annual water delivery request. Each contractor is limited to an annual contractual amount as specified in Article 6(c) and Table A (hence, water that falls under this contractual limit is commonly referred to as "Table A" water). As previously noted, Zone 7 first entered into an agreement with DWR in 1961. As the SWP was expanded and as Zone 7 demands increased over the years, Zone 7's Table A amount was increased, reaching the amount of 46,000 acre-feet annually (AFA) in 1997.

Since 1997, Zone 7 has increased its supply from the SWP through a series of five permanent transfers. In December 1999, Zone 7 secured Table A SWP allocations from Lost Hills Water District of 15,000 AFA and Berrenda Mesa Water District of 7,000 AFA. In December 2000, 10,000 AFA of SWP allocation from Belridge Water Storage District was acquired. An additional 2,219 AFA was obtained from the same source in October 2003. Finally, 400 AFA of water was acquired from the Tulare Lake Basin Water Storage District in 2003. Together, these transfers have raised Zone 7's current Table A allocation to 80,619 AFA through 2036 with an option to renew for another 75 years.

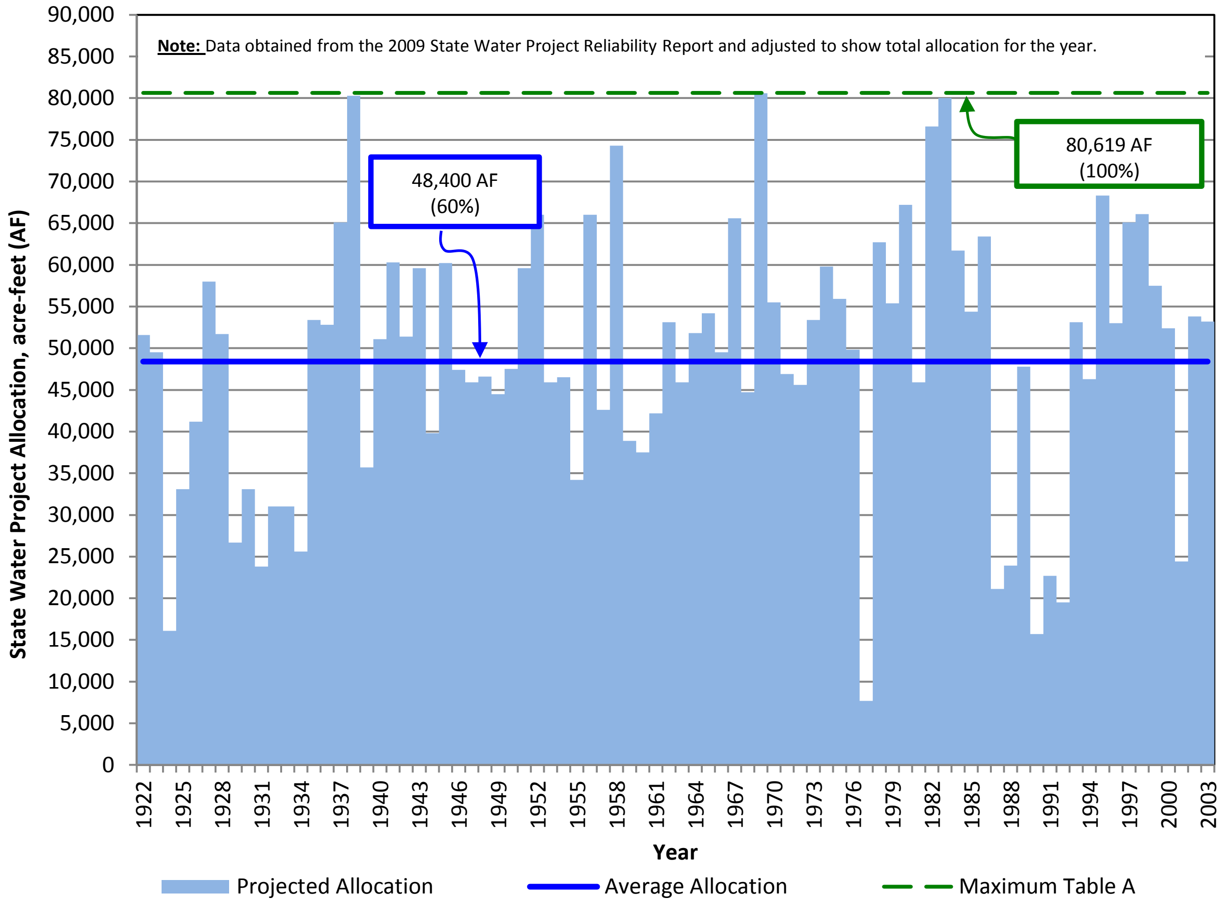
Zone 7 has the ability to carryover Table A water from one year to another via storage in San Luis Reservoir

In practice, the actual amount of SWP water available to Zone 7 under the Table A allocation process varies from year to year due to hydrologic conditions, water demands of other contractors, SWP facility capacity, and environmental/regulatory requirements. In January 2010, DWR issued the State Water Project Delivery Reliability Report for 2009[20], which estimates a long-term average yield of 60% of Table A amounts, equivalent to 48,400 AFA for Zone 7. This is equivalent to a median yield in a normal water year of 51,400 AFA (approximately 64%) to Zone 7. Figure 4-1 shows the projected allocations from the SWP.

The projected long-term average yield of the SWP has decreased by 15% since 2007, when it was at 75%. This decrease reflects the impacts of Delta pumping restrictions resulting from concerns over threatened/endangered species in the Delta and the predicted impacts of climate change. This 15% reduction translates to a total loss of 12,100 AF of water supply.

[20] DWR, 2010. State Water Project Delivery Reliability Report for 2009. (Available at http://baydeltaoffice.water.ca.gov/swpreliability/index.cfm).

Figure 4-1. Projected Allocations from the State Water Project



As a SWP contractor, Zone 7 has the option to carry over unused Table A water from one year to the next when there is available storage in San Luis Reservoir (SLR). The SLR is located approximately 70 miles southeast of Livermore. This "carryover" water is also called Article 12e and 56c water. Article 12e water must be taken by March 31 of the following year, while Article 56c water may be carried over as long as SLR storage is available. When SLR is full, and Article 21 water is available (see next section), a portion of carryover stored by each contractor is "spilled" or converted back to general SWP supplies, effectively reducing each contractor's carryover balance. The total amount of spill is equal to the amount of Article 21 water and is split amongst the contractors in proportion to their maximum Table A contract amounts.

The amount that Zone 7 can carry over from one year to the next depends on DWR's allocation for that year. For example, if the allocation is equal to or less than 50 percent of Zone 7's Table A amount, then carryover is limited to 25% of Zone 7's total Table A amount, or approximately 20,200 AFA (0.25 x 80,619 AFA). However, if allocations are equal to or greater than 75% of Zone 7's Table A amount, then carryover is limited to 50% of Zone 7's total Table A amount, or approximately 40,300 AFA (0.50 x 80,619 AFA). For drought protection, Zone 7 typically aims to have a total of 10,000 to 15,000 AF of carryover water available at all times to supplement the current year's allocation in case a dry year occurs.

4.1.1.2 Article 21 Water (Interruptible or Surplus Water)

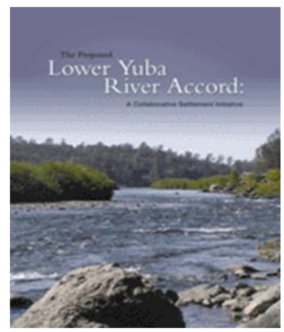
Under Article 21 of Zone 7's contract with DWR, Zone 7 also has access to excess water supply from the SWP that is available only if: 1) it does not interfere with SWP operations or Table A allocations, 2) excess water is available in the Delta, and 3) it will not be stored in the SWP system. The amount of Article 21 water available is calculated as the pumping capacity available at Banks Pumping Plant minus the contractor demands. If there is no demand for Article 21 water, this excess water flows out to the ocean. Per the State Water Project Reliability Report for 2009[20], the projected yield from Article 21 is very low and represents neither a significant nor a reliable water supply for Zone 7.

4.1.1.3 Article 56d Water (Turnback Pool Water)

Article 56d is a contract provision that allows SWP contractors with unused Table A water to sell their water to contractors who have water needs that exceed their allocation for the year. Historically, only a few SWP contractors have been in a position to make Turnback Pool water available for purchase, particularly in normal or dry years. Zone 7 currently does not anticipate a significant amount of water supply to be available under Article 56d.

4.1.1.4 Yuba Accord

In 2008, Zone 7 entered into a contract with DWR to purchase additional water under the Lower Yuba River Accord (Yuba Accord). The contract expires in 2025. There are four different types ("Components") of water available; Zone 7 has the option to purchase Components 2 and 3 water during drought conditions, and Component 4 water when the Yuba County Water Agency has determined that it has excess water available to sell.



In addition to protecting fish habitat, the Yuba Accord made additional water supplies available to SWP contractors.

The annual amount of water supply available to Zone 7 during dry years under the Yuba Accord is relatively small. For long-term planning, Zone 7 estimates an average yield of 250 AFA under the Yuba Accord. This yield was estimated by assuming a maximum yield of 676 AF (Components 2 and 3 only; Component 4 not included) during critical dry years and zero yield during wet years.

4.1.2 <u>Imported Surface Water - Byron Bethany Irrigation District</u>

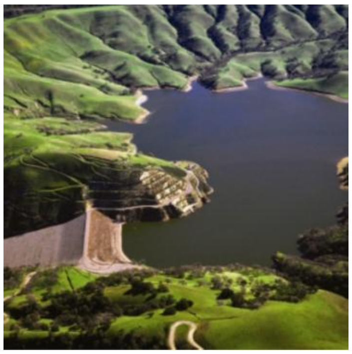
The Byron Bethany Irrigation District (BBID) diverts water from the Delta pursuant to a "Notice of Appropriation of Water" dated May 18, 1914[21]. Zone 7 entered into a water transfer demonstration project in 1994 with BBID, which provided a minimum supplemental water supply of 2,000 AFA to Zone 7 with a potential to purchase up to 5,000 AFA. This original agreement was valid for five years. In 1998, Zone 7 and BBID agreed to convert the demonstration project into a long-term 15-year contract, renewable every five years up to a total of 30 years. In August 2010, the contract was extended through 2030 with an option to extend through 2039 and beyond.

Like SWP supplies, water purchased from BBID is delivered to Zone 7 via the SBA. While Zone 7 has had a contract with BBID since 1998, Zone 7 has historically requested less than the full amount available; this may change in the future as demands and available supplies change. Zone 7 also plans to investigate

[21] Source: Mountain House Master Plan.

whether the minimum yield of 2,000 AFA can be increased over the long-term; this effort is described in more detail in Section 6.3.1.

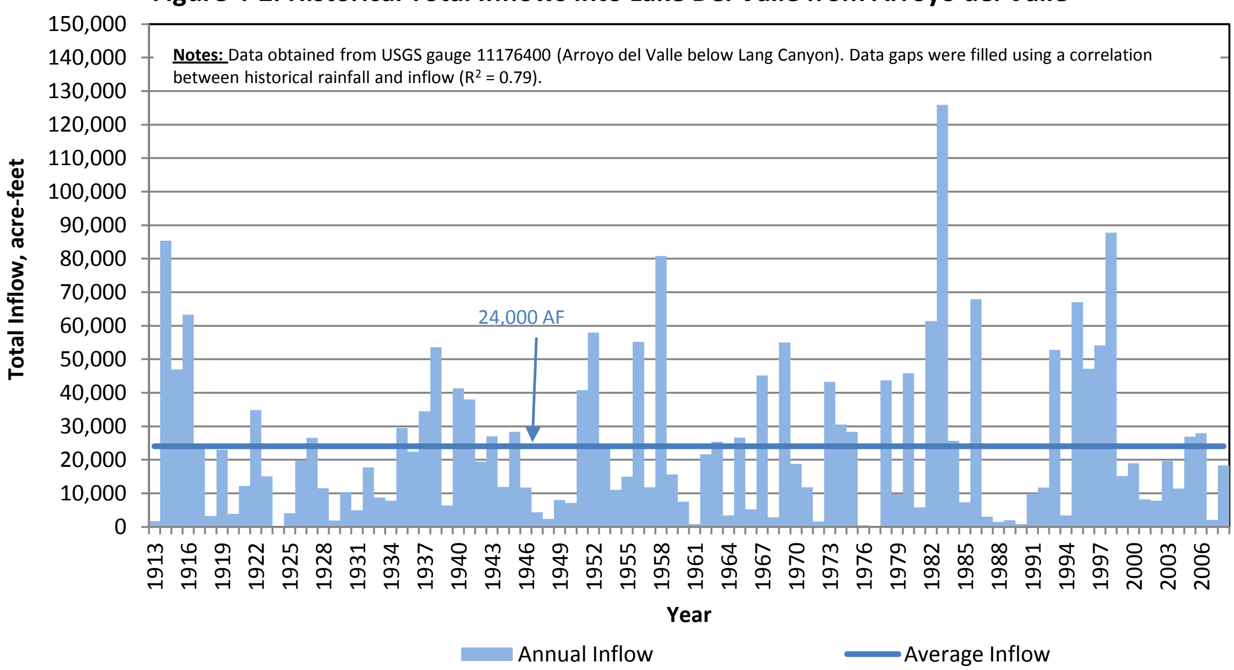
4.1.3 Local Runoff - Arroyo Del Valle



Supply from Arroyo del Valle is stored in Lake Del Valle

Zone 7, along with Alameda County Water District (ACWD), has a water right permit to divert flows from Arroyo del Valle[22]. Runoff from the Arroyo del Valle watershed above Lake Del Valle is stored in the lake, which is managed by DWR. A review of historical runoff from Arroyo del Valle over 1913 to 2008[23] indicates that the average total inflow into Lake Del Valle has been approximately 24,000 AFA (Figure 4-2). A maximum annual inflow of 126,000 AF was observed in 1983. Inflows into Lake Del Valle, after accounting for permit conditions, are equally divided between ACWD and Zone 7; however, total diversions cannot exceed 60,000 AFA. Based on historical conditions and existing facilities, the average yield to Zone 7 is projected to be 7,300 AFA from local runoff. Section 6.3 discusses future facilities that will be used to increase the yield under the existing permit.

Figure 4-2. Historical Total Inflows into Lake Del Valle from Arroyo del Valle



4.2 WATER STORAGE FACILITIES

Zone 7 has three options for local storage: storage in Lake Del Valle, storage in the Livermore Valley Groundwater Basin and, in the future, surface storage in the Chain of Lakes. Zone 7 also has access to

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[22] Permit 11319 (Application 17002).

[23] Note that actual data is only available for the following years: 1912 (partial)-1930, 1942, 1944-1952, 1958–present. Gaps were filled using correlations with local rainfall.

groundwater banking or storage facilities in Kern County through the Semitropic Water Storage District and the Cawelo Water District.

Water stored in the local groundwater basin and the aquifers in Kern County represent water previously stored from Zone 7's surface water supplies during wet years; therefore, they do not make a net contribution to Zone 7's water supply over the long-term and in fact result in some operational losses as described further below. Very importantly, however, they provide a source of water during drought years. Note that the banked water supplies in Kern County are only accessible when the SBA (described in Section 4.3.1) is operational.

Each of Zone 7's storage options is described below.

4.2.1 Local Storage: Lake Del Valle

Lake Del Valle is a 77,110 acre-foot reservoir with a 235-foot high dam that is located approximately 10 miles southeast of Livermore. It was constructed by DWR in 1968 to provide recreation and fish and wildlife enhancement, flood control for Alameda Creek, and storage for SWP water delivered through the South Bay Aqueduct (see Section 4.3.1)[24]. It normally stores from 25,000 to 40,000 AF, with the remaining capacity left available for flood control. The storage capacity available to Zone 7 ranges from 7,000 to 10,000 AFA depending on lake drawdown and hydrology.

The 1.5-mile Del Valle Branch Pipeline, which branches off the SBA downstream of the Patterson Pass Water Treatment Plant (see Section 4.3.2), is used for filling the lake, as well as releasing water from it. Water is pumped into the lake and released by gravity flow. Lake Del Valle is used to store runoff from the Arroyo del Valle watershed above the lake (the rights to which are shared between Zone 7 and ACWD) and to store imported surface water deliveries from the SWP for the three SBA contractors (Zone 7, ACWD, and Santa Clara Valley Water District). In the late summer/early fall, DWR typically lowers the lake level to 25,000 AF in anticipation of runoff from winter storm events, and to provide flood control capacity.

Water supply in Lake Del Valle is made available to the SBA contractors via the SBA through operating agreements with DWR. As in the case of SWP water taken directly from the SBA, water released from Lake Del Valle is also used by Zone 7 to artificially recharge the Main Basin, as discussed further in Section 4.2.2.

4.2.2 Local Storage: Livermore Valley Groundwater Basin and Recharge Facilities

Zone 7 overlies the Livermore Valley Groundwater Basin (DWR Basin 2-10), which extends from the Pleasanton Ridge east to the Altamont Hills and from the Livermore Uplands north to the Tassajara Uplands[25]. The portion of the Livermore Valley Groundwater Basin that contains high-yielding aquifers and good quality groundwater is called the Main Basin, which is composed of the Castle, Bernal, Amador, and Mocho II sub-basins.

The Main Basin has an estimated storage capacity of 254,000 AF and receives an annual average natural recharge of approximately 13,400 AFA through percolation of rainfall, natural stream flow, and irrigation waters, and inflow of subsurface waters[26]. This natural recharge is considered the long-term natural sustainable yield of the Main Basin, or the amount that can be pumped without lowering the long-term

[24] DWR, 2001. South Bay Aqueduct (Bethany Reservoir and Lake Del Valle).

[25] DWR, 2003. California's Groundwater - Bulletin 118 Update 2003.

average groundwater volume in storage. The long-term natural sustainable yield is based on over a century of hydrologic records and projections of future recharge conditions.

Zone 7 uses the Main Basin as a storage facility and not a source of long-term water supply because Zone 7 only pumps groundwater it has artificially recharged using its surface water supplies. As the groundwater basin manager, Zone 7's policy is to maintain groundwater levels above historical lows in the Main Basin through its artificial recharge operations. SWP water or runoff from Arroyo del Valle (stored in and released from Lake Del Valle) is used to recharge the Main Basin by releasing water from turnouts along the SBA and the Del Valle Branch Pipeline into the Arroyo Mocho and Arroyo del Valle for percolation down to the aquifers. The streams' total recharge capacity varies depending on hydrologic conditions, with higher recharge capacities occurring during dry years. The long-term average recharge capacity through the Arroyo Mocho and Arroyo del Valle is estimated at 9,200 AFA, as noted in Section 3.3.7.

Zone 7 established historical lows based on the lowest measured groundwater elevations in various wells in the Main Basin; historical lows correspond to a groundwater storage volume of about 128,000 AF.[26] In general, the difference between water surface elevations when the Main Basin is full and water surface elevations when the Main Basin is at historical lows defines Zone 7's available operational storage. Operational storage is about 126,000 AF based on Zone 7's experience operating the Main Basin.

Before the construction of the SWP in the early 1960s, groundwater was the sole water source for the Livermore-Amador Valley. This resource has gone through several periods of extended withdrawal and subsequent recovery. In the early 1960s, when approximately 110,000 AF of groundwater was extracted, the Main Basin reached its historical low of 128,000 AF. The Main Basin was then allowed to recover from 1962 to 1983. It was during this era that Zone 7 first conducted a program of groundwater replenishment by recharging imported surface water via its streams ("in-stream recharge") for storage in the Main Basin, began supplying treated surface water to customers to augment groundwater supplies, and regulating municipal pumping by contractually establishing GPQs as discussed above. Figure 4-3 shows Zone 7's total annual artificial recharge amounts from 1974 to 2009.

[26] Zone 7, 2010. Annual Report for the Groundwater Management Program – 2009 Water Year. May.

Figure 4-3. Zone 7 Historical Artificial Recharge

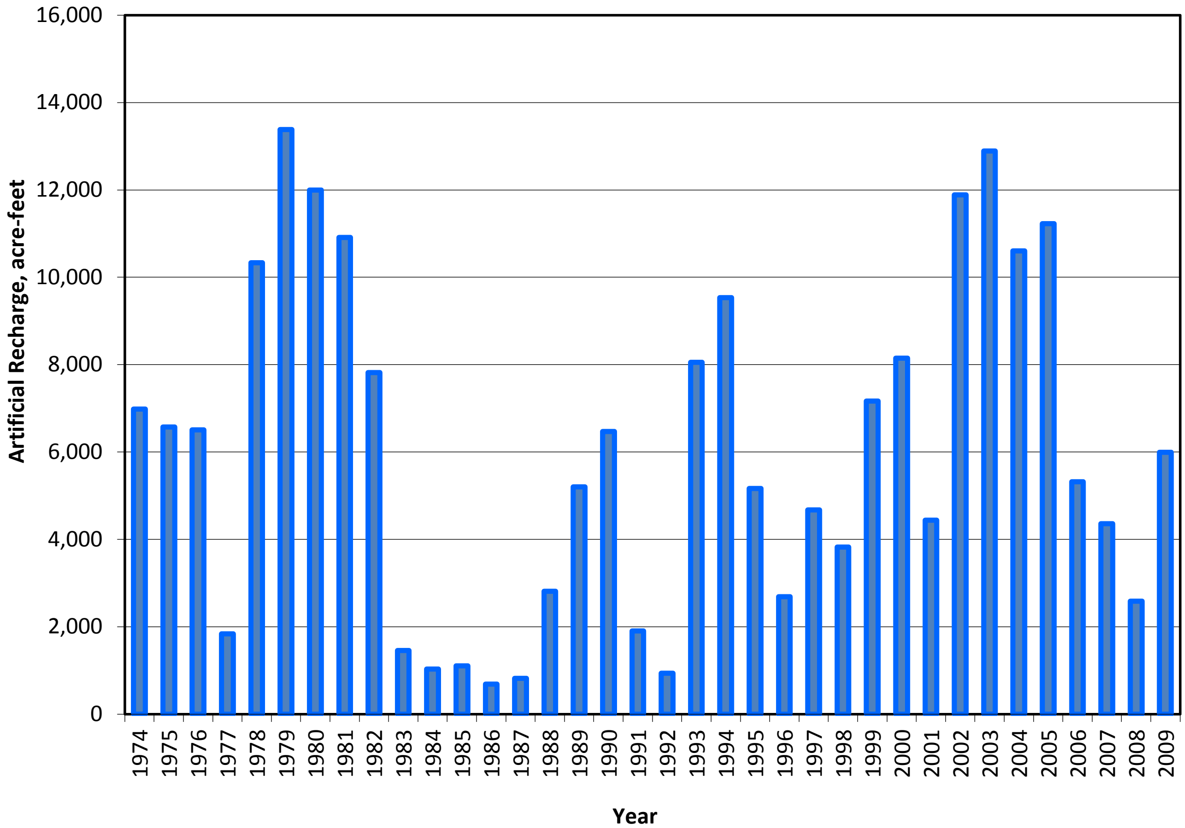
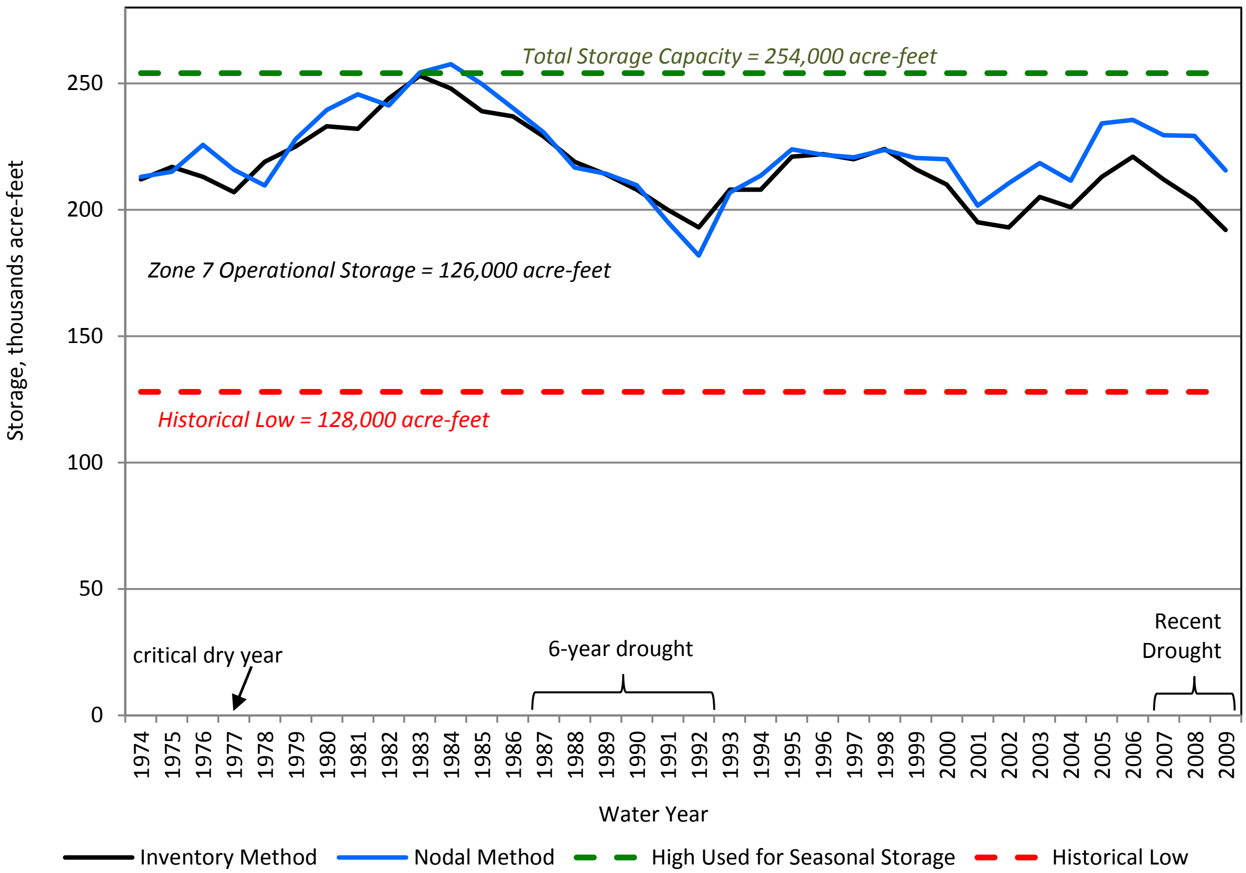


Figure 4-4 shows the volumes of storage in the Main Bain between 1974 and 2009. As shown, the Main Basin went through an extended withdrawal from 1987 to 1992 due to drought. Figure 4-4 also shows the Main Basin responding to the drought that started in 2007. At the end of the 2009 water year, there was 204,000 AF[27] of stored water in the Main Basin; of this amount, 76,000 AF of groundwater was available for Zone 7's use (as noted above, the Main Basin is to be maintained at or above 128,000 AF at all times). This left 50,000 AF of available storage capacity for recharge activities at the end of the 2009 water year.

[27] Calculated as the average of the results from the two storage calculation methods. See Table 4.2-4 of the 2009 Annual Report for the Groundwater Management Program included as a CD attachment.

Figure 4-4. Main Basin Groundwater Storage



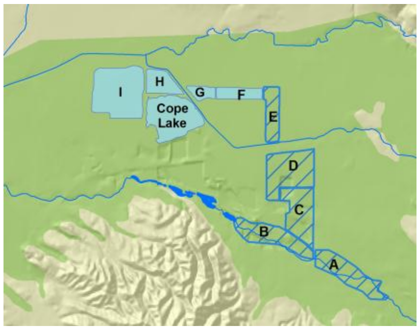
During high demands, groundwater is used to supplement surface water supply delivered via the SBA. Groundwater is also used when the SBA is out of service due to maintenance and improvements or when Zone 7's surface water treatment plants are operating under reduced capacity due to construction, repairs, etc. As mentioned previously, the Main Basin is a key component of Zone 7's drought and emergency management efforts; Zone 7 taps into its stored groundwater when there may be insufficient surface water supply available due to emergency or drought conditions. Finally, Zone 7 pumps groundwater out of the Main Basin during normal water years to help reduce the salt loading in the Main Basin. Salt issues in the Main Basin are discussed in more detail in Section 4.3.4.

Zone 7's stream recharge capacity is 9,200 AFA on average, which means that Zone 7 can pump an equivalent 9,200 AFA on average from the Main Basin; this pumping allows for operational flexibility (i.e., short-term storage of surface water supplies to be extracted when demands increase) and salt removal.

More detailed descriptions of the Main Basin are available in Zone 7's Groundwater Management Plan (GMP).[28]

[28] Jones & Stokes, 2005. Groundwater Management Plan for Livermore-Amador Valley Groundwater Basin.

4.2.3 Local Storage: Chain of Lakes – Lake I and Cope Lake



The Chain of Lakes is located over the Main Basin, and will enhance Zone 7's existing artificial recharge activities

The Chain of Lakes refers to a series of ten mined out or active gravel quarry pits that have been or will be transferred to Zone 7 for water resource management applications. These applications might include surface storage of stormwater or other local runoff, surface storage of water from the SWP, use as groundwater recharge basins once mining has been completed, and flood control along the Arroyo Mocho and Arroyo Las Positas. The ten quarry pits or lakes are named Cope Lake, and Lakes A through I.

Although the Chain of Lakes will ultimately cover approximately 2,000 acres and store approximately 100,000 AF of water, Zone 7 currently only owns Cope Lake and Lake I. Zone 7 expects to take ownership of Lake H sometime within the next five years, while the remaining lakes will be transferred to Zone 7 over the next 20 years.

4.2.4 Non-Local Storage: Semitropic Water Storage District

The Semitropic Water Storage District (Semitropic), which started as an irrigation district, began a groundwater storage or banking program in the early 1990s in response to problems with groundwater overdraft, rising costs, water shortages, and poor agricultural economy[29]. It is one of eight water storage districts in California and is the largest in Kern County. The total capacity of Semitropic's groundwater storage bank is 1.65 million AF.

Zone 7 originally acquired a storage capacity of 65,000 AF in Semitropic's groundwater banking program in 1998. Subsequently, Zone 7 agreed to participate in Semitropic's Stored Water Recovery Unit, which increased pumpback capacity and allowed Zone 7 to purchase an additional 13,000 AF of storage capacity towards a total of 78,000 AF. The storage agreement is in effect through December 31, 2035.

During non-drought periods, Zone 7 can store up to 5,883 AFA into the Semitropic groundwater bank. There is a 10% loss associated with water transferred into Semitropic. During a drought year, Zone 7 has the ability to request up to 9,100 AF of pumpback and any amount up to 8,645 AF of exchange water; the availability of exchange water depends on projected SWP allocation. Pumpback is water that is pumped out of the Semitropic aquifer and into the California Aqueduct for distribution to SWP contractors. Exchange water is water that is transferred between Zone 7 and Semitropic by adjusting the amounts of Table A water allocated between Zone 7 and Semitropic. Note that water taken out of storage from Semitropic requires delivery via the SBA to Zone 7.

4.2.5 Non-Local Storage: Cawelo Water District

Similar to the arrangements with Semitropic, Zone 7 has 120,000 AF of groundwater banking storage available with the Cawelo Water District (Cawelo), as executed in an agreement in 2006. The agreement is in effect through December 31, 2035.

Zone 7 only receives storage credit for 50% of the water provided to Cawelo. Per the existing contract, Zone 7 can normally only send 10,000 AF in any given year during non-drought periods to Cawelo;

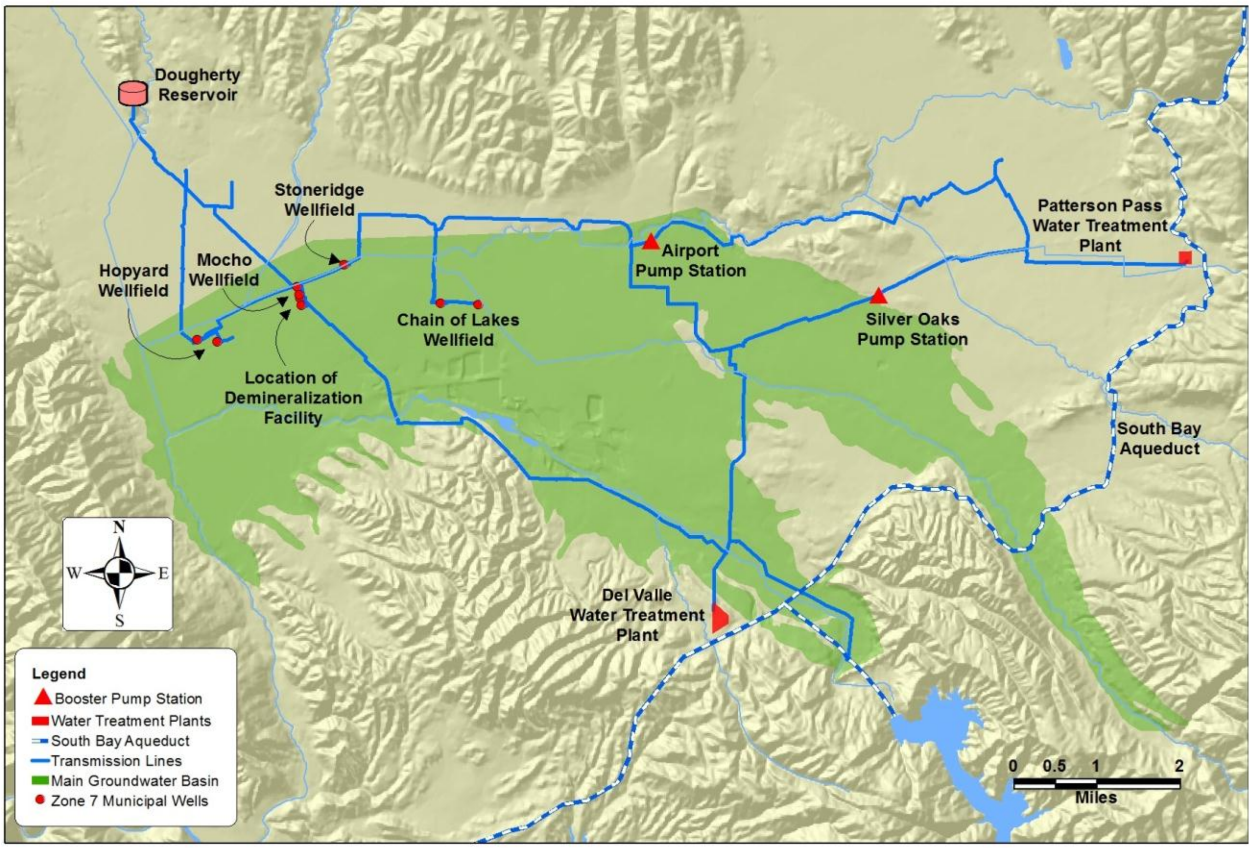
[29] http://www.semitropic.com

therefore, the maximum contractual credit is 5,000 AFA. During droughts, Zone 7 has the ability to request up to 10,000 AFA of pumpback (or exchange water) from Cawelo.

4.3 WATER FACILITIES

Zone 7 has a robust water supply system consisting of an aqueduct, surface water treatment plants, groundwater wells, a groundwater demineralization facility, booster pump stations, reservoirs, and transmission pipelines. Key facilities are discussed below, while Figure 4-5 illustrates the location of Zone 7's major water system facilities.

Figure 4-5. Zone 7's Major Treated Water System Facilities



4.3.1 Raw Water Conveyance – South Bay Aqueduct

Zone 7 imports surface water from the SWP through the South Bay Aqueduct (SBA) for direct use by untreated water users and for treatment, storage, and recharge for municipal and industrial customers. The SBA, which is operated by DWR, starts from the 4,808 AF Byron Bethany Reservoir in the northeastern corner of Zone 7's service area near Tracy, then leaves the service area southwest of San Antonio Reservoir.

The SBA is made up of pipelines and open channels. The South Bay Pumping Plant (SBPP) lifts water 566 feet into the first reach of the SBA, discharging water through pipelines to the eastern ridge of the Diablo Range[24], where the SBA becomes an open channel. Nine miles downstream, some water is diverted to the Patterson Reservoir, which serves Zone 7's Patterson Pass Water Treatment Plant (see Section 4.3.2). From that point, water flows nine more miles to where the Del Valle Branch Pipeline meets the SBA, and where some water can be pumped to Lake Del Valle for storage. The SBA converts to a pipeline for the rest of its length, terminating in a steel tank east of downtown San Jose. Zone 7 and the other two SBA contractors (Alameda County Water District and Santa Clara Valley Water District) divert water from the SBA at various turnouts.

In 2012, DWR is expected to complete improvements to the SBA that will provide significantly increased capacity to serve Zone 7. These improvements include expansion of the SBPP, raised linings on open channel sections, enlarged pipelines, improved pipeline lining, enlargement of Patterson Reservoir, and construction of a new 425-AF raw water reservoir (Dyer Reservoir). Dyer Reservoir is located near one of the proposed sites for a future Zone 7 water treatment plant. Zone 7's current plans for enhanced surface water treatment capacity is discussed in Section 6.4.1.

The 425-AF Dyer Reservoir under construction in January 2011 as part of the South Bay Aqueduct Enlargement Project.

4.3.2 Water Treatment Plants

Zone 7 operates two surface water treatment plants: the Del Valle Water Treatment Plant (DVWTP) and the Patterson Pass Water Treatment Plant (PPWTP).

4.3.2.1 Del Valle Water Treatment Plant

The DVWTP is located in the southern portion of Livermore and along the SBA, downstream of Lake Del Valle. It can therefore receive 100% Delta water from the SBA, 100% Lake Del Valle water, or a blend of the two sources. It became operational starting in 1975, and was expanded twice, in 1979 and 1990, to its current rated capacity of 40 MGD.

DVWTP is a conventional treatment plant whose processes include coagulation, flocculation, clarification, granular media filtration, and chlorine disinfection. In addition, chloramine is used to maintain a disinfectant residual in the distribution system.[30] Clarification at the DVWTP is achieved using two technologies that operate as parallel treatment trains: upflow solids contact clarifiers (Superpulsators) and dissolved air flotation (DAF) clarifiers. The 10 MGD DAF clarification process was installed at DVWTP in 2007 to improve the reliability of the DVWTP.

[30] Zone 7, 2009. Del Valle Water Treatment Plant Site Specific BMPs Plan. September.

4.3.2.2 Patterson Pass Water Treatment Plant

The PPWTP is located along the SBA, just south of Interstate 580, and has a capacity of 19 MGD.[31] Because PPWTP is upstream of Lake Del Valle, it is not able to receive water from this water supply source[32] and relies on 100% Delta water. The Patterson Reservoir, a 100-AF raw water reservoir located adjacent to the PPWTP and operated by DWR, provides supply to PPWTP in case of disruptions to water supply from the Delta. The reservoir also provides pre-settling and equalization of raw water quality of the influent to PPWTP.

There are two separate, parallel treatment plants at the PPWTP site: a conventional plant and an ultrafiltration (UF) plant. The 12-MGD conventional plant consists of coagulation, flocculation, sedimentation, and granular media filtration processes. The 7-MGD UF plant consists of solids contact clarification as a pretreatment to UF membranes. Both plants utilize chloramine for maintaining a disinfectant residual in the distribution system. The two plants share the same water source, finished-water clearwell, and solids handling facilities, but are operated independently of each other by Zone 7 staff. The UF plant was designed to be a temporary pilot facility to test UF membranes for a future water treatment plant, and it is intended to be replaced when it is no longer viable.

4.3.3 Zone 7 Groundwater Wells

Zone 7 owns and operates nine municipal supply wells located in four wellfields: the Chain of Lakes, Hopyard, Mocho, and Stoneridge. These wellfields are located on the west side of Zone 7's service area, and therefore primarily serve retailers on the west side of Zone 7's system (Dublin San Ramon Services District and the City of Pleasanton). Together, the wellfields have a combined peak capacity of 41 MGD; however, the newest two wells, which are located in the Chain of Lakes wellfield and represent approximately 9 MGD in capacity, are primarily intended for emergency or drought conditions. Therefore, under normal operating conditions, Zone 7 plans on a peak capacity of 32 MGD from the wells. Table 4-1 lists the capacities of the various wells and wellfields.

There are no regulatory requirements for treating Zone 7's groundwater; however it is chloraminated to match the disinfectant residual in the treated water produced by the surface water treatment plants.

[31] Zone 7, 2009. Patterson Pass Water Treatment Plan Site Specific BMPs Plan. September.

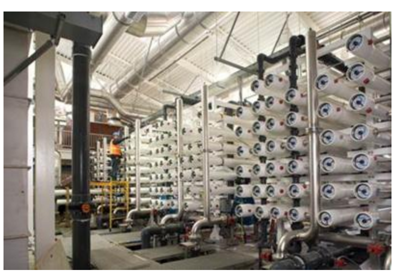
[32] PPWTP can put water supply diverted under an existing water right permit to beneficial use through exchanges with other SWP contractors.

Table 4-1. Zone 7 Groundwater Wells

Facility	Peak Capacity		Sustained Capacity[a]
	GPM	MGD	MGD
Hopyard Wellfield			
Hopyard 6	3,800	5.5	5
Hopyard 9	1,110	1.6	1
Mocho 1 and 2 Wellfield			
Mocho 1	2,290	3.3	3
Mocho 2	2,220	3.2	3
Mocho 3 and 4 Wellfield[b]			
Mocho 3	4,170	6.0	5
Mocho 4	3,680	5.3	5
Stoneridge Wellfield	4,580	6.6	6
Total for Normal Operations	**21,850**	**32**	**29**
Chain of Lakes Wellfield			0
Chain of Lakes 1	2,500	3.6	3
Chain of Lakes 2	3,500	5.0	5
Additional Capacity	**6,000**	**9**	**8**

[a] Estimated as 90% of peak capacity.
[b] This does not include the reduction in net water production due to brine concentrate losses when the demineralization facility (see Section 4.3.4) is operating.

4.3.4 Mocho Groundwater Demineralization Plant



Reverse osmosis membrane modules at the Mocho Groundwater Demineralization Plant

The Main Basin is characterized by relatively good quality groundwater that meets all state and federal drinking water standards; groundwater is chloraminated simply to match the disinfectant residual in the distribution system. However, there has been a slow degradation of groundwater quality as evidenced by rising total dissolved solids (TDS) and hardness levels over the last few decades. To address this problem, Zone 7 developed a Salt Management Plan (SMP)[33], which was approved by the Regional Water Quality Control Board in 2004 as a condition of the Master Waste Reuse Permit and incorporated into Zone 7's Groundwater Management Plan (GMP) in 2005[34].

In accordance with Zone 7's GMP, Zone 7 completed construction of a 6.1-MGD demineralization facility at the Mocho Wellfield in 2009. This facility is referred to as the "Phase 1 Demineralization Facility" in Zone 7's Capital Improvement Program, reflecting Zone 7's plans to install additional demineralization facilities depending on the performance of the first facility and future needs.

[33] Zone 7 Water Agency, 2004. Salt Management Plan.

[34] Jones and Stokes, 2005. Groundwater Management Plan for the Livermore-Amador Valley Groundwater Basin.

Employing a reverse osmosis membrane-based treatment system, the Mocho Groundwater Demineralization Plant simultaneously allows for the removal and export of concentrated minerals or salts from the Main Basin[35] and the delivery of treated water with reduced TDS and hardness levels to Zone 7's customers. Only a portion of the groundwater pumped from the Mocho wellfield is treated at the demineralization facility; demineralized water is blended with non-demineralized water to achieve a target salt concentration (measured as total dissolved solids or TDS). Section 5.4 contains a more detailed discussion of Zone 7's Water Quality Management Program, including water quality goals and strategies.

4.3.5 Treated Water Transmission System

Zone 7's treated water transmission system consists of approximately 43 miles of pipelines ranging from 12 to 42 inches in diameter. Elevations across the transmission system range from 600 to 680 feet above mean sea level (msl) on the east side of the service area to approximately 330 feet above msl on the west side of the service area.

Construction of El Charro Pipeline in 2009

[35] The brine concentrate resulting from the treatment system is exported to the San Francisco Bay via a regional wastewater export pipeline.

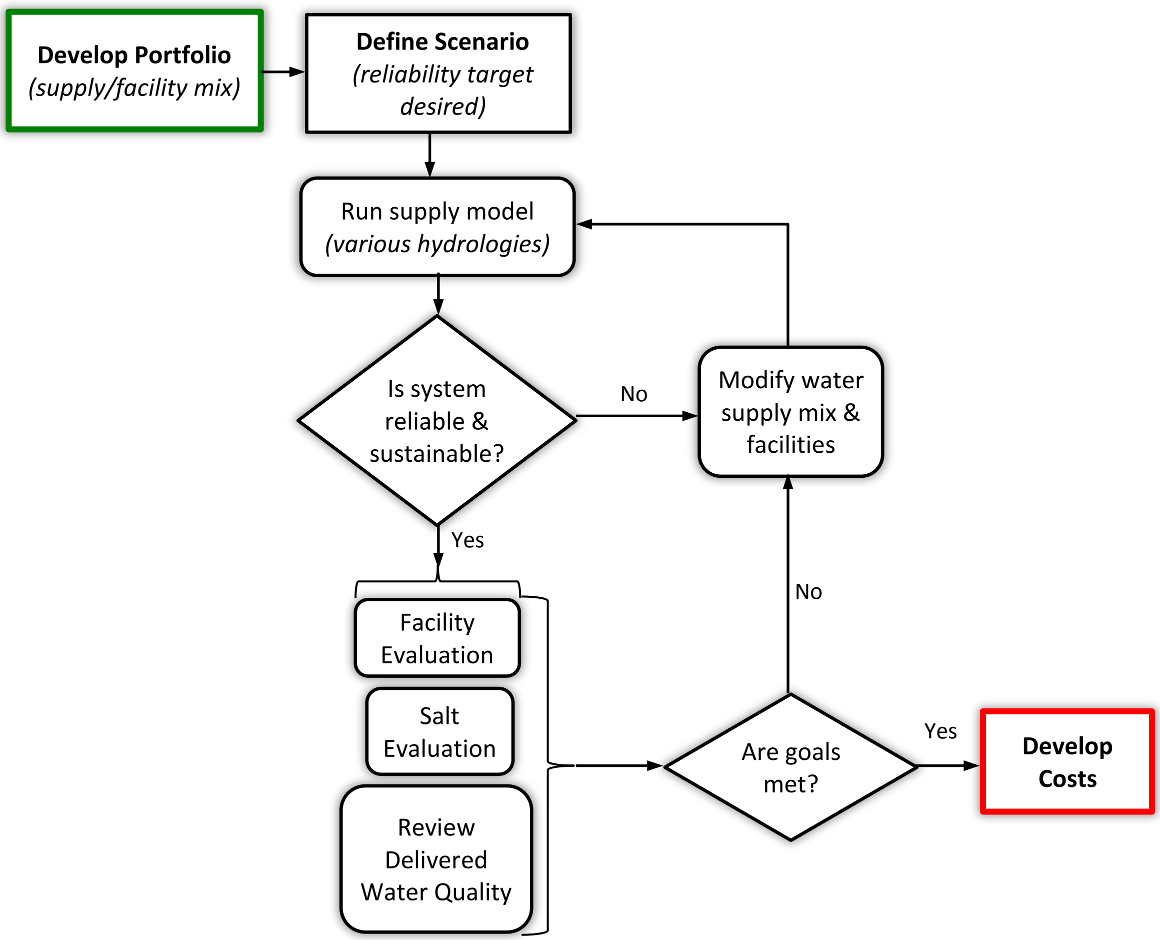
5. METHODOLOGY AND CRITERIA USED TO EVALUATE THE WATER SYSTEM

As part of evaluating each water system portfolio in this Water Supply Evaluation (WSE), Zone 7 Water Agency (Zone 7) considered new water supply options, water facilities required for meeting maximum day demands, salt balance of the underlying groundwater basin, and the delivered water quality goals established as part of Zone 7's Water Quality Management Program (WQMP). The purpose of this section is to describe the methodology and criteria used for analyzing each of these key areas as listed below:

- 5.1 Probability-Based Water Supply Methodology and Criteria
- 5.2 Water Facility Evaluation Methodology and Criteria
- 5.3 Salt Balance Methodology and Criteria
- 5.4 Qualitative Approach to Delivered Water Quality

Figure 5-1 illustrates the process used for the analysis completed in this WSE.

Figure 5-1. Methodology and Approach



5.1 PROBABILITY-BASED WATER SUPPLY METHODOLOGY AND CRITERIA

The purpose of this section is to describe the probability-based water supply model developed by Zone 7 staff to help quantify the reliability of Zone 7's water system. More specifically, this section describes the objectives of the model; the need for Monte Carlo methods; the software package selected to meet these objectives; how climate change was incorporated into the analysis; and how the model works. This section also provides definitions for system reliability and sustainability as used in this WSE.

5.1.1 Objectives of the Probability-Based Water Supply Model

Traditional long-term water supply planning assumes that subjecting a water supply system to a repeat of historical hydrology is a good predictor for future system reliability. Historically, Zone 7 has used this traditional approach, and evaluated the reliability and sustainability of its water supply system assuming a repeat of the historical sequence of wet, normal, and dry years, which has important impacts on storage reserves and the ability to meet water demands during dry years.[36]

In the last few years, however, legal and environmental concerns have introduced significant uncertainty into the future of Zone 7's largest water supply source, the State Water Project (SWP). DWR modeling projects that the long-term average yield from Zone 7's SWP supplies decreased from 75% to approximately 60% between 2007 and 2010.[37] Moreover, the expected year-to-year allocations of State Water Project supplies will become more uncertain as additional endangered species are identified in the Sacramento-San Joaquin Delta (Delta), the ecosystem of the Delta continues to decline, and more lawsuits are filed. All of these factors make it difficult to plan future water supply activities assuming a repeat of historical hydrology, especially for a storage-rich system like Zone 7's, where the number of normal and wet years between droughts required to replenish storage reserves is as important as planning for minimal water supply deliveries during critical dry years.

For example, the current historical sequence published in DWR's 2009 Reliability Report separates two six-year droughts by over 50 years (see Figure 5-2), which raises the following questions:

- What happens if less than 50 years separate the last six-year drought (1987 to 1992) from the next six-year drought?
- What is the probability of having sufficient drought storage before the next six-year drought if less than 50 years separate the two droughts?
- What are the implications of having droughts longer than six years?
- What is the likelihood of a water supply shortage if Zone 7 did not have over 50 years to prepare for the next six-year drought?
- What are the implications of having a critical dry year (e.g., 1977 conditions) fall right after a long drought?

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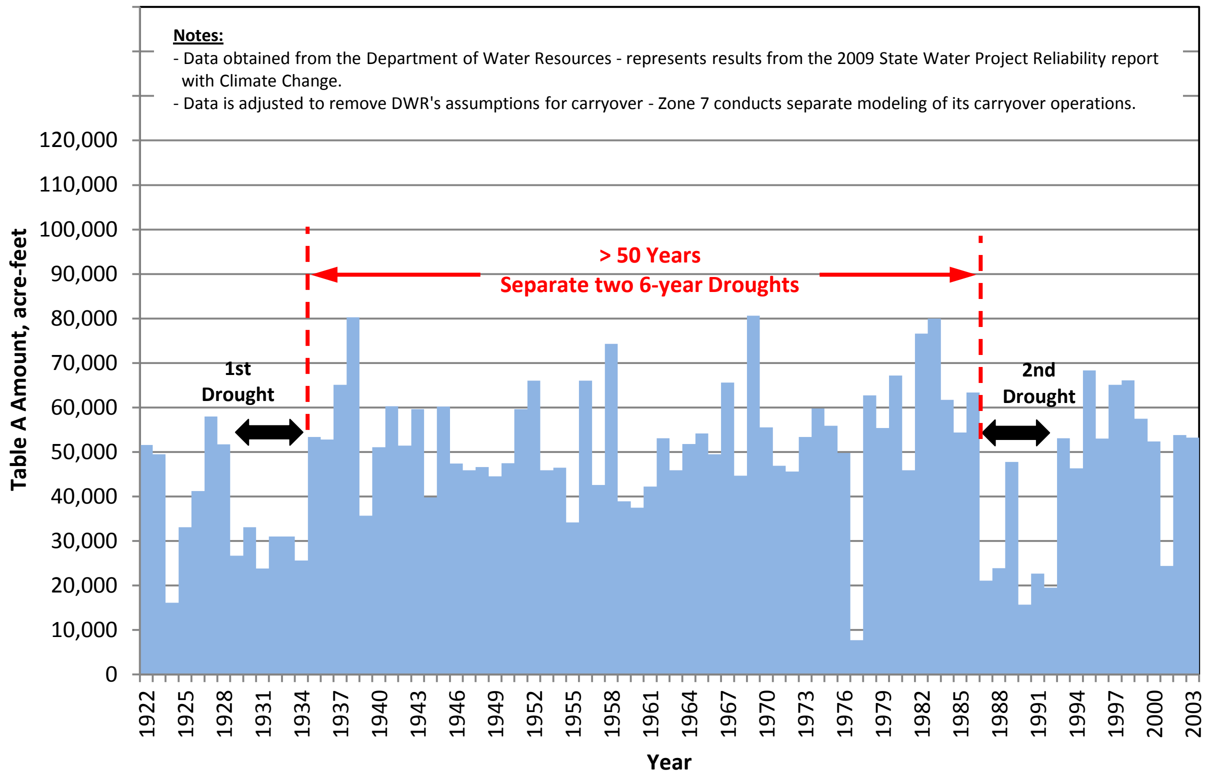
[36] The historical hydrologic sequence for State Water Project supplies was obtained from CalSIM modeling completed by the Department of Water Resources, while actual historical data was used to develop the historical sequence for other supplies (e.g., runoff from Arroyo del Valle).

[37] See Section 4.1.1 for more detail.

Figure 5-2. Projected State Water Project Allocations to Zone 7



Based on these questions and other similar questions, it became clear that Zone 7 required a new water supply model that could vary the hydrologic sequence, help quantify the risk of water supply shortages, and identify the future long-term water system investments or follow-up studies necessary to minimize near-term risk of water supply shortages (i.e., the next five years).

Consequently, the main objective of developing the probability-based water supply model was to evaluate the ability of Zone 7's water supply system to handle varying hydrologic sequences, and then use the results to help:

1. Quantify the likelihood of having a water supply shortage through buildout of Zone 7's service area or the chance of having sufficient storage to allow Zone 7 to meet water demands during drought conditions, and
2. Identify the future water supply projects and follow-up studies required to maximize flexibility while minimizing risk.

5.1.2 Applicability of Monte Carlo Methods for Analyzing Zone 7's Water Supply System

Choosing only one variation or even several variations of the historical hydrologic sequence would not meet the objectives of the probability-based water supply model because any sequence not randomly selected would yield biased results—one could manipulate the sequence chosen to yield positive or negative outcomes. Additionally, if too few sequences are analyzed, then the chance of a shortage or the probability of having sufficient drought protection could be under- or over-estimated.

To eliminate this, the probability-based water supply model needed to have the ability to generate random sequences from the historical hydrologic data to stress Zone 7's existing water supply system. It also needed to have the ability to run a sufficient number of randomly generated sequences so that the probabilities of various outcomes could be determined. The Monte Carlo method was used in this WSE to conduct this type of risk analysis.

5.1.2.1 Applicability of Monte Carlo Analysis to Meeting Objectives

The Monte Carlo method was originally developed by physicists working on the atomic bomb in the 1940's , and relies on repeated random sampling of probability distributions to generate results. The results of a Monte Carlo simulation provide thousands of different outcomes that one can use to identify the probability of different scenarios. For example, a Monte Carlo simulation helps Zone 7 staff quantify the probability of having sufficient drought storage by subjecting the existing water supply system to thousands of different sequences of Table A deliveries from the SWP, and then reviewing how often deliveries exceed demands, allowing Zone 7 to store water.

5.1.3 Software Used to Develop the Model

In addition to evaluating the existing water supply model, Zone 7 staff also evaluated three different software packages for constructing the probability-based water supply model. The pros and cons of each software package, including the existing sustainability model, are discussed below, followed by a discussion of the selected software.

5.1.3.1 Existing Water Supply Model

Zone 7 staff has an existing water balance model that was originally created in Lotus 1-2-3 and converted to Microsoft Excel. This existing water balance model simulates a repeat of the historical hydrologic sequence used by DWR in its CalSIM II model. As part of this effort, Zone 7 staff reviewed the potential for using this model.

After initial testing, however, Zone 7 staff found that the macros necessary to create and run Monte Carlo methods were extremely slow, and that Zone 7 staff would need to modify the model extensively to capture and display the necessary statistical information. Moreover, a Microsoft Excel-based statistics program (see Risk Solver below) already existed that could be used to create a new model.

