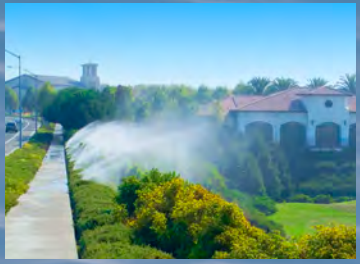

WSMP 2040

WATER SUPPLY MANAGEMENT PROGRAM 2040 PLAN

EBMUD EAST BAY MUNICIPAL UTILITY DISTRICT

FINAL APRIL 2012

WSMP 2040

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The primary purpose of the Water Supply Management Plan 2040 is to identify solutions to meet dry-year water needs through 2040.

1. Introduction

1.1 Purpose

The Water Supply Management Program 2040 Plan (WSMP 2040) is an update to the East Bay Municipal Utility District's (EBMUD)'s 1993 Water Supply Management Program. The primary purpose of the WSMP 2040 is to identify and recommend solutions to meet dry-year water needs through the year 2040. The WSMP 2040 advocates performance objectives for EBMUD's water planning, to the benefit of its customers and the environment (presented in Table 2-1 in Chapter 2).

The WSMP 2040 continues the District's commitment to demand-side water management solutions by extending and expanding the current goals for rationing, conservation, and recycled water through 2040. Supplemental supply components are identified to ensure that the District will reliably provide water to its customers into the future without extreme burden due to rationing.

1.2 Key Aspects of the WSMP 2040 Plan

The WSMP 2040 seeks to provide a diverse and robust water supply portfolio[1] that ensures water reliability in an uncertain future while also protecting the environment. Through implementation of the WSMP 2040, EBMUD is meeting future growth with aggressive conservation and recycling, while supplemental supply components allow a lower rationing level and thereby decrease direct impacts on EBMUD customers during dry years. The WSMP 2040 pushes conservation and recycling to the maximum, with a total of 50 million gallons per day (MGD) of future supply being provided from those two component categories.

[1] When components such as recycling, conservation and supplemental supply are combined into a set of interrelated actions, the set of actions is referred to as a "portfolio."

Key Aspects of the WSMP 2040

Rigorous methodology for demand projection and need for water calculations.

Future demand change primarily due to infill development and densification.

Conservation and Recycling are pushed to the edge of cost-effectiveness.

Up to 15% Rationing allows flexibility in the face of future uncertainty.

Environmental benefits are considered throughout.

Climate Change effects on water supply and demand.

Regional partnerships are essential for success.

An active and participatory public outreach process.

Components of the WSMP 2040 Portfolio

The WSMP 2040 Portfolio includes the following rationing, conservation, and recycled water goals:

- Rationing Up to 15%
- Conservation Level D (39 MGD)
- Recycling Level 3 (11 MGD)

Rationing of up to 15% was chosen to allow the District flexibility in an emergency or to respond to the many unknown factors in the future. Maximum levels of conservation (39 MGD) and recycled and raw water (11 MGD) were chosen to maintain the District's current aggressive policies for overall demand management. The combination of rationing, conservation, and raw and recycled water will satisfy increased customer demand through 2040.

Supplemental supply components will also be needed to keep rationing at a lower level and to meet the Need for Water in drought years. EBMUD will continue to study several supplemental supply components as part of the WSMP 2040 Portfolio.

- Northern California Water Transfers
- Bayside Groundwater Project Phase 2
- Sacramento Basin Groundwater Banking / Exchange
- San Joaquin Basin Groundwater Banking / Exchange
- Regional Desalination
- Expand Los Vaqueros Reservoir
- Enlarge Lower Bear Reservoir

Multiple supplemental supply components will be pursued on parallel tracks to provide a diverse and flexible strategy to meet future water needs. The success of one component could result in delaying the need for additional supplemental supply components over the course of the planning period.

The graph to the right shows how the Need for Water assuming 15% rationing of 82 million gallons per day in 2040 could be met with Conservation (C), Recycled Water (RW), Transfers (T), Bayside Groundwater Project Phase 2 (BGW2), Sacramento Groundwater Banking Exchange (SacGW), and Desalination (D).

Variability of Mokelumne River flows requires storage to ensure system reliability. While below ground storage components are generally preferred over above ground storage options, both are included in the WSMP 2040 to provide continued reliability and diversity in the supply source and storage mechanism. To some degree, all of the supplemental supply components included in the WSMP 2040 Portfolio (also referred to as the Preferred Portfolio) involve regional partnerships, which are necessary for success.

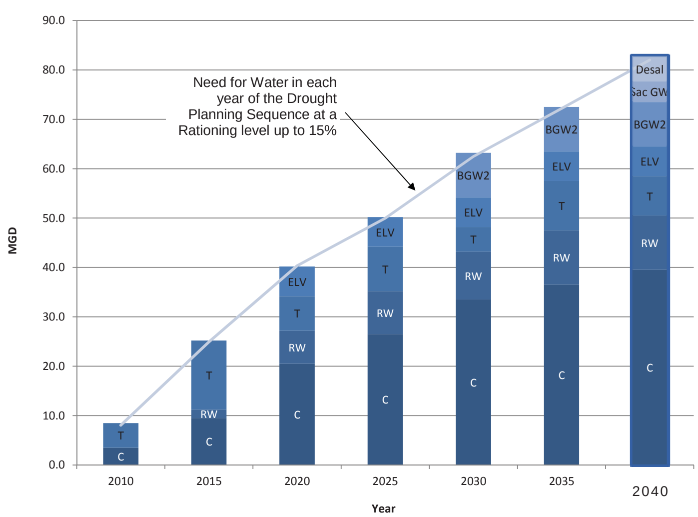


Figure 1-1 *The WSMP 2040 Portfolio Meets the Need for Water over the Planning Period.*

The information presented in this figure is based on studies that were prepared for the 2009 WSMP 2040 Portfolio, prior to the CEQA revision effort. The WSMP 2040 Portfolio meets the Need-For-Water over the planning period. See Chapter 2, Figure 2-7 for more detail. Note that the Board amended rationing to up to 15% for the Plan. The PEIR Preferred Portfolio (i.e., WSMP 2040 Portfolio), Portfolio A, Portfolio B, and Portfolio E called for 10% rationing.

1.3 The Plan – Summary

The WSMP 2040 Portfolio provides water supply reliability through 2040 with a flexible program that:

- Meets projected growth in customer demand through aggressive water conservation and recycled water development; and
- Lowers customer rationing burdens during an extended drought from the District's current policies through development of new supplemental water supply initiatives.

Many of the supplemental supply and recycled water projects components that are proposed in the WSMP 2040 have institutional or legal complexities or will require yet unknown amounts of time to develop, design, and construct. Thus, to provide flexibility and a robust strategy to deal with these uncertainties, as well as those relating to global climate change, an adaptable and flexible WSMP 2040 Portfolio was developed.

- **Robust:** A robust plan for an uncertain future (e.g., global climate change).
- **Parallel Tracks:** Pursue multiple, parallel project components.
- **Flexible:** Diverse & flexible strategy.

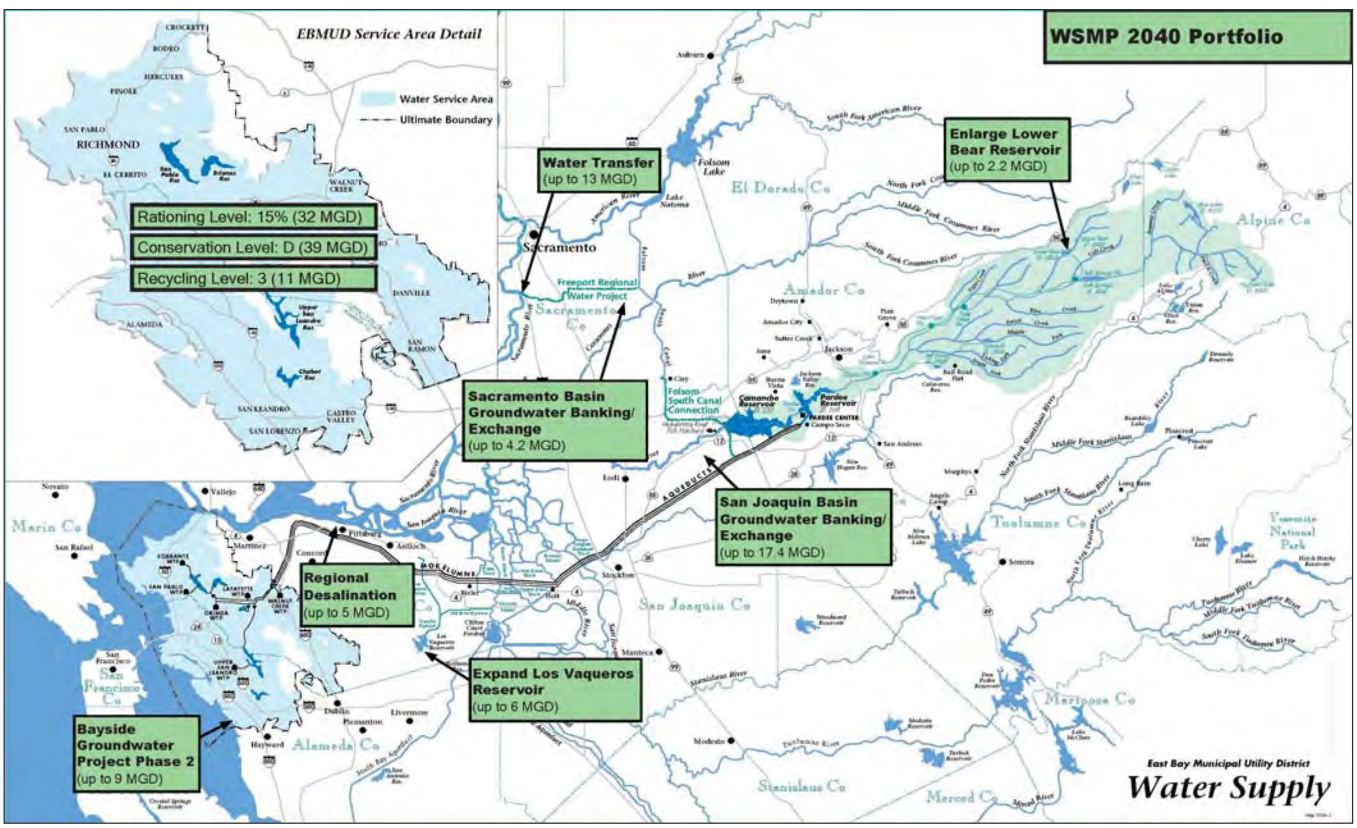


Figure 1-2 *Overview of the WSMP 2040 Portfolio Components. See Chapter 2, Figure 2-3 for more detail.*

1.4 Revisions to the 2009 WSMP 2040

In 2009, the Program Environmental Impact Report (PEIR) for the 2009 WSMP 2040 was challenged in court. EBMUD prepared draft revisions to the PEIR to address the deficiencies identified in the order issued by the Superior Court for the County of Sacramento in the matter of Foothill Conservancy et al. v. East Bay Municipal Utility District, Case No. 34-2010-80000491. The revisions to the PEIR analysis resulted in recommended changes to the WSMP 2040 Portfolio of policies and project options which are embodied in this WSMP 2040 Plan.

Changes to the 2009 Plan include revisions to the WSMP 2040 Portfolio to include the Expand Los Vaqueros Reservoir component and to remove the Enlarge Pardee Reservoir component.

Where appropriate, the Plan was updated to reflect the current status of District efforts. For example, the descriptions of the Bayside Groundwater Project Phase 1 and the Freeport Regional Water Project were updated to reflect that their construction is now complete. The discussion of recycled water projects was updated to reflect that certain projects have been implemented. The discussion of water conservation measures proposed for WSMP 2040 was augmented to include a description of the requirements of Senate Bill x7-7. Finally, in Chapter 5, Board meetings and public meetings conducted as part of the revision effort are now inserted.

A full list of the changes made to the Final Plan is presented in Appendix A: Revisions to the 2009 WSMP 2040.

The planning objectives of the WSMP 2040, as developed by the EBMUD Board of Directors, address the Program's ability to provide flexibility and reliability, minimize environmental and socioeconomic effects, and minimize overall costs to the customers.

2. The Plan

2.1 WSMP 2040 Planning Objectives

EBMUD is updating its 1993 Water Supply Management Program (WSMP), which identified projects that could be implemented to meet projected water demands through 2020. The WSMP 2040 estimates water supply needs to the year 2040, and proposes a program of policy and project initiatives to meet those needs.

EBMUD's water supplies are estimated to be sufficient during the planning period (2010-2040) in normal and wet years. The primary purpose of WSMP 2040 is to identify and recommend solutions to meet dry-year water needs through the year 2040. Increased water demand through 2040 by the other water agencies that rely on the Mokelumne Basin for their supply, expected growth within EBMUD's own service area, and the potential impact(s) climate change could have on river flow and customer demand means that EBMUD cannot completely rely upon stored water in its reservoirs under drought conditions in the future. Thus, the WSMP 2040 was developed to counteract future dry-year water supply shortages that are likely to occur more frequently.

The planning objectives of the WSMP 2040, as developed by the EBMUD Board of Directors, address the Program's ability to provide flexibility and reliability, minimize environmental and socioeconomic effects, and minimize overall costs to EBMUD customers. These objectives provide the basis for the policies and facility development/improvement projects included in the WSMP 2040. The WSMP 2040 planning objectives are organized under four categories. (See Table 2-1).

Operations, Engineering, Legal and Institutional address water supply reliability, utilization of the District's current water right entitlements, and the development of regional solutions.

Table 2-1 WSMP 2040 Planning Objectives

Operations, Engineering, Legal & Institutional
Provide water supply reliability.
Utilize current water right entitlements.
Promote District involvement in regional solutions.
Economic
Minimize cost to District customers.
Minimize drought impact to District customers.
Maximize positive impact to local economy.
Public Health, Safety & Community
Ensure the high quality of the District's water supply.
Minimize adverse socio-cultural impacts (including environmental justice).
Minimize risks to public health and safety.
Maximize security of infra-structure and water supply.
Environmental
Preserve and protect the environment for future generations.
Preserve and protect biological resources.
Minimize carbon footprint.
Promote recreational opportunities.

The Economic objectives address both the cost of water supply and water cutbacks as borne by District customers, and maximizing the positive impact of water supply portfolios on the local economy (through jobs).

The Public Health, Safety, and Community objectives address the need to ensure that the District's high quality water is maintained, that adverse sociocultural impacts and risks to public health and safety are minimized and that the security of the District's water supply and infrastructure is maximized.

The Environmental objectives address the District's interest in sustainable solutions that preserve and protect the environment for future generations, protection of biological resources, minimizing carbon footprint and contributions to global climate change, and the continuation and promotion of recreational opportunities.

2.2 The Process

The development of the WSMP 2040 Portfolio and Primary water supply portfolios required detailed evaluation of a wide range of potential dry-year water supply solutions. The development of water supply portfolios was a robust and detailed evaluation of a wide range of potential water supply solutions. The building blocks of the proposed WSMP 2040 portfolios are "components" consisting of various rationing policies, conservation levels (and conservation elements/programs that reside in the particular levels), recycled water program levels (and project components that reside in particular levels), and a range of supplemental supply options. The individual components are described in detail in Section 6.1 as well as Appendix B.

When components are combined into a set of interrelated actions, the set of actions is referred to as a "portfolio." A thematic approach was used to develop the portfolios to emphasize one or more of the planning objectives (see Table 2-1) and respond positively to meeting the screening criteria. Preliminary portfolios were presented to the EBMUD Board of Directors as well as the Community Liaison Committee and refinements were made resulting in a total of 14 preliminary portfolios.

The 14 portfolios were tested using a water supply model to:

- Ascertain operational feasibility and the volume of water delivered during the worst-case drought;
- Determine the frequency and severity of required rationing, and the potential cost of such rationing to customers in the EBMUD service area; and
- Calculate the capital, operating and maintenance costs to the District.

An exclusion criteria evaluation provided the "fatal flaw" analysis; either a portfolio does or does not meet the criterion.

Any portfolio that did not meet any one exclusion criteria failed to meet the planning objectives and was held from further study.

The Community Liaison Committee, which is made up of 19 community representatives, met eight times during the two-year planning period to provide feedback on the process. All meetings were open to the public.

Table 2-2 Exclusion and Evaluation Criteria

Operations, Engineering, Legal & Institutional Criteria

1. Provide Water Supply Reliability

Exclusion Criteria
- Must be technically feasible using proven technology.
- Must meet projected water demands through 2040.
- Must meet demand during the District's Drought Planning Sequence.
- Must not be located in areas of unmitigable geologic, hydrologic or toxic/ hazardous materials hazards.

Evaluation Criteria
- Minimize the vulnerability & risk of disruptions.
- Minimize disruptions in water service during construction.
- Maximize the system's operational flexibility to respond to change.
- Maximize implementation flexibility to respond to change.
- Minimize the institutional & legal complexities & barriers.

2. Utilize current water right entitlements

Exclusion Criteria
- Must meet all existing & anticipated water rights permit & license conditions, all dam & reservoir operating permit conditions, including releases for instream & downstream users.

Evaluation Criteria
- Optimize use of existing water right entitlements.

3. Promote District involvement in regional solutions

Evaluation Criteria
- Maximize partnerships & regional solutions.

Public Health, Safety, & Community Criteria

1. Ensure the high quality of the District's water supply

Exclusion Criteria
- Must ensure that the District's potable water will be able to meet existing & future state & federal primary & secondary drinking water quality standards.
- Must ensure that the District's non-potable water will be of suitable quality for District use.

Evaluation Criteria
- Minimize potential adverse impacts to the public health of District customers.
- Maximize use of water from the best available source.

2. Minimize adverse sociocultural impacts

3. Minimize risks to public health & safety

Evaluation Criteria
- Minimize disproportionate public health or economic impact to minority or low-income populations (environmental justice).
- Minimize adverse impacts to cultural resources, including important archaeological, historical, & other cultural sites.
- Minimize short-term community impacts.
- Minimize long-term adverse community impacts (e.g., aesthetics, noise, air quality).
- Minimize adverse social effects (e.g., impacts to community character, social cohesion, community features).
- Minimize conflicts with existing & planned facilities, utilities & transportation facilities.

4. Maximize security of infrastructure & water supply

Evaluation Criteria
- Minimize the risk of death or injury from the failure of a program component in an earthquake or flood or from other causes.
- Maximize the protection of supply sources & associated infrastructure.

Economic Planning Criteria

1. Minimize cost to District customers

Evaluation Criteria
- Maximize use of lowest cost water supply options.
- Minimize the financial cost to the District of meeting customer demands for given level of system reliability.

2. Minimize drought impact to customers

Exclusion Criteria
- Must not result in average annual customer shortages exceeding 25% of demand for District design drought.

Evaluation Criteria
- Minimize customer water shortage costs & District supply augmentation costs.

3. Maximize positive impact to local economy

Evaluation Criteria
- Maximize local water supply options.

Environmental Criteria

1. Preserve & protect the environment for future generations

Evaluation Criteria
- Minimize adverse impacts on the environment (including land, air, water, minerals, flora, fauna, noise, & aesthetics).
- Minimize construction & operation effects on environmentally sensitive resources.
- Maximize long-term sustainability by applying best management & sustainability principles.

2. Preserve & protect biological resources

Exclusion Criteria
- Must not cause a net loss of wetlands & riparian habitat.

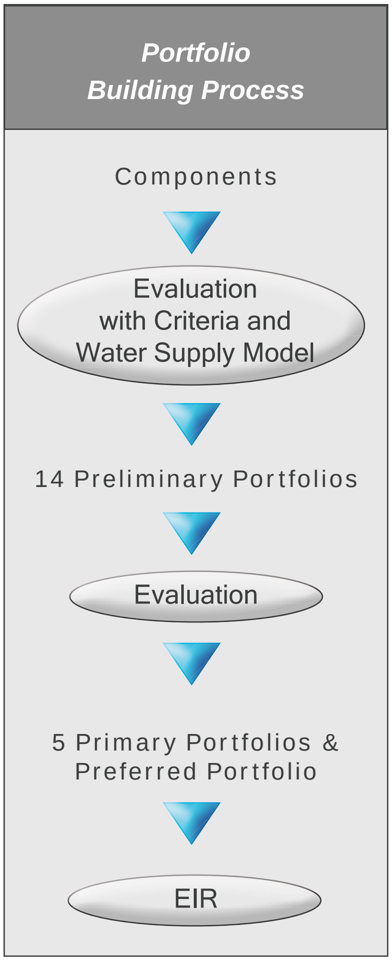
Evaluation Criteria
- Maintain populations or known habitat of state or federally listed plant or wildlife species at or above sustaining levels.
- Minimize the reduction of riverine habitat of state or federally listed fish species & must not cause a net loss of spawning or rearing habitat of native anadromous fish species.
- Minimize impacts to wetlands, their values, & other jurisdictional waters of the United States.
- Minimize habitat loss for sensitive & native plant & wildlife species, pristine areas & special habitat features.
- Minimize adverse affects to native fish & other native aquatic organisms.
- Maximize benefits to fish, including natural production of anadromous fish.
- Maximize the likelihood of meeting federal & state ambient water quality standards to protect natural resources.
- Minimize alterations to water flow in waterways & reservoirs/lakes that would have an adverse impact on biological resources.

3. Minimize carbon footprint

Evaluation Criteria
- Minimize short term & long term greenhouse gas emissions from construction (e.g., raw material & waste transportation, construction equipment use, site deforestation, carbon emissions from cement production).
- Maximize energy efficiency associated with operations & maintenance.
- Maximize CO2-efficient & renewable energy use.
- Maximize contributions to AB 32 goals.

4. Promote recreational opportunities

Evaluation Criteria
- Minimize adverse impacts to recreation resources, designated parklands, designated wilderness areas, or lands permanently dedicated to open space, particularly rare opportunities & ADA access that are not found in other parts of the region.
- Provide recreational benefits.



Two exclusion "Need for Water" screening criteria, *Meet projected water demands through 2040,* and *Meet demand during the District's Drought Planning Sequence*, were applied to the 14 portfolios. Two of the portfolios – Portfolio #1 "Low Customer Impact" and Portfolio #2 "Flexibility to Respond to Future Extended Drought or Climate Change" -- failed to meet the Need for Water criteria due to timing constraints under which the components were able to come online, and thus failed to satisfy the project objectives. In addition, these two portfolios were not able to meet the capacity limitations as present in EBMUD's Mokelumne Aqueducts and the District's East Bay water treatment plants.

The remaining twelve portfolios were then subject to more detailed evaluation criteria to compare and array each for their relative satisfaction of the criterion related to the WSMP 2040 planning objectives. Following this evaluation, it was found that while distinct themes were established, several of the portfolios included primarily the same components. These portfolios were consolidated into at the time most promising portfolios and the water supply model and the evaluation criteria were re-applied to these newly-constructed portfolios. From this subgroup, five portfolios were shown to be of most promise. Each of these Primary Portfolios was designed to satisfy the Need for Water and has a cornerstone component that it is based around. These five Primary Portfolios were identified as A, B, C, D and E and carried forward for additional analysis.

Portfolio Number	Portfolio Theme	Operations, Engineering, Legal & Institutional				Economic		Public Health, Safety & Community		Environmental		Portfolio Number	Rationale/Notes	
		• Minimize the vulnerability to natural disruptions (i.e., reliability)	• Maximize the system's operational flexibility	• Minimize institutional & legal complexities & barriers	• Maximize partnerships & regional solutions	• Minimize the financial cost to the District of meeting customer demands for given level of system reliability	• Minimize customer water shortage costs	• Minimize potential adverse impacts to the public health of District customers • Maximize use of water from the best available source	• Minimize long term adverse community impacts • Minimize adverse social effects • Minimize conflicts with existing & planned facilities, utilities & transportation facilities	• Minimize adverse impacts on the environment • Minimize construction & operation effects on environmentally sensitive resources	• Minimize short term & long term greenhouse gas emissions from construction • Maximize energy efficiency associated with operations & maintenance • Maximize contributions to AB 32 goals			
1	Low Customer Impact	Failed Modeling Analysis										1		X
2	Flexibility for Future Extended Drought or Climate Change	Failed Modeling Analysis										2		X
3	Upcountry Surface Storage Emphasis		H				H	H+				3	Combine with P-10	
4	Groundwater Storage		H	L	H	L	H			H		4	Includes both Sac & SJ Groundwater Banking/Exchange	➡
5	Regional Partnerships	H		L	H	L	H	L			L	5	Most robust number of Components, including Desal	➡
6	Emergency Reliability - A	H+	H+						L	L		6	Buckhorn storage - Highest Ops & Engineering scores	➡
7	Emergency Reliability - B	H		L		L		L			L	7	Heavy reliance on Desalination ?	
8	Diversified	H		L				L			L	8	Reliance on Desalination ?	
9	Conservation & Recycling Emphasis		H		L	L						9	Conservation Level E - Cost Effectiveness?	
10	Low Carbon Footprint		H					H+				10	P-3 with Rationing at 15% & Recycling Level 2	➡
11	Low Capital Cost / Low Structural		L			H	L			H		11	Cost to customer of 25% Rationing is Prohibitive	X
12	Coleman Alternative 1	L	H	L	H	L	H			H		12	Heavy reliance on a Water Transfer of 27 MGD in dry years	➡
13	Katz Alternative 1		L		L	L				H		13	20% Rationing can be tested in Portfolios 4 & 12	⇨
14	Katz Alternative 2	H	L		L		L			H		14	Cost to customer of 25% Rationing is Prohibitive	X

H = High Response to Evaluation Criteria L = Low Response to Evaluation Criteria X = Hold from Further Consideration ➡ = Carry Forward as Primary Portfolio for Further Refinement (LT)

Figure 2-1

Evaluation Summary of 14 Preliminary Portfolios *shows which of the 14 Preliminary Portfolios were carried forward after the evaluation process.*

A larger image and more detail about each portfolio is provided in Chapter 6.

Preliminary Portfolio Number	Primary Portfolio	Portfolio Themes	Portfolio Description	Components	Rationing		Conservation		Recycling		Supplemental Supply							
					10%	15%	Current Program Equivalent (C)	Current Program Equivalent + 2 (D)	Recycling Level 2	Recycling Level 3	Northern California Water Transfers	Bayside Groundwater Project Phase 2	Sacramento Basin Groundwater Banking/Exchange[1]	Regional Desalination	Enlarge Pardee Reservoir	Enlarge Lower Bear Reservoir	San Joaquin Basin Groundwater Banking/Exchange	Buckhorn Canyon Reservoir
					22 MGD	32 MGD	37 MGD	39 MGD	5 MGD	11 MGD	4.5-44.8 MGD	9 MGD	4.2 MGD	20 MGD	51.2 MGD	2.2 MGD	17.4 MGD	42 MGD
4	A	Groundwater / Conjunctive Use & Water Transfers	Groundwater storage/exchange & transfers		•			39	5		15	9	4.2				17.4	
5	B	Regional Partnerships	Partnership projects including groundwater, desalination & transfers		•		37		5		4.5		4.2	20		2.2	17.4	
6	C	Local System Reliance	West of delta surface storage			•	37		5									42
10	D	Lower Carbon Footprint	Upcountry surface storage			•	37		5			9			51.2			
12	E	Recycled Water & Water Transfers	High recycling & major transfer		•		37			11	28.5	9	4.2					

Note: [1] Sacramento Basin Groundwater Banking/Exchange component must be coupled with a transfer water component.

Figure 2-2 ***Summary of 5 Primary Portfolios*** *shows the 5 Primary Portfolios and their components. A larger image and more detail about each portfolio is provided in Chapter 6.*

Note: On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component and added the 160 TAF Expand Los Vaqueros Reservoir component to the WSMP 2040 Portfolio.

The Primary Portfolios were also modeled in the water supply model and scored against the evaluation criteria. Through this process, the advantages and disadvantages of the five Primary Portfolios were identified. For example, Portfolio B scored high on reliability and maximizing partnerships, but low on minimizing institutional and legal complexities. Portfolio C performed well in terms of reliability, but low on public health, safety, and community, and environmental criteria. None of the Primary Portfolios was clearly ideal or optimum and all had advantages and disadvantages. Results from the screening and modeling of the five Primary Portfolios indicated that each of the portfolios had strengths as well as weaknesses and assisted in development of the WSMP 2040 Portfolio, as described in Section 2.3. On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component and added the 160 TAF Expand Los Vaqueros Reservoir component to the WSMP 2040 Portfolio.

2.3 The Plan

The WSMP 2040 Portfolio is designed to be robust, flexible, diverse, and to pursue projects on multiple, parallel tracks in order to respond flexibly to an uncertain water future. This flexibility is particularly important, given the mix of supplemental supply and recycled water projects proposed in the WSMP 2040 (see Table 2-3). Such projects take considerable time to develop (plan, design, permit and construct). The broad mix of projects, the inherent scalability present in several of the elements, and the ability to adjust implementation schedules for a particular project or program included in WSMP 2040 help to minimize the risks associated with the uncertainties and development time issues identified above.

- **Robust:** A robust plan in an uncertain future (e.g., global climate change).
- **Parallel Tracks:** Pursue multiple, parallel project components.
- **Flexible:** Diverse & flexible strategy.

Table 2-3

Summary of Guidance on the WSMP 2040 Portfolio from the Board

A rationing level of 10% (amended to "up to 15%" on October 27, 2009).

Conservation Level D (39 MGD) and Recycled Water Level 3 (11 MGD).

Several supplemental supply components remain in consideration to meet the Need for Water (that is not met through rationing, conservation and recycling).

Supplemental supply projects would be pursued on parallel tracks in the event that one or more projects is not able to produce the expected dry-year yield. Projects include:

- Water Transfers (to meet the initial Need for Water);
- Bayside Groundwater Project Phase 2;
- Sacramento Basin Groundwater Banking / Exchange;
- Regional Desalination;
- Expand Los Vaqueros Reservoir (added on April 24, 2012);
- Enlarge Lower Bear Reservoir; and
- San Joaquin Basin Groundwater Banking / Exchange.

* Enlarge Pardee Reservoir (removed on April 24, 2012)

The WSMP 2040 Portfolio approaches EBMUD's 2040 water supply reliability needs with a flexible program that:

- Meets projected growth in customer demand through aggressive water conservation and recycled water development; and
- Lowers customer rationing burdens during an extended drought significantly from the District's WSMP 2040 objectives through development of new supplemental water supply initiatives.

2.3.1 Guidance on the WSMP 2040 Portfolio from the Board

Table 2-3 summarizes the guidance received from EBMUD's Board of Directors at the June 24, 2008 Board Workshop #9 on the rationing level, conservation level and level of recycled water as well as specific supplemental supply components.

The EBMUD Board of Directors provided guidance on a maximum rationing level of 10% to allow the District flexibility in an emergency or to respond to the many unknown factors in the future. Guidance was also provided on maximum levels of conservation (39 million gallons per day (MGD)) and recycled water (11 MGD) to maintain the District's current aggressive policies for overall demand management. The combination of these rationing, conservation, and recycled water levels will satisfy the increased demand through 2040; however, supplemental supply components will also be needed to keep rationing at a lower level and to meet the Need for Water in drought years.

Role of Conservation & Rationing

Current Customer Conservation	*22.5 MGD/yr*
Current Recycling	*9 MGD/yr*
WSMP 2040 Future Planned Customer Conservation	*39 MGD/yr*
WSMP 2040 Dry-Year Customer Rationing	*Up to 15%*
WSMP 2040 Future Planned Recycled Water	*11MGD/yr*
Total Customer Cutback In Usage Under 2040 Plan	***33 % of Gross 2040 Demand***

On October 13, 2009, the EBMUD Board of Directors passed a resolution adopting the WSMP 2040 Plan. On October 27, 2009, the Board of Directors amended the WSMP 2040 Plan by authorizing a slightly modified rationing approach. As amended, instead of a target rationing level of 10% during the Drought Planning Sequence, the Board selected "Rationing of up to 15%." That adjustment has been reflected in pages of this WSMP Plan where applicable.

The supplemental supply components included in Table 2-4 have subsequently been revised to include the 160 TAF Expand Los Vaqueros Reservoir component and remove the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.

2.3.2 WSMP 2040 Portfolio Components

Based on the Board's guidance, the WSMP 2040 Portfolio proposes rationing of up to 15% as the policy to be enacted (as part of the designated Drought Planning Sequence) and assumes that EBMUD will successfully carry out a number of the water conservation, recycled water, and supplemental supply initiatives (that are also part of the WSMP 2040 Portfolio) within the WSMP 2040 planning horizon.

The WSMP 2040 Portfolio will include the following rationing, conservation, and recycled water levels and may contain the supplemental supply components listed in Table 2-4 and displayed in Figure 2-3.

Table 2-4: WSMP 2040 Portfolio Components

Component	Comments
Up to 15% Rationing	Impose as needed throughout the planning period[1]
Conservation Level D (39 MGD)	Pursue throughout the planning period beginning in 2010
Recycled Water Level 3 (11 MGD)	Pursue throughout the planning period
Northern California Water Transfers	Pursue beginning in 2010 and use as needed to meet the Need for Water as other supplemental supply projects are being developed
Bayside Groundwater Project Phase 2	Pursue beginning in 2015
Sacramento Basin Groundwater Banking / Exchange	Pursue beginning in 2025
Regional Desalination	Pursue throughout the planning period and use as needed to meet Need for Water as other supplemental supply projects are being developed
Expand Los Vaqueros Reservoir	
Enlarge Lower Bear Reservoir	
San Joaquin Basin Groundwater Banking / Exchange	

[1] The WSMP 2040 Portfolio establishes a drought rationing policy.

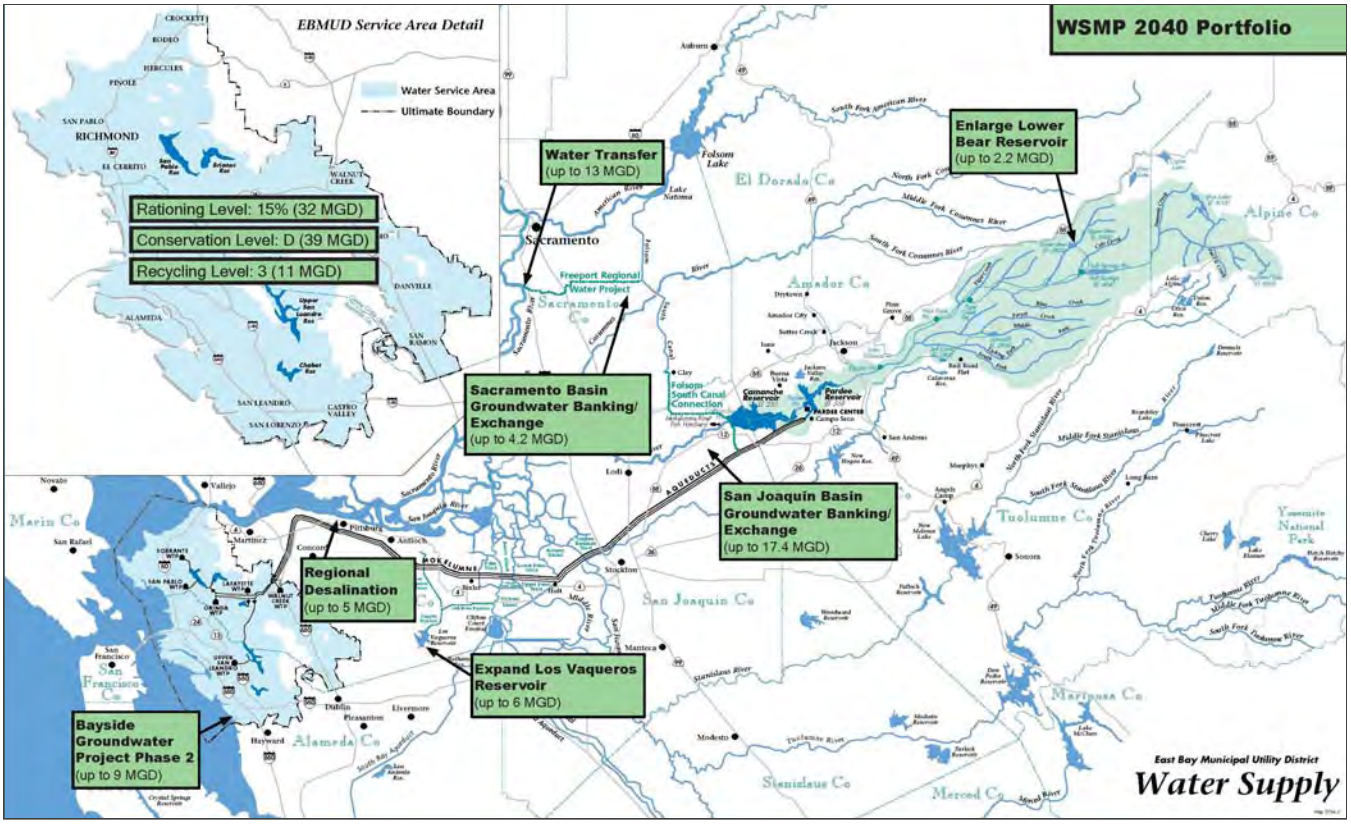


Figure 2-3 *Revised WSMP 2040 Portfolio Components*

As a practical matter, EBMUD may be unable to reduce rationing to the WSMP 2040 Portfolio level until it develops additional dry-year supplemental water supplies. As new supplemental supplies are secured, EBMUD will be able to gradually reduce the amount of rationing it imposes upon its customers. To the extent that uncertainties impede attainment of supplemental supplies, higher rationing restrictions may be imposed in a specific drought event. The benefit of targeting up to 15% rationing in WSMP 2040 is that it preserves the flexibility to increase rationing to higher levels as one of several responses to dry year conditions that may occur before supplemental supplies are made adequate.

If uncertainties such as the adverse effects of global climate change and decreased availability of water in the Mokelumne and Sacramento River systems impede attainment of these supplies, higher rationing restrictions may be imposed in a specific drought event. The amount of water needed by 2040 to meet projected demands based on a rationing level of 10%, 15%, 20%, and 25% that were considered in the WSMP 2040 planning process, is shown in Chapter 4.

2.3.3 Implementation of the WSMP 2040 Portfolio

EBMUD's approach to carrying out the WSMP 2040 Portfolio is to develop the supplemental water supply components that are most feasible and environmentally responsible according to the circumstances that arise during the 2010-2040 planning period.

As noted previously, many of these circumstances—funding availability, political will and success, legal and institutional hurdles, and resolution of technical issues—cannot be predicted with certainty. The success of one project could result in delaying the need for an additional supplemental supply project over the course of the planning period. Conversely, were a project to encounter a development hurdle that prevents its advancement, an alternative would need to be found. The District's supplemental water project planning response must remain flexible in order to respond to these unknown future implementation challenges.

The WSMP 2040 Portfolio strategy is not to focus on one scenario, but rather to be open and flexible to pursue different components based on which are the most feasible for implementation. An example implementation scenario was developed to provide a meaningful comparison with the Primary Portfolios and to illustrate how the WSMP 2040 Portfolio could be accomplished. Figure 2-4, which was presented in the 2009 WSMP 2040, summarizes one example scenario and the order in which components could be pursued throughout the planning period.[1] Figure 2-5 summarizes a revised example scenario that was developed following the legal challenge of the WSMP 2040 PEIR.

In this revised example scenario, EBMUD would secure short-term Northern California Water Transfers early in the planning period to allow adequate time for conservation, recycled water, and other supplemental supply components to be developed. The example scenario assumes that the 160 TAF Expand Los Vaqueros Reservoir component would be completed by 2020, the Bayside Groundwater Project Phase 2 component would be completed by 2030, and the Sacramento Basin Groundwater Banking / Exchange and Regional Desalination components would be completed by 2040 as needed depending on the yields achieved, partnership opportunities, funding, and refinements in the Need for Water.

Alternately, an implementation scenario could also be described where Regional Desalination gains traction and is able to be implemented by 2020, thereby pushing out the need for implementation of other supplemental supply components into the future. Likewise, if any other component gains traction, it could be accelerated while other components would be delayed.

Aggressive pursuit of recycled water projects and conservation will serve to offset the need for supplemental supply projects; however, additional projects will still be required to achieve 85% or greater water supply reliability (with up to 15% rationing). High levels of conservation and recycled water will take pressure off of the Mokelumne River, providing continued opportunity to provide downstream releases and preserve and enhance aquatic habitat and recreation opportunities on the Mokelumne River. This flexible strategy for water management planning will allow the District to adapt to unknown future conditions including global climate change, pursue the components that are gaining the most traction, and respond to emergency conditions.

2.3.4 Modeling of the WSMP 2040 Portfolio

A water supply model was developed as a tool to assess the performance of EBMUD's water system under different hydrologic conditions and future supply and demand scenarios. This model was used to evaluate the performance of the portfolios in meeting the Need for Water and to estimate the cost of each portfolio.

[1] *The example scenario from the 2009 WSMP 2040 is presented in this revised WSMP. Some of the modeling conducted and referenced in this document applies to that previous scenario.*

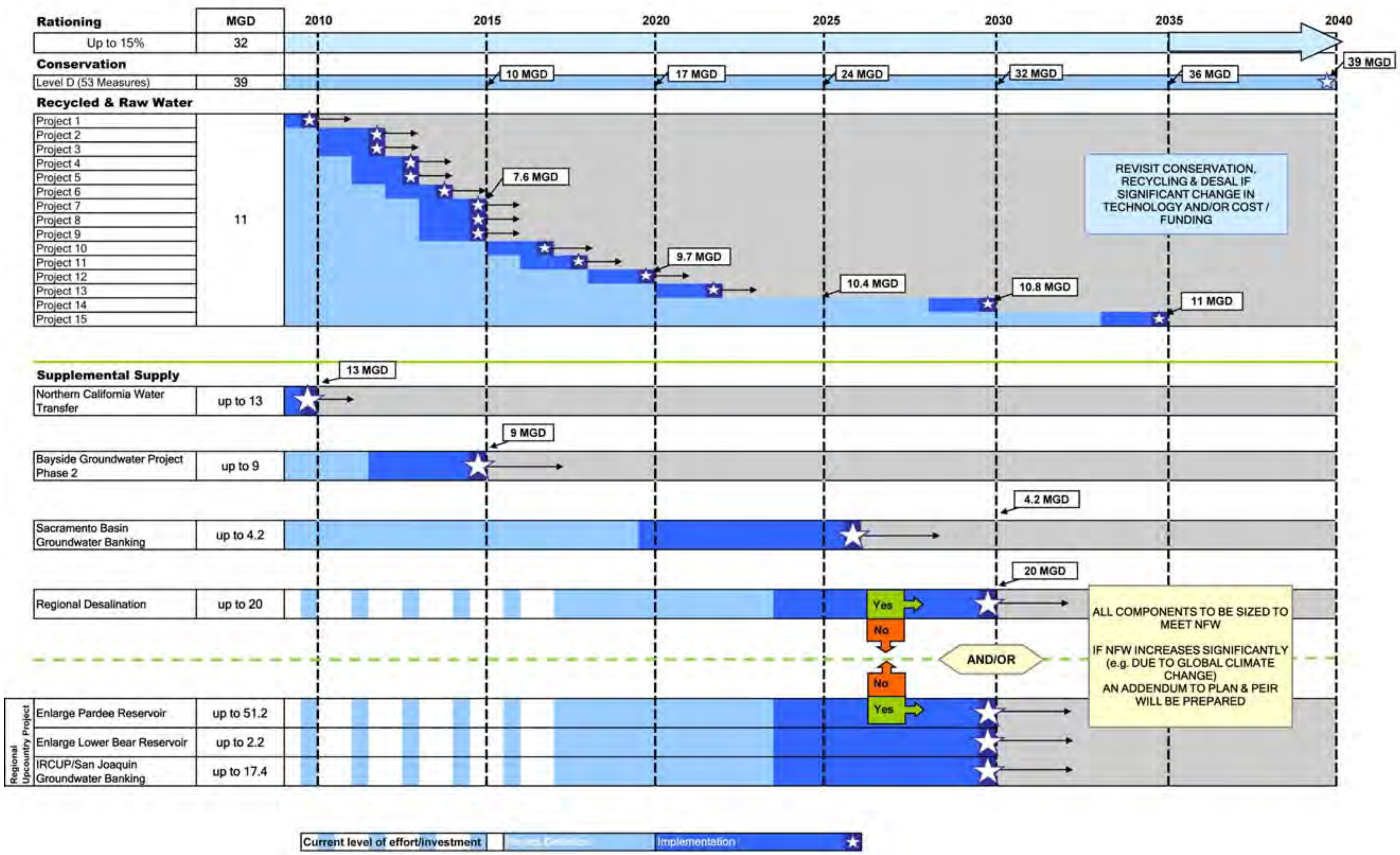
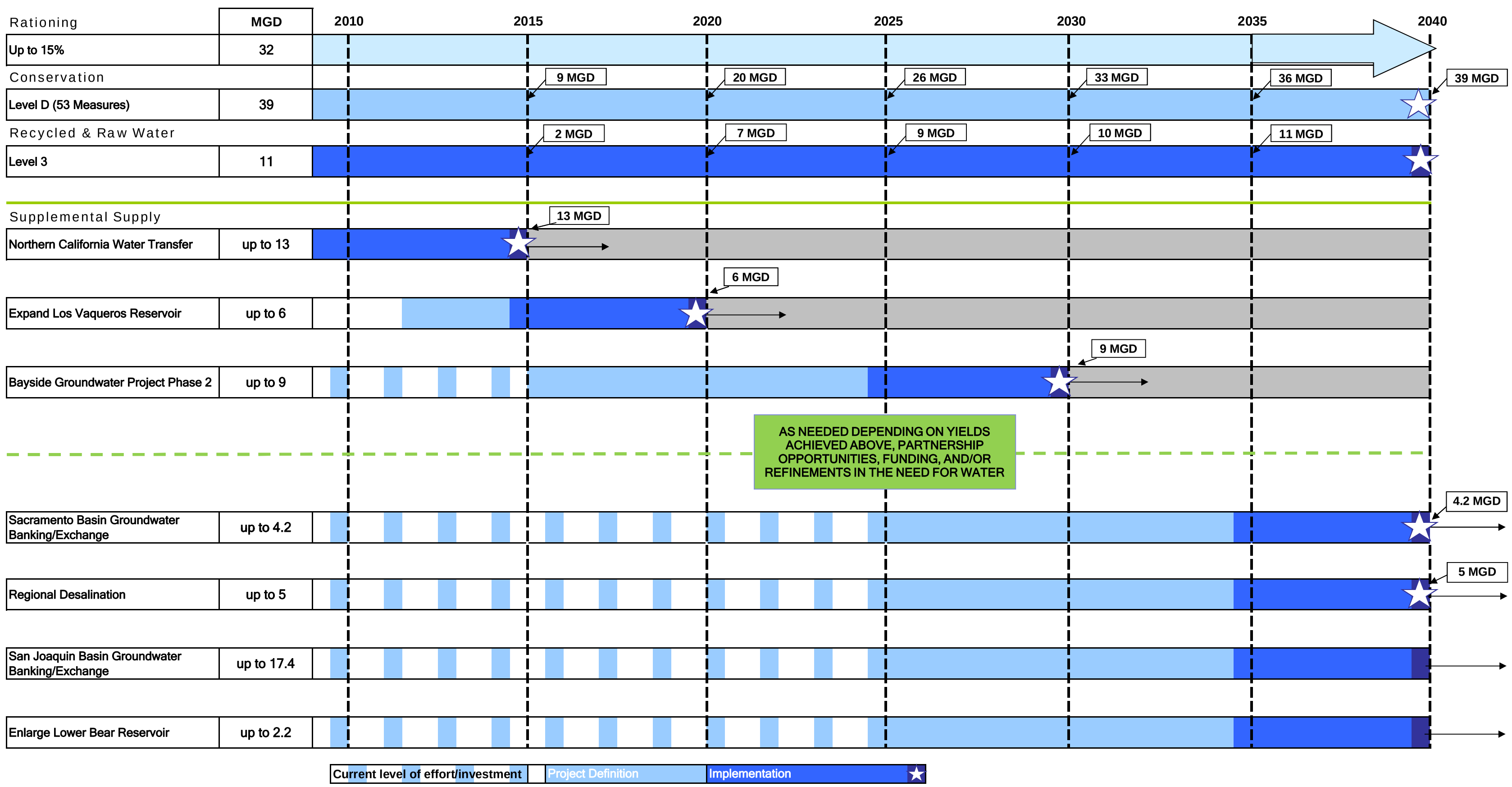


Figure 2-4 *2009 WSMP 2040 Portfolio: Example Scenario*

Note: On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component and added the 160 TAF Expand Los Vaqueros Reservoir component to the WSMP 2040 Portfolio. The revised WSMP 2040 Portfolio Example Scenario is presented in Figure 2-5.



Notes:
- The Enlarge Pardee Reservoir project is deferred beyond the planning horizon of the WSMP 2040. EBMUD participation in the current project to expand Los Vaqueros Reservoir has been added to the WSMP 2040.
- Total yield of all projects exceeds the NFW. Revisit conservation, recycling & desalination if there are significant change in technology and/or cost / funding.
- All components to be sized to meet the NFW depending on actual yields of preceding projects. If the NFW increases significantly (e.g. due to global climate change), an addendum to Plan & PEIR will be prepared.
- The yield for the Regional Desalination component has been revised from 20 mgd to 5 mgd since the 2009 WSMP 2040 was published. This document has been edited to note that revised yield. Although economic and hydrologic analyses as performed for the 2009 WSMP 2040 have not been revised to account for the smaller-yielding desalination component, in future years, if and when a Regional Desalination project is contemplated, updated hydrologic, economic, and other relevant engineering analyses will be performed to identify how such a project can be used to complement EBMUD's existing suite of water supply portfolio elements.
- The example scenario is based on studies that were prepared for the 2009 WSMP Preferred Portfolio, prior to the CEQA revision effort.

Figure 2-5 *Revised WSMP 2040 Portfolio: Example Scenario*

EBMUD's existing EBMUDSIM model, currently used to simulate water delivery from the Mokelumne River to the District service area, was combined with the Water Evaluation and Planning (WEAP) System Model (see Figure 2-6). This combined WEAP-EBMUDSIM (W-E) model enabled simulation of the District's water system, assessment of the operational impacts of each portfolio on the District's water supply system, and the cost of each portfolio.

It should be noted that multiple alternative portfolios with various demand management and water supply options were evaluated before selecting the WSMP 2040 Portfolio. These alternative portfolios emphasized specific themes such as groundwater storage, future flexibility, regional partnerships, emergency reliability, and low carbon footprint. These alternative portfolios are further described in Chapter 6.

The model was also used to determine the District's need for water and to conduct a climate change sensitivity analysis where variations in water demand, drought frequency, and the volume and timing of runoff from the Mokelumne River were modeled.

The Need for Water in 2040 was estimated using five different rationing levels: no rationing and system-wide rationing of 10%, 15%, 20% and 25%. At 10% rationing, mandatory rationing would occur in approximately 1.5 years over the thirty year planning period of 2010 – 2040, and voluntary rationing would occur in 2.6 years. With a 15% rationing goal, mandatory rationing would occur in 2 years over the planning period, and voluntary rationing would occur in 2.8 years. With a 20% rationing goal, mandatory rationing would occur in 2.7 years, and voluntary rationing would occur in 2.5 years over the planning period. Further detail on this analysis is provided in Appendix D.