5.1.3.2 Extend Simulation Model (ExtendSIM)

ExtendSIM is a software package sold by Imagine That, Inc., which allows a user to create a Decisions Support System (DSS) model for most processes; Santa Clara Valley Water District (SCVWD) used this model to support their 2005 Integrated Water Resources Planning Study. ExtendSIM has a graphic user interface (GUI) and can use Monte Carlo methods for evaluating long-term water supplies.

Zone 7 staff downloaded a demonstration version of the software, and found that it had a friendly user interface, but would likely require extensive training. Additionally, it appeared that the output of the model would still require additional processing in Microsoft Excel and/or Geographic Information System (GIS)-based software.

Depending on the version and needs, ExtendSIM costs from $1,000 to $5,000 plus a maintenance fee that would cost another $100 to $500 per year.[38] Additionally, Zone 7 staff would need outside training and guidance to develop, run, and analyze Zone 7's existing water supply system.

[38] Costs based on data obtained in the summer of 2009.

5.1.3.3 *Water Evaluation and Planning (WEAP) System*

The WEAP system is a software package licensed through the Stockholm Environment Institute (SEI), which allows a user to create a water balance model based on user inputs. The software uses a GUI that runs within its own shell; other key mapping data from Zone 7's GIS could be pulled into the model. DWR is also working to develop a Statewide Water Analysis Network (SWAN) based on WEAP, and used the WEAP system as part of the 2009 California Water Plan update.

Zone 7 staff downloaded and evaluated the demonstration version of the WEAP system, and found that setting up a water balance model was simple, and would be an excellent replacement for our existing water balance model. During the trial, however, it was found that the software could use sequences chosen by the user, but not randomly create new sequences based on probability distribution functions (i.e., it could not implement Monte Carlo methods).[39]

The WEAP system would cost Zone 7 approximately $3,000 every two years, not including training.[40] During the time the software is licensed, an unlimited number of users can use it simultaneously and all upgrades and technical support are free.

5.1.3.4 *Risk Solver*

Risk Solver is an application by Frontline Systems that runs within Microsoft Excel, and was designed for conducting risk analysis using Monte Carlo methods. The software includes standard probability distribution functions and an extensive set of tools for analyzing the enormous amounts of data generated by Monte Carlo simulations. Zone 7 staff is unaware of another water agency currently using this software to analyze the risks with their water balance models.

Zone 7 staff downloaded a trial version of the software, and found that it was simple to use, and was only limited by the number of equations or formulae one can add to Microsoft Excel. Unlike ExtendSIM or the WEAP model, however, Risk Solver did not have a GUI.

Frontline Systems sells permanent licenses for its Risk Solver application for approximately $1,000 plus an annual maintenance fee of $200.[41] All updates and technical support are provided as long as the maintenance fees are paid.

5.1.3.5 *Software Package Selected for the New Model*

Only two of the software packages reviewed (ExtendSIM and Risk Solver) allowed the user to implement Monte Carlo methods; the WEAP model might be a good alternative in the future if SEI modifies it for direct use of Monte Carlo methods rather than relying on third-party software. ExtendSIM would require extensive training, while Risk Solver required a basic understanding of statistical methods. Assuming that the lowest cost option for ExtendSIM was purchased, then the cost for ExtendSIM and Risk Solver would be about the same (not including training).

Most of Zone 7's data and modeling information, however, is already in Microsoft Excel, and creating a new water balance model based on the Risk Solver software was much easier than learning an entirely new software package. Additionally, most Zone 7 staff use Microsoft Excel, which makes information transfer seamless – only specially trained Zone 7 staff could run and process ExtendSIM models.

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[39] Subsequent review conducted in 2010 indicated that third-party software exists that allows WEAP modeling to incorporate Monte Carlo methods. Zone 7 staff may consider implementing WEAP in the next update of its Water Supply Evaluation.

[40] Costs based on data obtained in the summer of 2009.

[41] Costs based on data obtained in the summer of 2009.

Consequently, Zone 7 staff chose Frontline Systems Risk Solver to create Zone 7's risk model. Table 5-1 compares the software packages reviewed.

Table 5-1. Comparison of Software Packages Reviewed

Software	Ability to Directly Use Monte Carlo Methods	Training Required	Cost[(b)]
Existing Water Supply Model - Excel[(a)]	Yes, but macros slow	No	$0
ExtendSIM	Yes	Yes	$1,000 to $5000 + maintenance ($100-$500/year)
Water Evaluation and Planning Model	No[(a)]	Minimal	$3,000 every two years
Risk Solver	Yes	No	$1,000 + maintenance ($200/year)

(a) Subsequent review conducted in late 2010 indicated that third-party software exists that allows WEAP modeling to incorporate Monte Carlo methods.

(b) Based on costs data obtained in the summer of 2009.

5.1.4 Brief Description of How the Probability-Based Water Supply Model Functions

Zone 7's new model is essentially a water balance model created in Microsoft Excel; however, unlike typical water balance models, key water supplies are modeled as uncertain variables (i.e., variables without a known value) – their value is determined by randomly selecting numbers from a probability distribution function (i.e., through Monte Carlo methods). The major inputs treated as uncertain variables included local rainfall and SWP Table A allocations. The model itself runs by randomly generating a 40-year sequence of local rainfall and SWP Table A deliveries, and then conducting a water balance using that sequence. Each Monte Carlo simulation uses a different sequence. Zone 7 ran 30,000 sequences (i.e., trials) for each 40-year evaluation—or about 1.2 million years per evaluation.[42]

5.1.5 Incorporation of Climate Change into the New Model

As discussed in Section 4, allocations from the State Water Project makeup over 80% of Zone 7's long-term average water supplies; hence, climate changes that reduce State Water Project allocations likely dominate the potential impacts of climate change on Zone 7's overall water supplies. Consequently, the analysis in this WSE used DWR projections that incorporated climate change, but did not include an extensive analysis of the impacts of climate change on local water supplies (e.g., runoff from Arroyo del Valle).[43]

5.1.6 Definition of Portfolio and Scenario Used in the Analysis

For comparative purposes, Zone 7 staff used two different terms to describe each evaluation completed: (1) portfolios and (2) scenarios. Portfolios refer to the mix of different water supplies and facilities, while scenarios refer to different reliability targets evaluated.

[42] Based on numerous simulations, 30,000 trials appeared to yield consistent results without adding too much modeling time.

[43] State Water Project Allocations were obtained from the State Water Project Delivery Reliability Report 2009.

5.1.7 Definition of Reliability and Sustainability Used for this Water Supply Evaluation

Zone 7 staff used two criteria to evaluate the effectiveness of various water supply portfolios: (1) Reliability and (2) Sustainability. Each is discussed below.

5.1.7.1 Definition of Reliability

After developing the probability-based water supply model, Zone 7 staff reviewed the reliability policies for various water agencies in the Bay Area, including a separate survey commissioned by Dublin San Ramon Services District (DSRSD) in 2008, to help define reliability for planning purposes in this WSE. Based on this review, Zone 7 staff found that most water supply agencies use a maximum potential shortage to define reliability. For example, a maximum shortage of 25% implies a reliability of 75%.[44] Although this definition does indicate the maximum potential shortage, it does not express other key conditions. For example, it does not communicate the percent of time the agency will have no shortage or the frequency of shortages that are less than 25%.

Figure 5-3 presents an example risk curve at buildout developed using Zone 7's probability-based water supply model. As shown on Figure 5-3, using the maximum shortage to define the reliability only provides one point on the risk curve – this particular example shows a maximum shortage of 25%, which would imply a reliability of 75 percent. This risk curve, however, shows that in addition to a maximum, there are also ranges of shortages that are less than 25%.

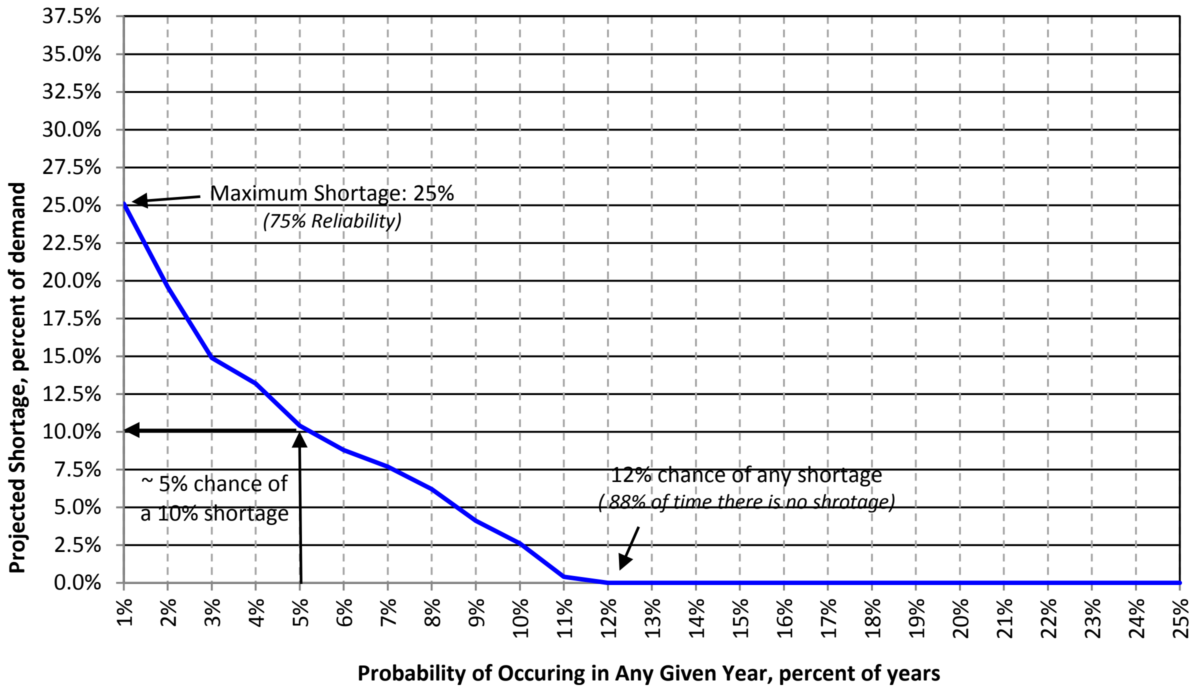
Consequently, for planning-level purposes in this WSE, Zone 7 staff defined reliability using the maximum shortage, but also added two other elements (the frequency of shortages less than the maximum and the percent of time the agency will have no shortages) to help communicate the entire risk curve. Using the example presented in Figure 5-3, the reliability would be 75 percent; however, the following information would also be included for clarity:

- a maximum shortage of 25%,
- a 5% chance of a 10% or larger shortage in any given year, and
- no shortages 88% of the time.

Zone 7 shared and discussed this definition with all four water supply retailers during workshops in November 2010, January 2011, and March 2011, while the same information was presented to Zone 7's Delta Committee in December 2010 and March 2011. Both the water supply retailers and the Delta Committee agreed that this definition of reliability was appropriate for comparative purposes in this WSE.

[44] WYA, 2008. Evaluation of Water Supply Reliability Policies for Other Bay Area and California Water Systems. November 12.

Figure 5-3. Example Risk Curve at Equilibrium[45] from the Water Supply Model



5.1.7.2 Definition of Sustainability

The term "sustainability" has been increasingly used since the 1990s. The term is generally used to imply conditions that can be maintained over the long-term. For this WSE, Zone 7 uses sustainability to describe projected long-term storage level for Zone 7's water supply system. Projected storage levels indicate whether storage is being mined to meet water demands, or more generally, whether Zone 7's water supply system can meet projected water demands during normal years without depleting drought storage reserves.

Figures 5-4 and 5-5 present example output from the probability-based water supply model for total storage within Zone 7's water supply system; Figure 5-4 presents an unsustainable scenario, while Figure 5-5 presents a sustainable scenario. As shown, the trend of median storage levels over the entire planning horizon was used to determine whether a particular scenario was sustainable over the long-term, with increasing or stable median storage levels indicating sustainability.

Zone 7 shared and discussed this definition with all four water supply retailers during workshops in November 2010, January 2011, and March 2011, while the same information was presented to Zone 7's Delta Committee in December 2010 and March 2011. Both the water supply retailers and the Delta Committee agreed that this definition of sustainability was appropriate for planning-level purposes in this WSE.

[45] Equilibrium in this case represents build out demands, after all new supplies or facilities are constructed.

Figure 5-4. Example of an Unsustainable Scenario Based on Total "End of Year" Storage

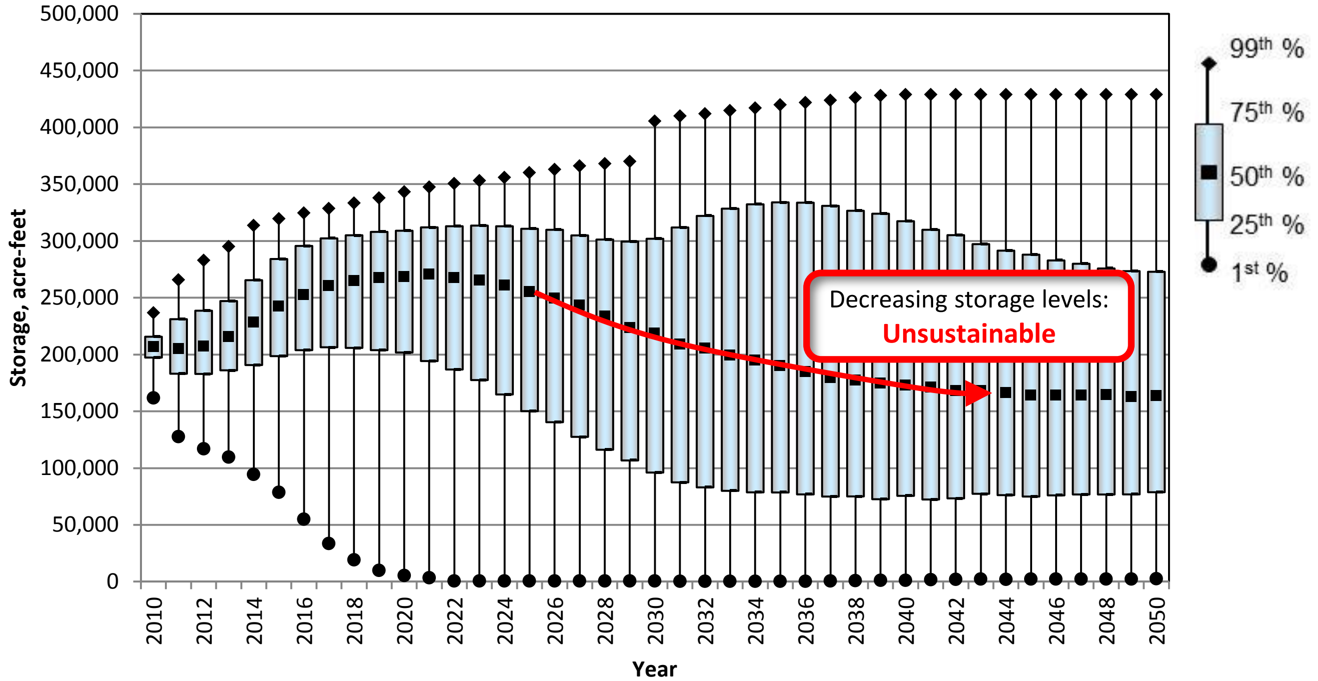
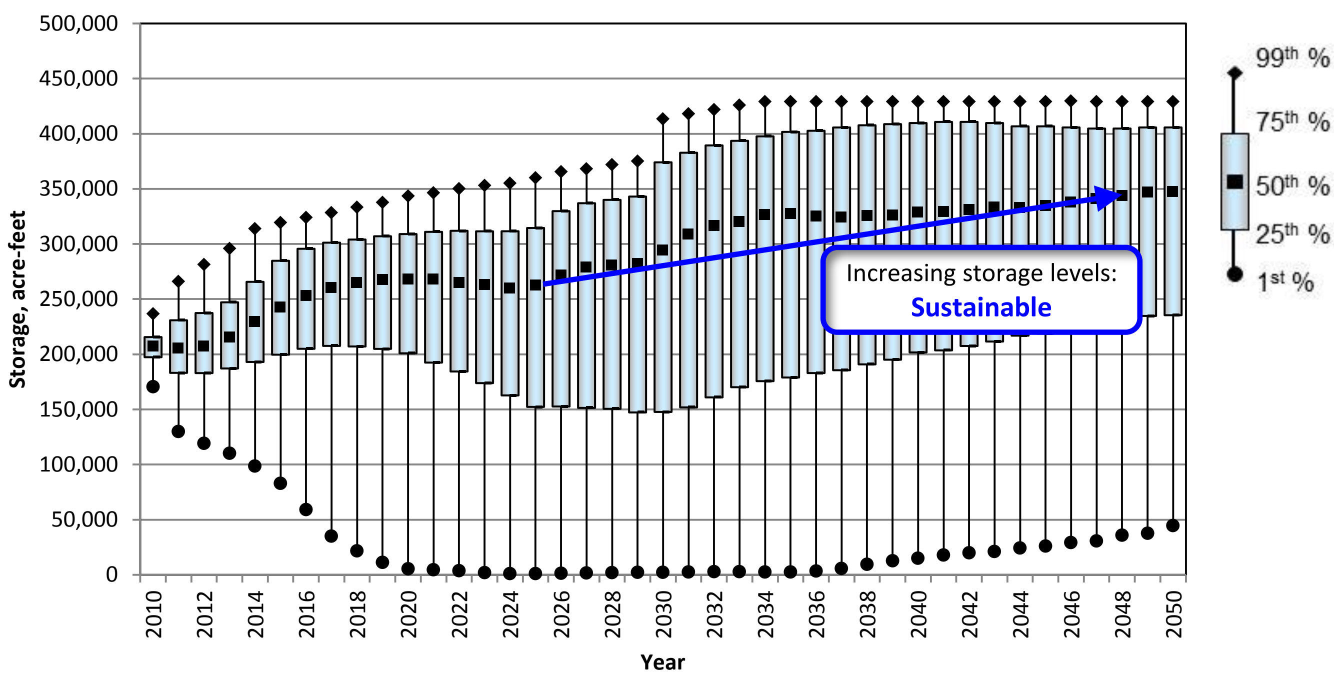


Figure 5-5. Example of a Sustainable Scenario Based on Total "End of Year" Storage



5.2 WATER FACILITY METHODOLOGY AND CRITERIA

Each of the scenarios evaluated in this WSE involved different water supply sources that could influence facility needs. This is especially true for potable water demand reductions achieved through recycled water, which removes outdoor use from the potable water system; thereby, reducing maximum day demands (i.e., the day of the year with the highest water use). Consequently, for comparative purposes in this WSE, Zone 7 staff evaluated the ability for each water supply portfolio to meet maximum day demands, meet monthly demands during a single dry year, and meet the outage criteria established in Zone 7's existing water reliability policy[46] for facilities.

No actual hydraulic modeling was completed in support of this analysis; instead, the production capacity of existing and planned facilities was compared to projected maximum day demand and drought demand in a Single Dry Year over the entire planning horizon to determine whether established goals could be met. The following subsections present the methodology and criteria used to evaluate potential facility needs:

- 5.2.1 Summary of Facility Policies and Criteria Used in the Evaluation
- 5.2.2 Facilities and Production Assumptions for Normal Operation
- 5.2.3 Facilities and Production Assumptions for a Single Dry Year
- 5.2.4 Facilities and Production Assumptions for Outage Scenarios

5.2.1 Summary of Facility Policies and Criteria Used in the Evaluation

Table 5-2 summarizes the policies and criteria used to evaluate facility needs associated with each water supply portfolio.

Table 5-2. Summary of Policies and Criteria Used

Policy/Criteria	Goal	Comments
Facility Sizing	Meet 100% of Maximum Day Demands during Normal Operation	Analysis is based on a peaking factor of 2.0 times the average day demand.
	Meet 100% of Maximum Day Demands during a Single Dry Year	Required to determine the maximum groundwater production required.
Reliability Policy (Resolution 04-2662)	Meet 75% of maximum day demands with a major facility out of service.	Analysis reviewed the impact of the largest well field,[a] PPWTP,[b] DVWTP,[c] or the SBA[d] individually being out of service.

(a) Largest Well Field – Mocho Wellfield
(b) PPWTP – Patterson Pass Water Treatment Plant
(c) DVWTP – Del Valle Water Treatment Plant
(d) SBA – South Bay Aqueduct

5.2.1.1 Level of Service Criteria for Evaluating Facility Outages

As previously presented in Table 5-2, Zone 7 endeavors to meet 75% of maximum day demand with a major facility out of service. The typical water customer, however, does not likely fully understand the implications of this policy. Consequently, for communication purposes in this WSE, Zone 7 staff, with

[46] Resolution 04-2662, see Appendix B.

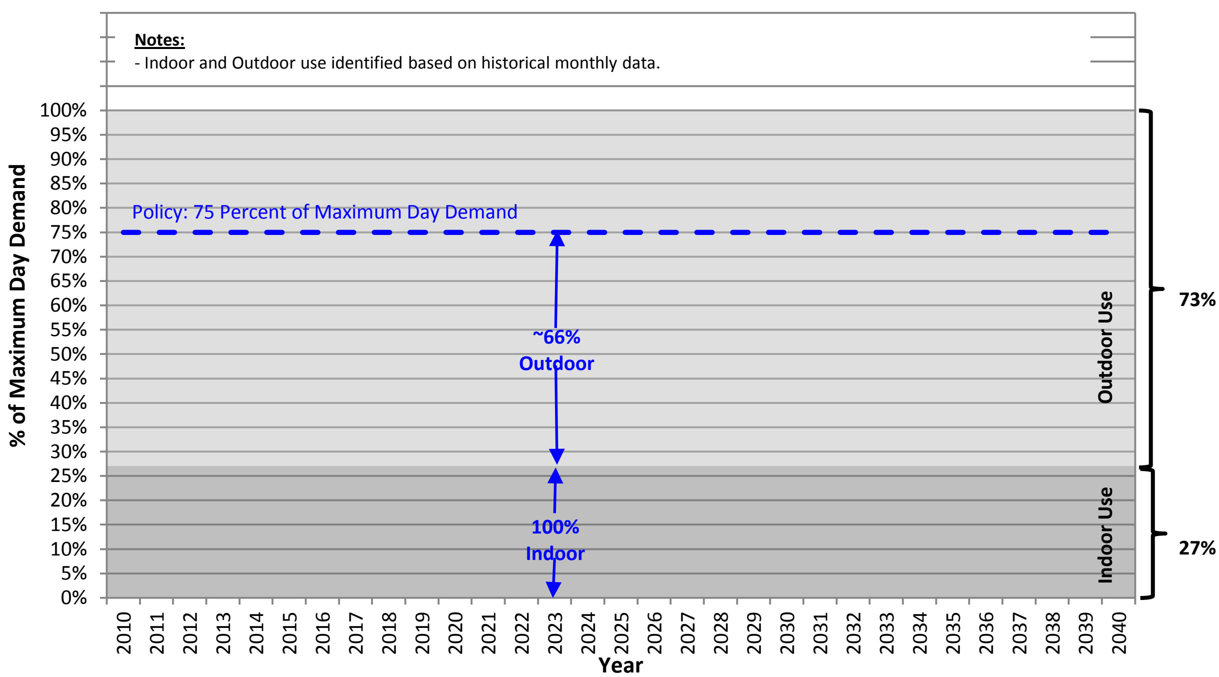
input from the local water supply retailers, also used a concept called "level of service" to help describe the reliability policy associated with facility outages.

Specifically, Zone 7 staff reviewed potable water deliveries to all four of the local water supply retailers to estimate indoor and outdoor use on the maximum day (i.e., the day of the year with the highest water use); dividing the projected maximum day demand into outdoor and indoor water use allowed expression of the facility outage criteria in different terms. This review indicated that approximately 73% of projected demand on the maximum day is associated with outdoor water uses (e.g., irrigation), while the remaining 27% was associated with indoor uses (e.g., drinking water, showers, and washing machines).[47]

Figure 5-6 compares the estimated outdoor and indoor uses on the maximum day to the current reliability policy associated with facility outages, assuming the ratio of indoor and outdoor use is consistent over time for the maximum day demand.[48] As shown on Figure 5-6, meeting 75% of the maximum day demand could also imply meeting 100% of indoor use and approximately 66% or almost two-thirds of outdoor use.

Hence, the "level of service" provided by Zone 7's current reliability policy for facility outages could be interpreted as meeting 100% of indoor water use and approximately 66% of outdoor water use.

Figure 5-6. Level of Service Interpretation of Current Facility Outage Policy



5.2.2 Facility and Production Assumptions for Normal Operation

The first criterion Zone 7 staff uses to size facilities is to provide sufficient production capacity to meet maximum day demands (called "peaking capacity") during normal operations (i.e., production

[47] A detailed description of the indoor and outdoor analysis is provided as Appendix A.

[48] The ratio of indoor to outdoor use will likely change as additional water conservation and recycled water programs are implemented in the Livermore-Amador Valley. Zone 7 staff will continue to monitor uses over time, and will make changes in this ratio as required. This ratio, however, provides an initial baseline, and helps explain the implications of the current policy.

requirements without a drought or facility outages). The comparison of total production capacity to maximum day demands helps determine the need for additional capacity. Table 5-3 summarizes the total production capacity available for all water supply portfolios during normal operation.

As shown in Table 5-3, the combined one day peaking capacity of the Del Valle Water Treatment Plant, Patterson Pass Conventional Plant, and the Patterson Pass Ultrafiltration Plant is 59 MGD, while the total production capacity including groundwater wells is 91 MGD. For planning-level purposes in this WSE, new groundwater production capacity associated with the Well Master Plan[49] (including the Chain of Lakes wells 1 and 2 completed in 2010) was only assumed available during droughts or outage scenarios; consequently, Table 5-3 also indicates that the maximum groundwater production capacity available to meet maximum day demand does not exceed 32 MGD.

Table 5-3. Existing Production Capacity for Normal Operation

Facility		Production Capacity to Meet the Maximum Day Demand, MGD[(a)]
Surface Water	Del Valle Water Treatment Plant	40
	Patterson Pass Conventional Plant	12
	Patterson Pass Ultrafiltration Plant	7
	Total Surface Water Production	*59*
Groundwater	Hopyard Wellfield	7
	Mocho Wellfield	18
	Stoneridge Wellfield	7
	Total Groundwater Production	*32*
Total Production		**91**

(a) Production capacities rounded to the nearest MGD for planning-level purposes.

5.2.3 Facilities and Production Assumptions for a Single Dry Year

During a single dry year, surface water supplies for Zone 7's treatment plants are severely limited, and although Zone 7 has access to additional supply in non-local storage (Semitropic Water Storage District [Semitropic] and Cawelo Water District [Cawelo]), the majority of Zone 7's water supply under this condition is previously-stored surface water in the local groundwater basin. Consequently, Zone 7 staff also evaluated the monthly groundwater production capacity required under each portfolio to determine the portion of water demands during a single dry year that could be met with total planned groundwater production capacity.

Table 5-4 presents the existing and planned groundwater production capacity assumed available during a single dry year. The production capacities presented in Table 5-4 represent 3-month sustainable well production capacities, not peak capacity, because the analysis of single dry year conditions considers the use of groundwater over a longer period of time - not a single day of operation. The maximum

49 CH2MHILL, 2003. Draft Report Well Master Plan. October.

groundwater production capacity over a 3-month period is lower than during a single day of operation due to increased groundwater level drawdown caused by extended use of certain well fields.

As shown in Table 5-4, the maximum monthly groundwater production capacity during drought conditions will increase to 45 MGD by buildout, while the maximum total annual groundwater production capacity will increase to 34,400 acre-feet.[50] During drought and facility outage conditions, new wells are allowed to be placed in service.

Table 5-4. Assumed Groundwater Production Capacities during Drought Conditions[a,b]

Year	Sustainable Production Capacity over Three Months, MGD	Approximate Maximum Annual Quantity that can be Pumped in a Single Year, AF
2010	32.6	28,000
2020	37.6	30,100
2025	40	32,200
2030	45	34,400

(a) Actual production capacities depend on initial groundwater levels. Production values shown are based on the Well Master Plan, and assume that the groundwater basin is about 80 percent full.
(b) The increase from 2010 to 2030 is based on potential capacity associated with new wellfields identified in the Well Master Plan, including additional Chain of Lakes wells, Busch Valley wells, and Bernal wells.

5.2.4 Facility and Production Assumptions for Outage Scenarios

Zone 7 staff evaluated the ability of existing and planned facilities to meet maximum day demands without a major facility in operation. The major facility outages evaluated included the following:

- Largest wellfield (Mocho Wells 1, 2, 3 and 4),
- Patterson Pass Water Treatment Plant,
- Del Valle Water Treatment Plant, and
- South Bay Aqueduct (SBA) Pumping Plant.

The first three scenarios assumed that 100 percent of the facilities production capacity was out of service. However, the last scenario (SBA Pumping Plant out of service), assumed that only the PPWTP was out of service; the DVWTP can still operate because it can use surface water supply from Lake Del Valle. Table 5-5 presents the peak capacity associated with groundwater wells. As shown on Table 5-5, the peak capacity was used instead of the sustainable capacity because this particular evaluation reviewed an outage on the highest water use day of the year and lasting up to 30 days. Table 5-5 also shows that the capacity of the Del Valle Water Treatment Plant was limited to 22 MGD; this limitation reflects contractual capacity constraints in the Del Valle Branch pipeline, the pipeline that connects Lake Del Valle to the SBA – additional capacity could be available depending on the use by the other two SBA contractors.

[50] The maximum groundwater production capacities are tied to beginning of year groundwater levels. The capacities in Table 5-4 assume the groundwater basin is about 80 percent full.

Table 5-5. Assumed Production Capacities during Outage Scenarios

Facility		Facility Outage Scenario			
		Largest Wellfield[a]	Patterson Pass Water Treatment Plant	Del Valle Water Treatment Plant	SBA Pumping Plant
Surface Water	Del Valle Water Treatment Plant	40	40	0	22[c]
Surface Water	Patterson Pass - Conventional	12	0	12	0
Surface Water	Patterson Pass – Ultrafiltration	7	0	7	0
Groundwater[b]	2010	22	40	40	40
Groundwater[b]	2020	30	48	48	48
Groundwater[b]	2025	34	52	52	52
Groundwater[b]	2030	42	60	60	60

(a) Largest wellfield is the Mocho Wellfield. The current peak capacity of the Mocho Wellfield is 18 MGD.
(b) Assumes the demineralization facility is not operating.
(c) DVWTP was limited to 22 MGD to account for capacity limitations in the Del Valle Branch pipeline.

5.3 SALT BALANCE METHODOLOGY AND CRITERIA

As the basin manager for over forty years, one of Zone 7's key water quality objectives is to prevent the buildup of salts (calcium, magnesium, sodium, chloride, and other minerals) in the Livermore Valley Groundwater Basin. As part of its groundwater management activities, Zone 7 estimates the salt loading within the Main Basin to determine whether the buildup of salts is positive or negative. Typically, Zone 7 staff estimates salt loading by quantifying the amount of salt (measured as Total Dissolved Solids or TDS) entering or leaving the Main Basin: if the loading is positive, the regional water quality is deemed to be degrading; and if the loading is negative, then basin quality is deemed to be improving.

Zone 7 is preparing to update its Groundwater Management Plan (GWMP), which will also include an update of the Salt Management Plan (SMP). Zone 7 plans to start this effort in the next 6 to 12 months, and hopes to complete the update over the next several years. However, because each of the scenarios evaluated in this WSE involved different water supply sources and strategies (e.g., quality, quantity, and timing) that could affect salt loading within the Main Basin, Zone 7 staff performed a preliminary evaluation of potential salt loading for each scenario using a mass balance approach.

The purpose of this section is to describe the salt model used by Zone 7 staff to help estimate the potential salt loading associated with each scenario. More specifically, this section provides a brief overview of Zone 7's existing Salt Management Program and a description of the modifications made to the existing salt model in support of this WSE.

5.3.1 Previous Salt Planning and Mitigation Activities

In 2004, Zone 7 prepared a SMP to address the increasing level of total salts and to protect the long-term water quality of the Main Basin. The Regional Water Quality Control Board (RWQCB) required the SMP as part of the Master Water Recycling Permit (RWQCB Order No. 93-159, issued jointly to Zone 7, the City of Livermore, and Dublin San Ramon Services District) and approved the Final SMP in October 2004. Zone 7 incorporated the SMP into its GWMP in 2005. As part of the SMP, Zone 7 developed a spreadsheet model to calculate existing and future salt loading, and recalibrated its numeric groundwater model to project salt transport within the basin (Section 5.3.1.2). As planned for in the SMP, Zone 7 increased its groundwater pumping and constructed a demineralization facility to mitigate a portion of projected salt loading.

5.3.1.1 Salt Management Plan

The SMP identified potential salt management strategies to offset the long-term average salt loading to the Main Basin. The viable alternatives evaluated generally fell into three categories:

- Managing artificial recharge to take advantage of low-TDS imported water when available,
- Pumping and delivering more higher-TDS groundwater, which would result in more salts being exported through local wastewater disposal systems; and
- Constructing and operating a groundwater demineralization facility to remove salts that are exported as waste by-products (reverse osmosis concentrate/brine) to the San Francisco Bay, and blend the low-salt effluent with groundwater or Zone 7 system water.

The SMP also evaluated 15 basic salt management strategies (referred to as 'studies') as possible viable plans for managing water facilities to meet customer demands under any hydrologic conditions. Each of the salt management strategies was evaluated using screening criteria that included technical feasibility, timing, economics, impacts on delivered water quality, and public or institutional acceptance. One of the significant conclusions from the SMP was that certain composite salt management strategies (i.e., approaches using several individual salt management strategies) were most promising.

As discussed previously, Zone 7 is preparing to update its Groundwater Management Plan (GWMP), which will also include an update of the SMP strategies.

5.3.1.2 Salt Loading Models

As part of the SMP, Zone 7 used two methods to evaluate the viability of the strategies to remove salt from the Main Basin while minimizing negative impacts to delivered water quality; these methods included:

- A spreadsheet model to calculate existing salt loading and future steady-state salt loading, and
- An updated and recalibrated numerical groundwater basin model for groundwater flow (Visual Modflow) and solute transport (modeled as TDS using MT3D).

For this WSE, the SMP's spreadsheet model approach, described in detail below, was modified to compare the different WSE alternatives. As this WSE is a planning-level evaluation of different alternatives, the groundwater model, which provides salt migration detail within the basin, was not used, but may be used to evaluate specific alternatives as part of the GWMP update.

Historical salt loading calculations included data and information collected from Zone 7's various monitoring programs. These took into account the addition and removal of minerals in the Main Basin by tracking the salt mass associated with the basin inflow (recharge) and outflow (discharge) components.

In general, salts are added to the Main Basin through the recharge and application of water from:

- Natural stream recharge,
- Artificial supplemental stream recharge,
- Applied water (irrigation) recharge where salts are concentrated about 6 to 10 times through the evapo-transpiration of irrigated water, and
- Subsurface groundwater inflow (i.e., seepage from adjacent sub-basins).

In general, salts are removed from the Main Basin through:

- Wastewater export where a portion of the export includes pumped groundwater,
- Reverse osmosis treatment (demineralization) of groundwater pumped from the Mocho Wellfield. The salts stripped from the source water are also exported from the Valley via a treated wastewater export line,
- Mining area discharge and export,[51] and
- Groundwater basin overflow (i.e., that portion of groundwater discharging to creeks and arroyos that flow out of the basin.

The net salt loading is calculated by multiplying the volume of each inflow and outflow component by its respective Total Dissolved Solids (TDS) concentration, and then subtracting the results.[52]

For the SMP, Zone 7 also calculated a 'steady state' salt loading for evaluating various salt mitigation alternatives. These steady-state calculations forecasted salt loading for a given set of land use conditions (e.g., water demand and urbanized acreage over the Main Basin). Values for parameters that are primarily weather dependent, such as natural stream recharge, were calculated using long-term average values. Then the volume of recharge and demand components was adjusted so there was no net change in storage to eliminate the effects of changes in salt loading simply due to changes in Main Basin volume. Salt concentrations for each of these parameters were estimated based on existing and probable future conditions.

5.3.2 Salt Loading Calculations for this WSE

Zone 7 modified the steady-state method used in the SMP for calculating salt loading to evaluate the salt loading impacts from each of the scenarios evaluated in this WSE. Modifications were made in order to calculate planning-level comparisons of both the short- and long-term salt loading on the Main Basin, and to identify the need for salt mitigation, if any, for each of the scenarios. The primary modification was to convert the steady-state calculations to transient calculations where water volumes and salt concentrations can change annually over time. The following components of the salt loading calculations were provided as transient outputs from the probability-based water supply model:

- Volumes of Artificial and Natural Recharge

[51] It should be noted that evaporation of groundwater in the mining area ponds has the effect of concentrating salts in the Main Basin as water is removed but the associated salts are left behind.

[52] Each year, Zone 7 calculates the net salt loading using volumes and concentrations measured as part of Zone 7's monitoring programs.

- Municipal Pumping
- Groundwater Basin Overflow
- Mining and Evaporation Losses
- TDS concentrations of State Water Project delivered water
- Number of additional demineralization facilities
- Retailer Demand
- Volume of Additional Recycled Water

Some of the other transient components that were not supplied by the probability-based water supply model (e.g., TDS concentration of groundwater pumped) were recalculated every year based on previous year's outputs. Other components that were not likely to change much over time (e.g., TDS concentration of natural stream recharge), or were not considered to have a significant effect on salt loading (e.g., volume of agricultural pumping) were held constant throughout the calculations.

For the In-Valley Portfolio, which included significant additional volumes of recycled water, the percentage of recycled water applied over the Main Basin was adjusted so that the long-term salt loading would be neutral or negative. It was assumed that the remainder of that recycled water would be applied over the fringe basins, or would require additional salt mitigation.

5.3.3 Methodology used to Evaluate the Results

The tons of salt added and removed from the Main Basin for each forecast year were calculated by multiplying the water volume for each supply and demand component by its corresponding TDS concentration. The salt loading effect of each change in supply or demand was evaluated using tables and graphs that show annual basin-wide salt loading.

Long-term salt loading was evaluated after equilibrium was reached (i.e., when all supply alternatives had been implemented and demand had stabilized). Average long-term salt loading, which was calculated for years 2030 to 2050, was used to evaluate whether or not additional phases of salt mitigation (e.g., demineralization) were required.

5.3.4 Limitations of the Salt Modeling Methodology

The intent of modeling salt loading as part of this WSE was to allow additional water quality comparisons of the scenarios; the intent was not to update the SMP. Consequently, the salt loading calculations include several fundamental and intentionally simplifying assumptions that were necessary for the planning-level analysis completed as part of this WSE. The key simplifying assumptions included:

1. The Main Basin is well mixed. In reality, this is not the case; salt concentrations in the upper aquifer and in the western portion of the basin are typically higher than those in the lower aquifer and in the eastern portion of the Main Basin, respectively.
2. The location of where recycled water is applied has no impact. The current model does not account for the location of the recycled water applied over the Main Basin. It is possible that certain areas of the Main Basin will be more or less susceptible to applied recycled water than others. This will be further evaluated as part of the GWMP/SMP update.
3. The primary strategy for mitigating the buildup of salts is assumed to be through additional groundwater pumping with demineralization facilities. However, the SMP update will evaluate if this is still the case.

4. Supply and demand components each have associated TDS concentrations based on recent and historical monitoring data and a few assumed (otherwise unmeasurable) values.
5. All salts applied through irrigation eventually make their way to the underlying groundwater. In actuality, vadose zone processes can delay salt transport for decades.
6. Salts removed by plant uptake and added by the application of fertilizers are considered to cancel each other.
7. For water applied over the Main Basin, percolate quality is assumed to be primarily a function of the differing percent of applied water that recharges throughout the area due to site specific variations in soil characteristics.
8. The concentration of subsurface inflow from the fringe basins into the Main Basin is constant. However, it is possible that the application of recycled water over the fringe basin will indirectly impact the Main Basin as subsurface inflow, especially to the north of the Main Basin. Unfortunately, the nature of the boundary between the fringe basins and the Main Basin is not well understood at this time and will be further evaluated as part of the SMP update.

5.4 QUALITATIVE APPROACH TO DELIVERED WATER QUALITY

For comparative purposes, each scenario was reviewed to ensure that it met the goals of the Water Quality Policy, and that the anticipated delivered water quality would meet the treated water quality targets established by the Water Quality Management Program (WQMP). The review did not include actual quantitative analysis or use of a hydraulic model; instead, each scenario was evaluated qualitatively to determine the potential positive or negative water quality impact on Zone 7's system. The purpose of this section is to briefly describe Zone 7's WQMP and the key factors considered as part of the qualitative review.

5.4.1 Description of the Water Quality Policy and WQMP

Zone 7's Water Quality Policy and its WQMP, adopted by the Zone 7 Board of Directors in 2003, were developed after extensive discussions and in cooperation with local water supply retailers, as well as other interested stakeholders. The Water Quality Policy[53] addresses several treated and untreated water goals. The treated water goals include:

- meeting or exceeding the public health requirements for drinking water, which include continual compliance with all State and Federal primary Maximum Contaminant Levels (MCLs), while reaching applicable Public Health Goals (PHGs) or MCL Goals (MCLGs), as close as feasible; and
- deliver water that is aesthetically acceptable by meeting all State and Federal secondary MCLs, mitigating earthy-musty taste and odor events from surface water supplies,[54] minimizing chlorinous odor, and reducing hardness to "moderately hard" among the retailers.

The WQMP established specific water quality targets and recommended mitigation projects that were driven by the Policy goals. The water quality targets are, for the most part, more stringent than regulatory standards to assist in guiding operations, and in the planning and design of capital projects

[53] A copy of the Water Quality Policy can be found in Appendix B.

[54] The qualitative review completed in this WSE focused on mineral water quality.

necessary to meet the Policy goals. These water quality targets also serve as operational guidelines and design criteria for future facilities.

The recommended method of mitigating hardness in the groundwater delivered by Zone 7 (typically between 240 and 650 mg/L as $CaCO_3$) is the use of wellhead demineralization. Demineralization can produce extremely soft water (less than 10 mg/L hardness) for blending with untreated groundwater to reduce delivered hardness to a level that is similar to surface water (typically less than 150 mg/L). As discussed in the previous section, groundwater pumping and demineralization has also been identified by the SMP as a key component in the management of the salt loading within the groundwater basin, so coordination with the SMP was also considered in developing recommendations for demineralization projects for water quality purposes.

To assist in the periodic updates of the WQMP, a Joint Water Quality Resolution[55] was signed between Zone 7 and two of its retailers, DSRSD and City of Pleasanton, in August 2005. This Joint Resolution includes several Policy Principles to be considered by all three agencies when developing projects and operational guidelines relating to improving water quality. There are five general areas associated with these Policy Principles: (1) General Policies, (2) Operations, (3) Facilities, (4) Education, and (5) Funding. Overall, these Policy Principles call for support of projects and operational guidelines that would improve and better equalize delivered water quality but must not result in any degradation of the existing delivered water quality for east-side retailers.[56]

5.4.2 Description of Qualitative Approach to Delivered Water Quality

Each of the scenarios evaluated in this WSE involved different water supply sources that had different water quality characteristics and might require groundwater demineralization to mitigate the potential additional salt loading to the Main Basin. Consequently, each scenario could change the delivered water quality in Zone 7's system; therefore, Zone 7 staff evaluated each water supply portfolio under each scenario by qualitatively answering the following basic questions:

- *Does the anticipated treated water quality meet the treated water goals of the Water Quality Policy, and more specifically, does it meet the treated water quality targets set forth in the WQMP?*
- *Does the anticipated treated water provide similar or better delivered water quality than existing supplies?*

The second question is to ensure that each portfolio does not degrade existing treated water quality.

As Zone 7 staff reviewed the potential influence of each water supply portfolio on delivered water quality, special attention was given to TDS and hardness. TDS accounts for all dissolved solids, while two specific compounds (calcium and magnesium) cause hardness. At high levels, TDS also has aesthetic impacts, imparting a salty taste to the water. The SMP uses TDS to monitor the amount of salt loading within the groundwater basin, while the WQMP focused on reducing the aesthetic and economic impacts of hard water.

Hence, Zone 7 staff reviewed the TDS and hardness associated with each source of supply in each portfolio. If overall TDS and hardness for each source of supply were better than current sources, then it was considered as a potential candidate for improving delivered water quality.

[55] A copy of the Joint Water Quality Resolution can be found in Appendix B.

[56] The east-side of Zone 7's system generally receives more surface water.

6. CURRENTLY PLANNED FACILITIES AND ACTIONS

The purpose of this section is to discuss the programs and projects that Zone 7 is already undertaking, or already plans to undertake, in order to improve the reliability of the water supply for the Livermore-Amador Valley. The components included in this "Current Plan"—broken down by water supplies, facility improvements, and water quality—are identified in Table 6-1 and discussed in more detail in the following sections.

Table 6-1. Components of the Current Plan

Type	Component
Water Supplies	Long-Term Delta Fix
	Potable Demand Reductions
	Confirmation of Minimum Yield from BBID Contract
	Reduction of Unaccounted-for-Water
	Reduction of Brine Losses
	Enhanced In-Lieu Recharge Program
	Arroyo del Valle: Perfection of Existing Permit
Facility Improvements	Increased Surface Water Treatment Capacity
	Increased Groundwater Pumping Capacity
	Increased Transmission System Capacity
	Arroyo Mocho Diversion Structure
	Arroyo del Valle Diversion Structure
	Reliability Intertie
Water Quality	Phase 2 Demineralization Facility

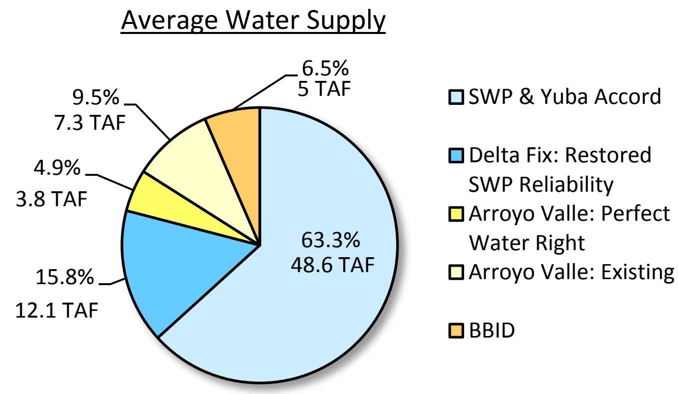
6.1 WATER SUPPLIES

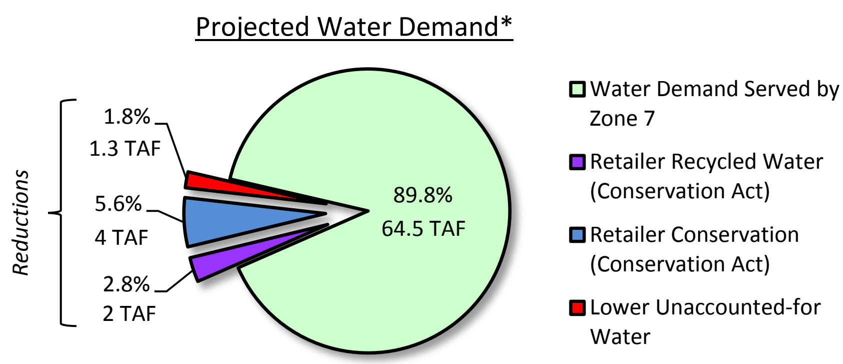
Under the Current Plan, Zone 7's water supply and demand balances are expected to be improved in several ways. In addition to restored yield from the SWP from the Delta Fix, additional supplies are expected through confirming the yield from the Byron Bethany Irrigation District (BBID) contract, and perfection of the Arroyo del Valle water right permit made possible through facility improvements[57]. Potable water demands are also expected to decrease through the implementation of the Water

[57] Future facilities required to full perfect the existing water right permit include the Chain of Lakes, which are currently being quarried; Zone 7 does not have control over how fast the quarry operators complete their activities.

Conservation Act of 2009. Losses are minimized through the reduction of unaccounted-for water and brine losses from the Mocho Groundwater Demineralization Plant. Finally, an enhanced in-lieu recharge program will provide more locally stored water supply during dry years until additional recharge capacity is available via the Chain of Lakes. Figure 6-1 provides a summary of projected average water supply and water demands under the Current Plan.

Figure 6-1. Projected Supply and Demand Mix: Current Plan





** Demands in this figure do not include water supply required for groundwater recharge or storage losses.*

6.1.1 Long-Term "Delta Fix"

As described in Section 4.1, Zone 7 currently has a long-term contract with the Department of Water Resources (DWR) for a maximum annual amount of 80,619 acre-feet (AF) of Table A water from the State Water Project (SWP), which translates to a long-term average yield (currently at 60%) of 48,400 acre-feet annually (AFA). This amount represents over 80% of Zone 7's supply and is therefore critical to the overall reliability of Zone 7's water supply system. Each year, DWR allocates a portion of this annual amount—up to 100%—depending on hydrologic conditions, DWR's operation of the SWP, and legal and environmental constraints.

6.1.1.1 New Legal and Environmental Constraints

From 2005 to 2009, DWR reduced the projected long-term average allocation of Table A water from approximately 75% to 60% due to projected impacts associated with pumping restrictions in the Delta and climate change. Pumping restrictions—as described in the Biological Opinions (B.O.) issued in December 2008 and June 2009 by the two federal fish agencies[58]—result from concerns over threatened and endangered species in the Delta, with the Delta smelt and certain salmon species being of particular concern. This decrease in reliability from the SWP has reduced Zone 7's sustainable water supplies by approximately 12,100 acre-feet (AF).[59]

6.1.1.2 Delta Fix: BDCP and DHCCP

A diverse stakeholder group is working together on the Bay Delta Conservation Plan (BDCP) in order to simultaneously address threatened and endangered species protection and the restoration of the reliability of water traveling through the Delta. The BDCP is a 50-year plan that would address the challenges facing the Delta with an ecosystem-based approach. In parallel, the Delta Habitat Conservation and Conveyance Plan (DHCCP) is developing alternatives for conveying SWP (and Central Valley Project [CVP]) water across the Delta in an environmentally-sound manner. The DHCCP will develop an Environmental Impact Report (EIR)/Environmental Impact Study (EIS), along with the preliminary design needed to support a decision and ultimately to construct alternative Delta conveyance facilities. Together, the BDCP and DHCCP processes are expected to result in a "Delta Fix".

Stakeholder groups involved in the BDCP and DHCCP development include DWR, fish and wildlife agencies, SWP and CVP contractors, environmental organizations, and other groups. As a contractor of the SWP that is highly reliant on water supply coming through the Delta, Zone 7 is actively engaged in the development of the BDCP and the DHCCP. Notably, Zone 7's General Manager is a member of the DHCCP Executive Committee.

The BDCP is evaluating both canal and tunnel systems as isolated conveyance options through the Delta, with capacities ranging from 3,000 to 15,000 cfs (Figure 6-2). As of December 2010, DWR has identified a tunnel system as the likely candidate. A dual-conveyance system is envisioned, with new primary intakes in the North Delta on the Sacramento River and an isolated conveyance system transporting water under the Delta to the existing Clifton Court Forebay in the South Delta. The existing South Delta diversion facility will be used as a stand-by facility, either used in conjunction with the new North Delta facility to optimize water quality and minimize fish impacts or used on its own when needed due to maintenance or repair requirements.

[58] The December 15, 2008 US Fish and Wildlife Service B.O. evaluated impacts to the delta smelt. The June 4, 2009 National Marine Fisheries Service B.O. evaluated impacts to winter-run and spring-run Chinook salmon, steelhead, green sturgeon, and resident killer whales.

[59] Reduction = 80,619 AF x (75% - 60%)

Figure 6-2. Isolated Conveyance Option in the Delta Being Considered in the BDCP[60]

[60] Source: http://baydeltaconservationplan.com/. Accessed March 2011.

6.1.1.3 Delta Fix Assumptions

Current plans indicate a goal of having a new Delta conveyance system in place between 2020 and 2030. For planning purposes, Zone 7 has assumed a new system to be available by 2025 that would restore SWP long-term water supply reliability to conditions before the B.O.s were issued, at approximately 75% (60,500 AFA for Zone 7). The alternative Delta conveyance facilities are also expected to result in a minimum allocation of approximately 10%.

In addition to improved reliability, the isolated conveyance option is expected to result in lower salinity levels, as well as other improved water quality parameters (e.g., total dissolved organic carbon). Table 6-2 below summarizes the anticipated changes in total dissolved solids (TDS) levels in the SWP supply used directly by Zone 7, and SWP supply used for recharge activities (Appendix C contains more detailed information on the variability of TDS levels in the SBA and in the vicinity of the proposed new intakes on the Sacramento River). Recharge is most active between the months of April and October, which generally coincides with lower TDS levels in the SBA. Furthermore, in case of levee failures, an isolated conveyance facility will better protect the SWP supply from salinity and organic carbon spikes, and other potentially drastic water quality impacts.

Table 6-2. Expected Improvements in TDS Levels Resulting from Delta Fix

SWP Supply	Existing TDS Levels (mg/L)	TDS Levels After Delta Fix (mg/L)*	% Reduction
Direct Use	240	190	~21%
Main Basin Recharge	220	172	~22%

*Based on current TDS levels at the Sacramento River at Hood water quality station.

The tunnel option is expected to cost approximately $12 billion dollars with costs shared amongst SWP and CVP contractors. The capital cost to Zone 7 is estimated to be approximately $140 million dollars to be paid over 40 years.

The determination of whether a Delta Fix will be implemented—and, if so, the final selection of the conveyance facility type and sizing—will likely not be determined until the environmental review process has been completed in the next two years. Zone 7 hopes to have more definitive answers by 2013 or 2014.

6.1.2 Potable Demand Reductions

As discussed in Section 3.3.5, a demand reduction of 6,000 AF is expected from the implementation of the Water Conservation Act of 2009 (Conservation Act) by the water supply retailers (California Water Service Company [Cal Water], Dublin San Ramon Services District [DSRSD], City of Livermore [Livermore], and City of Pleasanton [Pleasanton]; collectively referred to as the “Retailers”) in Zone 7’s service area. The reduction is expected to be achieved through traditional conservation approaches and increased use of recycled water in the Livermore-Amador Valley as described below.

6.1.2.1 Traditional Water Conservation

The traditional water conservation approach involves Best Management Practices such as the installation of water-efficient appliances such as toilets, washing machines, showerheads, etc.; improved landscape irrigation management; leak detection and control; tiered conservation pricing; and metering. For planning purposes, Zone 7 has assumed that these methods will achieve two-thirds (approximately 4,000 AFA) of the necessary demand reduction under the Conservation Act for the service area.

6.1.2.2 Recycled Water for Conservation Act Compliance

Recycled water is an increasingly important component of the total supply portfolio for the Livermore-Amador Valley. While Zone 7 does not produce or distribute recycled water directly, recycled water is produced by two retailers within the Zone 7 service area that also manage wastewater: DSRSD and Livermore. Together, these two retailers served 3,100 AF of recycled water in 2009. By 2030, DSRSD and Livermore are planning to serve 5,900 AFA of recycled water, accounting for the projected development and growth in recycled water infrastructure in their service areas.

Zone 7 is working with the Retailers to evaluate increasing local recycled water supplies.

Zone 7 assumed that additional recycled water use beyond that planned by DSRSD and Livermore would be used to meet the potable water demand reductions required under the Conservation Act. For planning purposes, Zone 7 assumed that increased production and use of recycled water will contribute towards one-third (approximately 2,000 AFA) of the demand reduction required under the Conservation Act. This assumption allowed Zone 7 to evaluate the potential implications of using recycled water for all scenarios.

As the groundwater basin management agency, however, Zone 7 is cognizant of the potential salt loading impacts arising out of recycled water use. Consequently, Zone 7 has taken a pro-active approach to mitigate such impacts, particularly within the Main Basin. Zone 7 is also aware that expansion of recycled water use over the groundwater basin may require additional measures to mitigate associated additional salt loading. Therefore, Zone 7 staff is recommending that any relevant changes to recycled water programs be incorporated into the planned update of the Groundwater Management Plan and Salt Management Plan.[61]

6.1.3 Confirmation of Minimum Yield from BBID Contract

Zone 7 currently has a contract with the Byron Bethany Irrigation District (BBID) that can provide up to 5,000 AFA, but the minimum yield is limited to 2,000 AFA; the contract is valid through 2030 with an option to extend through 2039 and beyond[62]. Zone 7 plans to monitor closely the available supply from

[61] Zone 7 Water Agency, 2004. Salt Management Plan.

[62] See Section 4.1.2 for more details.

BBID over the next several years and will work with BBID to determine if a higher minimum yield is possible.

For planning purposes, Zone 7 expects to spend approximately $100,000 in investigating how the BBID contract yield can be maximized, and hopes to complete the study by 2013.

6.1.4 Reduction of Unaccounted-for-Water

Zone 7 plans to undertake an investigation to reduce unaccounted-for water from 4% to 2% of total demand. Historical records indicate that unaccounted-for water losses were less than 2% between 1995 and 2002. After 2002, unaccounted-for water losses increased to about 4% on average. Zone 7 has assumed that UAFW can be reduced from 4% to 2% of total production by the end of 2012. By 2020, this decrease in UAFW is estimated to result in approximately 1,200 AF of annual demand reduction.

For planning purposes, this effort is estimated to cost approximately $500,000 in capital costs and $100,000 in annual operation and maintenance costs. An investigation into UAFW is planned to be completed before the end of 2012.

6.1.5 Reduction of Brine Losses at the Mocho Groundwater Demineralization Plant

The Mocho Groundwater Demineralization Plant (MGDP, or Phase 1 Demineralization Plant) uses reverse-osmosis membranes to desalinate groundwater. This process removes and concentrates the salts in a brine solution that is ultimately discharged via a regional wastewater export pipeline to the San Francisco Bay. A portion of the influent water is lost through the disposal of this brine solution or concentrate. The percentage of the influent water that is ultimately produced by the desalination process is commonly called the recovery rate. Brine disposal is regulated under a permit, which specifies the allowable concentrations of constituents such as metals, etc. in the brine.

Influent or raw water quality data collected during the design of the MGDP indicated that certain constituents (e.g., Arsenic) were present in levels below the detection limit. To be conservative, the concentrations of these constituents were assumed to be at the detection limit; these concentrations were then used to calculate the amount of water needed in the brine to keep constituent levels below discharge limits. This translated to setting MGDP operational parameters at a 20 percent brine loss, or, equivalently, a recovery rate of 80 percent even though recovery rates as high as 85 to 90% are possible. Now that actual brine water quality data is available from the MGDP operations, Zone 7 plans to review this data to determine whether the MGDP can be operated effectively with a 15% loss or 85% recovery rate without exceeding constituent discharge limits. This change could potentially result in an additional 260 AFA of supply.

For planning purposes, Zone 7 expects to spend approximately $100,000 in investigating how the recovery from the Mocho Groundwater Demineralization Plant can be increased, and hopes to complete the study by the end of 2013.

6.1.6 Formalization of Enhanced In-Lieu Recharge Program

Per existing contracts with Zone 7's retailers, Zone 7 has the option of implementing in-lieu recharge, an agreement in which a retailer reduces pumping of its GPQ from the Main Basin and instead receives additional surface water as replacement. This has the effect of maintaining greater storage in the Main Basin, essentially increasing the ability of Zone 7 to “recharge” the Main Bain without being limited by the recharge capacity of the streams.

Zone 7 plans to develop a framework for exercising existing in-lieu recharge components of the current contracts with the retailers to optimize groundwater storage in the Main Basin. Although this enhanced storage would not provide new water supplies, it would increase the rate at which drought storage can be replenished during drought recovery, which would reduce the chance of a shortage.

For planning purposes, this effort is estimated to cost approximately $200,000; Zone 7 hopes to have this in place within the next few years.

6.1.7 Arroyo del Valle: Perfection of Existing Water Rights Permit

Zone 7 and Alameda County Water District (ACWD) have water right permits to divert flows from Arroyo del Valle. Inflows into Lake Del Valle—after accounting for permit conditions—are equally divided between ACWD and Zone 7. Unlike ACWD, however, Zone 7 is still perfecting its water right; perfection of the water right is contingent on Zone 7 taking full ownership of the Chain of Lakes, which is expected to occur sometime around 2030. Zone 7 projects that it may be able to add over 3,000 AFA to its long-term water supplies upon perfection of the water right.

For planning purposes, Zone 7 expects to spend approximately $1 million in preparing for increased capture of Arroyo del Valle water beginning in 2030.

6.2 CURRENTLY PLANNED FACILITY IMPROVEMENTS

Zone 7's current plans also include facility improvements for water supply and reliability, not only for the long-term, but also during peak demand periods over the course of the year.

6.2.1 Increased Surface Water Treatment Capacity

Zone 7 is evaluating the merits of either building a new water treatment plant or expanding the existing PPWTP.

Zone 7 requires additional surface water treatment capacity to meet both max day demands and facility outage conditions. Between 2004 and 2007, Zone 7 completed the design of the Altamont Water Treatment Plant (AWTP) and Altamont Pipeline (APL), and awarded a contract for constructing the first half of the APL, called the Livermore Reach, in April 2008. Zone 7 completed construction and testing of the Livermore Reach in September 2009. The Livermore Reach was constructed first because it provides a valuable interconnection within Zone 7's existing transmission system regardless of whether Zone 7 constructed the AWTP or remaining portion of the APL.

Based on a slower than anticipated growth in Municipal and Industrial (M&I) water demands and the concerns over capital and energy costs, Zone 7 decided to conduct a peer review of the proposed AWTP site and treatment process before proceeding with construction. The peer review was completed in December 2009.[63] Based on the analysis completed, the only viable alternative to the existing AWTP site was the expansion of the existing Patterson Pass Water Treatment Plant (PPWTP) (described in Section 4.3.2). The analysis also indicated that economics alone would not necessarily determine whether expanding the PPWTP is better for Zone 7's long-term needs because the difference in costs between the two options is within the contingency estimates typically used for planning purposes for Zone 7's Capital Improvement Program (CIP).

Zone 7 will continue to plan for the construction of a new surface water treatment plant, while

[63] WQTS, 2009. Peer Review of the Altamont Water Treatment Plant Site and Treatment Process Report.

monitoring future max day demands and potential changes resulting from the implementation of the Water Conservation Act of 2009. Key factors to include in the final determination of the plant location and size are the projected average and max day demands, the capacity available in the South Bay Aqueduct (SBA), and any revisions to existing policies. Potential sizing and costs of new water treatment plant under the Current Plan is discussed in Section 7.

6.2.2 Increased Groundwater Pumping Capacity

Section 5.2 describes the need for additional wells in the Main Basin to provide supply reliability during drought, meet demands during facility outages, and reduce localized drawdown of groundwater levels below historical lows, as previously identified in the Well Master Plan[64]. The additional wells will also provide Zone 7 with improved ability to manage groundwater levels, groundwater flow, salt build-up and removal, and delivered water quality. In 2010, two new wells with peak capacities of 3.6 and 5 MGD were installed in the Chain of Lakes wellfield as Phase 1 of the Well Master Plan implementation. Additional wells are planned to be constructed over the next twenty years or so, resulting in a total sustainable production capacity of 45 MGD during drought conditions.

Similar to existing wells, groundwater pumped from the new wells will require chemical treatment prior to entering the distribution system, likely using chloramination. Based on site-specific considerations, treatment may occur in a building adjacent to the well/s; there may be a common treatment system for multiple wells or individual treatment systems. Conveyance facilities will need to be constructed to connect new wells to the existing distribution system. New pipes will likely range in size from 10 to 36 inches in diameter.

The total cost of the additional new wells is estimated at $64 million in capital costs, with the next well expected to be in-service by 2020. Additional annual O&M costs are expected to be around $200,000.

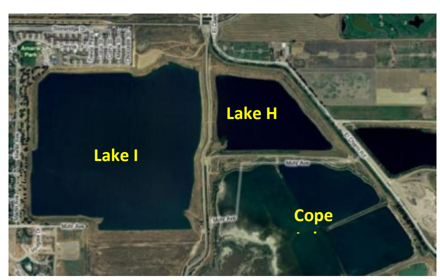
6.2.3 Increased Transmission System Capacity

As noted in Section 6.4.1, Zone 7 plans to construct a new surface water treatment plant to accommodate max day demands and facility outages through buildout. Zone 7's transmission system will need to be expanded accordingly to handle the higher flows. For cost comparison purposes only, Zone 7 has assumed a new surface water treatment plant at the PPWTP site, which will require the construction of a larger-diameter transmission pipeline leaving the PPWTP.

The total capital cost of this pipeline is estimated at $16.8 million. The construction of this pipeline—or the equivalent facility—will be coordinated with the construction of the new water treatment plant. For planning purposes, additional annual O&M costs are estimated at $50,000 for the new pipeline.

6.2.4 Arroyo Mocho Diversion Structure

As described in Section 4.2.3, Zone 7 expects to take ownership of Lake H—one of the quarry pits or lakes in the Chain of Lakes—sometime in the next five years. Lake I, which is already owned by Zone 7, and Lake H are intended to be used as artificial groundwater recharge percolation ponds. To deliver water to Lakes H and I for recharge, Zone 7 will release excess water into the Arroyo Mocho; a new diversion structure will then divert water from Arroyo Mocho to Lake H. Water will flow



Zone 7 is evaluating enhanced artificial groundwater recharge using Lakes H and I.

[64] CH2M Hill, 2003. Well Master Plan.

into Lake I through an existing conduit and then recharge into the Main Basin. Zone 7's enhanced artificial recharge capacity in the Main Basin will increase the rate at which storage reserves are replenished during drought recovery, which will reduce the chance of a water supply shortage. The addition of surface water to the lakes will also help offset evaporative losses from the groundwater basin due to the existence of the gravel quarry pits, and help protect the groundwater basin from salt build-up

For planning purposes, Zone 7 expects to spend approximately $2 million in capital costs for the Arroyo Mocho diversion structure, which is expected to be online sometime after 2014. Additional annual O&M costs are estimated at $200,000.

6.2.5 Arroyo del Valle Diversion Structure

It is anticipated that seven of the ten lakes in the Chain of Lakes (Lakes A to G) will not be dedicated to Zone 7 until after 2030. After mining of Lake A is completed, sometime around 2030, Zone 7 will have the ability to move its water supplies into the Chain of Lakes. Zone 7 is already planning to construct a diversion structure to move the water into Lakes A through I. Similar to the Arroyo Mocho diversion structure, permits will likely need to be obtained for this facility. Operational regulatory requirements will likely require the installation of fish screens, screen cleaning devices, monitoring equipment and automatic controls.

For planning purposes, the total capital cost for the Arroyo del Valle diversion structure is estimated at $5 million. It is expected to be in service by 2030, in time for when Zone 7 takes full ownership of the Chain of Lakes. Additional annual O&M costs are estimated at $250,000.

6.2.6 Feasibility Investigation of a Reliability Intertie

Section 4.1 describes Zone 7's critical dependence on water supplies being transported via the SBA—supplies that represent approximately 90% of Zone 7's incoming water (the SWP by itself represents approximately 80% of Zone 7's supply). Furthermore, during a drought, Zone 7's water supply stored in Kern County will need to be transported through the SBA as well. An outage of the SBA or major disruptions in the Delta that would prevent water transport to the SBA could potentially have catastrophic impacts to Zone 7's service area. In such an event, Zone 7 would be fully reliant on available water stored in Lake Del Valle—shared along with the two other SBA contractors—and on groundwater stored in the Main Basin. The severity of water shortage would depend on the timing of the event (e.g., winter versus late spring, middle of a drought period or after a series of wet years), which has significant implications on the amount of local water that would be available to Zone 7.

Delta and SBA outages and disruptions could result from terrorist acts, major storm events, and earthquakes. Earthquakes, in particular, are a major concern. The Greenville fault crosses the SBA in several locations. According to DWR's Delta Risk Management Study Phase 1 Report[65], "*a major earthquake of magnitude 6.7 or greater in the vicinity of the Delta Region has a 62 percent probability of occurring sometime between 2003 and 2032*." DWR further states that "*A seismic event is the single greatest risk to levee integrity in the Delta Region*" and that "*there is a 40 percent probability of a major earthquake causing 27 or more islands to flood…in the 25-year period from 2005 to 2030*." Recent estimates indicate that a major earthquake event could result in disruptions of SWP supplies for up to a year[66].

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[65] DWR, 2009. Delta Risk Management Study (DRMS) Phase 1 Report

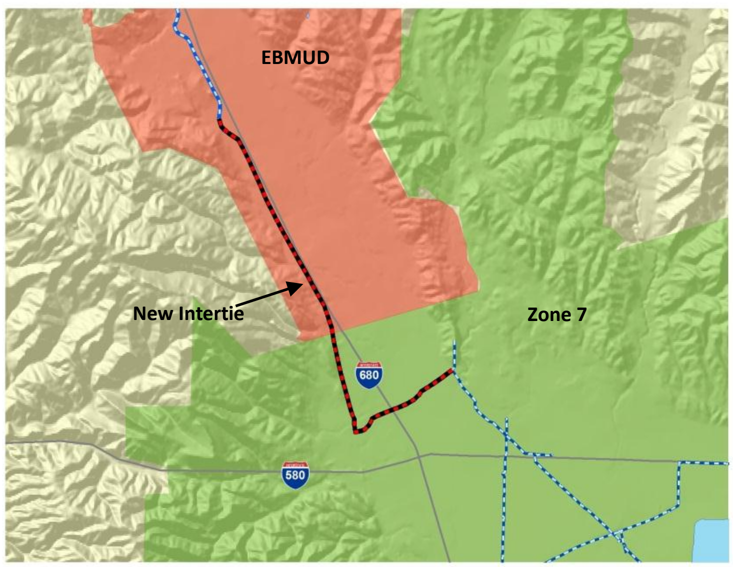
[66] DWR, 2009. 2009 State Water Project Delivery Reliability Report.

One way to help mitigate the significant risk to Zone 7's water supply under Delta/SBA outage conditions is to construct a new intertie with another water supply agency that would provide an additional means of acquiring water during such events. The most logical agency to connect to is the East Bay Municipal Utility District (EBMUD), whose service area is contiguous to the northwest portion of Zone 7's service area in the cities of Dublin and San Ramon. In fact, DSRSD already has three small interties with EBMUD ranging in size from 0.7 to 1.4 MGD. Another option could include connecting to the San Francisco Public Utilities Commission (SFPUC) facilities located on the eastern side of Zone 7's service area.

Zone 7 staff is still working with both EBMUD and SFPUC staff to better define potential benefits and roles in a new intertie project. Similar to Zone 7, EBMUD and SFPUC are partners in the Bay Area Regional Desalination Project (BARDP)[67], which would make use of a new intertie.

Zone 7 plans to investigate the feasibility of a reliability intertie with EBMUD and other agencies, including factors such as flow capacities under various conditions, possible site locations, etc. Figure 6-3 illustrates a potential alignment for the intertie with EBMUD. Based on this alignment and a 24-inch diameter pipeline, Zone 7 estimates a total capital cost of $18 million, with a potential in-service year of 2018.

Figure 6-3. Potential Alignment of a Reliability Intertie with EBMUD



6.3 WATER QUALITY: PHASE 2 DEMINERALIZATION FACILITY

A second demineralization facility with a planned capacity of 6.2 MGD of delivered water is already included in Zone 7's current Capital Improvement Program. Similar to Phase 1, Phase 2 is expected to remove salt from the Main Basin and have the added benefit of providing water with lower hardness and TDS levels, in accordance with Zone 7's Water Quality Management Program.

Zone 7 staff is recommending that the timing and sizing of Phase 2 be evaluated as part of the Salt and Nutrient Management Plan update, which will be part of the Groundwater Management Plan update

[67] Discussed in Section 9.2.

planned to be completed over the next several years. For comparison purposes, the Water Quality costs are based on a demineralization facility with capital costs totaling $36 million and annual O&M costs of $1.4 million.

7. EVALUATION OF THE CURRENT PLAN

The purpose of this section is to present the analysis and results of using the probability-based water supply model to determine the reliability provided by the Current Plan, and if necessary, present any potential changes to the Current Plan required to increase the reliability. As discussed in Section 6, the Current Plan assumed that the State of California implements a Delta Fix, and the local water supply retailers reduce potable demands mandated by the Water Conservation Act of 2009 (Conservation Act). The Current Plan also assumes that Zone 7 Water Agency (Zone 7) successfully reduces its unaccounted-for water, reduces brine losses, increases the minimum yield from its contract with Byron-Bethany Irrigation District (BBID), and enhances its an in-lieu recharge program.

The following subsections present the results:

- 7.1 Baseline Reliability for the Current Plan: 85%
- 7.2 Potential Measures for Increasing Reliability Above 85%
- 7.3 Reliability for the Current Plan: 90 to 99%
- 7.4 Facilities Evaluation for the Current Plan
- 7.5 Salt Management Evaluation for the Current Plan
- 7.6 Observations Regarding Delivered Water Quality
- 7.7 Cost Estimates for the Current Plan: 85 to 99%

7.1 BASELINE RELIABILITY FOR THE CURRENT PLAN: 85%

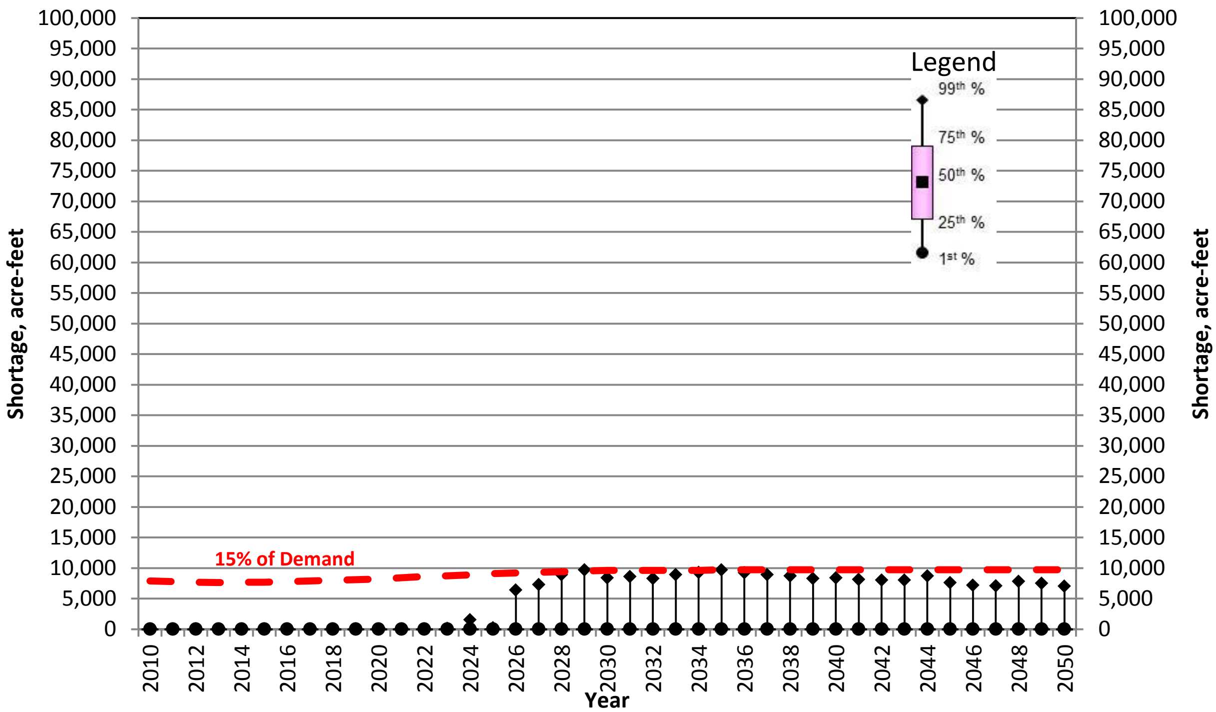
Zone 7 staff evaluated the ability of the water supplies and facilities included in the Current Plan (see Section 6) to prevent water supply shortages, while maintaining drought and emergency storage at a sustainable level. For this evaluation, Zone 7 staff first reviewed the risk of potential water supply shortages and corresponding reliability, and then reviewed the sustainability of system-wide storage, which included the Main Basin, Semitropic Water Storage District (Semitropic), Cawelo Water District (Cawelo), State Water Project (SWP) Carryover, and the Chain of Lakes.[68]

7.1.1 Risk of Potential Water Supply Shortages

Figure 7-1 presents the risk of potential shortages under the Current Plan. As shown on Figure 7-1, there is less than 1% chance of a shortage equal to or larger than 15%; the Current Plan mitigates the risk of shortages larger than 15% of projected water demands.

[68] Key source-specific storage results were included in Appendix F.

Figure 7-1. Risk of Potential Shortages for the Current Plan



7.1.2 Reliability of the Current Plan

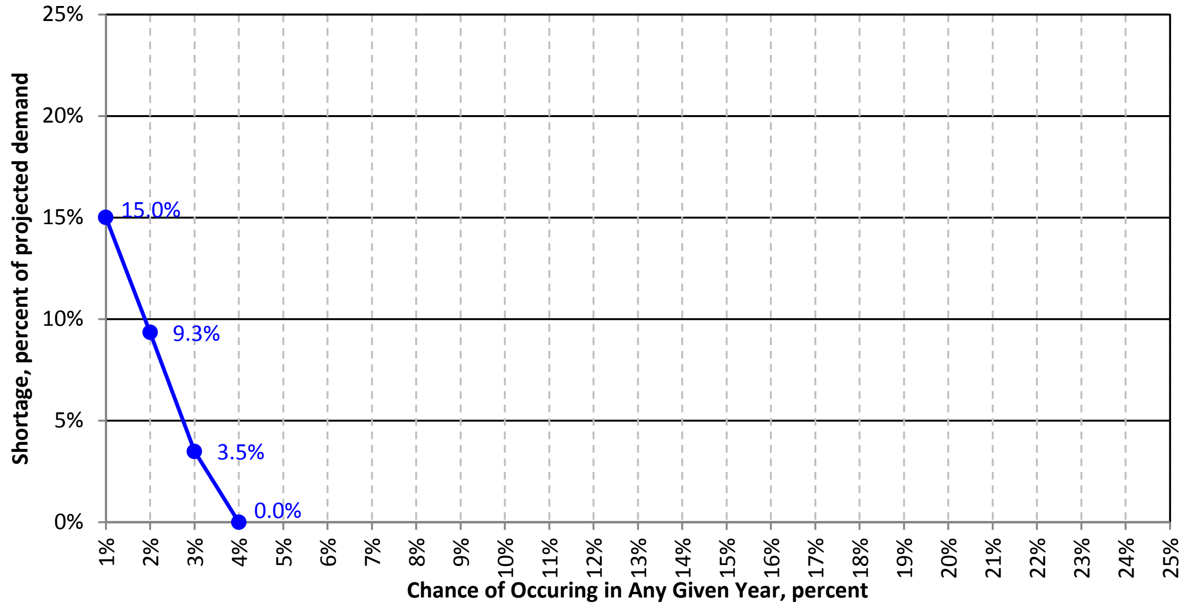
As discussed in Section 5, this Water Supple Evaluation (WSE) defined reliability based on three factors: (1) the maximum shortage, (2) the frequency of smaller shortages, and (3) the percent of the time with no shortages. Figure 7-2 presents the risk curve for the worst-case[69] observed over the entire period from 2010 and 2050 under the Current Plan.

As shown on Figure 7-2, the Current Plan provides a reliability of 85% (i.e., there is a less than 1% chance of a shortage larger than 15% of projected demands). Additionally, there is only about a 1.9% chance of a 10% shortage and no shortages are expected 96 percent of the time (i.e., 1 minus 0.04). The risk of small shortages is extremely low due to the Zone 7's groundwater pumping ability and the large amount of pump back associated with Semitropic and Cawelo.

The risk of shortages presented on Figure 7-2 appears relatively low (96 percent of the time there is no shortage), indicating that the water supply system is robust under the assumptions of the Current Plan. However, these results are dependent on the assumptions previously presented in Section 6; particularly, the assumptions that conveyance in the Sacramento-San Joaquin Delta (Delta) would increase the long-term reliability of the State Water Project to 75% of Table A amounts and the Tri-Valley successfully achieves 6,000 acre-feet (AF) of potable water demand reduction through water conservation and recycled water projects. As discussed in subsequent sections of this WSE, additional studies are required to confirm these assumptions.

[69] The largest shortage was limited to 15%; consequently, the worst-case was selected by choosing the year with the most frequent shortages less than 15%, or in this case, 2035.

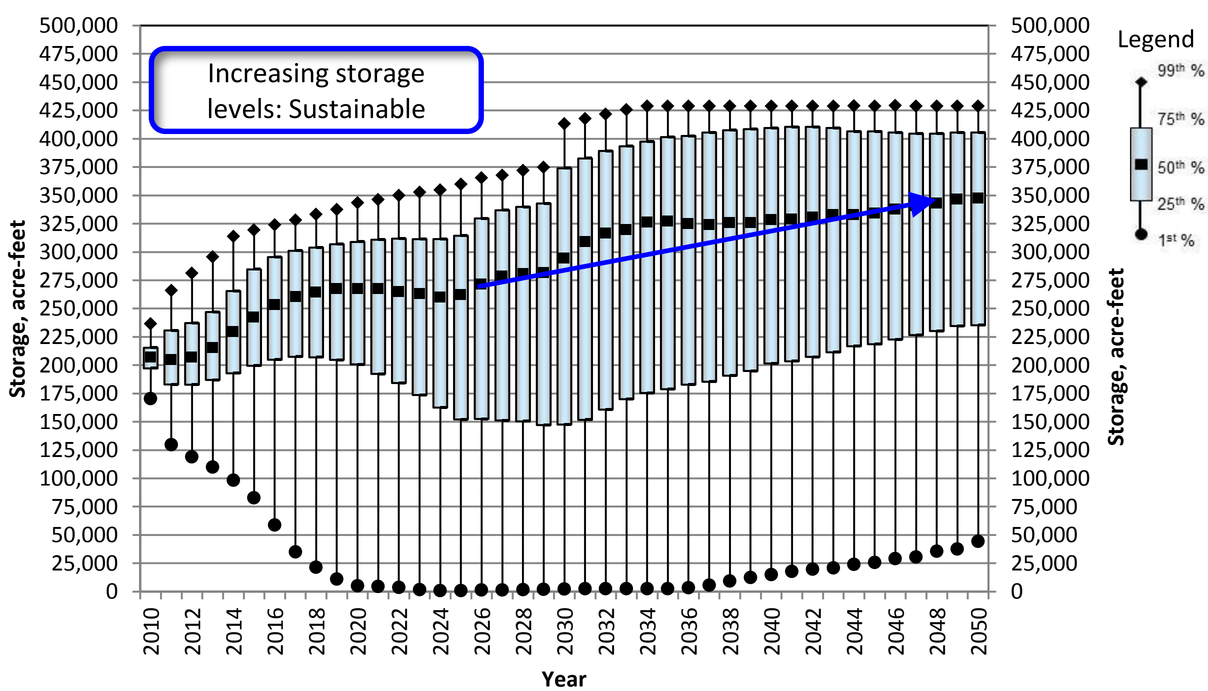
Figure 7-2. Reliability Curve for the Current Plan: 85%



7.1.3 Sustainability of the Current Plan

Figure 7-3 presents likely system-wide storage available to Zone 7 through 2050 using the supplies and facilities associated with the Current Plan. As shown in Figure 7-3, the Current Plan – without any additional modifications – appears to be sustainable.

Figure 7-3. Sustainability of the Current Plan at a Reliability of 85%



7.2 POTENTIAL MEASURES FOR INCREASING RELIABILITY ABOVE 85%

Zone 7 staff reviewed potential measures that could be taken to increase the reliability above 85%. The additional measures required beyond those already incorporated in the Current Plan (see Section 6) to increase reliability above 85% (i.e., reduce the maximum shortage to less than 15%) depend on the reasons for the shortages.

As shown previously on Figure 7-1, the maximum shortage possible under baseline conditions for the Current Plan is approximately 10,000 AF (about 15% of 64,500 acre-feet). A review of the probability-based water supply model results indicates that this 15% shortage can occur during several different drought conditions and for several different reasons. For example, an extremely severe drought lasting only five years or less can cause the shortages observed, while the same magnitude shortage can occur after a very long, but less severe, drought (e.g., more than 6 years). During these various drought scenarios, it appears that the following conditions, or any combination thereof, generally lead to highest shortages predicted:

a. There is insufficient pumpback capacity from non-local storage,
b. Groundwater levels are likely at historical lows – either at key well fields or basin-wide, or
c. There is no access to surface water previously stored in the Chain of Lakes for recharge.

In light of the challenges associated with the State Water Project (SWP), Zone 7 is continually looking for ways to reduce reliance on SWP facilities; therefore, increasing pumpback or buying into another SWP groundwater-banking program were not attractive options for improving reliability under the Current Plan. Although additional wells could help increase the rate at which Zone 7 can withdraw water from some portions of the Main Basin during drought, they would not increase the quantity of stored surface water available.

Zone 7 staff also considered locating a new water treatment plant at the Chain of Lakes. However, the drought conditions resulting in shortages greater than 15% do not occur frequently; therefore, the new water treatment plant would likely be idle for most of the time. Additionally, preliminary estimates indicated that the capital costs a new water treatment plant would be about twice the capital costs of a new pipeline, while the maintenance costs would likely be ten times higher.[70]

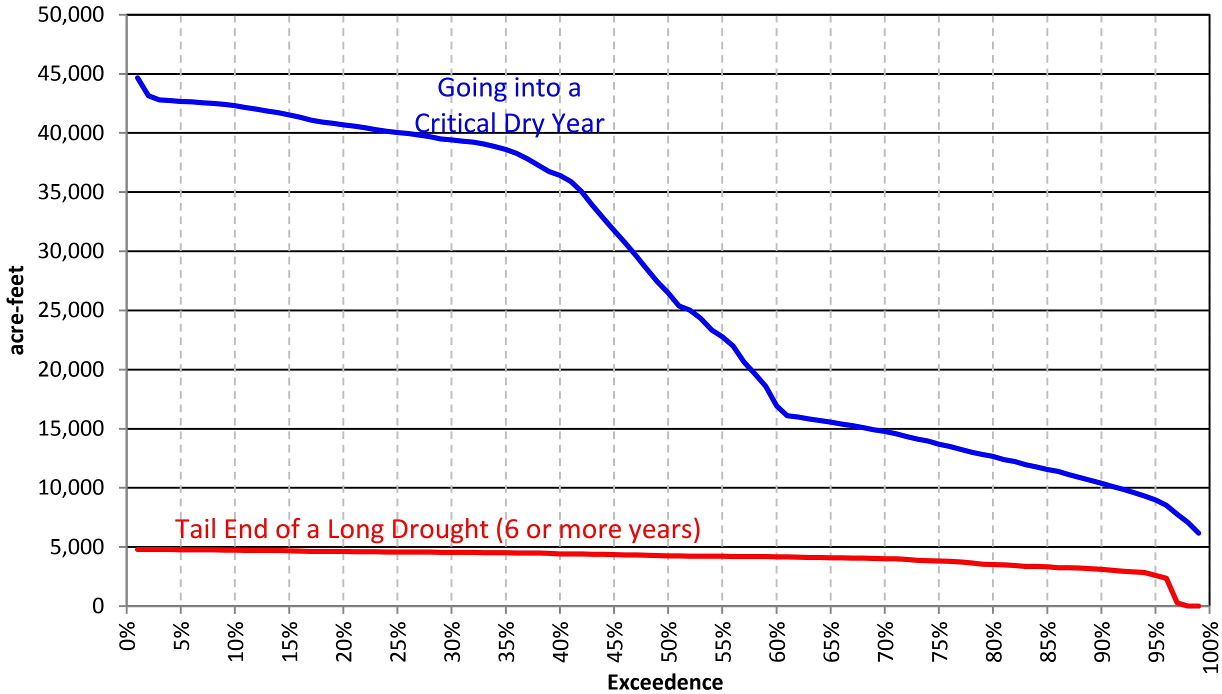
Consequently, Zone 7 staff reviewed two potential options for addressing these conditions: (1) constructing a pipeline from the Chain of Lakes to the Del Valle Water Treatment Plant and (2) purchasing spot-market water. Each is discussed in more detail below. These two options are not mutually exclusive, and if necessary, can be combined.

7.2.1.1 Pipeline Connecting the Chain of Lakes Pipeline to the Del Valle Water Treatment Plant

Using the probability-based water supply model, Zone 7 staff estimated the potential surface water supply available for use going into a critical dry year and at the end of a six-year drought to develop a range of potential supply in storage. Figure 7-4 compares the likelihood of having surface water in the Chain of Lakes under both conditions. As shown on Figure 7-4, the amount of surface water in the Chain of Lakes going into a critical dry year can range from about 5,000 to well over 40,000 AF, while the amount of surface water available for longer droughts (i.e., more than six years) is about 5,000 AF or less.

[70] The initial cost estimate ($38 million) was based on a pipeline, pump station, and demineralization type plant located near Lake I.

Figure 7-4. Potential Surface Water Available in the Chain of Lakes for the Current Plan after 2030



For planning-level purposes in this WSE, Zone 7 staff estimated the costs of constructing a pipeline from the Chain of Lakes to the Del Valle Water Treatment Plant assuming that up to 10,000 AF is transferred over a 9-month period (i.e., about 12 MGD). Figure 7-5 illustrates one potential alignment and the associated costs.[71] As shown on Figure 7-5, the pipeline would tie into future lakes; these lakes are not expected to be available to Zone 7 until sometime around 2030.

7.2.1.2 Spot Market Water

Spot market water refers to water purchased, delivered, and used in a single year.[72] The SWP would be the main conveyance and/or source of spot market water for Zone 7; however, if a new reliability intertie is constructed with another water agency (e.g., with East Bay Municipal Utilities District) then Zone 7 could potentially buy water on the "open market" – especially in markets north of the Sacramento-San Joaquin Delta. The open market refers to water supply available for single-year use that is not associated with the State Water or Central Valley Projects.[73]

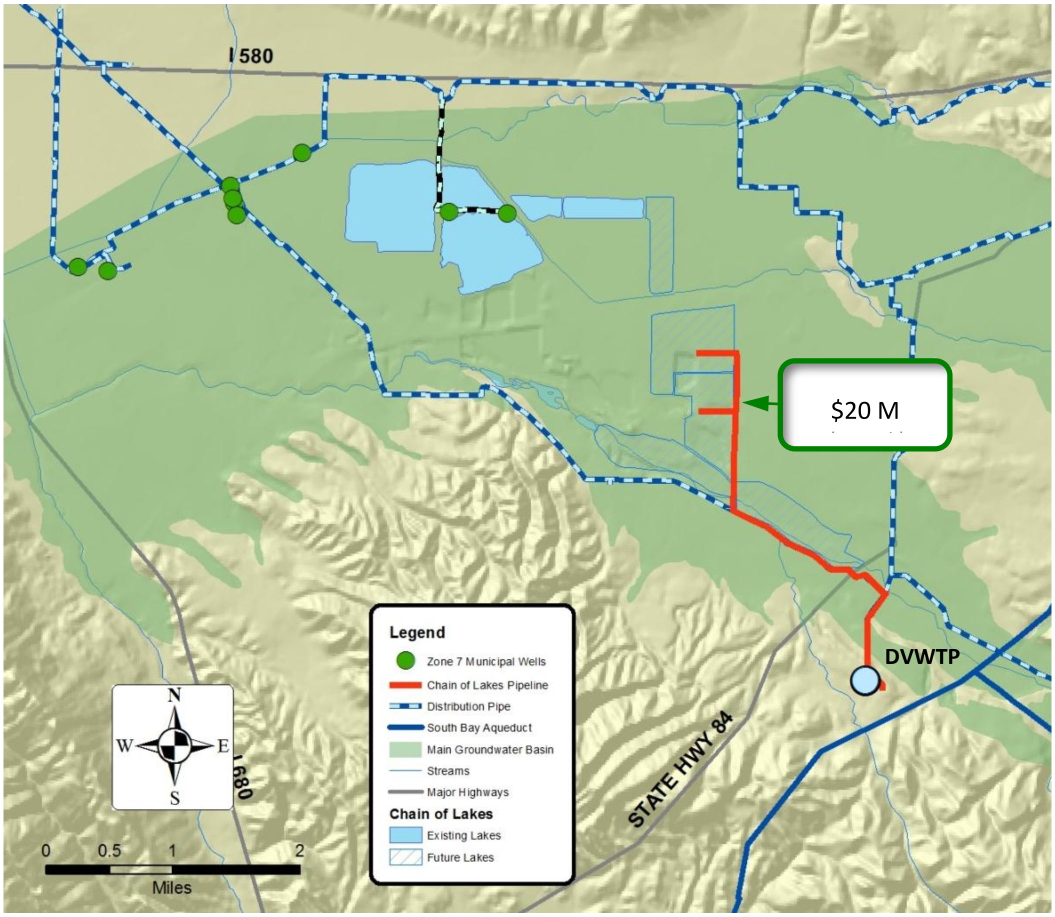
For planning-level purposes in this WSE, Zone 7 staff assumed that, if necessary, spot market water would be purchased via the SWP to improve reliability beyond that provided by a Chain of Lakes pipeline. Based on discussions with Zone 7 staff tracking State Water Project operations, the current rate for spot market water can be as high as $600 per acre-foot.

[71] Detailed cost estimates are provided in Appendix D.

[72] Howitt and Hank, 2005. Incremental Water Market Development: The California Water Sector 1985 to 2005. Canadian Water Resources Journal. Vol. 30(1): 73-82.

[73] Howitt and Hank, 2005. Incremental Water Market Development: The California Water Sector 1985 to 2005. Canadian Water Resources Journal. Vol. 30(1): 73-82.

Figure 7-5. Chain of Lakes Pipeline to Del Valle Water Treatment Plant



7.3 RELIABILITY FOR THE CURRENT PLAN: 90 TO 99%

Zone 7 staff evaluated the ability to increase the reliability of the Current Plan beyond 85% by adding a pipeline from the Chain of Lakes to Del Valle Water Treatment Plant and if necessary, purchasing spot market water. Zone 7 staff completed this evaluation for 90, 95, and 99% reliability scenarios; each is discussed below.

7.3.1 <u>Reliability of the Current Plan: Increased to 90%</u>

Under this scenario, shortages are kept equal to or below 10% of projected water demands through the purchase of spot market water between 2027 and 2030 and the installation of a Chain of Lakes pipeline by 2030 (Figure 7-6). Up to 3,500 AF of spot market water may need to be purchased to keep shortages equal to or lower than 10% (i.e., to maintain a 90% reliability policy). In addition to achieving 90% reliability, this scenario also results in no shortages 96% of the time (Figure 7-7) and sustainable system-wide storage (Figure 7-8).

Figure 7-6. Risk of Potential Shortages for the Current Plan: 10%

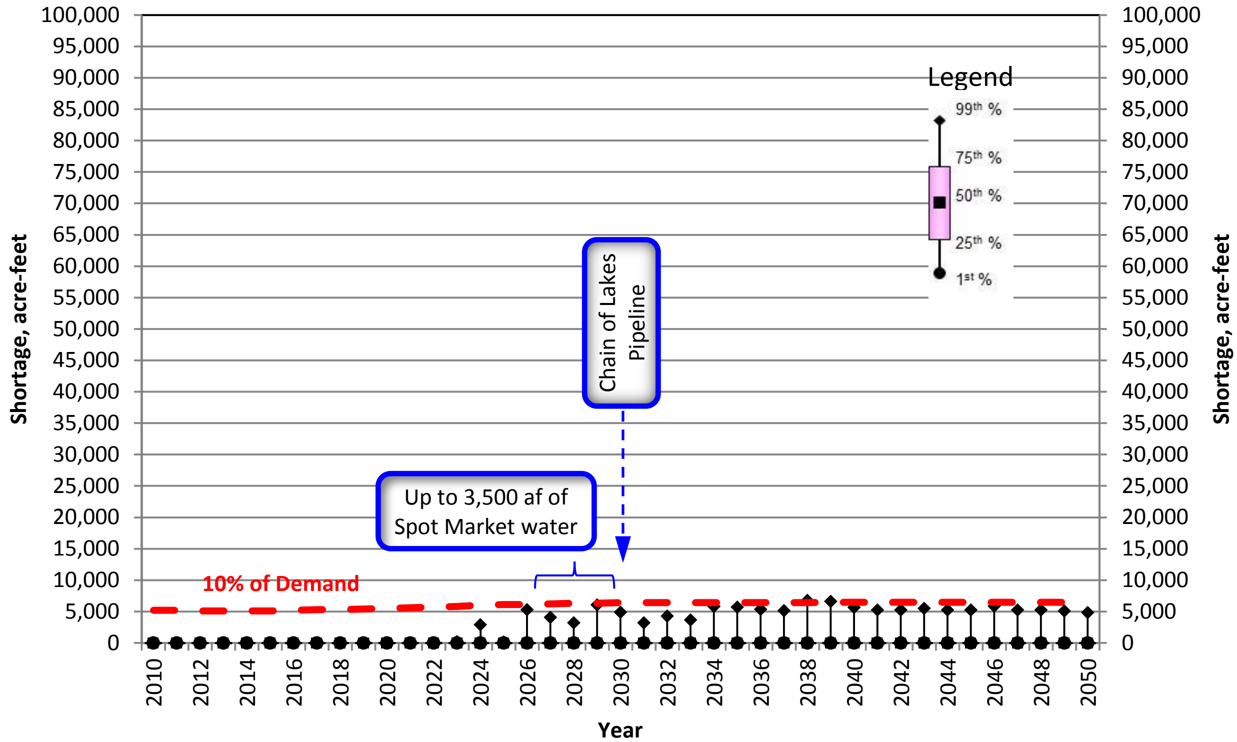


Figure 7-7. Reliability Curve for the Current Plan: 90%

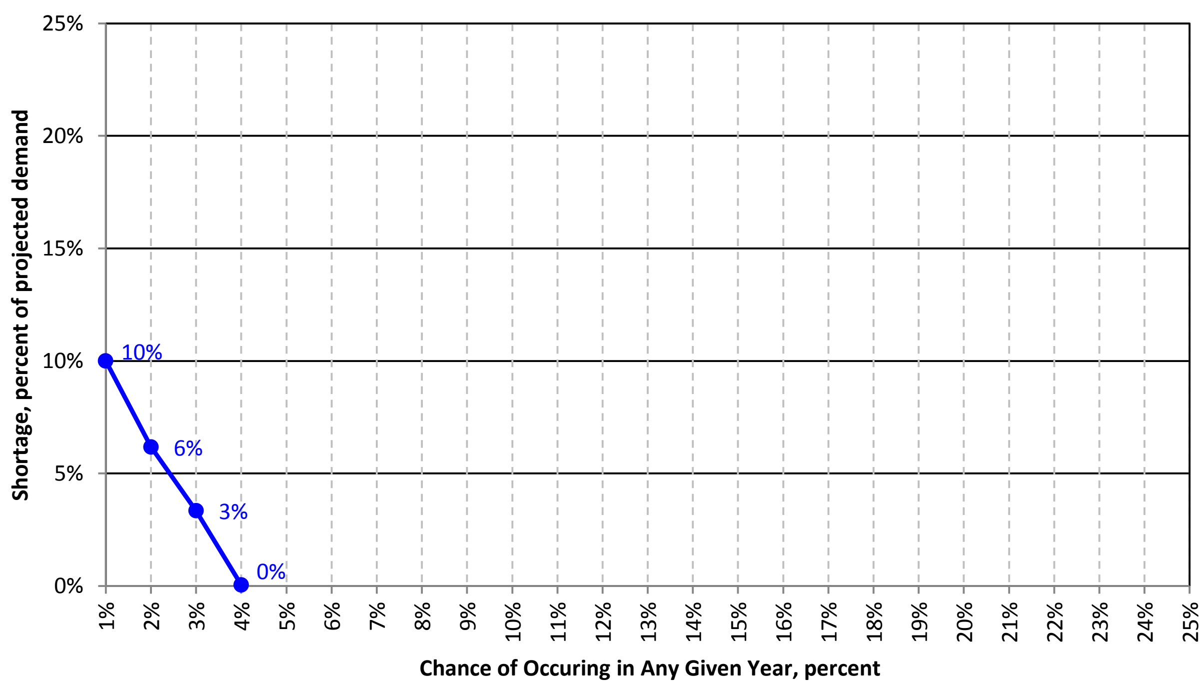
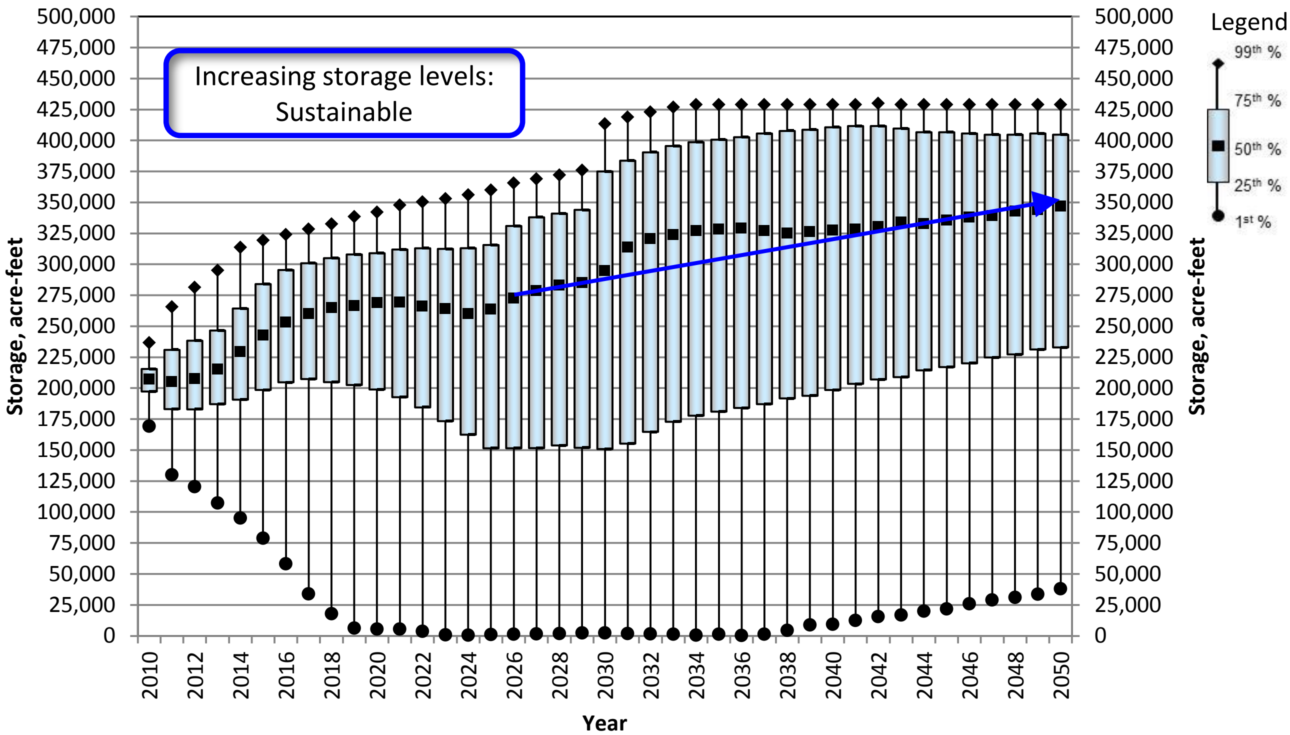


Figure 7-8. Sustainability of the Current Plan at a Reliability of 90%



7.3.2 Reliability of the Current Plan: Increased to 95%

Under this scenario, shortages are kept equal to or below 5% of projected water demands through the purchase of spot market water, as needed, starting in 2024 and the installation of a Chain of Lakes pipeline by 2030 (Figure 7-9). Up to 6,000 AF of spot market water may need to be purchased to keep shortages equal to or lower than 5% (i.e., to maintain a 95% reliability policy). In addition to achieving 95% reliability, this scenario also results in no shortages 98% of the time (Figure 7-10) and sustainable system-wide storage (Figure 7-11).

Figure 7-9. Risk of Potential Shortages for the Current Plan: 5%

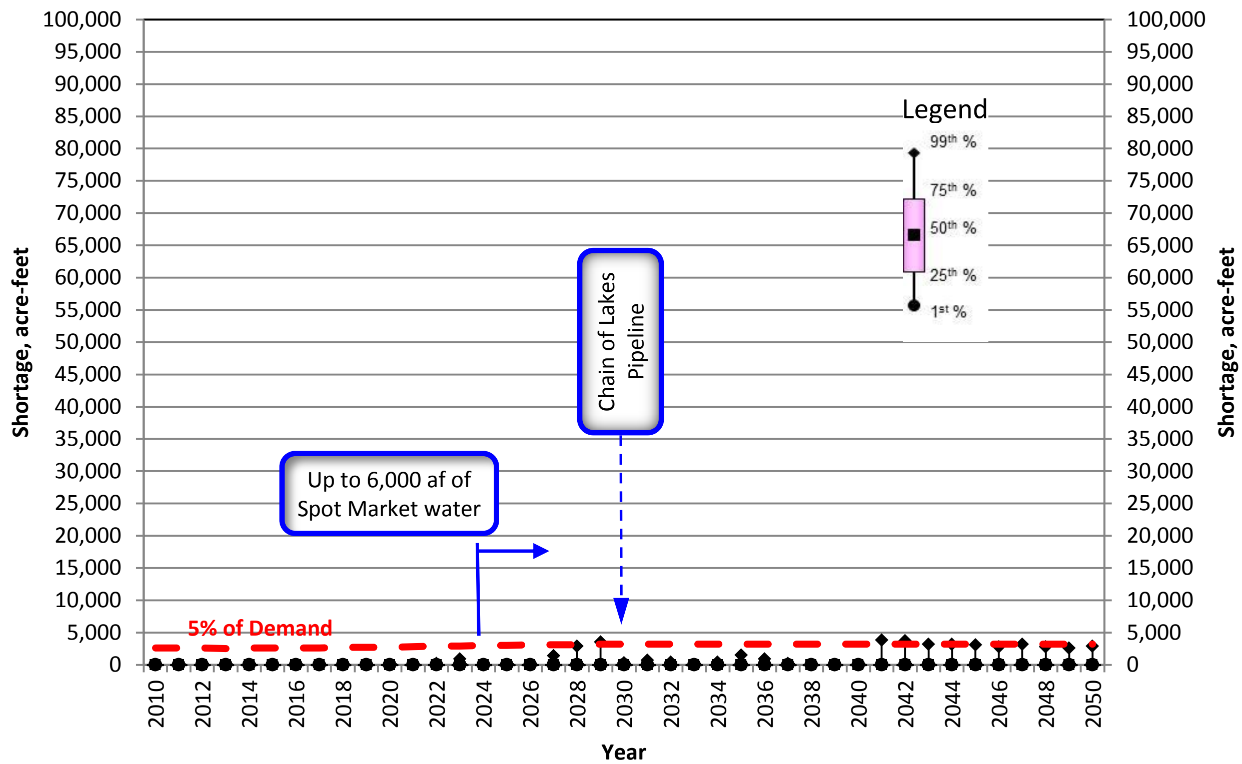


Figure 7-10. Reliability Curve for the Current Plan: 95%

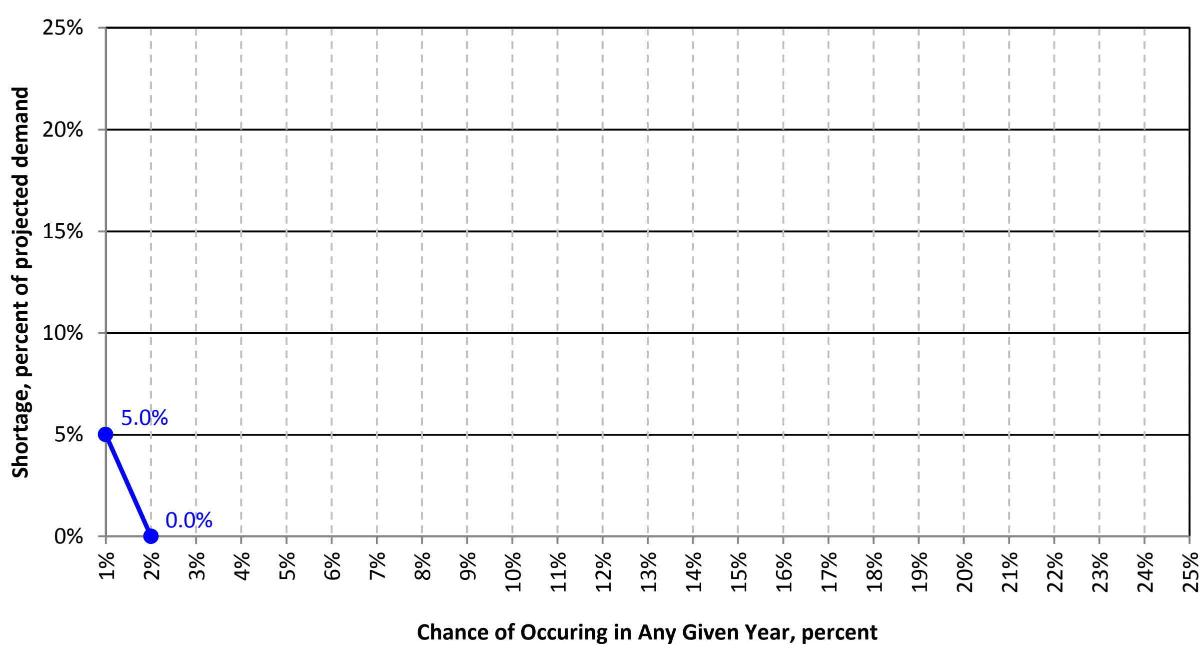
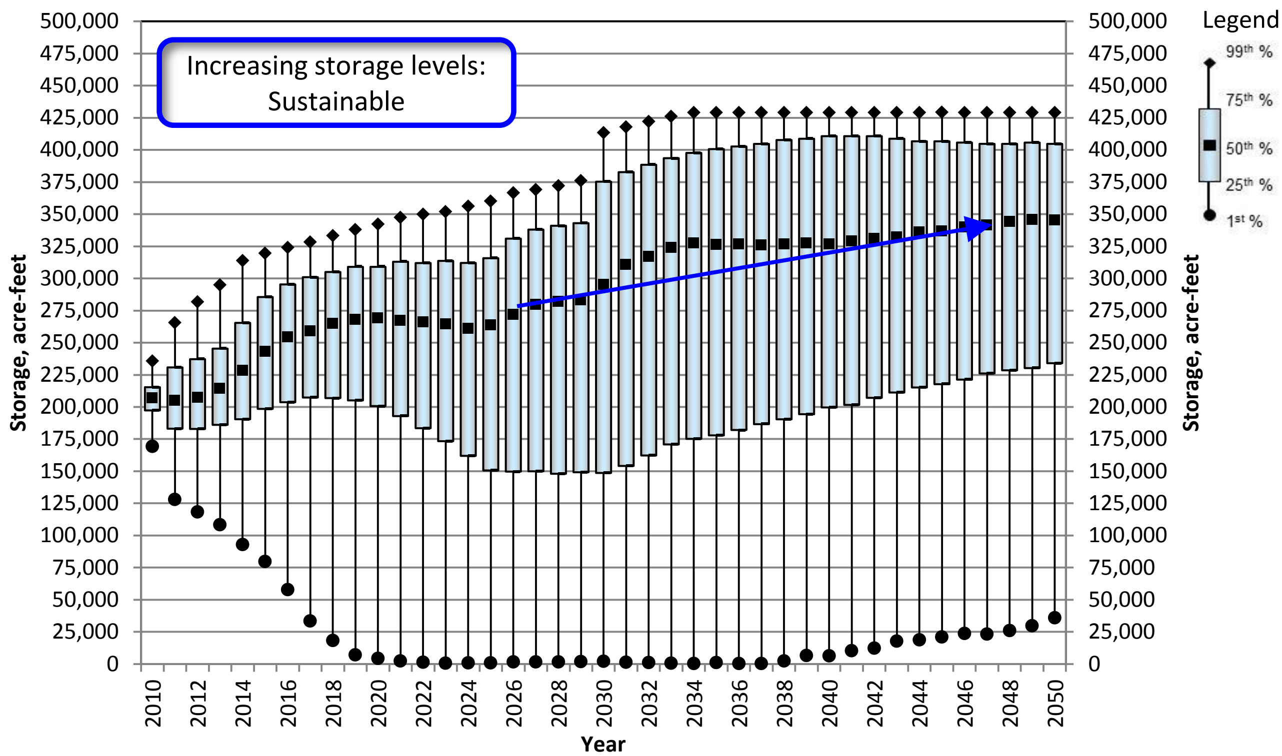


Figure 7-11. Sustainability of the Current Plan at a Reliability of 95%



7.3.3 Reliability of the Current Plan: Increased to 99%

Under this scenario, shortages are kept below 1% of projected water demands through the purchase of spot market water, as needed, starting in 2024 and the installation of a Chain of Lakes pipeline by 2030 (Figure 7-12). Up to 10,000 AF of spot market water may need to be purchased to keep shortages equal to or lower than 1% (i.e., to maintain a 99% reliability policy). In addition to achieving 99% reliability, this scenario also results in no shortages more than 98% of the time (Figure 7-13) and sustainable system-wide storage (Figure 7-14).