The model assumed that water transfers would be used to meet the Need for Water and would

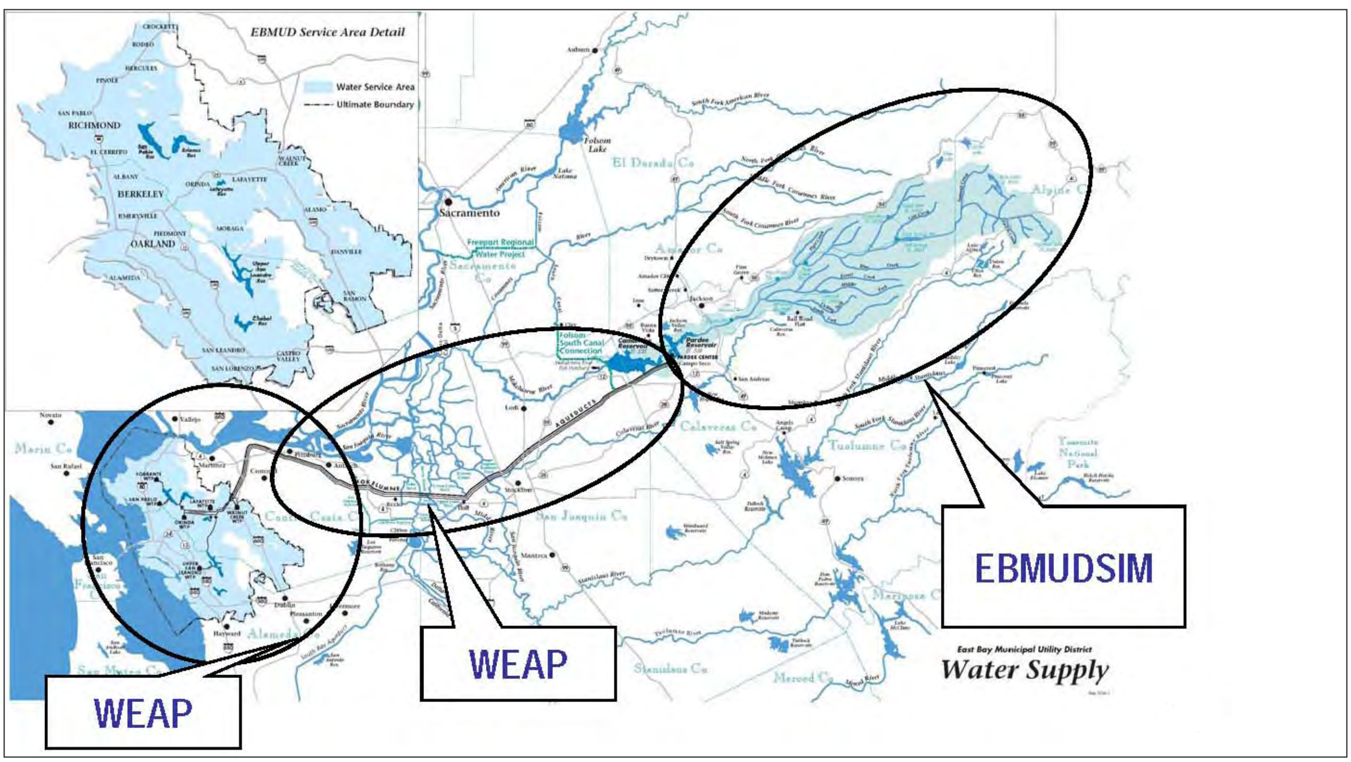
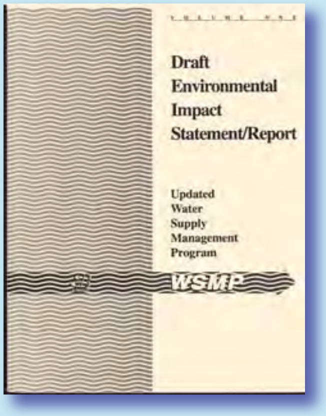


Figure 2-6 *WEAP-EBMUDSIM (W-E) Conceptual Model Areas*

Previous WSMP Efforts

Updated WSMP 2020 (1993)



EBMUD adopted an Updated WSMP 2020 (referred to as the 1993 WSMP) to allow the District to meet the water supply reliability needs of EBMUD customers, to improve the Mokelumne River fishery resources by implementing the Lower Mokelumne River Management Plan (LMRMP),[1] and to meet shortages during droughts.

The Updated WSMP addressed an extensive range of alternatives to help meet EBMUD's 2020 water needs. Six Primary Composite Programs were comparatively analyzed in an EIR/EIS and the most promising Primary Composite Programs were found to be three Composite Programs which all included Conservation (18 MGD), Reclamation (8 MGD), Aqueduct Security[2], and the LMRMP in common.

The differences were:

- Composite Program II included Groundwater Storage/Conjunctive Use;
- Composite Program IV included Groundwater Storage/Conjunctive Use and the Folsom South Canal Connection; and
- Composite Program V included a Raise Pardee composite.

On September 15, 1992, the EBMUD Board of Directors agreed to pursue two alternatives that include groundwater storage/conjunctive use: Composite Program II or Composite Program IV. The Proposed Action included the possible adjunct of American River water delivered through the implementation of a Folsom South Canal Connection, now known as the Freeport Regional Water Project (FRWP).

The original program was expanded in 1996 to pursue enlarging Pardee, the Folsom South Canal Connection, and a Sacramento joint project in addition to groundwater storage.

EBMUD is on schedule to achieve the 1993 WSMP water supply goals for 2020. The District completed the aqueduct security improvements, implemented the LMRMP, is carrying out conservation and recycled water development, and has undertaken the FRWP in partnership with the Sacramento County Water Agency (expected to be completed in 2010).

WSMP 2040 builds upon the foundation of programs and activities created in the 1993 WSMP, to meet water supply needs for the next 20 year planning horizon.

[1] *The Lower Mokelumne River Management Plan specifies flow regimes, reservoir operations, and hatchery operations that would enhance benefits to fishery resources in the Mokelumne River while maximizing flexibility in managing a variable water supply, uncertain future demands and uncertain linkages between fish populations and fishery management activities.*

[2] *Aqueduct Security: An approximate 10-mile section of the Mokelumne Aqueducts through the Sacramento-San Joaquin Delta was secured against prolonged outages resulting from earthquake-induced failures.*

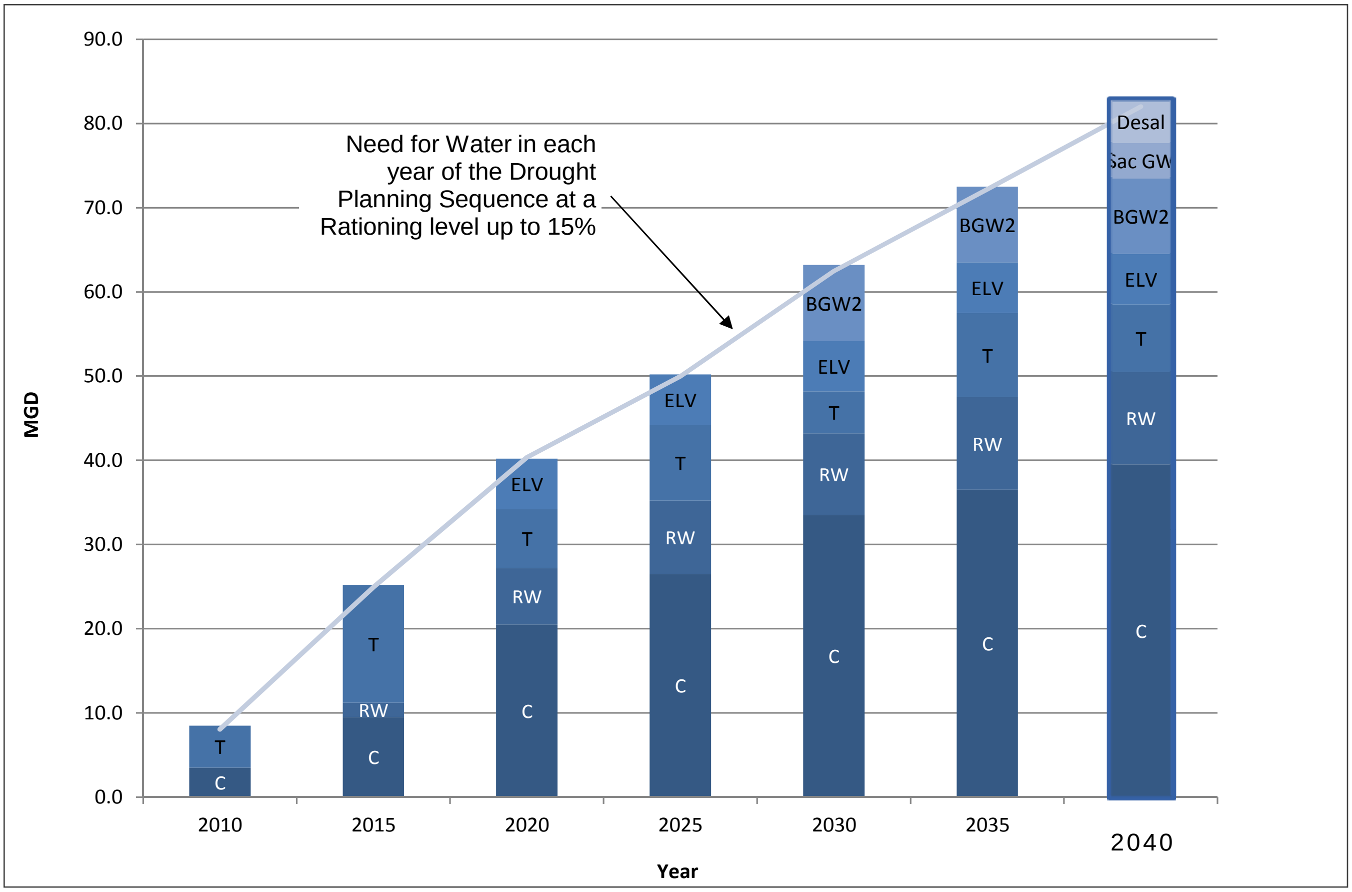


Figure 2-7 *The Revised WSMP 2040 Portfolio Meets the Need for Water over the Planning Period. Note that the Board amended rationing to up to 15% for the Plan. The 2009 PEIR Preferred Portfolio called for 10% rationing.*
Key: C = Conservation RW = Recycled Water T = Transfer ELV = Expand Los Vaqueros Reservoir
SacGW = Sacramento Basin Groundwater BGW2 = Bayside Groundwater Project Phase 2 Desal = Regional Desalination

be decreased as other supplemental supply projects, recycled water projects, and conservation come online. In addition, the model also assumed that if later projects were not necessary to meet the Need for Water, they would not be brought online. For example, if a combination of rationing, recycled water, conservation, the Bayside Groundwater Project Phase 2, and Regional Desalination met the Need for Water, then the other supplemental supply components would not be brought online.

The WSMP 2040 Portfolio would meet the Need for Water in all years, with necessary components coming online in a stepwise fashion, similar to that as described in the example implementation scenario in Section 2.3.3.

Figures 2-4 and 2-5 depict the year that each component would start operating; however, the first year that each project would actually deliver water to EBMUD may occur later for some components. For example, groundwater banking and exchange projects located in certain basins may require several wet years to fill before they can be used as a water supply source. In addition, each component is shown as being used to its maximum capacity in all years. However, components would be only be used as needed given the hydrology of any given year and situation.

The supplemental supply components included in the revised WSMP 2040 Portfolio example scenario are small to moderately sized, so excess supply is generally not brought online before it is needed to meet the Need for Water (see Figure 2-7). There are very limited sequences during the planning period where a component delivers water before it is needed to meet the Need for Water. Water transfers or use of groundwater banking and exchange components can also be ramped down as needed so that the Need for Water is not exceeded by the supply in any given year.

The WSMP 2040 Portfolio also maximizes operational flexibility of the EBMUD water supply system, as it provides a variety of both East Bay (Bayside Groundwater Project Phase 2, Regional Desalination, and Expand Los Vaqueros Reservoir) as well as Upcountry projects. Providing additional dry year storage on the west side of the Delta at Bayside or Los Vaqueros would contribute to the District's ability to meet the 6-month local storage criterion. The WSMP 2040 Portfolio would also provide several opportunities for EBMUD to partner with other local and Upcountry water districts. See Appendix D, Technical Memorandum (TM) 6 Water Supply and Economic Modeling Report, for plots that graphically summarize average annual water operating scenarios for each year in the planning period (2010 to 2040) for the WSMP 2040 Portfolio. TM-6 and Chapter 6 provide a detailed description of the modeling that was conducted for the portfolios.

2.3.5 Simulated Drought Frequency under the WSMP 2040 Portfolio

Based on the modeling of one possible scenario, which assumed that the Board selects to ration at 10% as the target, the percent of years during which supplemental supply components would be required are shown in Figure 2-8. As the Board has selected 15% rationing, the likelihood could be slightly lower.

Assuming 10% rationing, from the year 2010 to 2040, supplemental supply would be required in 30-39% of years to meet the Need for Water. Conservation Level D (39 MGD) and Recycled Water Level 3 (11 MGD) contribute to minimizing the number of years that supplemental supply would be needed; however, supplemental supplies would still be required to meet the Need for Water through the WSMP 2040 planning period.

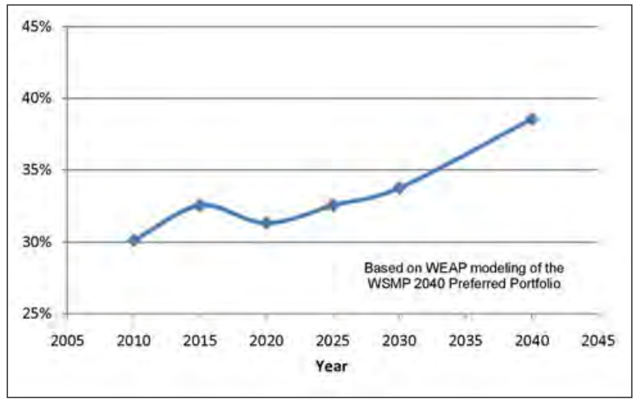


Figure 2-8 *Proportion of Years Requiring a Supplemental Supply*

Note: Data presented was developed for a 10% rationing case. Prior analyses suggest that were a 15% rationing case modeling run have been performed, results would be very similar to those graphed for the 10% scenario.

2.3.6 Cost Evaluation Results

The economic analysis conducted as part of the WSMP 2040 assessed the potential costs of each portfolio for the 2010 to 2040 period over a range of historic water conditions. These results were then used to describe a minimum, maximum and mid-range net cost for each portfolio under review. (See Appendix D TM-6, Chapters 5,6,7,8 and 9 for more information.)

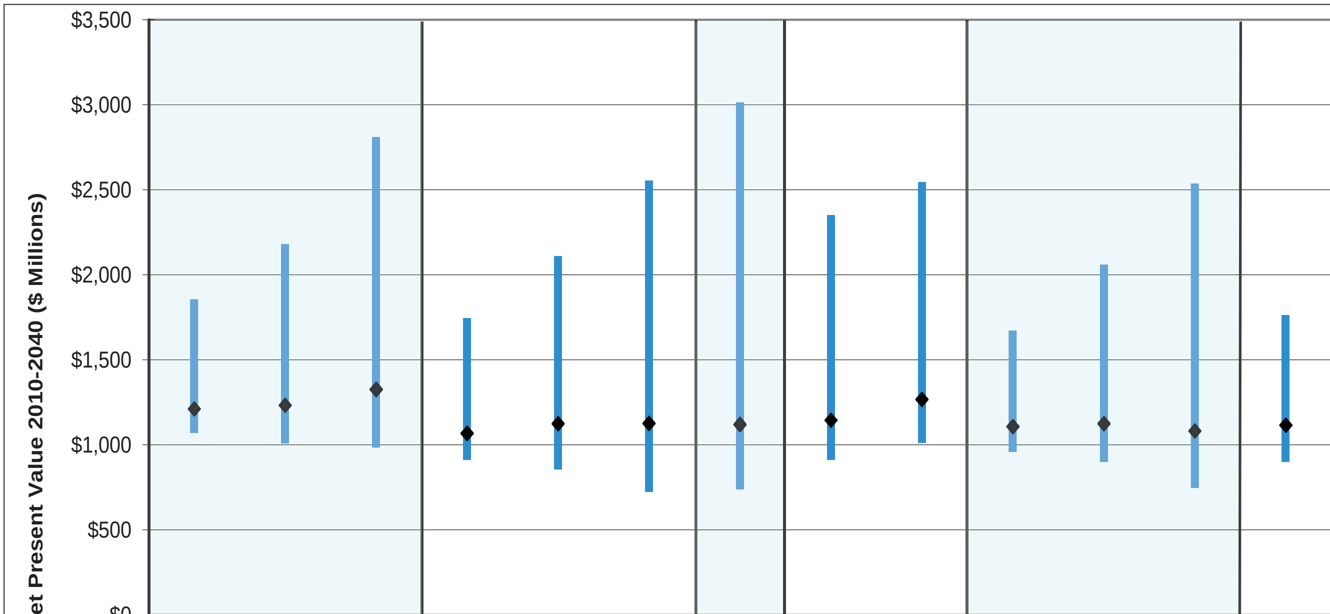
Figure 2-9 provides a summary of these results. The costs, on the y-axis, are the total cost for each portfolio, the sum of direct incremental utility costs (e.g., investment in new infrastructure and programs), customer shortage costs, and customer conservation costs. Each modeled portfolio is shown along the x-axis, with data on

> **Shortage costs**
>
> Shortage costs are losses when EBMUD customers reduce water use in response to rationing policies. For residential, institutional, and irrigation customer classes, shortage costs are measured in terms of lost customer surplus. Lost customer surplus is an estimate of the willingness to pay for a resource, and is not equivalent to a direct financial cost to the customer. For commercial and industrial customer classes, shortage costs are based on lost regional value added (e.g., lost labor income, profits, indirect business taxes, proprietor income and property income).

the median total cost, the minimum and maximum total cost and the rationing level.

Portfolios A, B, and E, were each modeled at 10, 15, and 20% rationing to compare the customer shortage and total cost of each portfolio at these different rationing levels. Portfolio D was modeled at two different thresholds for implementing rationing to account for an increase in Pardee Reservoir storage.

Varying the rationing targets was found to have two effects. First, increased rationing was found to lead to higher shortage costs. Second, an offsetting effect occurred where the utility



	A	A2	A3	B	B2	B3	C	D	D2	E	E2	E3	WSMP 2040 Portfolio
Maximum	$1,854	$2,179	$2,809	$1,745	$2,108	$2,552	$3,014	$2,347	$2,544	$1,671	$2,059	$2,536	$1,761
Minimum	$1,069	$1,007	$983	$911	$856	$723	$737	$909	$1,010	$957	$899	$746	$900
Median	$1,212	$1,232	$1,326	$1,068	$1,124	$1,126	$1,120	$1,145	$1,267	$1,107	$1,125	$1,082	$1,116
Rationing	10%	15%	20%	10%	15%	20%	15%	15%	15%*	10%	15%	20%	10%

Portfolios

Figure 2-9 *Total Customer and Utility Cost Ranges for WSMP Portfolios: Net Present Value (NPV) 2010-2040*

Note: Although the 2009 WSMP 2040 Portfolio costs are represented here, the inclusion of participation in an Expand Los Vaqueros Reservoir component, the removal of participation in an Enlarge Pardee Reservoir component, and the participation in a smaller (5 mgd) Regional Desalination component is not anticipated to have a marked impact on the range of NPV as graphed for the various portfolio alternative options. Given that opinion, economic analysis were not updated as part of the revisions to the 2009 WSMP 2040.

costs, and thus rates, were lowered because of a reduction in the acquisition of water and a subsequent deferral in investment in projects and programs.

The cost evaluation analysis also confirmed that the cost of the Recycled Water Programs increases from approximately $400 per acre-foot of water for Level 2 (5 MGD) to approximately $600 per acre-foot for Level 3 (11 MGD) (these are the direct costs related to operation and maintenance of the recycled water projects). Though more costly, the Board unanimously supported Recycled Water Level 3 for inclusion in the WSMP 2040 Portfolio as it would provide greater reduction in the District's overall water need. It is also possible that grant funding and technological changes could reduce the overall cost of recycled water programs in the future.

For the Conservation programs, the potential water savings ranged from an additional 19 MGD for Level A to a maximum of 41 MGD for Level E.

Finally, as shown in Figure 2-9 and Table 2-5, the range of costs increases with higher rationing targets. The 2009 WSMP 2040 Portfolio has a median cost of $1.12 billion as compared to the Primary Portfolios, and a more narrow range of costs, between $900 and $1,760 million. This narrow range of potential costs represents a lower risk of cost fluctuation than the other portfolios, and is thus another potential advantage of the WSMP 2040 Portfolio.

Table 2-5: Summary of Customer and Utility Cost Ranges for WSMP 2040 Portfolios: Net Present Value (NPV) in $ Million (2010 - 2040)

Cost to the Customer/Shortage Cost

Portfolio	A	A2	A3	B	B2	B3	C	D	D2	E	E2	E3	WSMP 2040 Portfolio
Maximum	$698	$1,105	$1,804	$688	$1,099	$1,718	$2,221	$1,362	$1,524	$616	$1,096	$1,777	$684
Minimum	$9	$21	$46	$9	$15	$40	$9	$0	$57	$6	$19	$45	$7
Median	$109	$200	$348	$110	$197	$345	$354	$194	$274	$107	$201	$344	$121
Average	$220	$365	$625	$218	$358	$613	$559	$355	$469	$201	$361	$620	$221

Utility Cost

Portfolio	A	A2	A3	B	B2	B3	C	D	D2	E	E2	E3	WSMP 2040 Portfolio
Maximum	$1,156	$1,074	$1,005	$1,056	$1,009	$834	$793	$985	$1,021	$1,056	$964	$760	$1,077
Minimum	$1,060	$987	$937	$903	$841	$683	$729	$909	$953	$952	$880	$701	$893
Median	$1,103	$1,032	$978	$958	$927	$781	$766	$951	$993	$1,000	$924	$738	$995
Average	$1,106	$1,033	$975	$970	$932	$781	$764	$952	$991	$1,003	$925	$735	$990

Total Median	$1,212	$1,232	$1,326	$1,068	$1,124	$1,126	$1,120	$1,145	$1,267	$1,107	$1,125	$1,082	$1,116

Note: Although the 2009 WSMP 2040 Portfolio costs are represented here, the inclusion of participation in an Expand Los Vaqueros Reservoir component, the removal of participation in an Enlarge Pardee Reservoir component, and the participation in a smaller (5 mgd) Regional Desalination component is not anticipated to have a marked impact on the range of NPV as graphed for the various portfolio alternative options. Given that opinion, economic analysis were not updated as part of the revisions to the 2009 WSMP 2040.

EBMUD serves an estimated 1.3 million people plus industrial, commercial, and institutional water users in the East Bay region of the San Francisco Bay Area.

The District currently produces an average of 220 million gallons of potable water per day (MGD) in non-drought years; the principal raw water source of these supplies is the Mokelumne River in the Sierra Nevada, with a diversion point at Pardee Reservoir in Calaveras and Amador Counties.

3. Water Supply System

EBMUD's 331-square-mile service area is shown on Figure 3-1. The EBMUD water system serves 20 incorporated cities and 14 unincorporated communities in Alameda and Contra Costa counties. The cities within the EBMUD service area include Alameda, Albany, Berkeley, Danville, El Cerrito, Emeryville, part of Hayward, Hercules, Lafayette, Moraga, Oakland, Orinda, Piedmont, Pinole, part of Pleasant Hill, Richmond, San Leandro, San Pablo, San Ramon, and part of Walnut Creek. The unincorporated communities within the service area include Alamo, Ashland, Blackhawk, Castro Valley, Cherryland, Crockett, Diablo, El Sobrante, Fairview, Kensington, North Richmond, Rodeo, San Lorenzo, and Selby.

The District currently produces an average of 220 million gallons of potable water per day (MGD) in non-drought years; the principal raw water source of these supplies is the Mokelumne River in the Sierra Nevada, with a diversion point at Pardee Reservoir in Calaveras and Amador counties.

3.1 EBMUD Water Sources and Hydrology

3.1.1 Mokelumne River Watershed and Hydrology

The Mokelumne River watershed lies on the western slope of the Sierra Nevada Mountains in Alpine, Amador, Calaveras, and San Joaquin counties. The watershed covers an area of 627 square miles and extends from Highland Peak (elevation 10,934 feet) near the crest of the Sierra Nevada Mountains to Camanche Reservoir (elevation 235 feet) located in the lower western foothills near Clements. Most of the watershed is forested land within the El Dorado and Stanislaus National Forests. Over the long term (multiple year perspective), about 90 percent of the water delivered to EBMUD's customers originates from the Mokelumne River watershed. The remaining 10 percent originates as runoff from the protected watershed lands in the East Bay. However,

EBMUD Mission Statement

To manage the natural resources with which the District is entrusted; to provide reliable, high quality water and wastewater services at fair and reasonable rates for the people of the East Bay; and to preserve and protect the environment for future generations.

In carrying out this mission, we will:

1 Exercise responsible financial management

2 Ensure fair rates and charges

3 Provide responsive customer service

4 Promote ethical behavior in the conduct of District business

5 Ensure fair and open processes involving the public

6 Provide a healthy work environment

7 Promote diversity and equality in personnel matters and contracting

8 Promote environmental responsibility

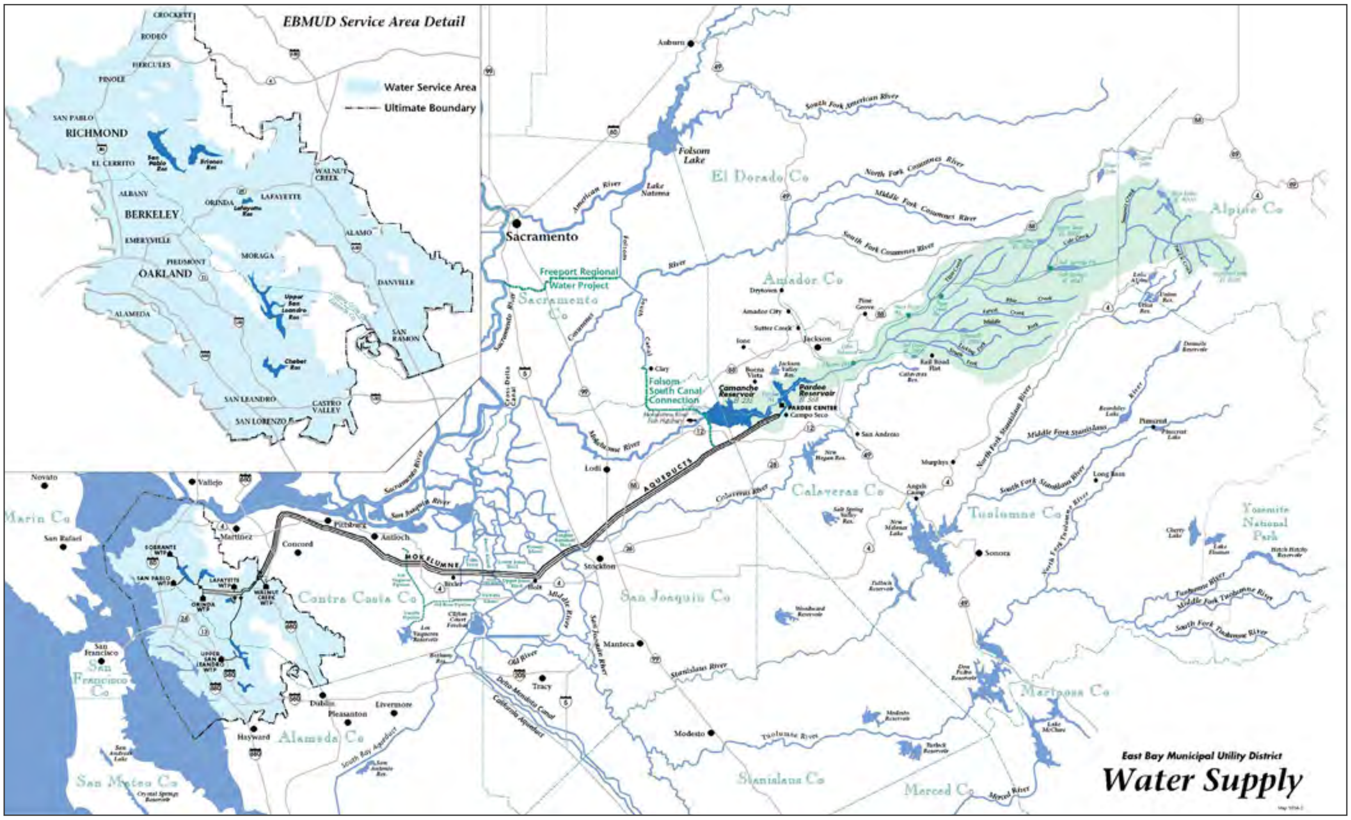


Figure 3-1 *EBMUD Service Area and Ultimate Service Boundary*

during dry years, local runoff essentially matches evaporation, resulting in no net contribution from this local supply.

The District will be adding two additional supplemental water supplies to its water supply portfolio: the Freeport Regional Water Project (FRWP) and the first phase of the Bayside Groundwater Project (see Section 3.2.3). Both of these projects are designed to provide additional water to augment EBMUD's water supply during dry periods.

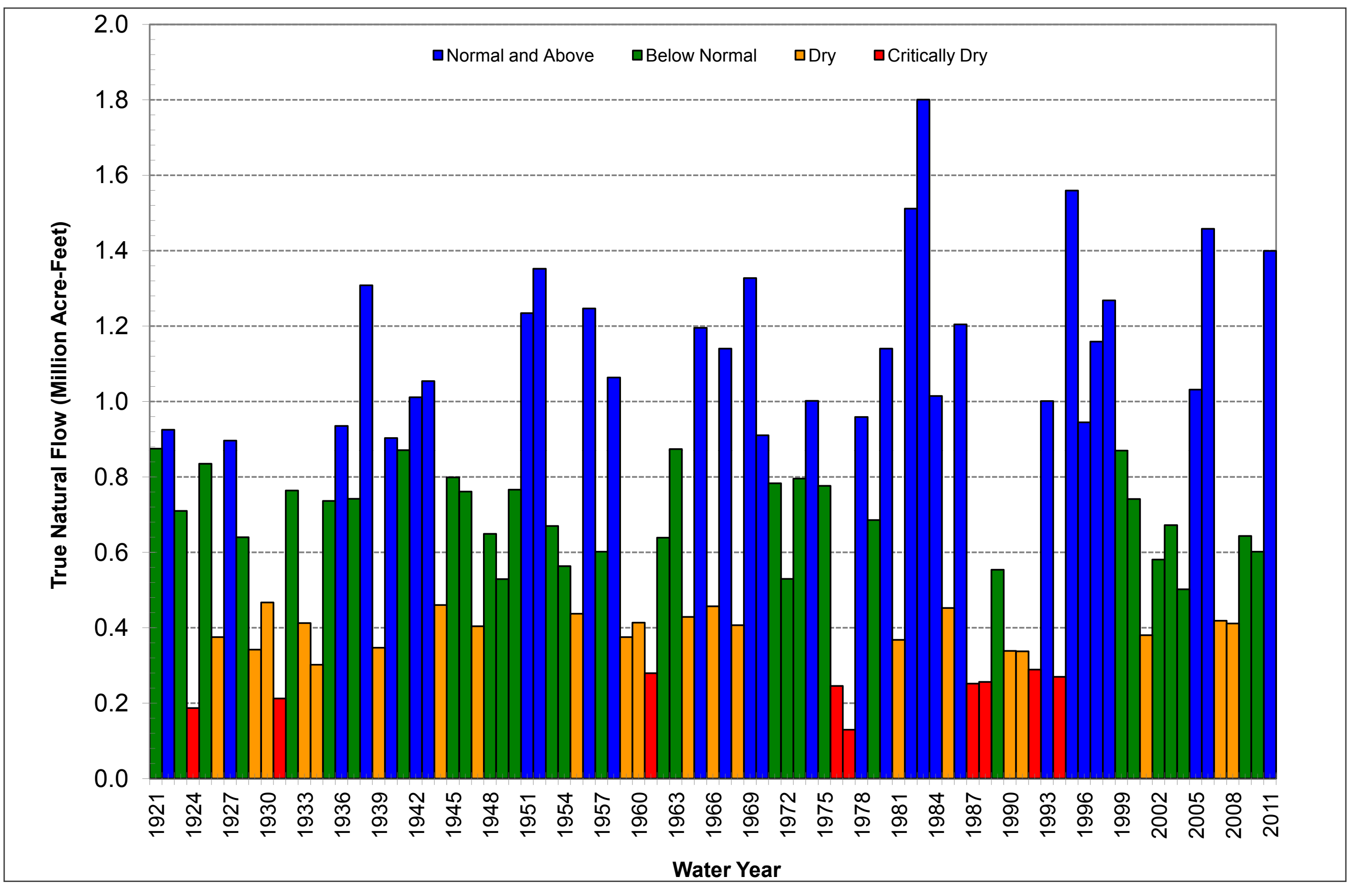
During dry years, approximately 22 percent of water would be sourced from the Sacramento River (via the FRWP).

Annual precipitation and streamflow in the Mokelumne River watershed are highly variable from year to year. Fourteen years out of the last two decades were considered Below Normal to Critically Dry water years[1] for the Mokelumne River (see Figure 3-2 which depicts flow by water year). Within one year, precipitation is highly seasonal with most normally occurring between November and May and very little occurring between late spring and fall. Table 3-1 presents average climatic data for the Mokelumne River watershed. Peak flows in the Mokelumne River normally occur during winter storms or during the spring snow-melt season from March through June. River flows decrease to a minimum in late summer or fall.

[1] Five water year types have been established for the Mokelumne basin, using the flow records (total annual runoff) as kept for the River system. A mathematic approach was originally used to establish the range / limits of the particular year type. The five types present on the Mokelumne are as follows: Wet, Above Normal, Below Normal, Dry and Critically Dry.

Snowmelt from parts of Alpine, Amador and Calaveras counties contribute to the Mokelumne River runoff. The river's primary tributaries are the North, Middle and South Forks of the Mokelumne River, with the North Fork tributary draining close to 85% of the Mokelumne River watershed. Smaller tributaries include Summit Creek, Bear Creek, Cole Creek, Moore Creek, Blue Creek, Tiger Creek, Panther Creek, Forest Creek, and Licking Fork. While the South Fork remains unimpaired, flows in the North and Middle Forks and significant tributaries are regulated by a series of PG&E reservoirs located directly upstream and adjacent to EBMUD's Pardee Reservoir. Snowmelt enters the upper reaches of the Mokelumne River, which flows into reservoirs owned by PG&E. Those on-line reservoirs release flows back into the river, and progressing downstream, the flows enter Pardee Reservoir.

Snowmelt in the Mokelumne River watershed is the main source for EBMUD's high quality drinking water



Note: Water Year Type determination based on the April-September JSA water year designation. Based on the actual unimpaired runoff into Pardee Reservoir on November 5.

Source: EBMUD 2012.

Figure 3-2 *Mokelumne River JSA (April-September) Year-Type Classification Water Years 1921-2011*

Table 3-1: EBMUD Climate Data

	East Bay Area		Mokelumne Basin		
	Average Precipitation[1]	Average Temperature[2]	Average Percipitation[3]	Average Snow Depth[4]	Average Temperature[5]
Month	(inches)	(°F)	(inches)	(inches)	(°F)
January	5.53	49.9	8.93	58	27.5
February	4.73	53.7	7.92	76	27.7
March	3.78	55.3	7.08	73	28.8
April	1.92	57.9	4.10	51	33.6
May	0.71	60.2	2.16	11	41.2
June	0.16	62.8	0.80	0	49.7
July	0.04	63.2	0.25	0	56.5
August	0.08	64.0	0.29	0	56.5
September	0.31	65.5	0.82	0	50.7
October	1.40	62.8	2.50	1	43.0
November	3.44	56.2	5.61	22	33.0
December	4.73	50.2	7.87	44	28.2
Total	26.83	--	48.33	--	--

[1] East Bay precipitation is the average of Lafayette Reservoir and USL WTP stations from 1953-2004.

[2] East Bay temperature from National Weather Service Richmond station, 1961-1990. (Climatological Data Annual Summary: California. NOAA, 2002). Note: The Richmond station illustrates the temperature variability in the western portion of EBMUD's service area. Temperature variability in the eastern portion of the service area (termed by EBMUD as the "East of Hills" region) sees more pronounced temperature variability.

[3] Mokelumne precipitation is the EBMUD 4-station average from 1930-2004.

[4] Average end-of-month snow depth measured at Caples Lake, 1968-2004.

[5] Mokelumne temperature from National Weather Service Twin Lakes station, 1961-1990. (Climatological Data Annual Summary: California. NOAA, 2002).

Source: EBMUD UWMP 2005.

Flows are reduced by upstream diversion. Inflows to Pardee are recorded at the U.S. Geological Survey (USGS) Gauge No. 11319500 on the Mokelumne River near Mokelumne Hill. A portion of the water stored in Pardee Reservoir is conveyed to the EBMUD service area via the Mokelumne Aqueducts. The remainder of the water is released from Pardee Reservoir into Camanche Reservoir.

Most of the Mokelumne River watershed is protected and undeveloped, consisting of open space and forest land with small concentrations of residential/commercial development along the major highways, and large tracts of designated wilderness. Forest land, located chiefly within the El Dorado and Stanislaus National Forests, accounts for about 75% of the watershed land. The remaining land includes small agriculture areas, mainly orchards and vineyards, and several areas of recreational developments (including winter sports facilities). Aside from minor industrial and commercial uses, logging is the major land use activity in the watershed.

Restriction Conditions

Conditions which restrict EBMUD's ability to use its full entitlement include:

- Upstream water use by prior right holders;
- Downstream water use by riparian and senior appropriators and other downstream obligations, including protection of public trust resources; and
- Variability in rainfall and runoff.

EBMUD's Right to Divert Mokelumne River Water

EBMUD has the water rights and the capacity to divert up to 325 MGD from the Mokelumne River for municipal and industrial use within its service area in Alameda and Contra Costa counties. EBMUD's ability to garner this amount of water, however, is controlled by the interrelationship between its water rights and the rights of other users of Mokelumne River water, its ability to store water, and the amount of Mokelumne River runoff. The extent of these water rights was defined by several lawsuits, negotiated settlements, and decisions of the State Water Resources Control Board (SWRCB). EBMUD also possesses other state water rights related to hydroelectric power generation and the appropriation of runoff into the East Bay terminal reservoirs in the District service area. A summary of EBMUD's Mokelumne River water rights is shown in Table 3-2.

Upper Mokelumne River

Table 3-2: EBMUD Entitlements

Water Right	Maximum Annual Direct Diversion to Service Area (MGD)	Maximum Annual Diversion to Storage (AF/Year)	Maximum Annual Direct Diversion and Diversion from Storage for Use within EBMUD Service Area
Pardee Reservoir 1924 Application 4228 1981 License 11109[1]	200	209,950[1]	200 MGD (224,037 AF)
Camanche Reservoir 1949 Application 13156 1956 Permit 10478	125	353,000	125 MGD[2] (140,000 AF)
Total	325	562,950	325 MGD (364,037 AF)

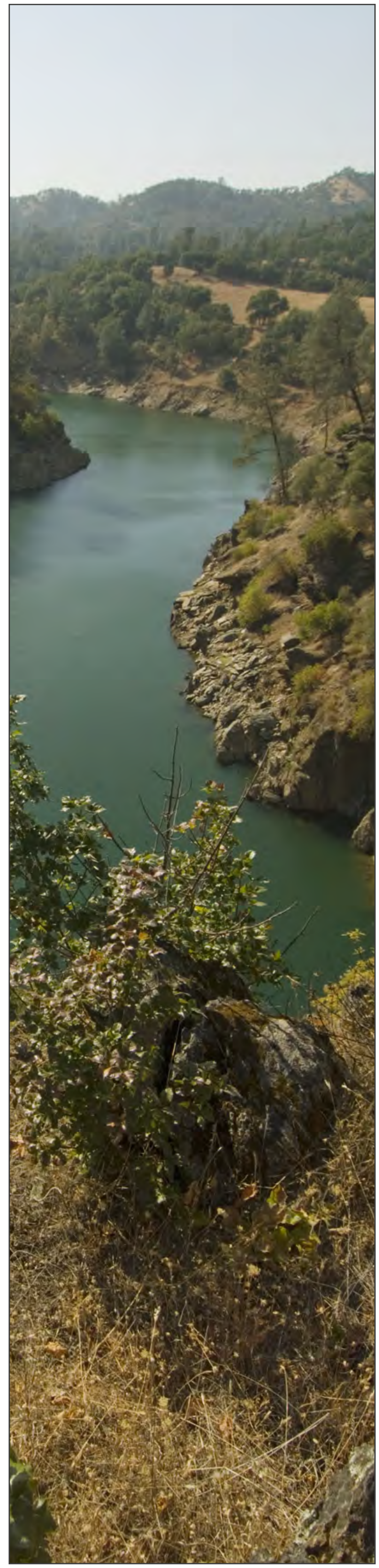
[1] Total amount to be taken from the source (the river) under License 11109 shall not exceed 316,250 AF per year.

[2] Total amount to be taken from the watershed by direct diversion or diversion from storage under Permit 10478 (and any subsequent license), as restricted by the 1959 Release of Priority, shall not exceed 194 cfs (125 MGD).

Source: WSMP 2020, 1992, p. 3-13.

Other Mokelumne River Water Entitlements, Users, Facilities and Resources

The Mokelumne River serves a variety of uses, including agriculture, fisheries, hydropower, recreation, and municipal and industrial use. Before water can be put to use or diverted to storage under EBMUD's water rights, the needs of senior users (persons with the oldest water use priority) and fishery release requirements must be met. Riparian landowners, who have rights that are tied to the river's natural flow, and other individuals and agencies with appropriative water rights that predate EBMUD's rights, have claims on the river that are senior to EBMUD's rights. Figure 3-3 shows how the river's flow is typically divided among the various users. EBMUD has also negotiated water right agreements with certain Mokelumne River water users to clarify how these users may exercise state-granted rights consistent with EBMUD's water right priorities. These water rights agreements and the entitlements associated with each user on the river are described in greater detail, by entity or agency, in the 2005 Urban Water Management Plan, Appendix A: Urban Water Planning Act.


Upper Mokelumne River

In 1961, EBMUD entered into an agreement with CDFG that required EBMUD to build a fish hatchery at Camanche Dam and to release 13 TAF annually from Camanche Reservoir for fishery production, in addition to the releases for the Woodbridge Irrigation District, riparian and senior appropriators, and accounting for channel losses. EBMUD also reached agreement, in 1962, with the U.S. Army Corps of Engineers (the Corps) for the operation of the then-proposed Camanche Reservoir to accommodate the reservation of up to 200 TAF of flood control space for the protection of downstream areas in San Joaquin County.

Pursuant to the 1998 JSA between EBMUD, CDFG, and the U.S. Fish and Wildlife Service (USFWS), a revised schedule of fishery releases from Camanche Dam was developed. The Federal Energy Regulatory Commission (FERC) issued its "Order Approving Settlement Agreement and Amending License" on November 27, 1998. The California State Water Resources Control Board (SWRCB) incorporated the flow provisions of the Joint Settlement Agreement (JSA) into EBMUD's Mokelumne River water rights in 2000 through the SWRCB's Decision 1641. The JSA replaces the 1961 agreement with DFG regarding flows in the lower Mokelumne River and provides additional in-stream flows, funding for non-flow enhancement measures, and monitoring requirements and new reporting objectives over the remainder of the FERC License period, which expires in 2031.

Basin Runoff / Diversions and Losses	Maximum (TAF/CY)		Dry Year Maximum (TAF/CY)
Amador & Calaveras Counties	47.0		13.1
Mokelumne Hill Gage		Average [1] 728	
Jackson Valley Irrigation District [2] (Amador County)	3.85		0
EBMUD Aqueduct Draft	364 (325 *MGD*)		see footnote 3
EBMUD Diversions to Storage	562.9		see footnote 3
Total Camanche Release		Average [1] 484	
Fish Release per Joint Settlement Agreement (JSA)	165.9 [4]		65[5]
North San Joaquin Water Conservation District [6]	20		0
Riparian and Senior Appropriators (Above WID)	14.4		11.2
Woodbridge Irrigation District [7]	60		39
Riparian and Senior Appropriators (Below WID)	6.2		4.8
Net Channel Losses	120		56
Woodbridge Gage [8]		Average [1] 415	

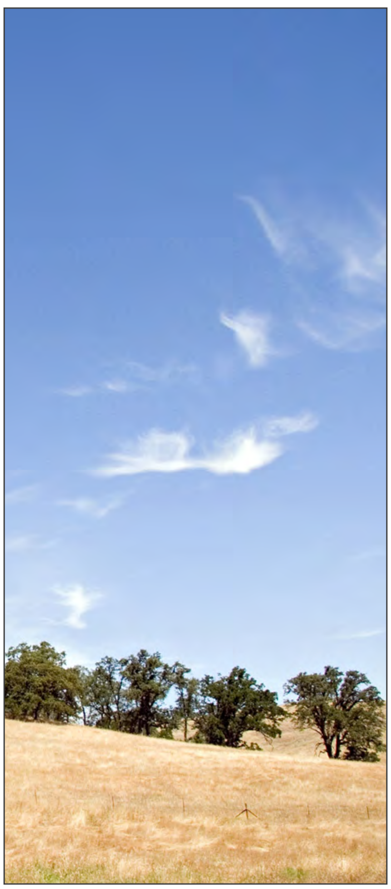
Notes:

(1) Average data provided for the period of historical record.
(2) May be "0" if no water is available under JVID priority or Pardee elevation is below 550 ft.
(3) Varies with runoff and storage conditions.
(4) Water releases committed by EBMUD to protect fishery per "Normal and Above" water year type under JSA criteria.
(5) Water releases committed by EBMUD to protect fishery per "Dry" water year type under JSA criteria. In critically dry years, the minimum flow could be as low as 22.5 TAF.
(6) May be "0" if no water is available, surplus to EBMUD needs.
(7) EBMUD's obligation to release water to the Woodbridge Irriation District is governed by a series of water rights settlement agreements to a maximum of 60 TAF/yr when inflow to Pardee is greater than 375 TAF.
(8) Includes local runoff between Camanche and WID.

Source: EBMUD UWMP 2005.

Figure 3-3 *Mokelumne River Releases, Diversions, and Losses*

EBMUD headquarters at 375 11th Street in Oakland, CA



Golden Hills with oak trees in the eastern part of the service district - EBMUD covers various climate zones that have different water needs

3.1.2 EBMUD Service Area Watershed and Hydrology

EBMUD supplies raw and potable water to parts of Alameda and Contra Costa Counties in the East Bay area of the San Francisco Bay metropolitan region. This 331-square-mile service area was established during EBMUD's formation, in addition, EBMUD established the Ultimate Service Boundary (USB), which defines its limit of future annexation for extension of water service. The Local Agency Formation Commissions (LAFCOs) of Alameda and Contra Costa counties established a Sphere of Influence (SOI) for EBMUD. The SOI defines, for LAFCO purposes, the probable and ultimate extent of the area to be served by EBMUD. The USB and SOI are also shown in Figure 3-1.

The availability of water from local runoff is dependent on two factors. First, hydrologic conditions determine the amount of runoff in the local watershed. In dry years, evaporation can exceed runoff, resulting in no net supply. Second, the amount of storage available for capturing local runoff is limited. Lower water levels in a reservoir would provide space for storing local runoff, if it were available. However, because the East Bay reservoirs ("terminal reservoirs") also regulate EBMUD's Mokelumne supply and provide emergency standby storage, limited space is available to develop a reliable supply from local runoff. Average local supply put to beneficial use is 15-25 MGD during normal hydrologic years and is near zero during drought conditions. Because of the variability of these factors, the supply from local runoff is not dependable.

Within the EBMUD service area there are significant differences in geography, climate, and land use. These characteristics are important as they influence how water is used in various portions of the service area. These characteristics are also factors considered in future water demand projections. Geographically, the western portion of the service area is characterized by a plain that extends from Richmond to Hayward and from the shore of the San Francisco Bay (the Bay) inland to the base of the Oakland/Berkeley Hills that rise to about 1900 feet above sea level. East of the Oakland/Berkeley Hills, the terrain is characterized by rolling hills as the land descends to about 100 feet above sea level in Walnut Creek. Much of the central hilly portion of the service area is undeveloped and comprises the watershed lands of the District's local (terminal) reservoirs. While these protected watershed lands are located within EBMUD's USB, a large part are not located within the District service area. The western and eastern portions of the service area also differ climatically. Areas near the Bay experience a moderate climate that is tempered by ocean and Bay waters. In contrast, the inland areas (such as Lafayette, Walnut Creek and San Ramon Valley) experience greater extremes in climate with cooler winters and hotter summers. Average historical climate characteristics for the District service area are shown in Table 3-1.

There are a number of land uses on EBMUD-owned lands. The predominant agricultural land use is livestock grazing. EBMUD also leases its watershed lands for other agricultural uses such as Christmas tree and red oat hay farming, a tool used to reduce the wildland fire danger at the urban interface.

3.2 Summary of EBMUD's Water Supply and System

3.2.1 EBMUD

EBMUD is a publicly owned utility formed under the Municipal Utility District (MUD) Act passed by the California Legislature in 1921. Formed in 1923 in accordance with the MUD Act's provisions, EBMUD began delivering water from the Sierra Nevada to the East Bay in 1929 with the completion of Pardee Dam and the Mokelumne Aqueduct. EBMUD provides domestic water service to 1.3 million customers in the East Bay region of the San Francisco Bay Area. EBMUD also provides approximately 600,000 customers west of the Oakland/Berkeley hills with wastewater services.

3.2.2 EBMUD System Infrastructure

The EBMUD water supply system collects, treats, and distributes raw water from its primary water source in the Sierra Nevada to its customers in Alameda and Contra Costa counties. The water supply system consists of a network of raw water reservoirs, aqueducts, water treatment plants, pumping plants, and distribution pipelines. Major EBMUD water storage and conveyance facilities are identified in Figure 3-1 and described in the following paragraphs.

Photovoltaic solar panels at Sobrante Water Treatment Filter Plant

EBMUD obtains almost all of the water used to serve its customers (about 90 percent of its total water supply) from the Mokelumne River's 627-square-mile watershed. District Mokelumne River storage facilities include Pardee Dam and Reservoir located near Valley Springs in the Sierra foothills, and Camanche Dam and Reservoir, located 10 miles downstream on the Mokelumne River. Pardee Reservoir is where District's water supply begins its approximately 91[2]-mile journey through the Mokelumne and Bay Area Aqueducts, the raw water transmission system to its East Bay.

Since the District's water supply from the Mokelumne River is subject to a variable hydrologic regime as well as the entitlements of other users, EBMUD relies on the storage capacity of both Pardee and Camanche Reservoirs to make the river's yield more dependable, to ensure required base flow requirements are met, and to provide downstream flood protection. The combined storage capacity of Pardee and Camanche Reservoirs is approximately 615 TAF. Storage in Camanche Reservoir is used to meet the District's downstream obligations, including releases for irrigation, streamflow regulation, flood control, fishery needs, and the senior rights of other riparian and appropriator entitlements, while Pardee Reservoir storage

[2] 2 miles Pardee Tunnel + 82 Mokelumne Aqueducts + 7 miles Lafayette/Briones Aqueducts = 91/91.2 miles.

is used to meet District demands. Without the storage capacity provided by Camanche Reservoir, the rights of downstream users to Mokelumne River water would increase the demand for water stored in Pardee Reservoir, reducing the supply of water available to the District's customers and reducing the downstream flood protection.

Thus, the existing Mokelumne River reservoir storage capacity is vital to the District's ability to meet its obligations to provide reliable service to its customers and to provide water for instream uses in dry years. In wetter years these reservoirs provide flood protection and help manage water quality. Any portion of the District's water right entitlement that is not directly diverted for current use in the District service area or diverted to storage in Pardee or Camanche Reservoir, is released downstream and is no longer available to the District.

Pardee Reservoir

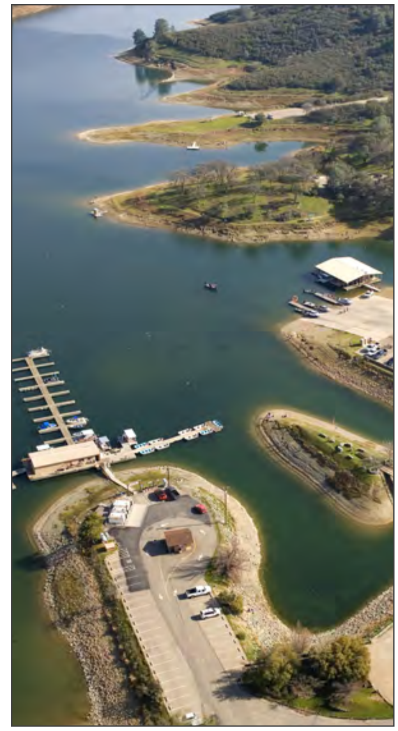
Pardee Reservoir

Mokelumne River water is collected at Pardee Dam and Reservoir, located 38 miles northeast of Stockton near the Town of Jackson. Pardee Reservoir is used principally for municipal water supply, for power generation, and also as a source of water for Jackson Valley Irrigation District. Pardee Reservoir is also operated for non-contact recreational facilities to the public and to maintain Lower Mokelumne River and fish hatchery water quality and quantity objectives.