Figure 7-12. Risk of Potential Shortages for the Current Plan: < 1%

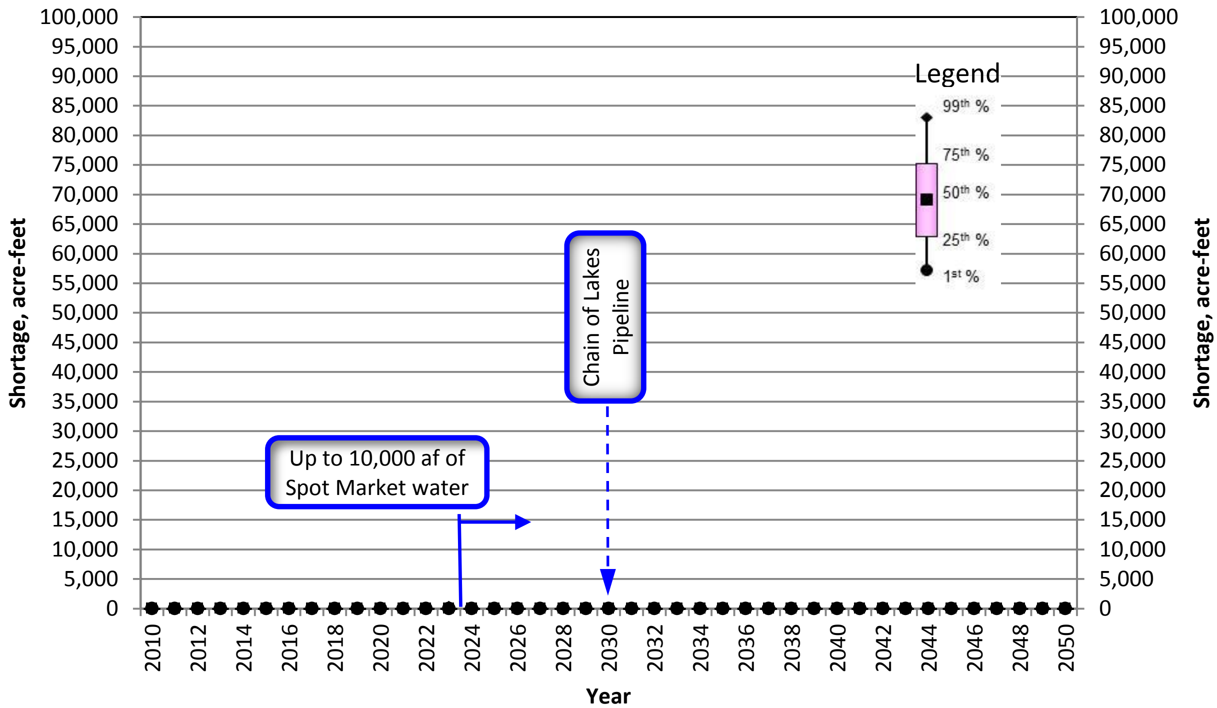


Figure 7-13. Reliability Curve for the Current Plan: 99%

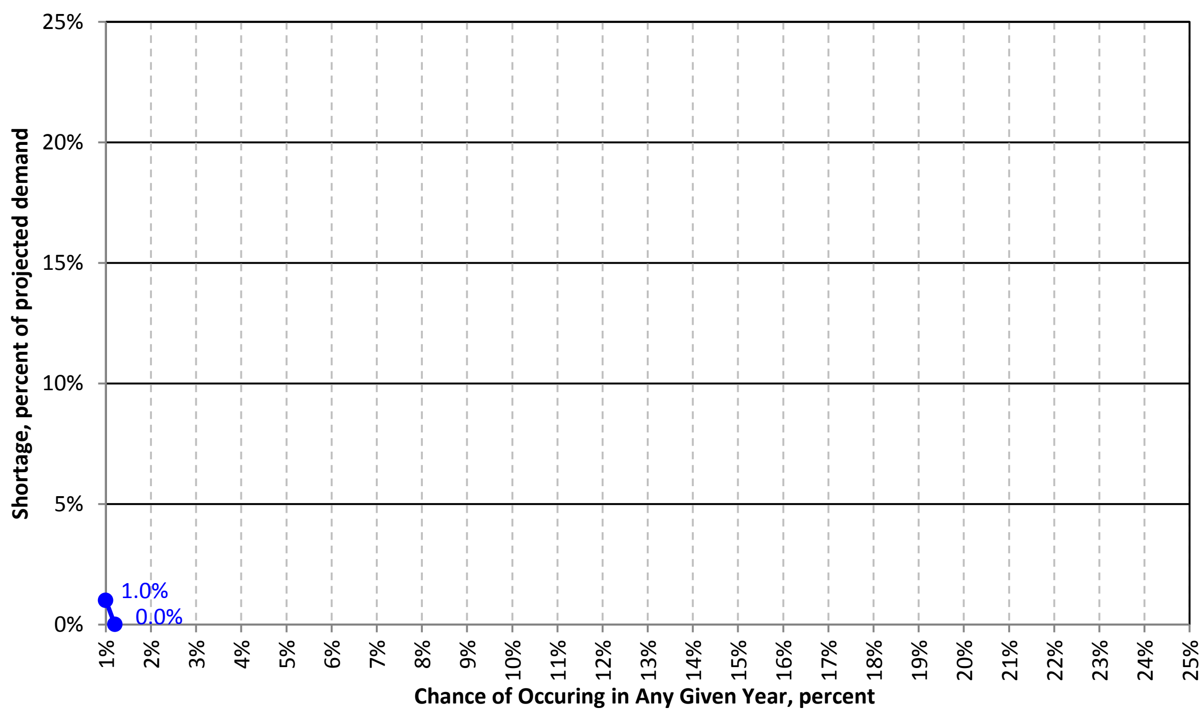
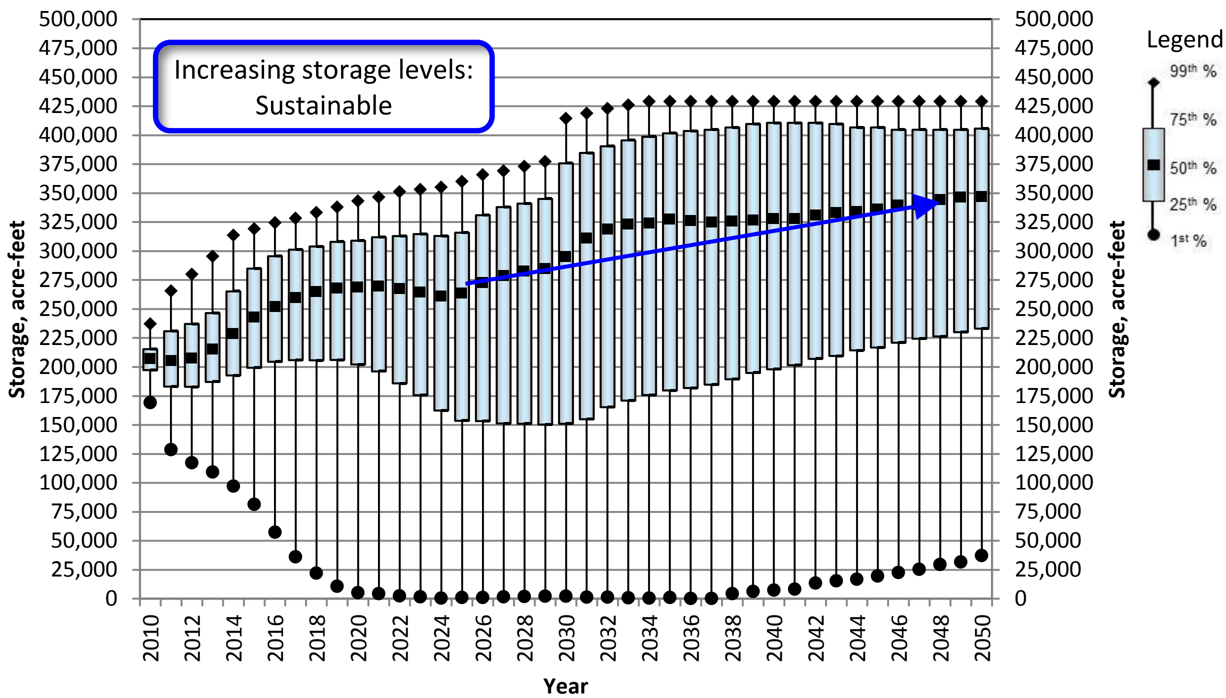


Figure 7-14. Sustainability of the Current Plan at a Reliability of 99%



7.4 FACILITIES EVALUATION FOR THE CURRENT PLAN

Zone 7 staff reviewed the capacities of existing and planned facilities associated with the Current Plan to meet 100% of maximum day demands under normal conditions and 75% of maximum day demands assuming one major facility is out of service. Each condition is discussed below.

7.4.1 Maximum Day Demand for the Current Plan

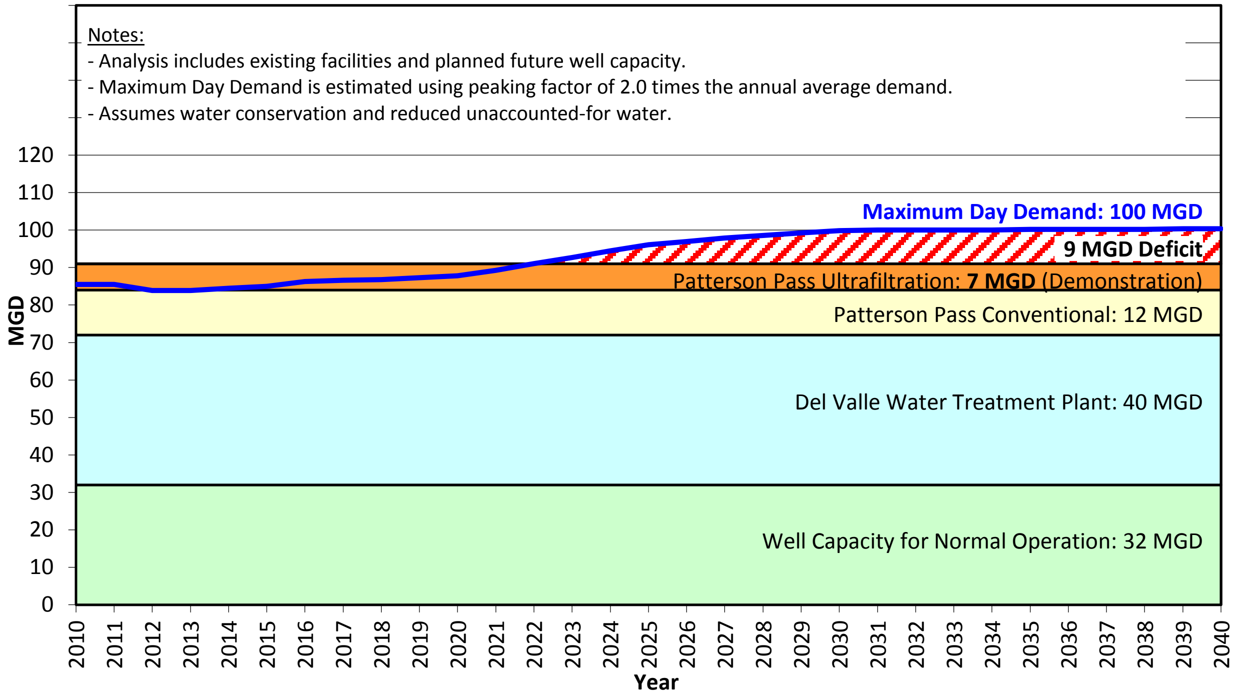
Figure 7-15 compares the capacity of existing and planned facilities associated with the Current Plan with projected maximum day demands.[74] Based on this comparison, Zone 7 can meet 100% of maximum day demands through 2022, but will require additional surface water treatment capacity by 2023 (9 million gallons per day [MGD]). However, the temporary ultrafiltration (UF) plant at the Patterson Pass Water Treatment Plant (PPWTP) will need to be replaced; therefore, the total new surface water treatment capacity required is at least 16 MGD (9 plus 7 MGD).

This analysis is dependent on the assumptions for potable demand reductions associated with the Water Conservation Act of 2009, and a 1,000 to 2,000 AF fluctuation in these assumptions could easily translate into 2 to 4 MGD of additional treatment capacity.[75] Consequently, for planning-level purposes in this WSE, the cost estimates for an initial expansion of water treatment plant capacity were based on a 20 MGD facility.

[74] Projected water demands were previously discussed in Section 3; the maximum day is obtained by multiplying by 2.

[75] 2, 000 acre-feet is about 1.8 MGD, which translates to about 3.6 MGD on the maximum day assuming a peaking factor of 2.

Figure 7-15. Current Plan: Ability to Meet Maximum Day Demand



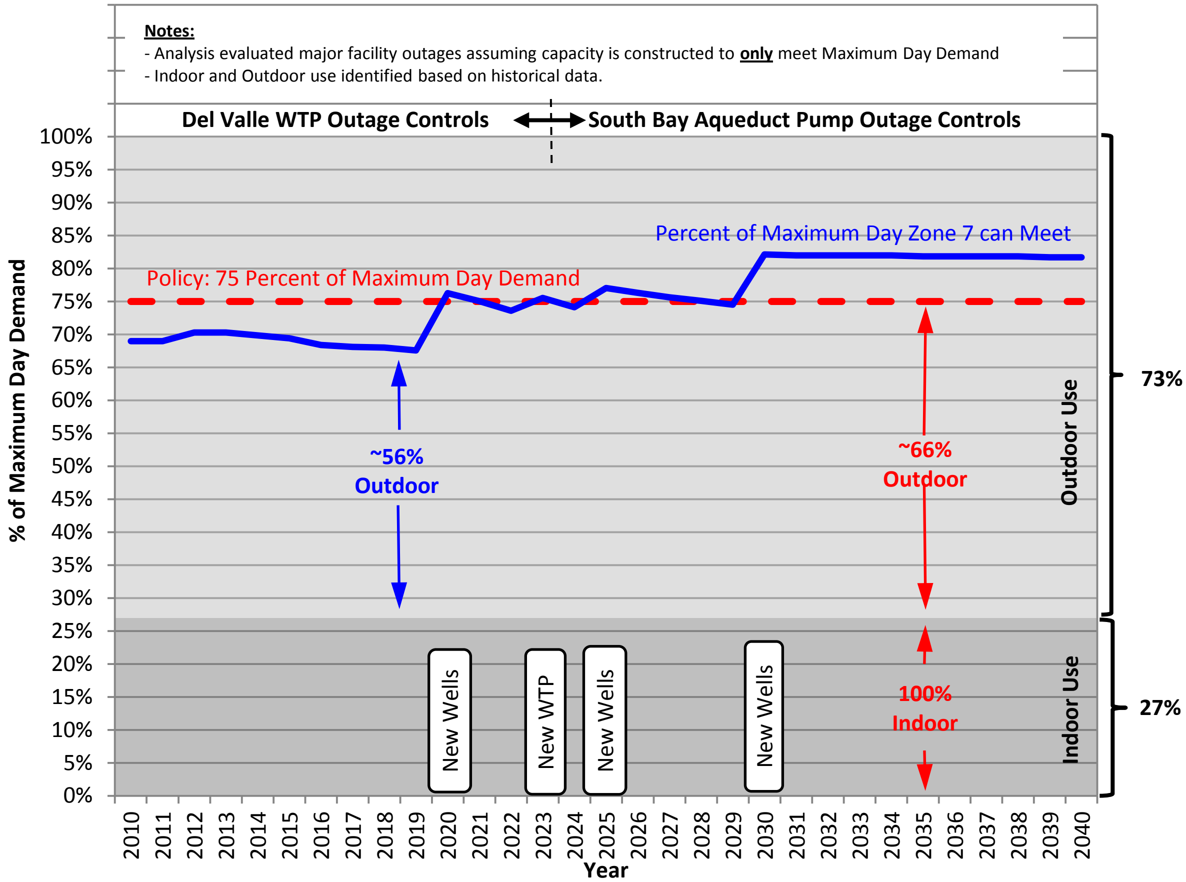
7.4.2 Level of Service for the Current Plan with a Major Facility Outage

Zone 7 staff evaluated the ability of existing and planned facilities associated with the Current Plan (see Section 6) to meet the current facility outage policy. Figure 7-16 presents the results of this evaluation by comparing the percent of maximum day demand that the Current Plan facilities can meet over time. For discussion purposes, Figure 7-16 splits the maximum day demand into indoor and outdoor use,[76] and presents the current facility schedule. The current facility schedule reflects delayed construction associated with reduced demands caused by the current economic downturn.

As shown on Figure 7-16, the current policy is to meet 75% of maximum day demand with a major facility out of service; however, another interpretation of the policy is to meet 100% of indoor use and 66% outdoor use during the same conditions. Figure 7-16 clearly shows, with a major facility outage, that existing facilities can meet 100% of indoor water needs, but only about 56% of outdoor needs until 2020. As new facilities come online, Zone 7 is increasingly able to meet and eventually exceed the existing policy.

[76] Zone 7 staff reviewed historical monthly data to split projected water demands into indoor and outdoor use. This analysis is provided as Appendix A.

Figure 7-16. Ability of Current Plan to Meet Maximum Day Demand during an Outage



7.4.2.1 *Consideration: Level of Service during a Maximum Month*

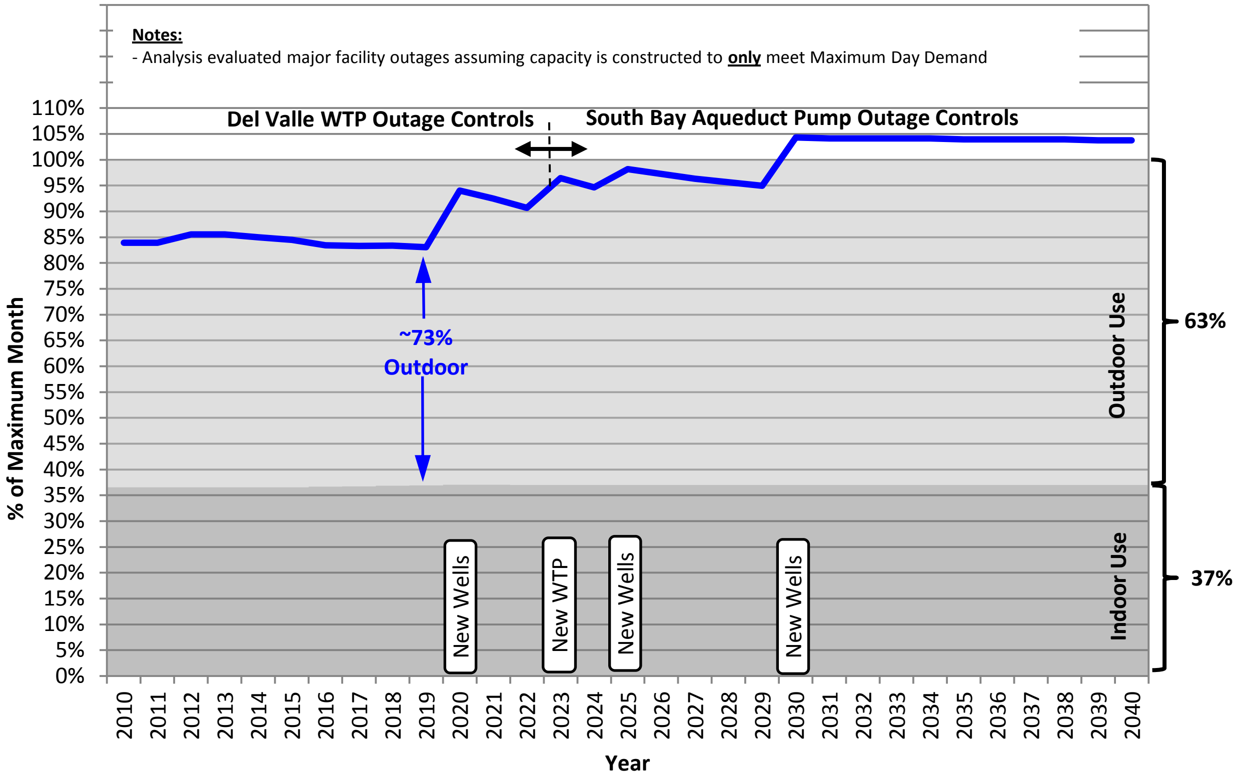
The assumptions presented on Figure 7-16 are relatively conservative. For example, one scenario evaluated assumes that all of the treatment capacity associated with the Del Valle Water Treatment Plant happens to be lost on the highest water use day of the year (i.e., the maximum day), which typically occurs between 1 to 5 out of 365 days – less than 2 percent of the time. Additionally, barring a major emergency (e.g., an earthquake, Delta levee failure, or transmission line burst), it would take multiple, simultaneous, failures of internal plant equipment to lose all treatment capacity for an entire day.[77]

Consequently, for discussion purposes in this WSE, Zone 7 staff also reviewed the same outage scenarios over the highest water use month (i.e., the maximum month) instead of the maximum day demand. Figure 7-17 presents the same analysis completed for the maximum month.

As shown on Figure 7-17, existing facilities can meet 100% of indoor use and almost three-quarters of the outdoor use during the highest water use month and therefore, about a 25% reduction in water use would be required over a 30-day period. Assuming the typical residential customer waters their lawn four times per week during the hottest month of the year, then a 25% reduction could be achieved by only watering their lawn about three times a week.

[77] Based on conservations with Zone 7 operations staff.

Figure 7-17. Ability of Current Plan to Meet Maximum Month Demand during an Outage



7.5 SALT MANAGEMENT EVALUATION FOR THE CURRENT PLAN

Zone 7 is preparing to update its Groundwater Management Plan (GWMP), which will also include an update of the Salt Management Plan (SMP). As part of this update, Zone 7 staff will conduct a more rigorous analysis of potential salt and nutrient loading in the Main Basin – a rigorous analysis of salt loading was not completed as part of this WSE.

Each of the scenarios evaluated in this WSE involved different water supply sources with different water quality characteristics that could influence future salt loading in the Main Basin. Consequently, Zone 7 staff completed a preliminary review of the potential salt loading associated with the Current Plan for comparative purposes in this WSE.[78] As discussed in Section 5, this review involved using spreadsheet models previously developed as part of Zone 7's original SMP to evaluate whether net salt loading in the Main Basin associated with the Current Plan was either increasing or decreasing. Preliminary results indicate that a new demineralization facility may be required to achieve decreasing salt loading under the Current Plan. The GWMP/SMP update will further evaluate this finding.

7.6 OBSERVATIONS REGARDING DELIVERED WATER QUALITY

As discussed previously in Section 5, conducting hydraulic modeling to quantify potential benefits to delivered water quality was beyond the scope of this WSE; however, each of the scenarios evaluated in this WSE involved different water supply sources with different water quality characteristics. Consequently, a qualitative review of each scenario was completed to evaluate whether the scenario

[78] Zone 7 will evaluate nutrients as part of the SMP update.

had the potential for improving or degrading delivered water quality. The potential benefits to delivered water quality of the Current Plan fall into two categories: (1) those associated with the Delta Fix and (2) those associated with the groundwater demineralization activities. Both are discussed below.

7.6.1 Potential Delivered Water Quality Benefits of a Delta Fix

Based on information gathered via Zone 7's participation in the Bay Delta Conservation Plan (BDCP) and the Delta Habitat Conservation and Conveyance Plan (DHCCP), it is likely that any solution in the Delta will also involve conveyance of water supplies from the Sacramento River during various conditions resulting in dual conveyance. The total dissolved solids (TDS) concentration of water in the Sacramento River is significantly lower than the TDS concentration of supply conveyed through the Delta.[79]

As discussed in Section 6, it was assumed that overall TDS concentrations would only decrease by about 20% due to the dual conveyance nature[80] of potential solutions being evaluated for the Delta. Even a 20% decrease in TDS concentration, however, will likely improve overall delivered water quality for the Valley, both delivered water quality and the quality of water used for recharge of the Main Basin.

7.6.2 Potential Delivered Water Quality Benefits Associated with Demineralization

As previously discussed in Section 7.5, Zone 7 staff conducted a preliminary evaluation of salt loading associated with the Current Plan, and although it is recommended that future salt mitigation strategies be evaluated as part of the Salt Management Plan Update, another phase of demineralization is in Zone 7's existing Capital Improvement Program. Therefore, a second phase was also included in the cost estimates of the Current Plan for comparative purposes in this WSE. Another phase of demineralization will have a direct positive influence on delivered water quality because it treats groundwater before it enters Zone 7's distribution system.[81]

7.7 COST ESTIMATES FOR THE CURRENT PLAN: 85 TO 99%

The purpose of this section is to provide planning-level cost estimates for each reliability scenario evaluated under the Current Plan portfolio. For illustrative purposes, the cost estimates were divided into three categories: (1) facilities, (2) water supply, and (3) water quality. The facilities component of the cost estimates represent hard construction, such as water treatment plants, diversion structures, and groundwater wells, while the water supply component generally represents the cost of purchasing or acquiring water. The cost estimate for water quality reflects a second phase of demineralization; however, as discussed previously, future salt mitigation needs further evaluation as part of the GWMP/SMP update.

In all cases, the costs are presented in 2010 dollars based on an Engineering News Record San Francisco Construction Cost Index. The following planning-level cost contingencies were also applied as necessary:

- Construction Contingency: 25 percent
- Planning and Environmental: 10 percent
- Design and Implementation: 10 percent

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[79] This was based on an analysis of historical EC levels in the Sacramento River near Hood and current deliveries to Zone 7's Patterson Pass Water Treatment Plan. Average TDS concentrations in the Sacramento River are less than 100 mg/L, while average concentrations of raw water delivered to Zone 7's PPWTP is about 240 mg/L.

[80] Dual conveyance may only bypass the Delta for a portion of the year.

[81] The benefits of demineralization were thoroughly analyzed as part of the 2003 Water Quality Management Program report.

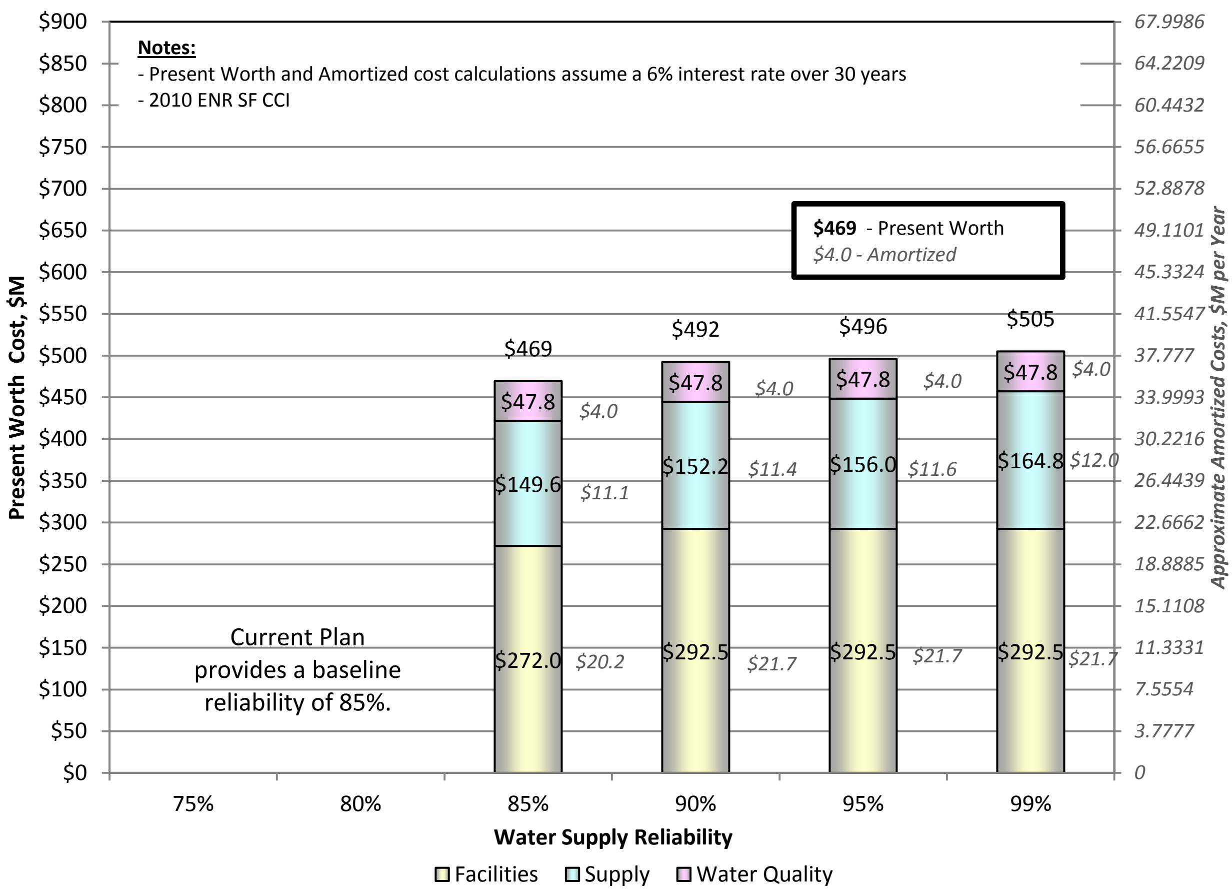
- Construction Management: 10 percent

Appendix D contains a more detailed description of the cost estimates used and preliminary schedules developed for each scenario that were used to develop present worth and amortized values.

7.7.1 Observations Regarding the Cost of Reliability

As shown on Figure 7-18, the facility costs increase between 85% and 90% reliability due to the construction of the Chain of Lakes pipeline. Supply costs increase proportionally depending on the amount of spot market water required. Water quality costs are the same because all of the scenarios assume the need to construct a second demineralization facility. Overall, there is a less than 10% increase portfolio costs when comparing an 85 and 99% reliability target.

Figure 7-18. Cost of Reliability for the Current Plan



8. POTENTIAL BACKUP SUPPLY SOURCES IF CURRENT PLAN CHANGES

When Zone 7 Water Agency (Zone 7) staff began evaluating the reliability of Zone 7's water supply system and develop a plan for addressing near-term risks, one of the first key tasks was development of a list of potential supply options for enhancing Zone 7's system. In particular, the options represent potential ways in which Zone 7 can continue to provide a reliable supply of water if the Current Plan, as described in Section 6, radically changes.

In 2009, Zone 7 began the task by developing a draft comprehensive list meant to capture a range of ideas—from the obvious to the unlikely—then solicited review and input from within Zone 7. This step helped to provide additional context—both historical and current—that could be used to evaluate the potential benefits and limitations (e.g., technical feasibility, institutional barriers, etc.) of the various options. The options were then presented to the Retailers, who provided additional feedback as a group and in separate meetings. The Delta Committee of the Zone 7 Board of Directors (Board) and subsequently the entire Board were both presented with the refined list of water supply options for their input in mid-2010.

The supply options were classified into several strategies:

- *Increased yield from existing supplies* – This strategy looks at ways in which the yields from Zone 7's existing water supply sources (i.e., State Water Project, Arroyo del Valle, and Byron Bethany Irrigation District) can be increased.
- *New or additional water supplies* – This strategy looks at new sources of surface water and groundwater that can potentially be acquired through new contracts with other agencies.
- *Stormwater runoff and rainfall capture* – Options under this strategy include not only the acquisition of new water rights for local waterways at the agency level but also the implementation of rainfall capture at the user level.
- *Recycled water for Livermore-Amador Valley* – This strategy considers both the conventional use of centrally-produced recycled water and the less common reuse of wastewater at the end-user level.
- *Desalination/Demineralization* – This strategy includes the desalination or demineralization of surface water and groundwater supplies either for the direct use of Zone 7 or for the purpose of a water exchange program.
- *Operational Improvements* – Activities considered under this strategy are designed to increase the efficiency of Zone 7's water system through the reduction of losses from the system and the enhanced recharge capacity of the Main Basin.

Zone 7 staff then screened the water supply options based on potential water supply yield, the associated technical and institutional barriers, and any unique contributions any particular supply added to Zone 7's water system. The remaining options were then used to augment the Current Plan (Section 6) and create two backup portfolios (Section 9); only low-cost, low-impact options were used to augment the Current Plan. Appendix E presents a table summary of the comprehensive list of water supply options, including their yields and costs; the table also identifies those that have been included in the portfolios analyzed in this Water Supply Evaluation (Current Plan and Backup Portfolios). Options that have not been selected for inclusion in the portfolios at this time may be re-considered in future evaluations in light of new technologies, regulatory developments, etc. Details of the cost estimates and associated assumptions for the various options were previously presented in Appendix D.

Table 8-1 lists the options that were ultimately selected for the Backup Portfolios (In-Valley and Intertie Portfolios), including their average yields and amortized unit costs. Note that some of these options are also included in the Current Plan.

Descriptions of the individual options considered for the Backup Portfolios (see Table 8-2) are presented in the following pages and in Section 9, and are grouped according to strategy. The descriptive sheets include estimated yields, availability during various hydrologic conditions, costs, benefits, and limitations. They also indicate whether the option has been included in the Backup Portfolios. The average yield is the long-term average supply available over various hydrologic conditions; in some cases, the supply is only available during normal/wet years or during dry years, or the yields differ between the different hydrologic conditions. Timing indicates the projected timeframe that the supply would become available to Zone 7, after planning, design, CEQA, and construction; near-term occurs between 2011 and 2015, mid-term occurs between 2016 and 2025, and long-term occurs between 2026 and 2040. The amortized costs in dollars per acre-foot include capital, and operation and maintenance costs (expenses necessary to maintain the supply such as power and chemicals); for comparative purposes, the costs were amortized based on 6 percent interest over a 30 year term.

Note that the supply options are not all designed for implementation by Zone 7—some are implemented at the user level, as described above, and some may be implemented by the individual retailers. While capital and O&M costs have been estimated where possible, sources of funding for the various options may vary.

Table 8-1. Water Supply Options Included in the Backup Portfolios

Option	Average Yield, acre-feet annually	Amortized Cost, $/acre-foot[(a)]
Arroyo Valle – Perfection of Existing Permit	3,800	$20
Reduction of Brine Losses Mocho Demineralization Losses	260	$30
Reduction of Unaccounted-for Water	1,300	$100
Enhance Existing In-Lieu Recharge	500 to 830	$110
Arroyo Las Positas Water Rights	750	$200
Arroyo Mocho Water Rights	900	$200
Confirm BBID Yield	3,000	$285
Intertie Supply: Long-term Leases	up to 10,900	$1,400
Recycled Water – Direct	up to 3,700	$1,500
Groundwater Injection: Recycled Water	2,800	$1,600
Intertie Supply: Regional Desalination	up to 9,300	$2,000
Recycled Water - Storage	up to 17,300	$2,400

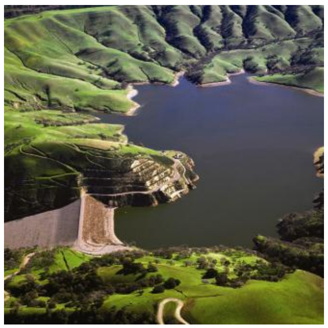
(a) Based on 2010 ENR SF CCI. Amortized costs assume a 6% interest rate for 30 years.

Table 8-2. Supply Options Considered for the Backup Portfolios

Supply Option	Page Number
Increased Yield from Existing Supplies	
Modified Operation of Lake Del Valle	116
New or Additional Supplies	
Additional Water from the State Water Project	117
Long-Term Non-State Water Project Lease or Transfer	118
Los Vaqueros Reservoir Expansion	119
Transfers via Purchase of Agricultural or M&I Land	120
Stormwater Runoff and Rainfall Capture	
Acquisition of Arroyo Las Positas Water Rights	121
Acquisition of Arroyo Mocho Water Rights	122
Acquisition of Tassajara and San Ramon Valley Creeks Water Rights	123
End-User Local Rain Capture for Irrigation	124
End-User Local Rain Capture for Recharge	125
Recycled Water for Livermore-Amador Valley	
Acquisition of Yara Yara Well	126
Agricultural Waste Stream Reuse	127
Commercial/Industrial Waste Stream Reuse	128
End-User Graywater Reuse for Residential Irrigation	129
Groundwater Injection with Highly Treated Recycled Water	130
Recycled Water – Direct and Indirect Use	131
Desalination/Demineralization	
ACWD Entitlement Exchange via Demineralization	132
Bay Area Regional Desalination Project	133
Fringe Basin Development	134
Operational Improvements	
Aquifer Storage and Recovery in the Main Basin	135
In-Stream Infiltration via Swales	136
Reduction of Cawelo and Semitropic Losses	137
Reduction of Well Start-Up Waste	138

DESCRIPTION

This option increases the amount of water that can be captured under Zone 7's existing Arroyo del Valle water right by lowering the lake an additional 5,000 acre-feet annually (AFA) during November and December when recreational use of the lake is minimal. It would require minor modifications of Lake Del Valle infrastructure and operation during the rainy season. Specifically, the level of Lake Del Valle would be lowered to 20,000 AF, instead of 25,000 AF as is currently practiced, at the beginning of the rainy season. This change will allow for increased capture of stormwater runoff between November and April. The intake for the East Bay Regional Parks District (EBRPD) would need to be lowered to allow continued access when the lake level is below 25,000 AF.



Zone 7 could increase the yield of its existing permit through modified operation of Lake Del Valle in the winter.

The water supply yield for Zone 7 was estimated based on historical flows and water right conditions for Zone 7's existing permit. The capital cost, including coordination of an institutional agreement and moving the EBRPD intake, was estimated at $500,000 to $1 million, pending participation by ACWD.

Yield:	600 AFA (average)
Availability:	Normal/wet years only
Cost ($/AF):	$140-200
Timing:	Mid-term

POTENTIAL BENEFITS	• Makes use of existing facilities and rights.
LIMITATIONS	• Requires institutional agreement with DWR, EBRPD, and ACWD. • Minimal amount of water.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time, pending success of planned water conservation and recycled water programs

DESCRIPTION

Under this option, Zone 7 would increase its contractual maximum supply from the State Water Project (SWP)—commonly referred to as the Table A amount—by purchasing a transfer from one of the other SWP contractors. The availability of this transfer depends on the willingness of other contractors to sell and the price Zone 7 is willing to pay.

Lake Oroville and Oroville Dam, keystone of the SWP. (Source: http://www.water.ca.gov/swp/)

Zone 7 analyzed historical and recent sales in the water market, resulting in an estimated capital cost of $10,000 to $12,500/ acre-foot (AF). Capital costs included a transfer fee paid to the contractor, and amounts paid to the Department of Water Resources (DWR) to cover bond surcharges, the Delta Charge, and the Transportation charge over a 30-year period. Annual O&M costs, consisting of power and chemicals, were estimated at $130/AF. The total amortized cost ranged between $840-1,050/AF.

The transfer fee on a per AF basis was adjusted to reflect the effective yield of the contract amount, which is 60% based on a long-term average projection from DWR. This is the expected long-term yield for Zone 7's existing Table A amount published in DWR's 2009 Reliability of SWP report.

Yield:	60% of transfer amount (average) 10-30% of transfer amount (dry)
Availability:	Varies with hydrologic conditions
Cost ($/AF):	$840-1,050
Timing:	Near/Mid-term

POTENTIAL BENEFITS	• Makes use of existing SBA infrastructure.
LIMITATIONS	• Subject to market conditions. • Increased dependence on the SWP system - does not diversify portfolio. • Uncertainty of the Delta Fix.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time until more is known about the potential yields of the Delta Fix.

DESCRIPTION

This option involves the purchase or long-term transfer of water from a non-State Water Project (SWP) contractor. This transaction would be similar to the contract Zone 7 holds with the Byron Bethany Irrigation District, which provides a minimum water supply of 2,000 acre-feet annually (AFA) to Zone 7 with a potential to purchase up to 5,000 AFA. This is a 20-year contract, renewable every five years up to a total of 30 years. However, unlike the water from the BBID contract, which is delivered through the South Bay Aqueduct, Zone 7 would seek water that can be delivered via a new intertie with another major agency (e.g., East Bay Municipal Utility District). This would have the added benefit of diversifying Zone 7's portfolio.

The availability of other transfers similar to the BBID contract depends on the willingness of other contractors to sell and the price Zone 7 is willing to pay. Based on discussions with other agencies, a long-term lease could cost about $200-300/AF, an amount that would be paid annually based on deliveries. There will also be wheeling costs for conveying water to Zone 7. For planning-level purposes, the wheeling costs were based on assumptions provided via participation in the Bay Area Regional Desalination Project - $600-1,000/AF. The amortized cost, not including the intertie, is estimated at $900-1,400/AF.

Yield:	Depends on contract provisions
Availability:	Depends on contract provisions
Cost ($/AF):	$900-1,400
Timing:	Near/Mid-term

POTENTIAL BENEFITS

- Makes use of a new reliability intertie.
- Potential for high-quality water wheeled to Zone 7.
- Diversified Zone 7 water supply portfolio.

LIMITATIONS

- Subject to market conditions.
- Uncertainty of supply source - particularly, in normal/wet years.
- Uncertainty of wheeling costs.

INCLUDED IN PORTFOLIO ANALYSIS?

- YES.

DESCRIPTION

Los Vaqueros Reservoir was constructed by the Contra Costa Water District (CCWD) in 1997 to allow for storage of higher-quality Delta water when it is available and to provide emergency storage.

Los Vaqueros Reservoir. (Source: http://www.ccwater.com/)

In 2010, the CCWD Board approved the expansion of the Los Vaqueros Reservoir from 100,000 to 160,000 acre-feet (AF), providing opportunities for other water agencies to use any excess capacities in the reservoir and associated conveyance facilities (e.g., intake pumps in the Delta). Two such opportunities identified by CCWD involved 1) storage of environmental water for the State Water Project and the Central Valley Project by shifting pumping to CCWD's intake pumps and 2) supply reliability deliveries to the South Bay Aqueduct (SBA) Contractors, including Zone 7[82]. For the latter, stored water in the reservoir would be used to make up delivery reductions due to the Delta pumping restrictions stipulated in Biological Opinions. This water would be derived from a new water right acquired in the Delta, assuming there is unappropriated Delta water supply available.

Yield:	0-8,300 AFA
Availability:	Depends on water right limitations
Cost ($/AF):	$330-2,200
Timing:	Near/Mid-term

The potential capital costs were estimated based on a buy-in fee, and construction costs for new/expanded conveyance facilities and the expanded reservoir. For a potential 8,300 AF yield, Zone 7's capital cost were estimated to range between $32 to 212 million. Annual O&M costs were expected to range between $420,000 to $2.8 million. The lower costs represent the scenario where state and federal contractors participate and share the costs, along with the SBA contractors.

POTENTIAL BENEFITS	• Makes use of shared facilities.
LIMITATIONS	• The 8,300 AF is based on the assumption that unappropriated Delta Water rights exist - this is not likely true.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time - this option does not appear to provide additional supply.

[82] For more details, see CDM, 2009. Delta Water Supply Reliability Report. May.

DESCRIPTION

Under this option, new water supplies are acquired through the purchase of agricultural and/or municipal/industrial land. Associated water rights and/or contracts would be transferred as part of the purchase.

Significant institutional, legal, and political barriers would likely prevent implementing this supply option. Most irrigation districts and cities would likely oppose any such activities. Consequently, these options were not evaluated as part of this analysis.

Yield:	Depends on contract provisions
Availability:	Depends on contract provisions
Cost ($/AF):	Not analyzed
Timing:	Near/Mid-term

POTENTIAL BENEFITS	• Depending on source and delivery mechanism, can potentially diversify water supply portfolio.
LIMITATIONS	• Significant institutional and political barriers.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time due to potenitally insurrmountable institutional and political barriers.

DESCRIPTION

This supply would involve the acquisition of a new water right permit on the Arroyo Las Positas to put water to beneficial use. This supply would require the completion of the diversion structure at Arroyo Las Positas, a project recommended under the StreamWISE Program[83] for flood control purposes; the structure would allow the diversion of water to the Chain of Lakes for detention storage.

Based on available data from the Arroyo Las Positas Near El Charro gage station[84], annual estimated inflows range between 1,400 to 26,000 AF. Assuming that 12.5 to 25% of the total inflow is potentially available for diversion after accounting for existing water rights and environmental needs, Zone 7 estimates an average annual yield between 750 to 1,500 AF, with a dry year yield less than 200 AF. This yield already accounts for poor water quality during low flows (i.e., less than 100 cfs).

The total estimated capital cost for acquiring a new water right on the Arroyo Las Positas is $1.6 million, including permit application fees, environmental analysis, and legal costs. The diversion structure was not included in the capital cost since its primary purpose will be flood control, independent of any water right acquisition. The annual O&M cost is estimated at $12,000. If a decision is made to pursue an Arroyo Las Positas water right – after additional feasibility studies – then the process for acquiring a new water right could take 10 to 15 years; for evaluation purposes as part of the backup portfolios, a new water right was assumed available in 2025.

Yield:	750-1,500 AFA (average) <200 AFA (dry)
Availability:	Depends on hydrologic conditions
Cost ($/AF):	$100-200
Timing:	Mid-term

POTENTIAL BENEFITS	• Local supply. • Portfolio diversification. • Reduces reliance on the Delta.
LIMITATIONS	• Ability to obtain water rights - significant study is required. • Yield may be substantially lower pending prior rights and potential environmental needs.
INCLUDED IN PORTFOLIO ANALYSIS?	• Yes, but only for backup portfolios - additional study is required.

[83] StreamWISE is a suite of multi-benefit projects designed to implement the Stream Management Master Plan. This program is designed to provide flood protection as well as environmental benefits. More information can be found at: http://www.zone7water.com/streamwise/index.html.

[84] Source: Zone 7's monthly database maintained by Water Resources.

DESCRIPTION

This supply would involve the acquisition of a new water right permit on the Arroyo Mocho to put water to beneficial use. The construction of the Arroyo Mocho Diversion Structure, which is already planned to be completed in 2014 (for more details, see section 6.4.4), could allow for the perfection of any acquired water right.

Zone 7 completed a preliminary analysis of data available from the Arroyo Mocho Near Livermore and Arroyo Mocho at Hagemann gage stations[85] to estimate total monthly inflows to the Arroyo Mocho between 1913 and 2008. Estimated annual inflows range between 150 to 23,000 acre-feet (AF), with an average annual inflow of 7,000 AF. Assuming that only 12.5 to 25% of the total inflow is potentially available for diversion after accounting for existing water rights and environmental needs, Zone 7 estimates an average annual yield between 900 to 1,800 AF, with a dry year yield of less than 200 AF.

The total estimated capital cost for acquiring a new water right on the Arroyo Mocho is $1.8 million, including permit application fees, environmental analysis, and legal costs. The annual operation and maintenance (O&M) cost is estimated at $12,000. If a decision is made to pursue an Arroyo Mocho water right – after additional feasibility study – then the process for acquiring a new water right could take 10 to 15 years; for evaluation purposes as part of the backup portfolios, a new water right was assumed available in 2025.

Yield:	900-1,800 AFA (average) <200 AFA (dry)
Availability:	Depends on hydrologic conditions
Cost ($/AF):	$100-200
Timing:	Mid-term

POTENTIAL BENEFITS	• Local supply. • Portfolio diversification. • Reduces reliance on the Delta.
LIMITATIONS	• Ability to obtain water rights - significant study is required. • Yield may be substantially lower pending prior rights and potential environmental needs.
INCLUDED IN PORTFOLIO ANALYSIS?	• Yes, but only for the backup portfolios - additional study is required.

[85] Source: Zone 7's monthly database maintained by Water Resources.

DESCRIPTION

This supply would involve the acquisition of new water rights on the Tassajara Creek and San Ramon Valley Creek.

There is insufficient flow data to evaluate the potential yields of these creeks. Furthermore, limited water quality data indicate poor water quality from Tassajara Creek. Finally, these creeks are downstream of the Chain of Lakes, and there is no practical or feasible way to capture, store, and/or treat the flows from these creeks.

Due to its obvious limitations, this option was not analyzed in detail.

Yield:	Not analyzed
Availability:	Depends on hydrologic conditions
Cost ($/AF):	Not analyzed
Timing:	Not analyzed

POTENTIAL BENEFITS

- Local supply.
- Portfolio diversification.
- Reduces reliance on the Delta.

LIMITATIONS

- Tassajara Creek has poor water quality.
- No practical or feasible way to capture, store, and treat this supply.

INCLUDED IN PORTFOLIO ANALYSIS?

- Not at this time as there does not appear to be an economically feasible way to capture water.

DESCRIPTION

Under this option, residential, commercial, industrial, and institutional customers would install equipment to capture rainwater from rooftops. Drainpipes transfer rainwater collected from rooftops to storage tanks placed aboveground, as on the figure shown, or underground. Rain capture (or rainwater harvesting) is practiced all over the world; examples of industrialized countries where this practice is widespread include Australia and Germany.

Source: http://www.irainharvest.com/

The amount of water supply made available from this option depends on hydrology (i.e., rainfall) and equipment sizing. The analysis assumed an average roof size and storage of two months of available supply. Costs vary depending on the ability to retrofit existing accounts with rain capture equipment. Capital costs were estimated to range between $4,000 to $20,000 per system. Costs associated with regulatory oversight or inspection of the systems were not included. It was assumed that this supply would not provide peak day capacity because there is little to no control over customer use of captured water. There is always a minimum amount of rainfall; dry year supply is estimated based on a minimum historical rainfall of 5.2 inches.

Yield:	220-860 AFA
Availability:	All hydrologic conditions
Cost ($/AF):	$73,600-79,300
Timing:	Mid-term

POTENTIAL BENEFITS

- Direct household contribution.
- Decentralized supply: does not require Zone 7 system enhancements.
- Portfolio diversification - reduced reliance on the Delta.

LIMITATIONS

- Zone 7 does not have land-use authority.
- Potentially significant oversight costs.
- Difficulty of predicting supply impacts since users are responsible for implementation.
- High costs.

INCLUDED IN PORTFOLIO ANALYSIS?

- Not at this time due to costs and difficulty regulating end-user (cannot enforce compliance).

DESCRIPTION

This option represents encouraging low-impact development through the use of pervious surfaces to allow for improved management of stormwater and enhanced groundwater recharge, particularly in developed areas.

Supply would be generated by directing onsite stormwater to vegetated or rock swales, which are broad and shallow channels that facilitate the permeation of water into the ground. Swales can be covered primarily with vegetation, or with rocks. Both can act as a pre-filter for runoff.

Drain rock is used to prevent erosion of this vegetated swale at Zone 7 Water Agency's office building – drain rock can also enhance recharge if placed over permeable areas of the groundwater basin.

The amount of water supply potentially available from this option depends on hydrology (i.e., rainfall) and swale design. In general, costs vary depending on the swale system design. There will also be costs associated with regulatory oversight or inspection of the systems. Due to its obvious limitations, this option was not analyzed in detail; however, the cities may want to consider including this concept into land development ordinances.

Yield:	Not analyzed
Availability:	All hydrologic conditions
Cost ($/AF):	Not analyzed
Timing:	Not analyzed

POTENTIAL BENEFITS	• Local supply. • Swales can enhance landscaping. • Reduces reliance on the Delta
LIMITATIONS	• Zone 7 does not have land-use authority. • Potentially significant oversight costs. • Difficulty of predicting impacts on supply since users are responsible for implementation and maintenance.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time due to difficulty of regulating end-user (cannot enforce compliance).

DESCRIPTION

This option involves purchasing an existing well located just outside the Camp fringe sub-basin in the DSRSD service area. The well could be used to offset peak DSRSD recycled water demands for irrigation, potentially reducing storage needs. The quality of groundwater from this well is not as good as that of the groundwater in the Main Basin; therefore, this well would be more appropriate for non-potable application.

Preliminary analysis by Zone 7 staff indicates that the Yara Yara well is unlikely to sustain 0.75 MGD for long periods, given its location in the Tassajara Formation outside of the fringe basins.

The capital cost of this small well was assumed to be about $4 million with an annual O&M cost of $28,000 (based on discussions with the local water supply retailers). These costs do not include additional pipelines required to connect the well to DSRSD's recycled water system. In addition, the costs assume that the well operates at 0.75 MGD for 122 days per year (based on irrigation needs).

Yield:	280 AFA
Availability:	All hydrologic conditions
Cost ($/AF):	$1,140
Timing:	Near-term

POTENTIAL BENEFITS	• Drought-resistant supply.
LIMITATIONS	• Relatively poor water quality suitable for nonpotable applications only. • Low yield.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time due to low yield and potentially poor water quality.

DESCRIPTION

The Livermore-Amador Valley is home to a number of wineries and their vineyards, as well as other agricultural enterprises. The potential water supply savings from the reuse of process wastewater and the residual capture of stormwater runoff at the five largest vineyards in the area was evaluated.

A vineyard in Livermore. (Source: http://www.murrietaswell.com/)

Process wastewater and stormwater runoff at the five largest vineyards—with a total acreage of 1,726 acres—were estimated at 57 AFA, which is a relatively small amount of water relative to the water supply needs of the Zone 7 service area. While this water may be usefully captured and reused by individual landowners, this does not appear to be a viable supply option for Zone 7.

Yield:	<100 AFA
Availability:	All hydrologic conditions
Cost ($/AF):	Not analyzed
Timing:	Not analyzed

POTENTIAL BENEFITS

- Drought-resistant supply.

LIMITATIONS

- Minimal amount of water.
- Possible water quality issues.
- Potential constraints from the RWQCB.

INCLUDED IN PORTFOLIO ANALYSIS?

- Not at this time due to low yield.

DESCRIPTION

There are potential opportunities to reduce water consumption at commercial and industrial facilities by implementing wastewater reuse programs. Examples of such efforts include graywater application for toilet flushing and/or irrigation. However, these types of improvements are likely to be implemented as part of water conservation programs, particularly in response to the Water Conservation Act of 2009. Zone 7 and the retailers all have robust conservation programs in place. Zone 7, therefore, did not investigate this option further.

Yield:	Not analyzed
Availability:	All hydrologic conditions
Cost ($/AF):	Not analyzed
Timing:	Near to long-term

POTENTIAL BENEFITS	• Drought-resistant supply.
LIMITATIONS	• Not analyzed.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time as it will likely be implemented by others.

DESCRIPTION

Over 2009-2010, the California Plumbing Code[86] was modified to facilitate the reuse of graywater by residences for outdoor use, primarily irrigation. Under this option, water from washing machines, sinks, showers, and/or bathtubs would be collected, filtered, and applied to lawns or gardens for irrigation. Permit requirements vary depending on the source of the graywater; for example, use of graywater from washing machines would not require a permit.

A garden irrigated with graywater. (Source: http://greywateraction.org/)

A key goal for graywater reuse is the reduction in the demand for potable water. The "yield" or, more appropriately, demand reduction from this option depends on whether graywater reuse systems are installed only in new developments or in existing residences as well. Installation of such systems would occur over time. The capital cost of a graywater system consisting of a pump, pipelines, and a filter is estimated at $2,500 per unit, with an O&M cost of $375 annually.

[86] Title 24, Part 5, Section 16A: "Nonpotable Water Reuse Systems"

Yield:	1,200 to 5,400 AFA
Availability:	All hydrologic conditions
Cost ($/AF):	$3,700-6,600
Timing:	Near to long-term

The impact of irrigating with graywater on groundwater quality in the Main Basin is an important consideration and would need to be evaluated.

POTENTIAL BENEFITS

- Direct household contribution.
- Decentralized supply: does not require Zone 7 system enhancements.
- Diversifies supply portfolio.
- Reduces reliance on the Delta.

LIMITATIONS

- Difficulty of predicting impacts on supply since users are responsible for implementation and maintenance.
- Potential water quality impacts to the Main Basin.
- High cost.

INCLUDED IN PORTFOLIO ANALYSIS?

- Not at this time due to cost and difficulty enforcing end-user compliance.

DESCRIPTION

This program would inject up to 2.5 MGD (2,800 AFA) of recycled water that has been treated using reverse osmosis (RO) technology. Recycled water provides significant reliability since it is a drought-resistant supply; furthermore, the RO process produces water with extremely low total dissolved solids content, which would benefit salt management of the Main Basin.

Reverse Osmosis membranes – similar to those at Zone 7's Mocho Demineralization Facility – would provide highly treated recycled water for injection into the Main

Capital costs range between $34 and $40 million, depending on the level of effort required to rehabilitate an existing RO unit, cost to purchase secondary effluent, and participation by the City of Livermore. They include rehabilitation of an existing RO unit, a new pipeline for Zone 7's Demineralization Facility, and a new injection well. Annual maintenance is estimated at $1.4 million.