Dedication day luncheon on Pardee Dam October 19, 1929

Pardee Dam is a concrete gravity arch structure completed in 1929 that rises 345 feet above the Mokelumne riverbed. The 23.6-megawatt (nameplate capacity) Pardee Powerhouse at the base of the dam generates 140 million kilowatt hours of electrical energy during a year of average runoff. The reservoir has 37 miles of shoreline and a maximum surface area of 2,222 acres at a spillway crest elevation of 567.7 feet. The reservoir has a licensed capacity of 209,950 AF at spillway crest elevation. The reservoir is the point of diversion for the District's water supply and also provides hydroelectric power generation; it is used in conjunction with Camanche Reservoir to provide flood control protection for the lower Mokelumne River area under an agreement with the U.S. Army Corps of Engineers.

EBMUD can divert up to 125 MGD from the Mokelumne River to direct use from December 1 to July 1, and can divert up to 353,000 AFY of water to storage between December 1 and July 1 for municipal use in its East Bay service area. EBMUD's Pardee water right allows EBMUD to divert up to 200 MGD from the Mokelumne River. Together, the Camanche Permit and the Pardee License allow delivery of a maximum of 325 MGD from the Mokelumne River, or 364,000 AFY, subject to the availability of Mokelumne River runoff and EBMUD's meeting obligations to senior water rights, downstream fishery flow requirements, and other Mokelumne River water uses (see Table 3-2). EBMUD's water supply is diverted from Pardee Reservoir through the Pardee Tunnel into three Mokelumne Aqueduct pipelines, with a capacity of 325 MGD, for delivery to terminal reservoirs and filter plants in the East Bay area. Water for downstream Mokelumne River uses as well as flows that are within EBMUD's rights, but which are in excess of EBMUD's ability to store, are released through the hydroelectric power plant or sluice valves at the base of Pardee dam. Water flowing by gravity from Pardee Reservoir takes 30 to 45 hours to reach the Bay Area.



Camanche Reservoir recreation facilities

Camanche Reservoir

Camanche Dam is located 10 miles downstream from Pardee Dam on the Mokelumne River. Camanche Dam is a gravel and earthfill structure that rises 171 feet above the Mokelumne riverbed. The main Camanche Dam has a crest length of 2,640 feet, and there are four miles of earthen dikes. A 10.8-megawatt (nameplate capacity) power plant is located at the base of the dam, generating 40 million kilowatt-hours of electrical energy during a year of average runoff.

Camanche Reservoir was created when construction of the dam and dikes were completed in 1964, developing an additional supply for EBMUD by providing additional streamflow flood-control space and capacity to meet downstream needs. Under its existing Camanche water right, EBMUD can divert up to 125 million gallons per day (MGD) from the Mokelumne River to direct use from December 1 to July 1, and can divert up to 353,000 acre-feet per year (AFY) of water to storage between December 1 and July 1 for municipal use in its East Bay service area. Camanche Reservoir has a surface area of 7,470 acres (about 12 square miles), a 63-mile shoreline, and a reservoir capacity of 417,120 acre-feet (AF) at the dam's spillway crest. Camanche Reservoir is operated jointly with Pardee Reservoir to store water for irrigation and for stream-flow regulation, to provide flood protection,

Camanche Reservoir Fish Hatchery

San Pablo Reservoir, one of EBMUD's five terminal reservoirs

Standby Storage Policy

If the aqueducts are shut down because of severe water quality events, EBMUD implements water management plans that are already in place and responds to these conditions. Because terminal reservoirs are normally operated to provide 180-days of standby storage, EBMUD meets its service area demands by relying on this supply when the Mokelumne River supply is temporarily unavailable. After water quality has returned to acceptable levels, the terminal reservoirs are refilled as soon as practical to meet standby storage levels using the supply from the Mokelumne Aqueducts.

to provide water to meet the needs of downstream water rights holders, and water for fisheries and riparian habitat. Like Pardee Reservoir, Camanche Reservoir is also operated to provide recreational facilities to the public.

The total capacity of Camanche Reservoir is not available for water supply storage. As a condition of its water rights, EBMUD manages Camanche and Pardee Reservoirs to provide up to 200 TAF of flood control space each year under an agreement with the U.S. Army Corps of Engineers. Flood control requirements imposed under the Agreement are specified in the Camanche Dam and Reservoir Water Control Manual (Revised 1981) and are based on available storage space and expected runoff during the winter and spring months.

East Bay Terminal Reservoirs

EBMUD operates five terminal reservoirs within the East Bay service area: Briones, Chabot, Lafayette, San Pablo, and Upper San Leandro reservoirs. The maximum capacity of the terminal reservoirs is 155,550 AF. The terminal reservoirs serve multiple functions, including regulating EBMUD's Mokelumne River supply in winter and spring, augmenting EBMUD's Mokelumne water supply with local runoff, providing emergency sources of supply during extended drought or in the event of water supply facility outage, providing environmental and recreational benefits to East Bay communities, and minimizing flooding.

Water from Pardee Reservoir is transported to the East Bay service area in three Mokelumne Aqueduct pipelines which terminate in Walnut Creek. From Walnut Creek, the water is sent directly to three of the District's filter plants or to the East Bay terminal reservoirs. Two of EBMUD's terminal reservoirs, Upper San Leandro (USL) and San Pablo, are the source of water for three other treatment plants which serve the northern and southern parts of the EBMUD distribution system west of the Oakland-Berkeley Hills. These two reservoirs (USL and San Pablo), along with Briones Reservoir, store water before treatment and serve to re-regulate the Mokelumne River supply, to provide emergency supply, and to store local runoff. The two remaining reservoirs, Lafayette and Lake Chabot, provide emergency standby supply and are also used extensively for recreation (fishing, sailing, canoeing, hiking jogging, bicycling, picnicking, and nature observations). San Pablo Reservoir also provides extensive recreation for the communities of the East Bay. Table 3-3 summarizes the capacities of the terminal reservoirs.

Table 3-3: EBMUD Terminal Reservoir and Dam Characteristics

Name/Dam Type	Water Sources	Capacity TAF (Billion Gallons)	Overflow Elevation (Feet) MSL	Construction Date	General Location
BRIONES Earthfill Dam	Mokelumne Aqueducts Bear Creek	60.5 (19.7)	576.1	1964	North of Orinda, Contra Costa County
CHABOT Earthfill Dam	Mokelumne Aqueducts San Leandro Creek Upper San Leandro Reservoir Miller Creek	10.4 (3.4)	227.3	1875	East of San Leandro, Alameda County
LAFAYETTE Earthfill Dam	Lafayette Creek[1]	4.3 (1.4)	449.2	1929	Lafayette, Contra Costa County
SAN PABLO Earthfill Dam	Mokelumne Aqueducts San Pablo Creek Bear Creek Briones Reservoir	38.6 (12.6)[2]	313.7	1920 (Dam reinforced in 1979)	East of Richmond, Contra Costa County
UPPER SAN LEANDRO Earthfill Dam	Mokelumne Aqueducts San Leandro Creek & Tributaries	38.0 (12.4)	460.0	1929 (New dam built immediately downstream in 1978)	Between Moraga and Castro Valley, Alameda and Contra Costa Counties

[1] The raw water line for the Mokelumne Aqueducts was disconnected from the Lafayette Reservoir in 1971.

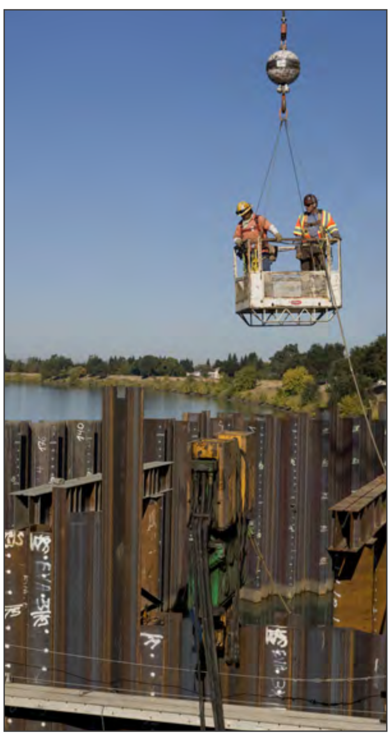
[2] San Pablo Reservoir has been temporarily restricted to a maximum water surface elevation of 294 feet, corresponding to storage of 24.2 TAF (7.9 Billion Gallons).

Source: Table 2-1 of the UWMP 2005 (p. 2-4) and the WSMP 2020, Exhibit 3-7.

Conveyance

Raw water from Pardee Reservoir is transported approximately 91 miles to East Bay water treatment plants and terminal reservoirs through the Pardee Tunnel, the Mokelumne Aqueducts, and the Lafayette Aqueducts. Raw water from Pardee Reservoir moves through the Pardee Tunnel, a 2.2-mile 8-foot-high horseshoe structure completed in 1929, to the Mokelumne Aqueduct System near Valley Springs in Calaveras County. There, the raw water enters the three 82-mile-long pipelines referred to as the Mokelumne Aqueducts. The three pipelines transport water miles from the Pardee Tunnel at Campo Seco in the Sierra Nevada foothills to Walnut Creek at the east end of the two Lafayette Aqueducts.

The Mokelumne Aqueducts traversing the Delta



Construction of the Freeport Regional Water Project (FRWP) is to be completed by the end of 2009

Once in the District service area, the raw water is distributed via the two Lafayette Aqueducts (completed in 1928 and 1963) to filter plants in Walnut Creek, Lafayette or Orinda for treatment and distribution, or stored in one of the District's terminal reservoirs (Upper San Leandro, Briones or San Pablo) for later use. Mokelumne River water within EBMUD's rights but which is in excess of EBMUD's ability to store, is released through the hydroelectric power plant at Camanche Dam or sluice valves at the base of the dam.

Mokelumne Aqueducts

The three steel Mokelumne Aqueducts are buried for most of the 82-mile length. However, the pipes are elevated for approximately 10 miles over the islands of the Delta. The elevated aqueducts are supported on reinforced concrete or steel support structures, spaced every 30 feet in the case of Mokelumne Aqueduct No. 1 and every 60 feet in the case of Mokelumne Aqueducts No. 2 and No. 3. Where the aqueducts traverse rivers and sloughs in the Delta, they are buried from 10 to 40 feet below channel bottoms or levee crests. The aqueducts have a total capacity of approximately 200 MGD as conveyed by gravity flow. Water flowing by gravity from Pardee Reservoir takes 30 to 45 hours to reach the Bay Area. The aqueducts' capacity can be increased to 325 MGD by pumping at the District's Walnut Creek Pumping Plant. Mokelumne Aqueduct No. 1, constructed in 1929, is 5 feet 5 inches in diameter, while Mokelumne Aqueduct No. 2, constructed in 1949, is 5 feet 7 inches, and Mokelumne Aqueduct No. 3, constructed in 1963, is 7 feet 3 inches in diameter.

Treatment

As stated above, two of EBMUD's terminal reservoirs, Upper San Leandro and San Pablo, supply water to three treatment plants serving the northern and southern parts of the EBMUD distribution system west of the Oakland-Berkeley Hills. These plants, which provide full conventional treatment, are the Upper San Leandro Water Treatment Plant (WTP), the San Pablo WTP and the Sobrante WTP. In addition, the District operates three inline-filtration plants located in Walnut Creek, Lafayette and Orinda.

3.2.3 New Supplemental Supplies

The District recently developed additional water supply sources specifically for providing supplemental water supplies during dry years. The Bayside Groundwater Project - Phase 1 became operational in 2010 and the Freeport Regional Water Project (FRWP) became operational in February 2011.

Freeport Regional Water Project

The Freeport Regional Water Project (FRWP) is a cooperative project between the Sacramento County Water Agency (SCWA) and EBMUD to supply surface water from the Sacramento River to customers in central Sacramento County and the District service area to meet a portion of its drought year water demands. The project enables EBMUD to take delivery of Central Valley Project (CVP) water under contract with the U.S. Bureau of Reclamation to meet a portion of its drought year water demands. The project's intake facilities are sited along the Sacramento River near the unincorporated town of Freeport. Conveyance facilities transport the water from the Sacramento River intake via pipeline to EBMUD's Mokelumne Aqueducts, where it then flows to the EBMUD service area for treatment and distribution. Through the FRWP, up to 100 MGD of water may be delivered to EBMUD customers in dry years. Under its CVP contract, EBMUD is limited to a total delivery of 165,000 AF over any consecutive three-year period, with a maximum of up to 133,000 AF in a single dry year. The FRWP also provides SCWA with up to 85 MGD.

The Final Environmental Impact Report / Environmental Impact Statement (EIR/EIS) for the FRWP was certified and the project approved in March 2004. The FRWP consists of multiple project components, including shared elements (i.e., those that both SCWA and the District require in order to treat and deliver Sacramento River water to their respective customers) and *unique* elements (i.e., those that only one agency requires as part of its respective treatment and delivery system).

The FRWP Intake Facilities, incorporating fish screens and a pumping plant, are located on the eastern bank of the Sacramento River in the City of Sacramento. Up to 185 MGD of water diverted at the Intake Facility on the Sacramento River are pumped approximately 11.5 miles to

*The FRWP construction in progress, April 2009
Sacramento River near Freeport, CA*

the Turnout Facility using an 84-inch diameter welded steel, coated pipeline. The Turnout Facility marks the endpoint of the shared facilities. From the Turnout Facility, a 72-inch diameter pipeline capable of transporting up to 100 MGD transports water to the Folsom South Canal. Once in the Canal, water destined for the District service area continues to the southern end of the canal, where it is pumped through pipelines to EBMUD's Mokelumne Aqueducts in San Joaquin County. From the Brandt flow splitting facility at the aqueduct connection to the split off between EBMUD's terminal reservoirs, the water travels approximately 75 miles for delivery to District customers.

Bayside Phase 1

The Bayside Groundwater Project Phase 1 involves the injection of potable drinking water into the South East Bay Plain Basin (SEBPB) during wet years for storage and later recovery and use during a drought. Phase 1 uses an existing 18 inch diameter well located at 2600 Grant Avenue in San Lorenzo for both injection and extraction operation, together with water treatment facilities (used to treat the water extracted) located at 2540 Grant Avenue.

Placement of recycled and raw water pipes in front of EBMUD's headquarters in Oakland, CA

Treated water from EBMUD's distribution system is injected through the single well into the deep aquifers of the SEBPB in normal and above-normal water years for later recovery during a drought. Phase 1 provides for an annual 1 MGD injection into the deep aquifers and a maximum annual 1 MGD extraction capacity, although it may be operated, over the short (partial / portion of a given year) term, at an extraction rate of up to 2 MGD during a particular drought year. The recovered water is treated to meet Federal and State drinking water standards before it is distributed to EBMUD customers.

The first year start-up testing of the Bayside Groundwater Project – Phase 1 has been completed and the preparation of a Groundwater Management Plan has been initiated.

3.3 Existing Raw Water Infrastructure System

The District's raw water system is a complex network of reservoirs, aqueducts, pump stations, wasteways, and flow controls that span a wide range of geomorphic and environmental conditions. Integral to the raw water system are the Mokelumne Aqueducts, which cross 82 miles of terrain from Pardee Reservoir in the Sierra foothills, through the Sacramento-San Joaquin Delta (Delta) to the District's terminal reservoirs in the East Bay.

3.3.1 Document Review and Data Gap Analysis

EBMUD has completed infrastructure reliability studies for various parts of its raw water system. These summarize the condition of key system components, describe performance of the system under normal operating conditions and projected performance after stress events such as seismic or flood events, and estimate the time required to put these facilities back into operation following stress events. It was determined that the District has adequately documented current conditions and known risks to its raw water infrastructure. Additionally, as part of this reliability review, an assessment of the District's 6-month emergency storage policy was made. In the event of a raw water outage, such as a failure of all three Mokelumne aqueducts in the Delta, the District would primarily rely on local terminal reservoir storage.

The infrastructure reliability review for the WSMP 2040 consisted of analyzing the coverage of reliability topics and quality of information contained in these reports; detailed probability analyses to develop cost-risk comparisons were not conducted as part of this analysis. While the probabilities of seismic risks, especially in the Delta, have been adequately documented, discrete probabilities of other future events may not be documented to the degree desired for long-term planning initiatives. For example, the probability that rising sea-level and increased wind-wave action will increase levee failure risk may not be well understood. Table 3-4 lists the documents reviewed as part of the infrastructure reliability assessment.

At a qualitative level, a score-based evaluation indicated that the District has a good understanding of the condition and reliability of its raw water infrastructure.

The susceptibility of the raw water system to levee failures and earthquakes, and the resulting failure scenarios, are adequately understood and documented. A number of studies have concentrated on the Mokelumne Aqueducts, including subsequent improvement projects, in addition to studies related to other system aqueducts (i.e., Moraga Aqueduct, Briones Aqueduct, Lafayette Aqueducts). Information regarding the condition of tunnels, flow control facilities, diversion structures, and pump stations has also been adequately documented. In general, the impacts of four subtopics were deemed to be less understood: fires, security vulnerability, non-EBMUD bridges, and climate change/sea-level rise. These are subtopics and the potential information gaps are discussed below.

Fire

Fires can present a significant risk to water quality if subsequent rainstorms wash debris and toxins into the District's raw water reservoirs. EBMUD's 2000 *Fire Management Plan* presented mitigation measures to reduce this risk for the area surrounding the East Bay terminal reservoirs. The District developed a Watershed Management Plan (WMP) for the upper Mokelumne River watershed, which includes fire management recommendations. The Mokelumne WMP and PEIR were published in April 2008.

Table 3-4: Sources of Infrastructure Reliability Information

Year	Document	Author
1992	Mokelumne Aqueduct Security Plan	Kaiser Engineers/Calpine
1993	Seismic Assessment of Tunnels	Geomatrix Consultants
1996	Lafayette Aqueduct No. 1 Repair Study	Carollo Engineering
1997	Raw Water System – Seismic Assessment	G&E Engineering Systems Inc.
1999	Post Earthquake Recovery, Mokelumne Aqueduct No. 3	CH2MHill
2000	Fire Management Plan	EBMUD
2001	Raw Water Infrastructure Strategic Plan	Mark Lewis & Nicholas J. Irias
2007	Raw Water Infrastructure Study, Aqueduct No. 1 Analysis	EBMUD
2007	Draft TM No.1 "Strategy for Protecting the Aqueducts in the Delta"	EBMUD
2007	Draft TM No.2 "Preliminary Cost Estimates"	EBMUD
2007	Draft TM No.3 "Strategy for Protecting the Aqueducts in the Delta Summary Report"	EBMUD
2007	Phase 1 Delta Risk Management Strategy Report	URS Corporation/Jack R. Benjamin & Associates
2007	Emergency Response - Repair of Aqueduct No. 3	EBMUD
2007	WSMP 2040, Appendix A – Field Notes, 2007	EBMUD

Security Vulnerability

In 2003, EBMUD conducted a security Vulnerability Assessment (VA) of its water system and submitted it to the United States Environmental Protection Agency. This VA is a comprehensive assessment of potential security vulnerabilities of EBMUD facilities. According to the District's *2005 Urban Water Management Plan*, the District has since taken steps to protect its infrastructure from security issues raised in the VA process.

The Mokelumne Aqueducts crossing the Delta

Non-EBMUD Bridges

There are several locations within the Delta where at-grade railroad bridges cross over the Mokelumne Aqueducts. Structural evaluations of these bridges was recommended in the District's *2001 Raw Water Infrastructure Strategic Plan*. While improvements have been made recently to several bridge crossings, some bridges still pose a threat to the aqueducts. EBMUD has designed mitigation measures to protect the aqueducts, and requested approval from the railroad for construction.

Climate Change and Sea Level Rise

Some of the possible effects of global warming, climatic variability, and sea-level rise to the District's raw water system have been studied, including failure of the Delta levees and subsequent flooding around the aqueducts. The risks associated with Delta levee failure are well documented. As part of its *Strategy for Protecting the Aqueducts in the Delta* (2007), the District is in the process of developing a series of reports with the goal of developing a risk-based evaluation of the Mokelumne aqueduct system and analyzing project alternatives to protect the aqueducts. EBMUD will utilize the results of the Delta Risk Management Strategy (DRMS), prepared by the Department of Water Resources, to assist in responding to potential improvement scenarios proposed by the State. Phase 1 of the DRMS report will present discrete probabilities of levee failure under several future scenarios as a result of climate change and sea-level rise.

Coastal wetland on the shoreline of Point Pinole, CA

Overall, the District has a good understanding of the risks to its raw water system and is in a good position to develop long-term water supply planning initiatives. In summary, the District's raw water system is considered sufficiently reliable under normal operating conditions and is expected to withstand most seismic events (which are possible in almost all parts of the raw water system) to an extent sufficient to allow continued operation at reduced levels. However, significant reliability concerns exist in the Delta region due to the potential for levee failures and flooding associated with large seismic events.

3.3.2 Emergency Response and Recovery

A major seismic event in the East Bay is expected to cause a number of system interruptions, however, most repairs would be manageable and redundancy in the system will limit outage times. The event believed most likely to cause the most significant outage to the District's raw water system is an earthquake or levee failure in the Delta, (or possibly, a combination of the two) which would cause one or more of the Mokelumne Aqueducts to fail. In the event of Mokelumne Aqueduct outage, the District would primarily rely on storage in its terminal reservoirs to supply east-of-hills (EOH) and west-of-hills (WOH) demands.

The reliability of Mokelumne Aqueduct No. 3 has been significantly improved in the last decade and it is expected to perform well during severe earthquakes and flooding; however, it is not indestructible. If Mokelumne Aqueduct No. 3 were to fail, No. 1 and No. 2 would almost certainly fail as well, resulting in a complete loss of the District's raw water supply until completion of repairs. The District would likely be able to meet demands for 5 to 6 months (assuming maximum 25% rationing) at the 2010 level of demand, decreasing to 4 to 5 months at the 2040 level of demand (again, assuming 25% rationing). Based on previous reports, repair of Mokelumne Aqueduct No. 3 could take from 4 weeks to 8 months, depending on the failure scenario, but most situations could be repaired in 6 months. It is likely that additional water will be necessary beyond that available in local reservoirs. Additional local water supply sources and continued improvements to its raw water system will improve the ability of the District to supply demands during emergency raw water outages.

Work on the Hayward Intertie Project 2006 was one of EBMUD's recent emergency preparedness measures

3.4 Existing Policies and Measures to Reduce Demand

3.4.1 Existing Rationing Policy

EBMUD evaluates the adequacy of its water supply each year in accordance with its Water Supply Availability and Deficiency Policy (Policy 9.03). This policy establishes a drought demand reduction limit of up to 15 percent of total customer demand on an annual basis while continuing to meet its fisheries flow requirements and obligations to downstream agencies. This approach is unusual among water agencies; many others do not assume any rationing at all in their water planning.

Based on a total water year (October 1 through September 30 of the next year), runoff as predicted during the month of April of that current water year, EBMUD estimates its total system storage available at the end of the water year (September 30). If total system storage is projected to be less than 500,000 AF, the Drought Committee will convene and prepare a Drought Management Program (DMP). EBMUD developed guidelines that call for rationing levels as the projected total system storage decreases. By imposing varying levels of rationing in the early years of potentially prolonged drought periods, the need for more severe rationing in subsequent years is reduced.

During the development of the 2009 WSMP 2040, the District had a rationing policy of no more than 25%. Required reductions in water use vary across customer categories to achieve the targeted reduction of total customer demand. As shown in Figure 3-4, at the 25% rationing level which was the established maximum rationing policy until 2009, different user groups were asked to ration at different levels in order to meet the overall 25% rationing goal. In the past, water use reductions in drought periods have been achieved by effective public information programs combined with water rate increases. EBMUD customers have an excellent record of achieving water savings. On October 27, 2009, the Board of Directors revised the target rationing level to be up to 15%.

3.4.2 Existing Conservation

EBMUD currently implements water conservation programs that encourage voluntary reductions in long-term water use by customers. Supply-side programs improve water use efficiency through actions such as distribution system leak detection and repair. Demand-side water conservation programs include incentives given to residential and non-residential customers (that are applied toward the purchase and/or installation of water saving devices or landscape elements), education and outreach activities, and support activities such as water-use surveys. In addition, and to set an example, EBMUD follows a water-wise approach in managing its own facilities. The District works to avoid and/or correct practices that are seen as wasteful (i.e., permanently turn off water-wasting landscape features such as outdoor fountains, replace grassed lawn with drought-resistant plantings, perform facility surveys aimed at identifying means by which to cut back the District's water use, etc.).

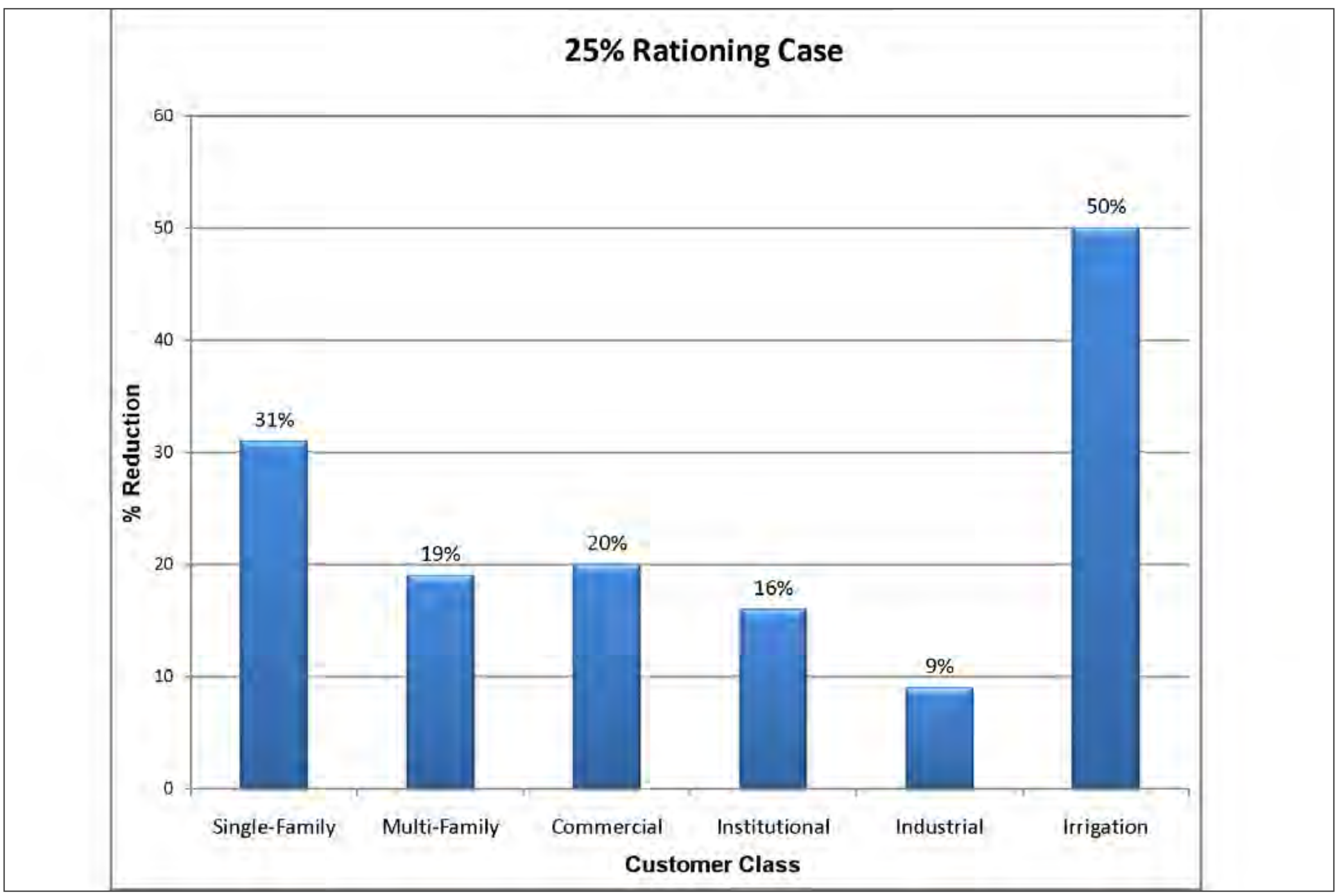


Figure 3-4 *25% Rationing Broken Down by Customer Class*

Additional water savings are gained from natural replacement that occurs without customer participation in a formal EBMUD program. As an example of "natural replacement", when regulations are enacted that require the installation of efficient hardware (e.g., toilets, showerheads, and faucets), while it is beyond EBMUD's authority to require homeowners to install the equipment (as part of a house remodeling project), it is within the authority of the regulatory body issuing the building permit. Hence the regulation produces a water saving benefit (termed a "natural replacement" benefit) to EBMUD and the community. Other "natural replacement" savings include customer-initiated water savings actions (i.e., actions that are triggered by EBMUD water conservation customer awareness / education / outreach, without an accompanying direct EBMUD incentive for the actions).

The water use reduction from EBMUD's existing conservation programs, as implemented since the adoption of the 1993 WSMP, is projected to reach 22.5 million gallons per day (MGD) by the year 2010 and will increase to 35 MGD by 2020. This does not include the estimated savings from conservation programs in effect between 1977 and 1993.

Senate Bill x7-7

Senate Bill x7-7 establishes the program known as the Water Conservation Act of 2009 and often referred to as '20 by 2020,' creates a framework for future planning and actions by urban and agricultural water suppliers to reduce California's water use. The bill requires urban water agencies to assist in reducing statewide per capita water consumption by 20 percent by the year 2020. The act requires urban water suppliers to set an interim urban water use target for 2015 and meet the overall target by 2020.

As a water supplier, EBMUD is required to comply with the requirements of this bill to be eligible for water related state grant funding or loans. The projected demand of 221 MGD in year 2020 is expected to meet the requirements of Senate Bill x7-7. The development of the water use baseline and targets is presented in EBMUD's Urban Water Management Plan (UWMP) 2010. EBMUD's progress towards achieving the targets will be presented in future UWMPs.

EBMUD sponsors several rebate programs for water efficient fixtures and appliances

Demand-Side Water Conservation

In October 1993, the EBMUD Board of Directors approved the WSMP 2020, which set a conservation goal of 33 MGD for 2020. The Board directed staff to prepare a Water Conservation Master Plan (WCMP) and to report annually on the status of the conservation program. The WCMP was designed to meet 2020 water savings goals through a cost-effective conservation program while maintaining EBMUD's long-standing emphasis on voluntary conservation by customers. The WCMP was adopted in May 1994, and a pilot program was implemented. The programs defined in the WCMP were projected to save 16 MGD. An additional 17 MGD was expected to result from natural replacement, the installation of conservation hardware such as toilets, showerheads, and faucets independent of an EBMUD program. In 1998, the water savings goal was increased to

Encouraging gardens that use little water and have water retaining benefits is one of the conservation measures.

Best Management Practices (BMPs)

The California Urban Water Conservation Council (CUWCC), a group of water agencies, public interest groups, and other interested parties, was formed as part of the "Memorandum of Understanding Regarding Urban Water Conservation in California" (MOU), dated September 1991, for the good faith implementation of water conservation techniques known as Best Management Practices (BMPs). The statewide MOU to implement the BMPs was signed by EBMUD in 1993. EBMUD is in full compliance with the MOU.

34 MGD to offset demand from anticipated annexations to EBMUD service area.

Table 3-5 summarizes the water conservation programs made available to residential and non -residential customers as well as the net water conservation savings of those programs through 2005.

Incentives are part of EBMUD's demand-side conservation program to improve customer water-use efficiency. Incentives include residential, industrial, commercial, and institutional audit and rebate programs; water-saving device distribution programs; and education and outreach activities, including publications, presentations, community events, and displays. Education and outreach activities support all other conservation programs and increase customers awareness and acceptance of EBMUD conservation efforts.

EBMUD has two regulations that prohibit water waste, one that is enforced even when there is no declaration of water shortage emergency as well as regulations there are invoked when a water shortage emergency is declared by EBMUD Board of Directors. Section 28 of the *Regulations Governing Water Use by Customers of the East Bay Municipal Utility District* is involved only when Water Shortage Emergency is declared by the Board. Provisions in that section are tailored to the severity of the water shortage and may include restrictions on annexations and new connections, allotments, drought rates, and prohibition of certain types of water use. Section 29 of the Regulations is in force at all times and prohibits wasteful use, but does not prohibit any specific type of water use. When there is no Water Shortage Emergency, the provisions of Section 29, Prohibiting Wasteful Use of Water, are enforced primarily by customer education. As part of current planning efforts, and through the development of the WCMP, EBMUD continues to participate in a statewide process of policy planning on conservation practices.

Supply-Side Conservation

Like any water system EBMUD's pipelines are vulnerable to leaks, corrosion, and other damage or water loss. EBMUD has two crews equipped with electronic sound detection equipment that survey approximately 300 miles of pipeline per year for leaks. Systematic replacement of troublesome pipes, cathodic protection, and improved leak detection methods have stabilized the leak rate, indicating that the overall system rate of deterioration

Table 3-5: Water Conservation Savings Summary

Program	FY1995-2008 Estimated Net Savings (MGD)
Residential	
Water Surveys[1]	1.97
Single-Family	*0.77*
Self Survey Kits	*0.14*
Multi-Family	*1.06*
Rebates and Incentives[2]	2.62
Residential Landscape Rebates	*0.03*
Toilet Replacement Rebates	*1.38*
Residential Clothes Washer Rebates	*0.99*
Device Distribution	*0.22*
Water Waste[4]	0.17
Subtotal	**4.76**
Natural Replacement[3]	5.94
Total Residential	**10.7**
Non-Residential	
Water Surveys	5.42
Commercial	*0.91*
Industrial	*1.27*
Institutional	*0.89*
Large Landscape Irrigation	*1.86*
Irrigation Reduction Information System	*0.49*
Rebates and Incentives[2]	2.05
Direct Pre-Rinse Installation	*0.26*
Direct Toilet/Urinal Installation/Rebates	*0.04*
District Facility Retrofit	*0.01*
Rebates for Business and Industry	*0.24*
Irrigation Controller Rebates/Vouchers	*0.30*
Irrigation Upgrade Rebates	*0.96*
Commercial Clothes Washer Rebates	*0.23*
Commercial Irrigation Workshops	0.03
Water Waste[4]	1.35
Subtotal	**8.85**
Natural Replacement[3]	2.97
Total Non-Residential	**11.82**
TOTAL	**22.52**

[1] Roll-up of water survey programs, landscape workshops, and separately tracked savings from customers who participated in multiple programs during the FY95-FY98 pilot program.

[2] Includes fixed and customized rebate, direct installation, and device distribution.

[3] Projected natural (or passive) savings from (indirect) customer actions consistent with codes and ordinances.

[4] Includes savings from water waste and leak repair.

Source: Urban Water Management Plan 2005 Table 6-2, page 6-3; East Bay Water 2008 Report, FY2005-07 Water Conservation Annual Reports.

Role of Recycled Water in the WSMP 2020

Recognizing water recycling as an important method for stretching limited water supply resources, the District's Board of Directors adopted the WSMP in 1993 with recycled water included as a key element in a diverse and balanced supply portfolio.

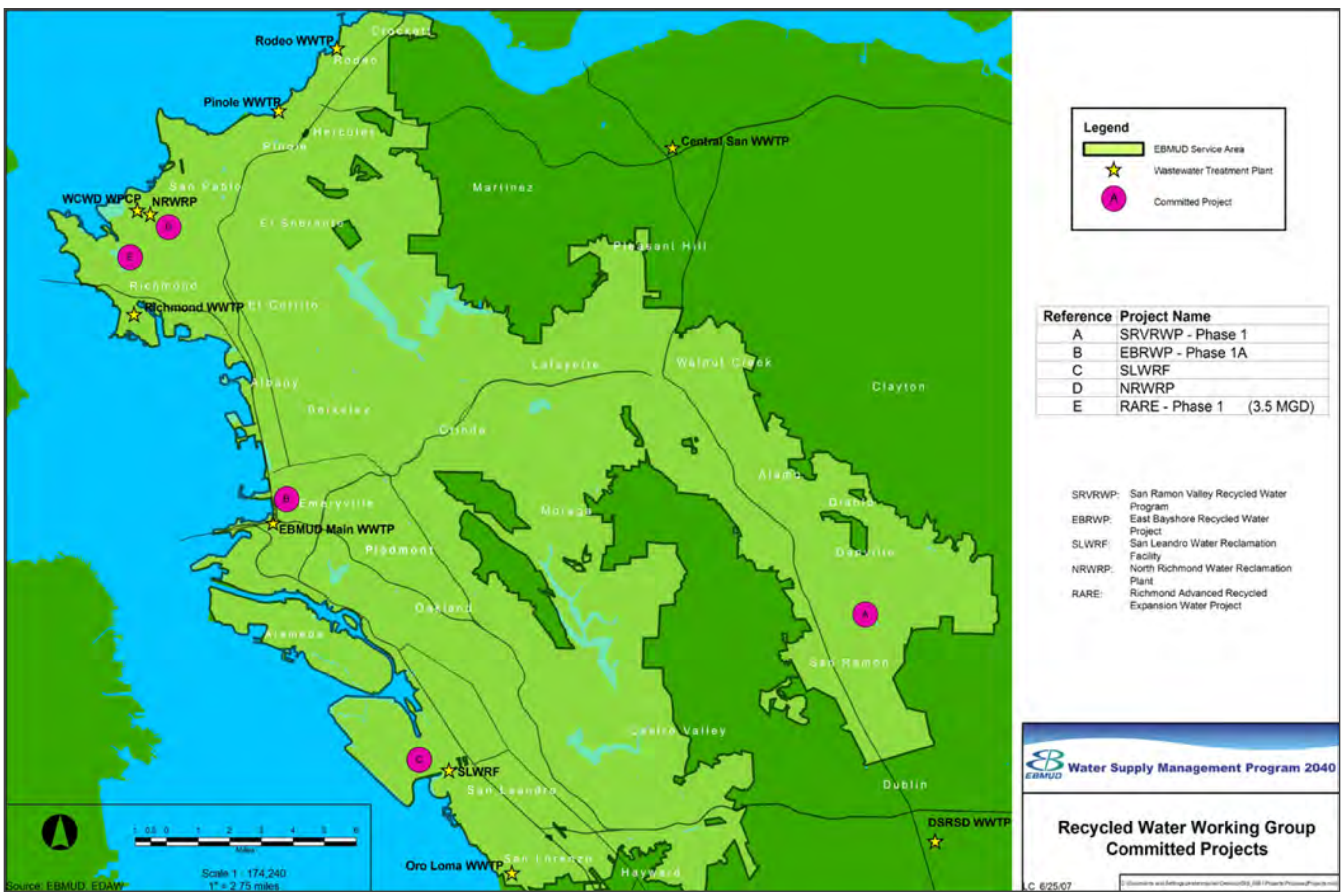
The Board set a water recycling goal of 14 MGD by 2020. This amount of water would free enough of the District's potable supply to meet the indoor and outdoor water needs of approximately 90,000 District customers and would help reduce the severity of water rationing that could be required in future droughts.

Signs like these are used to identify landscapes irrigated with recycled water is not increasing with time. EBMUD's Pipeline Replacement Program documents main failure through the maintenance and evaluation of leak records. Recurring leaks on any segment of pipeline trigger an evaluation that compares the cost of replacement to the present worth of projected costs associated with continued maintenance of the pipeline. EBMUD's current goal is a renewal rate of 10 miles per year. The estimated water saved as a result of the leak detection program ranges from 0.5 to 1.5 MGD each year.

EBMUD's corrosion control program encompasses the Mokelumne Aqueducts, distribution piping, and facilities, and has effectively reduced corrosion-related deterioration of EBMUD's infrastructure, resulting in substantial leak reduction and savings of water. The corrosion control program extends the useful life of EBMUD pipelines by installing and upgrading cathodic protection systems.

3.4.3 Existing Recycled Water Projects

Recycled water use reduces demand for potable water and potentially reduces the need for rationing during droughts as it can be used for applications such as irrigation and industrial processes. By definition, recycled water projects use treated wastewater. However, EBMUD also has some project options that use untreated (raw) water from local runoff. These projects are included in the recycled water category for the



Note: Construction on San Ramon Valley Phases 2 to 4 began in 2010, however, they were not included in the committed projects list developed for the WSMP 2040.

Figure 3-5 *Committed Recycled Water Projects*

Table 3-6: Committed Recycled Water Projects

Reference Label[1]	Project Name or Program Title	Annual Demand (MGD or acre-ft/year)[2]	Project On Line Date
A	San Ramon Valley Recycled Water Program – Phase 1[3]	0.7 MGD (800 acre-ft/year)	Currently operating with approx. ¾ of Phase 1 customers connected. In operation since Feb. 2006. Anticipate full implementation / final customer connections by FY 2009. EBMUD received $3.5 million in economic stimulus funding in 2009 for this project.
B	East Bayshore Recycled Water Project – Phase 1A	0.7 MGD (800 acre-ft/year)	Construction in progress, to be completed by FY09. Anticipated to begin first deliveries in 2007. Expect full implementation / final customer connections by FY 2009.
C	San Leandro Water Reclamation Facility	0.4 MGD (450 acre-ft/year)	Currently operating. In operation since 1988.
D	North Richmond Water Reclamation Plant (NRWRP)	4.0 MGD (4,500 acre-ft/year)	Currently operating. Began operation in 1996; increased NRWRP production in January 2007.
E	Richmond Advanced Recycled Expansion (RARE) Water Project - Phase 1	3.5 MGD (3,900 acre-ft/year)	Commenced operations in 2010 at the Chevron Refinery.
Total		9.3 MGD (10,450 acre-ft/year)	

Note: FY = fiscal year, MGD = million gallons per day.

[1] See Figure 3-5 for a graphical representation of committed recycled water projects.

[2] Demand rounded to nearest 0.1 MGD and 50 acre-ft/yr.

[3] Construction on San Ramon Valley Phases 2 to 4 began in 2010; however, they were not included in the committed projects list developed for the WSMP 2040.

Source: WSMP 2040 RW TM #3, July 30, 2007; EBMUD UWMP 2010.

The landscaping around Lake Merritt is irrigated with recycled water

Purple pipes indicate recycled water

purposes of the WSMP 2040. Typical recipients of recycled water include oil refineries, golf courses, cemeteries, and public landscaping such as roadway medians.

EBMUD has been recycling water for irrigation and in-plant processes at its main wastewater treatment plant since 1971. To centralize and expand water recycling, EBMUD's Board of Directors approved the Office of Water Recycling (OWR) in 1988. The initial goal of the EBMUD recycled water program was to expedite recycled water projects in response to the second year of the drought that lasted from 1987 until 1992. Today, the goal of the program continues to be the planning, development, and implementation of recycled water projects throughout EBMUD service area in order to reduce the demand on EBMUD's high-quality drinking water supplies.

EBMUD's existing and committed inventory of recycled water projects (in total and as implemented since the 1993 WSMP) are estimated to generate 9.3 MGD (10,450 acre-ft/year) of recycled water by the year 2010. These projects are shown on Figure 3-5 and described in Table 3-6.

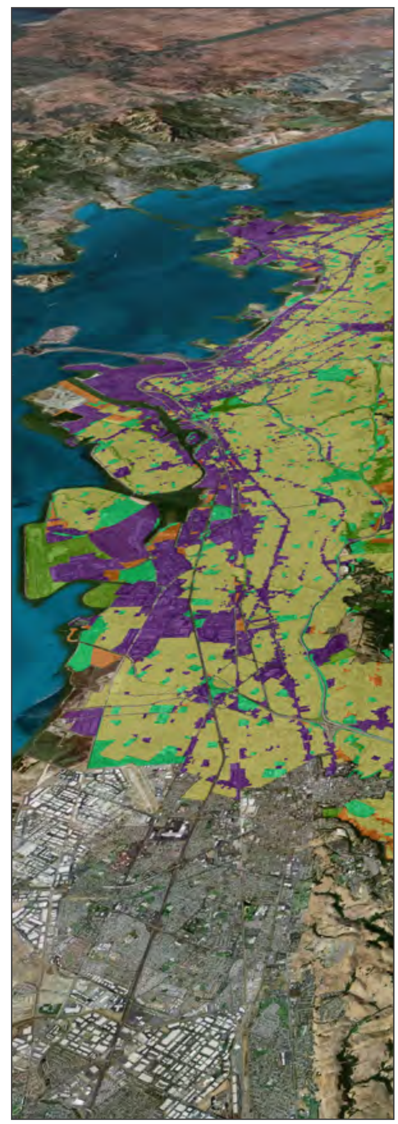
A Demand Study Update, Need for Water Analysis, and Climate Change Analysis were used to help guide EBMUD's future water supply planning.

4. Defining the Challenge

This chapter provides an overview of the projected water supply that will be required by EBMUD by 2040. Section 4.1 provides a description of the Demand Study Update, summarizing the process that was used to project District demands to 2040 as well as the projected demand levels. Section 4.2 provides a description of the Need for Water Analysis, which uses the projected demands as one of the inputs to determine the additional water required to limit drought restrictions when a worst case drought occurs. Section 4.3 provides the results of the Climate Change Analysis which evaluated potential climate change impacts on EBMUD's water supply system and was used to inform development of a WSMP 2040 Portfolio that would be responsive to a range of possible future climate scenarios and help to guide future water supply planning.

4.1 Projecting Water Demand

One of the key elements of WSMP 2040 is the projection of annual water demand in the EBMUD service area to the year 2040. The demand projections are essential to quantifying the District's water supply needs. The projected demand was then used along with existing District water supplies and rationing to estimate the Need for Water, as described in Section 4.2.3. While the projected demand is the total amount of water that the District needs to supply customer needs, the Need for Water is an estimate of the additional amount of water necessary on top of what the District is already able to supply (e.g., through existing conservation programs, existing recycled water projects, existing supplemental supply sources, and savings that can be expected from rationing) to reliably provide water to District customers.



Landuse patterns in the EBMUD Service Area

Future Demand Factors

Future demands were calculated by applying adjustment factors for future conditions to each land use polygon. Two types of adjustments were made:

1. Existing land uses that are not anticipated to change but where consumption patterns may change over time to reflect changing demographic and economic conditions. Such changes may result in greater numbers of people per household and employees per acre, increased usage of lands in general such as higher occupancy rates and more intense uses, and infill development of small parcels.

2. Lands that will either be developed as a new use (formerly vacant land) or redeveloped (rebuilt uses resulting in a change to its land use category). These new and redeveloped uses typically reflect higher densities of development and greater intensity of use of the land.

The demand projections were developed prior to the onset of the economic recession in December 2007.[2] As such, the timing of development and associated demand could be realized slower than what is initially projected in this study, but over time, averaging out close to the projected value. In addition, the continuation of the drought and the mandatory conservation imposed by the District (since the latter half of 2008) will likely reduce future demands temporarily in the same way. The magnitude and duration of reductions to projected demands is dependent on myriad factors such as the continuation of the drought, conservation/rationing policies, and the state of the economy. In future years, it is expected that these possible temporary deviations will be offset by other factors (e.g., growth patterns and types of growth) and demand will be consistent with estimates.

The 2010 demands presented in this document are projections from the Demand Study Update and are not the actual demands that have since occurred. Actual demands that have been recorded since the date of the Demand Study are presented in the District's Urban Water Management Plan (UWMP) 2010. In the future, the UWMP efforts will review the demand projections and provide an update as necessary.

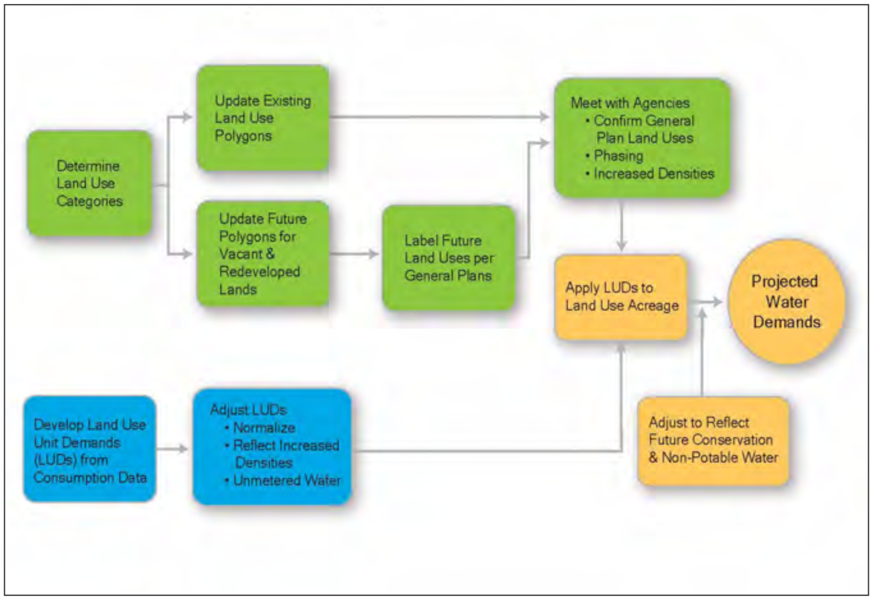


Figure 4-1 *Overview of Water Demand Projection Methodology*

[2] National Bureau of Economic Research, December 11, 2008 (http://www.nber.org/cycles/dec2008.html).

4.1.1 Land Use-Based Approach

EBMUD projected water demands through 2040 via a rigorous land-use-based approach. An overview of the demand projection methodology is provided in Figure 4-1. EBMUD chose to base its demand projections on changes in land use rather than the traditional approach of using estimates of population growth, household size, and employment. A land-used based approach was used because:

- It allows for a more rigorous, spatially based projection of demands based on local planning agency land use policy and unit factors.
- Higher demand projections may be associated with other forecasting techniques such as long range population projections or demands based on assumptions that most land uses will increase in density over time but without specifically reflecting community policy.

Economic, demographic, and real estate data was used to identify trends in land use changes. In addition, review of general plan documents, zoning maps, aerial photographs and information obtained from meetings with planning agency staff informed the projections.

EBMUD considers the adopted community general plans, and any subsequent amendments thereto, to be the most reliable indicators of future development policy because they have been subject to extensive public review under the Planning, Zoning, and Development statute, and rigorous environmental documentation under CEQA prior to adoption.

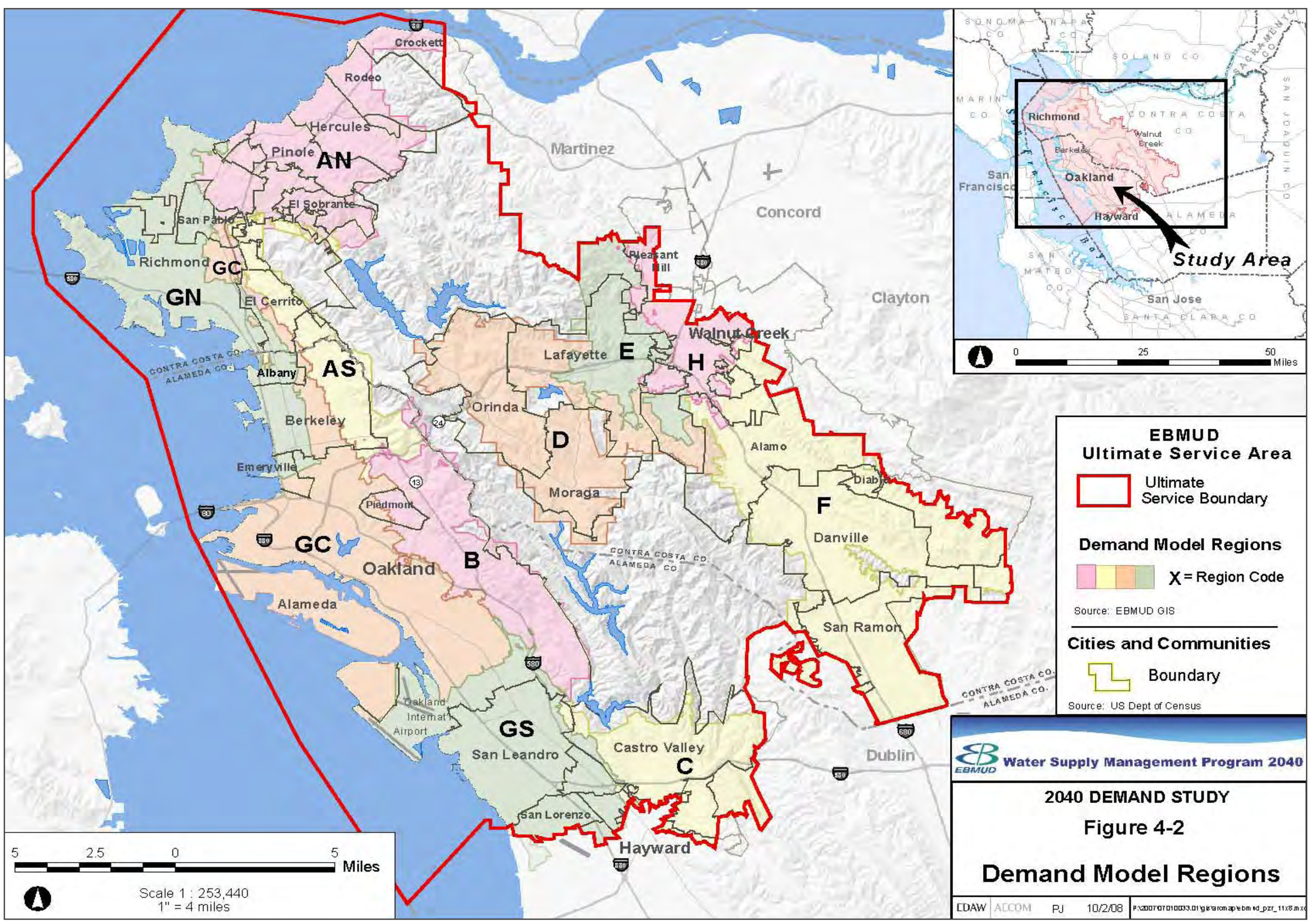


Figure 4-2 *Demand Model Regions*

Table 4-1: Land Use Categories

Existing Land Uses	*Future Land Uses*
ER1: residential 0 to 2.9 du/ac [1]	FR1
ER2: residential 3 to 9.9 du/ac	FR2 and FMUR2 [2]
ER3: residential 10 to 19.9 du/ac	FR3
EMUR3: residential 10 to 19.9 du/ac plus commercial	FMUR3 [2]
ER4: residential 20 to 49.9 du/ac	FR4 and FMUR4 [2]
ER5: residential 50 to 100 du/ac	FR5 and FMUR5 [2]
ER6: residential100+ du/ac	FR6
EIL: low intensity industrial	FIL
EO: office and industrial	FC: office, retail, services, and industrial
EC: retail and industrial	
EOH: high density office	FOH
ER: petroleum refinery	Same as existing
ES: schools	FS
EPI: irrigated turf	FPI
EP: public and quasi-public uses	FP
EHW: high water users [3]	Same as existing
ERW: recycled water [4]	[4]
ERAW: raw (untreated) water [4]	[4]
EV: vacant, developable (no current water use)	Same as existing
EOS: open space (no water use)	Same as existing

[1] For example, ER1 means existing residential land uses at a density of 0 to 2.9 dwelling units per acre (du/ac). FR1 is future residential at the same density.

[2] Future Mixed Use utilizes the same density categories as existing and future residential categories.

[3] Each high water user is labeled separately.

[4] Future recycled and raw water usage was applied to specific polygons without changing the land use categories.

There are 123 individual pressure zones within the EBMUD service area; these pressure zones reflect areas of the system with a common elevation for pumping and storage requirements. For use in the Demand Study analysis, the pressure zones were grouped into 11 study regions called Demand Model Regions (DMR or regions) reflecting similar climates and historical spatial designations (see Figure 4-2). The Demand Study also accounted for the unique spatial division of the Oakland and Berkeley Hills, and resulting differences in climatic conditions and consumption patterns in the service area. These two areas, referred to as 'West of Hills' and 'East of Hills,' were used in the analysis, particularly when detailed information was not available at the DMR scale.

Land use categories were developed specifically for the District's demand studies and do not necessarily conform to the District's business classification codes, ABAG categories, or Standard Industrial Classification categories. Table 4-1 presents the land use categories used for the existing (starting with E) and future (starting with F) land use mapping and analysis. The largest single existing land use within the EBMUD service area is low to medium density residential (ER2: 3.0 to 9.9 dwelling units per acre [du/ac]) at 58,900 acres, followed by open space (EOS) at 44,150 acres, and low density residential (ER1: 0.1 to 2.9 du/ac) at 16, 100 acres.

Using actual water usage data for 2005, water use factors were calculated for each land use category (dividing acreages of each land use by the water use data for each land use type). The result is a measurement of water consumption by land use in gallons per day per acre, also referred to in the Demand Study as land use unit demands, or LUDs. The LUDs were adjusted, or normalized, for weather conditions (average water year conditions), economic variability, areas with increased densities, and unmetered water. Adjustments were also made to the demands based on the WSMP 2040 Portfolio assumptions regarding conservation and recycled water programs.

The changes to consumption over time are attributed to variances in weather, economy, demographics, and other factors. Although not as dramatic as drought effects, smaller temporal variations in consumption can bias the demand projections. These smaller variations in consumption from both weather and non-weather (e.g., economic, demographic, etc.) factors were accounted for by applying normalization factors to the consumption data.

Normalization factors were developed using statistical methods to analyze historical water consumption for dependence on weather related variables. Non-weather effects were captured by averaging the weather normalization results. Individual variables for non-weather factors were not analyzed because data specific to regions and land use groups were not readily available and the non-weather effects were minor relative to the weather effects. Weather data (e.g., maximum day temperature, rainfall, and pan evaporation) from six locations throughout the District were analyzed to explain the variations in consumption patterns.

In addition to metered consumption, unmetered water (UMW), the water that is consumed but not recorded by a meter, contributes to the base year demand. UMW results from both authorized and unauthorized sources. Unmetered authorized consumption includes fire flows and District unmetered use, such as water use at unmetered facilities and water main flushing. Water losses include real water losses from physical sources such as losses from pipe breaks, storage facilities, water mains, and service connections; and apparent losses from non-physical sources such as unauthorized consumption, metering inaccuracies, and potentially other unidentified losses.

Adjusted system input was 214 MGD and represents the average annual rate of potable water that is needed by the distribution system in year 2005 (the starting point for this particular study). Existing land use polygons that were mapped as part of this process are shown in Figure 4-3.

Please refer to the Demand Study Report, provided in Appendix C, for an expanded description of the methodology and study results.

The term recycled water in the WSMP 2040 refers to both recycled water and raw water use. Recycled water use and conservation savings were incorporated into the demand projections to account for the potable offset to demand.

Changing and mixes of uses in Berkeley

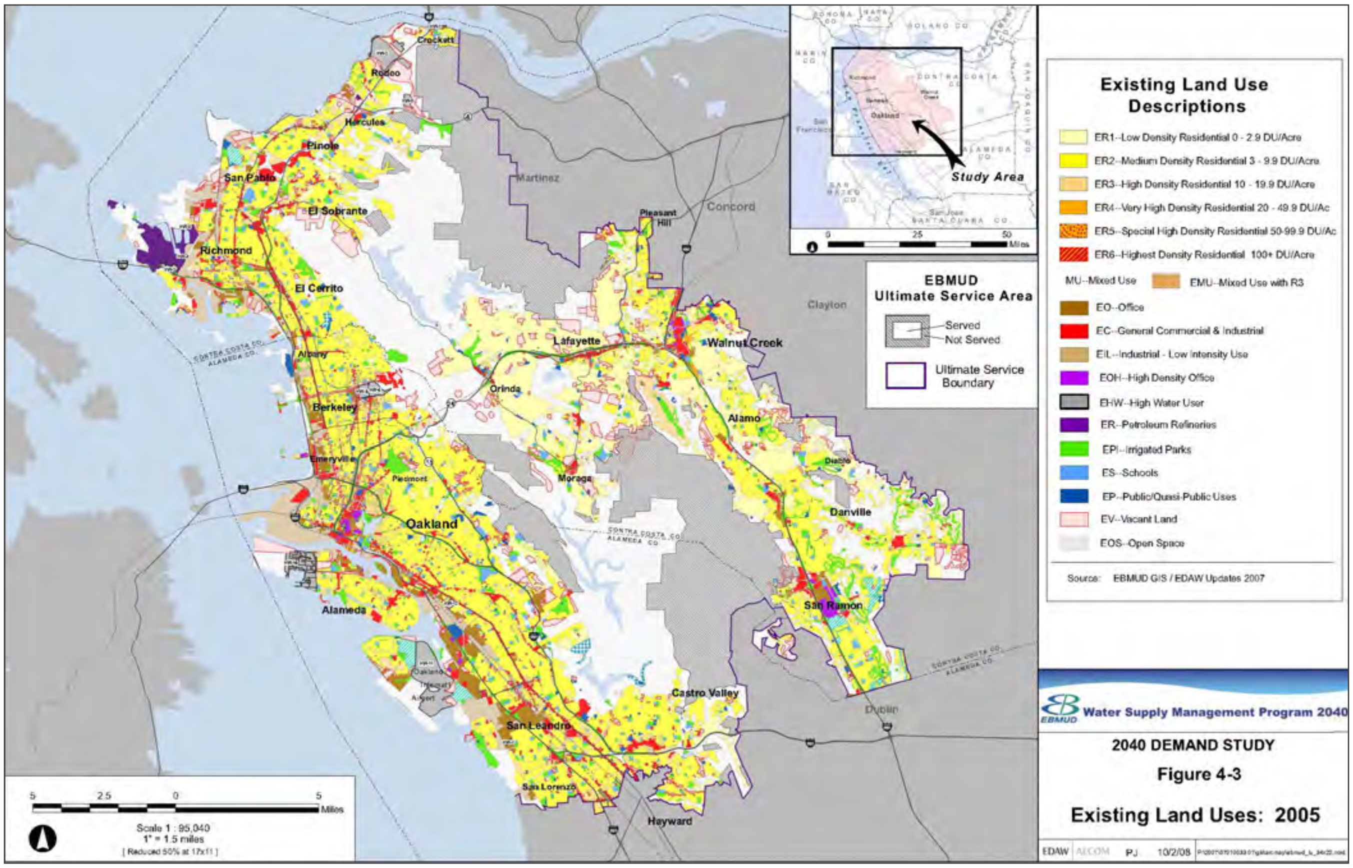


Figure 4-3 *Existing Land Uses 2005*

4.1.2 Analysis of Future Land Uses

Draft existing and future land use maps were developed and presented to the planning agencies of all 17 cities within the service area, Walnut Creek (a partially-served city), and Contra Costa County. The primary purpose of each meeting was to obtain input on land use planning trends observed within their community; review, confirm, and update general plan land use designations; delineate areas undergoing reuse (reusing existing buildings for different purposes) and redevelopment (replacing structures); and indicate the year that developable lands are likely to be developed. Additional information on these meetings can be found in the Demand Study Report (provided in Appendix C).

The most prominent trend that is expected to influence future growth in water demand is that densities of residential land use and the intensity of use on non-residential lands are increasing and are anticipated to continue developing throughout the service area to 2040. The "smart growth" approach of compacted development near transportation corridors advocated by many of the service area communities is consistent with the observed need to plan for higher densities than those that currently exist.

Other key land use trends, observations, and demographic data that influence water demands are described by region in the Demand Study Report Chapter 3, provided in Appendix C. Figure 4-4 also displays the changes in land use throughout the planning period.

Development of Future LUDs

The LUDs were modified for future scenarios reflecting trends described above. These adjustment factors were developed for 2040 conditions and typically distributed proportionately over each five year increment of the 2040 Demand Study planning period from 2005 through 2040 (except 2035). LUDs for future years were calculated in one of several ways.

- If the base year land use category remains the same in the future, a future adjustment factor based on infill potential, comparison of historical consumption patterns, occupancy rates, and jobs per acre was applied.
- If the base year land use category changes in the future, (as with new development or redevelopment triggering a land use or density change reflecting the general plan), an adjustment factor was applied based on the average LUD for each land use category in each region. This allows for the future land use category to reflect consumption patterns of recent developments and trends in changing land use patterns.

Vineyards in low-density areas

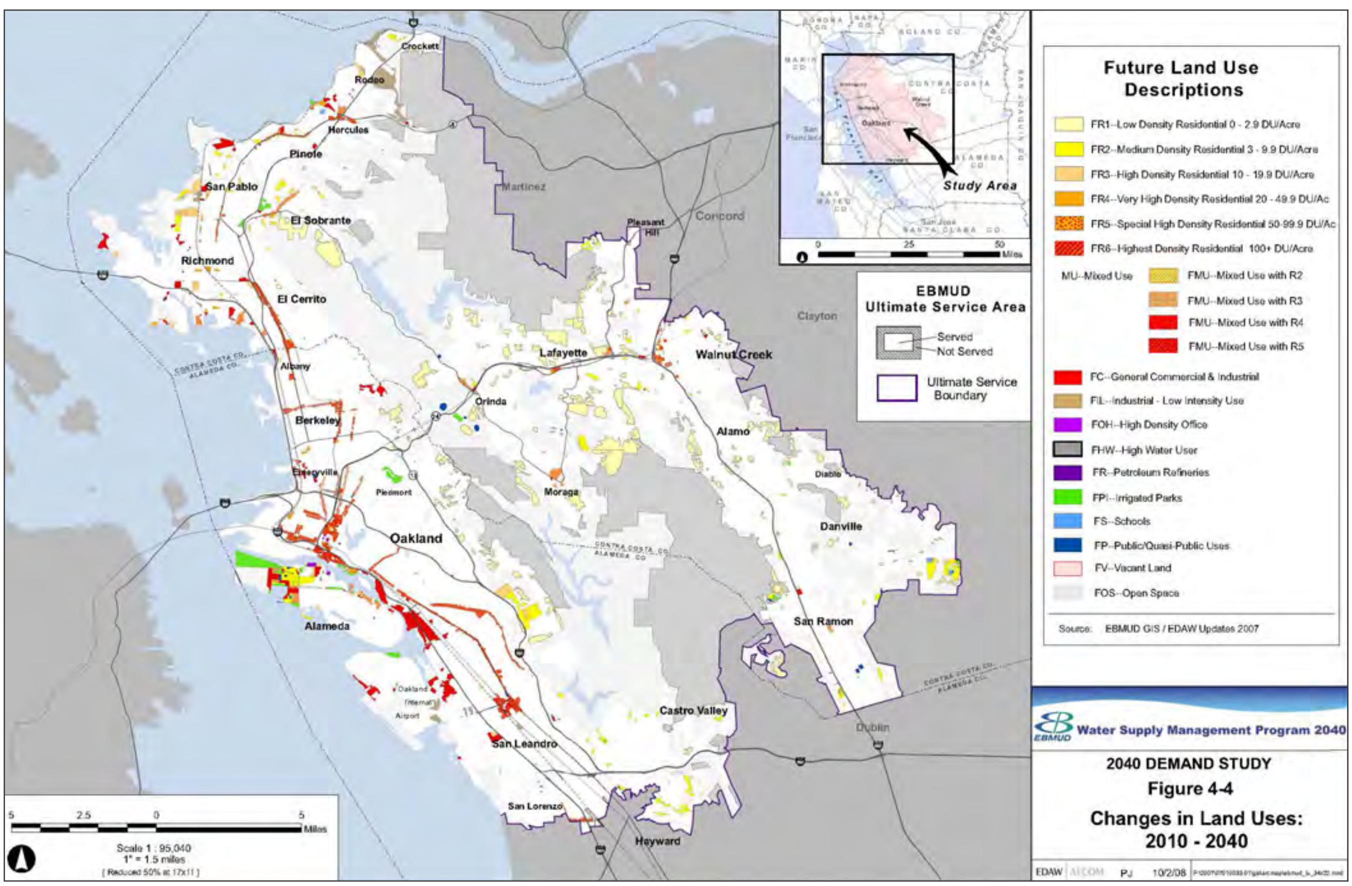


Figure 4-4 *Changes in Land Uses 2010-2040*

- If a land use category represents unique water users, future LUDs were determined individually. These include high water users; low density residential uses in steep sloped areas (e.g., cities of Lafayette, Moraga, and Orinda region), and mixed use land uses.

Only one future adjustment factor was used for each land use category per region per planning year. A detailed description of the future LUD adjustment factor development process is provided in Demand Study Report Chapter 5, provided in Appendix C.

4.1.3 2040 Demand Projections

Average annual demands were further adjusted to incorporate the WSMP 2040 Portfolio conservation and recycled water components resulting in significant decreases to demand projections between 2010 and 2040. For example, recycled water usage would increase from 9 MGD in 2010 to 20 MGD in 2040 and conservation efforts would increase from 23 MGD in 2008 to 62 MGD in 2040.

The projected demand throughout the planning period was also reviewed for the two primary District service area regions: east and west of the Berkeley/Oakland hills (see Figure 4-5). The East of Hills area, although subject to warmer summer temperatures, has historically recorded lower total annual demands than the West of Hills area due to its smaller geographic area, lower density development pattern, and fewer industrial and commercial users. Demand in the East of Hills area is projected to remain relatively flat throughout the planning period as well, due to the offsetting effects of future conservation and recycled water use. The WSMP 2040 demand projections indicate a shift in demand growth from the previously-anticipated development of new lands East of Hills to infill and redevelopment of lands in the West of Hills area.

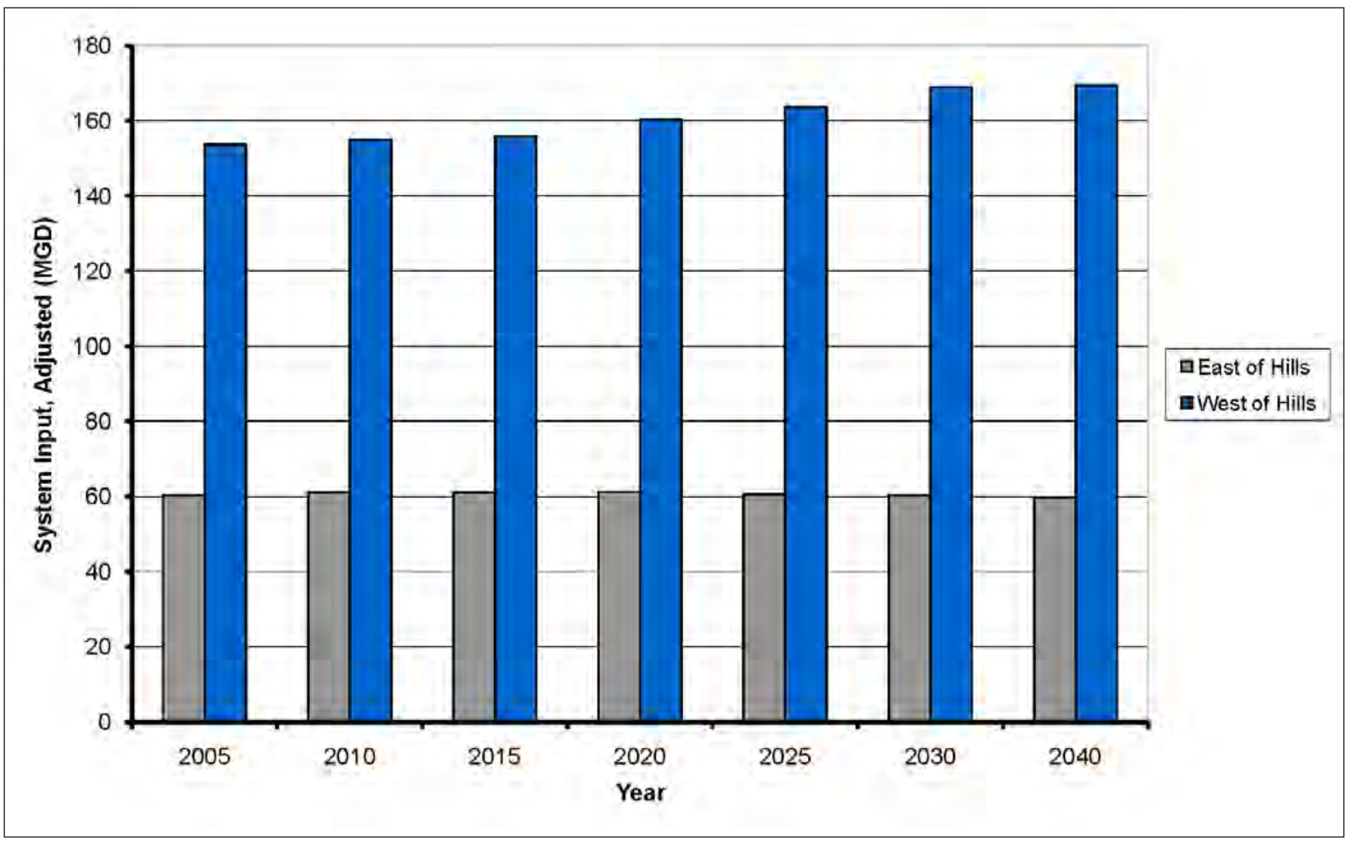


Figure 4-5 *Demand Projections East and West of Hills*

The demand projections in this analysis do not reflect the greatest potential water demands, but rather, reflect current planning policy by land use agencies.

4.2 Assessing the Need for Water

4.2.1 Overview of Future Water Needs

Water supply planning is complicated by the great variability that exists in the amount of water available each year. Drought planning further complicates water supply planning by the inability to predict the amount of rainfall and runoff that will occur in future years. In order to estimate future water supply needs, the District first prepared a projection of future District water demands using land use projections and existing water demands, as described in Section 4.1. The projected future demands were then compared to existing District supplies and the gap between the two values, the Need for Water, was estimated. This section describes the approach used to complete this Need for Water estimate.

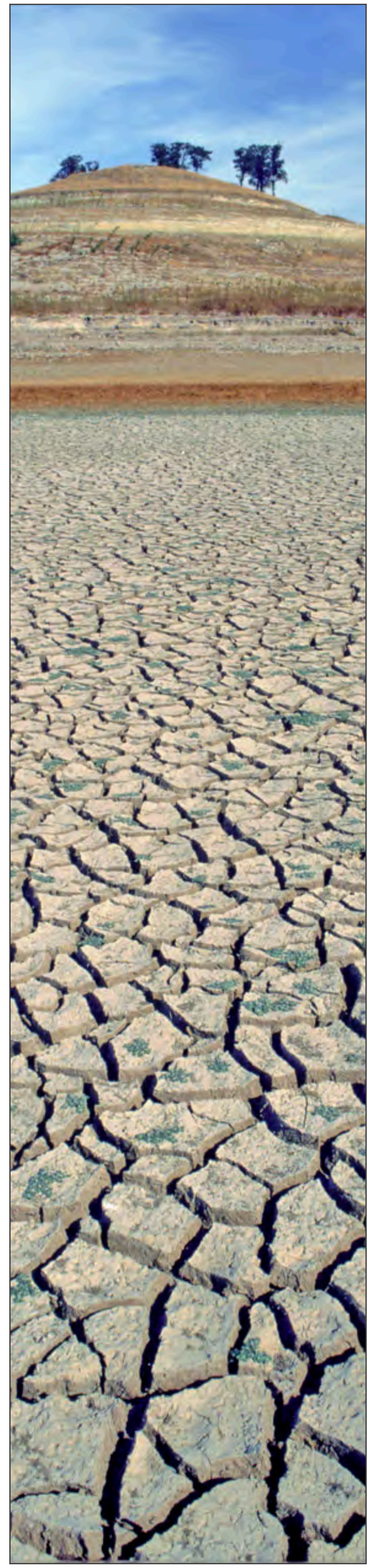
4.2.2 Drought Management Program

The District has recognized its relatively unique position of relying on a single water source, the Mokelumne River, for almost all of its supply. Annual precipitation (rainfall and snowfall) in the Mokelumne River watershed, and thus river runoff, is variable. The District mitigates the risk of climatic variability (i.e. incidences of drought) through its Drought Management Program which establishes voluntary and mandatory water rationing goals.

Drought Planning Sequence Hydrology

The District's current approach to drought planning was developed in response to the 1976-1977 drought. During this drought, runoff in the Mokelumne Watershed was less than any other two consecutive years on record. While the critically-dry year of 1977 was followed by a wet year in 1978 (which allowed the system to recover rapidly), it could not be known in September 1977 what the following hydrologic year would bring in terms of precipitation and runoff. As a result, the District conservatively planned for a third dry year and chose to implement several emergency measures in 1977 to provide adequate, but greatly reduced, carryover storage to preserve its remaining water supplies.

The drought planning sequence (DPS) used by the District to assess the adequacy of its water supply system reflects the District's experiences during the 1976-1977 drought. In the



Camanche Reservoir in 1988

Projected land use changes
• Smart growth - compact development along and near transportation corridors - and overall increased densities are occurring and planned for throughout the study area. Densities of residential lands and the intensity of use on non-residential lands are increasing, with each community planning for higher densities than what currently exists. • Water supply assessments for District water service indicate higher residential densities being constructed than historical densities. • Greater numbers of people per household are anticipated than historical patterns. • Warehousing, storage yards, and other underutilized lands are being replaced by more intense commercial and industrial uses or with high density mixed uses. Industrial uses are decreasing in acreage throughout the service area, particularly in heavy industrial cities like Oakland and Richmond. • Industrial and commercial uses are no longer segregated but are developing together with a variety of uses within new business parks and in older redeveloping areas. • Former industrial areas continue to attract mixed uses (lofts and other high density residential with retail on the ground floor) and other types of uses that differ from the original uses, such as retail or small offices in buildings or in neighborhoods where once manufacturing occurred. Buildings are either used differently or are replaced with new structures. • Difficult site conditions are less of a deterrent to development in communities with high land values; lands subject to the same difficult site conditions are not being developed as quickly in lower value areas. • Densification of transportation corridors East of Hills is occurring more slowly than West of Hills. • Downtown districts are exhibiting higher intensity of uses, and accelerated development of vacant infill parcels. • Mobile Home communities are slowly being converted to high density housing. • Underutilized industrial districts are continuing to convert to higher intensity uses (manufacturing mixed with commercial uses) due to demand and land value. Other areas are changing from industrial to high density residential uses. • Senior housing is being built throughout the service area. • Conversions of gray fields (strip commercial shopping centers) to higher density mixed uses are occurring.
Consumption patterns for existing residential land uses are expected to increase on a per acre basis over time because of the following:
• Infill of vacant lands. • Underutilized land converted to a more intense use without changing its land use designation, called densification. • Multiple generations living within the same dwelling unit and/or converting garages to living spaces (a trend identified by some planning agencies). • Accessory units (e.g., in-law, second) developed legally or illegally. • Development of steep sloped sites that were once considered too costly to develop.

District's DPS, historical runoff during water year 1978 has been replaced with a dry year amount of 185 TAF - the average annual runoff that occurred in 1976 and 1977 - since in actual operations, water operators do not know and cannot predict future precipitation. The resulting drought planning sequence, shown in Figure 4-6, is less conservative than one that assumes that driest year-of-record conditions (a worse third year of drought) would occur following a two-year drought; but it does provide a safeguard against the possibility of dry conditions continuing for a third year.

The District's current DPS also assumes that a severe drought will not continue beyond the third, synthesized year of the sequence (Skinner 2002). Therefore, the minimum storage level at this time would be equal to the aggregate total amount of the District's inaccessible or dead storage (35 TAF).

Alternatives to the District's current DPS were explored as part of the WSMP 2040 project. In a review of design droughts used by other Bay Area water agencies, it was observed that each agency selected a unique drought sequence for planning purposes, primarily based on each individual agency's regional water issues and experience related to their water source and distribution system configuration. In summary, the District uses a DPS for long-term water supply planning that has the advantages of being both reliable - it is based on the actual worst drought event in the District's history - and prudent - it involves a scenario somewhat more severe than the actual worst historical drought event.

Drought Management Program Implementation

EBMUD assesses its water supply situation in April of each year (and as necessary during dry periods), taking into account the amount of water stored in its reservoirs, the amount stored in the Mokelumne River watershed's snowpack, and the expected amount of customer demand. If the projected water supply is less than 500 TAF at the end of September, the District initiates water-use reduction programs and operates supplemental supply projects. Providing carryover storage is necessary because the following year's runoff is not known a priori.

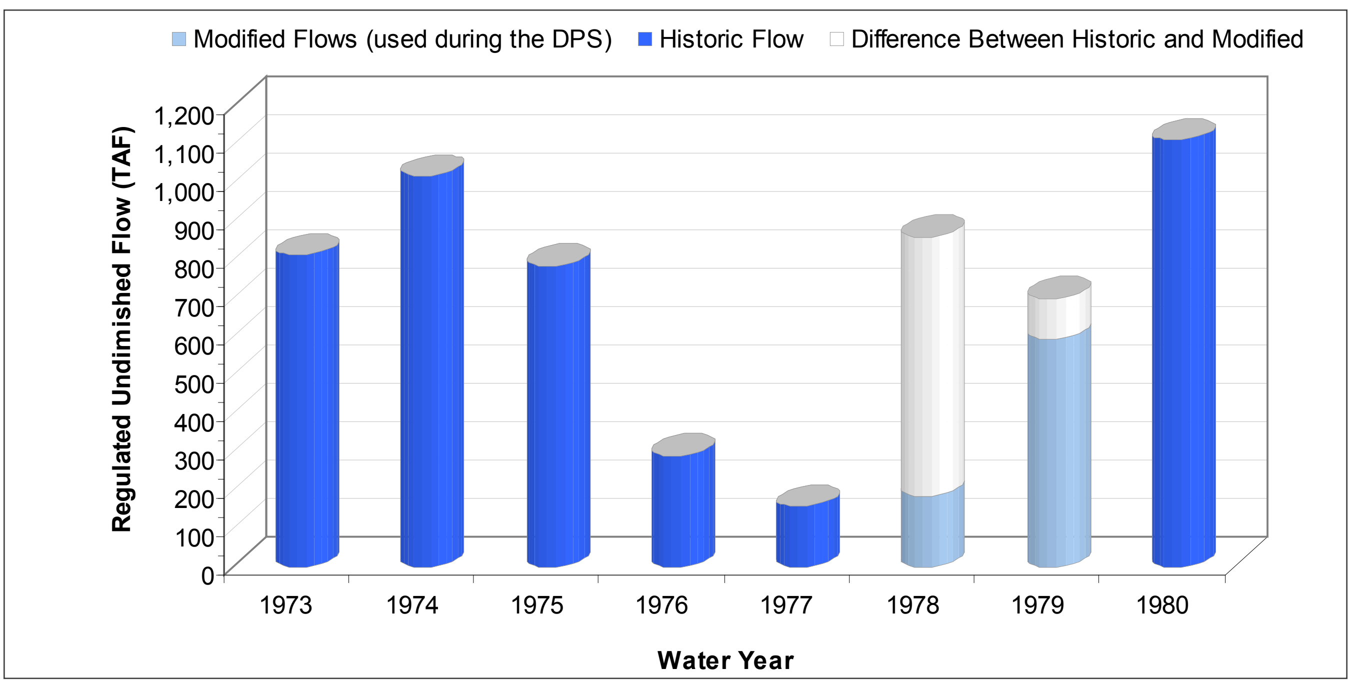


Figure 4-6 *EBMUD's Current Drought Planning Sequence Hydrology*

Key Water Supply Assumptions

Key water supply assumptions used in the W-E model for this analysis are summarized below.

- The only supplies available are current supplies and those expected to be operational before 2010. These include the Mokelumne River (Pardee Reservoir), Sacramento River via the FRWP, and Bayside Phase 1.
- EBMUDSIM determines the maximum amount of Mokelumne River water available for draft to the East Bay service area.
- WEAP determines the annual maximum amount of water available from the Sacramento River via the FRWP and Bayside Phase 1 subject to operational constraints, contracts, and agreements with other agencies.
- WEAP balances available supply from existing and potential new water supply project sources to meet demands.
- When triggered, supplies from FRWP and Bayside Phase 1 reduce demand on the Mokelumne System.

Pardee Reservoir during the 1977-78 drought

A minimum amount of carryover storage provides a safeguard against the severe impacts that would result from a complete loss of water supply should drought conditions continue. When projected system storage at the end of September is 500 TAF or less, the District also prepares a Drought Management Program, including limiting customer demands by implementing rationing.

4.2.3 Approach Used to Project the District's Need for Water

The WEAP-EBMUDSIM (W-E) model (as discussed in Section 2.3.4) was used to analyze the District's need for supplemental water supply. The WEAP model is used to simulate future water supplies in the District's service area, while EBMUDSIM is used to simulate current Mokelumne River reservoir operations and the amount of water that can be drafted from the Mokelumne Reservoir system. Together, the models were used to simulate the annual operations and water balance for the District's entitlement from the Mokelumne River basin, consistent with the constraints under which the District must operate.

By modeling demands, supplies, and rationing with the W-E model, the amount of supplemental water supply needed for consumptive use reliability was determined. This is the water necessary to reliably provide water to District customers and meet Pardee and Camanche Reservoir release requirements for all years in the hydrologic period of record considered, including the District's Drought Planning Sequence. This volume of water is what needs to be developed by the year 2040 in order to ensure that all District water supply needs are met in all years.

4.2.4 Results: Total Need for Water

A significant variable that affects the District's water supply reliability during times of drought is the amount of rationing imposed on the District's customers. Alternative maximum rationing levels of 0%, 10%, 15%, 20%, and 25% were evaluated as part of the Need for Water analysis. In order for EBMUD to reliably meet future demands and downstream release obligations, the District needs additional water as presented in Table 4-2. Need for water is reviewed as part of the update to the District's UWMP, which occurs every 5 years. The most current UWMP was adoped in June 2011.

The cost to the District and to the customer of these rationing levels were predicted using the W-E model to determine a reasonable level of rationing that would both provide for water supply reliability as well as minimize customer rationing burdens during an

Table 4-2: Total Need for Supplemental Water Supplies at 15% Maximum Rationing over the Three-Year Drought Planning Sequence[1,2]

Need for Supplemental Supply Component	15 % Maximum Rationing Scenario
Water Supply Reliability Shortages[3] (TAF)	225
Reduce First-Year Rationing (TAF)	8
Public Trust Resources (TAF)	33
Increased Evaporation (TAF)	10
Total[4] (TAF)	**277 TAF**
Total (MGD)	**247 MGD**
Average Annual Over DPS (3-yr period)	**82 MGD**

[1] Total need for supplemental water supplies was also developed for other rationing scenarios.

[2] Analysis based on studies done in 2008-2009 for the WSMP 2040. Please refer to the UWMP 2010 for the most current information.

[3] Water supply reliability shortages include both customer shortages and Lower Mokelumne River shortages.

[4] Due to rounding, the total may not equal the sum of individual line items.

Sensitivity Analysis Parameters

For the sensitivity evaluation described in this chapter, four parameters were each individually modified in the W-E model to provide information about the relative levels of system sensitivity.

Parameters varied in the sensitivity analysis included:

- 2040 customer demand;
- Mokelumne River annual runoff volume;
- Mokelumne River runoff timing and pattern; and
- Length and frequency of multi-year droughts.

extended drought. The previous rationing policy of no more than 25% of total customer demand on an annual basis is described in detail in Section 3.4.1.

4.3 Factor Climate Change

There is mounting scientific evidence that global climate conditions are changing and will continue to change as a result of the continued build-up of greenhouse gases in the Earth's atmosphere. A variable climate can affect water supplies through changes in the timing, amount, and form of precipitation, as well as the quality of surface runoff and resultant demands. These changes can affect all elements of water supply systems, from watersheds to reservoirs, conveyance systems, and treatment plants.

Research conducted by the California Department of Water Resources (DWR), the American Water Works Association (AWWA), and the Intergovernmental Panel on Climate Change (IPCC), among others, indicates that North America could see increased land and water temperatures and increased climatic variability in this century.

Water Supply depends on snowfall and snowmelt in the Mokelumne River Watershed

While the impacts of climate change will be felt differently between regions and even watersheds, most likely to be affected are those water supply systems which:

- Depend on surface storage for water supply and flood control;
- Depend on late spring snowmelt;
- Are sensitive to climactic variability;
- Contain biologic habitats that are sensitive to water temperatures, quality and runoff timing; and/or
- Are located in arid parts of western North America.

The current EBMUD water supply system includes all of these characteristics. However, predicting future climate conditions and the potential resulting impacts on water resources is not an exact science. Detailed analysis relies on assumptions about future carbon emissions and coarse disaggregation of global and regional climate model data into regional data weather patterns.

4.3.1 Approach

A key goal of the WSMP 2040 is to develop solutions for ensuring that EBMUD has the necessary water supply to meet its current and future demands through the year 2040 under a variety of hydrologic conditions. In deciding upon the methodology for evaluating climate change impacts on EBMUD's water supply system, methodologies used by other California water agencies for evaluating both climate change and drought impacts on their water systems were explored. A 'Bottom-Up' approach was selected for use in the WSMP 2040 to test the water supply system's sensitivity to a range of possible climate scenarios and then use this information to guide future water supply planning.

Drought tolerant "society garlic" for dry summer climates

A 'Bottom-Up' approach is, a sensitivity analysis using historic hydrology to evaluate climate change impacts. At this point in time, both global climate change models and regional downscaling models ('Top-Down' approaches) do not offer concrete conclusions as to how the San Francisco Bay-Delta region will be impacted by climate change; current methodologies are only initial evaluations of the potential effects of climate change. In a 'Bottom-Up' approach, the most critical vulnerabilities of the District's water supply system are identified, the causes of those vulnerabilities are articulated, and then steps are taken to better address and solve the vulnerability in the face of climatic uncertainty. As part of the WSMP 2040 climate change analysis, the District's current water supply system was stressed by systematically changing pre-identified factors (e.g., customer demand, annual runoff volume) and simulating results using the W-E model. The climate change scenarios were then compared to a Baseline scenario to determine how sensitive the system was to each of the factors and to identify critical vulnerabilities. The results were then used to help design portfolios that address the system's vulnerabilities.

In applying the 'Bottom-Up' approach for the WSMP 2040, sensitivity analyses were conducted on identified factors with a likelihood of future change, in addition to application of the District's existing drought planning sequence, to evaluate the potential impacts of a drought even more severe than that simulated by the DPS. Specifically, the District's current drought planning sequence was applied to the Baseline scenario as well as to all potential future water supply portfolios for initial screening for adequacy and baseline performance. Concurrently, the Baseline portfolio used to establish the Need for Water was evaluated under estimated future climate change conditions for comparison in the sensitivity analyses. Portfolios that performed well in the design drought were then evaluated using lessons learned from the climate change sensitivity analyses and adjusted, as needed, to ensure the proper mix of projects/components and to provide the District with information as to how well those water supply portfolios may perform under a variety of hydrologic conditions. This methodology allowed the District to identify a portfolio that met the widest range of possible future hydrologic conditions.

Future Temperature Changes

Regional air temperatures may continue to increase in the future likely resulting in an increase in water temperature along the Mokelumne River and downstream in Pardee and Camanche Reservoirs. The effects of climate change impacts have already been directly observed on the Mokelumne River watershed. Figure 4-7 shows temperature changes as observed at Camp Pardee (EBMUD, 2006). The data shown in this graph clearly depicts an upward trend in minimum and maximum annual temperatures.

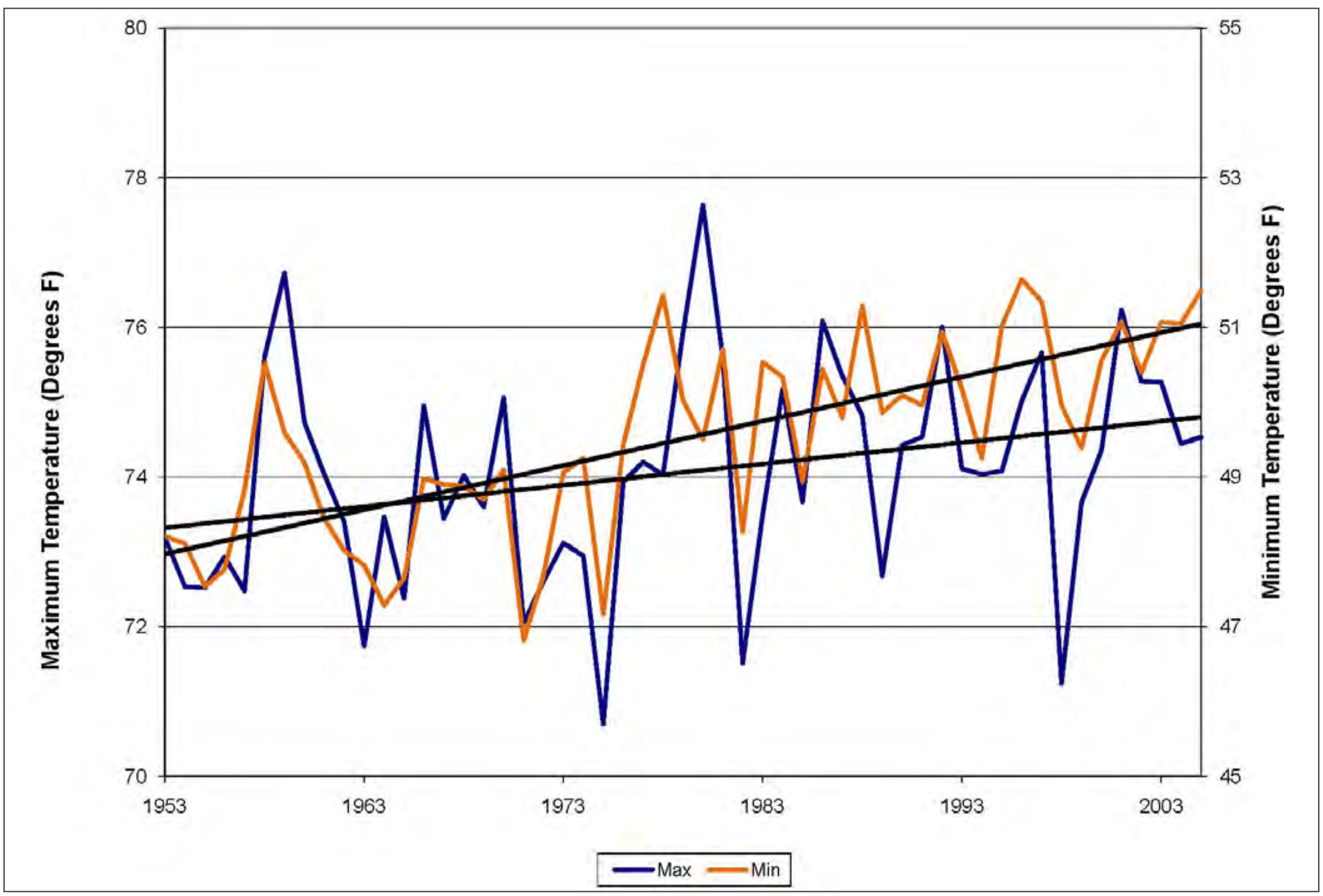
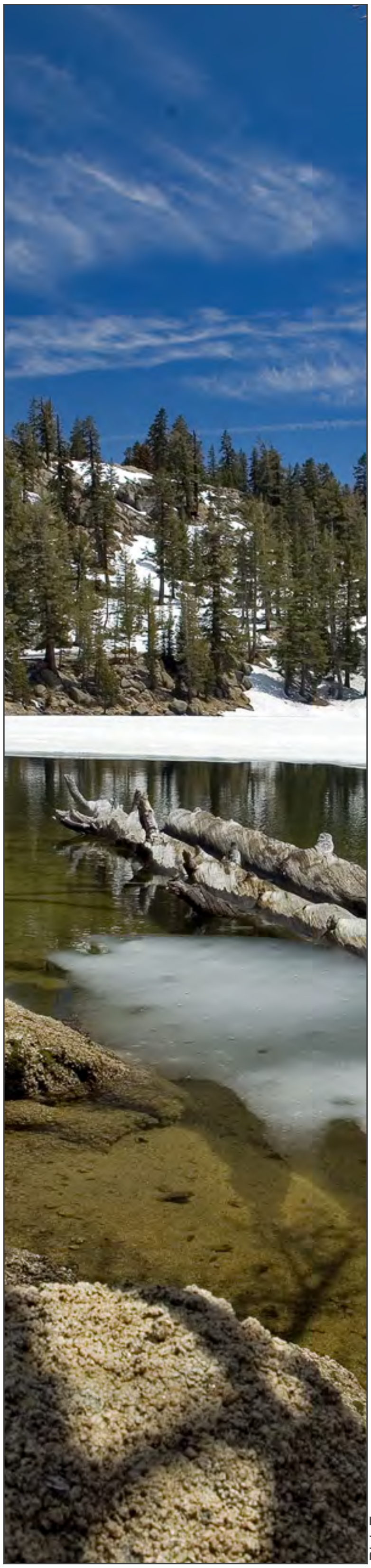


Figure 4-7 *Camp Pardee Average Annual Temperature*



Snowmelt at Pardee Reservoir

Evidence of warming is already apparent in winter temperatures in the Sierra Nevada; an increase of almost 2°C (4°F) was observed during the second half of the 20th century. Unless there is a significant decrease in greenhouse gases, the incremental increase of an additional 2°C (4°F) is expected over the next half-century. Based on reports by Michael Dettinger of the U.S. Geological Survey (USGS) *From Climate Change Spaghetti to Climate Change Distribution, 2004*, the *2007 Fourth Assessment Report* by the IPCC, and a recent report by the U.S. National Research Council (NRC), *Abrupt Climate Change: Inevitable Surprises*; by the end of the 21st century there is potential for a 3°C to 5°C median increase in temperature in the western United States; and projections for median precipitation vary from 10% wetter to 20% drier.

Future Precipitation Changes

Global climate change models that have been downscaled to California regional areas have shown a greater degree of variability in precipitation than in temperature predictions. Figure 4-8 shows the variability in projected changes in annual precipitation for Northern California (Dettinger, 2005). Based on global climate change modeling published to date, precipitation volumes in Northern California could increase as much as 77% or decrease as much as 25% by the year 2100, depending upon the model and future emissions scenario.

Precipitation increases can only enhance the volume of water available to the District for supply. As the purpose of the WSMP 2040 is to ensure an available future water supply under a variety of dry conditions (including the DPS), only future decreases in precipitation were considered in the sensitivity analysis. To that end, impacts of 10% and 20% decreases in precipitation in the Mokelumne River watershed, which were assumed to correspond directly to 10% and 20% decreases in river runoff, were evaluated.

In general, developing a protocol to simulate future droughts under a variety of climate change scenarios is difficult. There is no historical regularity in the timing of the droughts that allows a logical increase in drought frequency. Upon further examination of sensitivity scenarios to be modeled, it was determined that changes (decreases) in Mokelumne River runoff may result in derived droughts that are both longer and deeper than those modeled by the drought planning sequence in the Need for Water analyses previously conducted, thereby providing the desired sensitivity analysis effect. In other words, by changing the timing of

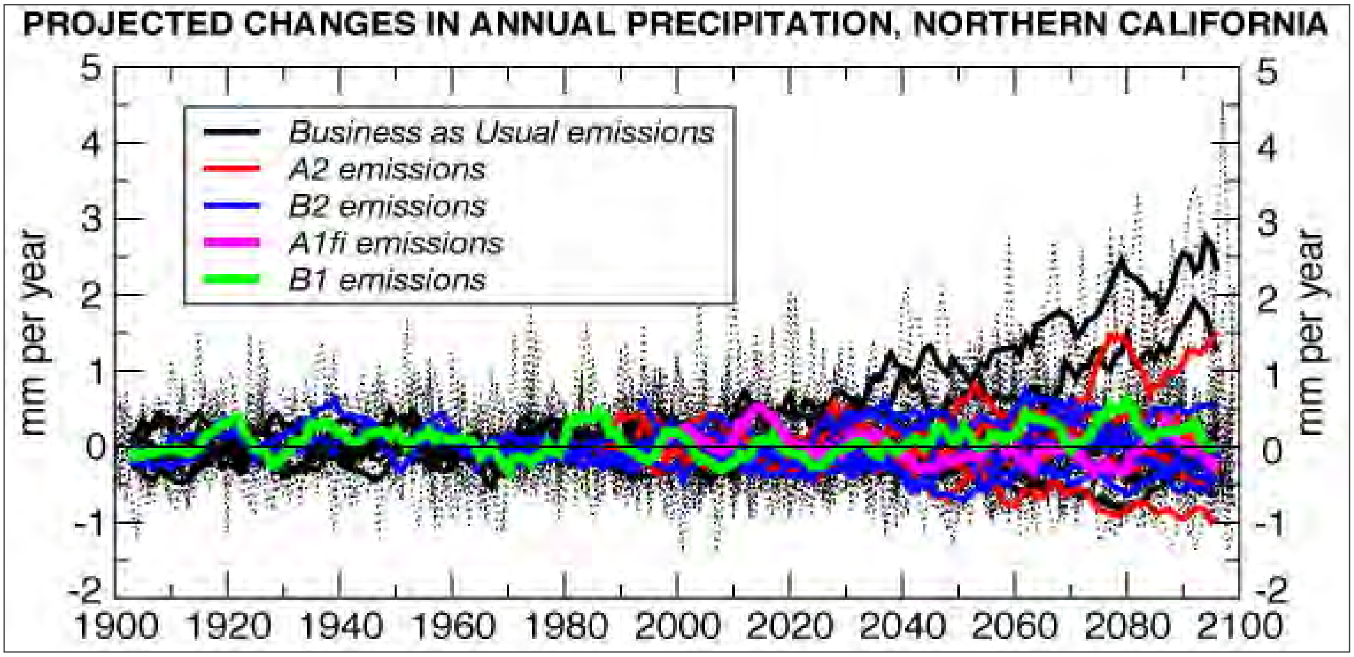


Figure 4-8 *Projected Future Changes in Annual Precipitation in Northern California*

the Mokelumne River runoff and/or decreasing the volume of runoff, new 'artificial' droughts are generated in the model that can be examined for their potential impacts on the District's water supply system.

For the purposes of this modeling, it is assumed (conservatively) that all of Northern California will experience drought conditions at the same time and therefore drought impacts on the Mokelumne River will also be experienced simultaneously on the Sacramento and other Northern California rivers (and therefore impact availability of CVP water at the same time as FRWP water supplies are required to offset shortages on the Mokelumne River).

4.3.2 Assumptions

Based on the previously mentioned research and other available publications, the following assumptions were used to evaluate potential climate change impacts on the District's system:

- Increase in average daily temperatures by 4°C between 1980 and 2040; and
- Decrease in precipitation rates by 20% by the year 2040.

For the purposes of modeling in the WSMP 2040, a revised demand estimate for the year 2040 was prepared to incorporate climate change impacts assuming a 4°C increase in temperature, but no change in precipitation. Although a decrease in precipitation with an increase in air temperatures may seem to represent the most extreme climate change conditions, the analysis of projected future demands under such a scenario indicated that a 20% reduction in precipitation had little influence on overall customer demands in comparison to a 4°C increase in air temperature; therefore, only the 4°C increase in air temperatures was incorporated into the revised customer demands to account for climate change affects. While indoor water use is not expected to change significantly under global warming, changes in outdoor water use may have significant impacts on projected future customer demands. As such, the projected 2040 customer demands were re-normalized using projected temperature changes under selected climate change scenarios.

The next step in the WSMP climate change sensitivity analysis was to develop the scenarios to be modeled using the W-E model. The current global climate models and corresponding regional models have indicated that, for Northern California, temperatures could increase in the future accompanied by uncertain future precipitation rates. Additionally, studies have indicated the potential for a more unstable future hydrology, resulting in possible longer and more frequent droughts.

Four parameters were selected for variation in the W-E model for the climate change sensitivity analysis:

- Change in customer demand resulting from an increase in air temperatures;
- Change in the timing of runoff in the Mokelumne River resulting from an increase in air temperature;
- Change (decrease) in precipitation resulting in a corresponding decrease in Mokelumne River runoff; and
- Change in hydrologic patterns resulting in longer and more frequent droughts.