Yield:	2,800 AFA
Availability:	All hydrologic conditions
Cost ($/AF):	$1,500-1,600
Timing:	Near/mid-term

POTENTIAL BENEFITS

- Drought-resistant supply.
- Use of existing equipment.
- Potentially improves salt loading in the Main Basin.
- Reduces reliance on the Delta.

LIMITATIONS

- Potential for strong public opposition.

INCLUDED IN PORTFOLIO ANALYSIS?

- YES.

DESCRIPTION

Yield:	2,600 to 16,000 AFA – depends on demand – additional analysis required.
Availability:	All hydrologic conditions
Cost ($/AF):	$1,500-$2,400
Timing:	Near to long-term

By 2030, the City of Livermore and the Dublin San Ramon Services District (DSRSD) expect a total demand of 5,900 AFA for recycled water in their service areas. In response to the Water Conservation Act of 2009, Zone 7 expects that an additional 2,000 AFA will be used in the service area by 2020 to reduce potable water use.

Use of recycled water for irrigation. (Source: http://www.derwa.org/)

Under this option, additional recycled water for irrigation—beyond the amounts listed above—is used to further reduce potable water demands. One of the challenges with recycled water use for irrigation is that wastewater—and therefore recycled water—is generally produced evenly throughout the year, while irrigation demand usually peaks in the warmer months; storage facilities would address this discrepancy. Where recycled water can be applied is another important issue that needs to be addressed. Given its salt content, it can potentially have a significant impact on salt loading in the Main Basin, which may require mitigation. Recycled water may also contain other contaminants of concern.

Capital and O&M costs were estimated for various scenarios and varied widely depending on the amounts of recycled water produced and the need for storage under indirect use. However, the amortized costs were consistent and ranged between $1,500 to $2,400 per AF. This cost range does not include any salt impact mitigation. Detailed studies examining demands, use patterns, storage options and costs, contaminants in recycled water, and potential salt loading impacts to the Main Basin will need to be completed to determine the feasible amounts of additional recycled water use in the Livermore-Amador Valley.

POTENTIAL BENEFITS	• Local supply. • Diversifies supply portfolio. • Recharges the Main Basin. • Reduces reliance on the Delta.
LIMITATIONS	• Groundwater salt loading and contaminant impacts. • Limited by demand and/or space for storage facilities. • Potable demand reductions requires additional study.
INCLUDED IN PORTFOLIO ANALYSIS?	• Yes, see "In-Valley" Portfolio.

DESCRIPTION

This water supply option includes construction of a Phase 3 Desalination Facility by Zone 7 for the Alameda County Water District (ACWD). In exchange, Zone 7 would receive a water supply along the South Bay Aqueduct (i.e, State Water Project Table A water) at 80% of yield.

The capital cost is estimated at $80 million and the annual O&M costs are estimated at $6 million.

Yield:	4,100 AFA
Availability:	All hydrologic conditions
Cost ($/AF):	$2,900
Timing:	Mid-term

POTENTIAL BENEFITS

- Potential diversification of Zone 7 water supply portfolio.

LIMITATIONS

- Initial conversations with ACWD indicate the potential yield may be much smaller, if anything.
- Cost estimates are likely too low.

INCLUDED IN PORTFOLIO ANALYSIS?

- YES, however, other options appear more cost effective.

DESCRIPTION

Since 2003, the Bay Area's four largest water agencies—Contra Costa Water District (CCWD), East Bay Municipal Utility District (EBMUD), San Francisco Public Utilities Commission (SFPUC), and Santa Clara Valley Water District (SCVWD)—have been working together to evaluate the feasibility of a regional desalination facility to improve water supply reliability for the more than five million people served by these agencies.

In May 2010, Zone 7 officially joined the BARDP. As a partner in the BARDP, Zone 7 is evaluating the feasibility of receiving up to 5,600 AFA under all hydrologic conditions, or only during normal/wet years. For Zone 7, desalinated water offers the significant benefits of providing a drought-resistant supply and diversifying Zone 7's water supply portfolio, both of which increase Zone 7's system reliability.

At this time, the most likely location for a desalination plant is in eastern Contra Costa County, where CCWD has existing water rights and other water rights may be available for purchase. The desalination plant can potentially produce up to 20 MGD of desalinated water (10,000 to 25,000 AFA), depending on the water rights obtained. Desalinated water would have to be wheeled through EBMUD for delivery to Zone 7 via a new intertie. The BARDP partners are planning to have something online by 2020.

Yield:	5,600 AFA (normal/wet) 1,500-5,600 AFA (dry)
Availability:	All hydrologic conditions
Cost ($/AF):	$1,400-2,000
Timing:	Mid-term

Zone 7's share of the capital cost is estimated at $42 million (does not include the intertie), with annual O&M costs estimated at $2.6-4.4 million depending on the amount of water that Zone 7 receives. Wheeling costs through EBMUD will be refined as part of a hydraulic modeling study to be undertaken starting in mid-2011; the current estimate of $600 to $1,000 /AF is included in the amortized cost listed above.

POTENTIAL BENEFITS	• Drought-resistant supply. • Diversifies supply portfolio. • High-quality water supply. • Makes use of new intertie.
LIMITATIONS	• Potentially highly variable costs due to the need for wheeling through another system. • Ability to obtain the necessary water rights for the BARDP.
INCLUDED IN PORTFOLIO ANALYSIS?	• Yes, as a potential source of supply for the Intertie Portfolio.

DESCRIPTION

As part of this option, Zone 7 would construct new wells in the fringe basins of the Livermore Valley Groundwater Basin; fring basins are generally lower yielding poorer quality portions of the basin.

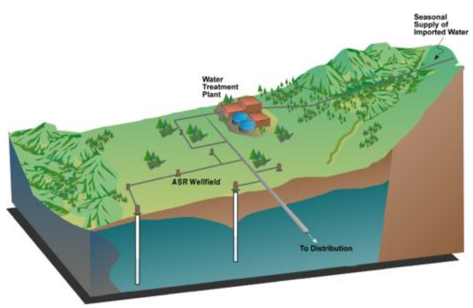
Based on existing data, Zone 7 believes that the potential yields from the fringe basins, including Mocho Sub-Basin I, are extremely low and that any groundwater pumped would likely require demineralization. A significant amount of additional study would be required to more accurately establish potential yields and costs.

Yield:	Not analyzed
Availability:	All hydrologic conditions
Cost ($/AF):	Not analyzed
Timing:	Not analyzed

POTENTIAL BENEFITS	• Local supply. • Reduced salt loading in the Main Basin.
LIMITATIONS	• Likely very low yields. • Likely requires demineralization, which will increase costs.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time due to low yields and potentially poor water quality.

DESCRIPTION

Zone 7's ability to conjunctively use the local groundwater basin can potentially be enhanced through the injection and storage of surface water and its subsequent recovery. This option, called Aquifer Storage and Recovery (ASR), re-evaluates previous ASR efforts by Zone 7, and is a possible back-up option in case recharge within the Chain of Lakes turns out to be limited.



Starting in 1997, Zone 7 retrofitted Hopyard Well 6 for ASR use. Between 1997 and 2000, a total of 3,200 AF was injected into the well to pilot-test ASR operations. Clogging problems resulted in lost production capacity (a 50% decrease) and the eventual shutdown of ASR operations. Possible causes of clogging include: air binding by entrained air bubbles, bacterial growth in and near the well screen, suspended solids in the injection water, and chemical reactions between the injected water and native groundwater and/or aquifer matrix[87].

The capital cost is estimated at $2.4 million with an estimated O&M cost of $600,000. These costs reflect the additional analysis (e.g., bench testing) required to address the clogging issues observed during the previous attempt to implement an ASR program. The costs only include the retrofit of Chain of Lakes wells 1 and 2 for use as injection wells.

Yield:	3,000 AFA of additional recharge in the Main Basin (normal/wet years)
Availability:	Normal/wet years only
Cost ($/AF):	$260/AF of additional storage
Timing:	Mid-term

POTENTIAL BENEFITS	• Makes use of existing facilities. • Increased availability of local storage.
LIMITATIONS	• Potentially recurring technical issues related to well clogging. • Does not provide additional supply. • Potentially the same benefits as the Chain of Lakes operations.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time due to like benefit already planned as part of the Chain of Lakes.

[87] CH2M Hill, 2000. ASR Test Results for the Hopyard 6 Well.

DESCRIPTION

Under this option, Zone 7's ability to recharge imported surface water through the Arroyo Mocho is enhanced through the construction of swales, which are broad and shallow channels that facilitate the permeation of water into the ground. Ponds would be constructed to increase the head on the streams and increase recharge; these ponds could be constructed to also facilitate environmental needs. This option represents a back-up option in case recharge in the Chain of Lakes turns out to have lower capacity than expected. The option is limited to Arroyo Mocho because a cursory review of available areas to construct eliminated Arroyo del Valle as a potential project.

Based on the construction of swales at two "example" sites (Madeiros Parkway and Robertson Park), as described in the StreamWISE Program[88], the capital cost is estimated at $7.8 million with O&M cost estimated at $1.6 million annually.

Yield:	830 AFA of additional recharge in the Main Basin (normal/wet years)
Availability:	Normal/wet years only
Cost ($/AF):	$2,600/AF of additional storage
Timing:	Mid-term

POTENTIAL BENEFITS	• Increased availability of local storage. • Improved reliability.
LIMITATIONS	• Does not provide additional supply. • Potentially the same benefits as the Chain of Lakes projects.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time due to like benefit already planned as part of the Chain of Lakes.

[88] StreamWISE is a suite of multi-benefit projects designed to implement the Stream Management Master Plan. This program is designed to provide flood protection as well as environmental benefits. More information can be found at: http://www.zone7water.com/streamwise/index.html.

DESCRIPTION

Groundwater banking facilities at Semitropic Water Storage District. (Source: http://www.semitropic.com/Facilities.htm)

The losses associated with the use of Zone 7's non-local groundwater banks in Kern County District and Cawelo Water District) are specified in contracts. Storage in Semitropic Water Storage District (Semitropic) is associated with a ten percent loss while fifty percent of the water placed into storage in Cawelo Water District is lost as compensation to Cawelo Water District. The institutional and political hurdles to reducing the water losses specified in the contracts are significant, and likely insurmountable. This is particularly true in the case of Semitropic, where the contract involves many different parties.

Yield:	Not analyzed
Availability:	All hydrologic conditions
Cost ($/AF):	Not analyzed
Timing:	Not analyzed

POTENTIAL BENEFITS	• Makes use of existing supplies.
LIMITATIONS	• Significant institutional/political barriers.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time due to potentially insurmountable institutional and political barriers.

DESCRIPTION

During well start-up, the initial groundwater pumped is directed to waste. An estimate of the potential water supply savings from the capture of water discharged to waste during the startup of existing groundwater wells indicates that the savings are within the rounding error of future water supply needs (e.g., < 100 AF). For example, data from 2006 to 2008 indicate a total average annual waste of 34 AF.

While more efficient operation of Zone 7 facilities will continue to be a goal, this option was not analyzed in detail due to the minimal yield expected.

Yield:	<100 AF
Availability:	All hydrologic conditions
Cost ($/AF):	Not analyzed
Timing:	Not analyzed

POTENTIAL BENEFITS	• Local supply. • No new infrastructure needed.
LIMITATIONS	• Low yield.
INCLUDED IN PORTFOLIO ANALYSIS?	• Not at this time due to low yield.

9. DESCRIPTION OF BACKUP PORTFOLIOS

This section describes the Backup Portfolios evaluated as potential alternatives to the Current Plan: the In-Valley Portfolio and the Intertie Portfolio. These portfolios were developed with input from the Retailers.

9.1 IN-VALLEY PORTFOLIO

Recognizing the complexity of challenges facing the Delta, and the uncertainty of the future reliability of the water supplies from the State Water Project (SWP) as discussed in Section 6.1, it is necessary to consider an alternative that reduces reliance on the Delta. This alternative is the In-Valley Portfolio, an alternative that focuses on supplies locally available in the Livermore-Amador Valley. The key difference in portfolio components between the In-Valley Portfolio and the Current Plan described in Section 6 is the assumption that the long-term Delta Fix does not happen or does not fully restore lost yield. Increased use of recycled water and the development of additional local water rights fill in the supply deficit. Figure 9-1 shows the alternative supply and demand mix under the In-Valley Portfolio.

Figure 9-1. Projected Supply and Demand Mix: In-Valley Portfolio

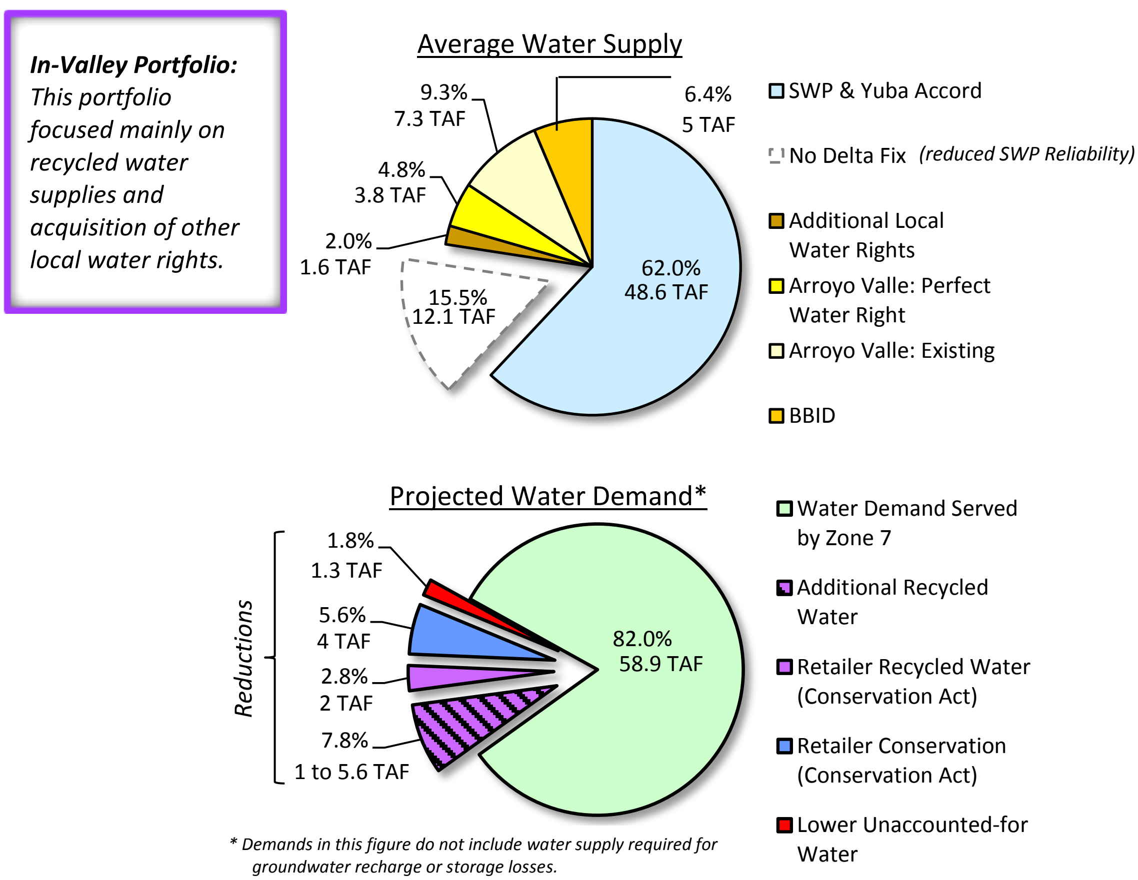


Table 9-1 lists the full set of components included in the In-Valley Portfolio, broken down by water supplies, water facilities, and water quality. As indicated in Table 9-1, a number of the components are already being implemented under the Current Plan and are therefore already described in Section 6. The other components are described in the following sections.

Table 9-1. Components of the In-Valley Portfolio

Type	Component	Included in Current Plan (see Section 6)
Water Supplies	*Potable Demand Reductions*	*Yes*
	Maximization of Supply from BBID Contract	*Yes*
	Reduction of Unaccounted-for-Water	*Yes*
	Reduction of Brine Losses	*Yes*
	Enhanced In-Lieu Recharge Program	*Yes*
	Arroyo del Valle: Perfection of Existing Permit	*Yes*
	Arroyo Mocho Water Rights	**No**
	Arroyo Las Positas Water Rights	**No**
	Additional Recycled Water – Direct Use	**No**
	Additional Recycled Water - Storage	**No**
Facility Improvements	*Increased Surface Water Treatment Capacity*	*Yes*
	Increased Groundwater Pumping Capacity	*Yes*
	Increased Transmission System Capacity	*Yes*
	Arroyo Mocho Diversion Structure	*Yes*
	Arroyo del Valle Diversion Structure	*Yes*
	Reliability Intertie	*Yes*
Water Quality	*Phase 2 Demineralization Facility*	*Yes*

9.1.1 Arroyo Mocho Water Rights

This supply would involve the acquisition of a new water right on the Arroyo Mocho. The construction of the Arroyo Mocho Diversion Structure, which is planned to be completed in 2014[89], could allow for the perfection of any permitted water right.

[89] For more details, see section 6.4.4.

Zone 7 analyzed available data from the Arroyo Mocho Near Livermore and Arroyo Mocho at Hagemann gage stations[90] to estimate total monthly inflows to the Arroyo Mocho between 1913 and 2008. Estimated annual inflows range between 150 acre-feet (AF) in 1924 and 23,000 AF in 1916, with an average annual inflow of 7,000 AF. Assuming that 12.5 to 25% of the total inflow is potentially available for diversion after accounting for environmental needs and prior rights, Zone 7 estimates an average annual yield between 900 to 1,800 AF, with a dry year yield less than 200 AF.[91]

The total estimated capital cost for acquiring a new water right on the Arroyo Mocho was estimated at $1.8 million, including permit application fees, environmental analysis, and legal costs. The annual operation and maintenance (O&M) cost is estimated at $12,000. Acquisition of a new water right is typically a lengthy process; for planning purposes, Zone 7 has assumed a 10-year process. Zone 7 is still investigating the need for new water rights, and if a decision is made to pursue an Arroyo Mocho water right beginning in 2014, a new water right may be available starting in 2025.

9.1.2 Arroyo Las Positas Water Rights

This supply would involve the acquisition of a new water right on the Arroyo Las Positas. Use of this supply may require the completion of the diversion structure at Arroyo Las Positas, a project recommended in the Stream Management Master Plan for flood protection purposes. The structure would allow the diversion of water from Arroyo Las Positas to the Chain of Lakes for detention storage to be returned to the arroyo once storm flows subside.

Zone 7 analyzed available data from the Arroyo Las Positas Near El Charro gage station to estimate total monthly inflows between 1913 and 2008. Because there is limited data available from this station, Zone 7 used rainfall correlation to fill in the inflow data gaps.

Natural runoff from the Alkali Sink and inflow from the groundwater basin diminish the water quality in the Arroyo Las Positas during low flows. The total dissolved solids (TDS) concentration of groundwater near the Chain of Lakes typically range between 500 to 1,000 mg/L during low flows; to minimize salt loading in the Main Basin, Zone 7 would generally only recharge with water with TDS levels below 500 mg/L. Consequently, Zone 7 also considered water quality data for the Arroyo Las Positas from October 2001 to September 2008, which indicated that TDS levels can be elevated up to 1,500 mg/L at flows less than 100 cubic feet per second (cfs); at above 100 cfs, TDS decrease to less than 500 mg/L[92]. If a water right is acquired for the Arroyo Las Positas, diversion may be limited to periods of flows greater than 100 cfs for salt management purposes.

Estimated annual inflows range between 1,400 AF in 1924 and 26,000 AF in 1983, with an average annual inflow of 6,000 AF. Assuming that 12.5 to 25% of the total inflow is potentially available for diversion after accounting for environmental needs and prior rights, Zone 7 estimates an average annual yield between 750 to 1,500 AF, with a dry year yield less than 200 AF.

The total estimated capital cost for acquiring a new water right on the Arroyo Las Positas is $1.6 million, including permit application fees, environmental analysis, and legal costs. The construction of the diversion structure was not included in this analysis of the capital costs since the proposed use of the structure will be for flood protection, and its construction is independent of any water right acquisition. Analysis of capital funding and final determination of the structure's use will be reevaluated once more

[90] Source: California Data Exchange Center

[91] These values are preliminary, and need much more robust analysis.

[92] TDS calculated as 0.7 x electrical conductivity (EC). EC data provided by G. Gates.

specific flood protection project needs have been defined and once key lakes of the Chain of Lakes are transferred to Zone 7 ownership. The annual O&M cost is estimated at $12,000. Similar to the Arroyo Mocho water right, if a decision is made to pursue an Arroyo Las Positas water right beginning in 2014, a new water right may be available starting in 2025.

9.1.3 Additional Recycled Water – Direct Use and With Storage

There are multiple existing and planned recycled water programs in the Livermore-Amador Valley. The City of Livermore and the Dublin San Ramon Services District (DSRSD) have been producing and serving recycled water for many years. By 2030, DSRSD and Livermore are planning for a total demand of 5,900 acre-feet annually (AFA), accounting for the projected development and growth in recycled water infrastructure in their service areas. Section 6.2 describes the demand reductions required under the Water Conservation Bill of 2009, and Zone 7's assumption that one-third of this demand reduction—approximately 2,000 AFA—will be met through the implementation of additional recycled water projects.

In-Valley Portfolio: focusing on local water supply sources.

In the In-Valley Portfolio, additional recycled water—beyond the programs and demands described above—is used to further reduce potable water demands in order to meet the required system reliability. Potential wastewater sources are DSRSD and the cities of Pleasanton and Livermore[93]. Appendix G provides a summary of the analysis used to estimate the amounts of recycled water supply available in the Livermore-Amador Valley.

9.2 INTERTIE PORTFOLIO

The key feature of the Intertie Portfolio is that it focuses on new water supplies entering Zone 7's water transmission system through an intertie with another agency. For example, water supply can be delivered via an intertie with the East Bay Municipal Utility District (EBMUD) system in the western portion of Zone 7's service area. The feasibility investigation of a reliability intertie with EBMUD, which is part of the Current Plan and described in Section 6.4.6, will consider the use of this intertie for this purpose.

Zone 7 staff is still working with EBMUD and San Francisco Public Utilities Commission (SFPUC)to better define potential benefits and roles in a new intertie project. The Bay Area Regional Desalination Project (BARDP)[94] could potentially make use of a new intertie. Secondary to the BARDP, shared use of the Freeport Regional Water Project, when excess capacity exists, is a potential opportunity for Zone 7 created by an intertie with EBMUD.

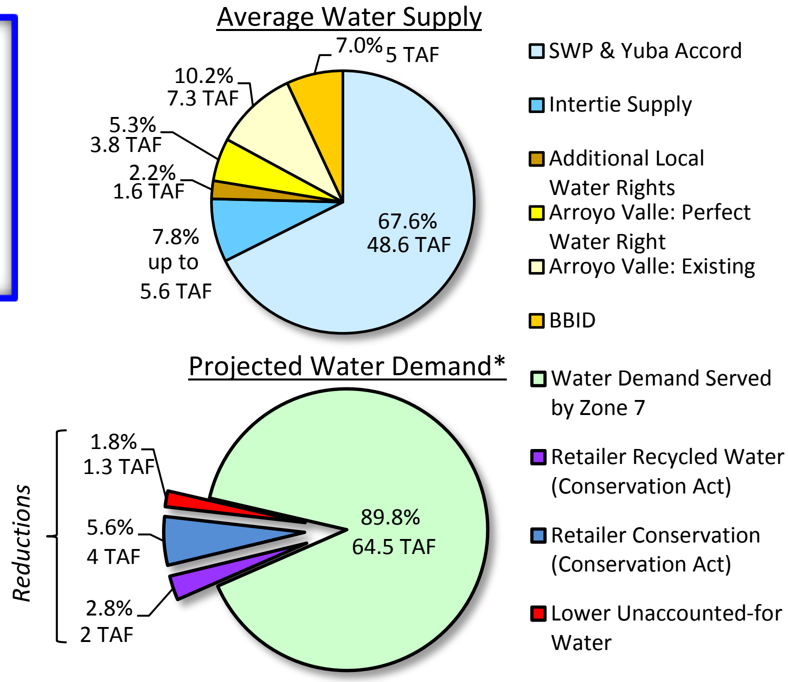
A significant potential benefit of this portfolio is that it represents a more diverse water supply portfolio, with reduced dependence on the Delta and the SWP facilities, and consequently increased reliability. Figure 9-2 shows the alternative supply and demand mix under the Intertie Portfolio.

[93] Cal Water's service area is located within the City of Livermore, where wastewater is collected by the City.

[94] Discussed in Section 9.2.

Figure 9-2. Projected Supply and Demand Mix: Intertie Portfolio

Intertie Portfolio: *This portfolio focused mainly on the lowest unit cost and highest quality water supplies.*



** Demands in this figure do not include water supply required for groundwater recharge or storage losses.*

Table 9-2 lists the full set of components included in the Intertie Portfolio, broken down by water supplies, water facilities, and water quality. As indicated in Table 9-2, a number of the components are already being implemented under the Current Plan and are therefore already described in Section 6. The other components are described in the following sections.

Table 9-2. Components of the Intertie Portfolio

Type	Component	Included in Current Plan (see Section 6)
Water Supplies	*Potable Demand Reductions*	*Yes*
	Maximization of Supply from BBID Contract	*Yes*
	Reduction of Unaccounted-for-Water	*Yes*
	Reduction of Brine Losses	*Yes*
	Enhanced In-Lieu Recharge Program	*Yes*
	Arroyo del Valle: Perfection of Existing Permit	*Yes*
	Arroyo Mocho Water Rights	**No**
	Arroyo Las Positas Water Rights	**No**
	Intertie Supply	**No**
Facility Improvements	*Increased Surface Water Treatment Capacity*	*Yes*
	Increased Groundwater Pumping Capacity	*Yes*
	Increased Transmission System Capacity	*Yes*
	Arroyo Mocho Diversion Structure	*Yes*
	Arroyo del Valle Diversion Structure	*Yes*
	Reliability Intertie	*Yes*
	Chain of Lakes Pipeline	*Yes*
Water Quality	*Phase 2 Demineralization Facility*	*Yes*

9.2.1 Arroyo Mocho Water Rights

The acquisition of a new water right for the Arroyo Mocho is also part of the In-Valley portfolio and is therefore described previously in Section 9.1.1.

9.2.2 Arroyo Las Positas Water Rights

The acquisition of a new water right for the Arroyo Las Positas is also part of the In-Valley portfolio and is therefore described previously in Section 9.1.2.

9.2.3 Intertie Supply

Zone 7 has identified a couple of potential options for obtaining new water supply that can be wheeled through a new EBMUD intertie: a regional desalination project or permanent water transfer/long-term lease. Zone 7 will continue to investigate other possible sources of supply that can similarly be delivered via an intertie with another agency.

9.2.3.1 Bay Area Regional Desalination Project

Since 2003, the Bay Area's four largest water agencies—Contra Costa Water District (CCWD), East Bay Municipal Utility District (EBMUD), San Francisco Public Utilities Commission (SFPUC), and Santa Clara Valley Water District (SCVWD)—have been working together to evaluate the feasibility of a regional desalination facility to improve water supply reliability for the more than five million people served by these agencies. The project, called the Bay Area Regional Desalination Project (BARDP), has the following benefits[95]:

- minimize potential adverse environmental impacts associated with the construction of separate desalination plants in close proximity to one another and construction of other new facilities;
- provide substantial cost savings through economies of scale, such as pooling resources and sharing of project administration, as compared to individual projects conducted separately by the agencies;
- promote a strong regional cooperation concept by joint ownership, operation, and management of a regional desalination facility that will serve the needs of multiple water providers in northern California;
- provide water during emergencies such as earthquakes or levee failures;
- provide a supplemental water supply source during extended droughts; and
- allow major facilities, such as treatment plants, water pipelines, and pump stations, to be taken out of service for maintenance or repairs.

In May 2010, Zone 7 officially joined the BARDP. As a partner in the BARDP, Zone 7 is evaluating the feasibility of receiving up to 5,600 AF every year, or only during normal/wet years, depending on Zone 7's needs and those of the other BARDP partners. For Zone 7, desalinated water offers the significant benefits of providing a drought-resistant supply and diversifying Zone 7's water supply portfolio, both of which increase Zone 7's system reliability.

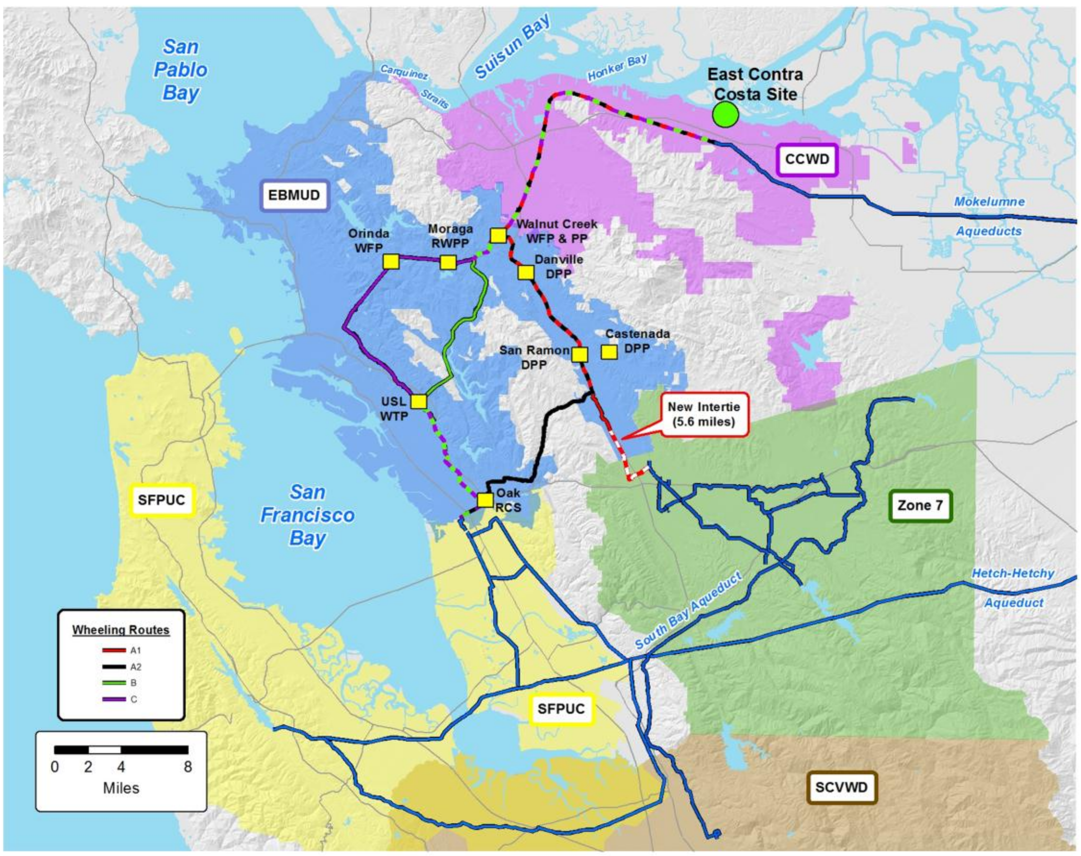
At this time, the most likely location for a desalination plant is in East Contra Costa, where CCWD has existing water rights. The desalination plant can potentially produce up to an average 20 million gallons per day of desalinated water, depending on the water rights obtained for the BARDP. Desalinated water would have to be wheeled through EBMUD's distribution system for delivery to Zone 7, as well as to

[95] MWH, 2010. Bay Area Regional Desalination Project: Pilot Testing at Mallard Slough – Pilot Plant Engineering Report.

SFPUC and SCVWD, as illustrated on Figure 9-3. A new intertie would therefore play a critical role in a desalinated water supply for Zone 7, as described above.

The BARDP partners are planning to adopt a Memorandum of Agreement in mid-2011 that describes future site-specific studies intended to address the BARDP's potential environmental impacts, costs, and water production and delivery capacities. A public outreach effort will also be undertaken to begin addressing stakeholder concerns. The costs of these studies will be shared equally amongst the partners. The studies and the outreach will provide additional valuable information on evaluating the BARDP's feasibility.

Figure 9-3. Potential Wheeling Routes for Desalinated Water Produced by the BARDP at an East Contra Costa site.



9.2.3.2 Permanent Water Transfers or Long-Term Lease

Zone 7 is investigating possible opportunities for permanent water transfers or long-term leases from a non-State Water Project (SWP) contractor. This transaction would be similar to the contract Zone 7 holds with the Byron Bethany Irrigation District, which is a 20-year contract, renewable every five years up to a total of 30 years[96]. However, unlike the water from the BBID contract, which is delivered through

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[96] See Section 4.1.2 for more details.

the South Bay Aqueduct, Zone 7 would seek water that can be delivered via a new intertie with another major agency as described above. This would have the added benefit of diversifying Zone 7's portfolio.

Costs associated with such a transfer or lease will likely include a payment upon contract execution, annual costs based on water delivery amounts, and wheeling costs similarly based on delivery amounts. In general, the availability of other transfers similar to the BBID contract depends on the willingness of other contractors to sell and the price Zone 7 is willing to pay.

10. EVALUATION OF BACKUP PORTFOLIO: IN-VALLEY

The purpose of this section is to present the analysis and results of using the probability-based water supply model to determine the reliability provided by the In-Valley Portfolio. As discussed in Section 9-1, the In-Valley Portfolio assumed that Zone 7 Water Agency (Zone 7) is able to work with the local water supply retailers to develop significant recycled water supplies beyond those already planned and assumed in this WSE for meeting the Water Conservation Act of 2009 (Conservation Act). The In-Valley Portfolio also assumed that Zone 7 successfully reduces its unaccounted-for water, reduces brine losses, increases the minimum yield from its contract with BBID, and enhances the existing in-lieu recharge program.

The following subsections present the results:

- 10.1 Reliability for the In-Valley Portfolio: 75 to 99%
- 10.2 Observations Regarding the Amount of Potable Water Demand Reduction
- 10.3 Facilities Evaluation for the In-Valley Portfolio
- 10.4 Salt Management Evaluation for the In-Valley Portfolio
- 10.5 Observations Regarding Delivered Water Quality
- 10.6 Cost Estimates for the In-Valley Portfolio: 75 to 99%

10.1 RELIABILITY FOR THE IN-VALLEY PORTFOLIO: 75 TO 99%

Zone 7 staff evaluated the ability of the water supplies and facilities included in the In-Valley Portfolio to prevent water supply shortages, while maintaining drought and emergency storage at a sustainable level. For this evaluation, Zone 7 staff first reviewed the risk of potential water supply shortages and corresponding reliability, and then reviewed the sustainability of system-wide storage, which included the Main Basin, Semitropic Water Storage District (Semitropic), Cawelo Water District (Cawelo), State Water Project (SWP) Carryover, and the Chain of Lakes.[97] Additionally, per discussions with the water supply retailers, Zone 7 did not evaluate reliabilities less than 75%. Each is discussed in more detail below.

10.1.1 <u>Reliability of the In-Valley Portfolio: 75%</u>

Under this scenario, shortages are kept equal to or below 25% of projected water demands through the development of an additional 1,000 acre-feet (AF)[98] of recycled water supply by 2025 (Figure 10-1).[99] In addition to achieving 75% reliability, this scenario also results in no shortages 94% of the time (Figure 10-2) and sustainable system-wide storage (Figure 10-3).

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[97] Key individual storage results were included in Appendix F.

[98] This is 1,000 AF more than the amount of recycled water already planned by water supply retailers (5,900 AF) and recycled water assumed developed to help meet the Conservation Act (2,000 AF), or a total of 8,900 AF of recycled water use in the Livermore-Amador Valley.

[99] Note that a 5-year ramp-up period was assumed to account for potential recycled water demand located far from treatment facilities (e.g., a park at the far end of a retailer distribution system).

Figure 10-1. Risk of Potential Shortages for the In-Valley Portfolio: 75%

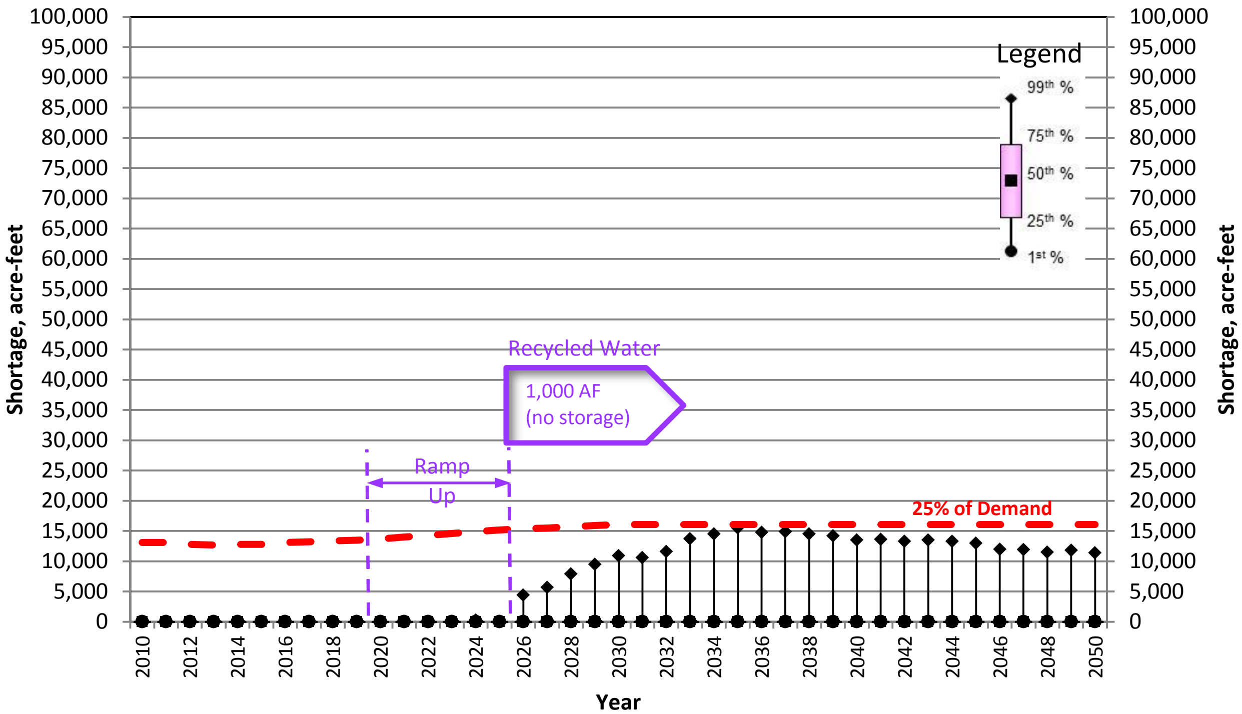


Figure 10-2. Reliability Curve for the In-Valley Portfolio: 75%

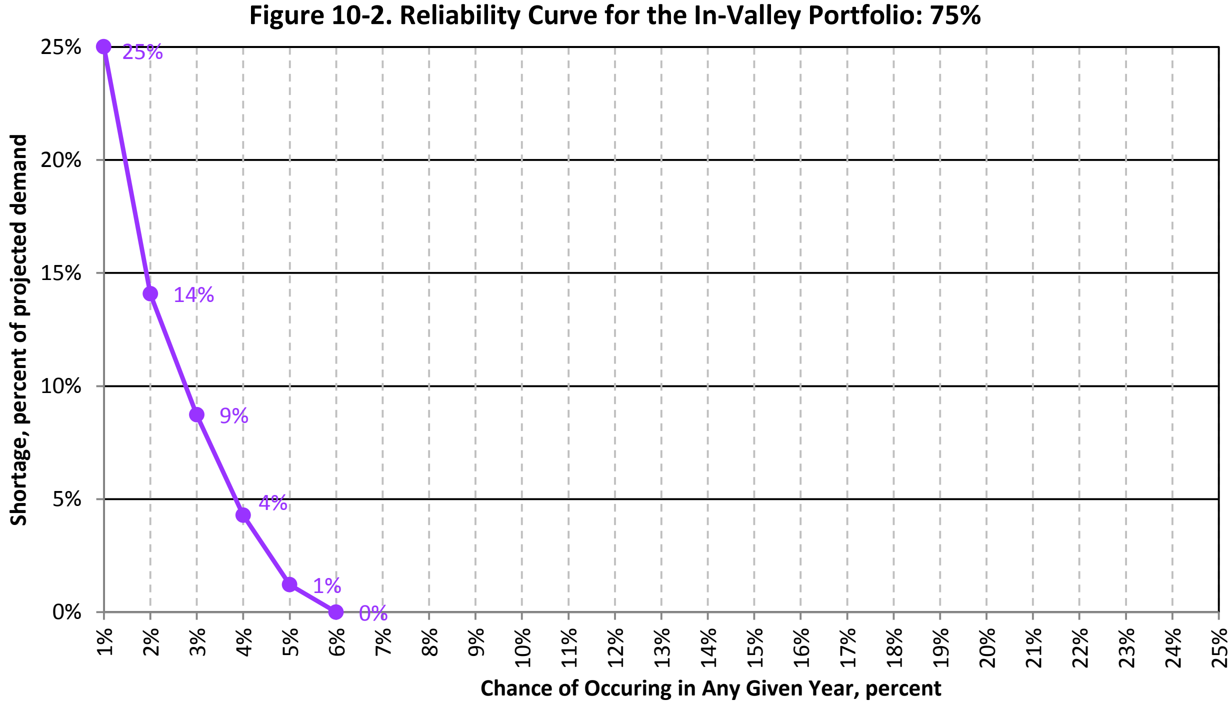
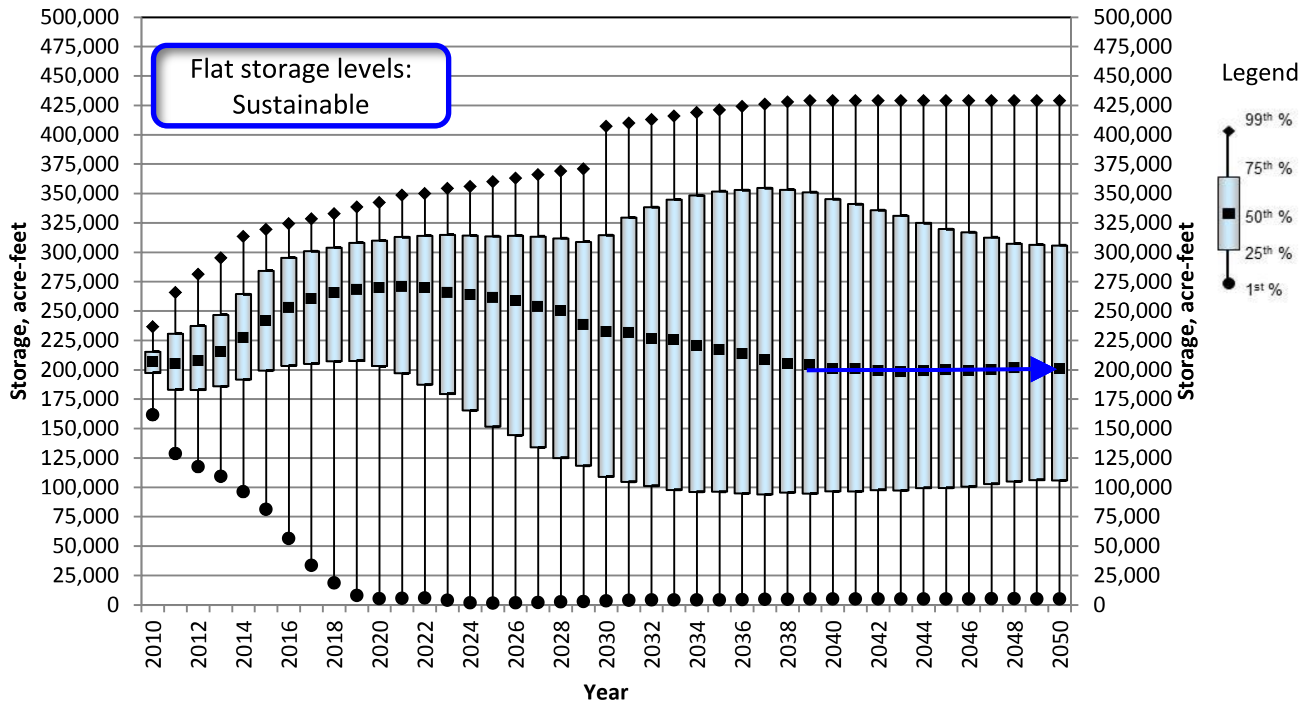


Figure 10-3. Sustainability of the In-Valley Portfolio at a Reliability of 75%



10.1.2 <u>Reliability of the In-Valley Portfolio: 80%</u>

Under this scenario, shortages are kept equal to or below 20% of projected water demands through the development of an additional 1,800 AF[100] of recycled water supply by 2025 (Figure 10-4).[101] In addition to achieving 80% reliability, this scenario also results in no shortages 95% of the time (Figure 10-5) and sustainable system-wide storage (Figure 10-6).

[100] This is 1,800 AF more than the amount of recycled water already planned by water supply retailers (5,900 AF) and recycled water assumed developed to help meet the Conservation Act (2,000 AF), or a total of 9,700 AF of recycled water use in the Livermore-Amador Valley.

[101] Note that a 5-year ramp-up period was assumed to account for potential recycled water demand located far from treatment facilities (e.g., a park at the far end of a retailer distribution system).

Figure 10-4. Risk of Potential Shortages for the In-Valley Portfolio: 80%

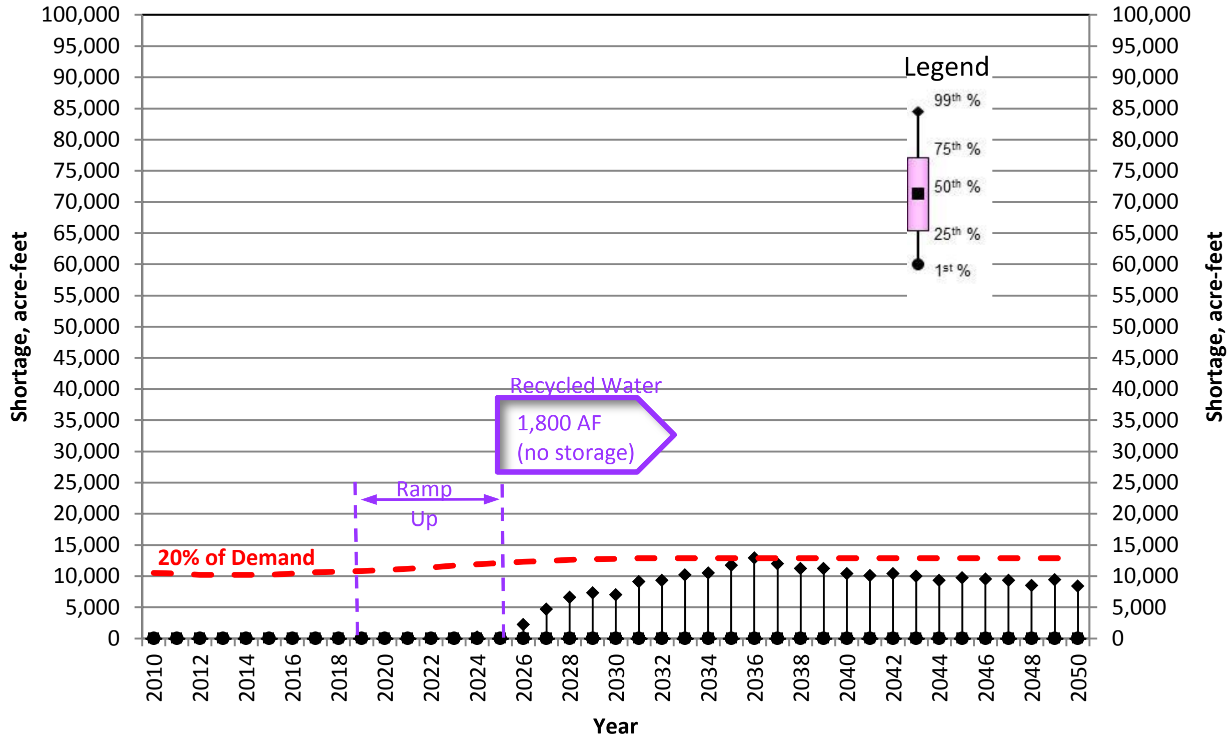


Figure 10-5. Reliability Curve for the In-Valley Portfolio: 80%

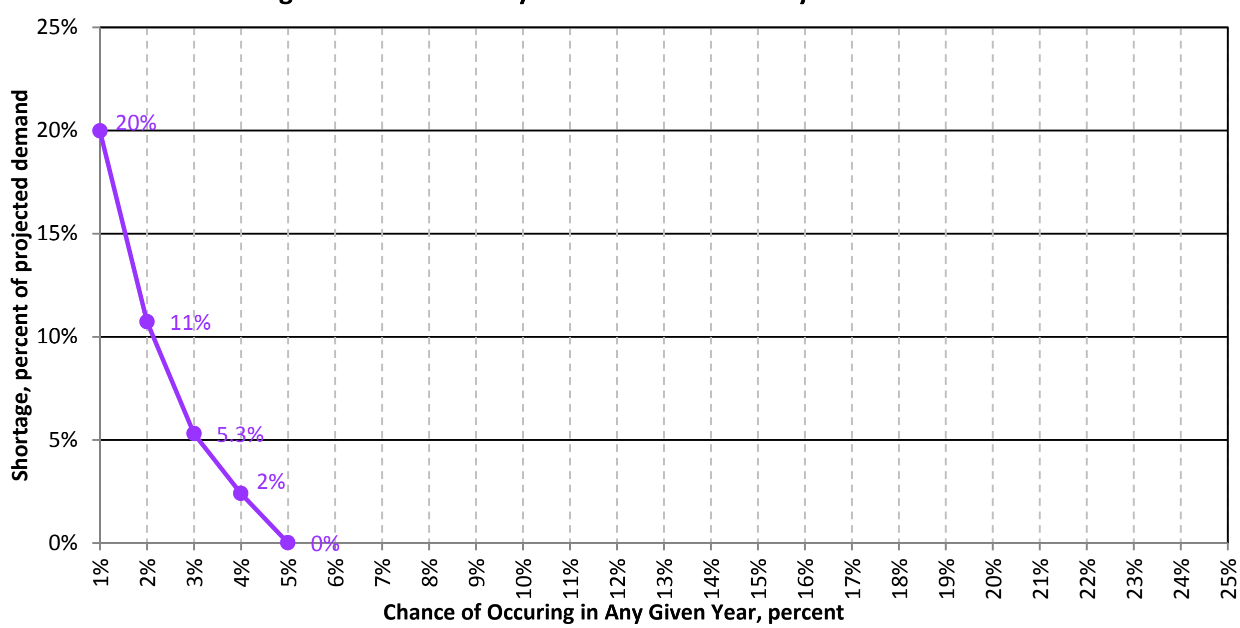
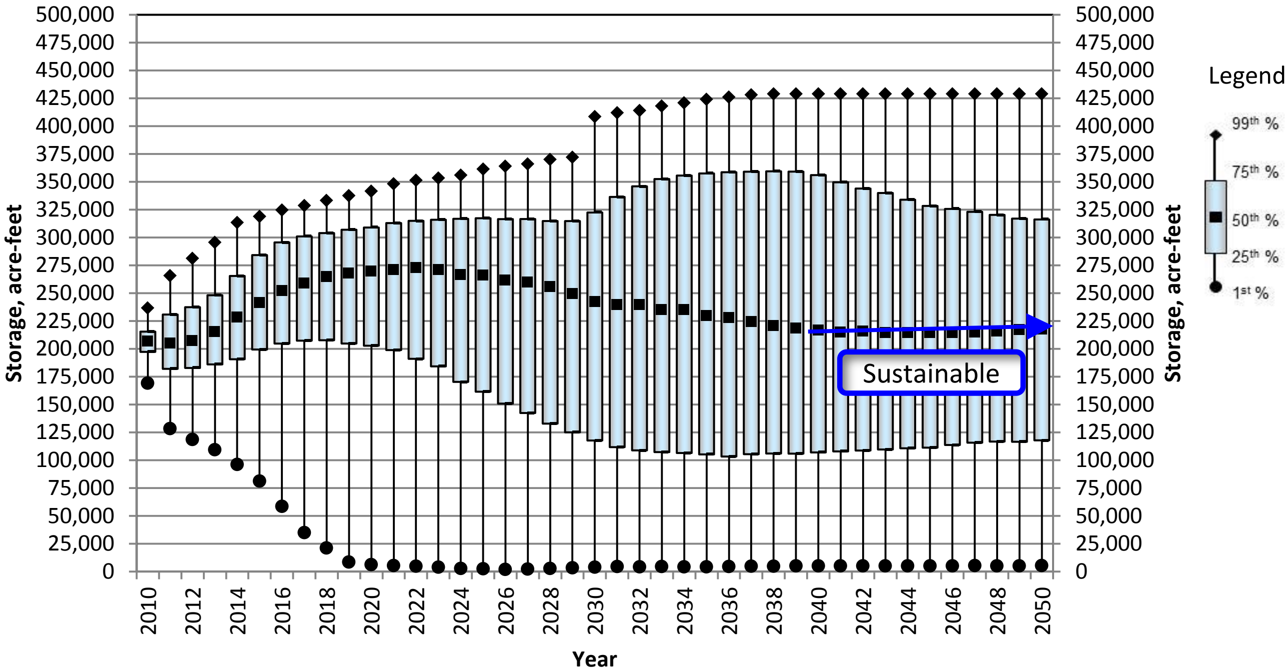


Figure 10-6. Sustainability of the In-Valley Portfolio at a Reliability of 80%



10.1.3 Reliability of the In-Valley Portfolio: 85%

Under this scenario, shortages are kept equal to or below 15% of projected water demands through the development of an additional 2,200 AF[102] of recycled water supply by 2025 (Figure 10-7).[103] In addition to achieving 85% reliability, this scenario also results in no shortages 95% of the time (Figure 10-8) and sustainable system-wide storage (Figure 10-9).

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[102] This is 2,200 AF more than the amount of recycled water already planned by water supply retailers (5,900 AF) and recycled water assumed developed to help meet the Conservation Act (2,000 AF), or a total of 10,100 AF of recycled water use in the Livermore-Amador Valley.

[103] Note that a 5-year ramp-up period was assumed to account for potential recycled water demand located far from treatment facilities (e.g., a park at the far end of a retailer distribution system).

Figure 10-7. Risk of Potential Shortages for the In-Valley Portfolio: 85%

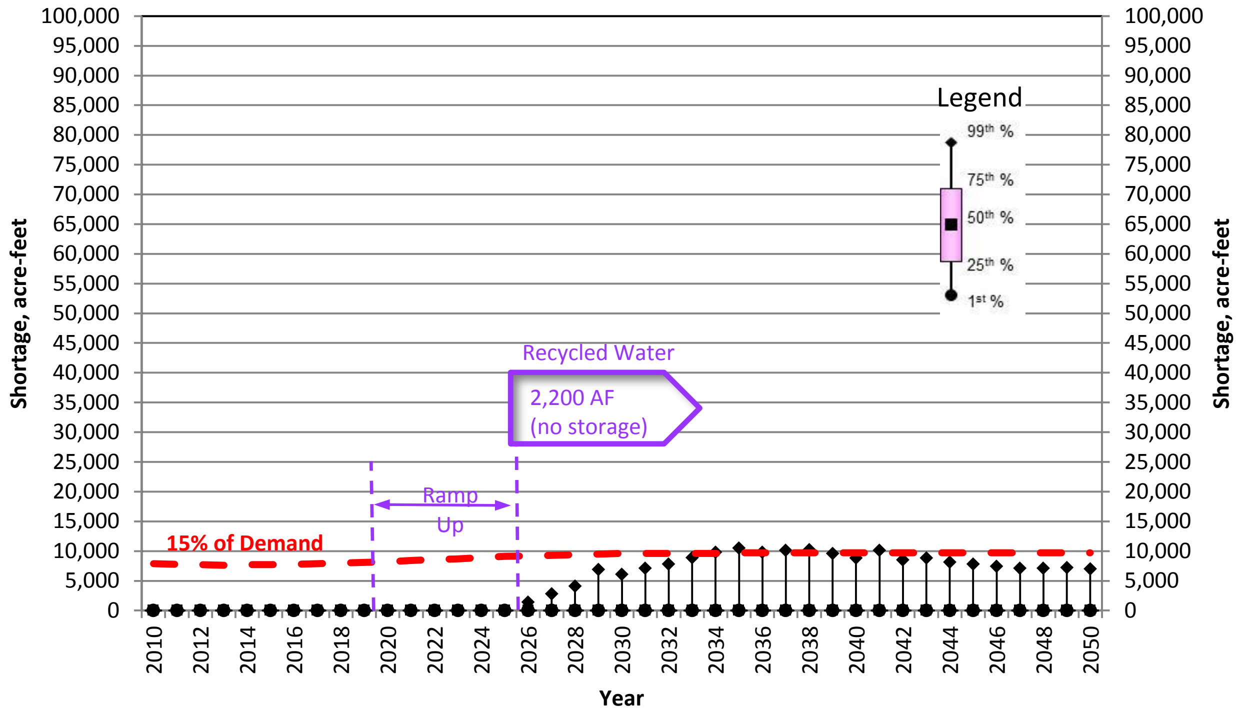


Figure 10-8. Reliability Curve for the In-Valley Portfolio: 85%

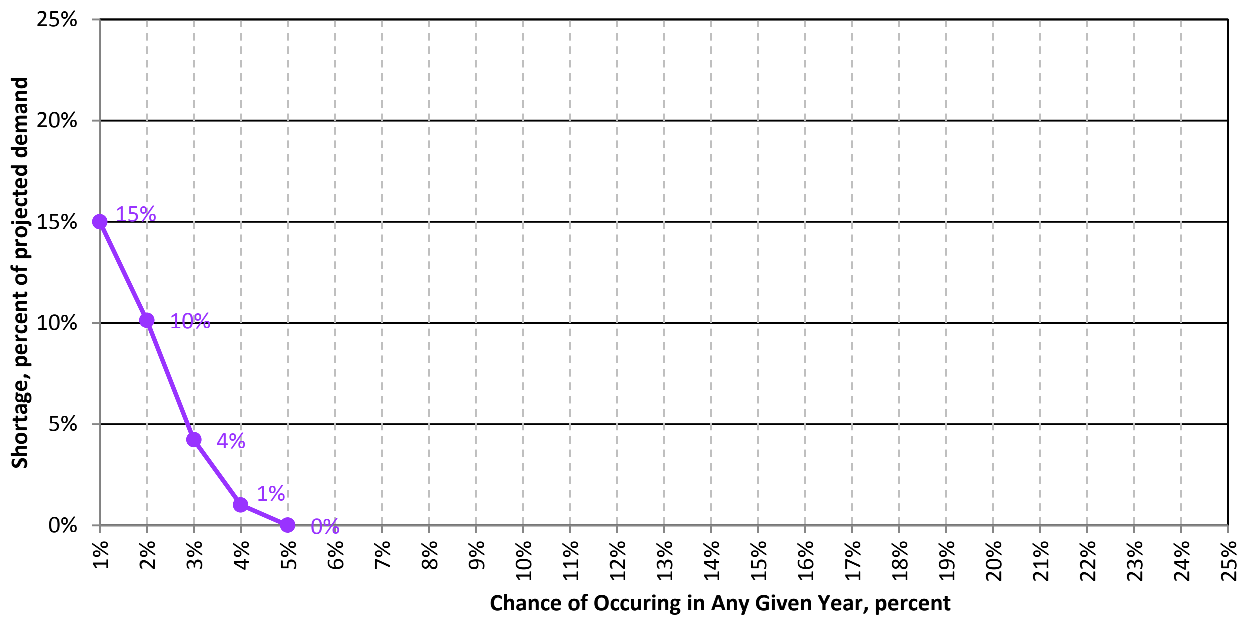
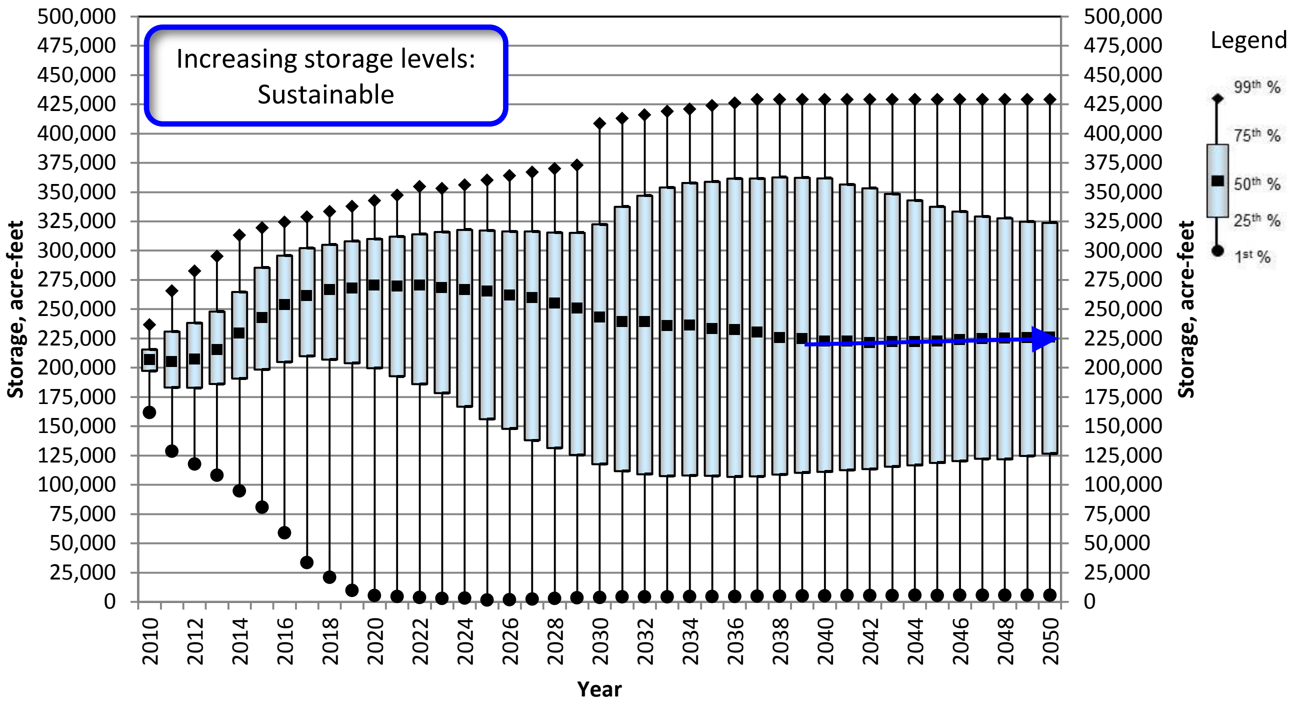


Figure 10-9. Sustainability of the In-Valley Portfolio at a Reliability of 85%



10.1.4 Reliability of the In-Valley Portfolio: 90%

Under this scenario, shortages are kept equal to or below 10% of projected water demands through the development of an additional 3,200 AF[104] of recycled water supply by 2025 (Figure 10-10).[105] In addition to achieving 90% reliability, this scenario also results in no shortages 96% of the time (Figure 10-11) and sustainable system-wide storage (Figure 10-12).

[104] This is 3,200 AF more than the amount of recycled water already planned by water supply retailers (5,900 AF) and recycled water assumed developed to help meet the Conservation Act (2,000 AF), or a total of 11,100 AF of recycled water use in the Livermore-Amador Valley.

[105] Note that a 5-year ramp-up period was assumed to account for potential recycled water demand located far from treatment facilities (e.g., a park at the far end of a retailer distribution system).

Figure 10-10. Risk of Potential Shortages for the In-Valley Portfolio: 90%

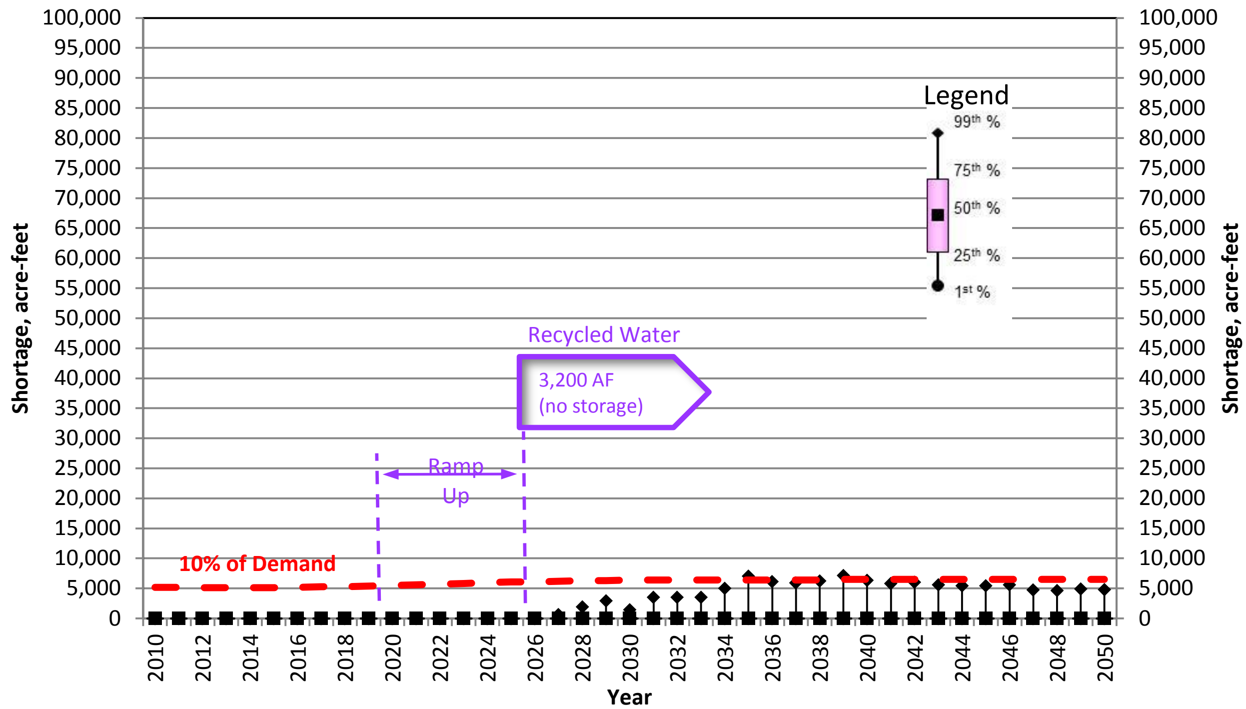


Figure 10-11. Reliability Curve for the In-Valley Portfolio: 90%

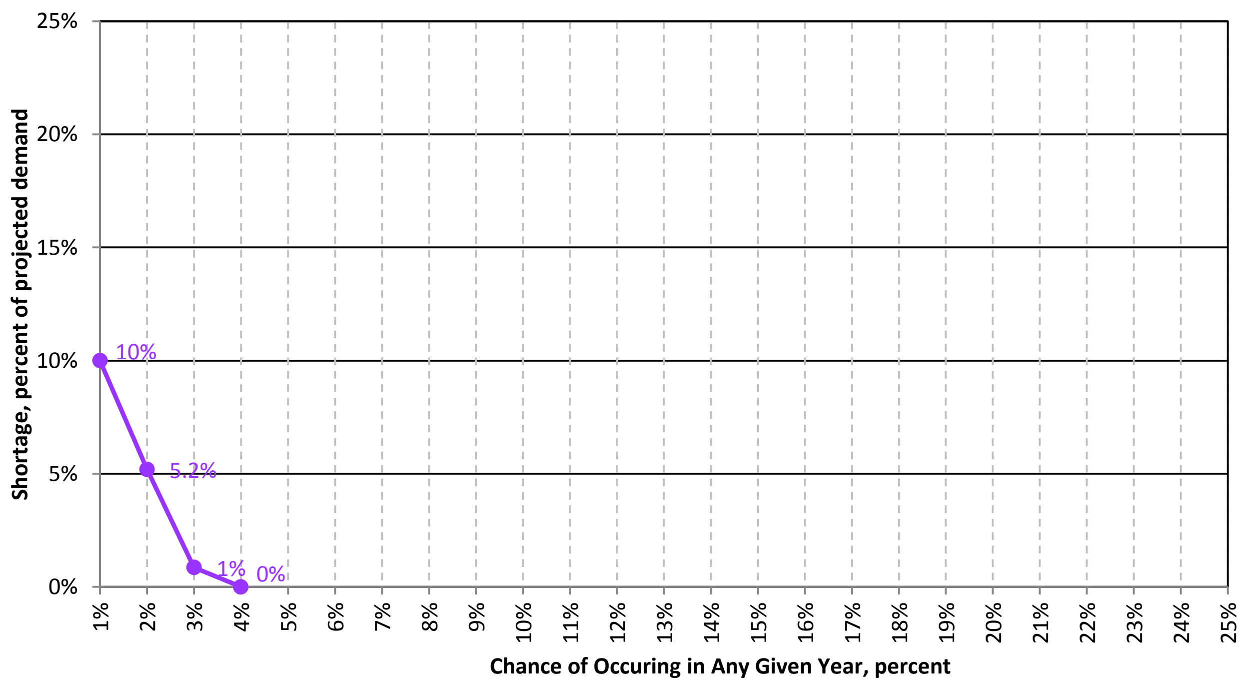
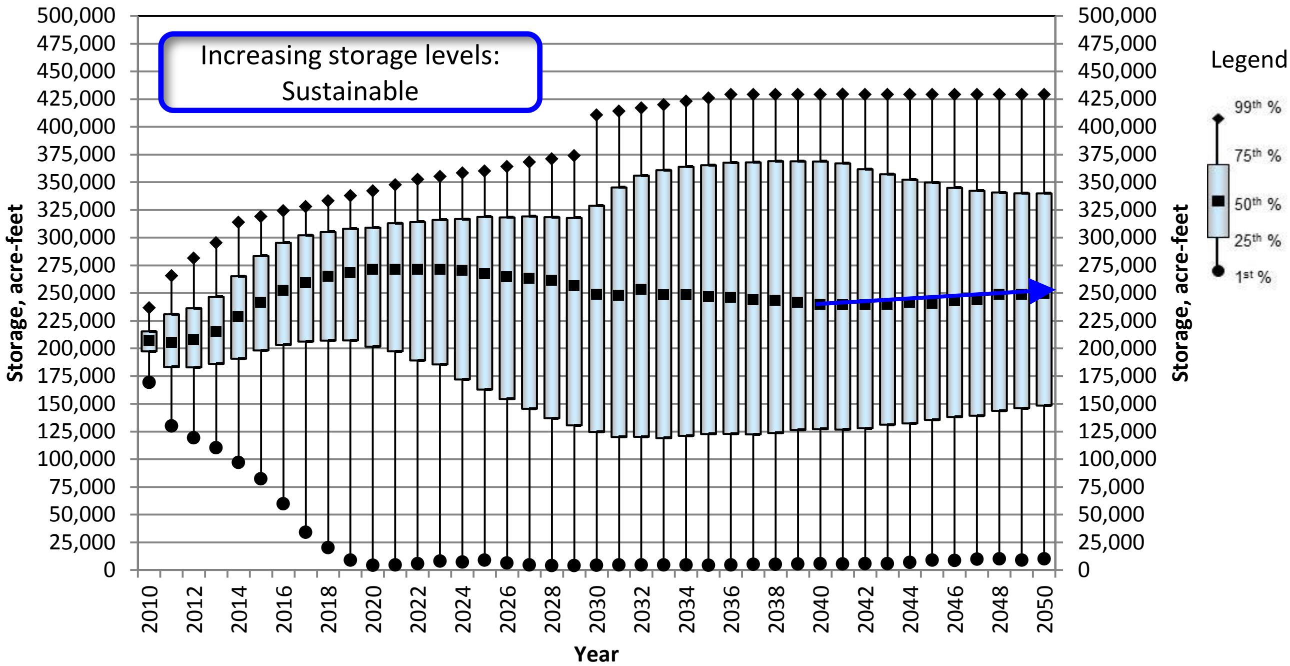


Figure 10-12. Sustainability of the In-Valley Portfolio at a Reliability of 90%



10.1.5 Reliability of the In-Valley Portfolio: 95%

Under this scenario, shortages are kept equal to or below 5% of projected water demands through the development of an additional 4,300 AF[106] of recycled water supply by 2025 (Figure 10-13), of which, approximately 1,100 AF[107] requires storage.[108] In addition to achieving 95% reliability, this scenario also results in no shortages 98% of the time (Figure 10-14) and sustainable system-wide storage (Figure 10-15).

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[106] This is 4,300 AF more than the amount of recycled water already planned by water supply retailers (5,900 AF) and recycled water assumed developed to help meet the Conservation Act (2,000 AF), or a total of 12,200 AF of recycled water use in the Livermore-Amador Valley.

[107] See Appendix G for more detail on recycled water storage estimates.

[108] Note that a 5-year ramp-up period was assumed to account for potential recycled water demand located far from treatment facilities (e.g., a park at the far end of a retailer distribution system).

Figure 10-13. Risk of Potential Shortages for the In-Valley Portfolio: 95%

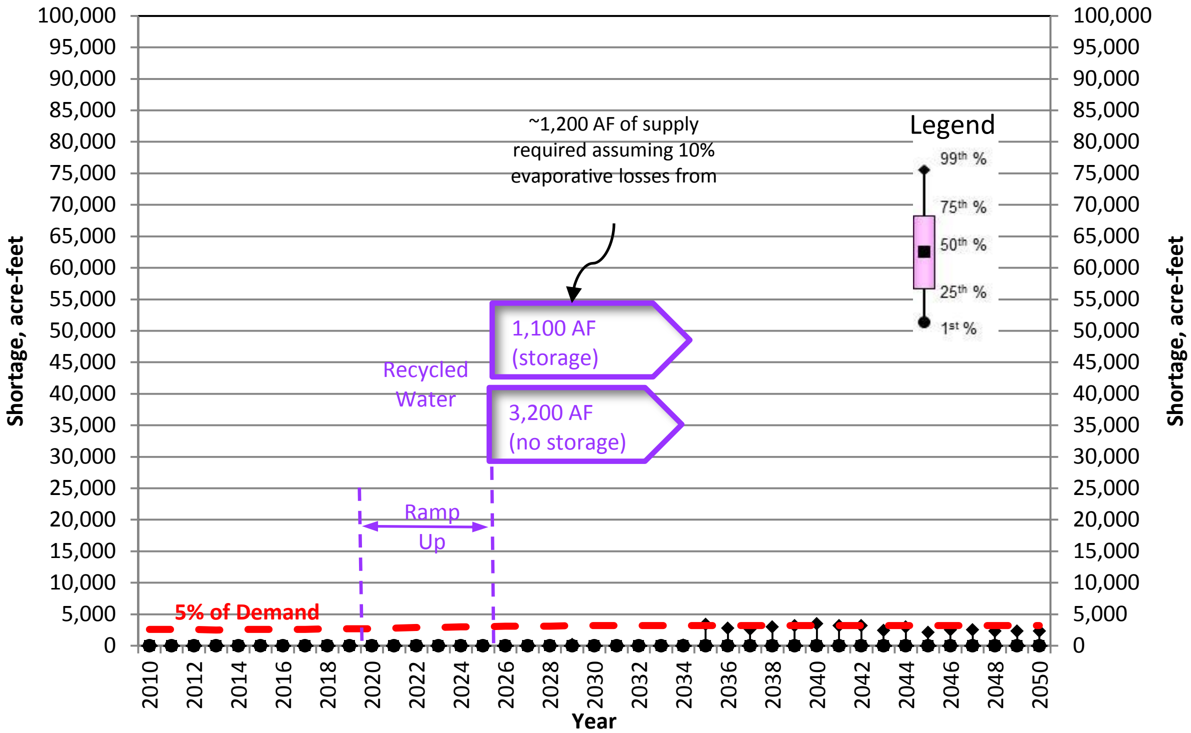


Figure 10-14. Reliability Curve for the In-Valley Portfolio: 95%

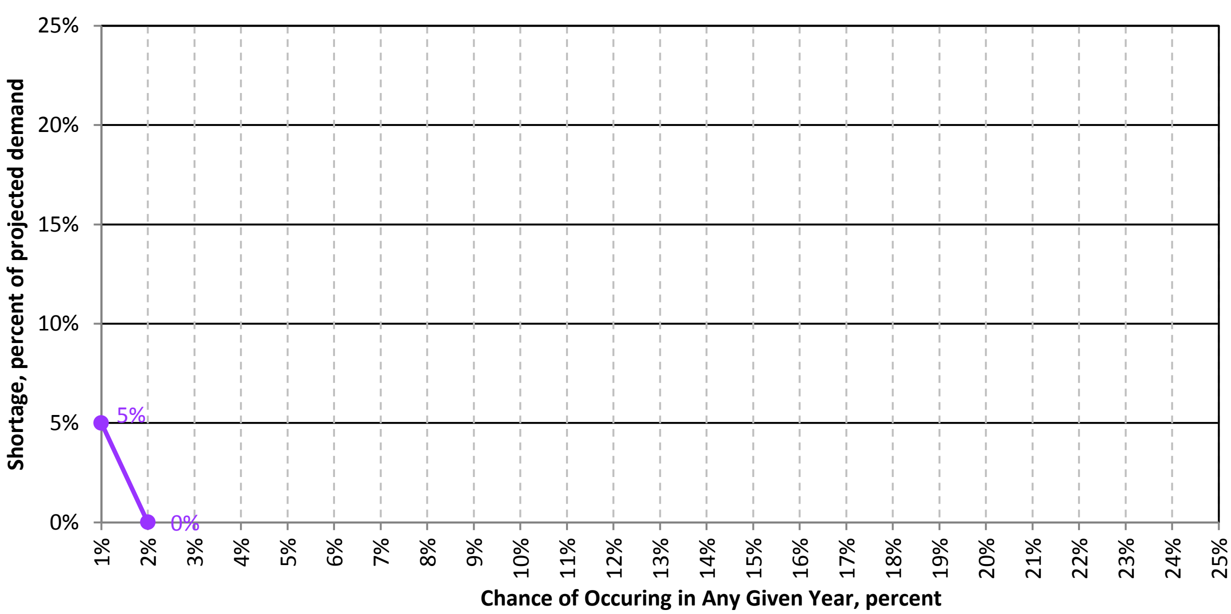
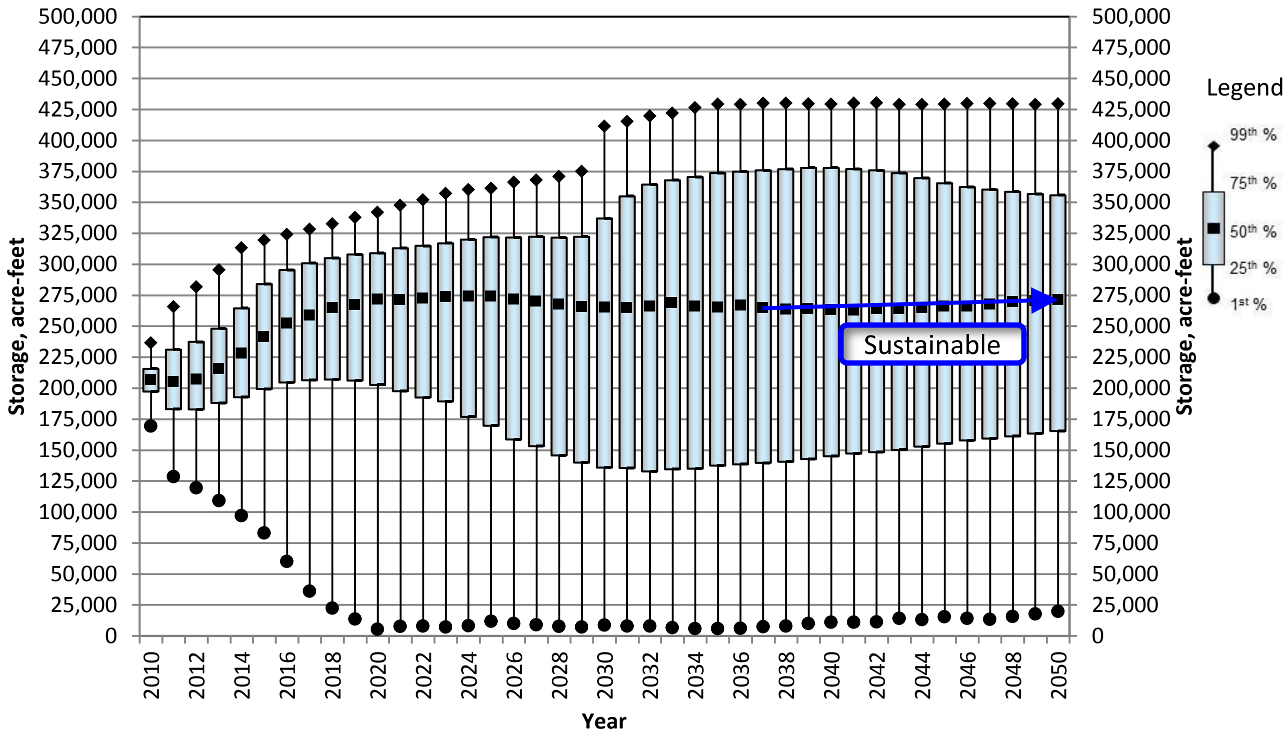


Figure 10-15. Sustainability of the In-Valley Portfolio at a Reliability of 95%



10.1.6 Reliability of the In-Valley Portfolio: 99%

Under this scenario, shortages are kept equal to or below 1% of projected water demands through the development of an additional 5,600 AF[109] of recycled water supply by 2025 (Figure 10-16), of which, approximately 2,400 AF[110] requires storage.[111] In addition to achieving 99% reliability, this scenario also results in no shortages 98% of the time (Figure 10-17) and sustainable system-wide storage (Figure 10-18).

[109] This is 5,600 AF more than the amount of recycled water already planned by water supply retailers (5,900 AF) and recycled water assumed developed to help meet the Conservation Act (2,000 AF), or a total of 13,500 AF of recycled water use in the Livermore-Amador Valley.

[110] See Appendix G for more detail on recycled water storage estimates.

[111] Note that a 5-year ramp-up period was assumed to account for potential recycled water demand located far from treatment facilities (e.g., a park at the far end of a retailer distribution system).

Figure 10-16. Risk of Potential Shortages for the In-Valley Portfolio: 99%

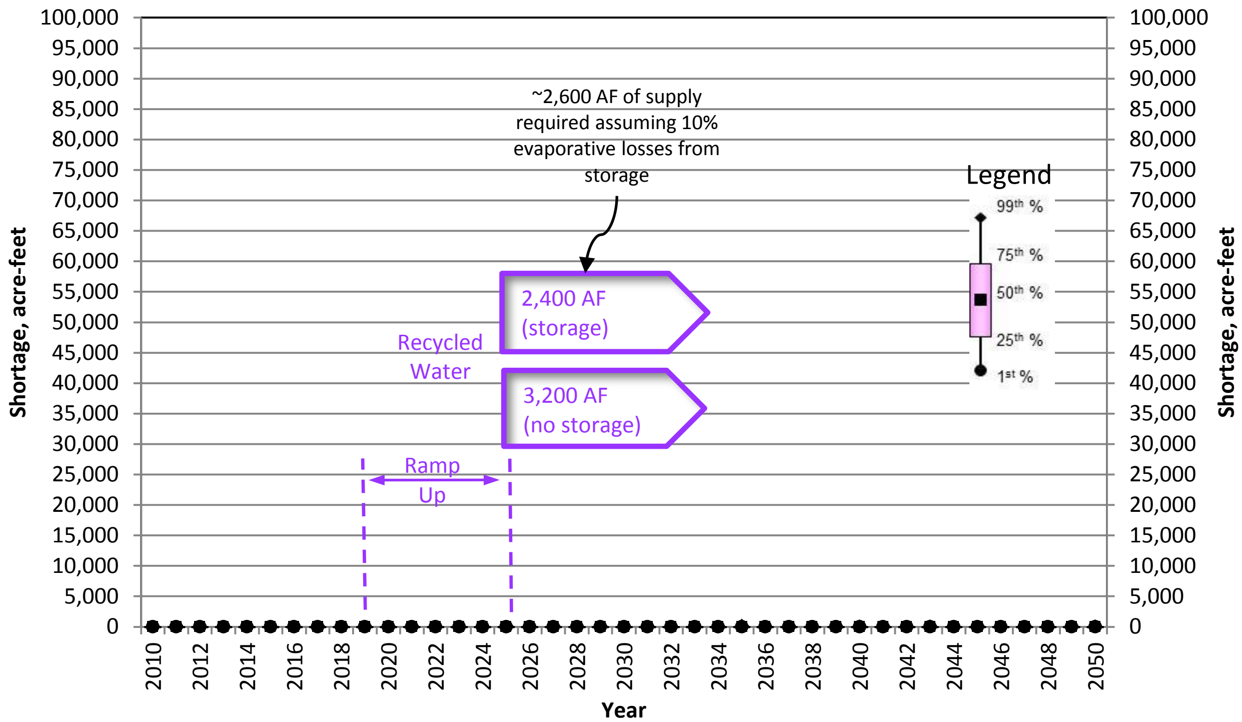


Figure 10-17. Reliability Curve for the In-Valley Portfolio 99%

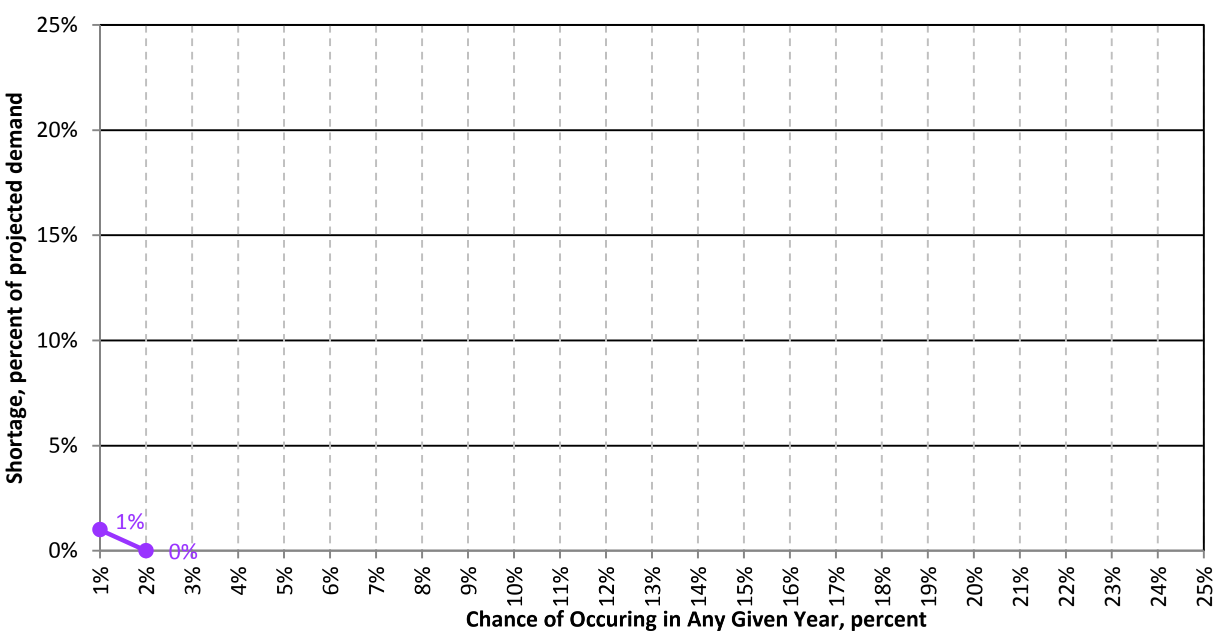
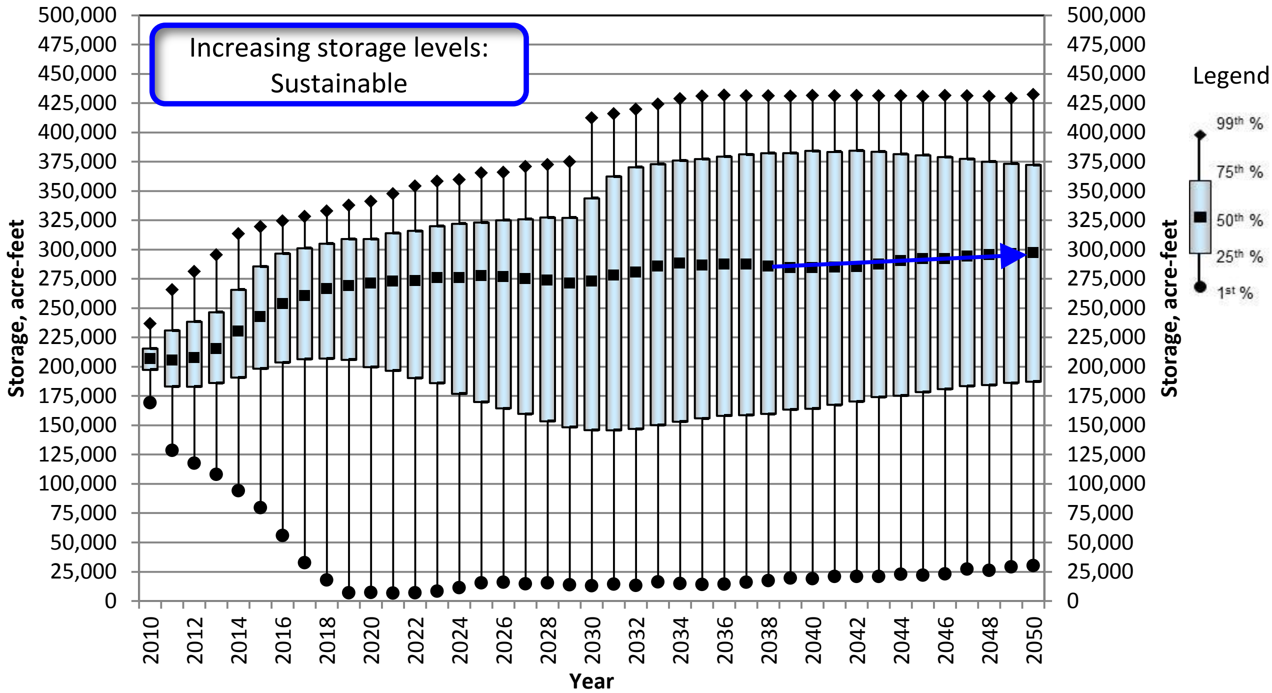


Figure 10-18. Sustainability of the In-Valley Portfolio at a Reliability of 99%



10.2 OBSERVATIONS REGARDING THE AMOUNT OF POTABLE WATER DEMAND REDUCTION REQUIRED

The amount of recycled water presented in this section represents the potable demand reduction required to achieve the reliability targets evaluated, and was limited based on available recycled water supply. The analysis did not consider whether a corresponding amount of recycled water demand *actually existed* in the system. The intent of the analysis completed in this WSE was to determine the potable demand reduction required – completing a detailed valley-wide recycled water system master plan was beyond the scope of this study. However, this does not mean that the potable reductions required should not be matched with actual irrigable area within the Livermore-Amador Valley.

As previously shown, the additional potable demand reduction required beyond existing plans or water conservation assumptions ranges from 1,000 to 5,600 AF, depending on the target evaluated. Assuming that a typical sports park uses about 40-inches[112] of water per year, approximately 300 to 1,700 acres[113] of irrigable area currently served potable water would need to be converted to recycled water. This is a significant amount of parks and other types of landscaping, and requires additional study – beyond the scope of this WSE – to confirm the feasibility of converting this much area to recycled water.

Consequently, as discussed further in Section 12, Zone 7 staff strongly recommends working with the water supply retailers to complete a separate more detailed study that analyzes potential recycled water demands within each of their respective service areas, including facility and timing requirements,

[112] WYA, 2005. Dublin San Ramon Services District – Water Master Plan Update – Section 10. December. Historical use on Dublin Sports Grounds.

[113] 40-inches of water is about 3.3 feet of water, therefore, the area required is 1,000 AF divided 3.3 Feet, or 300 acres. Similarly, 5,600 AF divided by 3.3 feet is about 1,700 acres.

and then compares these potential demands to the required potable demand reduction determined in this WSE.

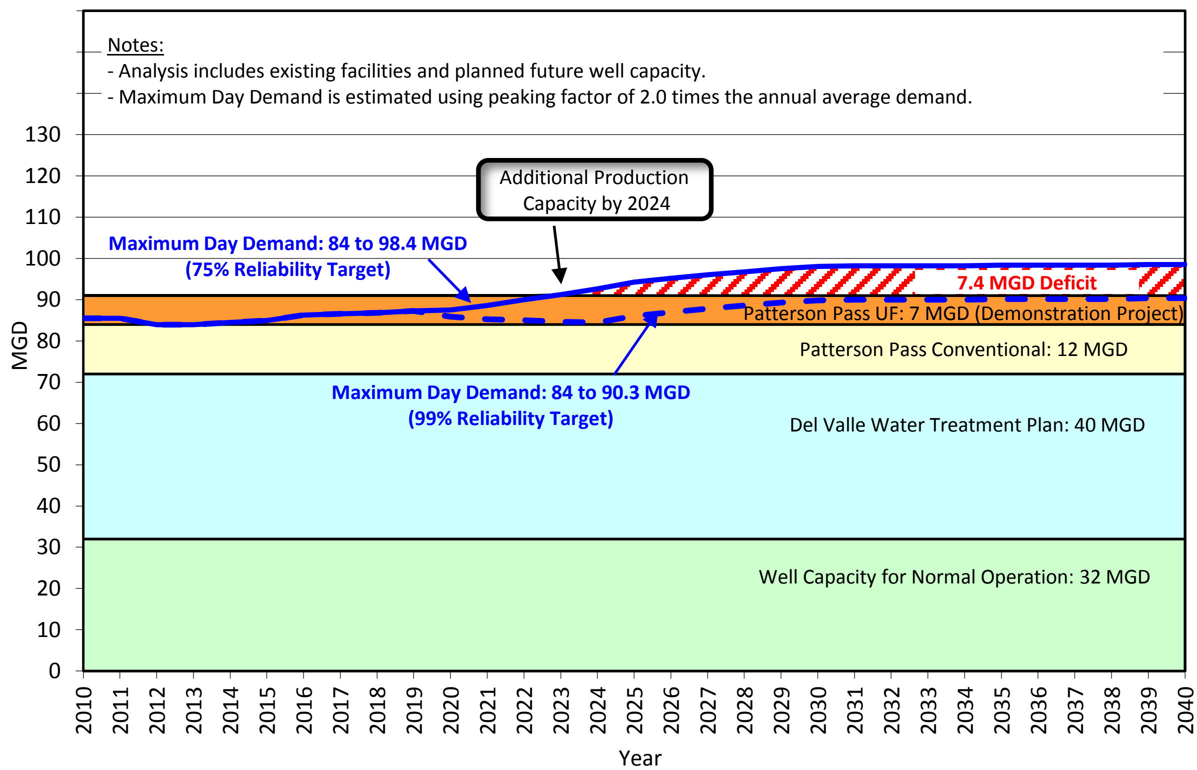
10.3 FACILITIES EVALUATION FOR THE IN-VALLEY PORTFOLIO

Zone 7 staff reviewed the capacities of existing and planned facilities associated with the In-Valley Portfolio to meet 100% of maximum day demands under normal conditions and 75% of maximum day demands assuming one major facility is out of service. Each condition is discussed below.

10.3.1 Maximum Day Demand for the In-Valley Portfolio

Increased use of recycled water to reduce potable water demands is expected to reduce the maximum day demand on Zone 7's potable water system. Figure 10-19 compares the capacity of existing and planned facilities associated with the In-Valley Portfolio with projected maximum day demands associated with a 75 and 99% reliability target.[114] Based on this comparison, Zone 7 can meet 100% of maximum day demands through 2023, but will require additional capacity by 2024 (7.4 million gallons per day [MGD]) under the 75% reliability scenario. However, the temporary ultrafiltration (UF) plant at the Patterson Pass Water Treatment Plant (PPWTP) needs to be replaced and therefore, the total maximum capacity required is about 15 MGD (8 plus 7 MGD). Figure 10-19 also shows that no additional capacity is required, beyond replacement of the existing UF plant, for the 99 percent reliability target due to a reduction in the projected maximum day demand associated with significant recycled water use (i.e., potable demand reductions).

Figure 10-19. In-Valley Portfolio: Ability to Meet Maximum Day Demand



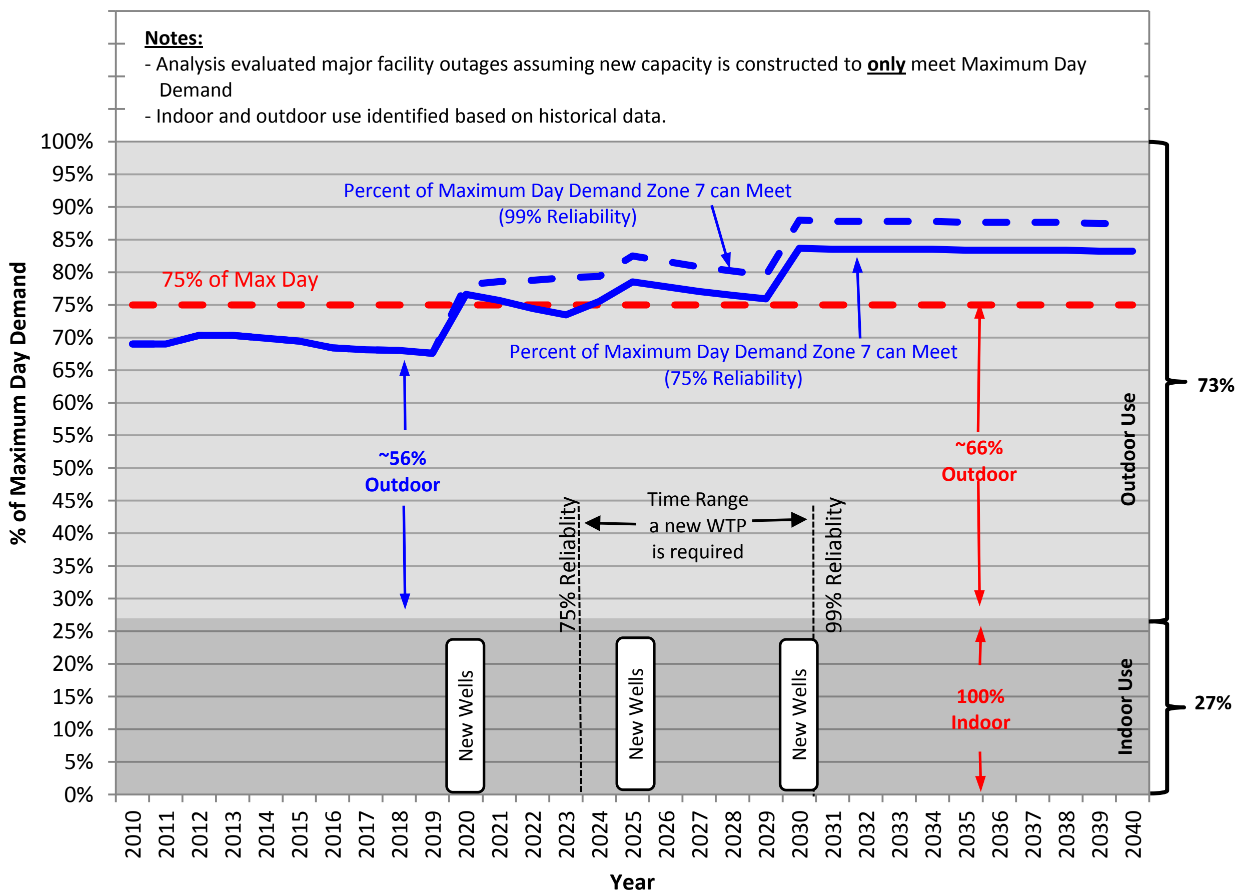
[114] Projected water demands were previously discussed in Section 3.

10.3.2 Level of Service for the In-Valley Portfolio with a Major Facility Outage

Zone 7 staff evaluated the ability of existing and planned facilities associated with the In-Valley Portfolio (see Section 9) to meet the current facility outage policy. Figure 10-20 compares the percent of maximum day demand that In-Valley Portfolio facilities can meet to the current policy over time for both a 75% and 99% reliability target. For discussion purposes, Figure 10-20 splits the maximum day demand into indoor and outdoor use,[115] and presents the current facility schedule. The current facility schedule reflects delayed construction associated with reduced demands caused by the current economic downturn.

As shown on Figure 10-20, the current policy is to meet 75% of maximum day demand with a major facility out of service; however, another interpretation of the policy is to meet 100 percent of indoor use and 66 percent outdoor use during the same conditions. Figure 10-20 clearly shows that existing facilities can meet 100% of indoor water needs, but only about 56% of outdoor needs until 2020. As new facilities come online, Zone 7 is increasingly able to meet, and eventually exceed, the existing policy requirements.

Figure 10-20. Ability of In-Valley Portfolio to Meet Maximum Day Demand during an Outage



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115 Zone 7 staff reviewed historical monthly data to split projected water demands into indoor and outdoor use. This analysis is provided as Appendix A.

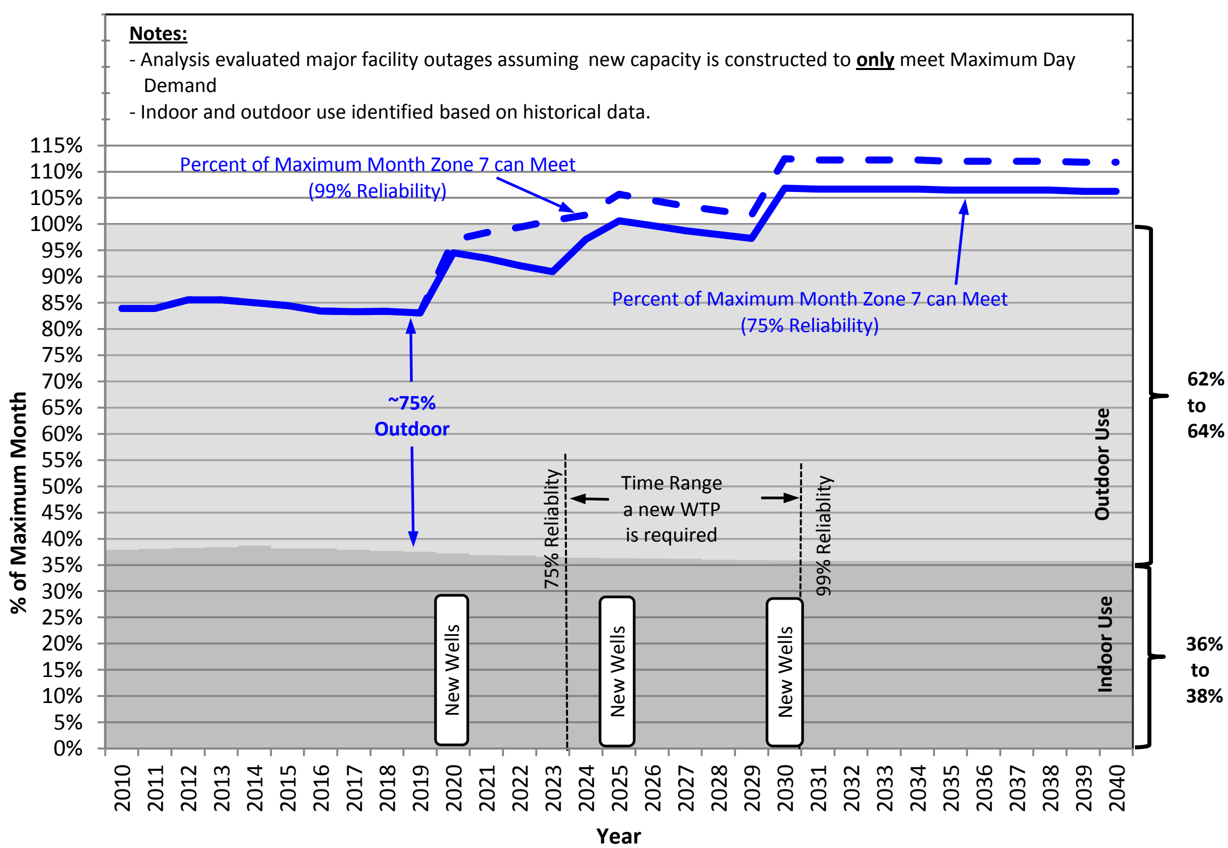
10.3.2.1 Consideration: Level of Service during a Maximum Month

The assumptions presented in Figure 10-20 are relatively conservative. For example, one scenario evaluated assumes that all of the treatment capacity associated with the Del Valle Water Treatment Plant happens to be lost on the highest water use day of the year (i.e., the maximum day), which typically occurs between 1 to 5 out of 365 days – less than 2% of the time. Additionally, barring a major emergency (e.g., an earthquake, Delta levee failure, or transmission line burst), it would take multiple, simultaneous, failures of internal plant equipment to lose all treatment capacity for an entire day.[116]

Consequently, for discussion purposes in this WSE, Zone 7 staff also reviewed the same outage scenarios over the highest water use month (i.e., the maximum month) instead of the maximum day demand. Figure 10-21 presents the same analysis completed for the maximum month.

As shown on Figure 10-21, existing facilities can meet 100% of indoor use and almost three-quarters of the outdoor use during the highest water use month and therefore, about a 25% reduction in water use would potentially be required over a 30-day period. Assuming the typical residential customer waters their lawn four times per week during the hottest month of the year, then a 25% reduction could be achieved by only watering their lawn about three times a week.

Figure 10-21. Ability of In-Valley Portfolio to Meet Maximum Month Demand during an Outage



[116] Based on conservations with Zone 7 operations staff.

10.4 SALT MANAGEMENT EVALUATION FOR THE IN-VALLEY PORTFOLIO

Zone 7 is preparing to update its Groundwater Management Plan (GWMP), which will also include an update of the Salt Management Plan (SMP). As part of this update, Zone 7 staff will conduct a more rigorous analysis of potential salt and nutrient loading in the Main Basin – a rigorous analysis of salt loading was not completed as part of this WSE.

However, each of the scenarios evaluated in this WSE involved different water supply sources with different water quality characteristics that could influence future salt loading in the Main Basin. Consequently, Zone 7 staff completed a preliminary review of the potential salt loading associated with the In-Valley Portfolio for comparative purposes in this WSE.[117] As discussed in Section 5, this review involved using spreadsheet models previously developed as part of Zone 7's original SMP to evaluate whether net salt loading in the Main Basin associated with the In-Valley Portfolio was either increasing or decreasing. Preliminary results indicate that a new demineralization facility may be required to achieve decreasing salt loading under the In-Valley Portfolio. The GWMP/SMP will further evaluate this finding.

Table 10-1 presents the percentage of the total additional recycled water that was assumed over the Main Basin. This percentage was based on limiting the total future demineralization capacity to 12.4 MGD (two equal phases), which is about 10,500 AF per year assuming it is only operated for nine months. Zone 7 staff found it was difficult to operate three equal phases of demineralization without exceeding potential recharge limits associated with the Arroyos and the Chain of Lakes.[118]

Consequently, Zone 7 staff recommends evaluating the need for additional demineralization and the potential for recharging enough water supplies into the Main Basin to support over 10,000 AF of normal operational groundwater pumping as part of the more rigorous analysis planned as part of the GWMP/SMP update.

Table 10-1. Recycled Water Over the Main Basin: In-Valley Portfolio[a,b]

Reliability, percent	Recycled Water for Conservation	Additional Recycled Water	Total Recycled Water	Applied Over Main Basin, percent
75	2,000	1,000	3,000	67
80	2,000	1,800	3,800	53
85	2,000	2,200	4,200	48
90	2,000	3,200	5,200	42
95	2,000	4,300	6,300	41
99	2,000	5,600	7,600	41

(a) Preliminary numbers are provided in Appendix C.

(b) Analysis assumed 2,000 acre-feet of recycled water is applied over the main basin

117 Zone 7 will evaluate nutrients as part of the SMP update.

118 Zone 7 can only pump groundwater it has previously recharged; therefore, its demineralization capacity is limited to its recharge capacity.

10.5 OBSERVATIONS REGARDING DELIVERED WATER QUALITY

As discussed previously in Section 5, conducting hydraulic modeling to quantify potential benefits to delivered water quality was beyond the scope of this WSE; however, each of the scenarios evaluated in this WSE involved different water supply sources with different water quality characteristics. Consequently, a qualitative review of each scenario was completed to evaluate whether the scenario had the potential for improving delivered water quality. The potential benefit to delivered water quality associated with the In-Valley Portfolio is linked with potential groundwater demineralization activities necessary to mitigate potential salt loading.

As previously discussed in Section 10.4, Zone 7 staff conducted a preliminary evaluation of salt loading associated with the In-Valley Portfolio, and although it is recommended that future salt mitigation strategies be evaluated as part of the GWMP/SMP Update, another phase of demineralization is in Zone 7's existing Capital Improvement Program. Additionally, a second phase was also included in the cost estimates of the In-Valley Portfolio for comparative purposes in this WSE. Another phase of demineralization will have a direct positive influence on delivered water quality because it treats groundwater before it enters Zone 7's distribution system.[119]

10.6 COST ESTIMATES FOR THE IN-VALLEY PORTFOLIO: 75 TO 99%

The purpose of this section to provide planning-level cost estimates for each reliability scenario evaluated under the In-Valley Portfolio. For illustrative purposes, the cost estimates were divided into three categories: (1) facilities, (2) water supply, and (3) water quality.

The facilities component of the cost estimates represent hard construction, such as water treatment plants, diversion structures, and groundwater wells, while the water supply component generally represented the cost of purchasing or acquiring water. For the In-Valley Portfolio, however, the recycled water supply costs also included the necessary tertiary treatment facilities, tanks, and pipeline costs. The cost estimate for water quality reflects a second phase of demineralization; however, as discussed previously, future salt mitigation will be further evaluated as part of the GWMP/SMP update.

In all cases, the costs are presented in 2010 dollars based on an Engineering News Record San Francisco Construction Cost Index. The following planning-level cost contingencies were also applied as necessary:

- Construction Contingency: 25 percent
- Planning and Environmental: 10 percent
- Design and Implementation: 10 percent
- Construction Management: 10 percent

Appendix D contains a more detailed description of the cost estimates used and preliminary schedules developed for each scenario that were used to develop present worth and amortized values.

10.6.1 Observations Regarding the Cost of Reliability

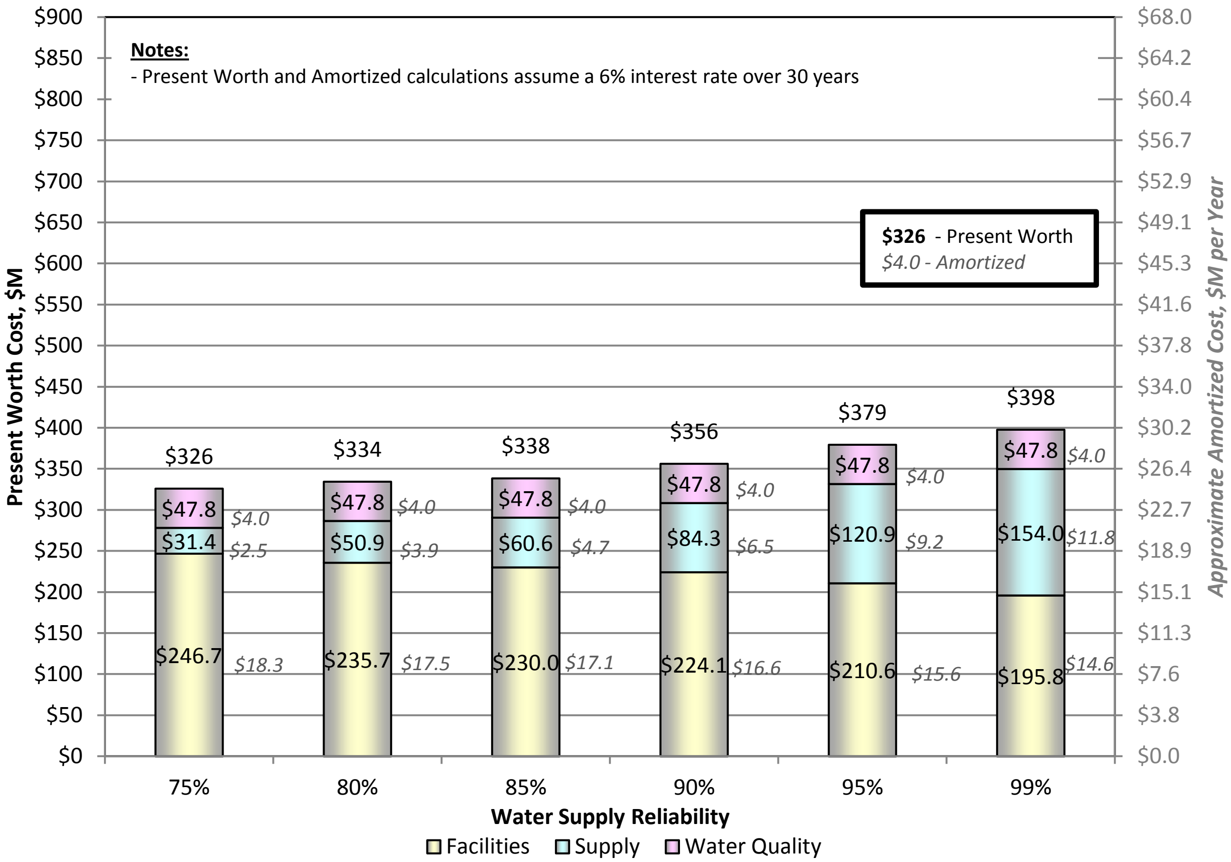
Figure 10-22 presents the Portfolio costs for each reliability scenario evaluated. As shown on Figure 10-22, the potable system facility costs for a 99% reliability target are about 20% ($51 million) lower than the facility costs for a 75% reliability target. This decrease is associated with smaller potable water

[119] The benefits of demineralization were thoroughly analyzed as part of the 2003 Water Quality Management Program report.

treatment facilities caused by the potable demand reductions associated with additional recycled water use.