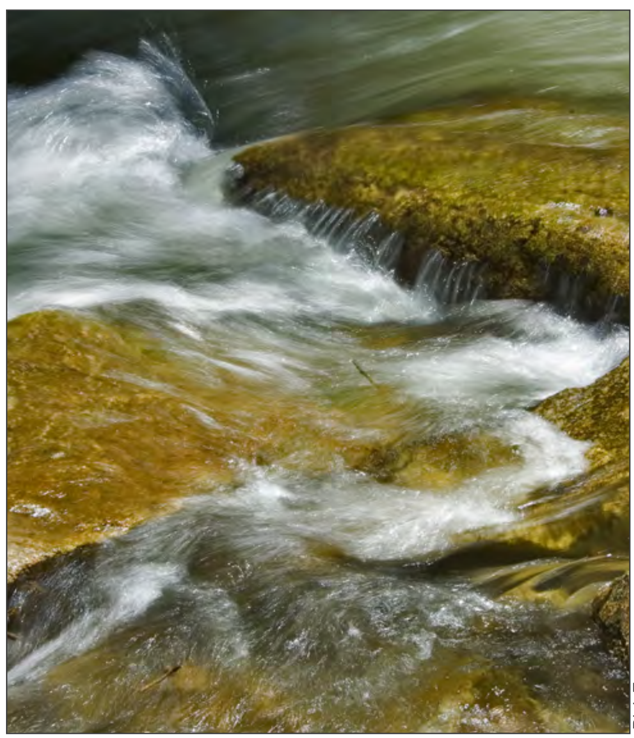
Modeling Climate Change Impacts

Assuming a 4°C increase in air temperature from 1980 to 2040 (corresponding to a 2.15°C increase in temperature between the years 2005 and 2040) resulted in a 3.6% increase in customer demand (or an increase of 10 MGD in customer demands) by the year 2040, representing a reasonable 'worst-case' scenario for climate change impacts on projected demands.

To simulate these scenarios, input data for the W-E model were developed for each scenario and the following individual cases were run:

- Changes in customer demands resulting from a 4°C increase in air temperature;
- Changes in the timing of Mokelumne River runoff corresponding to 2°C, 3°C and 4°C increases in air temperature; and
- Reductions in Mokelumne River runoff corresponding to 10% and 20% reductions in precipitation and Mokelumne River runoff. This scenario also inherently takes into account a future with longer and more frequent droughts.

Additional detail on modeling assumptions regarding future hydrology and operations of Mokelumne River facilities (i.e., PG&E reservoirs and powerhouses) is provided in Appendix D- TM-9, Climate Change Analysis.



Rich Turner

Mokelumne River watershed snowmelt March 2005

Operating assumptions applied with respect to PG&E's operations of upstream reservoirs include the following.

- When monthly unimpaired flow at Mokelumne Hill is less than historical, PG&E storage is not adjusted. The routine attempts to conserve as much water as possible without violating the Lodi Decree.
- When monthly unimpaired flow at Mokelumne Hill is more than historical, the model routine attempts to store as much as possible.
- Hydrologic inputs required to approximate PG&E operations included modifications to year 1978 to be consistent with District's DPS.
- Hydrologic period from 1953 to 2002, including District's DPS, is used in sensitivity analysis.
- Negative flow values are rounded up to zero.
- Reduction in April through July Mokelumne runoff was deducted from the May to July period to be consistent with Maurice Roos' 1994 study.
- Existing flood control capacity requirement is applied in all simulations.

4.3.3 Results

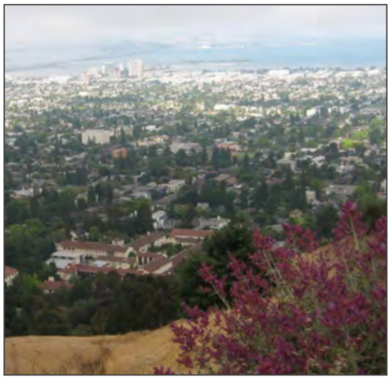
Seven model runs were conducted to test the sensitivity of the District's current water supply system to variables that will likely be affected by future changing climate. In general, the results of the climate change sensitivity analyses identified that the District is most vulnerable to decreases in annual runoff volumes (especially reductions of 20% or more in runoff), particularly in years surrounding the DPS.

In addition, modeling indicated that increases in air temperature mostly likely will result in both measurable increases in the temperature of water flowing into Pardee Reservoir and in customer demands. However, in all cases, the severity of these impacts on EBMUD, its customers, and the environment will depend on both the magnitude of air temperature increases and the hydrologic year type. It is also important to note that each of these variables (runoff timing, decrease in precipitation, increase in demand, etc.) was modeled independently of each other for this analysis. Increased flood releases resulting from climate change will typically result in less water being captured and stored. Model results corroborate this conclusion showing years with a decrease in carryover storage coinciding with an increase in wintertime flood releases and decrease in spring runoff. A decrease in annual Mokelumne River runoff volumes has significant implications for water supply reliability. A systematic reduction of 10% and 20% would notably strain Mokelumne resources, as shown by the model results, thereby requiring the District to rely on alternative sources of water.

Rationing is one way the District deals with periods of unusually dry hydrologic conditions. Climate change impacts on rationing, as observed in the W-E model simulations, show:

- The frequency of rationing appears to be sensitive only to decreases in annual precipitation volume. In general, the frequency of rationing did not change with increased customer demand or shifts in springtime runoff, while there was a significant increase in rationing frequency due to overall decreases in Mokelumne River runoff.

- The magnitude of rationing appears to increase by up to 16 TAF in a single year with increased customer demands, but is most severe (increasing up to 60 TAF in a single year) under decreases in annual runoff volume.



EBMUD Service Area West of Hills

Paul Cockrell

California poppies bloom at Pardee Reservoir

- The amount of rationing decreases with shifts in runoff due to earlier re-filling of reservoirs.

4.3.4 WSMP 2040 Portfolio and Climate Change

In general, based on the results of the climate change sensitivity analyses, additional storage combined with source diversity (i.e., water supplies from different watersheds for drought resistance) will provide the District with the maximum amount of flexibility and the ability to adapt to unknown future conditions (see Table 4-3).

The modeling conducted as part of the WSMP 2040 shows that it is likely that the District will experience changes in its Mokelumne River watershed water supply in the future; though, due to relatively coarse information currently available about the degree of future climate changes, these impacts cannot be known exactly. Nonetheless, the relative impacts can be mitigated through a combination of management measures and water supply projects that provide flexibility and reliability.

Table 4-3: Climate Change Sensitivity Analysis Summary

Parameter	Variation	Strategy	Related Elements of the 2009 WSMP 2040 Portfolio [1,2]
Demand increase reflecting increased outdoor water use resulting from temperature increases	Increase demands by 10 MGD	Employ potable demand management measures	39 MGD Conservation 11 MGD Recycled Water
Decrease in springtime runoff/ increase in wintertime runoff	Decrease in carryover storage in some years ranging from 10 to 100 TAF	Increase system storage Optimize use and storage of excess water in wet years Reoperation of Mokelumne Reservoir system Intra- and Inter-regional cooperation/agreements	4.3 MGD Sac GW Banking 9 MGD Bayside II 8 to 13 MGD Water Transfers 20 MGD Regional Desalination
Decrease in overall runoff volumes	Increase in customer shortages from 20 to 60 TAF during the DPS	Development of drought resistant supplies (not dependent on hydrologic conditions) Diversification of water supply source locations	20 MGD Regional Desalination 11 MGD Recycled Water 8 to 13 MGD Water Transfers 4.3 MGD Sac GW Banking

1 Modeling was conducted on the 2009 WSMP 2040 Portfolio.

2 Supplemental Supply components may show less yield than originally presented in the 2009 WSMP 2040.

The EBMUD Board of Directors and a Community Liaison Committee helped guide the development of the WSMP 2040 for over two years.

5. Who was Involved

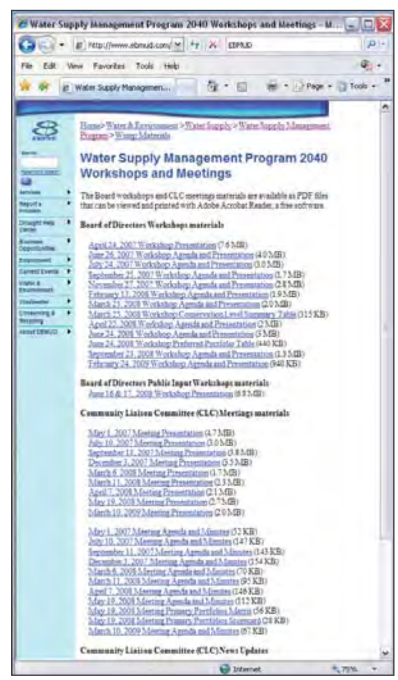
5.1 EBMUD Board of Directors Workshops

EBMUD's Board of Directors held regular WSMP 2040 Development Workshops, beginning in the Spring of 2007 and continuing into 2009, as part of a stepwise approach to the planning and screening of the WSMP 2040 and Alternative Portfolios. Workshops ran approximately two hours in length, included presentations by EBMUD staff and the consultant team, and included time for public comment. Public comments were most often centered on a particular topic that was on the agenda for discussion on a given day. As an example, the Board obtained comments regarding the study undertaken to estimate the Need for Water. The Board also gathered comments from citizens regarding projects that they were interested in seeing move forward for consideration as part of the WSMP 2040 portfolio development process.

Eleven regular WSMP 2040 Board Workshops were held. The first few of these workshops provided a historic perspective regarding the 1993 WSMP and the District's accomplishments since its adoption. The scope of the WSMP 2040 was also summarized at these early workshops. As the work effort advanced, workshops were used to seek Board input during portfolio development and review stages. Toward the end of the WSMP 2040 development effort, the workshops focused on water supply portfolio preferences and the portfolio screening process. Two additional Board Workshops were conducted in 2011 and 2012, which focused on the revisions to the PEIR and WSMP 2040 subsequent to the legal challenge.

A summary of Board Workshop dates and topics are summarized in Table 5-1. The complete set of Board Workshop PowerPoint presentations is presented in Appendix E.

Newsletters were sent out to the appointed CLC members and posted on EBMUD's website



EBMUD's public website lists the presentations, minutes, and materials from the WSMP 2040 planning process

Table 5-1: Summary of WSMP 2040 Board Workshop Topics

Board Workshop Number	Workshop Date	Summary of Topics Covered
1	April 24, 2007	• WSMP 2040 Objectives & Preliminary Message • Team Organization & Workplan • WSMP 2020 Overview - 1993 to Present • WSMP 2040 Purpose & Planning Objectives • Public Outreach Plan
2	June 26, 2007	• Demands Study Status Report & Preliminary Demand Estimate • Drought Planning Sequence Evaluation • Evaluation Criteria – Approach
3	July 24, 2007	• Water Transfers • Range of Components • Global Climate Change – WSMP 2040 Approach
4	September 25, 2007	• Evaluation Criteria • Conservation Component • Rationing Component • Recycled Water Component
5	November 27, 2007	• Conservation Program – more detail on programs as requested at BOD#4 • Water Supply Model • Need-for-Water Analysis Results • Supplemental Supply Component
6	February 13, 2008	• Updates: BOD#5 Action Items, Water Transfers, Final Demand Estimate, Need-for-Water • Component Screening & Evaluation, Part 1
7	March 25, 2008	• Component Screening & Evaluation, Part 2 • Identify Portfolio themes to be tested
8	April 22, 2008	• Portfolio Screening & Evaluation
9	June 24, 2008	• Identify WSMP 2040 Portfolio
10	September 23, 2008	• WSMP 2040 Update • Update on Existing & Ongoing District Programs
11	February 24, 2009	• EIR Status, Analysis & Findings • WSMP 2040 Portfolio Review
12	August 11, 2009	• WSMP 2040 & WSMP 2040 Portfolio Review • Draft PEIR: Outreach Effort & Comments Received
13	September 27, 2011	• Proposed PEIR Revision Effort
14	March 27, 2012	• Summary of PEIR Revision Effort

5.2 Public Involvement

Public outreach was a critical element of the WSMP 2020 (adopted 1993) and it remained so for the WSMP 2040. The WSMP 2040 planning process included a focused public outreach program. A Community Liaison Committee (CLC) was formed in the spring of 2007 to solicit ongoing public input during the different stages of the plan development: the demands study, the identification and evaluation of components and portfolios, and the drafting of the WSMP 2040 and PEIR. The CLC was used as a primary vehicle for EBMUD to disseminate information to the community and by which feedback and input from the community was received and provided to the Board for consideration.

All Board Workshops and Community Liaison Committee meetings were open to the public and all presentations, newsletters, and meeting notes were made public on EBMUD's website.

In addition to the public Board workshops and CLC meetings, two public information and input meetings were held on June 16 and 17, 2008, in Walnut Creek and Oakland, respectively. The WSMP 2040 is subject to environmental review in accordance with the requirements of the California Environmental Quality Act (CEQA) and two public scoping meetings were held on May 22 and May 29, 2008 in Oakland, and Stockton respectively to solicit comments on environmental issues to be addressed in the PEIR. Public comments were also received at the June 16 and 17, 2008 Board Workshops. The draft
Program EIR was issued for formal public comment on February 19, 2009. The end of the comment period was extended from April 6, 2009 to May 4, 2009, resulting in a 75-day comment period. The Draft PEIR was available online and in libraries throughout the EBMUD service area and in the counties of the main watersheds and catchment areas.

EBMUD Board Director Doug Linney welcoming meeting attendees in San Andreas, Calaveras County on March 30, 2009

Public Meetings to comment on the draft PEIR were held on March 16 in Lodi and Sutter Creek, March 18 in Oakland, March 23 in Walnut Creek, and March 30, 2009 in San Andreas, Calaveras County.

Table 5-2: WSMP 2040 Public Meetings Held During the Draft PEIR Comment Period (February 19 - May 4, 2009)

Date	Meeting Location	Number of Attendees	Number of Commenters
March 16	Lodi, San Joaquin County	29	7
March 16	Sutter Creek, Amador County	~100	36
March 18	Oakland	23	16
March 23	Walnut Creek	27	13
March 30	San Andreas, Calaveras County	~173	34
Total		~352	106

5.2.1 Community Liaison Committee

Each of the EBMUD Board of Directors were asked to identify members of the public to serve as representatives on the WSMP 2040 CLC. The CLC's first meeting was held in spring 2007. The CLC's purpose was to facilitate the exchange of information and the sharing of opinions. Sharing of information and opinions was extended beyond the CLC participants and EBMUD staff, as the CLC members themselves were tasked with holding side discussions with key stakeholder interest groups and/or the community counterparts that they represent (as a means to inform the broader public

From left, back row: Merlin Edwards, Howard Kerr, Charles Gilcrest, Chuck Brydon; front row: Eleanor Loynd, Stuart Flashman, Julia Liou at CLC Meeting # 8, March 2009.

Table 5-3: WSMP 2040 Community Liaison Committee (CLC) Members

Name	Organization
Barbara Becnel	Neighborhood House of North Richmond
Charles Brydon	W.A.T.E.R.
Merlin Edwards	Oakland African American Chamber of Commerce (OAACC)
Stuart Flashman	Rockridge Community Planning Council - Private Attorney
Henry Gardner	Association of Bay Area Governments
Charles Gilcrest	Senior Advisor to Mayor Santos of San Leandro
Walt Gill	Chevron Richmond Refinery
John Gioia	Contra Costa County Board of Supervisors
Bob Glover	Home Builders Association of N. CA.
Betty Graham	Dept of Health Services, SF District
Michael Hanemann	UC Berkeley, Water and Economics
Laura Harnish	Environmental Defense
Kris Hunt	Contra Costa Taxpayers' Association
Bruce Kern	East Bay Economic Development Alliance
Howard Kerr	Oro Loma Sanitary District
Julia Liou	Asian Health Services
Eleanor Loynd	May Valley Neighborhood Council, Richmond
David Nesmith	CA Environmental Water Caucus
Tomi Van de Brooke	Contra Costa County Board of Supervisors

about the WSMP 2040 development). CLC members included representatives of elected officials, industry, environmental interests, and community advocacy groups (see Table 5-3)

The CLC was presented with a broad overview of the various elements of the WSMP 2040, as well as the policy decisions of the Board of Directors. Consultants and EBMUD staff prepared presentations for the CLC meetings, which were held following the Board of Directors workshops. All comments were made available to the Steering Committee and the EBMUD Board of Directors.

The side discussions as conducted by CLC representatives between meetings (and as noted above) enabled the CLC to not only convey information regarding the District's WSMP 2040 progress to the community, it also enabled the CLC to report feedback as received from their constituents to the Board. CLC meetings were open to the public, and their proceedings were recorded in presentations, newsletters and meeting notes that were posted on EBMUD's website. Eight CLC meetings were held between May 2007 (at the beginning of the WSMP 2040 development process) and March 2009 (after publication of the draft PEIR).

5.2.2 Public Board Workshops

The EBMUD Board of Directors sponsored public information workshops on June 16 and 17, 2008 in Walnut Creek and Oakland, respectively. The Board scheduled these workshops to ensure timely consideration of public comments at their meeting on June 24, 2008, at which they provided guidance to staff and consultants regarding a recommended WSMP 2040 Portfolio. These workshops were specifically organized to present the public with the water supply options that had been advanced for Board consideration, the five portfolios that would be reviewed by the Board, and to hear comments about the portfolio options and the projects and programs that were components of one of more of the options. Both workshops were publicized in advance via media announcements (newspaper advertisements and emails to CLC members). Comments and key messages from these meetings were communicated to the Board before they provided guidance on the WSMP 2040 Portfolio on June 24, 2008.

The Public Board Workshops held on June 16 and 17, 2008 were attended by 28 members of the public. Of these, 20 commented on the WSMP 2040 (see sidebar).

Key Messages from the Public

The comments addressed similar issues and preferences; in summary to:

- Use water more wisely: maximize conservation, rationing & recycling;
- Support local community rainwater catchment, graywater & stormwater systems;
- Not build any new dams;
- Use pricing & education to increase perceived value of water; and to provide increased conservation incentives.

An additional three comments were received via the website and/or mail, together supporting:

- 20% rationing or more during droughts;
- Maximum conservation (i.e., Conservation Level D or better); and
- Optimizing use of groundwater storage.

Opposing:

- New surface reservoirs or expansion of existing ones; and
- Cross-Delta water transfers.

Members of the Sierra Club presented several hundred signed form letters regarding the WSMP 2040 Portfolio (included in the summary above) to the Board of Directors at the Public Board Workshops.

David Blau of EDAW presents the draft PEIR findings at the Amador County Water Agency in Sutter Creek on March 16, 2009

Water agency employees and public at the Amador County Water Agency in Sutter Creek on March 16, 2009

Board members and public following the presentation on the draft PEIR in San Andreas, Calaveras County, on March 30, 2009

San Andreas, Calaveras County, on March 30, 2009

The majority of commenters opposed a WSMP 2040 Portfolio that would include building a Buckhorn Reservoir due to considerable environmental impacts (14 people), but there were also some proponents supporting building a Buckhorn Reservoir to create more local water supply (2 people).

Members of the public also reminded EBMUD that "with Global Climate Change, EBMUD can provide leadership to change how water is being valued and used."

5.2.3 Upcountry Presentations

To inform representatives of communities that lie beyond the EBMUD service area located in the watersheds and catchment areas of EBMUD's water supply, (called the 'upcountry' regions of San Joaquin County, Amador County, and Calaveras County) about the WSMP 2040 effort, EBMUD staff spoke at various non-District-sponsored events:

- At the May 14, 2008 Northeast San Joaquin County Groundwater Banking Authority (GBA) meeting in Stockton, an EBMUD representative described the WSMP 2040 water supply projects under consideration as part of water supply portfolios.
- At the July 25, 2008 meeting of the Upper Mokelumne River Watershed Authority (UMRWA) in Amador County, an EBMUD representative described the WSMP 2040's objectives and recommended programs to attendees of the UMRWA governing board meeting.

At both meetings, EBMUD representatives obtained valuable information regarding the preferences, concerns, and views of both representatives of those organizations, and from the members of the public also present at said events. That information was relayed to the WSMP 2040 project team and to the EBMUD Board of Directors. As mentioned above, public meetings on the draft PEIR (including presentations on the WSMP 2040 Portfolio) were held in Lodi, San Joaquin County; Sutter Creek, Amador County; and San Andreas, Calaveras County in March 2009.

5.3 EBMUD Board Workshops and Public Involvement for the Revised WSMP 2040 (subsequent to the legal challenge)

Following the legal challenge of the PEIR for the 2009 WSMP 2040, EBMUD prepared draft revisions to the PEIR to address the deficiencies identified. As part of the revisions to the PEIR, three scoping meetings were held in Oakland (Alameda Co.), Jackson (Amador Co.), and San Andreas (Calaveras Co.) in July 2011.

Three public comment meetings were also held in January 2012, as summarized in Table 5-4.

Additional public Board Workshops were held, as summarized in Table 5-1, to present a summary of the legal challenge to the PEIR and the PEIR revision effort. The PowerPoint presentations from these Board Workshops are presented in Appendix E.

Table 5-4: WSMP 2040 Public Meetings Held During the Draft Revised PEIR Comment Period (December 6, 2011 – January 27, 2012)

Date	Meeting Location	Number of Attendees	Number of Commenters
January 11	Jackson, Amador County	14	4
January 12	San Andreas, Calaveras County	13	8
January 17	Oakland	4	3

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The WSMP 2040 is built with components organized into four categories: rationing, conservation, recycled water, and supplemental supply.

6. Building Blocks of the Plan

The WSMP 2040 includes new rationing, conservation, and recycled water targets, and supplemental supply components that will allow the District to meet the growing demands of EBMUD customers to 2040 and minimize rationing in dry years. This section describes the WSMP 2040 planning process that led to the WSMP 2040 Portfolio, including a description of the components, or individual projects, that were considered; how they were screened and which components were then carried forward; how the components were assembled into water supply management portfolios; and how these portfolios were evaluated to arrive at the WSMP 2040 Portfolio.

6.1 Components

The WSMP 2040 components are organized into four categories: rationing, conservation, recycled water, and supplemental supply. Proposed components would be located throughout the Upcountry area (the region east of the service area to the Sierra Nevada mountains in the vicinity of the EBMUD system), the Central Valley area (in the vicinity of the FRWP and Sacramento River watershed), and East Bay area (both inside and outside the EBMUD service area).

6.1.1 Rationing

EBMUD estimates its total system storage that will be available at the end of the water year (September 30) based on runoff for April of the current water year. If total system storage is projected to be less than 500,000 AF, a Drought Management Program (DMP) is prepared. EBMUD developed guidelines that call for increasing rationing levels as the projected total system storage decreases. By imposing varying levels of

Components

Rationing

Conservation

Recycling

Supplemental Supply

Water Transfers

Groundwater Banking / Exchange

Regional Desalination

Suface Water Reservoirs

EBMUD Rationing Measures

EBMUD declared a severe water shortage in May 2008. At that time, mandatory rationing measures were implemented.

1. Water Supply Response: Mandatory conservation / rationing in effect; Water savings patrol in place. Expanded leak repair implemented.
2. Drought surcharge applied.
3. Public conservation outreach campaign; Updating / adopting drought ordinance.
4. Local water emergency / water supply shortage declared.

Natural and adapted drought tolerant landscaping

rationing in the early years of potentially prolonged drought periods, the goal is to reduce the need for more severe rationing in subsequent years. In the past, water use reductions in drought periods have been achieved by effective public information programs combined with water rate increases. EBMUD customers have an excellent record of achieving water savings that are requested or targeted. For more detail on the existing rationing policy, see Section 3.4.1.

Five levels of rationing were considered throughout the WSMP 2040 planning process: no rationing (0%), and 10%, 15%, 20% and 25%. All five of these levels were considered in the first phase of portfolio analysis; however, the 0% rationing level was held from further consideration as it does not ask customers to make any cutbacks during drought years.

25% rationing was removed from consideration because it was thought to place unfair burden on EBMUD customers to cut back water use so severely during drought years. For example, in the 25% overall rationing scenario, irrigation customers would have to cut back water use by 50% and single-family residential customers would have to decrease their water use by 31% (see Figure 3-4 in Section 3.4.1, Existing Rationing Policy). During the summer months of July and August, single-family residential customers would be asked to cut back water use by 50%; this high level of rationing was considered as unacceptable. The cost of rationing to the customer was also deemed to be unacceptably high (see Appendix E, Board Workshop #7 Meeting Materials as well as Appendix D TM-6).

Thus, the three remaining levels of rationing, 10%, 15%, and 20%, were brought forward into the Portfolio analysis and were variously combined with conservation, recycled water and supplemental water supply components into a range of portfolios. In this capacity they were further evaluated as described in Section 6.2. A full description of the rationing level evaluation can also be found in Appendix B, Section 1.1.1.

6.1.2 Conservation

For the conservation evaluation, combinations of different conservation measures were analyzed and combined into programs for achieving varying levels of conservation savings. The multiple-tiered measures analyzed ranged from moderate to extensive market saturation levels covering both retrofits and new development. The analysis included quantifiable measures corresponding to the California Urban Water Conservation Best Management Practices (CUWCC BMPs) and new development measures to make new residential and business customers more water efficient, a process already started by EBMUD.

A "smart" water conservation garden in the East Bay

Determining Conservation Measures & Programs

The conservation evaluation process consisted of seven steps, using the Least Cost Planning Water Demand Management Decision Support System (DSS model), proprietary software developed by Maddaus Water Management (MWM). These steps were:

1. Use the WSMP 2040 demand study results for water use projections (without the national plumbing code, net of existing conservation and existing and planned recycled water projects).
2. Identify possible water conservation measures and screen qualitatively (to identify those that are applicable to the service area).
3. Estimate the affected customers (or number of accounts) for each conservation measure. This factor is called the market saturation or installation rate.
4. Estimate water savings: total annual average, seasonal and peak day.
5. Determine the initial and annual costs for measure implementation (based on pilot projects, local experience, and the costs of goods, services, and labor in the community).
6. Compare the present value of cost of the measures to the costs of water saved over the planning period.
7. Compile conservation packages.

A more detailed description is contained in Appendix D TM-5 Conservation Technical Memorandum and additional detail is provided in the Demand Study in Appendix C.


EBMUD customers can receive rebates for purchasing Water Smart high-efficiency toilets (HET) - when replacing toilets with 3.9 gallons per flush

Methodology for Compiling & Evaluating Future Conservation Measures

Approximately 100 conservation measures potentially appropriate for the EBMUD service area were considered. Measures not well suited to the Alameda and Contra Costa County area were eliminated; the remaining measures were screened against four qualitative criteria:

- Technology/Market Maturity;
- Service Area Match;

- Customer Acceptance/Equity; and
- Relative Effectiveness of Measure Available.

This screening process resulted in all but 53 of the conservation measures being set aside from further consideration.

A summary of the measures is provided in Table 3 of the Conservation Memo (TM C-5 in Appendix D).

Unit costs were determined for each of the 53 measures based on industry knowledge, past experience and data provided by EBMUD. These include incentive costs; fixed costs (such as marketing); variable costs (such as the costs to staff the measures and to obtain and maintain equipment); and a one-time set-up cost. The set-up cost is for measure design by staff or consultants, any required pilot testing, and preparation of materials that will be used in marketing the measure. Costs were estimated for each measure for each year of the implementation period. Lost revenue due to reduced water sales was not included as a cost because the conservation measures evaluated generally take effect over a span of time that is sufficient to enable timely rate adjustments, if necessary, to meet fixed cost obligations.

To forecast the water savings of measures, data on water use, demographics, market saturation, and unit water savings were reviewed. Savings normally develop at a measured and predetermined pace, reaching full maturity after the target market saturation is achieved. This was assumed to occur three to ten years after the start of implementation.

High efficiency clothes washers are part of EBMUD's Rebate Program

Unit costs and savings data were then input into the DSS model to determine net present value and cost of water saved. The cost analysis was performed from various perspectives, including the utility and community (utility plus customer).

Conservation Level/Program Formulation and Evaluation

Five conservation programs (Levels A through E) were created each providing increasing levels of water savings, with the fifth level (E) being the maximum theoretical level of water savings (Table 6-1). Each program built on the prior program: Program A included the plumbing code only; Program B (equivalent to the District's current program) contains 25 conservation measures. Program C includes Program B measures plus 15 additional measures and uses the Automatic Metering System (AMS) to help identify (to the customer and to EBMUD) leakage and excessive use. This enhances the ability of EBMUD to conduct effective water surveys of residential and business customers. Program D has all 40 measures from Program C and adds a net of three measures. Program E includes four additional measures to Program D.

The measures contained in each level are provided in Table 6 of the Conservation Memo (TM C-5 in Appendix D).

EBMUD will add to existing conservation measures by expanding conservation measures as part of its Water Conservation Master Plan. Program expansion may include measures such as water surveys, rebates for high efficiency toilets and washers, and providing

Table 6-1: Conservation Program Description and Future Water Savings 2008-2040

Conservation Program/ Level	Description	Total Year 2040 Water Savings* (MGD)
A	No additional conservation mesaures beyond Plumbing Code	19
B	Similar to Current EBMUD Program = 25 Measures	29
C	Add 15 Measures to Current Program	37
D	Add 3 Measures to Program C	39
E	Add 4 Measures to Program D	41

incentives for irrigation upgrades. It is important to note that these programs are not intended to be rigid but to demonstrate the range of water savings that could be gained.

Table 6-2 summarizes the water savings, and program costs of the alternate programs. The plumbing code is included as passive baseline savings in addition to the long-term conservation program in Programs B-E. Additional resources and customer contacts are required to reach higher levels of potential water savings. Most of the program water savings are indoors, as they include the plumbing code impacts. Real water loss savings are due to leakage reductions. Costs are expressed two ways, as total present value over the analysis period, and the cost of water saved.

Table 6-2: Economic Analysis of Alternative Programs A through E 2010 to 2040

	2040 Water Savings (MGD)				Average Cost of Water Saved ($/AF)		Incremental Cost of Water Saved ($/AF)
Conservation Program	Total 2040 Water Savings with Code	Indoor	Outdoor	Real Water Loss	Utility Cost	Community Cost	Utility Cost
Program A (Plumbing Code)	19.4	19.4	0.0	0.0	NA	NA	NA
Program B + Plumbing Code	27.0	25.3	1.7	0.0	$ 143	$ 1,378	A to B: $ 143
Program C + Plumbing Code	35.3	29.6	2.7	3.0	$ 480	$ 1,971	B to C: $ 839
Program D + Plumbing Code	37.2	29.8	2.9	4.4	$ 634	$ 2,544	C to D: $ 2,338
Program E + Plumbing Code	38.6	29.9	4.3	4.4	$ 845	$ 3,470	D to E: $ 3,161

Notes: Excludes 2 MGD in projected water savings for programs B – E from existing program during 2008 and 2009 to not include costs incurred in the past. Indoor water savings include plumbing code (Program A). The portion of new water needed refers to the growth in demand without the plumbing code.

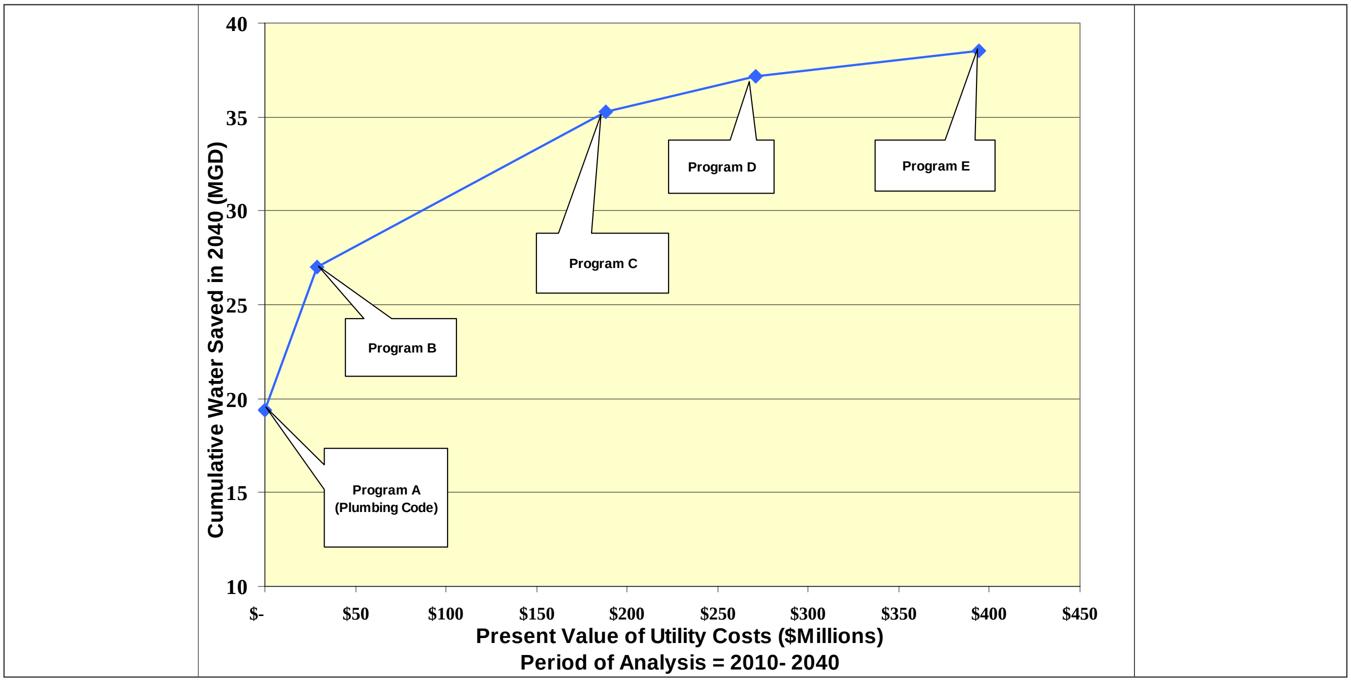


Figure 6-1 *Present Value of Utility Costs versus Cumulative (Total) Water Saved in 2040*

EBMUD employees are on staff to help customers with water conservation measures

All of the new potable water needed by EBMUD to accommodate planned growth in dry years could be met through demand reductions, including: aggressive conservation, recycled water projects, and customer rationing.

Present value and the cost of water saved are calculated for the utility; for the customer; and the total community (customer plus utility) (Figure 6-1).

Programs B, C, D, and E produce increasing incremental water savings and costs. As measures are added to each program beyond program B, the returns on water savings as compared to increasing costs diminish.

East Bay conservation garden

6.1.3 Recycled Water

For recycled water, the WSMP 2040 planning process focused on determining the potential quantity of recycled water production that would go beyond the District's current commitments of 9.3 MGD through 2020. As with conservation, individual recycled water projects were assembled to determine distinct implementation levels. To achieve the recycled water goal of 11 MGD by 2040, the individual projects would ultimately be comprised of various combinations of the projects.

The following information was used to develop alternatives for cost-effective expansion of recycled water use within the District's service area over the 30 year planning period.

- A summary of existing recycled water projects, including existing treatment and distribution facilities, recycled water customers and projects currently under construction.
- Previously identified recycled water projects proposed for consideration in WSMP alternatives. Implementation of some of these projects is currently underway in the planning or design phases.
- Updated potential recycled water customer information within the proposed projects areas, including location, current potable water usage, and type of use.

Recycled water irrigation signage

Three areas of opportunity were reviewed:

1. The potential market for urban reuse by assessing existing water accounts and future urban development,
2. The potential for recycled water partnerships with Mokelumne River watershed and Sacramento area agencies[1] was evaluated, and
3. The potential for other recycled water uses, such as groundwater recharge with recycled water and environmental use of recycled water, were identified.

Additionally, the potential recycled water demand associated with the District's existing potable water customers was determined. Customers with potable water use greater than 1.5 acre-ft/year were identified.[2] The resulting potential recycled water demand associated with existing accounts is summarized in Table 6-3 and shown in Figure 6-2. The potential users and recycled water projects are shown in Figure 6-3 and Table 6-4.

Other uses for recycled water were also explored, including groundwater recharge and environmental uses such as wetland augmentation, both of which were determined to be infeasible at this point. Recharging a groundwater aquifer with recycled water would not be in full compliance with District policy number 7.10, and developing potential recycled water projects with the sole purpose of providing water for the environment does not help to achieve the purpose of the WSMP 2040.

[1] The concept is that the District would provide funding and technical expertise to implement recycled water projects in the Upcountry and Sacramento areas. In exchange, potable water offset by use of recycled water in these areas would be made available to the District. Additional detail about these potential partnerships is provided in Appendix D TM-4.

[2] Users with potential recycled water demands less than 1.5 acre-ft/yr were excluded because supply of recycled water to minor users is generally not cost-effective. However, minor users have the potential to receive recycled water service if located along pipeline alignment.

Table 6-3: Demand Potential Associated with Existing Accounts

Demand Type	Potential Annual Recycled Water Demand (MGD)[1]	Potential Annual Recycled Water Demand (acre-ft/yr)[1]
Irrigation of Public or Common Areas (Includes Commercial and Industrial Sites)	19.5	22,000
Industrial Indoor	8.5	9,500
Commercial Indoor	2	2,000
Total	**30**	**33,500**

[1] Demand estimate rounded to nearest 0.5 MGD or 500 acre-ft/yr.
Source: RMC 2007 (Water Supply Management Program 2040 – Future Recycled Water Potential Analysis) – WSMP 2040 Appendix D TM-4.

Proposed recycled water projects to be evaluated as part of the WSMP 2040 solutions component portfolio were generally categorized into those within the District's service area, and those within the Mokelumne River (Upcountry) and Sacramento areas.

Potential Future Recycled & Raw Water Projects

Projects within the District's service area include recycled water centralized treatment, satellite treatment, and raw water projects. The centralized treatment projects use recycled water produced at only one of the wastewater treatment plants. These would be either

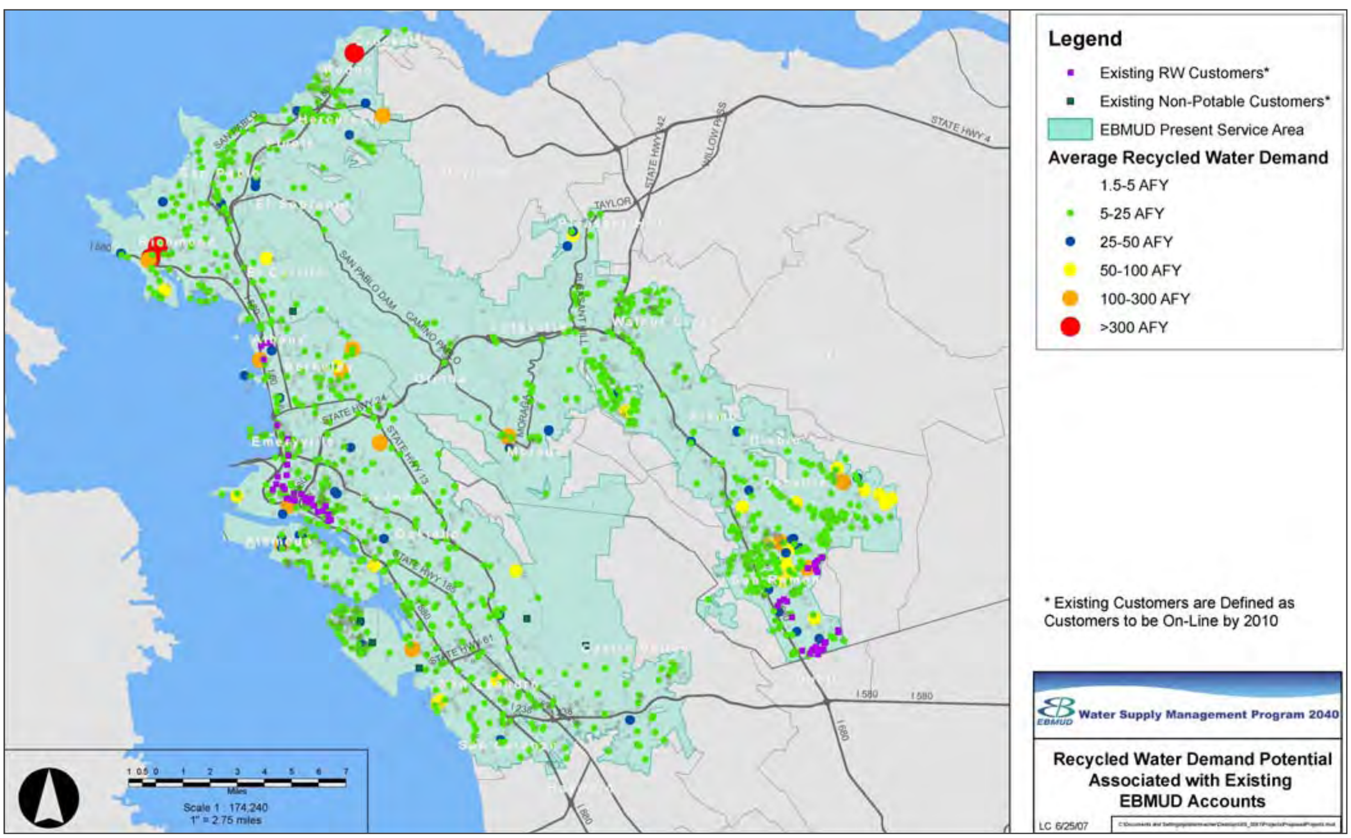


Figure 6-2 *Recycled Water Demand Potential Associated with Existing District Accounts*

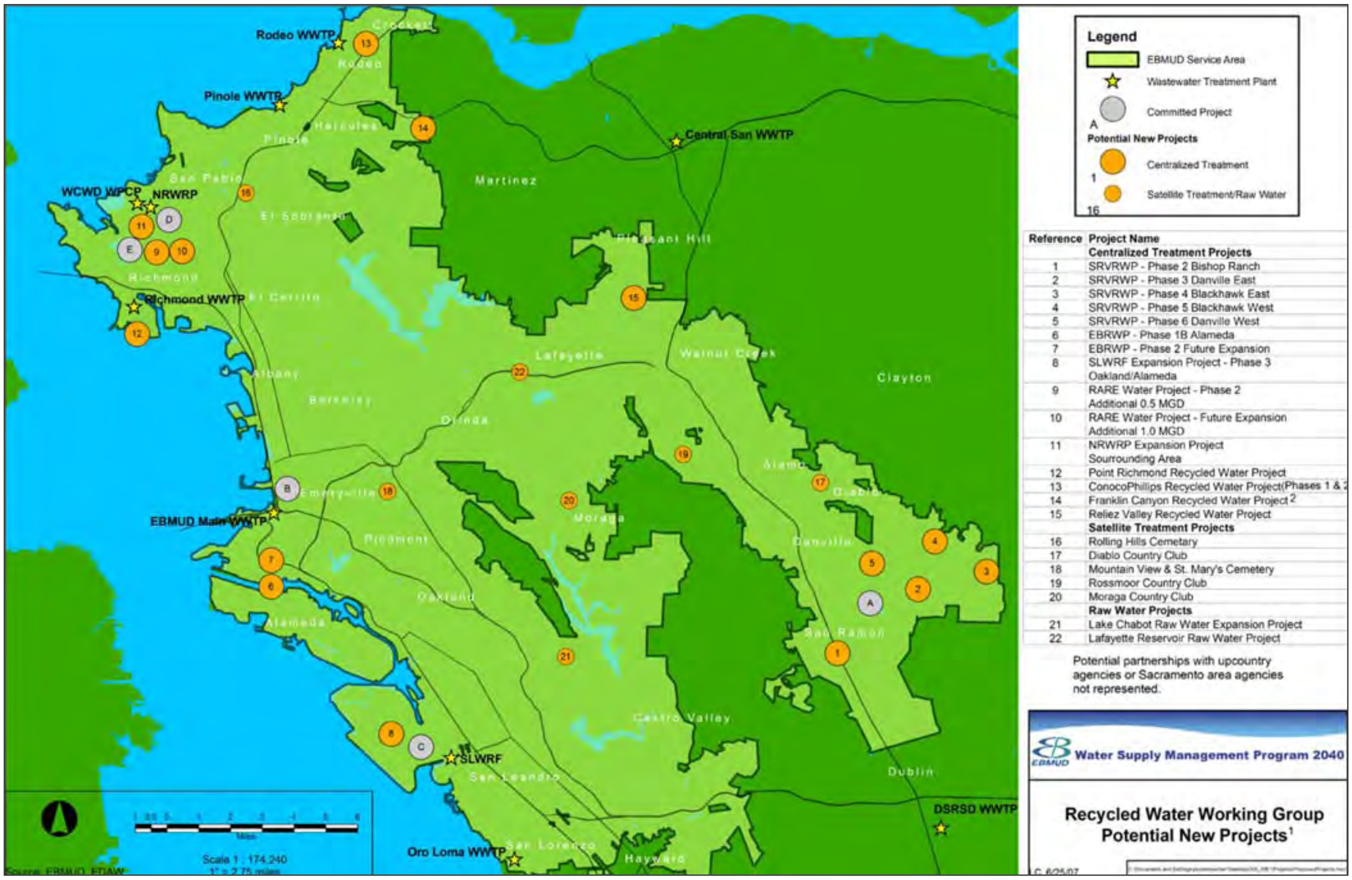


Figure 6-3 *Potential Recycled Water Projects*

[1] Combinations of these illustrated projects could be made to achieve the WSMP 2040 recycled water goal.
[2] Either Franklin Canyon or ConocoPhillips Recycled Water Projects would be chosen, as they use the same water source.

expansions of committed projects or newly developed independent projects. Satellite treatment projects provide recycled water to users located a long distance from or at significantly higher elevations than existing recycled water supply sources or distribution systems.[1] Raw water projects included in the evaluation were the Lake Chabot Raw Water Expansion Project and the Lafayette Reservoir Raw Water Project.

Projects within the Mokelumne River and Sacramento areas focused on potential recycled water partnerships with agencies in the Mokelumne River region (also called Upcountry) and the greater Sacramento Area with whom the District has existing relationships. These projects were typically in-lieu projects where the District would help to finance recycled water development in exchange for a share of the water savings. Most Upcountry recycled water projects were not further pursued for the WSMP 2040 because of potential supply limitations, long implementation time-lines and necessary agreements with multiple agencies. However, a partnership with the Sacramento County SRCSD and SCWA is being pursued further as part of the Sacramento Basin Groundwater Banking / Exchange supplemental supply component. The potential future recycled water projects that were included in the portfolio development are listed in Figure 6-3 and Table 6-4.

Additional information on existing recycled water project activities can be found in Section 3.4.3. Appendix D TM-4 also contains information on existing and potential future projects.

[1] Due to limited cost-effectiveness of constructing small satellite treatment systems, only users with average annual demand greater than 100 acre-ft/yr were considered for satellite treatment opportunities.

Table 6-4: Recycled Water Projects

Project Type	Project Location[1]	Project No.	Project Name or Program Title	Potential Demand (Annual, MGD or acre-ft/year)[2] Range or Max
Centralized Treatment	San Ramon Valley	1	San Ramon Valley Recycled Water Program - Phase 2 Bishop Ranch	0.7 MGD (800 acre-ft/yr)
Centralized Treatment	San Ramon Valley	2	San Ramon Valley Recycled Water Program - Phase 3 Danville East	0.7 MGD (800 acre-ft/yr)
Centralized Treatment	San Ramon Valley	3	San Ramon Valley Recycled Water Program - Phase 4 Blackhawk East	0.3 MGD (300 acre-ft/yr)
Centralized Treatment	San Ramon Valley	4	San Ramon Valley Recycled Water Project - Phase 5 Blackhawk West	0.2 - 0.3 MGD (200-350 acre-ft/yr)
Centralized Treatment	San Ramon Valley	5	San Ramon Valley Recycled Water Program - Phase 6 Danville West	0.1 - 0.2 MGD (150-250 acre-ft/yr)
Centralized Treatment	East Bayshore	6	East Bayshore Recycled Water Project - Phase 1B Alameda	0.5 - 1.7 MGD (550 - 1,950 acre-ft/yr)
Centralized Treatment	East Bayshore	7	East Bayshore Recycled Water Project - Phase 2 Future Expansion	0.1 - 0.5 MGD (100 - 550 acre-ft/yr)
Centralized Treatment	San Leandro	8	San Leandro Water Reclamation Facility Expansion Project - Phase 3 Oakland/Alameda	0.1 - 1.3 MGD (100 - 1,450 acre-ft/yr)
Centralized Treatment	Richmond	9	Richmond Advanced Recycled Expansion (RARE) Water Project - Phase 2 Additional 0.5 MGD	0.5 MGD (550 acre-ft/yr)
Centralized Treatment	Richmond	10	Richmond Advanced Recycled Expansion (RARE) Water Project - Future Expansion - Additional 1.0 MGD	1.0 MGD (1,100 acre-ft/yr)
Centralized Treatment	Richmond	11	North Richmond Water Reclamation Plant Expansion Project - Surrounding Area	0.2 - 1.7 MGD (150 - 1,900 acre-ft/yr)
Centralized Treatment	Richmond	12	Point Richmond Recycled Water Project	0.07 - 0.1 MGD (80-120 acre-ft/yr)
Centralized Treatment	Pinole/Rodeo/ Hercules	13[3]	ConocoPhillips Recycled Water Project Phases 1 and 2	4.0 MGD (4,500 acre-ft/yr)
Centralized Treatment	Pinole/Rodeo/ Hercules	14	Franklin Canyon Recycled Water Project	0.2 - 0.3 MGD (200- 300 acre-ft/yr)
Centralized Treatment	Reliez Valley	15	Reliez Valley Recycled Water Project (Portion of former Lamorinda Project)	0.1 - 0.2 MGD (100 - 250 acre-ft/yr)
Satellite Treatment	San Pablo/ Richmond	16	Rolling Hills Cemetery	0.05 - 0.18 MGD (50 - 200 acre-ft/yr)
Satellite Treatment	Diablo Valley	17	Diablo Country Club	0.18 MGD (200 acre-ft/yr)
Satellite Treatment	Oakland	18	Mountain View & St. Mary's Cemetery	0.1 - 0.19 MGD (100 - 200 acre-ft/yr)
Satellite Treatment	Rossmoor Valley	19	Rossmoor Country Club	0.1 - 0.15 MGD (100 - 150 acre-ft/yr)
Satellite Treatment	Moraga	20	Moraga Country Club	0.1 - 0.2 MGD (100 - 200 acre-ft/yr)
Raw Water	San Leandro/ Oakland	21	Lake Chabot Raw Water Expansion Project	0.1 - 0.2 MGD (100 - 250 acre-ft/yr)
Raw Water	Lafayette	22	Lafayette Reservoir Raw Water Project	0.01 - 0.05 MGD (10 - 50 acre-ft/yr)

[1] For additional information on project location, refer to Figure 6-3 and Appendix D TM-4.
[2] Demand rounded to nearest 0.1 MGD or 50 acre-ft/yr.
[3] The ConocoPhillips Recycled Water Project Phases 1 and 2 were subsequently separated into two separately numbered projects.

Recycled Water Levels

The recycled water production levels include:

- Level 1: No additional future recycled water production (0 MGD);
- Level 2: 5 MGD of additional recycled water production; and
- Level 3: 11 MGD of additional recycled water production.

All three recycled water levels were included in the initial portfolio building.

6.1.4 Supplemental Supply

To meet the Need for Water and ensure reliability during a drought year, supplemental water supply is needed. Rationing, conservation, and recycled water alone or combined would not generate sufficient water to meet water needs through 2040 during a reasonable, worst-case drought event. Supplemental supply includes such options as expansion of existing reservoirs, construction of new reservoirs, participation in the development of a regional desalination plant, groundwater banking/exchange projects, and water transfers. Each supplemental supply component would provide different amounts of water, and would be combined with one another and with various levels of rationing, conservation, and recycled water to meet water needs throughout the planning period.

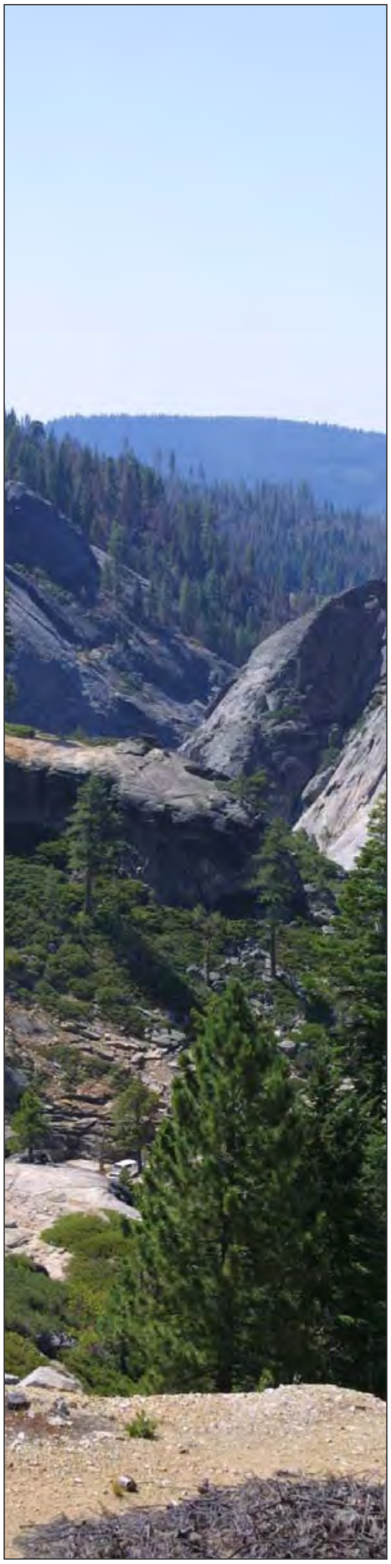
The WSMP 2040 explored many potential collaborative supplemental supply components that would require the District to partner with one or more local or upcountry water agencies.

Identifying Potential Future Supplemental Supply Components

Potential supplemental supply components were identified based on EBMUD's existing facilities and planning efforts already underway by EBMUD. Sources of information included, but were not limited to, the following planning documents:

- November 1992 EBMUD Updated WSMP EIS/EIR;
- June 1998 Pardee Enlargement Preliminary Design Report;
- July 2003 Draft Freeport Regional Water Project EIR/EIS;
- November 2006 Mokelumne/Amador/Calaveras Integrated Regional Water Management Plan;
- October 2007 Draft Project Description for the Lower Bear River Reservoir Expansion Project;
- December 2007 Draft - Mokelumne River Inter-Regional Conjunctive Use Project (IRCUP) Technical Memorandum: IRCUP Work Plan;
- February 2009 Draft Los Vaqueros Reservoir Expansion Project EIS/EIR; and
- March 2010 Final Los Vaqueros Reservoir Expansion Project EIS/EIR.

The full list of initial supplemental supply components considered for the WSMP 2040 are shown in Figure 6-4. Many of these components have been examined by EBMUD during the past 20 years. During the first stage of evaluation, if a component failed one of the exclusion criteria (as described in Chapter 2 and Section 6.2), the component was eliminated from further consideration. During the second stage of evaluation, the evaluation criteria were used to conduct a more detailed evaluation of the components (see Section 6.2).



Upper Mokelumne River Watershed below Lower Bear Reservoir

Supplemental Supply Components Eliminated in the First Stage

Several supplemental supply components were eliminated in the first stage of consideration because they did not satisfy one of the exclusion criteria. This includes several of the statewide components (Sites Reservoir, Temperance Flat Reservoir, and Expanded Los Vaqueros Reservoir), as it was not clear whether they would meet projected water demands through 2040. These components are currently at early stages of discussion and development and thus, detailed information on the water supply benefit to EBMUD is not currently known, cost sharing has not yet been identified and federal partners have not yet been identified. As such, all of the statewide components were held from further consideration in the WSMP 2040 planning process. The District will continue to track these projects for future consideration.

In the time period since the component screening process was undertaken for this WSMP, plans to expand Los Vaqueros Reservoir to 160 TAF have moved forward and Contra Costa Water District has completed environmental documents for this project. Technological uncertainties continue to warrant exclusion of the remaining statewide components, but EBMUD has added the 160 TAF Expand Los Vaqueros Reservoir (Current Expansion) component to the WSMP 2040 Portfolio as a possible supplemental supply project option that could be implemented in the future to meet EBMUD's dry year water needs.

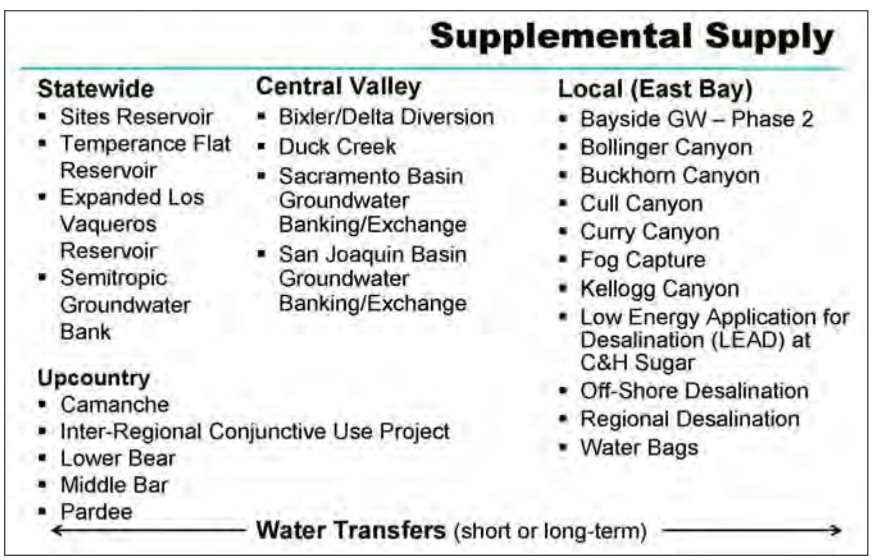


Figure 6-4 *Initial List of Supplemental Supply Components*

An additional four components were eliminated from consideration due to technical infeasibility: fog capture, Kellogg Reservoir, off-shore Desalination, and water bags. The technology for several of these components is still being developed and thus the projected water yield was unknown.

Components Eliminated in the Second Stage

The remaining components were scored using the evaluation criteria (see Chapter 2, Table 2-2). Any component that received two or more low scores on select "fatal flaw" criteria was eliminated. These criteria included:

- Provide water supply reliability [Minimize the institutional & legal complexities and barriers]
- Minimize adverse socio-cultural impacts;
- Minimize risks to public health & safety
- Preserve and protect biological resources.

The following components all scored low on more than two of the selected "fatal flaw criteria": Semitropic Groundwater Bank, the Bixler/Delta Diversion, Duck Creek Reservoir, Bollinger Canyon, Cull Canyon, Curry Canyon, Enlarging Camanche Reservoir, and creating a Middle Bar Reservoir. These components scored low due to concerns about associated institution and legal complexities in relation to water rights and Delta diversions as well as environmental and socio-cultural impacts. For additional description of these components as well as additional detail on the screening process, see Appendix B. Table 6-5 provides a summary of the components brought forward into the portfolio development.

Water Transfers

At its most basic level, a water transfer can be viewed as a change in the way that a given quantity of water is allocated. Water transfers have been used by local, state and federal agencies in California for many years as a means to balance supply and demand. As a consequence, the mechanics of water transfers

Table 6-5: Summary of Supplemental Supply Components Brought Forward into Portfolio Development

Component Type	***Component Names***
Water Transfers	Northern California Water Transfers
Groundwater Banking / Exchange	Bayside Groundwater Project Phase 2 San Joaquin Basin Groundwater Banking / Exchange Sacramento Basin Groundwater Banking / Exchange
Surface Water Reservoirs	Enlarge Pardee Reservoir[1] Enlarge Lower Bear Reservoir Buckhorn Canyon Reservoir Expand Los Vaqueros Reservoir[1]
Desalination	Regional Desalination LEAD at C&H Sugar

[1] On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component and added the 160 TAF Expand Los Vaqueros Reservoir component to the WSMP 2040 Portfolio.

How Water Transfers Work

The primary mechanisms for accomplishing a water transfer are:

- Reduction in use of surface water through actions such as crop-idling or water conservation. The water yielded from these surface water "saving" activities bypasses the specific land application and is conveyed for subsequent delivery and treatment to the entity on the receiving end of the transfer;
- Storage of excess diverted surface water (via groundwater banking) for later use by the entity on the receiving end of the transfer; and
- In-lieu use or exchange in which the "giving" end opts to use groundwater instead of a quantity of surface water and the "receiving" end gets the "saved" portion of surface water that was not used by the transfer party.

The Sacramento River between housing development and agricultural fields

are supported by legislative policy, in order to best ensure that water use can be sustained (i.e., regional shortfalls avoided) and that transfers can be performed in an environmentally sound yet economical manner.

Water transfers may be temporary, in which case the duration of the transfer usually lasts for one year or less. Long-term transfers are more reliable than short-term transfers, but almost always entail a much more complex agreement structure between participants and also typically require that transfer parties undertake a more extensive environmental review process. In addition to short-term and long-term transfers, there are permanent water right acquisitions.

Acquisition of a permanent water right offers the most reliability, but also has complex contractual and environmental burdens, and may involve extensive regulatory proceedings.

It was assumed for the WSMP 2040 PEIR that conveyance (by EBMUD) of transferred water would be accomplished through the completed FRWP. It was further assumed that EBMUD would seek water transfers with partners in the Sacramento Valley, or with partners who have supplies that originate north of the Delta. It should be noted that the water transfer partners have not been identified, so the sources of water are not known.

Bayside Groundwater Project Phase 2

Phase 1 of the Bayside Groundwater Project (described in Section 3.2.3) became operational in 2010. Phase 1 involves the use of an existing well in the deep portion of the South East Bay Plain Basin (SEBPB) with an annual capacity of 1 MGD and the construction of associated conveyance and treatment facilities.

The Bayside Groundwater Project Phase 2 would build upon successful operation of the Bayside Groundwater Project Phase 1 by expanding its extraction and storage capacity by as much as an additional 9 MGD. In the Phase 1 project's certified EIR (November 2005), EBMUD sought to assure the local community and other East Bay water interests that the District would proceed with a Phase 2 initiative after gathering operating data on water quality and groundwater level effects that demonstrate that a larger capacity groundwater project could be safely developed in the basin. EBMUD remains committed to that obligation.

In the certified EIR, EBMUD also stated that a project configuration for Phase 2 of the Bayside Groundwater Project was not known at the time. There is still no definitive Phase 2 project configuration (see Figure 6-5). For the WSMP 2040, EBMUD has made a number of assumptions based on what are seen as probable project elements and/or likely components of a 10 MGD combined Phase 1/Phase 2 Groundwater Project.

Operation

Bayside Groundwater Project Phase 2 facilities would be designed to inject treated water into the aquifer during years when water is available, and to recover stored groundwater during a drought. The extracted water would be treated prior to distribution to customers.

Bayside Groundwater Project Phase 2
Potential Facilities
• The existing Phase 1 injection/extraction well (see Figure 6-5) would be replaced with a new well and a second well of equal size would be added.
• Two new sites within the SEBPB, with two wells at each site, and a new treatment plant.
• Expanded network of monitoring wells; and
• Inlet/outlet pipelines to connect the two new Phase 2 sites to the existing distribution system for injection water and transmission of recovered groundwater.

Figure 6-5 *Bayside Groundwater Project Phase 2*

Sacramento Basin Groundwater Banking / Exchange

This component would develop in-lieu or artificial groundwater recharge and recovery in cooperation / partnership with Sacramento area interests such as Sacramento County Water Agency (SCWA) and/or the Sacramento County Groundwater Authority. EBMUD would support development of facilities to recharge the Sacramento groundwater basin, and would receive either groundwater extracted from the basin or surface water in exchange for a portion of the water stored, as a dry-year supply (Figure 6-6).

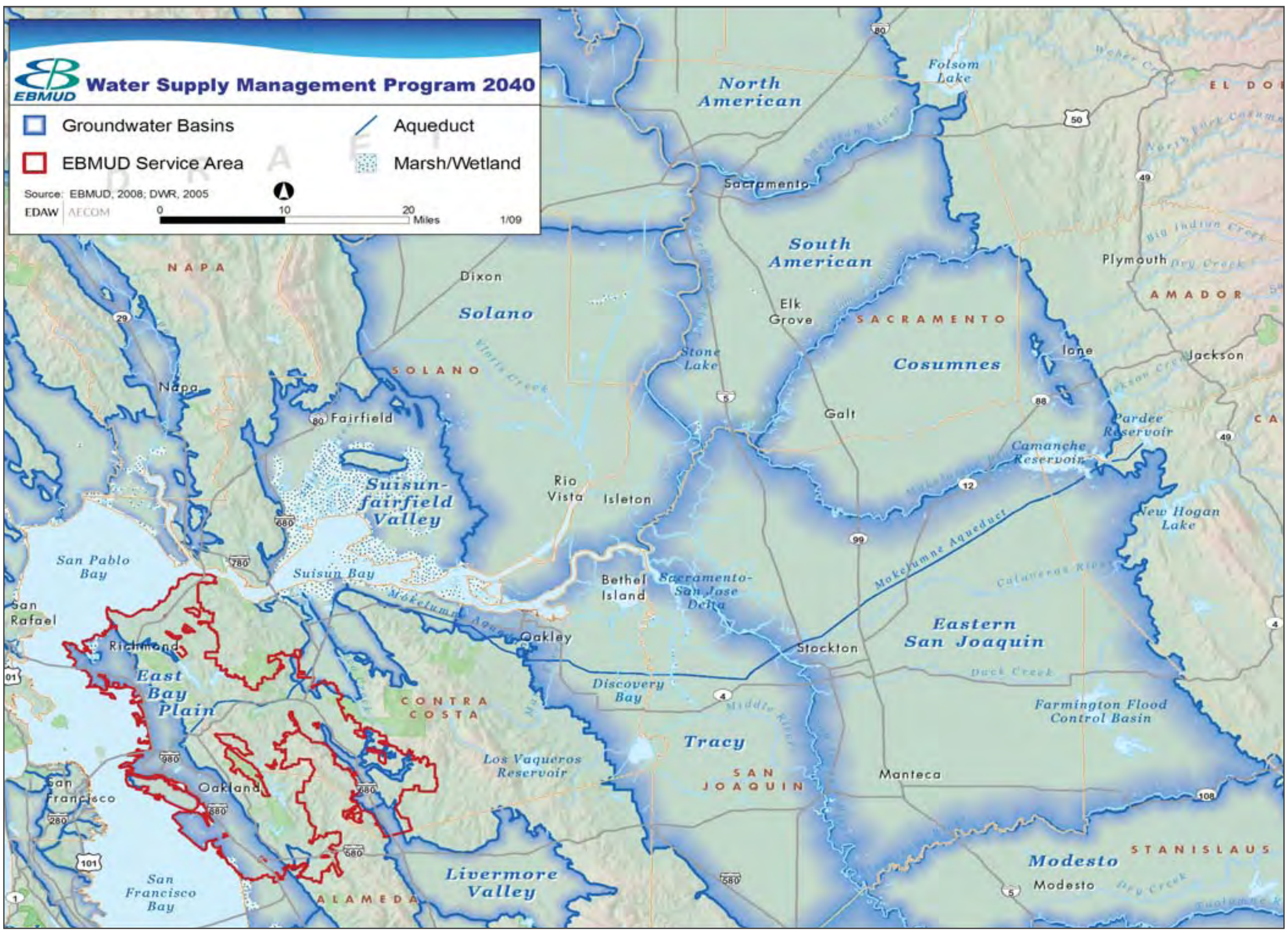


Figure 6-6 *Groundwater Basins*

Three options are considered in the WSMP 2040:

- Option 1 Operate a groundwater storage and recovery program in Sacramento County's Central (groundwater) Basin. Transfer water purchased by EBMUD (via an undefined transfer agreement) would be diverted from the Sacramento River and transported to the recharge facilities using FRWP conveyance facilities, for storage in the groundwater basin via recharge ponds, or in-lieu recharge via exchange with area water users. During dry years (which are predicted to take place approximately 3 out of 10 years), a portion of the water stored would be extracted from the Basin for EBMUD's use, conveyed via FRWP facilities, or provided in-lieu (surface water as sourced via an exchange for the groundwater banked).
- Option 2 Water district members of the Sacramento County Groundwater Authority would provide in-lieu surface water supplies. In wet years, additional surface water available under SCWA water rights would be provided to these districts. In dry years, these districts would forgo some or all of their typical diversions from the Lower American River and would rely more heavily on groundwater. Thus, they would allow their surface entitlements to flow downstream to SCWA's point of diversion at the FRWP. EBMUD would be provided a portion of the surface water entitlement via diversion at FRWP.
- Option 3 EBMUD would support Sacramento Regional County Sanitation District development of recycled water production in the Central Basin. This recycled water would be provided to local agricultural irrigators currently using groundwater as their source of water. Unused groundwater would be banked for dry-year use by both Sacramento water interests and EBMUD.

Operation

It was assumed that the yield of the Sacramento Basin Groundwater Banking / Exchange Project would be 4.2 MGD. Actual operational details, including specific yield for a project sited in this basin, would be determined at the project planning and development stage. EBMUD intends to operate the facilities such that it would provide a dry-year supply. Other potential partners would have their own specific operational objectives.

Sacramento Basin GW Banking / Exchange

Potential Facilities

The maximum facilities required were based on Option 1:

- 39 acres of recharge ponds;
- Three extraction wells, including one backup well, each capable of pumping 2,000 gallons per minute for 24 hours per day for a period of 12 months;
- Five miles of pipeline from the FRWP pipeline to the well field / recharge area;
- Intertie at the FRWP pipeline;
- Pump station for the new pipeline;
- Granular activated carbon (GAC) treatment system either at the well field or at the intertie with the FRWP pipeline; and
- A pre-treatment plant may also be needed.

Mokelumne River Forum

EBMUD, along with twelve other public agencies interested in Mokelumne River water resources, signed a Memorandum of Understanding with the California Department of Water Resources in June 2005 to work cooperatively to improve regional water supplies. The other signatories to the Mokelumne River Forum are Alpine County, Amador Water Agency, Amador County, Calaveras County Water District, Calaveras Public Utility District, City of Lodi, City of Stockton, Jackson Valley Irrigation District, North San Joaquin Water Conservation District, San Joaquin County Flood Control & Water Conservation District, Stockton East Water District, and Woodbridge Irrigation District.

San Joaquin Basin Groundwater Banking / Exchange

In late 2006, Mokelumne River Forum (Forum) members began reviewing an option to develop an Inter-Regional Conjunctive Use Project (IRCUP). The project as conceptualized utilizes the foothill counties' (Amador and Calaveras) Mokelumne River water rights as a source, EBMUD's Mokelumne River facilities as a conveyance mechanism, and San Joaquin County's groundwater basin for storage. At the time that the WSMP 2040 was completed, Forum members were working to move the concept forward so that studies (e.g., feasibility studies, water rights agreements, etc.) could be developed, resulting in a more definitive project configuration.

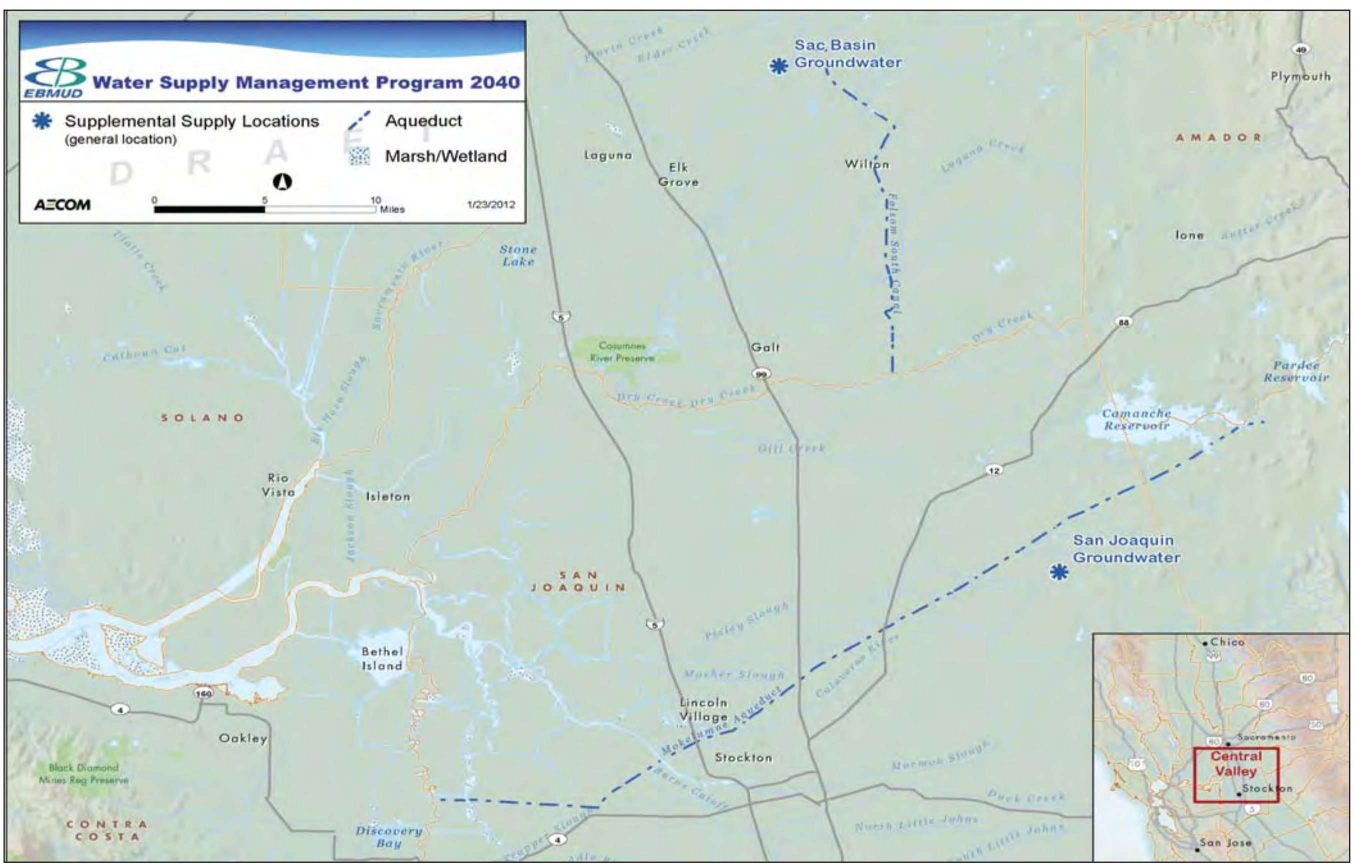


Figure 6-7 *Central Valley Supplemental Supply Components*

Surface Water Supply

One or more partners would either obtain a new water right, or modify an existing water right, to enable surface water to be diverted from the Mokelumne River and banked in the Eastern San Joaquin Groundwater Basin for later use by one or more of the parties.

Operation

Groundwater Recharge and Storage

Under one scenario, a portion of the Mokelumne River supply would be conveyed through the facilities for storage and regional use in the Eastern San Joaquin Groundwater Basin. Various in-lieu and direct recharge projects could be used to recharge water in wet years for use in dry years. For conceptual project sizing purposes, it is assumed that groundwater recharge would occur via recharge basin(s) with a total surface area of 137 acres.

Groundwater Extraction

Water stored in the Eastern San Joaquin Groundwater Basin would be extracted for use in dry years via up to 15 extraction wells. Extracted water would be divided for use in the Eastern San Joaquin Groundwater Basin, by foothill agencies in Amador and Calaveras Counties (most likely through in-lieu exchanges), and within the EBMUD service area, via EBMUD's Mokelumne Aqueduct.

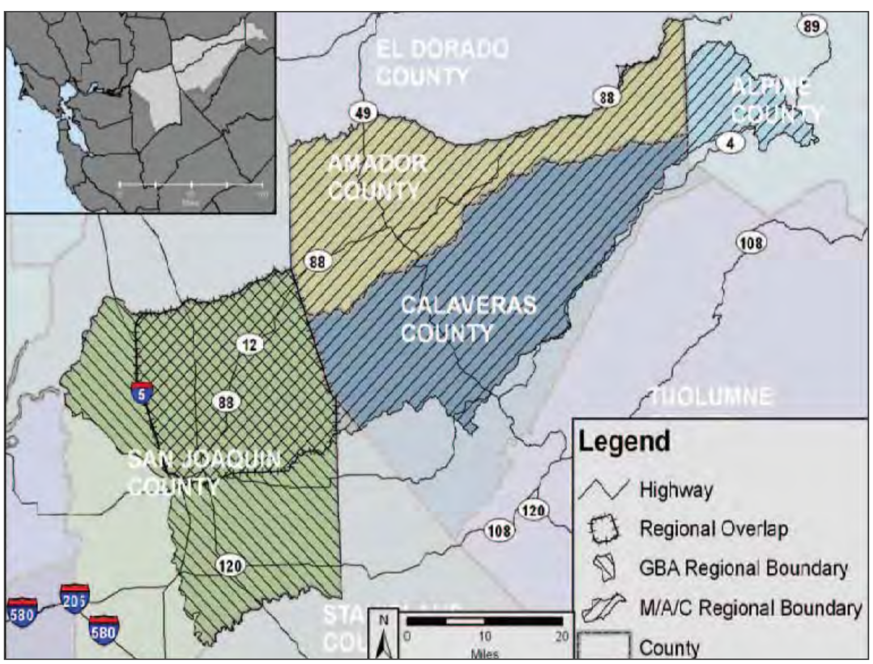


Figure 6-8 *San Joaquin Basin Groundwater Banking / Exchange Location Map*

San Joaquin Basin GW Banking / Exchange

Potential Facilities

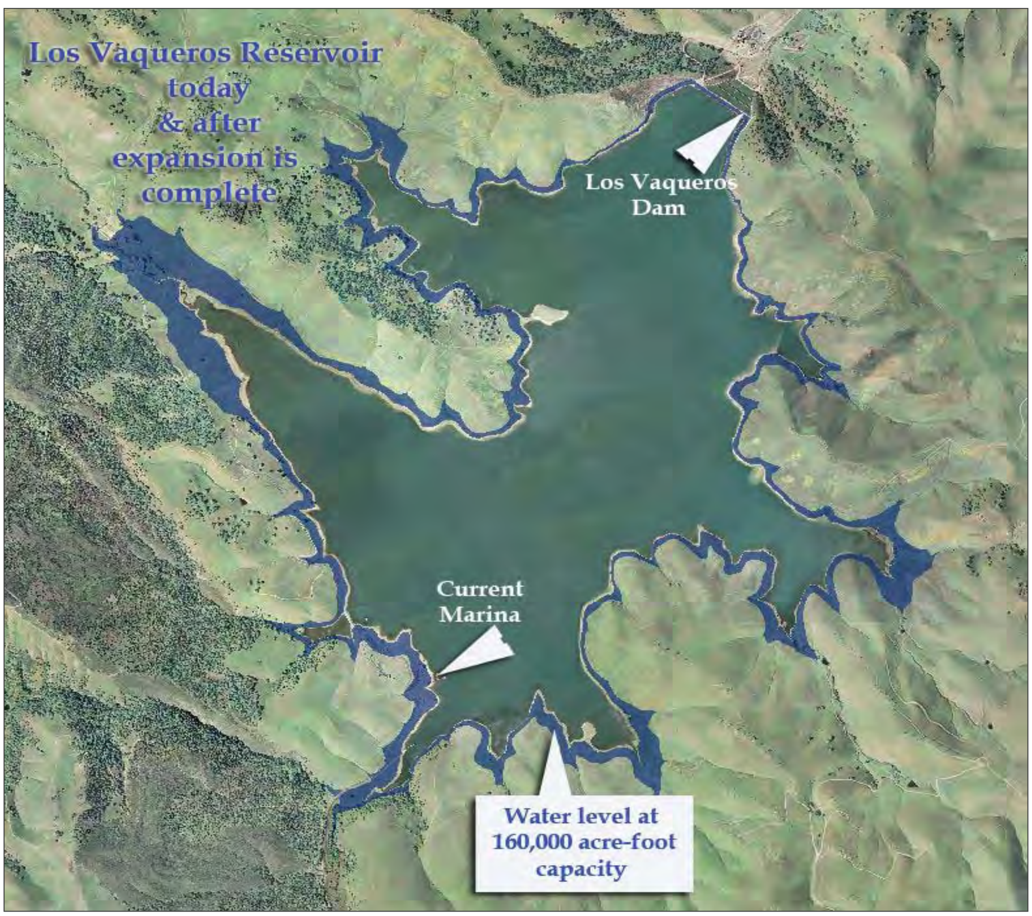
Under an envisioned use of new or existing facilities, and through agreements to be established among the parties, existing EBMUD facilities or other facilities would be used to convey Mokelumne River surface water to proposed San Joaquin County groundwater banking facilities.

While the project partners could initially rely on EBMUD's existing facilities to exchange the banked water to Amador and Calaveras counties, the following new facilities are assumed to be required for the project:

- A new Intertie with EBMUD's Mokelumne Aqueduct;
- A new pump station and pipeline from EBMUD's Mokelumne Aqueducts to the new well fields and/or recharge ponds; and
- Upcountry pre-treatment to treat recovered groundwater for blending with Mokelumne raw water.

Expand Los Vaqueros Reservoir

The Expand Los Vaqueros Reservoir component involves expansion of the existing Los Vaqueros Reservoir, which is owned and operated by CCWD. CCWD is undertaking this expansion to improve water supply reliability under drought and emergency conditions, and to further improve water quality for its customers. CCWD has indicated that a portion of the storage capacity currently under construction as part of the expansion could be operated to provide dry year water supply to EBMUD, and that CCWD water treatment and conveyance facilities could be used to deliver water supply to EBMUD. EBMUD would consider multiple sources of water for delivery to CCWD in wetter years. Possible sources include CCWD's CVP water or EBMUD's Mokelumne River water. For detailed information regarding the Expand Los Vaqueros component, please refer to the following document: "Contra Costa Water District, 2009, Draft Los Vaqueros Reservoir Expansion Project EIS/EIR, February." Data as compiled by EBMUD staff and shared with the EBMUD Board of Directors regarding participation options is presented in several WSMP 2040 Board Workshop slides as presented at the September 27, 2011 Workshop and at



Source: *CCWD 2012*

Figure 6-9 *Expand Los Vaqueros Reservoir (Current Expansion)* the March 27, 2012 Workshop. Those slides are provided in Appendix E1 to this document.

Untreated supplies delivered from Los Vaqueros Reservoir to EBMUD will not have water quality equivalent to the water that EBMUD receives from its Mokelumne facilities and thus additional treatment would be necessary and additional treatment facilities would be required to take additional raw water from Los Vaqueros Reservoir.

A range of potential options for connection to the Los Vaqueros system is described below.

Current Expansion

Construction on the current expansion of Los Vaqueros Reservoir is expected to be completed by Spring 2012. The current expansion will raise the water surface level 35 feet for a maximum reservoir water surface elevation of 507 feet above mean sea level (msl) and will increase the capacity from 100 TAF to 160 TAF (see Figure 6-9). Three options are considered in the WSMP 2040 for the Current Expansion:

- Treated Water - Boyd Road Intertie Option: EBMUD would take water from CCWD that is treated using CCWD's facilities. The treated water would be received at the existing Boyd Road intertie in Walnut Creek and would then be pumped to the EBMUD distribution system for delivery within its service area in specific areas.
- Treated Water - New Intertie Option: This option would function the same as the Treated Water - Boyd Road Intertie Option described above; however, the treated water obtained from CCWD would be transferred through a new intertie that would be constructed in the vicinity of Geary Road and Buena Vista Road in Walnut Creek.
- Untreated Water Option: Under this option, EBMUD would receive untreated water from CCWD and send it through the Mokelumne

Expand Los Vaqueros Reservoir

<u>Current Expansion Potential Facilities</u>

Treated Water - Boyd Road Intertie Option:

- Approximately 11,000 linear feet of 24-inch-diameter pipeline along Pleasant Hill Road, Geary Road, and Larkey Lane (between Boyd Road and Alvarado Avenue);
- New instrumentation and control equipment; and
- A pump station with a capacity of approximately 12 million gallons per day near the intertie.

Treated Water - Boyd Road Intertie Option:

- Approximately 4,000 linear feet of 24-inch-diameter pipeline along Buena Vista Avenue (between Geary Road and Alvarado Avenue);
- Approximately 3,000 linear feet of 24-inch-diameter pipeline along Geary Road (between Buena Vista Road and North Main Street); and
- A permanent intertie pumping plant (with a pumping rate of approximately 12 million gallons per day) at the Walnut Creek raw water pumping plant with remote control and instrumentation.

Untreated Water Option:

- Replacement or retrofit of one or two existing 60-inch check valves; and
- Interconnection between Mokelumne Aqueduct Nos. 1 and 3 with two 54-inch isolation valves.
- Additional treatment could be required at one or more of EBMUD's existing water treatment plants depending upon aqueduct configuration and EBMUD's raw water system operation.

Aqueduct to an existing EBMUD raw water reservoir for treatment at an existing EBMUD water treatment facility or, depending on the results of project-specific water quality studies, it could possibly be sent directly to one of EBMUD's in-line treatment facilities which treat water directly from the aqueducts. The latter alternative would require that additional treatment processes be installed at the in-line plants. Following treatment, the water would be delivered to customers within the EBMUD service area.

Current Expansion Operation

EBMUD would store water with CCWD during non-drought years and would receive water during drought years.

Treated Water Options: During drought years, the current expansion and a treated water connection could create an additional 18 to 21 TAF of storage for supplemental supplies for EBMUD, and allow delivery of about 8 MGD of water supply in the second and third years of a drought, or at other times if needed.

Untreated Water Option: During drought years, the current expansion could meet EBMUD's anticipated need for an additional 29 TAF delivered at a rate of about 45 MGD during years 2 and 3 of a drought; however, it is also possible that water would be delivered in drought year 1 or during other non-drought situations. This operation requires the use of EBMUD's Walnut Creek Pumping Plant which pumps raw water in the Mokelumne Aqueducts.

Future Expansion

Similar to the Untreated Water Option for the current expansion, participation in the future expansion would involve the transfer of untreated water to EBMUD from Los Vaqueros; however, due to the water quantities and quality, it would also require the construction of new treatment facilities to be located either at one or more of EBMUD's existing in-line water treatment plants or in another location. As with the current expansion, EBMUD would consider multiple sources of water for delivery to CCWD in wetter years, including water obtained through transfers, EBMUD's CVP water or EBMUD's Mokelumne River water.

Future Expansion Operation

EBMUD would store water with CCWD during non-drought years and would receive water during drought years. In drought years, the future expansion could provide EBMUD with supplemental supplies to meet anticipated need of up to 100 TAF of storage delivered at a rate of 45 MGD, primarily during years 2 and 3 of a drought. It is possible that water would be delivered in drought year 1 or during other non-drought situations, but this cannot be determined at this stage. This operation would require the use of EBMUD's Walnut Creek Pumping Plant which pumps raw water in the Mokelumne Aqueducts.

Expand Los Vaqueros Reservoir

Future Expansion Potential Facilities

- New treatment facilities would need to be constructed at one or more of EBMUD's existing in-line water treatment plants or in another to-be-determined location. Treatment would include the following processes: coagulation/flocculation, sedimentation, and chemical feed;
- Replacement or retrofit of one or two existing 60-inch check valves; and
- A new interconnection between Mokelumne Aqueduct Nos. 1 and 3 would be installed with two 54-inch isolation valves.

Buckhorn Canyon Reservoir

This component would involve constructing an earth fill dam for a terminal reservoir at Buckhorn Canyon, north of Castro Valley, about one-eighth mile up the eastern arm of EBMUD's Upper San Leandro (USL) Reservoir (see Figure 6-10). The new reservoir, which would be located within lands currently owned by EBMUD, would provide a maximum capacity of 143,000 AF. The spillway crest of the dam would be at 745 feet above sea level.

Operation

The reservoir would be filled by water pumped through the Moraga Aqueduct when it is available. When in use, water would flow via gravity back to the Lafayette Aqueducts and be treated at the Sobrante Water Treatment Plant (WTP) or would flow via gravity to the USL WTP. The reservoir would be operated continuously (year-round) as base supply in all years. During dry years, the reservoir would provide 43 MGD in each dry year up to three dry years in a row, or sustain for a longer duration if less water is used in each dry year.

Buckhorn Canyon Reservoir

Facilities Required

In addition to the new dam:

- A 5,100 horsepower (hp) pumping plant that conveys water from the Moraga Aqueduct to the Buckhorn Canyon Reservoir;
- A 6,200-foot tunnel; and
- A 23,000-foot pipeline.

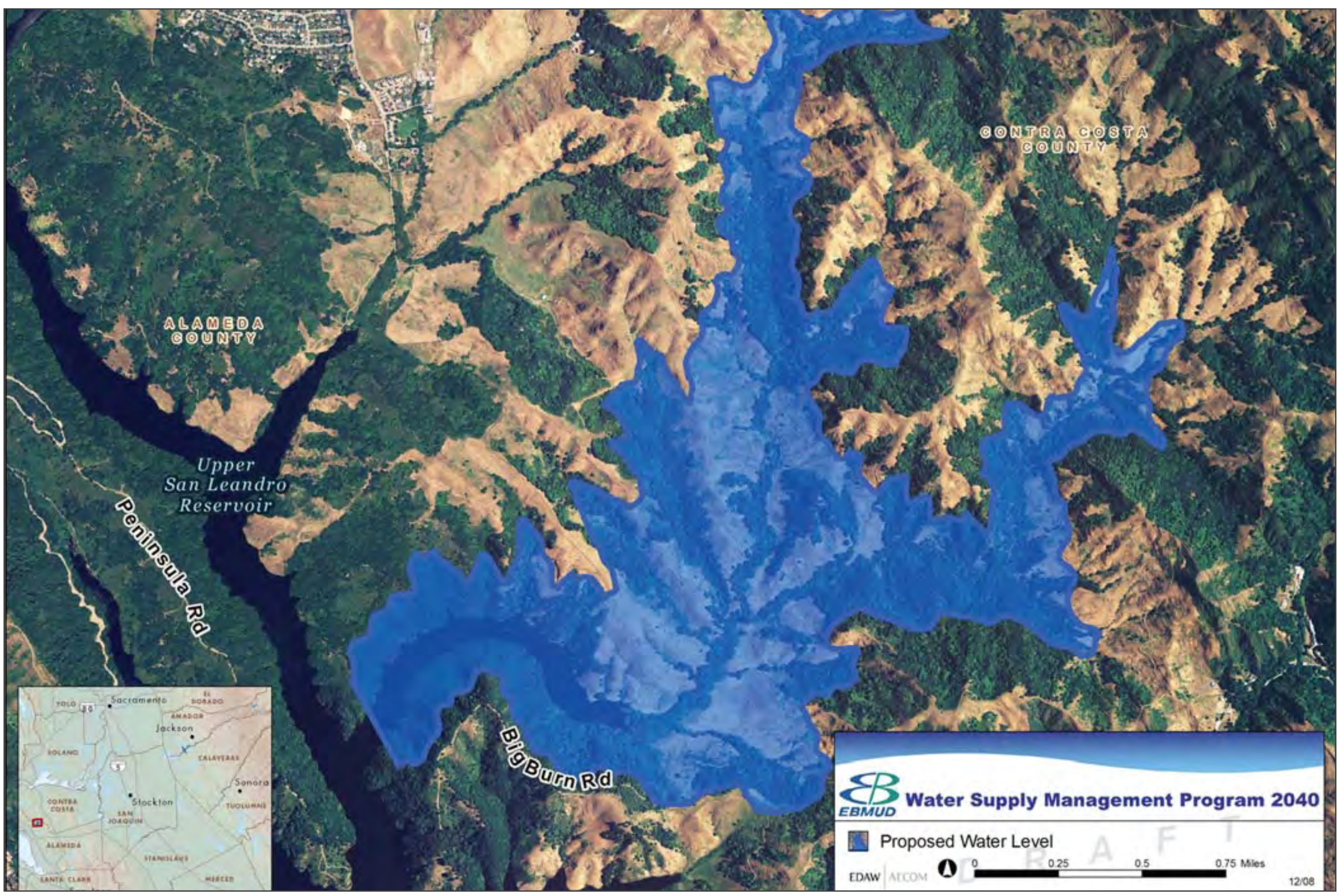


Figure 6-10 *Buckhorn Canyon Reservoir Component Location: Inundation Area*

Enlarge Pardee Reservoir

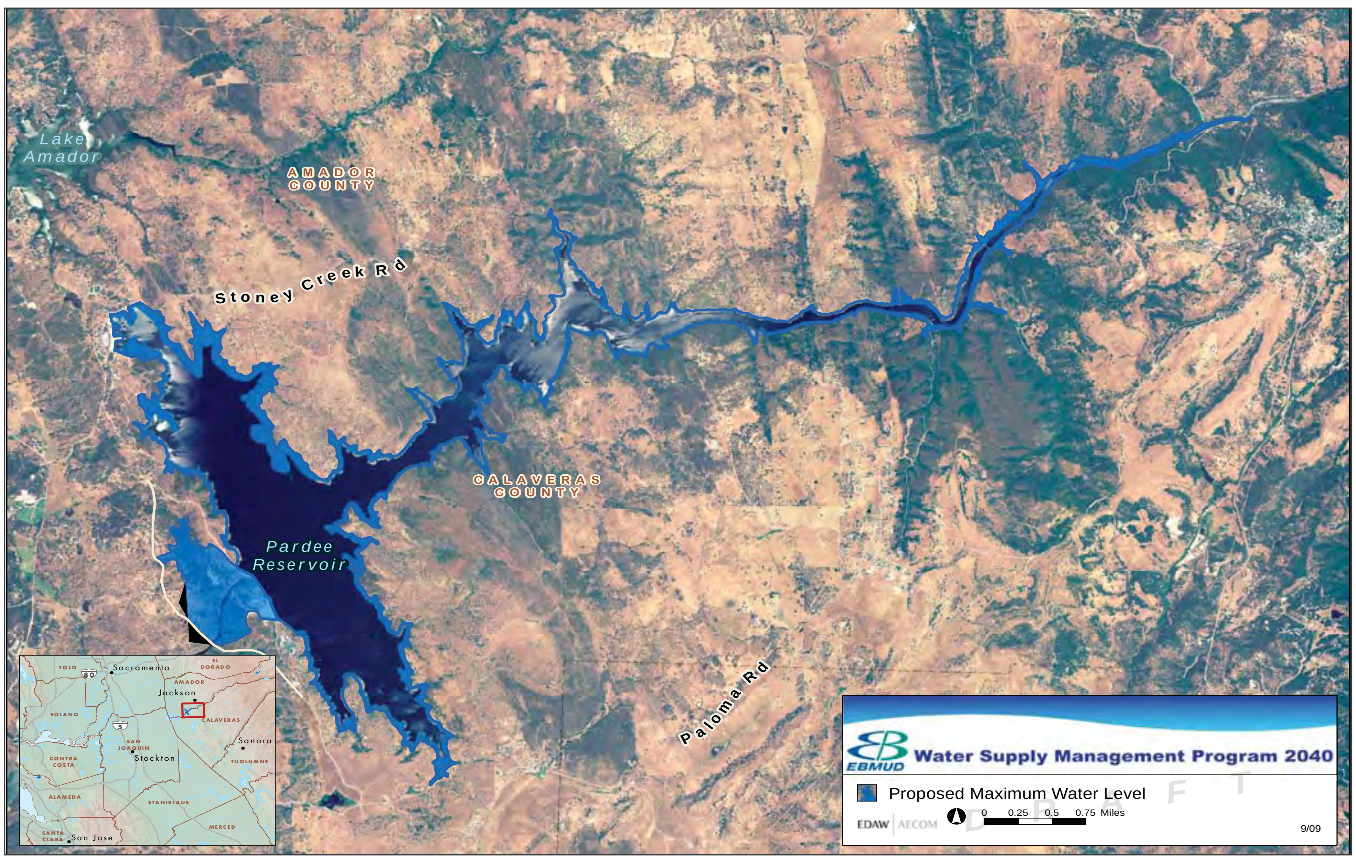
The existing Pardee Reservoir has a licensed capacity of 197,950 acre-feet (AF) behind a 345-foot-high concrete dam on the Mokelumne River based on an Engineering Feasibility Study prepared in the 1990s. Enlargement of the reservoir could potentially increase storage capacity by 126,000 AF.

The PEIR for the 2009 WSMP 2040 was challenged in court. On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.

Enlarge Lower Bear Reservoir

The existing Lower Bear Reservoir, owned by PG&E, is located approximately 35 miles northeast of Jackson. In conjunction with Upper Bear Reservoir, the two facilities provide water to water agencies and private users in five counties.

A possibility for enlarging Lower Bear Reservoir involves raising the dam by 32 feet to increase surface water storage capacity within the upper Mokelumne watershed. Figure 6-12 shows the increase in inundation area from enlargement of the reservoir. Previous studies by Amador Water Agency suggest that Lower Bear Reservoir would provide 18,300 AF of additional yield (Wil-



Notes:

[1] The extent of the existing pool and new inundation area on this image is approximate.

[2] On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.

Figure 6-11 *Enlarge Pardee Reservoir Component: Increase in Inundation Area* lard, 2005). For the purposes of the WSMP 2040, it is assumed that EBMUD, as a project partner, might receive approximately 4,500 AF during a wet or normal year and 2,500 AF during a dry year. When this WSMP 2040 was published, EBMUD had entered into a partnering agreement with Amador Water Agency, Calaveras County Water Agency, and San Joaquin County on a feasibility study to review the option of enlarging Lower Bear Reservoir. As part of that effort, more information will be developed regarding potential yield and the possible sharing of yield by project partners. The yield assumed for the WSMP 2040 effort may therefore differ from pending study estimates.

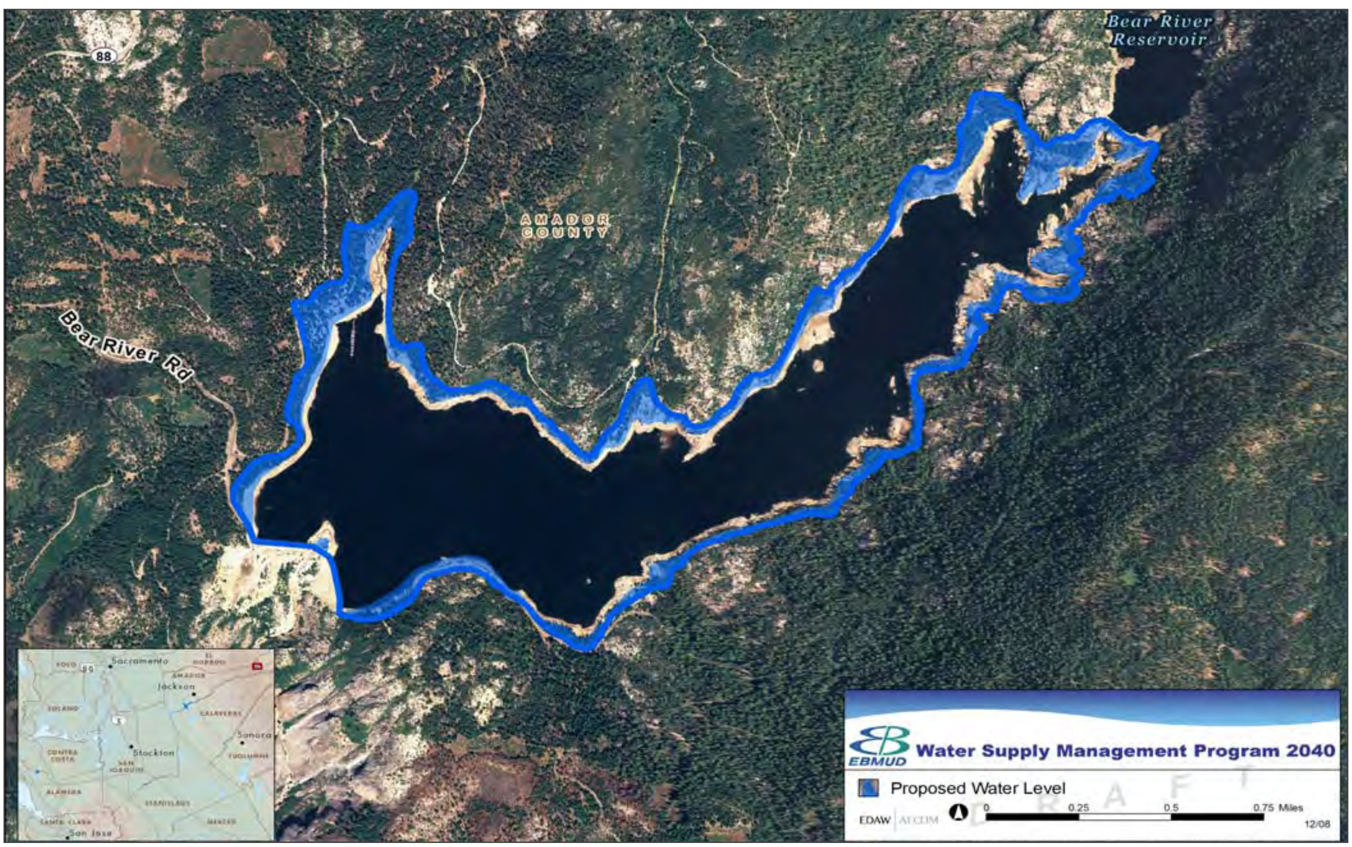
Enlarge Lower Bear Reservoir

Potential Facilities

In addition to the modified dam, other facilities to be refurbished or constructed include an upgraded intake structure and spillways, roads and relocation of existing recreation facilities.

Operation

The operation scheme for the enlarged reservoir has not yet been determined and would depend on the engineering design and the participants involved.



Note: *The extent of the existing pool and new inundation area on this image is approximate.*

Figure 6-12 *Enlarge Lower Bear Reservoir Component: Increase in Inundation Area*

Regional Desalination

EBMUD, in partnership with Contra Costa Water District (CCWD), the San Francisco Public Utilities Commission (SFPUC), and the Santa Clara Valley Water District (SCVWD), is exploring development of the Bay Area Regional Desalination Project, which could consist of one or more desalination facilities. Under the WSMP 2040 Portfolio presented in the 2009 WSMP 2040, the presumed capacity of the completed project is 71 MGD, of which EBMUD's share would be 20 MGD. In the revised WSMP 2040, it is assumed that EBMUD's share would be approximately 4 to 5 MGD.

Three desalination plant locations are being considered by the project partners: an Oceanside site in San Francisco, a Near Bay Bridge site in Oakland, and an East Contra Costa site in the west Delta in the vicinity of the south shore of Suisun Bay.

The Pittsburg site at CCWD's Mallard Slough Pump Station is currently hosting a pilot test of desalination technology to collect data on technical feasibility (pre-treatment options, membrane performance, design parameters) and to determine environmental impacts (brine disposal, marine life screening systems). The pilot study is scheduled to be completed in June 2009. This PEIR for the WSMP 2040 assumed the East Contra Costa site would be selected (see Figure 6-13).

The project location for a permanent regional desalination facility has not been selected. It could be one of the other two sites considered, or an entirely different location.

Alameda County Water District's Brackish Water Desalination Plant in Newark (dedicated in 2003)

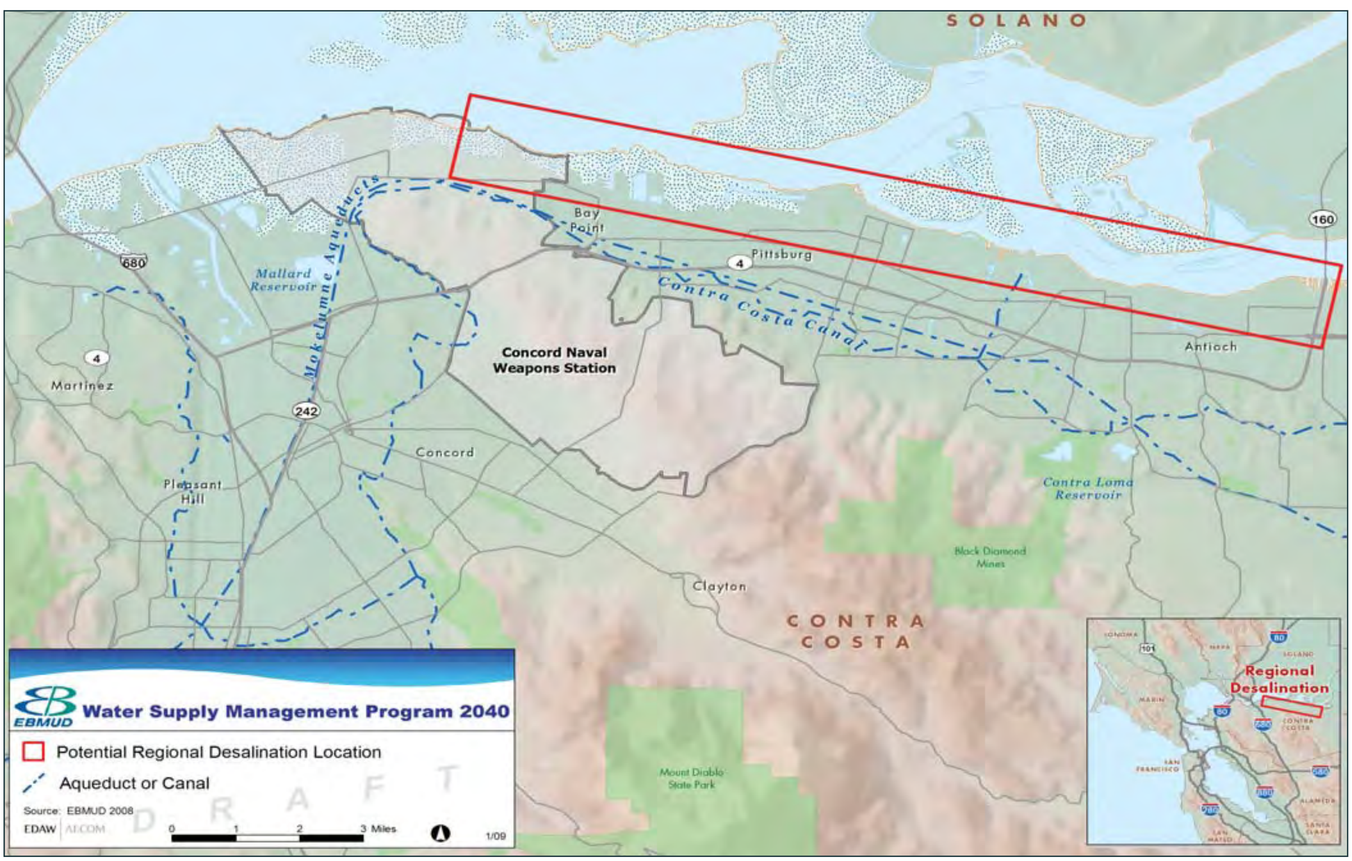


Figure 6-13 *Potential Regional Desalination Location*

Regional Desalination

Potential Facilities

- Desalination plant;
- Transmission and distribution pipelines;
- Water intake; and
- Outfall and brine disposal mechanism.