Figure 10-22 also indicates that the supply costs for a 99% reliability target are about 390% ($123 million) higher than the supply costs for a 75% reliability target, while the water quality costs remain the same.[120] However, increasing supply costs are offset by decreasing facility costs.[121] Overall, the total Portfolio costs for a 99% reliability target are only about 22% higher than the Portfolio costs for a 75% reliability target.

Figure 10-22. Cost of Reliability for the In-Valley Portfolio



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[120] The water quality costs are constant because the costs are based on only one additional phase of demineralization.

[121] As recycled water use increases, supply costs increase due to the construction of additional recycled water facilities; at the same time, facility costs primarily associated with surface water treatment plant capacity decrease due to associated potable demand reductions on Zone 7's water system.

11. EVALUATION OF BACKUP PORTFOLIO: INTERTIE

The purpose of this section is to present the analysis and results of using the probability-based water supply model to determine the reliability provided by the Intertie Portfolio. As discussed in Section 9, the Intertie Portfolio assumed that Zone 7 Water Agency (Zone 7) is able to construct a new intertie with another water agency (e.g., East Bay Municipal Utility District [EBMUD] and wheel high quality water supplies into Zone 7's water system. The supply could consist of several sources, including but not limited to the Bay Area Regional Desalination Project or long-term water leases and/or transfers. The Intertie Portfolio also assumed that Zone 7 successfully reduces its unaccounted-for water, reduces brine losses, increases the minimum yield from its contract with BBID, and enhances the existing in-lieu recharge program.

The following subsections present the results:

- 11.1 Reliability for the Intertie Portfolio: 75 to 99%
- 11.2 Facilities Evaluation for the Intertie Portfolio
- 11.3 Salt Management Evaluation for the Intertie Portfolio
- 11.4 Observations Regarding Delivered Water Quality
- 11.5 Cost Estimates for the Intertie Portfolio: 75 to 99%

11.1 RELIABILITY FOR THE INTERTIE PORTFOLIO: 75 TO 99%

Zone 7 staff evaluated the ability of the water supplies and facilities included in the Intertie Portfolio to prevent water supply shortages, while also maintaining drought and emergency storage at a sustainable level. For this evaluation, Zone 7 staff first reviewed the risk of potential water supply shortages and corresponding reliability, and then reviewed the sustainability of system-wide storage, which included the Main Basin, Semitropic Water Storage District (Semitropic), Cawelo Water District (Cawelo), State Water Project (SWP) Carryover, and the Chain of Lakes.[122] Additionally, per discussions with the water supply retailers, Zone 7 did not evaluate reliabilities less than 75%. Each is discussed in more detail below.

11.1.1 Reliability of the Intertie Portfolio: 75%

Under this scenario, shortages are kept equal to or below 25% of projected water demands assuming Zone 7 is able to develop and use 5,100 acre-feet (AF) of normal/wet year water supply between 2030 and 2038 (Figure 11-1); the supply was stopped after 2038 because it would not be needed at that time to achieve 75% reliability. In addition to achieving a reliability of 75%, this scenario also results in no shortages 94% of the time (Figure 11-2). However, stopping the new supply after 2038 makes system-wide storage unsustainable (Figure 11-3); the sustainability of drought and emergency storage is tied to the availability of normal/wet year water supplies. Consequently, this scenario is reliable but unsustainable.

[122] Key individual storage results were included in Appendix F.

Figure 11-1. Risk of Potential Shortages for the Intertie Portfolio: 75%

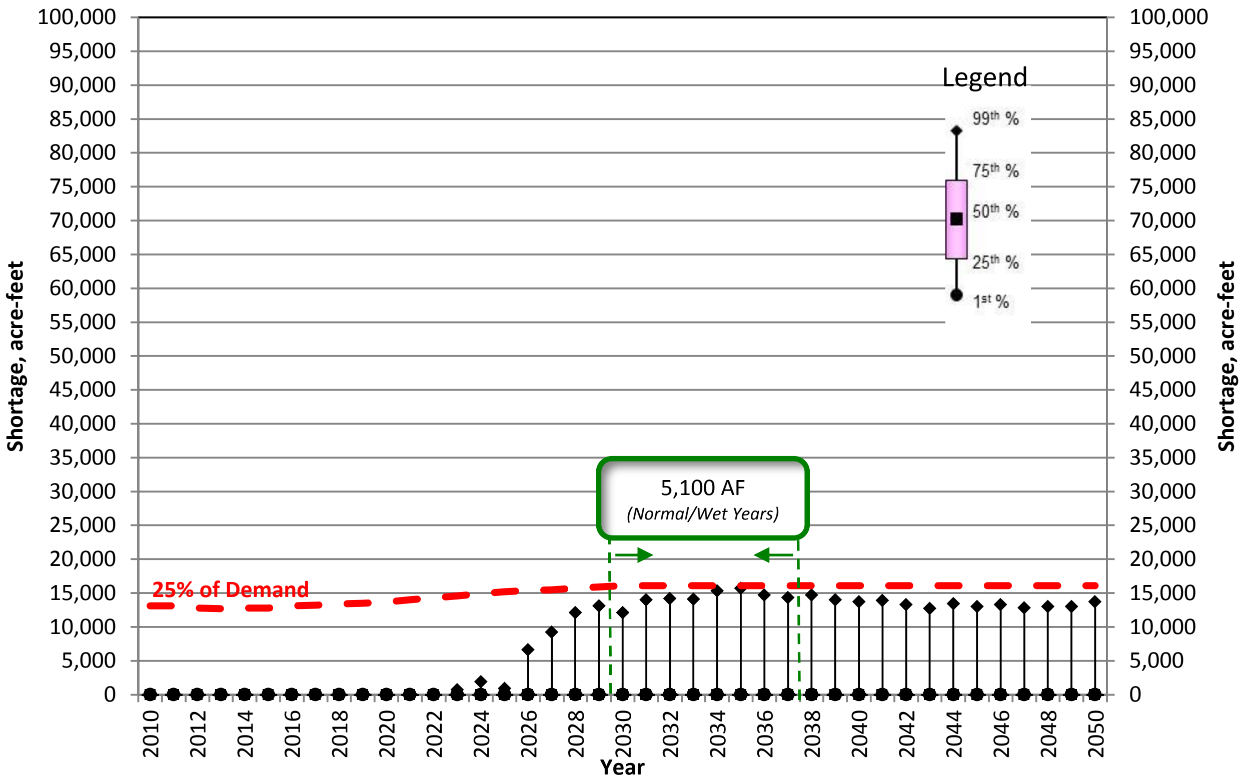
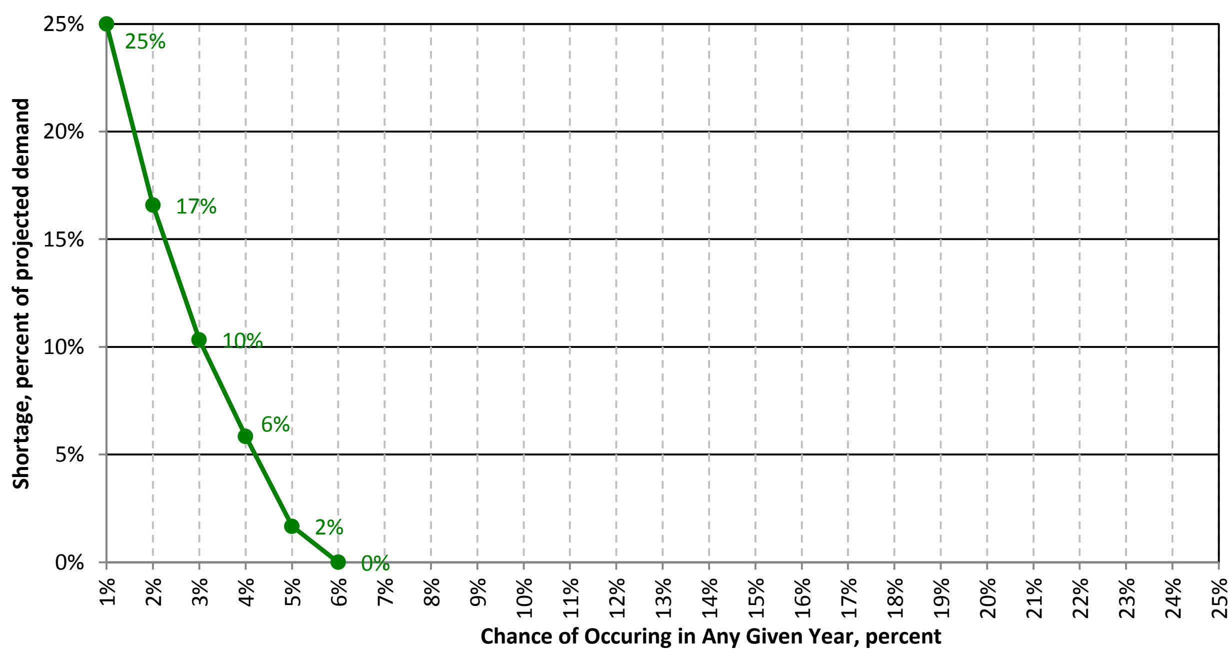
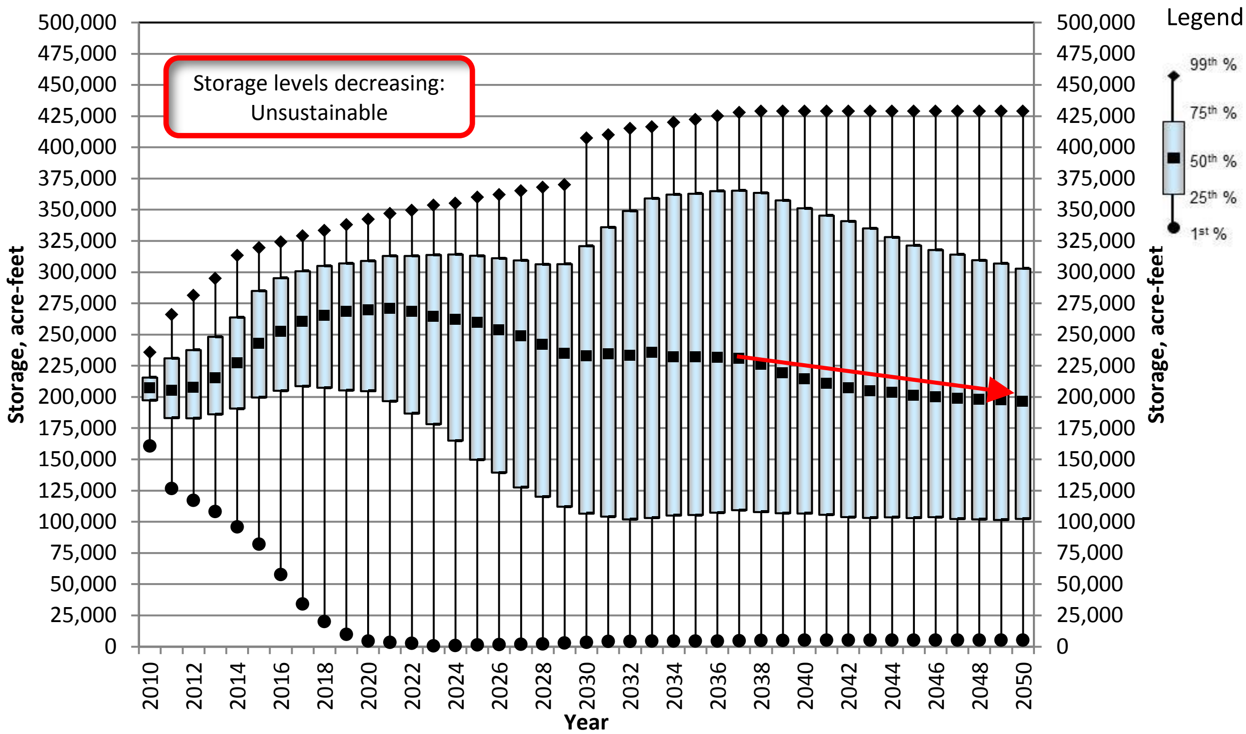


Figure 11-2. Reliability Curve for the Intertie Portfolio: 75%[123]



[123] Presents the risk curve for the worst-case observed over the entire period from 2010 to 2050.

Figure 11-3. Sustainability of the Intertie Portfolio at a Reliability of 75%



11.1.2 Reliability of the Intertie Portfolio: 80%

Under this scenario, shortages are kept equal to or below 20% of projected water demands assuming Zone 7 is able to develop and use 5,100 acre-feet (AF) of normal/wet year water and 1,100 AF of dry year water supply between 2029 and 2039 (Figure 11-4). The supply was stopped after 2039 because it would not be needed at that time to achieve 80% reliability. In addition to achieving a reliability of 80%, this scenario also results in no shortages 94% of the time (Figure 11-5). However, stopping the new supply after 2039 makes system-wide storage unsustainable (Figure 11-6); the sustainability of drought and emergency storage is tied to the availability of normal/wet year water supplies. *Consequently, this scenario is reliable but unsustainable.*

Figure 11-4. Risk of Potential Shortages for the Intertie Portfolio: 80%

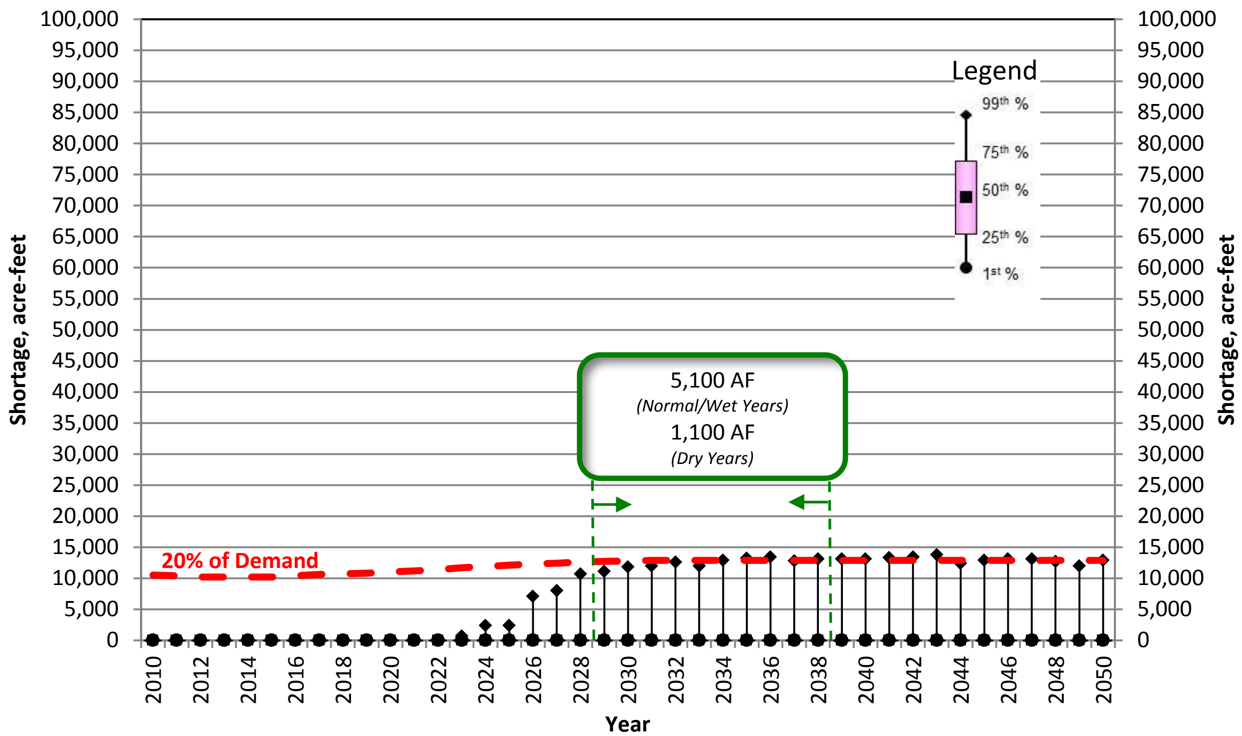


Figure 11-5. Reliability Curve for the Intertie Portfolio: 80%

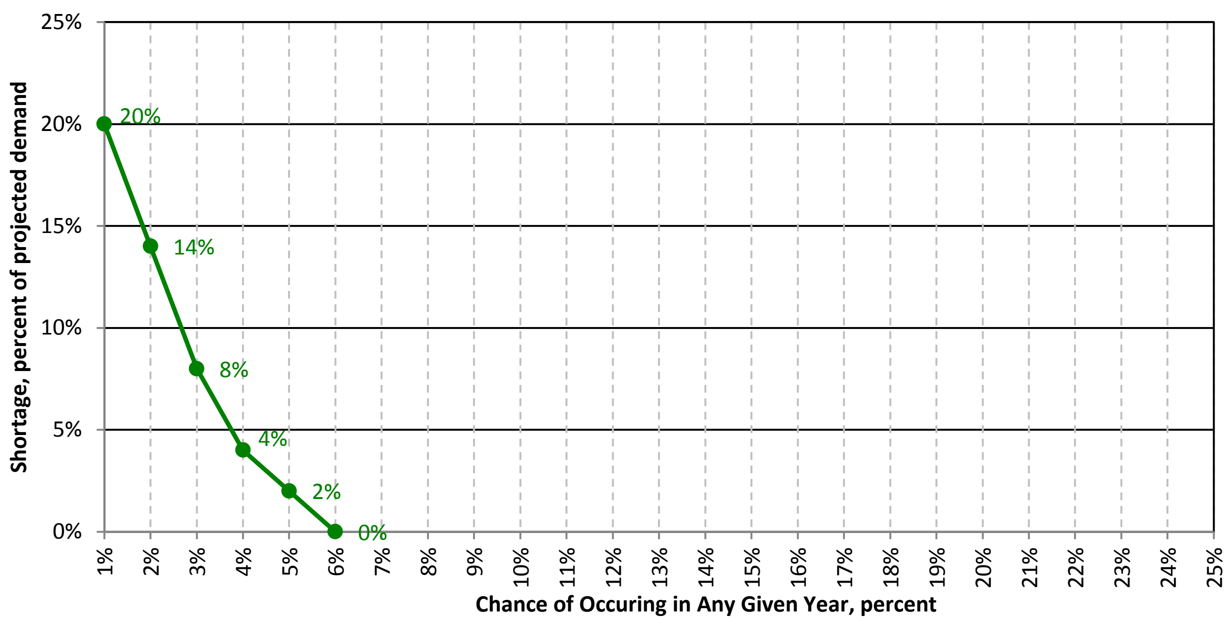
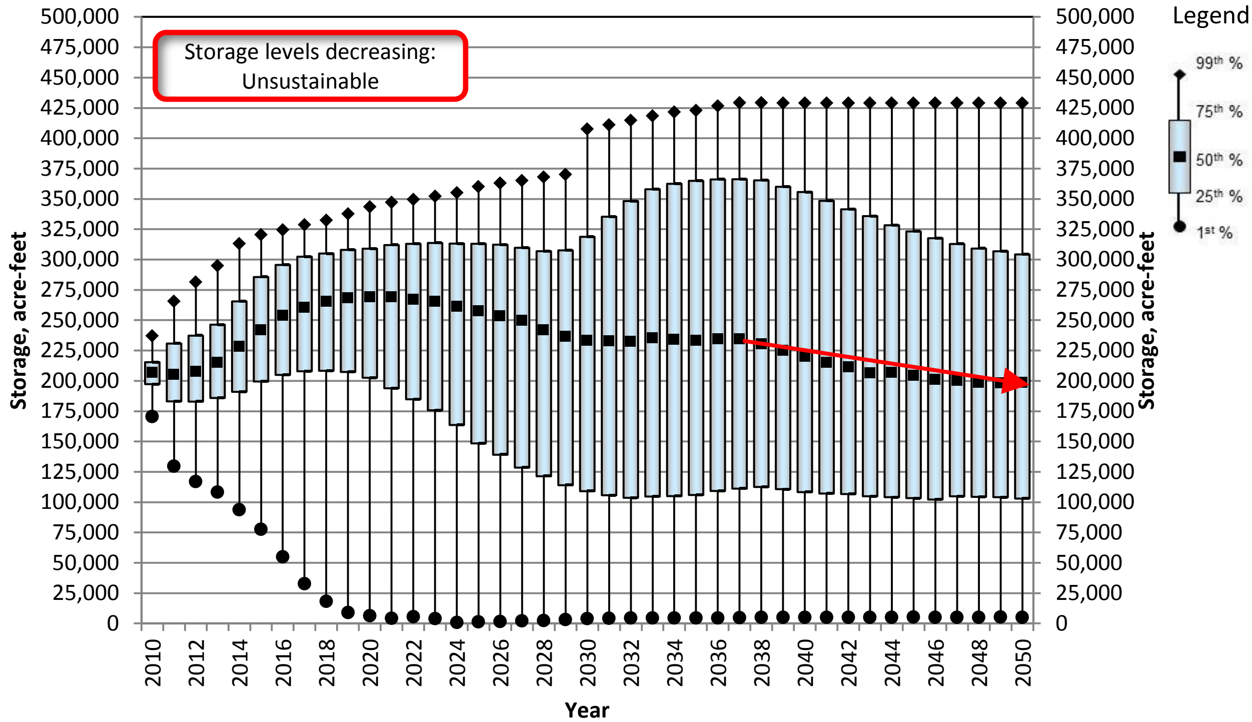


Figure 11-6. Sustainability of the Intertie Portfolio at a Reliability of 80%



11.1.3 Reliability of the Intertie Portfolio: 85 Percent

Under this scenario, shortages are kept equal to or below 15% of projected water demands assuming Zone 7 is able to develop and use 5,100 acre-feet (AF) of normal/wet year water and 1,900 AF of dry year water supply between 2029 and 2039, and 1,600 AF of dry year supply, perpetually, after 2039. (Figure 11-7). The supply was stopped at different periods because it would not be needed at that time to achieve 85% reliability. In addition to achieving a reliability of 85%, this scenario also results in no shortages 95% of the time (Figure 11-8). However, stopping the new normal/wet year supply after 2039 makes system-wide storage unsustainable (Figure 11-9); the sustainability of drought and emergency storage is tied to the availability of normal/wet year water supplies. *Consequently, this scenario is reliable but unsustainable.*

Figure 11-7. Risk of Potential Shortages for the Intertie Portfolio: 85%

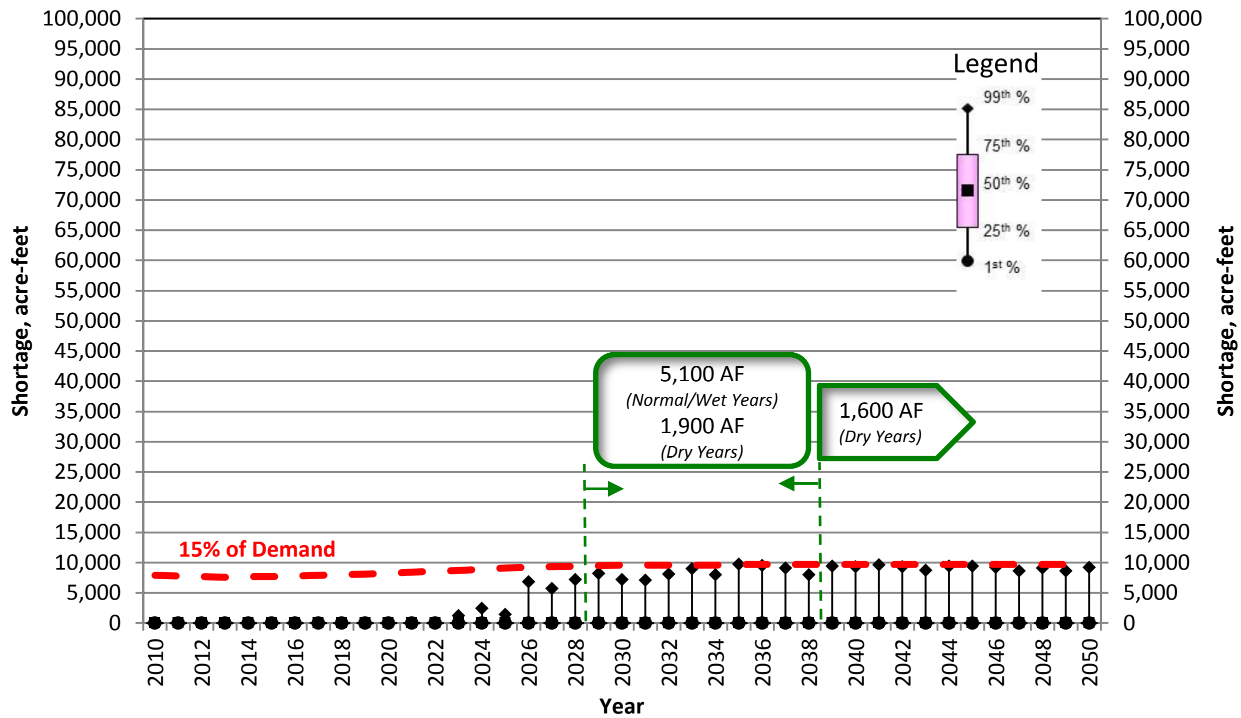
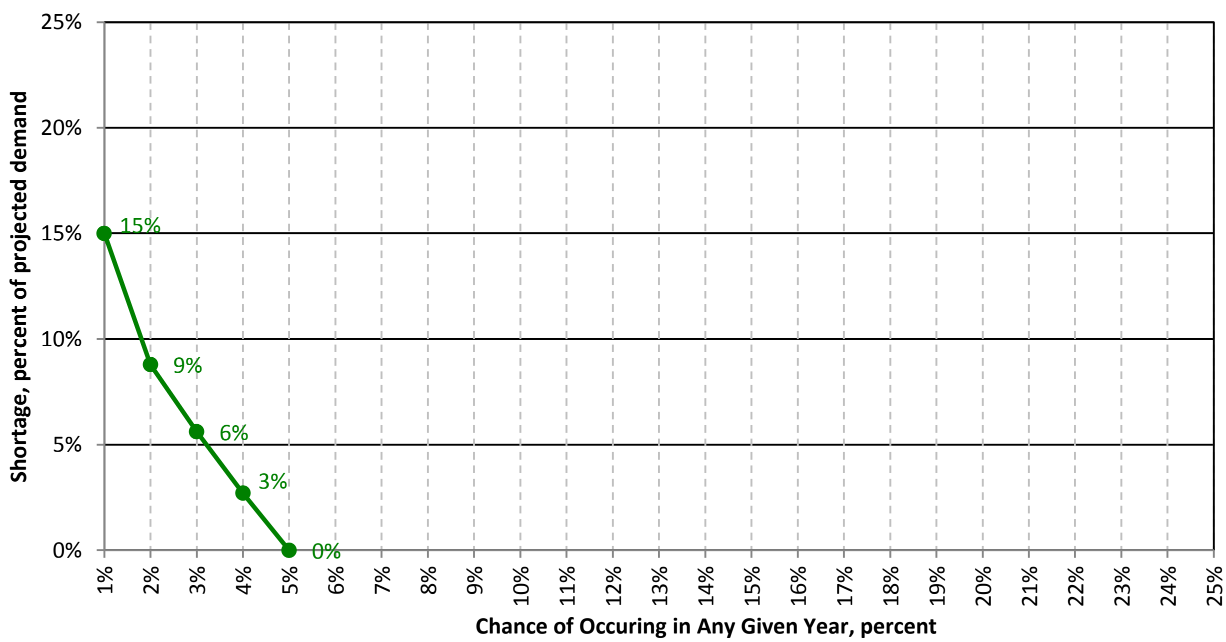
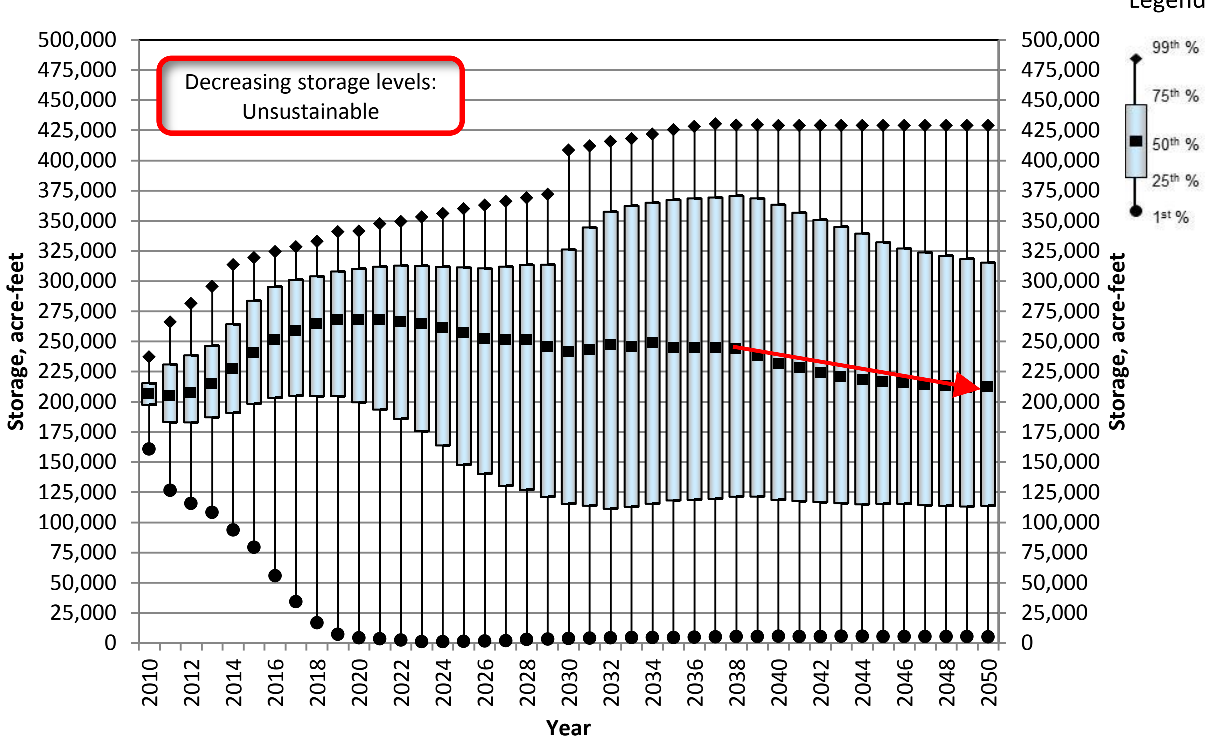


Figure 11-8. Reliability Curve for the Intertie Portfolio: 85%[124]



[124] Presents the risk curve for the worst-case observed over the entire period from 2010 to 2050.

Figure 11-9. Sustainability of the Intertie Portfolio at a Reliability of 85%



11.1.4 Reliability of the Intertie Portfolio: 90%

Under this scenario, shortages are kept equal to or below 10% of projected water demands assuming Zone 7 is able to develop and use 5,100 acre-feet (AF) of normal/wet year water and 2,200 AF of dry year water supply starting in 2026, and another 1,500 AF of dry year supply between 2029 and 2037. (Figure 11-10). The 1,500 AF of dry year supply was stopped after 2037 because it would not be needed at that time to achieve 90% reliability. In addition to achieving a reliability of 90%, this scenario also results in no shortages 96% of the time (Figure 11-11) and sustainable system-wide storage (Figure 11-12).

Figure 11-10. Risk of Potential Shortages for the Intertie Portfolio: 90%

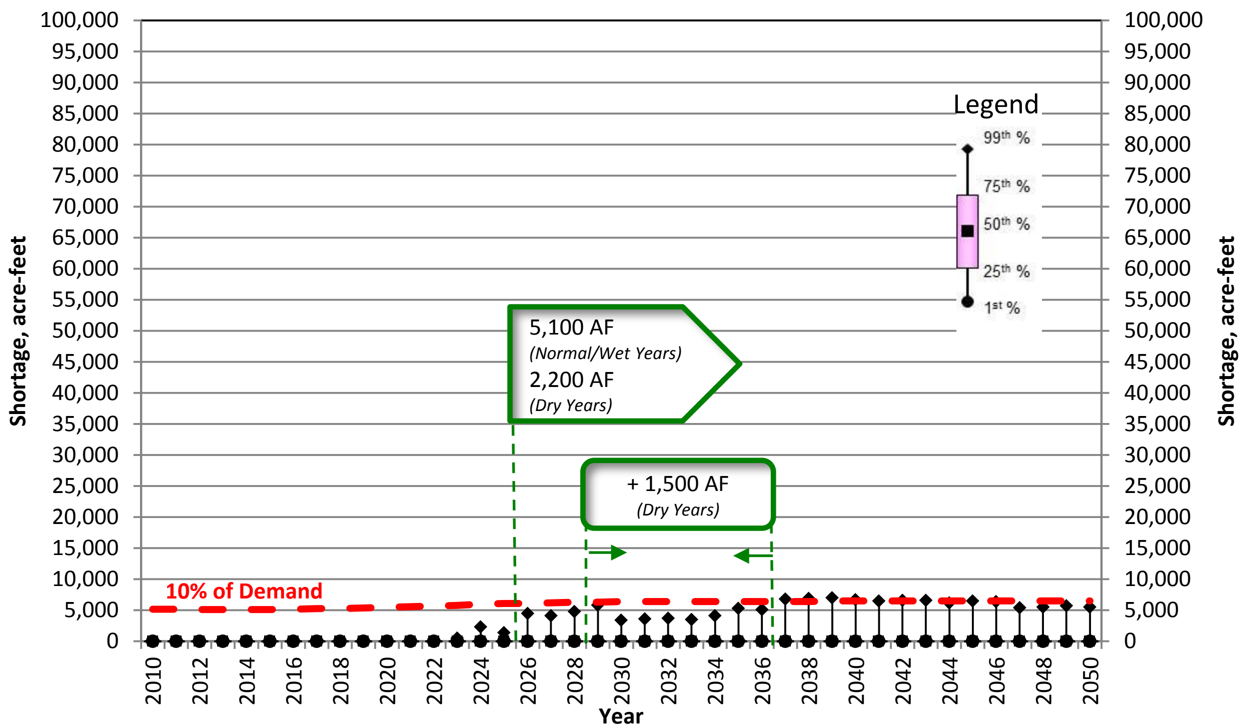


Figure 11-11. Reliability Curve for the Intertie Portfolio: 90%

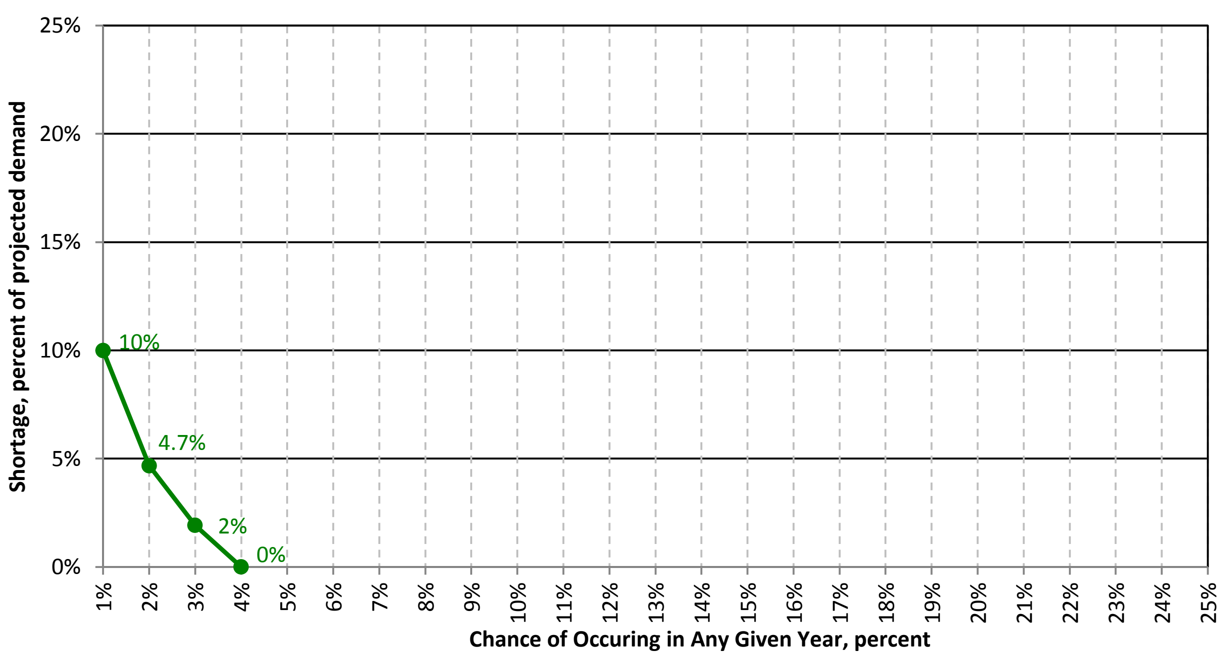
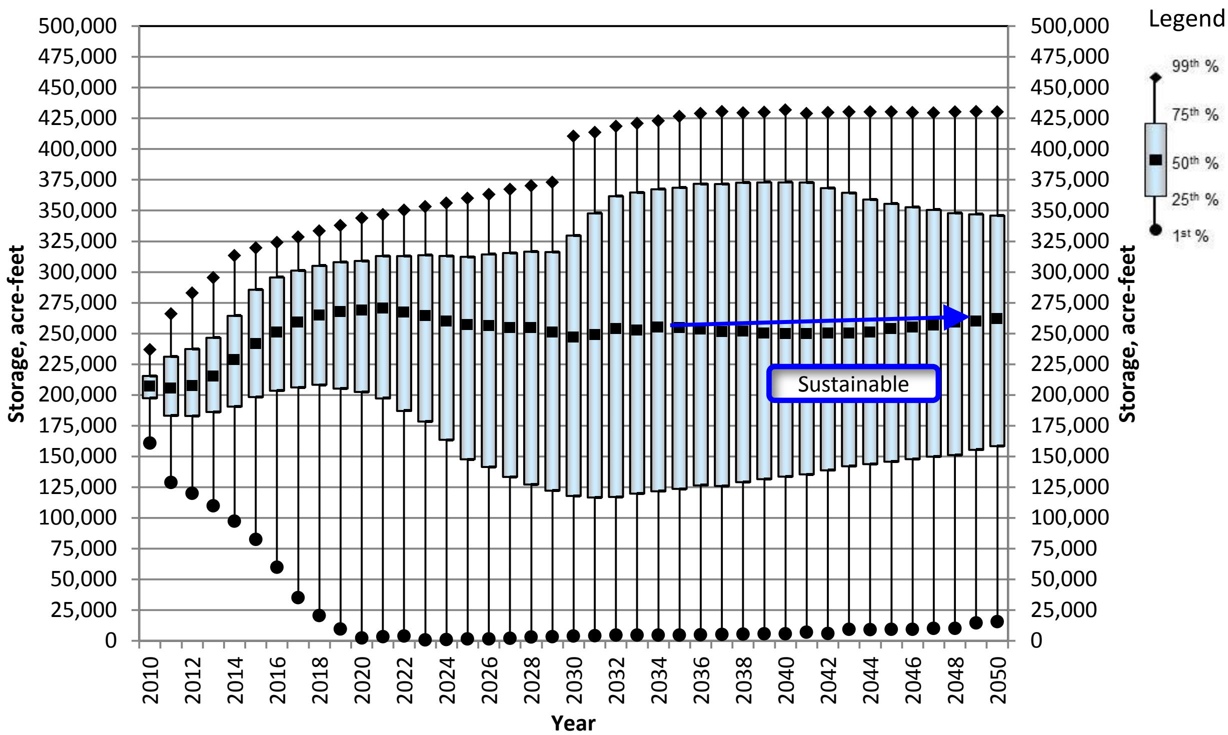


Figure 11-12. Sustainability of the Intertie Portfolio at a Reliability of 90%



11.1.5 <u>Reliability of the Intertie Portfolio: 95%</u>

Under this scenario, shortages are kept equal to or below 5% of projected water demands assuming Zone 7 is able to develop and use 5,100 acre-feet (AF) of normal/wet year water and 3,800 AF of dry year water supply starting in 2026, and another 1,500 AF of dry year supply between 2029 and 2037 (Figure 11-13). The 1,500 AF of dry year supply was stopped after 2037 because it would not be needed at that time to achieve 95% reliability. In addition to achieving a reliability of 95%, this scenario also results in no shortages 97% of the time (Figure 11-14) and sustainable system-wide storage (Figure 11-15).

Figure 11-13. Risk of Potential Shortages for the Intertie Portfolio: 95%

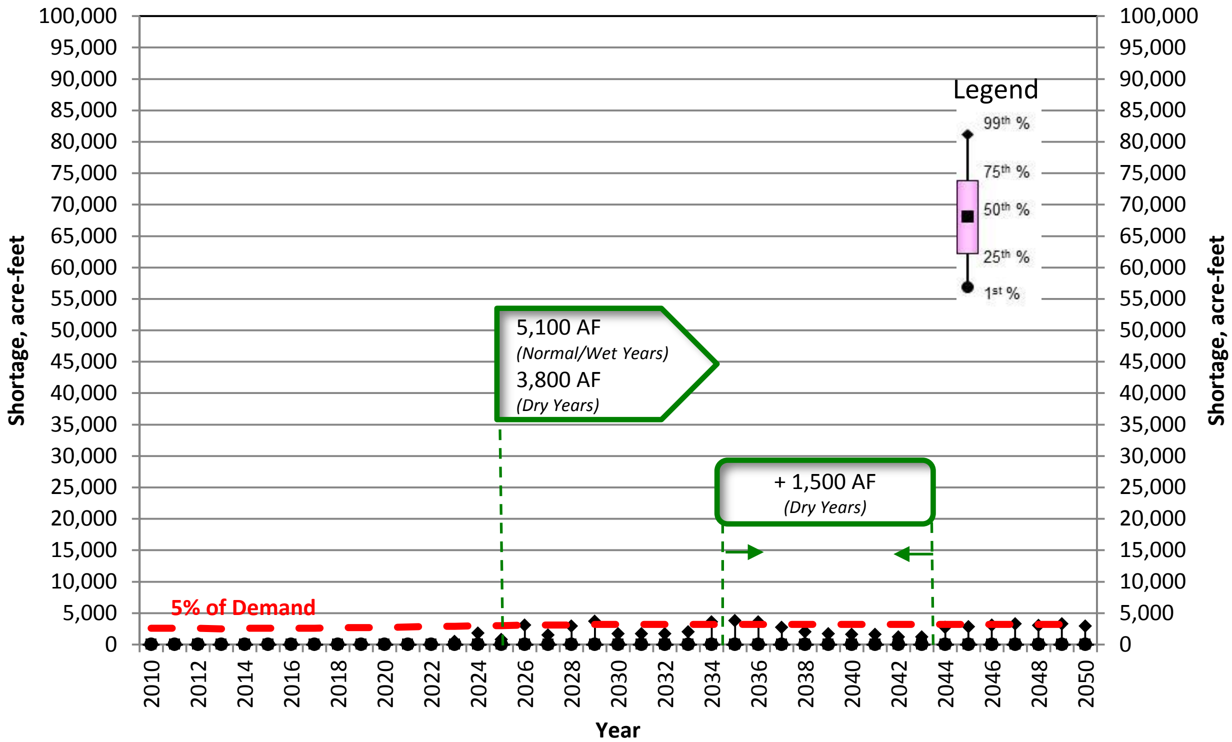


Figure 11-14. Reliability Curve for the Intertie Portfolio: 95%

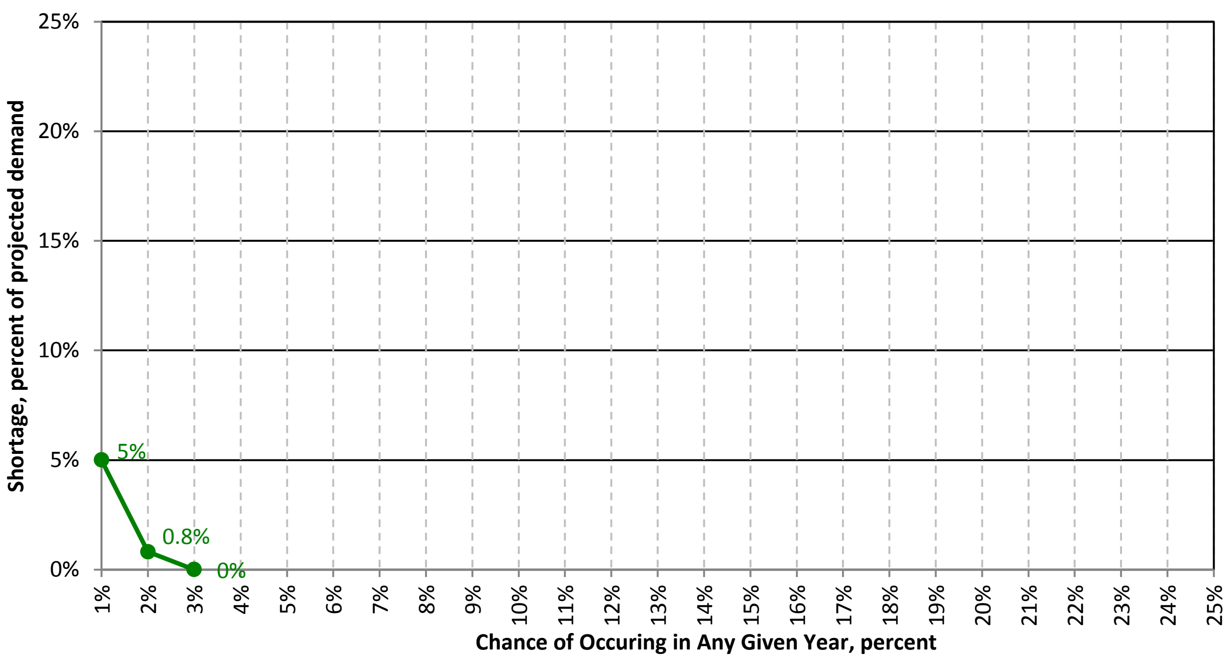
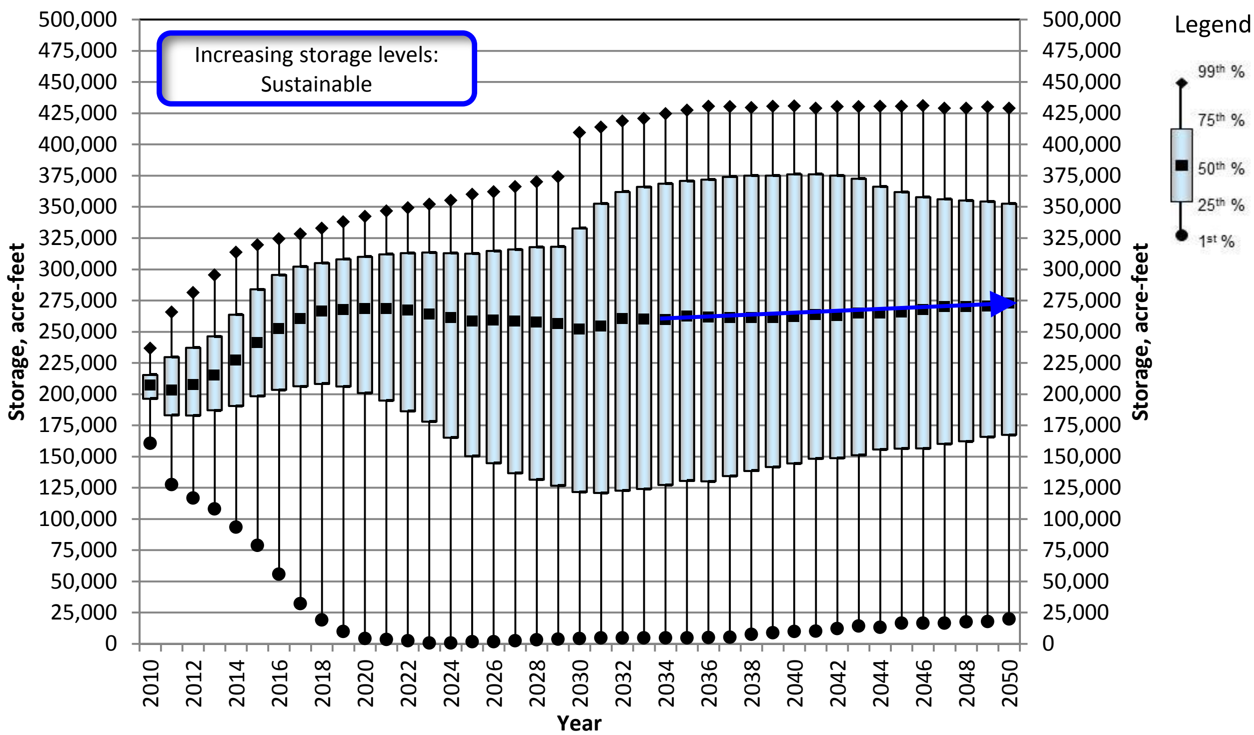


Figure 11-15. Sustainability of the Intertie Portfolio at a Reliability of 95%



11.1.6 Reliability of the Intertie Portfolio: 99%

Under this scenario, shortages are kept equal to or below 1% of projected water demands assuming Zone 7 is able to develop and use 5,600 acre-feet (AF) of water supply that is available during all water year types starting in 2024 (Figure 11-16). In addition to achieving a reliability of 99%, this scenario also results in no shortages 98% of the time (Figure 11-17) and sustainable system-wide storage (Figure 11-18).

Figure 11-16. Risk of Potential Shortages for the Intertie Portfolio: 99%

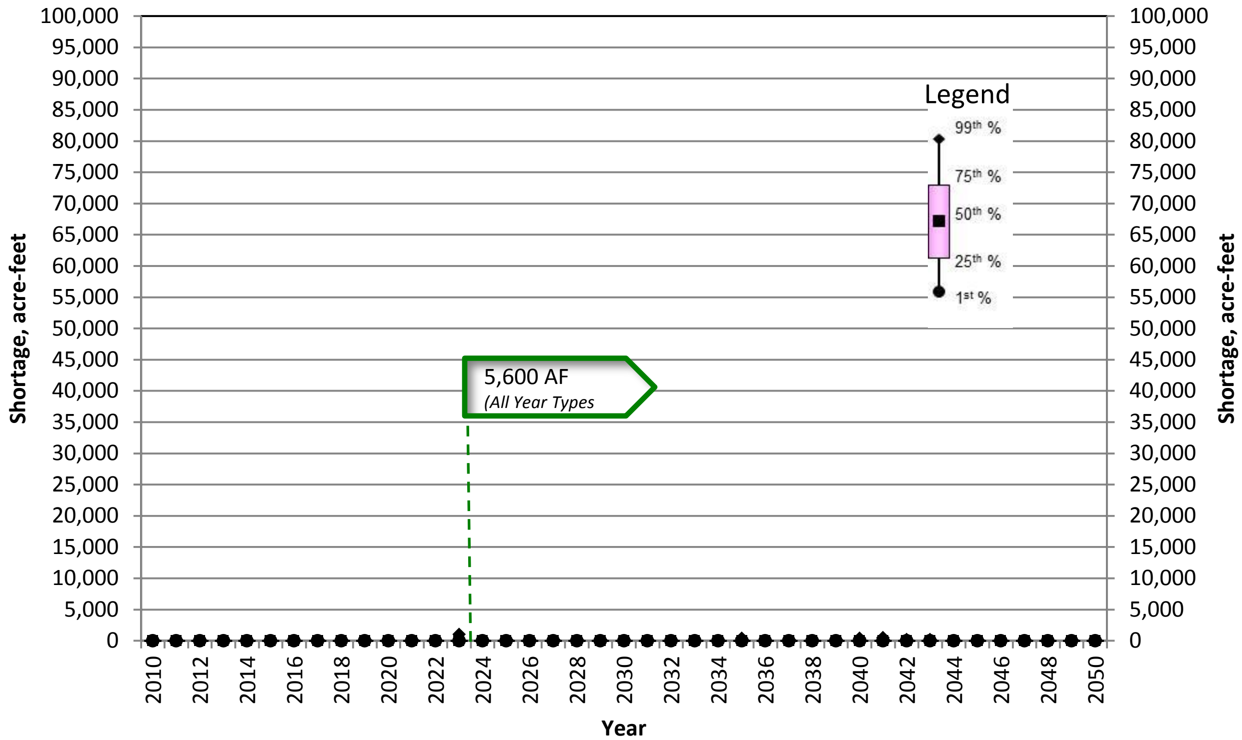


Figure 11-17. Intertie Portfolio at a Reliability of 99%

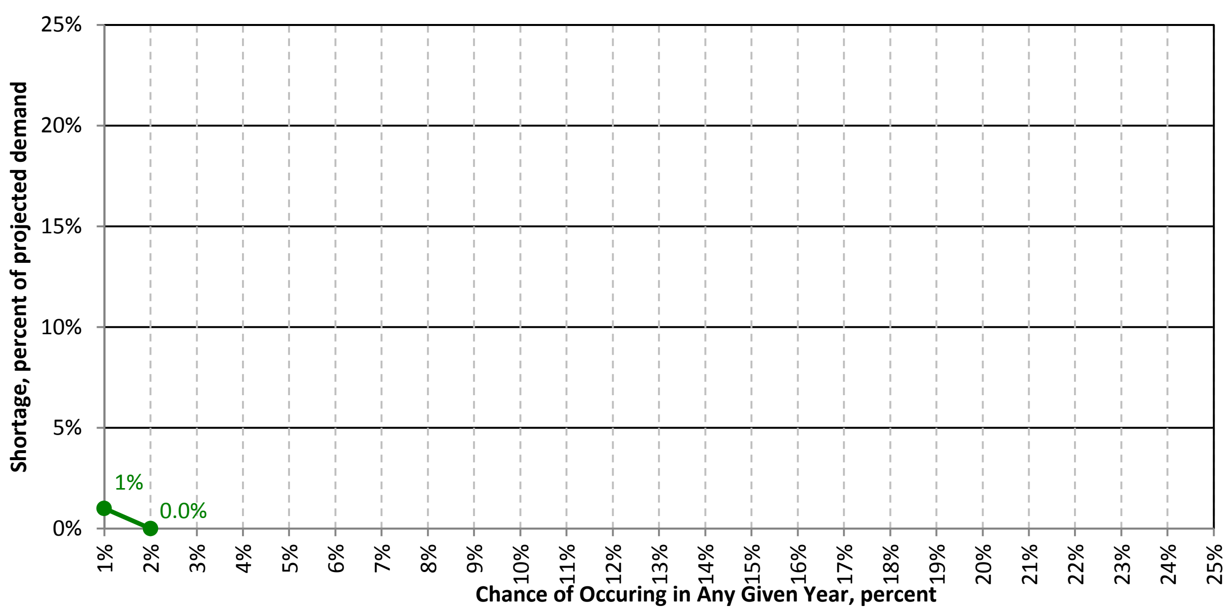
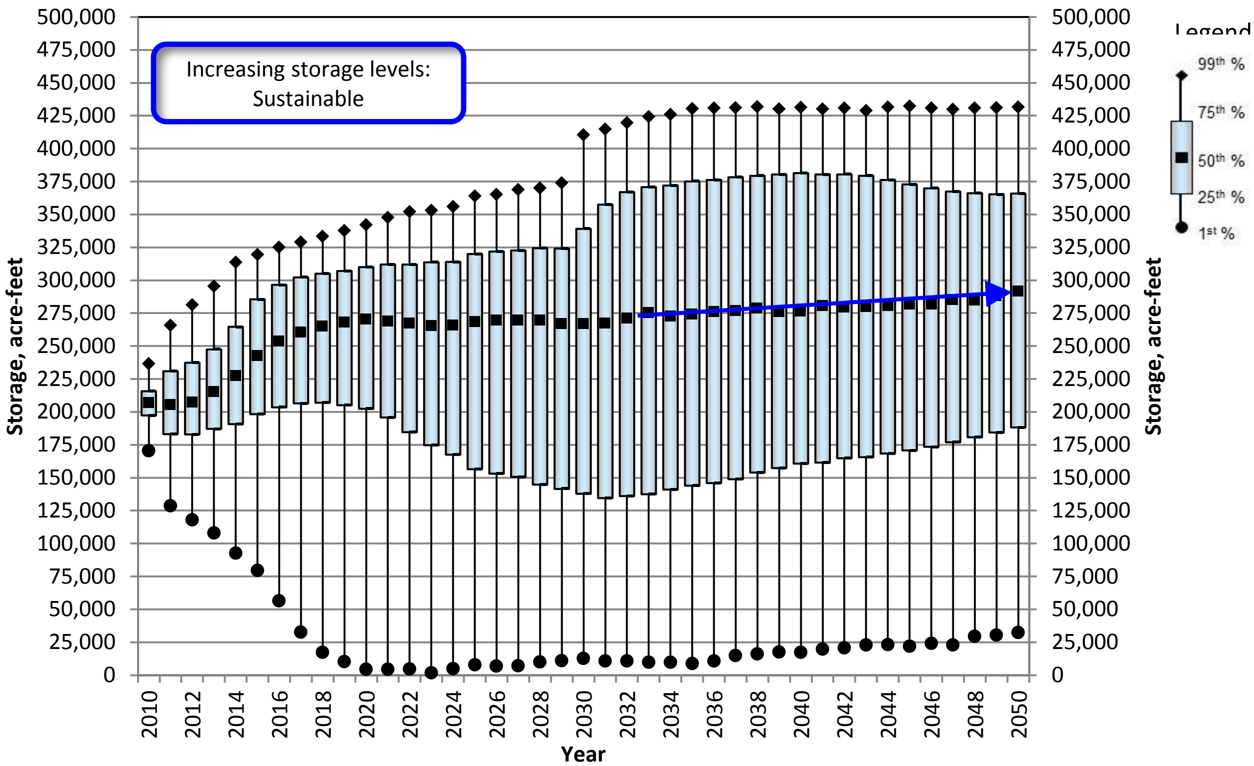


Figure 11-18. Sustainability of the Intertie Portfolio at a Reliability of 99%



11.2 FACILITIES EVALUATION FOR THE INTERTIE PORTFOLIO

Zone 7 staff reviewed the capacities of existing and planned facilities associated with the Intertie Portfolio to meet 100 percent of maximum day demands under normal conditions and 75% of maximum day demands assuming one major facility is out of service. Each condition is discussed below.