Operation

The desalination plant would be operated intermittently as a dry-year supplemental supply, subject to specific agreements between the partner agencies.

LEAD at C&H Sugar

The Low Energy Application of Desalination (LEAD) at C&H Sugar component would draw from a portion of the 23 MGD of Carquinez Strait water that C&H uses, following its use in plant operations, to produce up to 1.5 MGD of potable-quality water for use by C&H in place of potable water from the EBMUD water distribution System.

The LEAD component is unique in that it would use recovered steam to power the desalination facility. The steam energy would be recovered by replacing existing steam pressure-reducing equipment with a modern power generating unit.

Figure 6-14 *LEAD at C&H Sugar Component Location*


Saxon Holt

East Bay Conservation Garden

6.2 Screening Process

6.2.1 Screening Criteria

As described in Section 2.1 (Table 2-1), WSMP 2040 Planning Objectives, the WSMP 2040 planning objectives are organized into four objective categories:

- Operations, Engineering, Legal & Institutional;
- Economic;
- Public Health, Safety & Community; and
- Environmental.

Screening criteria for use in evaluating the individual components as well as the portfolios were developed as part of the WSMP 2040.

Exclusion and Evaluation Criteria

Exclusion criteria were used in the first round of screening to eliminate components that did not fulfill the basic objectives of the WSMP 2040. The exclusion criteria provide the "fatal flaw" analysis through a binary (yes or no) decision: either a component did or did not meet the criterion.

Any component that did not meet any one exclusion criteria, by definition, failed to meet the planning objectives and was eliminated from further study.

Evaluation criteria were used in the second stage of screening to provide a more detailed assessment of the remaining components. The evaluation criteria, rather than involving a binary decision, were used to compare and array the components for their relative satisfaction of a criterion. A high score indicated high response to the criteria and a low score indicated a low response to the criteria (or High = Good, Low = Bad).

Components were scored within but not across component classes (i.e., conservation, recycled water, and supplemental supply). For example, a "High" score for a supplemental supply component under the *minimize the system's operational flexibility* criteria is not the same as a "High" score for a recycled water component under the same criteria.

The same set of objectives and criteria were used to evaluate conservation level components, recycled water components, and supplemental supply components. The full list of criteria was viewed as a *menu of possible criteria* and individual criteria were only used if they were able to help distinguish between the components. Some criteria were used to evaluate all of the component categories, but others were only useful for some of the component category evaluation. For example, the criterion to *minimize disruptions in water service during construction* was used in the supplemental supply and recycled water component evaluation because these components would require construction and connection activities to the EBMUD water supply system that have the potential to disrupt water service. This criterion was not used, however, in evaluation of the conservation levels, as construction would not be required for any of the conservation level components and did not help in evaluating the difference between components.

Appendix B provides additional detail on the screening criteria as well as on the component and portfolio screening and evaluation process.

6.2.2 Rationing Level Screening

Rationing at 0%, 10%, 15% and 25% were considered in the initial portfolio development, and the 0% and 25% rationing levels were eliminated from further consideration. The 10%, 15% and 20% rationing levels were tested in several of the Primary Portfolios to determine the associated impact on EBMUD customers.

Under each rationing level, the amount of rationing for the different customer classes varies, (as shown in Table 6-6). The distribution of rationing across customer classes is based on the total demand of each customer class, the outdoor water use of each class, and the potential economic impact on the service area as a whole. The triggers to determine when rationing would be initiated would follow the existing DMP.

The average frequency of rationing event occurrence was determined by modeling the Primary Portfolios at several different rationing levels. At a 15% rationing goal, mandatory rationing occurs 30% more frequently than at a 10% rationing goal. At a 20% rationing goal, mandatory rationing occurs 80% more frequently than at a 10% rationing goal.

The level of variation (or risk) associated with the 3 rationing levels was also analyzed. At 20% rationing, although the median total

John Benson

Freeport Construction 2007

cost of a portfolio is only somewhat higher than at 10% and 15% rationing, the variability in the potential cost of the portfolio, or the risk, is larger. The dashed orange line in Figure 6-15 indicates that the range of variation in cost increases as a higher rationing level is chosen.

Table 6-6: Customer Class Percentage Cutbacks under 20%, 15% and 10% System-Wide Average Rationing

Customer Class	20% Rationing (%)	15% Rationing (%)	10% Rationing (%)
Single-Family	24	19	12
Multi-Family	15	11	7
Commercial	16	12	8
Institutional	13	9	6
Industrial	7	5	3
Irrigation	39	30	19

Preferred Level of Rationing

Up to 15% Rationing was favored for the Preferred Portfolio because it represents a reduction from the current 25% level and recognizes the challenges customers will have rationing in the future given the additional level of conservation for the WSMP 2040 Plan.

Fixing leaks will help conserve water and meet rationing goals

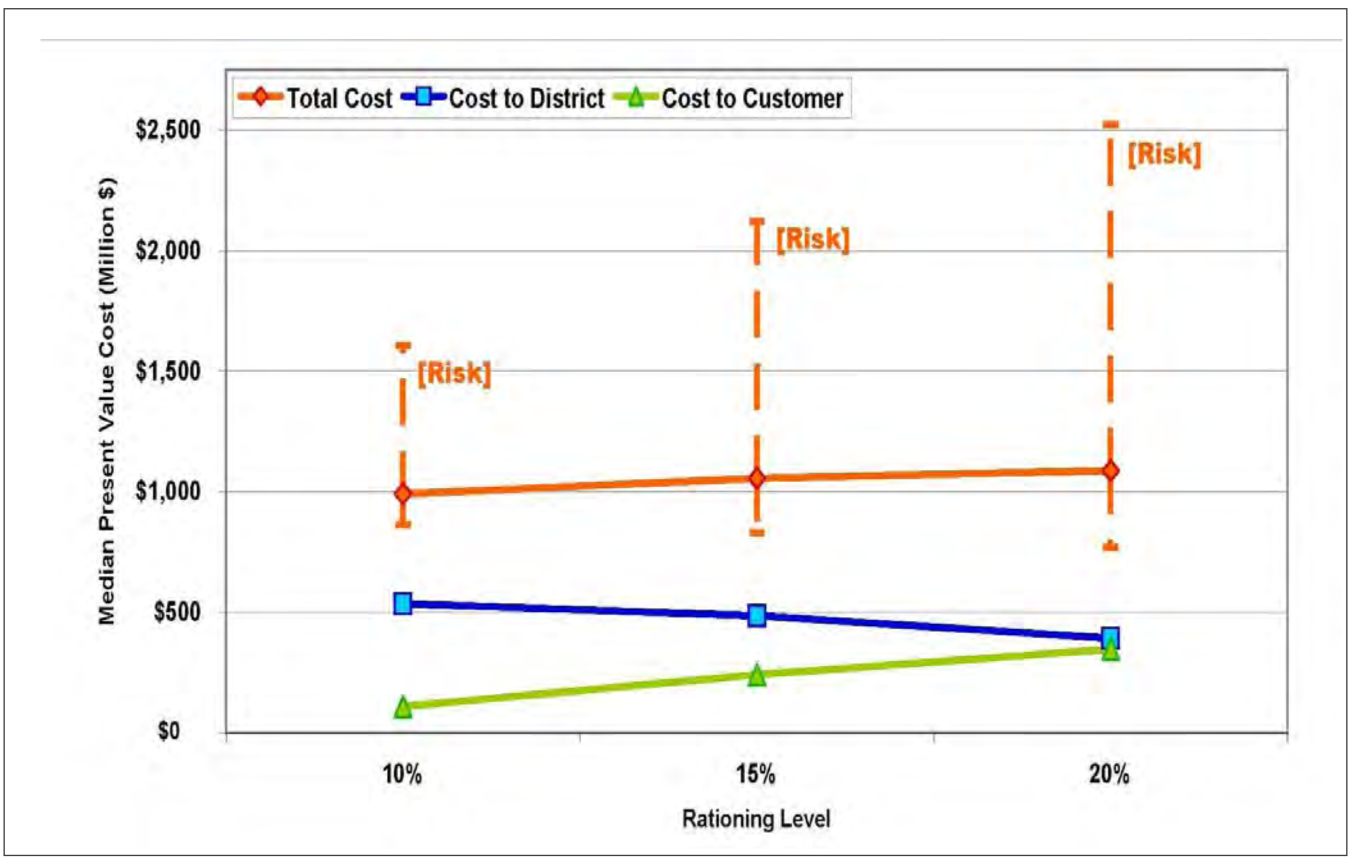


Figure 6-15 *Rationing Level - Risk*

6.2.3 Conservation Level Screening

Conservation Levels B, C, D, and E were brought forward into the initial portfolio building and were tested in at least one portfolio. (Level A is essentially included in each of the other levels as it is the required plumbing code).

Conservation Levels B and E were eliminated in this stage - Conservation Level B because it provides less than the District's current level of investment in conservation and Conservation Level E because the small increment of water savings gained over Conservation Level D comes at very high cost.

6.2.4 Recycled Water Level Screening

All three recycled water levels were included in the initial portfolio building. Recycling Level 1 (0 MGD) was tested in 2 out of 14 portfolios and eliminated from further consideration, as this level did not advance recycled water programs any further than current District goals.

Recycling Levels 2 and 3 were tested in the five Primary Portfolios (Table 6-7).

Table 6-7: Recycled Water Levels 2 and 3 Comparison

Recycled Water Level	Level 2	Level 3
Yield (MGD)	5	11
Total Cost (NPV)*	$97 Million	$277 MIllion
Rate Increase (%)	2.2	6.4
Rate Difference (%)	-	4.2

6.2.5 Supplemental Supply Components Screening

Following the first stage of component consideration (as described in Section 6.1.4), each of the remaining supplemental supply components was scored using the evaluation screening criteria.

Any component that received an extremely low score on select "fatal flaw" evaluation criteria was eliminated from further consideration. Additional detail on the screening process and the eliminated components is provided in Appendix B. The components brought forward into the portfolio development are shown in Table 6-5.

All of the components described in Table 6-5 with the exception of the Buckhorn Canyon Reservoir and the LEAD at C&H Sugar components were brought forward into the WSMP 2040 Portfolio.

The LEAD at C&H Sugar Component was eliminated because its very small yield does not outweigh the risk and investment of building a facility on an active industrial property that EBMUD would not own.

The Buckhorn Canyon Reservoir Component was eliminated from further consideration due to concerns expressed by stakeholders as shown in Table 6-8.

As part of the revision of the WSMP 2040 following the legal challenge, the Enlarge Pardee Reservoir component is no longer included in the WSMP 2040 Portfolio.

Table 6-8: Buckhorn Canyon Pros and Cons

Pros	Cons
West of Delta storage	Inundates approximately 7 miles of stream
High operational flexibility	Alters 40 acres of wetlands
High water quality of Mokelumne River	Inundates known habitat for Alameda whipsnake & sensitive fish species
Relatively remote EBMUD land	Very limited access. Traffic, noise, and air quality construction-related impacts (120 Truck trips daily for 2.5-3 years for Dam Construction and 120 Truck trips daily for 10 months for Pipeline construction; Vehicular emissions and dust generation at all construction sites. Most affected would be the 155 residences, college, library, and schools within 100 feet of pipeline construction. Effects would be short-term.[1])
High elevation - Gravity flow	Controversial history
No displacement of residences or land use	Would require an appropriative right for Buckhorn Creek and a process before the State Water Resource Control Board
Lowest cost to District of the 5 portfolios	

[1] East Bay Municipal Utility District (EBMUD). 1988. Water Supply Management Program Revised Draft Environmental Impact Report. September.

Buckhorn Canyon with potential inundation zone (see Figure 6-10 for entire image)

6.3 Portfolio Development

As described in Section 2.2, the development of alternative water supply portfolios was a robust and detailed evaluation of a wide range of potential water supply solutions.

Using the results of the criteria screening process, the narrowed list of water supply components was assembled into 14 portfolios (see Figure 6-16).

6.3.1 Portfolio Modeling

An integrated water supply model (as described in Section 2.3.4), the WEAP-EBMUDSIM (W-E) model, was used for portfolio evaluation to assess climate change impacts on EBMUD's water supply system, and to calculate portfolio costs.

The W-E model was used to assess portfolio performance under different hydrologic conditions and future supply and demand scenarios. Two distinct modeling approaches, the Fixed Level of Development (FLOD) Approach and the Indexed Sequential (IS) Approach, were used. The FLOD approach was used to evaluate performance for the initial set of 14 portfolios and to provide rough cost comparisons. The IS approach was used for detailed analyses of subsequent portfolios and to estimate the range of costs (in net present value) of portfolios.

The five Primary Portfolios carried forward for analysis in the WSMP 2040 are identified in Figure 6-17 with bolded arrows. Two of the portfolios (Portfolio 1 and 2) failed the modeling analysis, as they did not provide ample water to meet the Need for Water and did not satisfy operational constraints. In addition, Portfolios 1 and 2 were not able to meet the capacity limitations of the aqueducts and East Bay water treatment plants. Several of the other portfolios were consolidated, as it was determined that modeling a smaller number of portfolios would provide insight on the remaining range of rationing, conservation and recycled water levels, as well as supplemental supply components. The levels or components listed in Table 6-9 were held from further consideration after this initial round of modeling.

Portfolio Design

The portfolios were designed to meet the Need for Water at a selected rationing level. Portfolios were also designed to suit specific themes including:

- Low Customer Impact
- Flexibility in Case of Future Extended Drought or Climate Change
- Upcountry Surface Storage Emphasis
- Groundwater Storage
- Regional Partnerships
- Emergency Reliability A (west of delta surface storage)
- Emergency Reliability B (west of delta production including desalination, recycled water, and conservation)
- Diversified
- Conservation & Recycling Emphasis
- Low Carbon Footprint
- Low Capital Cost / Low Structural

Portfolio Number	Portfolio Themes	Portfolio Description	Components	Rationing 0%	10%	15%	25%	Natural Savings + 10 (B)
				0 MGD	22 MGD	32 MGD	52 MGD	29 MGD
1	Low Customer Impact	Balance of low rationing, low cost, high water quality.		●				29
2	Flexibility for Future Extended Drought or Climate Change	Keep rationing/conservation & transfers available as short-term response.		●				29
3	Upcountry Surface Storage Emphasis	Portfolio 2 with increased rationing & conservation & no recycling or desal.			●			
4	Groundwater Storage	Portfolio 3, but replace surface storage with groundwater, & increase conservation, recycling, & transfers.			●			
5	Regional Partnerships	All partnership projects & conservation.			●			
6	Emergency Reliability - A	West of delta surface storage.				●		
7	Emergency Reliability - B	West of delta production - desal, recycle, conservation.				●		
8	Diversified	Balanced levels of conservation & recycling, non-Mokelumne sources - transfers, desal, Bayside.				●		
9	Conservation & Recycling Emphasis	High conservation & recycling with LEAD. Transfers & Bayside to satisfy need for water.				●		
10	Low Carbon Footprint	Pardee plus conservation.				●		
11	Low Capital Cost / Low Structural	25% rationing, conservation, & transfers.					●	29
12	"Alternative 12"[3]				●			
13	"Alternative 13"[3]					●		
14	"Alternative 14"[3]						●	

Notes: [1] Groundwater Banking/Exchange (Sacramento Basin) component must be coupled with a transfer water component.

[2] If Conservation Level E is chosen for a portfolio, rationing is capped at 15%.

[3] These Alternatives were developed following input from the Board of Directors.

Figure 6-16 *Portfolio Development*

Conservation			Recycling			Supplemental Supply								
Current Program Equivalent (C)	Current Program Equivalent + 2 (D)	Maximum Voluntary Program (E)[2]	Recycling Level 1	Recycling Level 2	Recycling Level 3	Sacramento Basin Groundwater Banking/Exchange[1]	Northern California Water Transfers	Bayside Groundwater Project Phase 2	Buckhorn Canyon Reservoir	LEAD at C&H Sugar	Regional Desalination	San Joaquin Basin Groundwater Banking/Exchange	Enlarge Lower Bear Reservoir	Enlarge Pardee Reservoir
37 MGD	39 MGD	41 MGD	0 MGD	5 MGD	11 MGD	4.2 MGD	4.5-44.6 MGD	9 MGD	42 MGD	1.5 MGD	20 MGD	17.4 MGD	2.2 MGD	51.2 MGD
				5			20						2.2	51.2
				5							20		2.2	51.2
37			0											51.2
	39			5		4.2	15	9				17.4		
37				5		4.2	4.5				20	17.4	2.2	
37				5					42					
	39				11			9			20			
37				5			10	9			20			
		41			11		15	9		1.5				
37				5										51.2
			0				30							
37					11	4.2	27	9		1.5				
	39				11		8	9						
37					11			9						

Note: On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.

Portfolio Number	Portfolio Theme	Operations, Engineering, Legal & Institutional				Economic	
		• Minimize the vulnerability & risk of disruptions (i.e., **reliability**).	• Maximize the system's **operational flexibility**.	• Minimize **institutional & legal complexities** & barriers.	• Maximize **partnerships** & regional solutions.	• Minimize the financial **cost** to the **District** of meeting customer demands for given level of system reliability.	• Minimize **customer** water shortage **costs**.
1	Low Customer Impact	Failed Modeling Analysis					
2	Flexibility for Future Extended Drought or Climate Change	Failed Modeling Analysis					
3	Upcountry Surface Storage Emphasis		H				H
4	Groundwater Storage		H	L	H	L	H
5	Regional Partnerships	H		L	H	L	H
6	Emergency Reliability - A	H+	H+				
7	Emergency Reliability - B	H		L		L	
8	Diversified	H		L			
9	Conservation & Recycling Emphasis		H		L	L	
10	Low Carbon Footprint		H				
11	Low Capital Cost / Low Structural		L			H	L
12	"Alternative 12"	L	H	L	H	L	H
13	"Alternative 13"		L		L	L	
14	"Alternative 14"	H	L		L		L

H = High Response to Evaluation Criteria; L = Low Response to Evaluation Criteria;

Figure 6-17 *Portfolio Evaluation and Recommendations*

Public Health, Safety & Community		Environmental		Portfolio Number	Rationale/Notes	
• Minimize potential adverse impacts to the **public health** of District customers. • Maximize use of water from the **best** available **source**.	• Minimize long-term adverse **community impacts** • Minimize adverse **social effects**. • Minimize conflicts with existing & planned facilities, utilities & transportation facilities.	• Minimize adverse **impacts** on the **environment**. • Minimize construction & operation effects on environmentally **sensitive resources**.	• Minimize short term & long term **greenhouse gas emissions** from construction. • Maximize **energy efficiency** associated with operations & maintenance. • Maximize contributions to **AB 32 goals.**			
				1		X
				2		X
H+				3	*Combine with P-10*	
		H		4	*Includes both Sac & SJ Groundwater Banking/Exchange*	→
L			L	5	*Most robust number of Components, including Desalination*	→
	L	L		6	*Buckhorn storage - Highest Ops & Engineering scores*	→
L			L	7	*Heavy reliance on Desalination ?*	
L			L	8	*Reliance on Desalination ?*	
				9	*Conservation Level E - Cost Effectiveness?*	
H+				10	*P-3 with Rationing at 15% & Recycling Level 2*	→
		H		11	*Cost to customer of 25% Rationing is Prohibitive*	X
		H		12	*Heavy reliance on a Water Transfer of 27 MGD in dry years*	→
		H		13	*20% Rationing can be tested in Portfolios 4 & 12*	⇨
		H		14	*Cost to customer of 25% Rationing is Prohibitive*	X

X = Hold from Further Consideration; → = Carry Forward as Primary Portfolio for Further Refinement & Testing

Note: Portfolios 1, 2, 3, and 10 include the Enlarge Pardee Reservoir component. On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.

Conclusions from the Modeling Analysis of the Initial 14 Portfolios

Conveyance and Treatment Operations

- All portfolios except Portfolios 1 and 2 meet the annual Need for Water and satisfy operational constraints.
- Portfolios 1 and 2 do not work because of capacity limitations of the aqueducts and water treatment plants.
- In the third year of a drought, sources other than Mokelumne water are required. Not all of these sources can be treated at existing water treatment plants. Therefore, pretreatment is needed before entering the EBMUD aqueduct system.
- All portfolios except Portfolio 6 require Upcountry pretreatment.

Regional Desalination

- Desalinated water from the Pittsburg location would be treated a second time at EBMUD treatment plants due to transmission system configuration.
- Water cannot be delivered from Pittsburg to partners during peak summer months.

Rationing

- Portfolios 11 and 14 have the highest level of rationing at 25%. Rationing is triggered more often in these portfolios than others and cost of water shortage is the highest.

Summary of Eliminated Portfolios

These portfolios were examined and subsequently eliminated:

- **Portfolio 1 – Low Carbon Footprint and Portfolio 2 – Flexibility for Future Extended Drought or Climate Change**
Failed to meet the Need for Water.
- **Portfolio 3 – Upcountry Surface Storage** Closely mimicked Portfolio D and the Enlarge Pardee Reservoir level could be tested in that Portfolio. In addition, Recycled Water Level 1 (0 MGD) was eliminated from all portfolios.
- **Portfolio 7 – Emergency Reliability and Portfolio 8 – Diversified**
Heavy reliance on desalination above and beyond other elements; other portfolios offered a more "diversified" approach.
- **Portfolio 9 – Conservation & Recycled Water**
Included the very highest level of conservation (Level E at 41 MGD), but not as cost-effective as Conservation Level D (39 MGD).
- **Portfolio 11 – Low Capital Cost**
Included the highest rationing level of 25 percent but cost of this rationing level was found to be prohibitive.
- **Portfolio 13 – "Alternative 13"**
Closely mimicked Portfolio A; 20 percent rationing level could be tested in Portfolio A.
- **Portfolio 14 – "Alternative 14"**
High cost of the 25 percent rationing level.

Table 6-9: Components Held from Further Consideration after the First Round of Modeling

Component Category	*Level/Component Held from Further Consideration*
Rationing	0% and 25%
Conservation	Level B (29 MGD) and Level E (41 MGD)
Recycled Water	Level 1 (0 MGD)
Supplemental Supply	LEAD at C&H Sugar

Note: More information on why the above components were held from further consideration is provided in Section 6.1, Section 6.2, and Appendix B.

Primary Portfolios

The five Primary Portfolios that were carried forward were renamed:

- Formerly Portfolio 4 → **Portfolio A**
- Formerly Portfolio 5 → **Portfolio B**
- Formerly Portfolio 6 → **Portfolio C**
- Formerly Portfolio 10 → **Portfolio D**
- Formerly Portfolio 12 → **Portfolio E**

6.3.2 Primary Portfolios

All portfolios carried forward for analysis include rationing at levels of either 10, 15 or 20 percent, conservation savings of either 37 or 39 MGD, and recycled water at either the 5 or 11 MGD level (Figure 6-18). Each portfolio has a different theme and "cornerstone" component.

				Components						Supplemental Supply							
Preliminary Portfolio Number	Primary Portfolio	Portfolio Themes	Portfolio Description	10% (22 MGD)	15% (32 MGD)	Current Program Equivalent (C) (37 MGD)	Current Program Equivalent + 2 (D) (39 MGD)	Recycling Level 2 (5 MGD)	Recycling Level 3 (11 MGD)	Northern California Water Transfers (4.5-44.6 MGD)	Bayside Groundwater Project Phase 2 (9 MGD)	Sacramento Basin Groundwater Banking/Exchange[1] (4.2 MGD)	Regional Desalination (20 MGD)	Enlarge Pardee Reservoir (51.2 MGD)	Enlarge Lower Bear Reservoir (2.2 MGD)	San Joaquin Basin Groundwater Banking/Exchange (17.4 MGD)	Buckhorn Canyon Reservoir (42 MGD)
4	A	Groundwater / Conjunctive Use & Water Transfers	Groundwater storage/exchange & transfers	●			39	5		15	9	4.2				17.4	
5	B	Regional Partnerships	Partnership projects including groundwater, desalination & transfers	●		37		5		4.5		4.2	20		2.2	17.4	
6	C	Local System Reliance	West of delta surface storage		●	37		5									42
10	D	Lower Carbon Footprint	Upcountry surface storage		●	37		5			9			51.2			
12	E	Recycled Water & Water Transfers	High recycling & major transfer	●		37			11	28.5	9	4.2					

Notes: On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.
[1] Sacramento Basin Groundwater Banking/Exchange component must be coupled with a transfer water component.

Figure 6-18 *Primary Portfolio Composition*

Portfolio A
Groundwater/Conjunctive Use and Water Transfers

Emphasizes water production through water transfers and conjunctive use (groundwater) projects (Figure 6-19). Three groundwater projects would be combined with 15 MGD of water transfers, 39 MGD of conservation savings, and 5 MGD of recycled water projects. A 10 percent rationing level would be established.

The estimated dates for when the components would be online are shown in Table 6-10. While it appears on paper that excess water production capacity could be available in some years before it is needed to meet the Need for Water (Figure 6-20), this may not turn out to be the case. For example, the long lead time necessary to develop the Sacramento Basin Groundwater Banking / Exchange component (needed at the very end of the 2040 planning horizon) requires bringing the facility online 10 years earlier. During the bulk of those years, the project may be operated more in a storage mode rather than a withdrawal / extraction mode. Likewise, full utilization of San Joaquin area groundwater resources in 2040 requires initiation of that project in 2025 (and the operation of that project as well would be used for storage in some years, extraction in others).

Figure 6-20 also is a simplification of a complex modeling sequence - the figure depicts that each component is used to its maximum capacity in all years; however, in

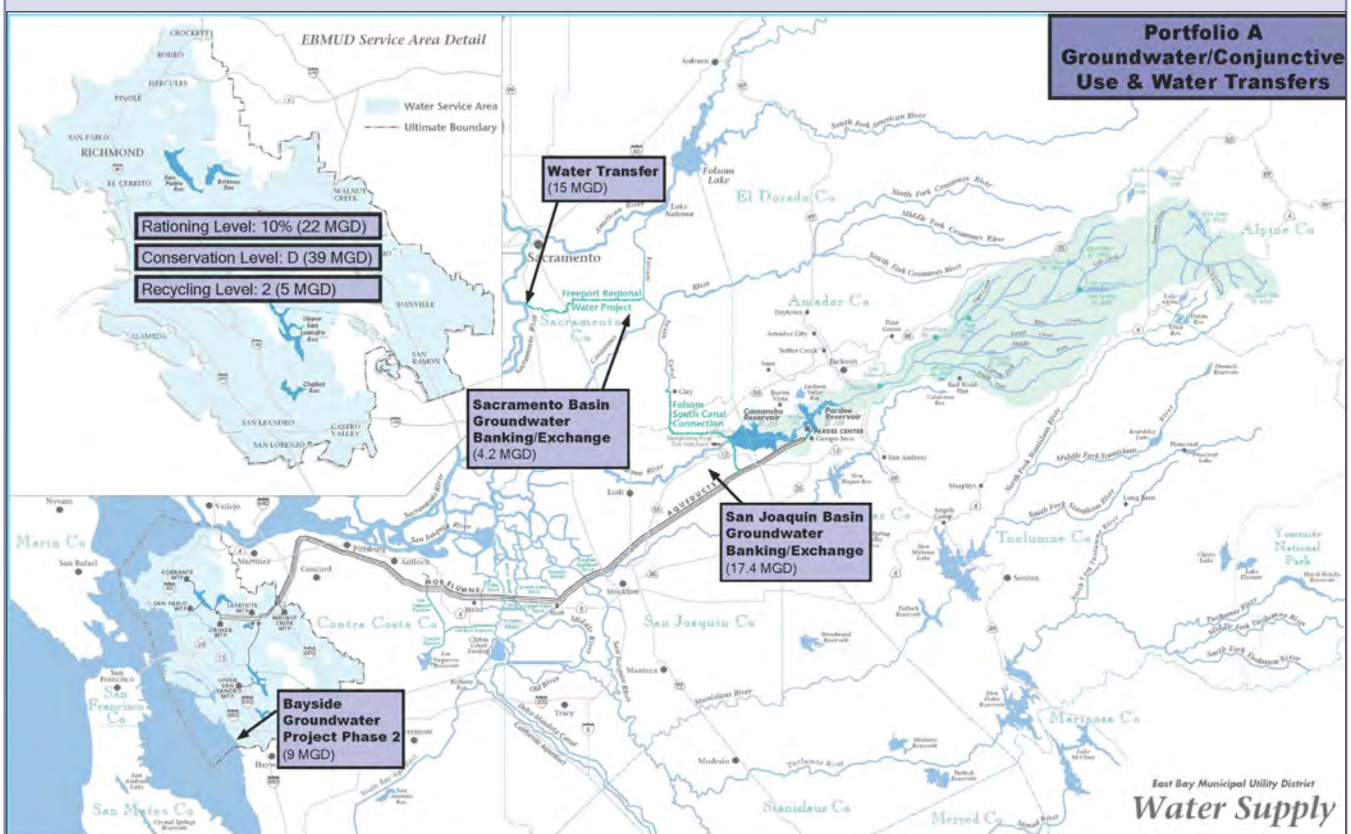


Figure 6-19 *Portfolio A Groundwater/Conjunctive Use and Water Transfers*

Table 6-10: Portfolio A Components and Project Online Dates to Meet the Need for Water

Component Category	Level/Projects	Component Yield (MGD)	Year Online
Rationing	10%	22	2010[1]
Conservation	Level D	39	Comes online throughout the 2010-2040 planning period with the full 39 MGD being achieved in 2040
Recycled Water	Level 2	5	Achieved by 2015
Supplemental Supply	Northern California Water Transfers	15	2010
	Bayside Groundwater Project Phase 2	9	2013
	Sacramento Basin Groundwater Banking / Exchange	4.2	2027
	San Joaquin Basin Groundwater Banking / Exchange	17.4	2022

[1] As a practical matter, EBMUD will be unable to reduce rationing to 10 percent until it develops additional dry-year supplemental water supplies.

the modeling as well as in reality, components would only be used as needed given hydrology of any given year and situation. The supplemental supply components included in Portfolio A are small to moderately sized, so supply would not be brought online until it is needed to meet the Need for Water.

Portfolio A places heavy reliance on overcoming all obstacles to implement groundwater storage and recovery and repeated success in securing water transfers. Transfers need to be in place as early as 2010 (see the "question mark" indicator as provided in Figure 6-20). While this is the same risk as for the WSMP 2040 Portfolio, Portfolio A does not include any other supplemental supplies. Institutional and legal complexities may also be encountered with implementing each of the components. For example, the timing of recycled water project implementation is subject to the availability of funding opportunities. Therefore, the 5 MGD of recycled water included in Portfolio A may not come online by the projected 2015 date.

In addition, finding and securing water transfers for 15 MGD starting in 2010, overcoming the institutional hurdles associated with the San Joaquin Basin Groundwater Banking / Exchange component, and overcoming local concerns about the Bayside Groundwater Project Phase 2, are just some of the challenges that may be encountered when implementing Portfolio A.

Components of this portfolio would require use of the Freeport facilities as well as the Mokelumne Aqueducts for transporting water to the East Bay Terminal Reservoirs and treatment plants.

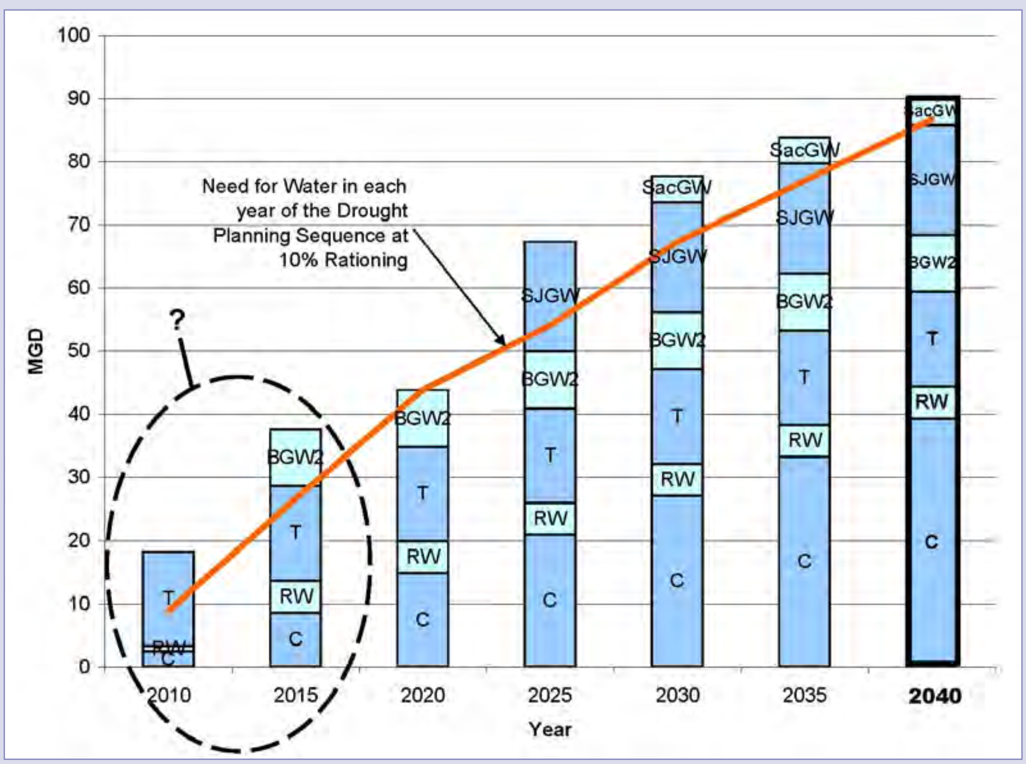
Pumping and energy requirements for Portfolio A are moderate and primarily related to the energy required for pumping and treating groundwater and recycled water. Total electricity use attributed to Portfolio A would range from a maximum of 154,259 megawatt-hours (MWh) to a minimum of 125,329 MWh, with a median electricity use of 136,487 MWh.

Portfolios A, C, and E all have similar median total electricity use and similar median greenhouse gas emissions. Total greenhouse gas emissions from Portfolio A would range from a maximum of 290 million metric tons of CO_2 to a minimum of 236, with a median emission level of 257.

Portfolio A would increase operational flexibility of the EBMUD water supply system, as it would provide a variety of both East Bay and Upcountry projects. Providing additional dry year storage on the west side of the Delta at Bayside would contribute to the District's ability to meet the 6-month local storage criterion. Portfolio A would provide approximately 173 days (5.8 months) of standby storage from May through October and 184 days (6.1 months) of standby storage from November through April based on a 2040 Demand. This portfolio would also provide several opportunities for EBMUD to partner with other local and Upcountry water districts.

Table 6-11: CLC Feedback for Portfolio A

Pros	***Cons***
Widest range of benefits	Must overcome public objections to Bayside Groundwater Project Phase 2 component
Would promote regional cooperation	Costly
Least environmental impacts	High dependence on complicated transfers, difficult to implement
Encourages efficiency in the agricultural sector	
Provides a safety net	
Diverse supply increases likelihood of success	



Key

C = Conservation

RW = Recycled Water

T = Transfer

SJGW = San Joaquin Groundwater

SacGW = Sacramento Groundwater

BGW2 = Bayside Groundwater Project Phase 2

Figure 6-20 *Portfolio A Meets the Need for Water over the Planning Period*

Portfolio B
Regional Partnerships

Portfolio B consists of 37 MGD of conservation, 5 MGD of recycled water, a small water transfer, and 10 percent rationing. It is uniquely characterized by its use of available partnership projects: a mix of groundwater projects, regional desalination, and enlargement of Lower Bear Reservoir (see Figure 6-21 and Table 6-12). This emphasis increases the chance of success for large projects (such as regional desalination) that could otherwise prove to be difficult for any one agency to develop and permit.

As with Portfolio A, it may appear that more water would be available in later years than is needed to meet the Need for Water (Figure 6-22), and that the Sacramento Basin Groundwater Banking / Exchange component is not needed to meet the Need for Water in all years. This approach is necessary to account for long project lead time coupled with the operational characteristics of the conjunctive use elements.

Again, the approach is to develop the supplemental water supply components that are most feasible according to the circumstances that arise during the 2010-2040 planning period. As an implementation scheduling example (beyond the conjunctive use elements discussed previously), the Regional Desalination component, although it has the capacity to provide excess water for approximately 5 years (until it is needed in full to meet the Need for Water in 2020), at least 10 MGD needs to be online by 2015 to avoid a shortfall in that given water year. To guard against potential growth-inducing effects of short-term surplus water supply, EBMUD would match the use of Regional Desalination to the Need for Water in a given year.

In a similar manner, the Enlarge Lower Bear Reservoir component is needed to meet the 2040 level of demand, but modeling indicates it is required by year 2027 to meet a short-term need for water until conservation can be fully implemented and the San Joaquin Basin Groundwater Banking / Exchange component is functional (Table 6-12). As a fall-back option, a short-term water transfer in 2027 could be used to provide an equivalent amount of water in place of the Enlarge Lower Bear Reservoir component.

A weakness of Portfolio B is that heavy reliance is placed on a Regional Desalination project being permitted, built and online by 2015 (see question mark in Figure 6-22). There are currently significant challenges to successfully implementing a large regional desalination project in California, particularly one that could potentially be sited in the Delta. EBMUD views that a more realistic time frame for implementation may be 2030.

Additional challenges exist in getting the Portfolio B components online at the necessary date to meet the Need for Water. For example, the recycled water project implementation is subject to the availability of funding opportunities and therefore, the 5 MGD of recycled water included in Portfolio B may not be able to come online by the projected 2015 date. Institutional and legal complexities may be encountered with implementing each of the components.

Operational considerations result from the inclusion of the Regional Desalination component in this Portfolio. Water would initially be desalinated using one-pass or two-pass reverse osmosis (RO). The desalinated water would be transported to the Mokelumne Aqueducts via a pump station and pipeline. Water distributed through the Mokelumne Aqueducts would need to be treated a second time at

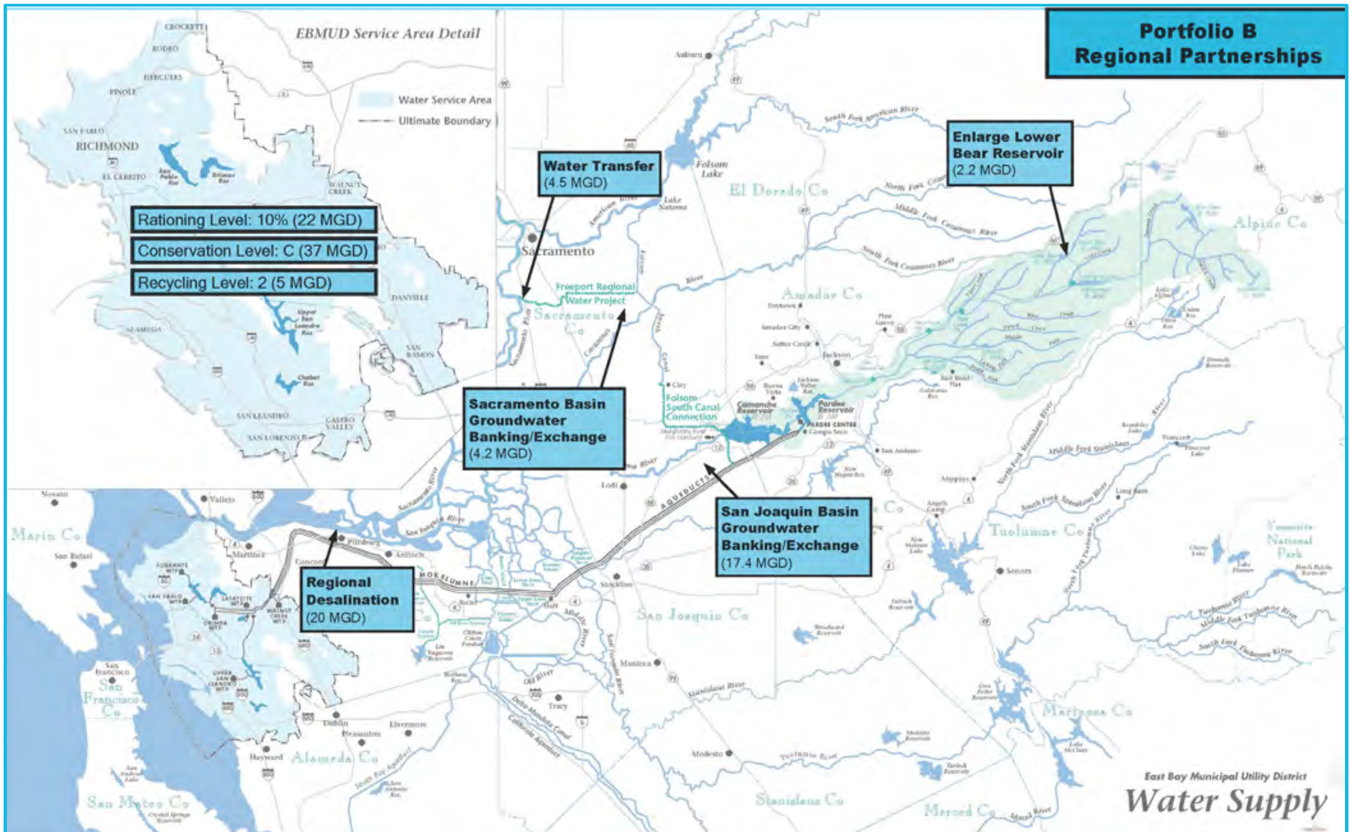


Figure 6-21 *Portfolio B Regional Partnerships*

Table 6-12: Portfolio B Components and Project Online Dates to Meet the Need for Water

Component Category	*Level/Projects*	*Component Yield (MGD)*	*Year Online*
Rationing	10%	22	2010[1]
Conservation	Level C	37	Comes online throughout the 2010-2040 planning period with the full 37 MGD being achieved in 2040
Recycled Water	Level 2	5	Achieved by 2015
Supplemental Supply	Northern California Water Transfers	4.5	2010
	Sacramento Basin Groundwater Banking / Exchange	4.2	2029
	Regional Desalination	20	2012
	Enlarge Lower Bear Reservoir	2.2	2027
	San Joaquin Basin Groundwater Banking / Exchange	17.4	2022

[1] As a practical matter, EBMUD will be unable to reduce rationing to 10 percent until it develops additional dry year supplemental water supplies.

EBMUD treatment plants due to transmission system configuration. Pumping and energy requirements for Portfolio B are high, primarily related to the energy required for the desalination process, as well as for pumping and treating groundwater and recycled water. Total electricity use attributed to Portfolio B would range from a maximum of 179,312 MWh to a minimum of 142,452 MWh, with a median electricity use of 154,753 MWh. Total greenhouse gas emissions from Portfolio B would range from a maximum of 338 million metric tons of CO_2 to a minimum of 268, with a median emission level of 291. Portfolio B has the highest median electricity use and median greenhouse gas emission level of all the portfolios.

Portfolio B would provide additional dry-year water availability on the west side of the Delta through use of the Regional Desalination component. Although it would use the Mokelumne Aqueducts to transport water to the East Bay Terminal Reservoirs and treatment plants, it would connect with the aqueducts west of the Delta and is therefore less likely to be affected by Delta failure. This component would contribute to the District's ability to meet the 6-month local storage criterion. Portfolio B would provide approximately 188 days (6.3 months) of standby storage from May through October and 195 days (6.5 months) of standby storage from November through April based on a 2040 Demand.

Table 6-13: CLC Feedback for Portfolio B

Pros	Cons
Opportunity to partner with others	Requires much agency cooperation
Diversifies supply off Mokelumne River, Greatest diversity & flexibility	Unless cost of desalination & recycled water decrease, it is too expensive
Desalination could be good option if it uses renewable energy sources and becomes more economical over time	
Less dependent on transfers then Portfolio A	
More leverage to adapt to population growth	

Key

T = Transfer

C = Conservation

RW = Recycled Water

SJGW = San Joaquin Groundwater

SacGW = Sacramento Groundwater

D = Regional Desalination

Bear = Enlarge Lower Bear Reservoir

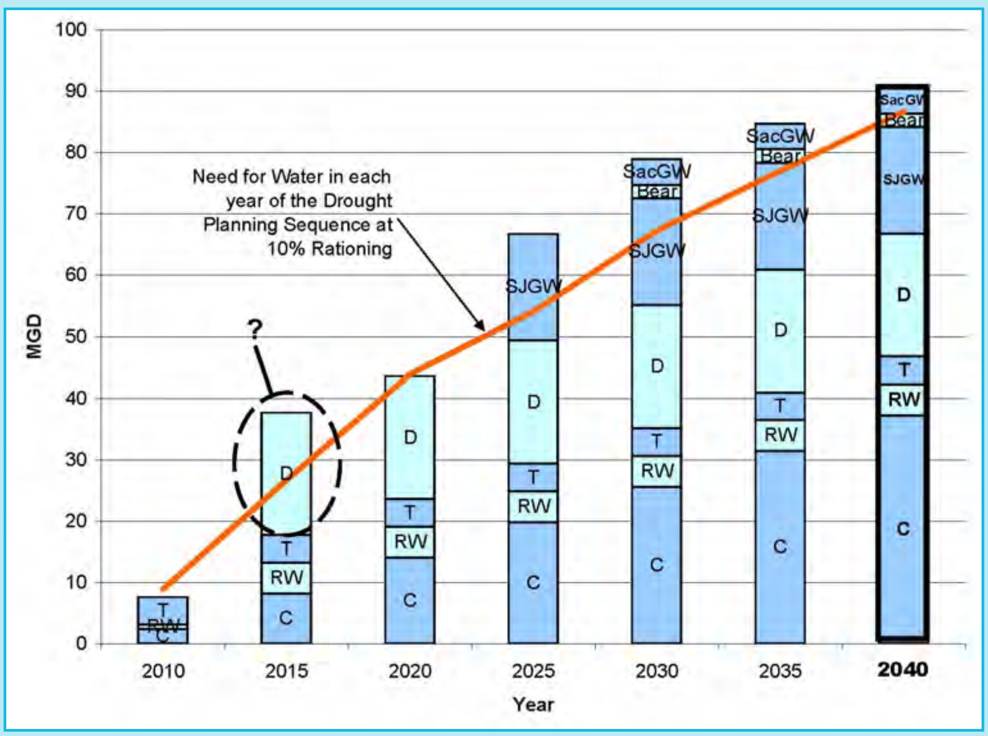


Figure 6-22 *Portfolio B Meets the Need for Water over the Planning Period*

Portfolio C
Local System Reliance

Portfolio C emphasizes reliance upon a new increment of water storage in the EBMUD service area. By locating new storage capacity west of the Delta, EBMUD may be able to lessen the impact of a prolonged interruption of its Sierra supply that would result from damage to the aqueduct system from floods, levee failures or earthquakes. This portfolio consists of a 15 percent rationing level, 37 MGD of conservation, 5 MGD of recycled water, and a single supplemental supply project: development of Buckhorn Canyon Reservoir (see Table 6-14).

The Buckhorn Canyon Reservoir component would involve constructing an earth fill dam, creating a "terminal" reservoir at Buckhorn Canyon, north of the Castro Valley community. The capacity of a new reservoir in Buckhorn Canyon (similar in layout and concept to a project as originally conceived in the 1980s) is 143,000 AF. Figure 6-10 shows the inundation area of the new reservoir. The reservoir would be operated continuously during times of drought, and would provide up to 43 MGD in each dry year, for up to three consecutive dry years.

The estimated dates when the Portfolio C components would be online are shown in Table 6-14. If drought conditions were to occur between years 2011 and 2019, before the projected in-service date for Buckhorn Canyon Reservoir, a temporary shortfall would be met by rationing at a maximum of 25 percent Districtwide. Portfolio C places total reliance on Buckhorn Canyon Reservoir permitting, constructing, and filling by 2020 (see question mark on Figure 6-24).

Figure 6-24 shows that with Buckhorn Canyon Reservoir in place, surplus water exceeds the Need for Water. However, the graphic depicts a best-case condition. Depending on the hydrologic circumstances, it may take several years to fill the new reservoir.

Until it is filled, it could not be fully operational. The capacity of Buckhorn Canyon Reservoir is defined in large measure by the geologic formation of the canyon and engineering considerations that restrict the dam's location. Moreover, the Buckhorn Canyon Reservoir component cannot be phased.

Portfolio C scored very high from an operations and economic viewpoint, primarily related to the inclusion of the Buckhorn Canyon Reservoir component (see Appendix B).

Table 6-14: Portfolio C Components and Project Online Dates to Meet the Need for Water

Component Category	Level/Projects	Component Yield (MGD)	Year Online
Rationing	15%	29	2010[1]
Conservation	Level C	37	Comes online throughout the 2010-2040 planning period with the full 37 MGD being achieved in 2040
Recycled Water	Level 2	5	Achieved by 2015
Supplemental Supply	Buckhorn Canyon Reservoir	42	2020

[1] As a practical matter, EBMUD will be unable to reduce rationing to 15 percent until it develops additional dry-year supplemental water supplies.