11.2.1 Maximum Day Demand for the Intertie Portfolio

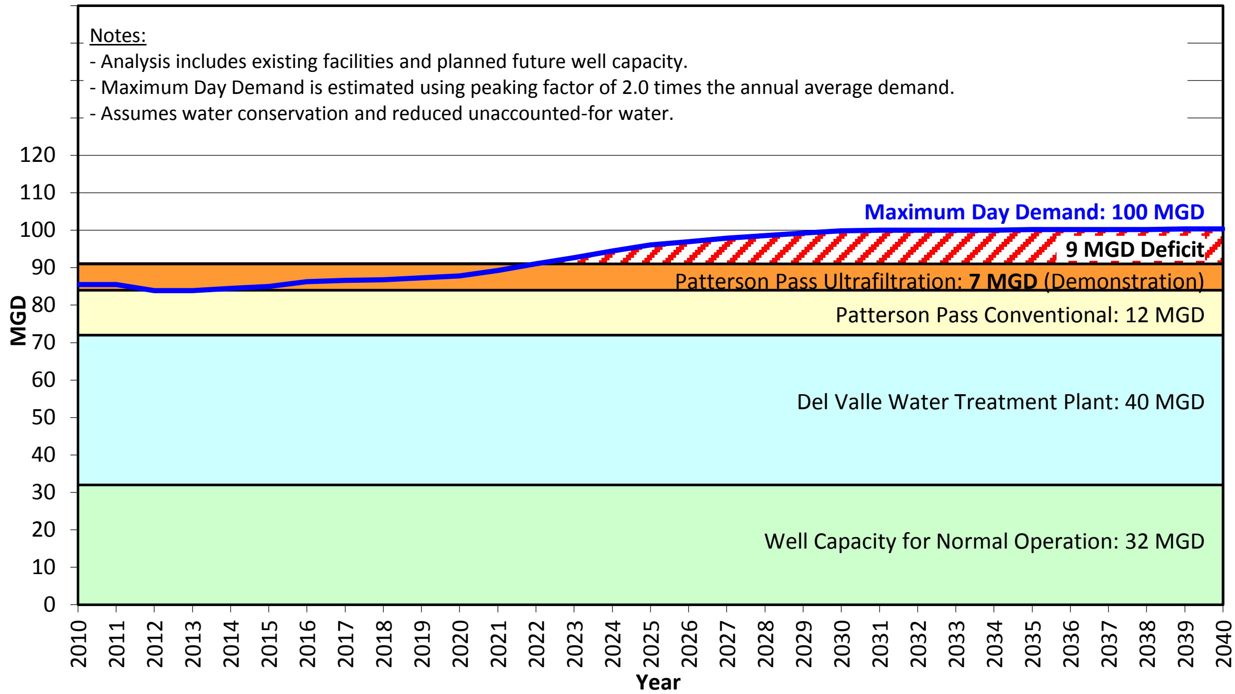
Figure 11-19 compares the capacity of existing and planned facilities associated with the Intertie Portfolio with projected maximum day demands.[125] Based on this comparison, Zone 7 can meet 100% of maximum day demands through 2022, but will require additional capacity by 2023 (9 million gallons per day [MGD]). However, the temporary ultrafiltration (UF) plant at the Patterson Pass Water Treatment Plant (PPWTP) will need to be replaced; therefore, the total new capacity required is at least 16 MGD (9 plus 7 MGD).

This analysis is dependent on the assumptions for potable demand reductions associated with the Water Conservation Act of 2009, and a 1,000 to 2,000 AF fluctuation in these assumptions could easily translate into 2 to 4 MGD of additional treatment capacity.[126] Consequently, for planning-level purposes in this WSE, the cost estimates for an initial expansion of water treatment plant capacity were based on a 20 MGD facility.

[125] Projected water demands were previously discussed in Section 3; the maximum day is obtained by multiplying by 2.

[126] 2, 000 acre-feet is about 1.8 MGD, which translates to about 3.6 MGD on the maximum day assuming a peaking factor of 2.

Figure 11-19. Intertie Portfolio: Ability to Meet Maximum Day Demand



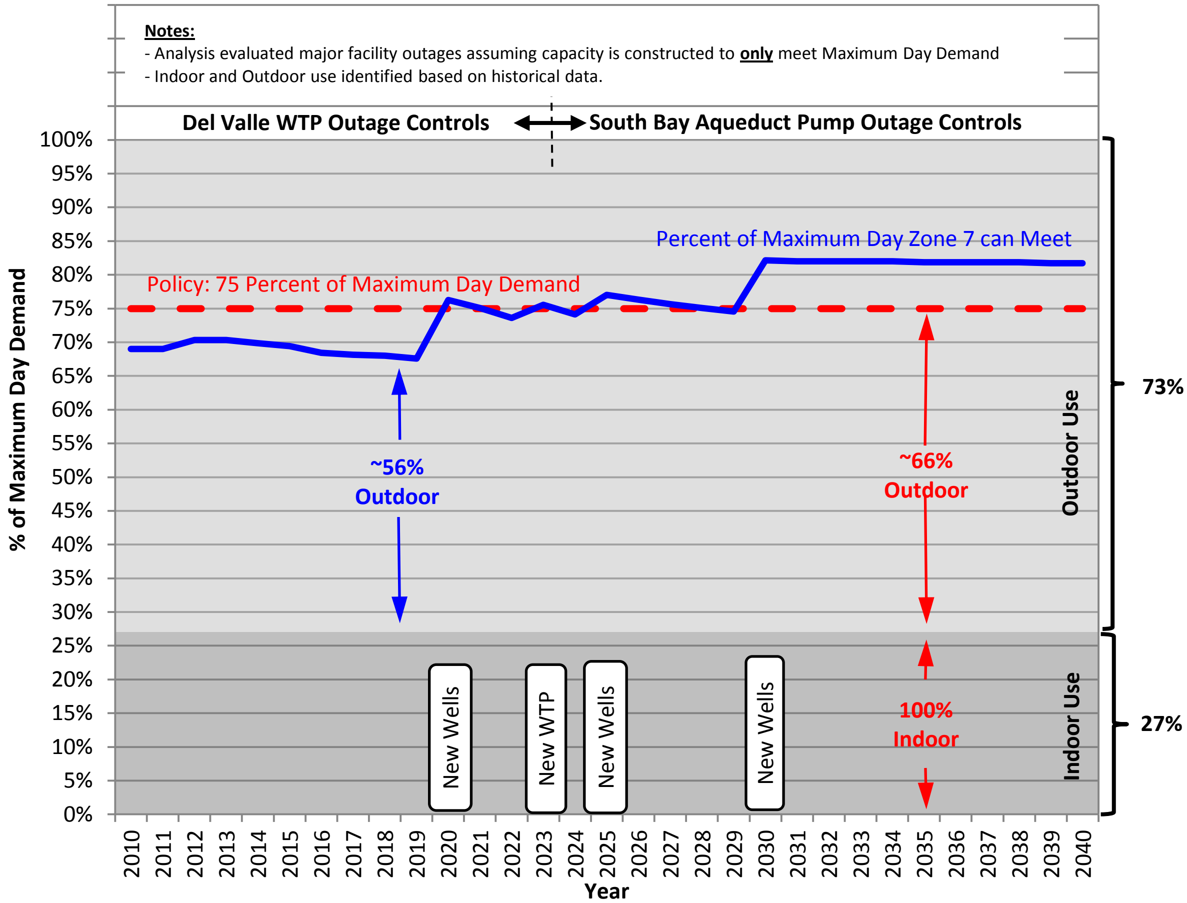
11.2.2 Level of Service for the Intertie Portfolio with a Major Facility Outage

Zone 7 staff evaluated the ability of existing and planned facilities associated with the Intertie Portfolio to meet the current facility outage policy. Figure 11-20 presents the results of this evaluation by comparing the percent of maximum day demand Intertie Portfolio facilities can meet to the current policy over time. For discussion purposes, Figure 11-20 splits the maximum day demand into indoor and outdoor use,[127] and presents the current facility schedule. The current facility schedule reflects delayed construction associated with reduced demands caused by the current economic downturn.

As shown on Figure 11-20, the current policy is to meet 75% of maximum day demand with a major facility out of service; however, another interpretation of the policy is to meet 100% of indoor use and 66% outdoor use during the same conditions. Figure 11-20 clearly shows, with a major facility outage, that existing facilities can meet 100% of indoor water needs, but only about 56% of outdoor needs until 2020. As new facilities come online, Zone 7 is increasingly able to meet and eventually exceed the existing policy.

[127] Zone 7 staff reviewed historical monthly data to split projected water demands into indoor and outdoor use. This analysis is provided as Appendix A.

Figure 11-20. Ability of the Intertie Portfolio to Meet Maximum Day Demand during an Outage



11.2.2.1 Consideration: Level of Service during a the Maximum Month

The assumptions presented on Figure 11-20 are relatively conservative. For example, one scenario evaluated assumes that all of the treatment capacity associated with the Del Valle Water Treatment Plant happens to be lost on the highest water use day of the year (i.e., the maximum day), which typically occurs between 1 to 5 out of 365 days – less than 2 percent of the time. Additionally, barring a major emergency (e.g., an earthquake, Delta levee failure, or transmission line burst), it would take multiple, simultaneous, failures of internal plant equipment to lose all treatment capacity for an entire day.[128]

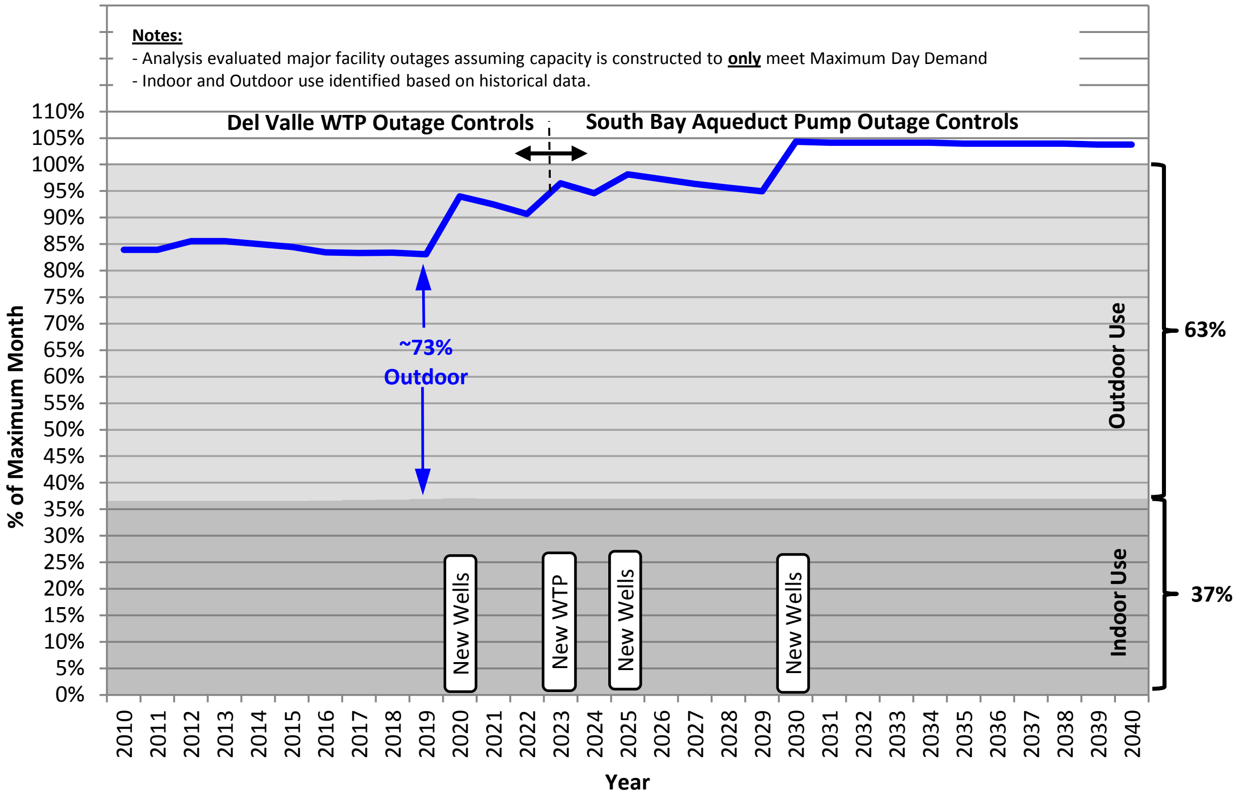
Consequently, for discussion purposes in this WSE, Zone 7 staff also reviewed the same outage scenarios over the highest water use month (i.e., the maximum month) instead of the maximum day demand. Figure 11-21 presents the same analysis completed for the maximum month.

As shown on Figure 11-21, existing facilities can meet 100% of indoor use and almost three-quarters of the outdoor use during the highest water use month and therefore, about a 25% reduction in water use would be required over a 30-day period. Assuming the typical residential customer waters their lawn

[128] Based on conservations with Zone 7 operations staff.

four times per week during the hottest month of the year, then a 25% reduction could be achieved by only watering their lawn about three times a week.

Figure 11-21. Ability of the Intertie Portfolio to Meet Maximum Month Demand during an Outage



11.3 SALT MANAGEMENT EVALUATION FOR THE INTERTIE PORTFOLIO

Zone 7 is preparing to update its Groundwater Management Plan (GWMP), which will also include an update of the Salt Management Plan (SMP). As part of this update, Zone 7 staff will conduct a more rigorous analysis of potential salt and nutrient loading in the Main Basin – a rigorous analysis of salt loading was not completed as part of this WSE.

Each of the scenarios evaluated in this WSE involved different water supply sources with different water quality characteristics that could influence future salt loading in the Main Basin. Consequently, Zone 7 staff completed a preliminary review of the potential salt loading associated with the Intertie Portfolio for comparative purposes in this WSE.[129] As discussed in Section 5, this review involved using spreadsheet models previously developed as part of Zone 7's original SMP to evaluate whether net salt loading in the Main Basin associated with the Current Plan was either increasing or decreasing. Preliminary results indicate that a new demineralization facility may be required to achieve decreasing salt loading under the Current Plan. The GWMP/SMP update will further evaluate this finding.

[129] Zone 7 will evaluate nutrients as part of the SMP update.

11.4 OBSERVATIONS REGARDING DELIVERED WATER QUALITY

As discussed previously in Section 5, conducting hydraulic modeling to quantify potential benefits to delivered water quality were beyond the scope of this WSE; however, each of the scenarios evaluated in this WSE involved different water supply sources with different water quality characteristics. Consequently, a qualitative review of each scenario was completed to evaluate whether the scenario had the potential for improving delivered water quality. The potential benefits to delivered water quality associated with the Intertie Portfolio fall into two categories: (1) those associated with the quality of supplies delivered via the intertie, and (2) those associated with the groundwater demineralization activities. Both are discussed below.

11.4.1 Potential Delivered Water Quality Benefits of the Intertie Portfolio

The quality of water supplies delivered via the intertie associated with the portfolio directly impact delivered water quality. For illustrative purposes, Table 11-1 compares the hardness and total dissolved solids of Zone 7's transmission system to those of EBMUD's system. As shown in Table 11-1, this portfolio would likely benefit delivered water quality.

Table 11-1. Comparison of Key Water Quality Constituents

Constituent	Zone 7[a]	EBMUD Walnut Creek System[b]
Hardness, mg/l	105 – 470	12 – 20
TDS, mg/l	297 – 709	45

(a) Source: Zone 7's 2009 Consumer Confidence Report

(b) Source: EBMUD's 2009 Annual Water Quality Report

11.4.2 Potential Delivered Water Quality Benefits Associated with Demineralization

As previously discussed, Zone 7 staff conducted a preliminary evaluation of salt loading associated with the Intertie Portfolio, and although it is recommended that future salt mitigation strategies be evaluated as part of the GWMP/SMP update, another phase of demineralization is in Zone 7's existing Capital Improvement Program. Therefore, a second phase was also included in the cost estimates of the Intertie Portfolio for comparative purposes in this WSE. Another phase of demineralization will have a direct positive influence on delivered water quality because it treats groundwater before it enters Zone 7's distribution system.[130]

11.5 COST ESTIMATES FOR THE INTERTIE PORTFOLIO: 75 TO 99%

The purpose of this section is to provide planning-level cost estimates for each reliability scenario evaluated under the Intertie Portfolio. For illustrative purposes, the cost estimates were divided into three categories: (1) facilities, (2) water supply, and (3) water quality. The facilities component of the cost estimates represent hard construction, such as water treatment plants, diversion structures, and groundwater wells, while the water supply component generally represented the cost of purchasing or acquiring water.

[130] The benefits of demineralization were thoroughly analyzed as part of the 2003 Water Quality Management Program report.

In all cases, the costs are presented in 2010 dollars based on an Engineering News Record San Francisco Construction Cost Index. The following planning-level cost contingencies were also applied as necessary:

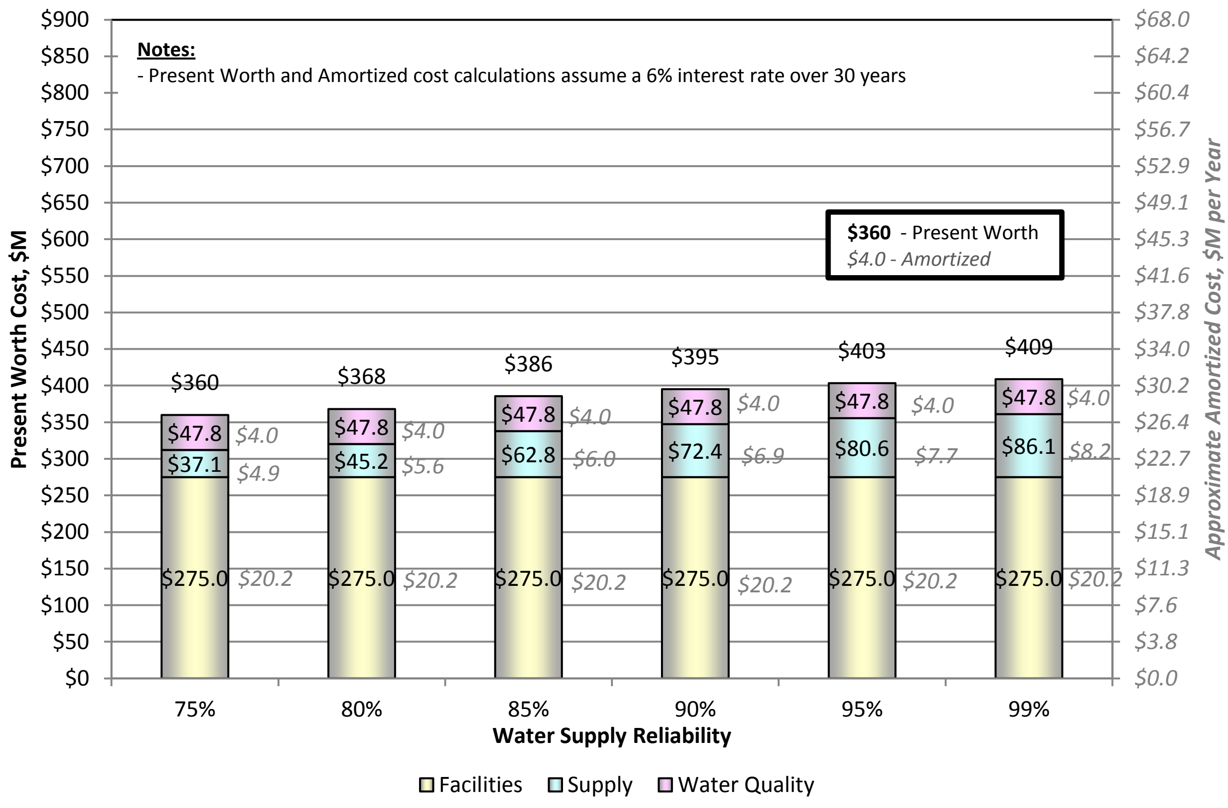
- Construction Contingency: 25 percent
- Planning and Environmental: 10 percent
- Design and Implementation: 10 percent
- Construction Management: 10 percent

Appendix D contains a more detailed description of the cost estimates used and contains preliminary schedules developed for each scenario that were used to develop present worth and amortized values.

11.5.1 <u>Observations Regarding the Cost of Reliability</u>

As shown on Figure 11-22, the facility costs do not increase between 75 and 99% reliability because the Intertie Portfolio does not provide supply on the maximum day demand. Supply costs increase proportionally depending on the amount of new supply acquired. Water quality costs are the same because all of the scenarios assume the need to construct a second demineralization facility. Overall, the total portfolio costs for a 99% reliability scenario are only about 14% ($49 million) higher than the portfolio costs for a 75% reliability scenario.

Figure 11-22. Cost of Reliability for the Intertie Portfolio



12. RECOMMENDED NEAR-TERM ACTIONS

The purpose of this section is to present the recommended "no regret" actions that will help minimize the risk of water supply shortages, while also maximizing Zone 7 Water Agency's (Zone 7) ability to adjust to an uncertain future. This section also outlines the additional studies necessary to confirm key assumptions made in this Water Supply Evaluation (WSE), while also summarizing the observations made regarding reliability, Zone 7 staff's recommendation to review the existing Reliability Policy after completion of this WSE, and a preliminary schedule for next steps.

The following subsections present the recommended near-term actions based on the analysis completed as part of this WSE:

- 12.1 Recommended No Regret Actions to Minimize Near Term Risk
- 12.2 Anticipated Benefits of the Recommended No Regret Actions
- 12.3 Additional Studies Required to Confirm Key Assumptions and Limitations
- 12.4 Observations and Proposed Next Steps Regarding Zone 7's Reliability Policy
- 12.5 Measures of Success: Preliminary Schedule for Next Steps

12.1 RECOMMENDED NO REGRET ACTIONS TO MINIMIZE NEAR-TERM RISK

Based on the analysis completed in this WSE, Zone 7 staff has the following recommendations to help improve near-term reliability, while also ensuring Zone 7 and the local water supply retailers have sufficient time to complete the additional studies necessary to confirm key assumptions made in this WSE. A more complete description of each action was previously provided in Section 6 or 7 since these actions are part of the Current Plan. All of the recommendations are lowest-cost alternatives and within the control of either Zone 7 or the local water supply retailers.

- *Confirm water supply available from the existing contract with Byron Bethany Irrigation District (BBID):*

  Zone 7 plans to work with BBID to complete a study that will help determine whether the minimum yield within Zone 7's existing contract with BBID can be modified, potentially adding 3,000 acre-feet (AF) of minimum water supply.

- *Minimize or reuse brine losses from the existing Mocho Groundwater Demineralization Plant:*

  In addition to working with Dublin San Ramon Services District (DSRSD) to develop and implement ways of capturing and reusing brine losses from the plant, Zone 7 staff also plans to use actual water quality results – not available at the time the facility was originally permitted – to reduce brine losses to 15 percent instead of 20 percent. This activity will potentially add 260 to 1,300 AF of supply.[131]

[131] The range in potential supply associated with reoperation of the Mocho Groundwater Demineralization plant depends on the quantity of brine loss that Zone 7 and DSRSD are able to capture and reuse, and depends on how much of the reuse results in potable demand reduction.

- *Reduce Unaccounted-for Water Losses:*

  Historically, Zone 7's transmission system has observed 2 percent unaccounted-for water losses; however, recent data suggests that unaccounted-for water within Zone 7's transmission system is increasing (i.e., above 4 percent). Consequently, Zone 7 plans to complete an investigation to reduce unaccounted-for water losses from 4 to 2 percent of total water production, which could reduce future water supply needs by 900 to 1,300 AF.

- *Work with Retailers to develop Additional Water Conservation and Recycled Water Programs:*

  In November 2009, the California legislature passed the Water Conservation Act of 2009 (Conservation Act), which required water supply retailers to reduce their per capita water consumption 20 percent from their baseline by 2020. Zone 7 plans to work with and help the water supply retailers meet their targets, which will likely happen via a combination of traditional water conservation measures[132] and increased use of recycled water. Initial estimates by Zone 7 staff indicate this new requirement may reduce future water supply needs by about 6,000 AF. As part of this, Zone 7 staff also recommends working with the water supply retailers to develop a water conservation tracking methodology.

- *Continue Implementing the Well Master Plan and Chain of Lakes Projects*

  Protecting local groundwater resources for the use and benefit of the Tri-Valley area is one of Zone 7's primary goals; the local groundwater basin also helps meet reliability goals during droughts or emergency conditions. Hence, Zone 7 staff recommends continuing to implement both the Well Master Plan and the Chain of Lakes projects to enhance Zone 7's ability to recharge and pump water from the groundwater basin.

- *Enhance Zone 7's Existing In-Lieu Recharge Program*

  Zone 7 staff already reduces its own groundwater pumping during wet years to help replenish and maintain groundwater supplies. Zone 7 plans to work with the water supply retailers during wet years to reduce the use of their groundwater-pumping quota and instead, use more surface water provided by Zone 7.

Zone 7 staff estimates that the total potential increase in water supply, or decrease in water demand, resulting from these actions could range from 10,000 to 12,000 AF.

12.2 ANTICIPATED BENEFITS OF THE RECOMMENDED NO REGRET ACTIONS

Zone 7 staff evaluated the ability of the water supplies and facilities included in the list of no regret actions to prevent water supply shortages, while also maintaining drought and emergency storage at a sustainable level over the next 5 to 10 years. For this evaluation, Zone 7 staff first reviewed the risk of potential water supply shortages and then reviewed the sustainability of system-wide storage, which included the Main Basin, Semitropic Water Storage District (Semitropic), Cawelo Water District (Cawelo), State Water Project (SWP) Carryover, and the Chain of Lakes.[133] Each is discussed below in more detail.

[132] Traditional water conservation measures in this WSE mean activities such as use of low-flow toilets, ET controllers, or high-efficiency washers, and improved landscape irrigation management.

[133] Key individual storage results were included in Appendix F.

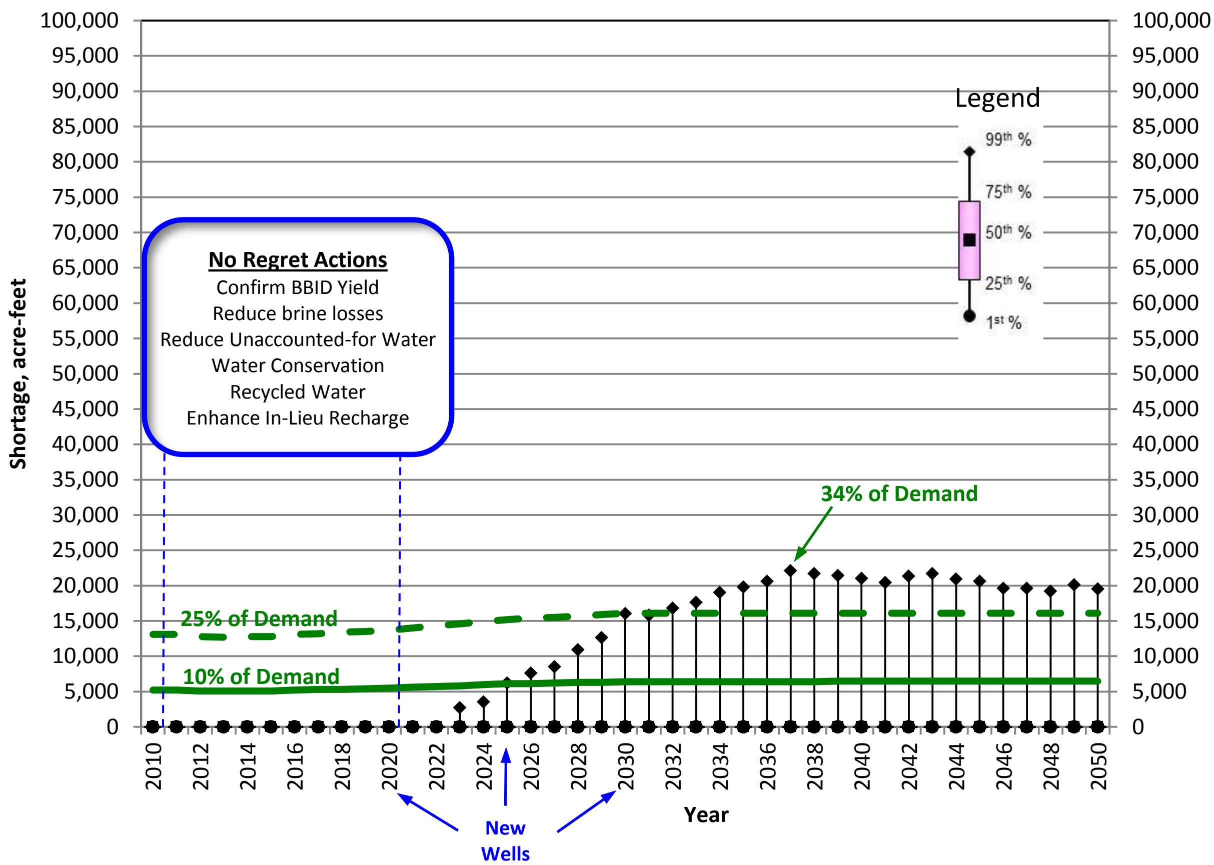
12.2.1 Reliability after Implementing No Regret Actions

Figures 12-1 and 12-2 present potential shortages and sustainability assuming Zone 7 and the local water supply retailers successfully implement no regret actions.

As shown on Figure 12-1, there is a less than 1% chance of a water supply shortage between 2011 and 2022 as long as Zone 7 and the local water supply retailers can successfully implement the no regret actions. Hence, implementing the no regret actions helps decrease the chance of shortages over the next 10 to 13 years, thereby, providing Zone 7 and local water supply retailers additional time to further investigate and refine the portfolios developed as part of this WSE. This is important, as a major new water supply project can take 10 to 15 years to implement.

Figure 12-1 also indicates that there is a risk of shortages larger than 10% between 2025 and 2050, and that the maximum potential shortage is over 30%.

Figure 12-1. Risk of Potential Shortages after Implementing No Regret Actions[134]

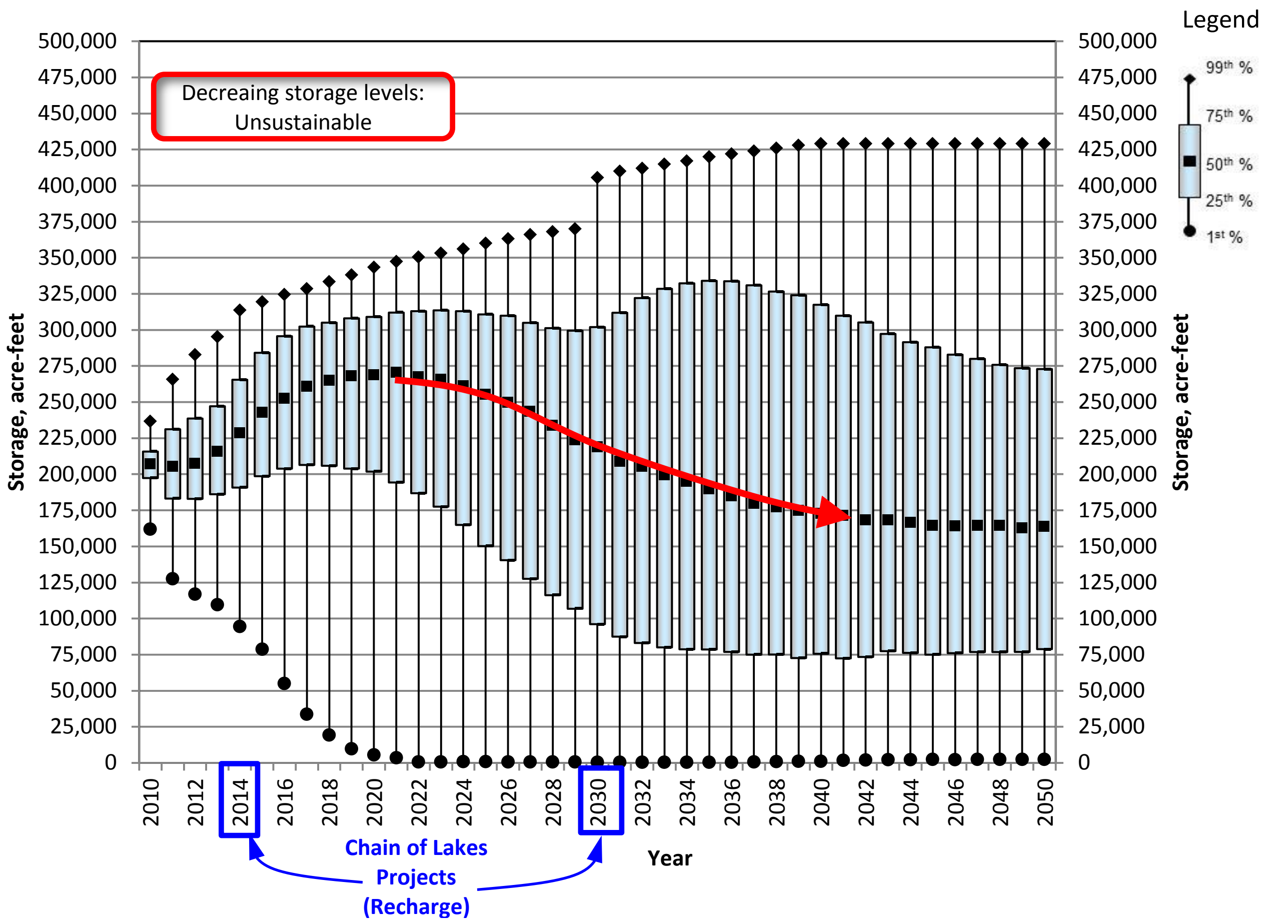


As shown on Figure 12-2, implementing no regret actions alone does not make total storage sustainable over the long-run; however, these actions do dramatically increase storage levels over the next 10 to 13

[134] The shortages presented in Figure 12-1 are projections assuming the State of California cannot implement a Delta Fix and no further action is taken by Zone 7.

years, which increases the likelihood of having sufficient drought and emergency storage until a new major water supply project[135] can be completed.

Figure 12-2. Sustainability of Total Storage after Implementing No Regret Actions



12.3 ADDITIONAL STUDIES REQUIRED TO CONFIRM KEY ASSUMPTIONS AND LIMITATIONS

Based on the analysis completed in this WSE and discussions with the local water supply retailers, Zone 7 staff recommends completing several new studies over the next few years to help confirm key assumptions used in this WSE and better define limitations associated with some of the portfolios (e.g., potential potable water demand reductions from recycled water). The purpose of this section is to provide a brief description of each study, including its intended goals and objectives.

12.3.1 Recommendation for the Current Plan: Continued Participation in Delta Fix Efforts

The key to improving water supply reliability under the Current Plan is the successful implementation of the Delta Fix, with SWP reliability restored to 75% by 2025. Even if the Livermore-Amador Valley (Valley) develops additional non-SWP water supplies, the State Water Project will continue to meet the majority

[135] Examples of a new major project include a fix in the Delta that improves State Water Project reliability, additional recycled water programs, and the Bay Area Regional Desalination Project.

of existing and future water demands – the reliability of the State Water Project and sustainability of the Sacramento-San Joaquin Delta (Delta) will therefore always be important for the Valley.

Consequently, Zone 7 staff recommends continued participation in any efforts potentially leading toward restored reliability of the State Water Project and improving the sustainability of the Delta, particularly, the Bay Delta Conservation Plan and the Delta Habitat Conservation and Conveyance Plan studies.

12.3.2 Recommended Studies for the In-Valley Portfolio: Understanding Water Quality and Demand

As previously discussed in Section 10, Zone 7 and the local water supply retailers may need to develop anywhere from 3,000 to 7,600 AF[136] of additional recycled water – above the 5,900 AF[137] already planned – to meet reliability targets ranging from 75 to 99%. This represents approximately 8,900 to 13,500 AF of total recycled water use in the Livermore-Amador Valley. This is a significant amount of recycled water, and assuming a sufficient number of potential recycled water customers, could increase total recycled water use in the Valley by approximately 128% over current plans. Additionally, some of the recycled water may require storage.

Consequently, Zone 7 staff recommends studying the potential water quality impacts of increased recycled water use as part of the planned Groundwater Management Plan Update (GWMP Update) and associated Salt Management Plan Update (SMP Update), while also working with the retailers to incorporate "valley-wide" recycled water demand estimates to ensure required potable water demand reductions are feasible. Zone 7 staff also recommends working with the local water supply retailers to complete a study that identifies potential recycled water storage options. Both are discussed below in more detail.

12.3.2.1 Understand Water Quality Implications Associated with Additional Recycled Water Use

Although an analysis was completed in this WSE to help compare the potential salt loading implications of each portfolio evaluated, Zone 7 staff plans to complete a much more rigorous analysis as part of the GWMP Update, which will include the SMP Update. As part of these updates, Zone 7 recommends analyzing the influence that applying 3,000 to 7,600 AF of additional recycled water may have on the water quality of the basin, focusing on answering the following questions:

- What is the best salt management strategy for allowing development of additional recycled water supplies?
- How much recycled water can be applied over the Main Basin without triggering extensive salt mitigation?
- Does it matter where the recycled water is applied over the Main Basin?
- Based on a qualitative review, would applying recycled water in large quantities increase nutrient loading or contaminants of emerging concern in the groundwater basin; if so, what are the appropriate mitigation strategies?

[136] Includes 2,000 AF of recycled water assumed implemented by the Retailers to meet water conservation targets under the Water Conservation Act of 2009.

[137] Both Dublin San Ramon Services District and the City of Livermore have existing recycled water systems; both systems together already plan to produce 5,900 AF by 2030.

Developing estimates or answers to these questions is vital to understanding the potential limits – from a water quality perspective – on the amount of recycled water Zone 7 and the local water supply retailers can develop and rely on in the future.

12.3.2.2 Link Potable Demand Reduction via Recycled Water with Potential Customers

Even if Zone 7 and the local water supply retailers can develop an additional 3,000 to 7,600 AF of additional recycled water in a way that protects local groundwater resources, additional analysis is necessary to determine whether sufficient demand exists for such large amounts of recycled water.

For example, 1,000 to 5,600 AF of additional recycled water may require converting 300 to 1,700 acres of land currently irrigated with potable water to recycled water (see Section 10). Assuming the average park or school within the Valley is about 20 acres would imply the need to convert anywhere from 50 to 280 parks to recycled water—this is a large, potentially unfeasible number. Additionally, the unit costs developed for the In-Valley Portfolio were based on previous studies that identified the infrastructure necessary to convert mostly parks and schools. Converting other types of land uses (e.g., commercial and multi-family) could significantly increase the costs.

Consequently, Zone 7 staff recommends completing a study – in cooperation with the local water supply retailers – that estimates the potential recycled water demand in the Valley, using the potable demand reductions identified in this WSE to help better refine cost estimates and schedules of construction. In particular, the study should focus on answering the following questions:

- How much recycled water demand exists in the Valley?
- Where is the recycled water demand located?
- How would cost estimates change if other land use types (e.g., commercial) were converted to recycled water?
- How long would it take to construct a recycled water system able to achieve the potable demand reductions identified in this WSE?

Developing estimates or answers to these questions is vital to understanding the potential limits – from a quantity perspective – on the amount of recycled water Zone 7 and the local water supply retailers can develop and rely on in the future.

12.3.2.3 Identify Feasible Recycled Water Storage Options

Based on the analysis completed in this WSE, Zone 7 staff identified the potential need for recycled water storage for potable demand reductions between 3,200 and 5,600 AF. Developing and implementing a recycled water storage facility could take 10 or more years; consequently, Zone 7 staff recommends completing a study that looks into feasible recycled water storage alternatives—both local and near Sunol. In particular, the study should focus on answering the following questions:

- What are the potential storage options and where are they located?
- How long will it take to develop identified options and do they provide enough storage?
- What are the costs of the various options identified: capital, and operation and maintenance?
- What are the permits required to construct options identified?
- Is there potential grant funding available for recycled water storage projects?

Providing answers to these questions will help Zone 7 and the local water supply retailers determine the feasibility of developing recycled water storage and the role that additional recycled water programs will play in improving water supply reliability for the Livermore-Amador Valley.

12.3.3 Recommended Studies for the Intertie Portfolio

As discussed in Section 11, Zone 7 may need to develop as much as 5,600 AF of normal/wet year water supply and as much as 5,600 AF of dry year supply using several potential sources that are conveyed to Zone 7 through a new intertie. The analysis completed in this WSE helped establish these potential water supply needs; however, additional study and analysis is necessary to better refine potential costs and supply yields.

Consequently, Zone 7 staff recommends working with EBMUD and other potential water agencies to understand intertie options, determine the feasibility of potential normal/wet year water supplies identified, determine the availability of dry year water supplies, and continue to participate in feasibility studies for the Bay Area Regional Desalination Project (BARDP). Each is discussed below in more detail.

12.3.3.1 Identify Feasible Options for a New Intertie with another Water Agency

Based on the analysis completed for this WSE (see Section 11), Zone 7 staff recommends investigating feasible options for reliability interties with other water agencies, focusing on potential options with both East Bay Municipal Utility District (EBMUD) and San Francisco Public Utilities Commission (SFPUC) – EBMUD and SFPUC are the closest major water agencies to Zone 7's conveyance and transmission system. In particular, the feasibility study should focus on answering the following questions:

- Are there intertie options with EBMUD and SFPUC, and are they feasible?
- What size are the intertie options, and can they meet the needs of both agencies involved?
- Which intertie options provide the most flexibility for future supplies?
- What are the associated costs for each intertie option identified?
- How long would it take to design and construct an intertie?
- Is there grant funding available for an intertie?
- What other benefits might an intertie offer?

Answering these questions will help confirm the best approach for increasing reliability and flexibility via an intertie with another water agency.

12.3.3.2 Identify Potential Normal/Wet Year Supply Options Available

Based on preliminary discussions with EBMUD staff, it appears that normal/wet year water cannot be wheeled to Zone 7 via EBMUD's Freeport project because EBMUD only operates the Freeport project during dry years. Additionally, subsequent discussions with EBMUD indicate that there are no normal/wet year water supplies available in the Mokelmune watershed, and due to source water constraints, EBMUD may not currently have a source of supply they can use to participate in a potential groundwater-banking program with Zone 7.

Consequently, Zone 7 staff recommends completing a study that looks into potential sources of normal/wet year water supply that can be wheeled through new interties with either EBMUD or SFPUC. The study should focus on answering the following questions:

- Is there normal/wet year water supply available?

- What is the quantity of normal/wet year supply?
- What is the water quality of possible supply sources?
- What types of exchanges and programs are required to wheel the water?

Answering these questions will help refine the limits associated with the Intertie Portfolio.

12.3.3.3 Determine the Availability of Dry Year Water Supplies and Refine Wheeling Costs

As previously shown in Section 11, wheeling dry year water supply via a new intertie with EBMUD can improve the long-term reliability of Zone 7's system. However, additional information and analysis is required to fully understand the limitations and benefits of such an arrangement; particularly, EBMUD's ability and willingness to wheel water, the cost to wheel water through EBMUD's systems, the potential yields and cost of the actual water supply, and whether short-term or long-term agreements to wheel water are even feasible. Consequently, Zone 7 staff recommends working with EBMUD to better understand these constraints and limitations over the next few years.

12.3.3.4 Continued Participation in Planning Efforts for Regional Desalination

As described in Section 9, Zone 7 is one of five partners[138] reviewing the feasibility of a new regional desalination facility. This regional facility is another potential source of water supply for Zone 7, particularly, normal/wet year water that could be used directly or to maintain existing drought and emergency storage reserves. Additionally, all five partners are working together to investigate and secure grant funding sources for this project, including Water Resources Development Act Funding that potentially pays 75 percent of project costs. Zone 7 staff recommends continuing to participate in the feasibility studies for this project, especially those studies that confirm water supply sources, refine wheeling constraints and costs, and evaluate environmental impacts and energy needs.

12.4 OBSERVATIONS AND PROPOSED NEXT STEPS REGARDING ZONE 7'S RELIABILITY POLICY

As part of this WSE, Zone 7 staff evaluated the influence costs and the mix of water supplies in each portfolio potentially have on the reliability and sustainability of Zone 7's water system. The purpose of this section is to summarize Zone 7 staff's observations regarding reliability and recommended next steps.

12.4.1 <u>Relationship of Costs to System Reliability</u>

Figures 7-18, 10-22, and 11-22 previously presented costs estimates for the Current Plan, In-Valley Portfolio, and Intertie Portfolio, respectively, for reliability targets ranging from 75 to 99%. Table 12-1 compares the percentage increase in costs from 75 to 99% reliabilities associated with each portfolio.

As shown in Table 12-1, the cost components of the Current Plan are less sensitive to the reliability target (i.e., only about 10%), while the supply costs for the In-Valley and Intertie Portfolios are very sensitive (i.e., 130 to 390% increase). However, Table 12-1 also shows that percentage increase in total portfolio costs from 75 to 99% reliability only varies from 10 to 20% ($36 to $72 million) – this small increase is well within the planning-level accuracy of this WSE and typical contingencies used as part of Zone 7's Capital Improvement Program.

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[138] The five partners include East Bay Municipal Utility District, San Francisco Public Utilities Commission, Contra Costa Water District, Santa Clara Valley Water District, and Zone 7 Water Agency.

Table 12-1. Estimated Cost Increase from 75 to 99% Reliability Target[a]

Cost Component	Current Plan		In-Valley		Intertie	
	$, million	%	$, million	%	$, million	%
Facility Costs	20.5	7.5	(50.9)	(20)[b]	0	0
Supply Costs	15.2	10	122.6	390	49	132
Water Quality Costs[c]	--	--	--	--	--	--
Total Costs	35.7	8	71.7	22	49	14

(a) Costs are in Present Worth dollars.

(b) The percentage increase is negative because the cost of recycled water facilities were included in the supply cost and the size of potable water facilities decrease as more potable demand reduction is achieved via recycled water.

(c) The water quality costs were based on an additional phase of demineralization for all scenarios under each portfolio; however, future salt mitigation strategies – including the pros and cons of demineralization – will be evaluated as part of the GWMP Update, which will include an update of the SMP.

12.4.2 Reliability Target that Achieves Sustainability

The Intertie Portfolio needs at least 5,100 AF of normal/wet year water supply to maintain a sustainable level of drought and emergency storage. Additional analysis completed by Zone 7 staff indicated that securing such a normal/wet year water supply for the Intertie Portfolio beyond 2030 result in at least 85 to 90% reliability in the long-term. Hence, a certain level of reliability is achieved while securing sufficient water supply to maintain sustainable storage levels.

Table 12-2 compares the reliability target required under each portfolio to achieve sustainability. As shown in Table 12-2, maintaining sustainable levels of storage provides a minimum reliability of 85% for both the Current Plan and the Intertie Portfolio, while the In-Valley Portfolio appears to provide a minimum 75% reliability. The In-Valley Portfolio likely supports a lower reliability target because the supply source varies less with hydrologic conditions – potable demand reductions automatically yield more normal/wet year water that can be used to replenish storage reserves and more dry year water for use during dry conditions.

Table 12-2. Minimum Reliability Target that Achieves Sustainability

Current Plan	In-Valley Portfolio	Intertie Portfolio
85%	75%	90%

12.4.3 Potential of Demand Hardening and Implications to Reliability Target

Table 12-3 presents the estimated potable water demand reductions assumed for the Current Plan and both backup portfolios. As shown in Table 12-3, Zone 7 expects potable water demands to decrease by 8.5 to 20% over the next 10 to 20 years. Most of this decrease is associated with water use reductions achieved through assumed water conservation efforts or new recycled water programs; in either case, this reduction is likely to be permanent. This implies that water demands will become less flexible and more difficult to reduce during drought conditions (i.e., water demands associated with the constituency of the Livermore-Amador Valley will become harder).

Table 12-3. Potential Future Potable Demand Reductions Assumed in this WSE

Current Plan	In-Valley Portfolio	Intertie Portfolio
8.5%	8.5%	11 to 19%

Additionally, as previously discussed in Section 5, each reliability target evaluated is based on the maximum potential shortage, or, in this case, the maximum amount of voluntary water conservation. For example, a reliability target of 85% implies a potential voluntary reduction in water use of up to 15% during severe drought conditions. If 10 to 20% of typical water use has already been permanently eliminated, then asking for an additional 15% reduction is effectively asking for a 25 to 35% total reduction from typical water use under the most severe drought conditions.

By comparison, Zone 7 staff has estimated that the total "valley-wide" voluntary water use reduction observed during the most recent drought (2007 to 2010) and the last six-year drought (1987 to 1992) was approximately 10 and 20%,[139] respectively. Consequently, under the most severe drought conditions for example, an 85% reliability target could result in total reductions that exceed historical observations by approximately 10 to 15%.

12.4.4 Recommended Next Steps Regarding Zone 7's Existing Reliability Policy

Based on the analysis completed as part of this WSE, Zone 7 staff recommends working with the local water supply retailers to develop several proposals for changing the existing reliability policy for Zone 7's Board of Directors to consider. Zone 7 staff recommends initiating this effort shortly after completing this WSE.

12.5 MEASURES OF SUCCESS: PRELIMINARY SCHEDULE FOR NEXT STEPS

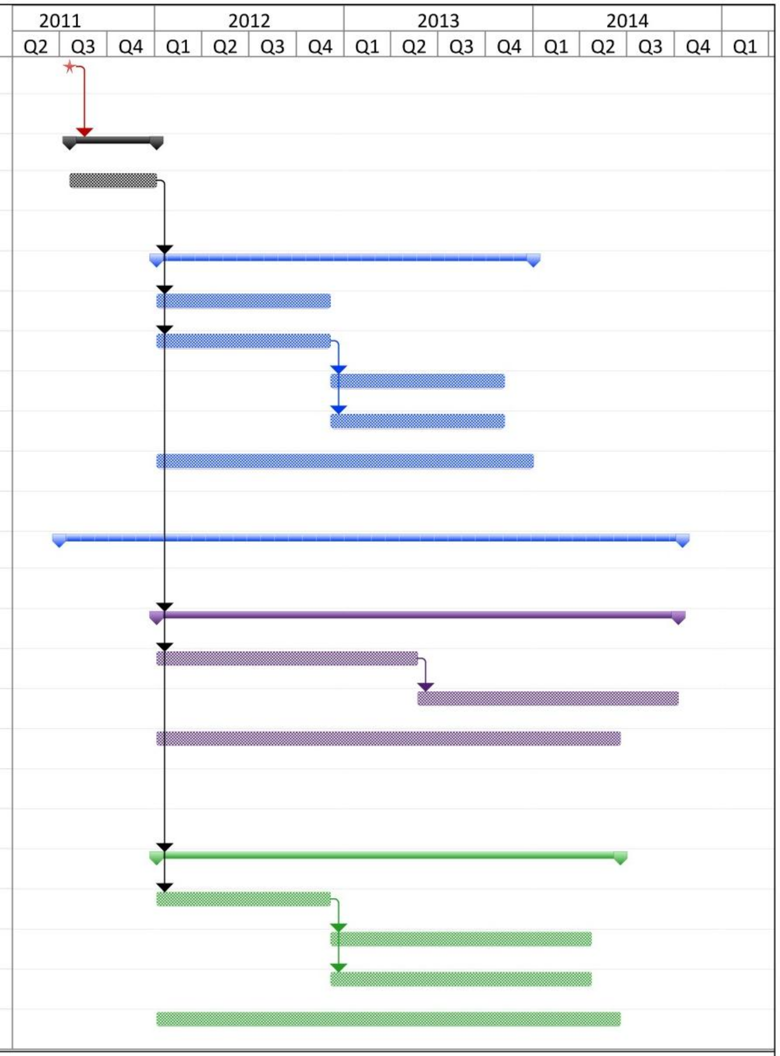
As previously discussed above, Zone 7 staff is recommending a series of additional studies that will help refine the limits of each portfolio evaluated as part of this WSE. The ability of Zone 7 to work with the local water supply retailers to implement the no regret actions is crucial to minimizing near-term risks of water supply shortages, while completing the recommended studies over the next few years to verify key assumptions is vital to maximizing the flexibility to change directions. Both elements are critical as successfully implementing the recommended no regret actions and understanding the limits of each portfolio are necessary to ensure that Zone 7 is properly positioned pending the outcome of a solution implemented by the State of California for the Delta.

This section presents a preliminary schedule for completing near-term actions recommended in this section. Figure 12-3 presents the preliminary schedule; this preliminary schedule provides a method for measuring the success of implementing no regret actions, while also refining each water supply portfolio. As shown on Figure 12-3, Zone 7 staff recommends working with the retailers to develop proposals for changing Zone 7's existing reliability policy over the next six to seven months, and hopes to complete the major studies by late 2013 and early 2014.

[139] Valley-wide demands were obtained from Zone 7's own turnout records and additional data provided by the local water supply retailers as part of Urban Water Management Plan activities and data collected in support of this WSE. Individual water use reductions for each local water supply retailer and Zone 7's own system differed significantly.

Figure 12-3. Measures of Success: Preliminary Schedule of Next Steps

ID	Task Name
1	**Finalize Water Supply Evaluation**
2	
3	**Review Reliability Policy**
4	Develop Proposals with Retailer Input
5	
6	**No Regret Actions**
7	Unaccounted-for Water Study
8	Brine Loss Study
9	Confirm BBID Yield
10	Formalize Enhanced In-Lieu Recharge Program
11	Water Conservation Tracking Methdology
12	
13	**On-Going Studies for the Delta and SWP**
14	
15	**Activities for the In-Valley Portfolio**
16	Link Potable Reductions Required to Potential Recycled Water Demand
17	Investigate Feasible Recycled Water Storage Options
18	Understand Water Quality Implications Associated with Recycled Water
19	*(in coordination with the Groundwater Management Plan Update)*
20	
21	**Activities for the Intertie Portfolio**
22	Identify Feasible Intertie Options
23	Investigate Potential Normal/Wet Year Supply Sources
24	Investigate Potential Dry Year Supplies with EBMUD
25	Bay Area Regional Desalination Project Studies



LEGEND

Completion of WSE ★ | Task | In-Valley
Summary | Current Plan | Intertie