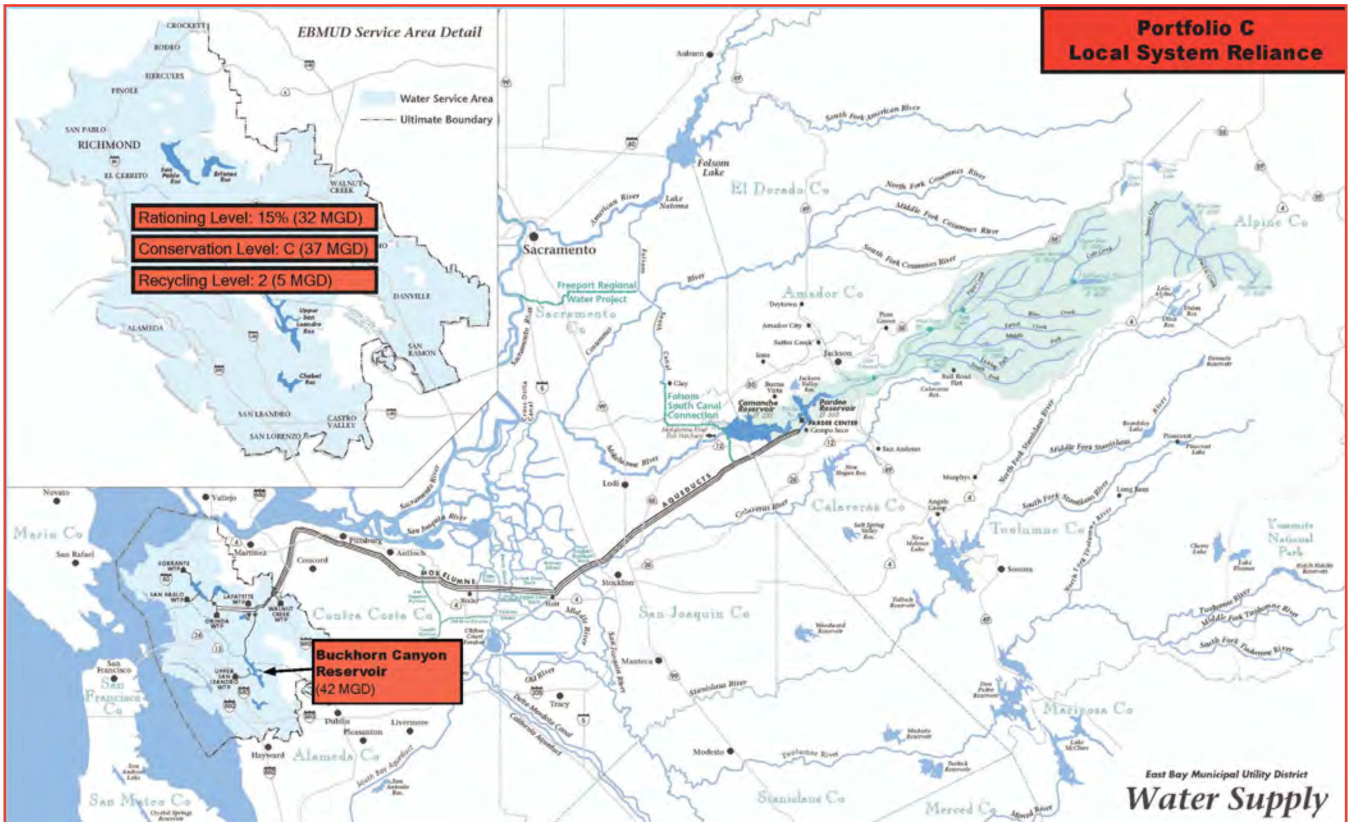


Figure 6-23 *Portfolio C Local System Reliance*

Pumping and energy requirements for Portfolio C are moderate and primarily related to the energy required for pumping and treating recycled and potable water. Total electricity use attributed to Portfolio C would range from a maximum of 145,503 MWh to a minimum of 127,992 MWh, with a median electricity use of 135,315 MWh. Total greenhouse gas emissions from Portfolio C would range from a maximum of 274 million metric tons of CO_2 to a minimum of 241, with a median emission level of 255. Portfolios A, C, and E all have similar median greenhouse gas emissions.

Portfolio C would increase operational flexibility and reliability of the EBMUD water supply system, as it would extend EBMUD's standby storage capacity to about one year and would locate a significant portion of that storage away from the vulnerabilities of the Delta. Providing additional terminal reservoir storage would allow for much great operational flexibility and the ability to store more water during the winter to supply summer demands. Providing additional dry year storage on the west side of the Delta at Bayside would contribute considerably to the District's ability to meet the 6-month local storage criterion. Portfolio C would provide approximately 359 days (12 months) of standby storage from May through October and 378 days (12.6 months) of standby storage from November through April (based on 2040 Demand) and would locate a significant portion of that storage away from the vulnerabilities of the Sacramento Delta. A potential shortfall with this portfolio as compared with others is that it would be hard to find means by which other agencies beyond EBMUD could partner in its operation.

Elimination of the Buckhorn Canyon Reservoir Component

While Buckhorn Canyon Reservoir would provide greater water supply reliability to the District, due to its location west of the Delta, its greatest constraint is the potential construction traffic that would be required on the single access road through a residential neighborhood. In addition, there would be impacts to wetlands and biological resources and this component would provide few, if any, regional collaboration opportunities.

Community and environmental interest groups also expressed strong opposition to Buckhorn Canyon Reservoir development during the WSMP 2040 PEIR scoping process.

As a result, the Buckhorn Canyon Reservoir component was eliminated from further consideration following analysis of the 5 Primary Portfolios.

Table 6-15: CLC Feedback for Portfolio C

Pros	Cons
Optimum control in case of drought or seismic event	"Go-it-alone" strategy will be hard to justify in the future
Certainty of supply within District's control	Delta-earthquake scenario should be dealt with by securing the aqueducts
Reliability is critical	Surface storage eliminates wetlands and habitat
On EBMUD property, on cooler side of District, provides winter storage	Buckhorn Reservoir still faces significant community opposition, due to construction traffic through residential neighborhood
Lowest cost to implement	

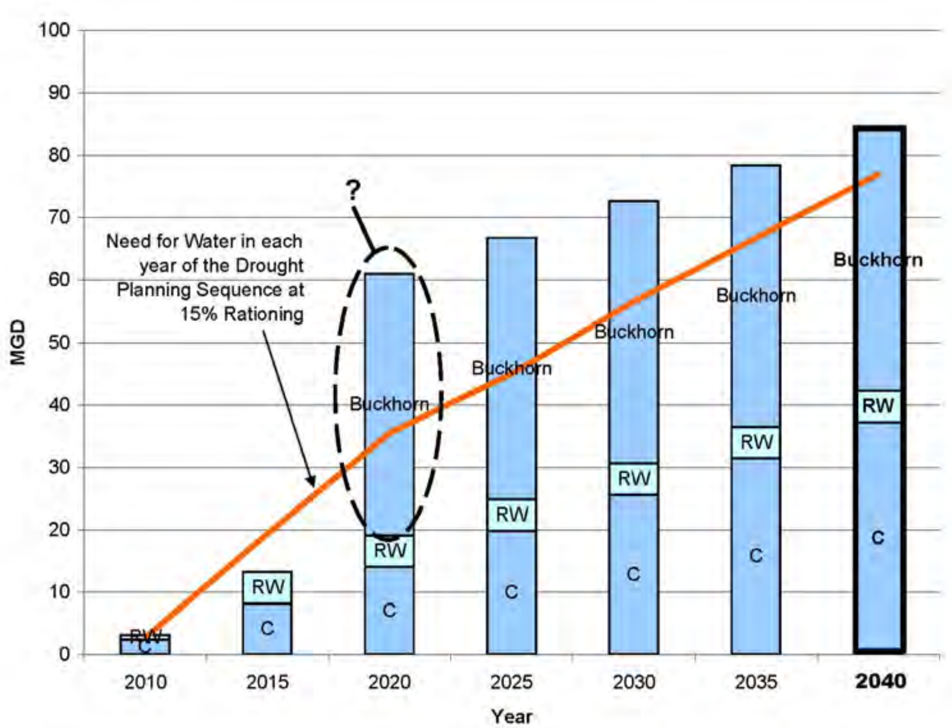


Figure 6-24 *Portfolio C Meets the Need for Water over the Planning Period*

Key

C = Conservation

RW = Recycled Water

Buckhorn = Buckhorn Canyon Reservoir

Portfolio D
Lower Carbon Footprint

Portfolio D seeks to reduce energy consumption and greenhouse gas emissions by increasing the hydroelectricity generation capacity at Pardee Powerhouse. In addition, Portfolio D would substantially reduce dry-year water demand by setting a 15 percent (32 MGD) Districtwide rationing level. This portfolio would include 37 MGD of conservation, 5 MGD of recycled water, enlargement of Pardee Reservoir, and implementation of Bayside Groundwater Project Phase 2 (see Figure 6-25 and Table 6-16). The estimated dates for when the components would be online are shown in Table 6-16.

Portfolio D includes only a Mokelumne River source of supplemental supply. However, it should be noted that the FRWP pre-treatment facility would be required for this portfolio to address water quality issues. Under this scenario, the FRWP is not activated in the first year of the Drought Planning Sequence if the existing 500 TAF trigger is utilized and therefore, a large amount of Sacramento River water would be used in the last two years of the drought instead of being spread out over three years. This increase in blended-water volume would likely require pre-treatment.

The Enlarge Pardee Reservoir component included in Portfolio D is of relatively large scale, and construction cannot be phased, however filling and operation could be flexible. On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.

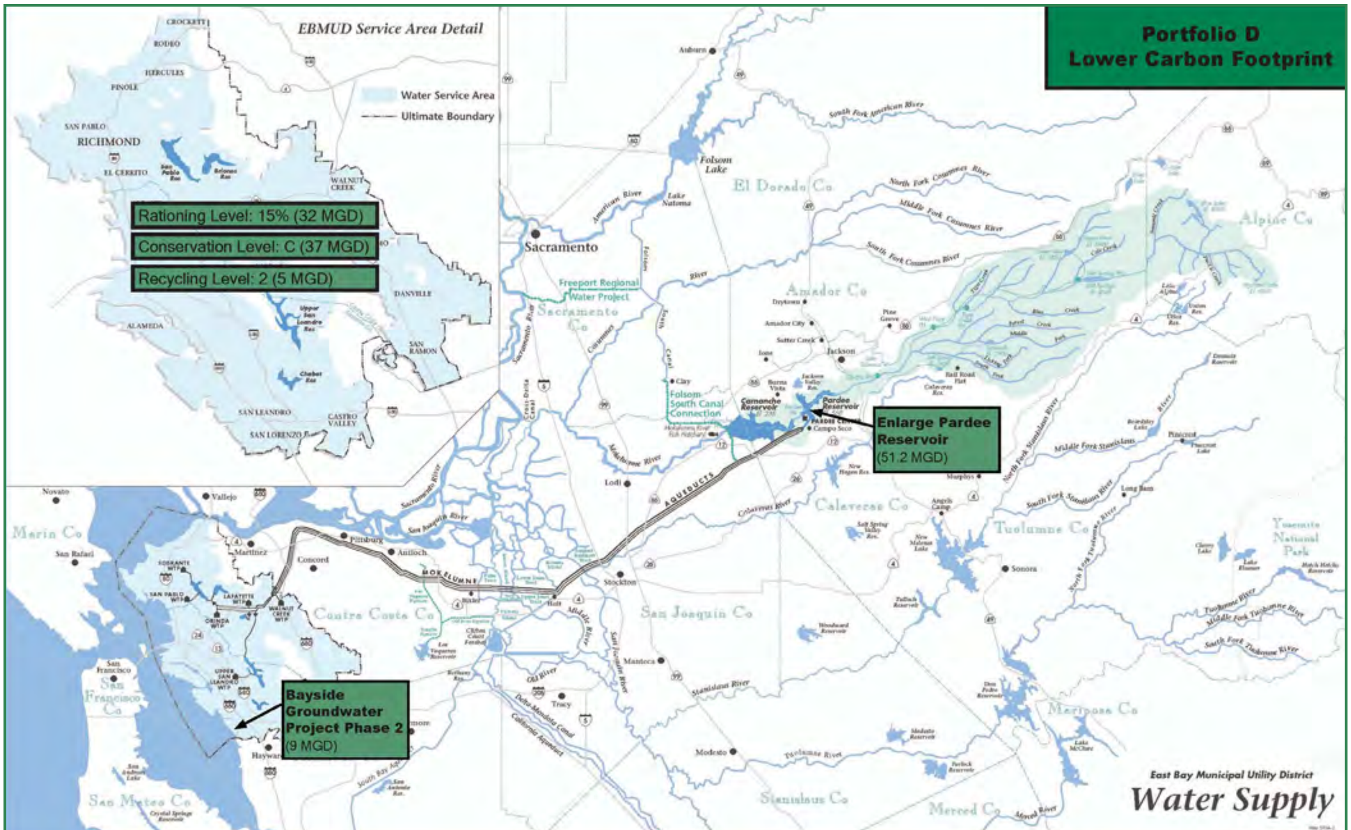
Bayside Groundwater Project Phase 2 is needed in 2015 to meet a short-term need for water until the Enlarge Pardee Reservoir component can come online (see Figure 6-26). Even with implementation of Bayside Groundwater Project Phase 2, Portfolio D may still have a shortfall before the enlarged Pardee Reservoir is filled and online. If EBMUD were to enter into beneficial partnerships with Upcountry water interests, the full yield of the Enlarge Pardee Reservoir component may be shared (partnering and yield sharing as would be determined during the project development stage).

Table 6-16: Portfolio D Components and Project Online Dates to Meet the Need for Water

Component Category	Level/Projects	Component Yield (MGD)	Year Online
Rationing	15%	29	2010[1]
Conservation	Level C	37	Comes online throughout the 2010-2040 planning period with the full 37 MGD being achieved in 2040
Recycled Water	Level 2	5	Achieved by 2015
Supplemental Supply	Bayside Groundwater Project Phase 2	9	2014
	Enlarge Pardee Reservoir[2]	51.2	2020

[1] As a practical matter, EBMUD will be unable to reduce rationing to 15 percent until it develops additional dry-year supplemental water supplies.

[2] On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.



Note: On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.

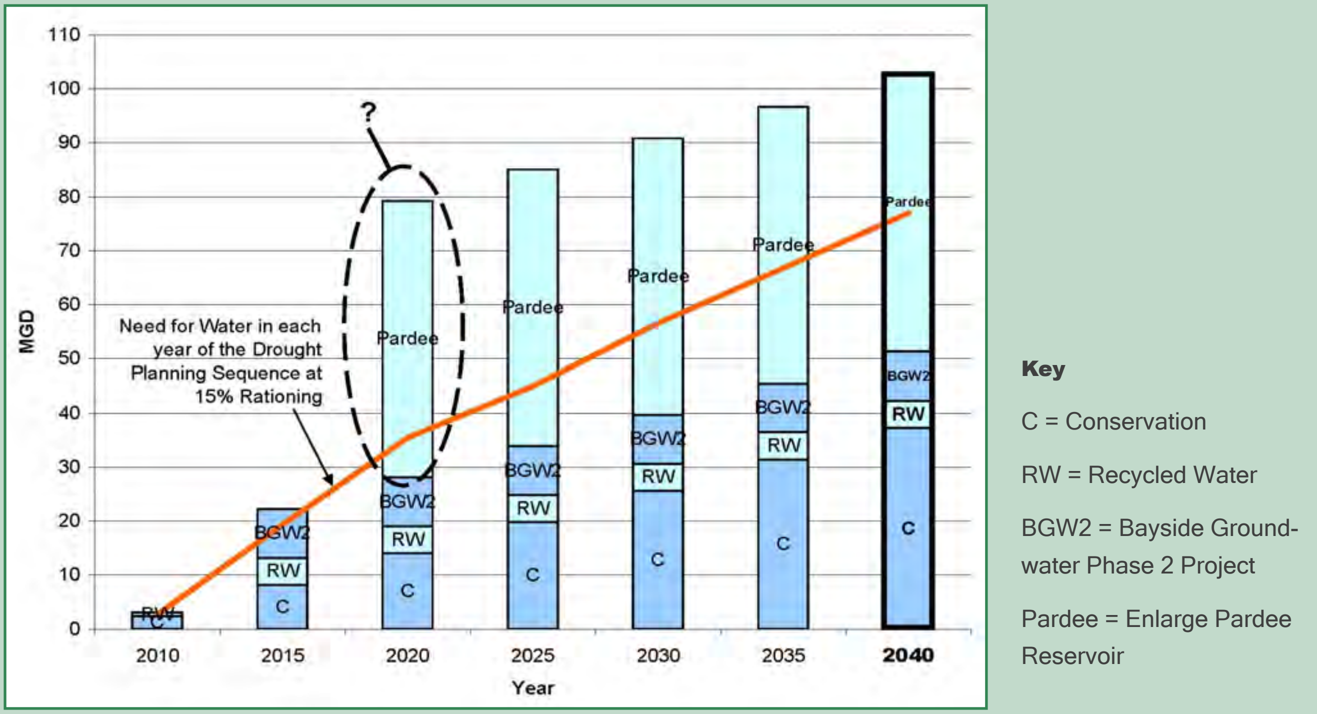
Figure 6-25 *Portfolio D Lower Carbon Footprint*

Challenges exist in getting the Portfolio D components online at the necessary date to meet the Need for Water. Portfolio D places heavy reliance on permitting, constructing, and filling an enlarged Pardee Reservoir by 2020 (see question mark on Figure 6-26). Another challenge may be obtaining the necessary permits for the Enlarge Pardee Reservoir component.

Pumping and energy requirements for Portfolio D are moderate and primarily related to the energy required for pumping and treating groundwater, recycled water, and water from Pardee Reservoir. Total electricity use attributed to Portfolio D would range from a maximum of 128,553 MWh to a minimum of 110,207 MWh, with a median electricity use of 117,885 MWh.

The Enlarge Pardee Reservoir component would result in a median annual increase in hydroelectric power generation of about 5%, giving Portfolio D the lowest total energy use and lowest median greenhouse gas emissions level of all the portfolios. Total greenhouse gas emissions from Portfolio D would range from a maximum of 242 million metric tons of CO_2 to a minimum of 207, with a median emission level of 222.

Aside from the service-area storage created as part of Bayside Groundwater Project Phase 2, the bulk of storage provided by Portfolio D would be east of the Delta and would therefore not contribute to meeting EBMUD's 6-month local storage criterion. Portfolio D



Note: On April 24, 2012, the EBMUD Board removed the Enlarge Pardee Reservoir component from the WSMP 2040 Portfolio.

Figure 6-26 *Portfolio D Meets the Need for Water over the Planning Period*

would provide approximately 170 days (5.7 months) of standby storage from May through October and 183 days (6.1 months) of standby storage from November through April based on 2040 Demand.

In addition to increasing operational flexibility to meet the needs of EBMUD customers, Portfolio D could also provide environmental benefits on the Mokelumne River by providing additional cold water storage in Pardee Reservoir for releases. Potential concerns exist, such as the impact of inundation on recreation activities, cultural and historic resources, biological resources, and road and bridge access.

Table 6-17: CLC Feedback for Portfolio D

Pros	*Cons*
If Portfolio D was managed properly, it could benefit the environment (more water for fish)	Bayside Groundwater Project Phase 2 will be more trouble then you anticipate; legal challenges are not worth the 9 MGD
Meets carbon reduction issue	Secure the aqueducts first, then enlarge Pardee Reservoir
Provides reserve source of supply	Without EIR/details of operation are difficult to assess

Portfolio E
Recycled Water & Water Transfers

Portfolio E (Table 6-18 and Figure 6-27) includes a number of recycled water projects and a greater reliance on water transfers as compared with other portfolios. It includes no surface water projects.

Portfolio E consists of 37 MGD of conservation savings, recycled water projects at the maximum 11 MGD, two groundwater projects, and a long-term, large, water transfer. Also, a 10 percent rationing level would be established. Portfolio E would provide additional dry-year storage west of the Delta through the Bayside Groundwater Project Phase 2. This portfolio would also provide several opportunities for EBMUD to partner with other water districts.

As is the case with those portfolios that include non-Mokelumne sources (i.e., all alternatives save Portfolio C), FRWP pre-treatment facilities would likely be needed to introduce such sources to the EBMUD raw water conveyance system (i.e., to address water quality / water treatment requirements, blending of supplies with Mokelumne water would not suffice).

Beyond the proposed FRWP pre-treatment plant, certain components of this portfolio would require the use of the constructed FRWP facilities as well as the use of the Mokelumne Aqueducts. The estimated dates for Portfolio E components to be online are shown in Table 6-18.

Portfolio E would provide water to meet the Need for Water in all years. Figure 6-28 displays how the portfolio was modeled for cost analysis purposes and it shows that excess water would be available in some years before it is needed to meet the Need for Water. Water transfers or use of groundwater banking and exchange components can also be ramped down as needed so that the Need for Water is not exceeded by the supply in any given year. However, the flexibility of the portfolio to provide water in excess of what has been estimated as being needed in a given year contributes to the ability of the portfolio to respond to unknown future conditions such as global climate change.

Challenges to implementation of Portfolio E are much the same as they are for those alternatives that rely on non-service-area

Table 6-18: Portfolio E Components and Project Online Dates to Meet the Need for Water

Component Category	Level/Projects	Component Yield (MGD)	Year Online
Rationing	10%	20	2010[1]
Conservation	Level C	37	Comes online throughout the 2010-2040 planning period with the full 37 MGD being achieved in 2040
Recycled Water	Level 3	11	Achieved by 2020
Supplemental Supply	Northern California Water Transfers	28.5	2010
	Bayside Groundwater Project Phase 2	9	2030
	Sacramento Basin Groundwater Banking / Exchange	4.2	2035

[1] As a practical matter, EBMUD will be unable to reduce rationing to 10 percent until it develops additional dry-year supplemental water supplies.

sources of supply as well as getting components online at the necessary date to meet the Need for Water. There are institutional and legal complexities that may be encountered. For example, finding and securing one or multiple water transfers up to 28.5 MGD by 2010 may be challenging, as it requires willing transfer partners (see "question mark" shown in Figure 6-28).

Pumping and energy requirements for Portfolio E are moderate and primarily related to the energy required for pumping and treating groundwater and recycled water. Total electricity use attributed to Portfolio E would range from a maximum of 149,266 MWh to a minimum of 122,884 MWh, with a median electricity use of 134,885 MWh. Total greenhouse gas emissions from Portfolio E would range from a maximum of 281 million metric tons of CO_2 to a minimum of 231, with a median emission level of 254. Portfolios A, C, and E all have similar median electricity use and greenhouse gas emissions.

Portfolio E would increase operational flexibility of the EBMUD water supply system, as it would provide a variety of both East Bay (Bayside Groundwater Project Phase 2) as well as Upcountry projects.

Providing additional dry year storage on the west side of the Delta at Bayside as well as increasing the amount of recycled water would contribute to the District's ability to meet the 6-month local storage criterion. Portfolio E would provide approximately 179 days (6.0 months) of standby storage from May through October and 188 days (6.3 months) of standby storage from November through April based on 2040 Demand. This portfolio would also provide several opportunities for EBMUD to partner with other Upcountry water districts.

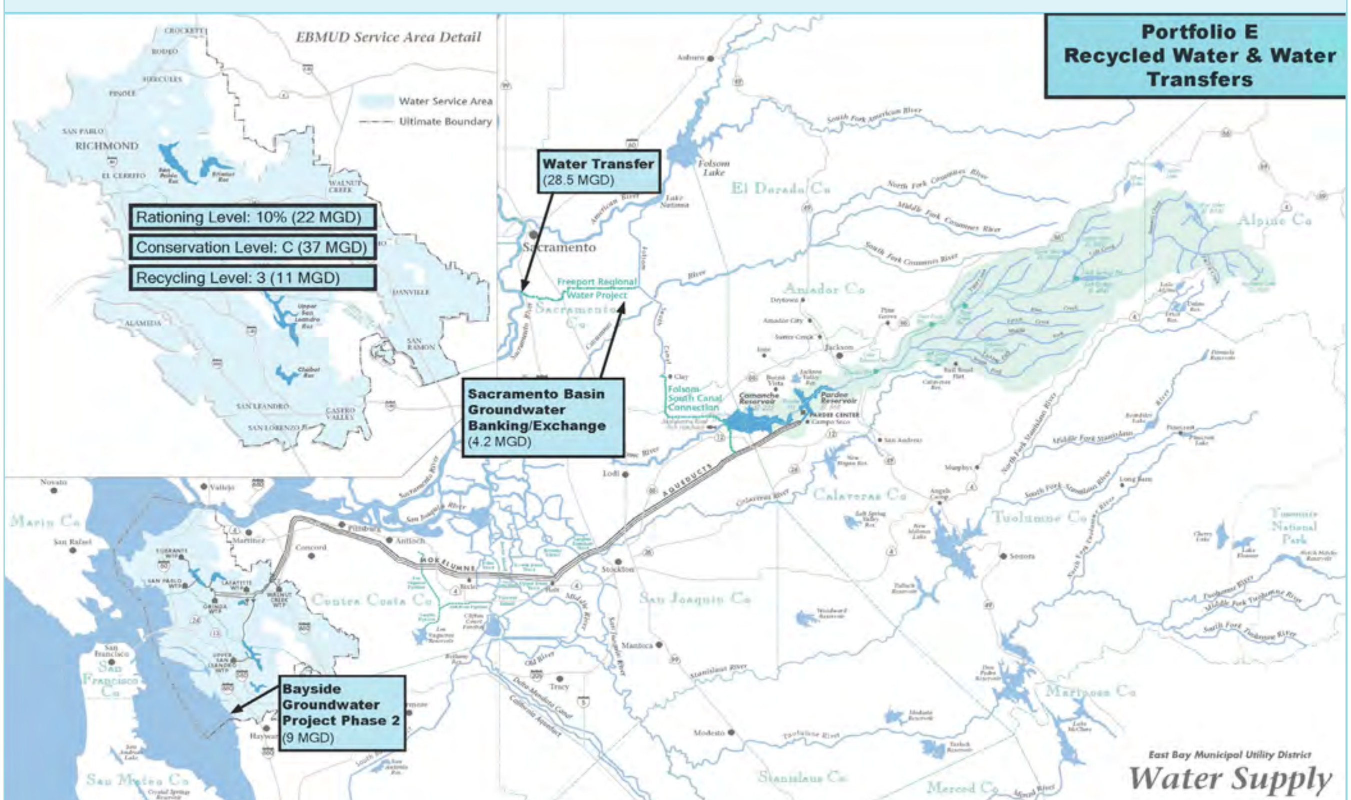
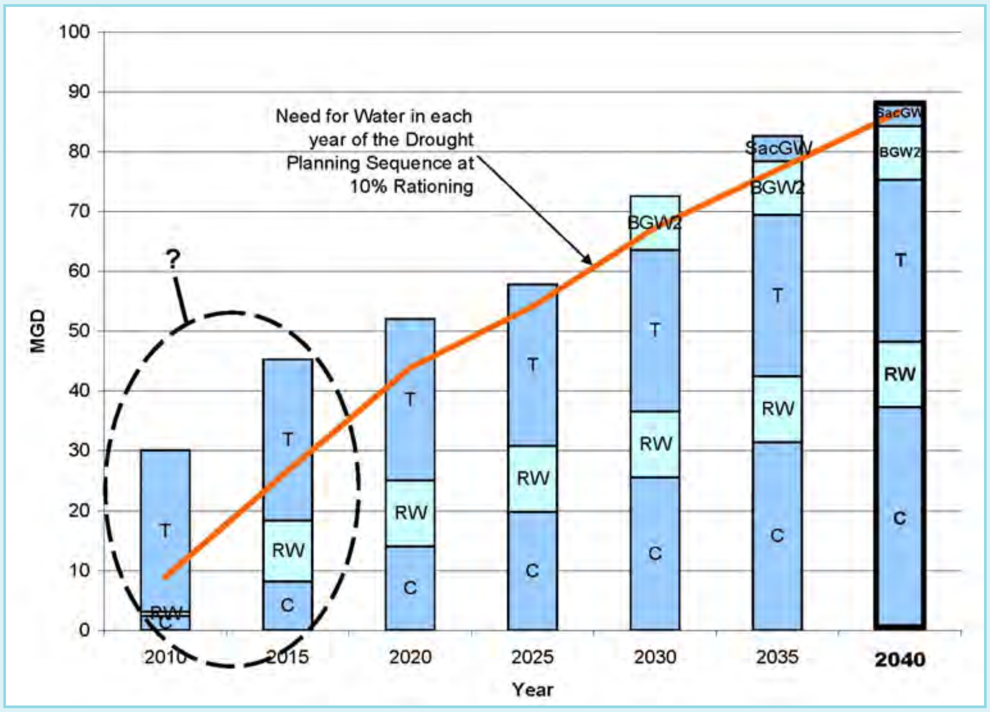


Figure 6-27 *Portfolio E Recycled Water and Water Transfers*

Table 6-19: CLC Feedback for Portfolio E

Pros	*Cons*
Higher levels of recycled water is direction California needs to go to leave more water for ecosystem purposes. EBMUD can be a pioneer for this.	Transfers would promote regional cooperation, but may be risky long-term
Using renewables to meet high energy demand would be a plus	Desalination is very costly
Use water multiple times (recycling) and more wisely (conservation) makes the system more reliable and environmentally sustainable	



Key

C = Conservation

RW = Recycled Water

T = Transfer

BGW2 = Bayside Groundwater Project Phase 2

SacGW = Sacramento Groundwater

Figure 6-28 *Portfolio E Meets the Need for Water over the Planning Period*

6.3.3 WSMP 2040 Portfolio

The WSMP 2040 Portfolio is designed to be robust, flexible, diverse, and to pursue projects on multiple, parallel tracks in order to respond flexibly to an uncertain water future. Many of the supplemental supply and recycled water components that are proposed in the WSMP 2040 have institutional or legal complexities or will require yet unknown amounts of time to develop, design, and construct. Thus, to provide flexibility and a robust strategy to deal with these uncertainties, as well as those relating to global climate change, an adaptable and flexible WSMP 2040 Portfolio was developed.

Rationing of up to 15% was chosen to allow the District flexibility in an emergency or to respond to the many unknown factors in the future. High levels of conservation (39 MGD) and recycled water (11 MGD) were chosen to maintain the District's current aggressive policies for overall demand management. The combination of rationing, conservation, and recycled water will satisfy increased customer demand through 2040.

Multiple simultaneous supplemental supply components will be pursued on parallel tracks to provide a diverse and flexible strategy to meet future water needs. The success of one component could result in delaying the need for additional supplemental supply components over the course of the planning period. Not all of the supplemental supply components listed above will be constructed as part of the WSMP 2040. The broad mix of projects, the inherent scalability present in several of the elements, and the ability to adjust implementation schedules for a particular project or program included in WSMP 2040 help to minimize the risks associated with the uncertainties and development time issues identified above. Table 6-20 provides a summary of the capital cost, operating and maintenance cost, dry-year cost per acre foot, and energy use for each element of the WSMP 2040 Portfolio.

A detailed description of the WSMP 2040 Portfolio is provided in Section 2.3, The Plan.

WSMP 2040 Portfolio Goals

The WSMP 2040 Portfolio includes the following rationing, conservation, and recycled water goals.

- Rationing of Up to 15%
- Conservation Level D (39 MGD)
- Recycled Water Level 3 (11 MGD)

Supplemental supply components needing to keep rationing at a lower level and meeting the Need for Water in drought years could include:

- Northern California Water Transfers
- Bayside Groundwater Project Phase 2
- Sacramento Basin Groundwater Banking / Exchange
- Regional Desalination
- Expand Los Vaqueros Reservoir (160 TAF Expansion)
- Enlarge Lower Bear Reservoir
- San Joaquin Basin Groundwater Banking / Exchange

Table 6-20: Summary of Capital, Operating and Maintenance, Dry Year Costs and Energy Use for Each WSMP 2040 Portfolio Element

Component[1]	Capital Cost (Mil. $)	O&M Cost ($/MG)	Dry Year Cost per Acre Foot ($/AF)	Energy Use (KWh/MG)
Conservation Level D	$319.4	$474	$4,000	--
ConocoPhillips Recycled Water Project Phase 1	$39.8	--	$1,700	3,751
ConocoPhillips Recycled Water Project Phase 2	$2.9	--	$400	3,751
East Bayshore Recycled Water Project - Phase 1B Alameda	$28.0	$987	$3,400	2,679
East Bayshore Recycled Water Project - Phase 2 Future Expansion	$9.4	$987	$2,600	2,679
Richmond Advanced Recycled Expansion (RARE) Water Project - Phase 2	--	$1,276	$5,606	1,400
Richmond Advanced Recycled Expansion (RARE) Water Project Future Expansion	--	$1,221	$1,300	5,606
Reliez Valley Recycled Water Project	$3.1	$2,807	$4,700	4,639
San Leandro Water Reclamation Facility Expansion Project - Phase 3	$16.3	$1,474	$5,300	2,509
San Ramon Valley Recycled Water Program - Phase 2	$5.0	$849	$1,600	4,265
San Ramon Valley Recycled Water Program - Phase 3	$5.5	$849	$1,900	4,265
San Ramon Valley Recycled Water Program - Phase 4	$2.5	$849	$1,600	4,265
San Ramon Valley Recycled Water Program - Phase 5	$5.4	$849	$2,700	4,265
San Ramon Valley Recycled Water Program - Phase 6	$4.0	$849	$2,900	4,265
Satellite Recycled Water Treatment Plant Project(s)[2]	$42.5	$574	$6,100	1,724
Lake Chabot Raw Water Expansion Project	$4.7	$468	$1,800	1,051
Water Transfers[3]	$20.0-$200.0	$649	$630	5,217
San Joaquin Basin Groundwater Banking / Exchange	$40.4	$1,051	$670	7,919
Enlarge Lower Bear Reservoir	$12.1	$418	$840	3,038
Bayside Groundwater Project Phase 2	$35.4	$853	$890	4,719
Sacramento Basin Groundwater Banking / Exchange	$25.0	$1,326	$1,250	8,895
Regional Desalination[4]	$79.3	$3,912	$1,970	11,000

[1] Cost information for the 160 TAF Expand Los Vaqueros Reservoir component is not provided, as cost modeling was not performed as part of the revision of the WSMP 2040
[2] Four satellite projects were included in the 11 MGD level for a total of 0.71 MGD
[3] Dry year yield ranging from 4.5-44.6 MGD
[4] The yield of the Regional Desalination component has been revised to 4 to 5 MGD since the 2009 WSMP 2040; however, all modeling results and cost estimates for this component were based on the yield assumption of 20 MGD

Source: WSMP Appendix D TM-6, sub-Appendix A: Cost Estimation Evaluation TM, September 30, 2008.

7. Glossary/Acronyms

7.1 Glossary

Acre-Foot - the quantity of water (43,560 cubic feet or 325, 800 gallons) that would cover one acre to a depth of one foot.

Aquifer - a porous soil or geological formation lying between impermeable strata in which water may move for long distances; yields groundwater to springs and wells.

Average annual runoff - the average annual (yearly) portion of the rainfall volume that contributes to overland flow and/or stream flow (i.e., the portion of rainfall that does not evaporate, get captured by plants via transpiration, and/or recharge the groundwater basin). Average annual runoff is calculated for drainage basins and/or specific areas or regions and is estimated based on a selected period of record that represents average hydrologic conditions.

Base Case - also called “Existing Conditions at 1990 Level of Development.” This case used 1990 demand conditions and fishery release requirements in accordance with the 1961 Agreement between EBMUD and CDFG.

Bay - unless otherwise noted, San Francisco Bay.

Beneficial use – the beneficial use of water is defined under federal law in the Clean Water Act, and by the State Water Resources Control Board in California. Some examples of beneficial uses include agricultural supply, industrial uses, groundwater recharge, freshwater replenishment, navigation, hydropower generation, water contact recreation, commercial and sport fishing, aquaculture, warm fresh water habitat. These categories are used to facilitate qualitative and quantitative water quality objectives.

Carbon footprint - a measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, measured in tons of carbon dioxide.

Carriage Water - Delta outflow required to compensate for the hydraulic effects of Delta exports on Delta circulation and, thus, water quality standards, or flow required in channel to provide adequate head for water delivery.

Cathodic protection (CP) - is a technique to control the corrosion of a metal surface by making it work as a cathode of an electrochemical cell. Cathodic protection systems are commonly used to protect water or fuel pipelines and storage tanks.

CDFG Plan - the plan for operations and other management proposed by the California Department of Fish and Game (CDFG) for the lower Mokelumne River.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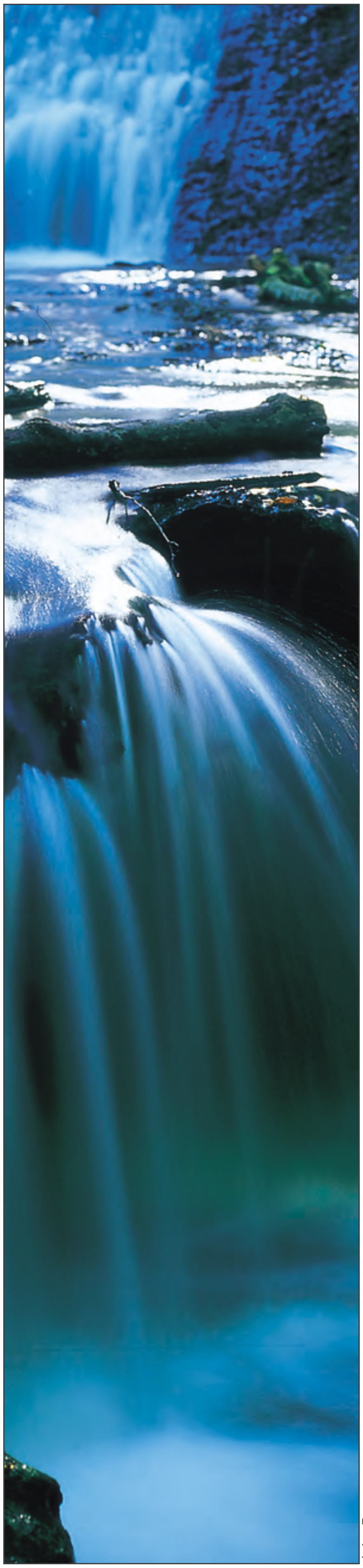

John Benson

Component - a constituent part; in this case, a water supply project or alternative part of a portfolio which can include a conservation component, a rationing goal, a recycled water component, and supplemental supply components such as groundwater storage/ conjunctive use, reservoir enlargements, desalination.

Conjunctive use - the operation of a ground water basin in combination with a surface water storage and conveyance system. Water is stored in the ground water basin for later use by recharging the basin during years of above-average water supply. Also termed aquifer storage and recovery.

Conservation - reduction in water consumption due to more efficient water use through technology or programs such as low-flow toilets, fixing of leaks, and restrictions on outdoor irrigation.

Conveyance - the transportation of raw water from the source to the point of delivery.

Critical Dry Water Year - for the Lower Mokelumne River Management Plan (LMRMP), a critical dry water year occurs when Pardee and Camanche storage is more than 250,000 acre-feet below that allowed by the Corps flood control rules.

Cubic Feet per Second (cfs) - a rate of flow; one cfs is equal to 0.265 acre-feet per day.

Customer shortage costs - shortage costs are losses when EBMUD customers reduce water use in response to rationing policies. For residential, institutional, and irrigation customer classes, shortage costs are measured in terms of lost customer surplus. For commercial and industrial customer classes, shortage costs are based on lost regional value added (e.g. lost labor income, profits, indirect business taxes, proprietor income and property income).

Delta - the Sacramento-San Joaquin River Delta.

Demand hardening - relates to the amount of conservation or rationing that customers are able to achieve, given that they have already achieved a certain level of water efficiency and savings.

Desalination (or desalinization) - the removal of salt from seawater or brackish water to produce drinking water.

Downstream Beneficial Uses - valued water uses downstream of a specified point. Beneficial water uses are recognized by state law.

Drought - a prolonged serious shortage of runoff resulting from lack of precipitation.

Drought Planning Sequence (DPS) - a system performance analysis technique used by water agencies to guide operational decisions in the event of a drought. A drought planning sequence is typically a series of years where their water sources (e.g., river intakes, reservoirs, etc.) produced the least amount of available water. Such a sequence is used to model how a water agency would respond to a similar condition in the future via its existing supply system and/or the existing system plus planned upgrades.

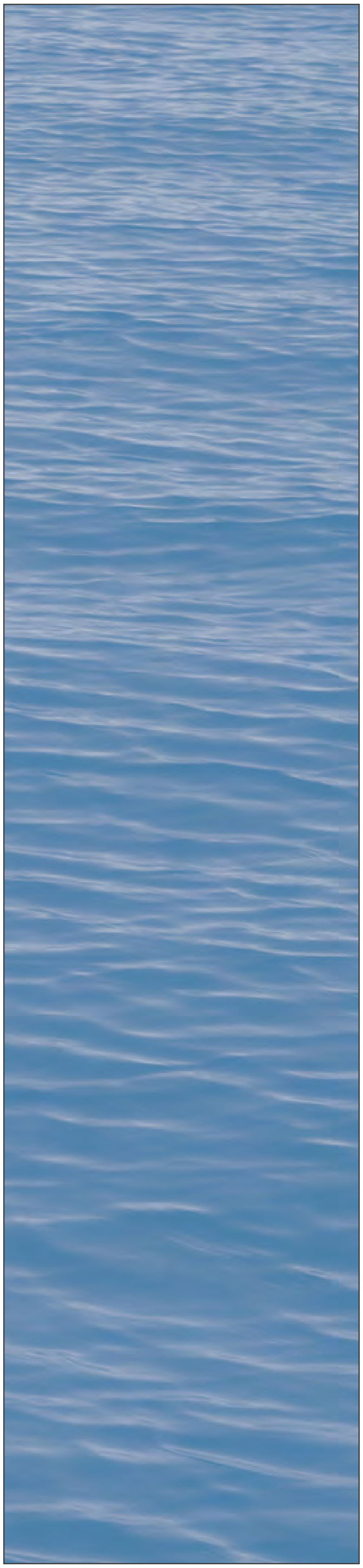
Dry Water Year - for the CDFG Plan, a dry year occurs when annual unimpaired inflow into Pardee Reservoir is less than 50 percent of the historical average. For the LMRMP, dry year releases are made if the storage on November 5 in Pardee and Camanche reservoirs is below (but by no more than 250,000 acre-feet) that allowed by COE flood control rules.

Evaluation Criteria - criteria used to rate components and portfolios. Evaluation criteria were applied to those components and portfolios which passed the exclusion criteria. The evaluation criteria were used to compare and array the components and alternatives for their relative satisfaction in meeting the WSMP 2040 planning objectives.

Exclusion Criteria - criteria by which potential components and portfolios were screened. These criteria are stated in terms of "must" and "must not" and provide the fatal flaw analysis through a binary decision; either a component does or does not meet the criteria. Any component/ portfolio which does not meet any one exclusion criterion, by definition, fails to meet critical WSMP 2040 planning objectives and is eliminated from further study.

Global Warming Solutions Act of 2006 (AB 32) - requires that California's global warming emissions be reduced to 1990 levels by 2020. This reduction will be accomplished through an enforceable statewide cap on global warming emissions that will be phased in starting in 2012.

Gross reservoir capacity - the total storage capacity available in a reservoir for all purposes, from the streambed to the normal maximum operating level. Includes dead (or inactive) storage, but excludes surcharge (water temporarily stored above the elevation of the top of the spillway).



Groundwater - water that occurs beneath the land surface and fills pore spaces of the alluvium, soil or rock formation in which it is situated.

Groundwater basin - a ground water reservoir, defined by impermeable surfaces and the underlying aquifers that contain water stored in the reservoir.

Groundwater banking – is a water management tool designed to increase water supply reliability by storing water underground during wet years for use during dry years. By using dewatered aquifer space to store water during wet years (when there is abundant rainfall and surplus water available), it can be pumped and used during dry years.

Groundwater overdraft – a condition that would exist in a ground water basin when the amount of water withdrawn exceeds the amount of water that is recharged into the basin (i.e., added to basin storage), resulting in declining water levels as measured in wells and an overall loss in water stored within the aquifer.

Groundwater recharge - increases in ground water storage by natural conditions (infiltration of rainfall and/or lateral flow of water into the basin from an adjoining and/or adjacent aquifer) or by human activity (man-made infiltration ponds and injection wells and/or via agricultural application of water as examples).

Lamorinda - areas in the region of the cities of Lafayette, Moraga, and Orinda.

Lower Mokelumne River Management Plan (LMRMP) - the Lower Mokelumne River Management Plan specifies flow regimes, reservoir operations, and hatchery operations that would enhance benefits to fishery resources in the Mokelumne River while maximizing flexibility in managing a variable water supply, uncertain future demands and uncertain linkages between fish populations and fishery management activities. The plan was developed by BioSystems and EBMUD for the lower Mokelumne River.

Need for Additional Water - describes the difference between the supply available to EBMUD during the drought planning sequence and EBMUD's demand for water during the drought. EBMUD's need for *additional* water is discussed in Chapter 4.

Need for Water - refers to the *total* amount of water EBMUD needs to supply its customers, the natural resources of the lower Mokelumne River, and the senior water right holders below Camanche Reservoir. (The need for additional water only refers to the incremental amount of water EBMUD cannot supply during the drought planning sequence.)

Normal Water Year - for the CDFG plan, annual unimpaired inflow into Pardee Reservoir is between 50 and 110 percent of historical inflow. For the LMRMP, a normal water year occurs when Pardee and Camanche storage on November 5 is at or above levels allowed by the COE.

Portfolio - for WSMP 2040, the combination of water supply components such as recycling, conservation, and supplemental supply components into one group; to be considered as an alternative for the overall water supply management program.

Rationing – voluntary or mandatory restrictions on customer water use during droughts. The Districts current rationing policy limits rationing to no more than 15 percent of total customer demand on an annual basis during a critical drought.

Rationing Goal - required reductions in water use to achieve the targeted reduction of total customer demand. At a given percent rationing target, different user groups are asked to ration at different levels in order to meet the overall percent rationing goal.

Raw Water - raw water is water taken from the environment, and is subsequently treated or purified to produce potable water. Raw water should not be considered safe for drinking or washing without further treatment.

Recycled water (reclamation) – wastewater that is treated to a secondary or tertiary level and is suitable to be used for agriculture, landscape, industrial and recreational uses

Regional Desalination - the Bay Area's four largest water agencies, Contra Costa Water District, East Bay Municipal Utility District, San Francisco Public Utilities Commission, and Santa Clara Valley Water District are jointly exploring developing regional desalination facilities that would benefit the 5.4 million Bay Area residents and businesses served by these agencies. Desalination removes salts from the ocean or brackish water to produce fresh water through distillation or filtration.

Riparian vegetation - vegetation growing on the banks of a stream or other body of water.

Runoff - the total volume of surface flow from an area over a specified time.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Sensitive Species - species with special legal or management status: federal endangered or threatened, federal candidate species, California state threatened or endangered, California state fully protected, and Department of Fish and Game bird and mammal species of species concern,

Streamflow - the rate of water flow past a specified point in a channel.

Water conservation – a reduction in water consumption due to more efficient water use through technology or programs such as low-flow toilets, fixing of leaks, and restrictions on outdoor irrigation; thus using less water to accomplish the same purpose.

Watershed Area - the areas drained by different rivers or river systems.

Water Transfers - selling or exchanging water or water rights among individuals or agencies.

Water Use - the quantity of water actually being diverted or assumed to be diverted in the future.

Water Year - October 1 to September 30.

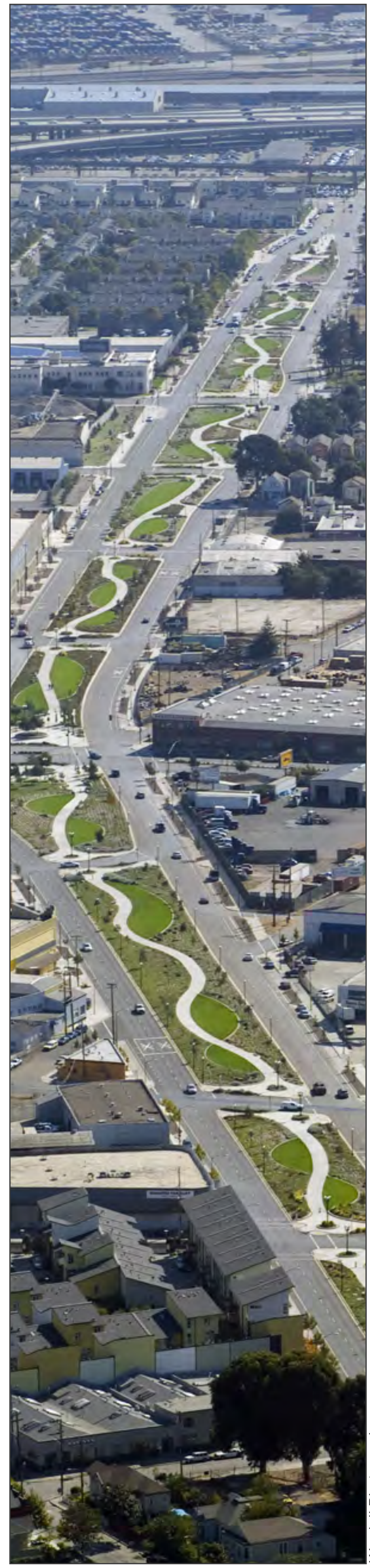
Water year types - five water year types have been established for the Mokelumne basin, using the flow records (total annual runoff) as kept for the River system. A mathematic approach was originally used to establish the range / limits of the particular year type. The five types present on the Mokelumne are as follows: Wet, Above Normal, Below Normal, Dry and Critically Dry.

WSMP 2040 Planning Objectives - broad statements of intent based on the District's overall needs. In the analysis process these objectives are divided into four categories for evaluation: Operational, Engineering, Legal and Institutional; Economic; Public Health, Public Safety and Sociocultural; and Environmental. Further described in Chapter 2.

Yield - the volume of water available over a period of time from a storage facility.

7.2 Acronyms

AB	Assembly Bill
ABAG	Association of Bay Area Governments
AC	acre
AF	acre-feet
AFY	Acre-feet per year
ASR	aquifer storage and recovery
AWA	Amador Water Agency
AWWA	American Water Works Association
AWWARF	American Water Works Association Research Foundation
Bay	San Francisco Bay
BCC	Business Classification Code
BCDC	San Francisco Bay Conservation and Development Commission
CCWD	Contra Costa Water District
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CLC	Community Liaison Committee
CoP	Conoco Phillips; ConocoPhillips Recycled Water Project
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
Delta	Sacramento-San Joaquin River Delta
DERWA	DSRSD/EBMUD Recycled Water Authority
District	East Bay Municipal Utility District
DMP	Drought Management Program
DMR	Demand Model Regions


Wardell Photography

EBMUD area site using recycled water

DPS	Drought Planning Sequence
DRMS	Delta Risk Management Strategy
DSRSD	Dublin San Ramon Services District
DSS	Decision Support System
DWR	Department of Water Resources (California)
EBMUD	East Bay Municipal Utility District
EBMUDSIM	EBMUD Simulation Model
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EOH	east-of-hills
FERC	Federal Energy Regulatory Commission
FLOD	Fixed-Level of Development
FRWA	Freeport Regional Water Authority
FRWP	Freeport Regional Water Project
ft	Feet
FY	fiscal year (July 1 through June 30)
GAC	granular activated carbon
GBA	Groundwater Banking Authority
GHG	greenhouse gas
GDP	gross domestic product
GSP	gross state product
GPM	gallons per minute
GPF	gallons per flush
GW	groundwater
GWh	gigawatt-hours
GWh/yr	gigawatt hours per year
Ha	hectares
hp	horsepower
IPCC	Intergovernmental Panel on Climate Change
IRCUP	Mokelumne Inter-Regional Conjunctive Use Project
IS	Index Sequential
JPA	Joint Powers Authority
JSA	Joint Settlement Agreement
JVID	Jackson Valley Irrigation District
kWh/MG	kilowatts hours of energy per million gallons of water
LAFCOs	Local Agency Formation Commissions
LEAD	Low Energy Application of Desalination
LUD	land use unit demand
MGD	million gallons per day
MOU	Memorandum of Understanding
MRFH	Mokelumne River Fish Hatchery
MSL	mean sea level
MWh	megawatt-hours
MWD	Metropolitan Water District of Southern California
NEPA	National Environmental Policy Act
NPV	net present value
NRC	U.S. National Research Council
NRWRP	North Richmond Water Reclamation Plant
OWR	Office of Water Recycling

PG&E	Pacific Gas and Electric Company
PEIR	Program Environmental Impact Report
PUC	Public Utilities Commission
RA1	Reclamation Alternative 1
RA2	Reclamation Alternative 2
RA6	Reclamation Alternative 6
RARE	Richmond Advanced Recycled Expansion
RO	reverse osmosis
SCVWD	Santa Clara Valley Water District
SCWA	Sacramento County Water Agency
SDWA	Safe Drinking Water Act
SDWMP	South Delta Water Management Plan
SEBP	South East Bay Plain
SEBPB	South East Bay Plain Basin
Semitropic	Semitropic-Rosamond Water Bank Authority
SFPUC	San Francisco Public Utilities Commission
SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SGA	Sacramento Groundwater Authority
SMUD	Sacramento Municipal Utility District
SOI	Sphere of Influence
SRVRWP	San Ramon Valley Recycled Water Program
SWP	State Water Project
SWRCB	California State Water Resources Control Board
TAF	thousand acre-feet
TAFY	thousand acre-feet per year
The Corps	US Army Corps of Engineers
TM	Technical Memorandum
ULF	Ultra low flush
UMRWA	Upper Mokelumne River Watershed Authority
UMW	unmetered water
USB	Ultimate Service Boundary
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USL	Upper San Leandro
VA	Vulnerability Assessment
W-E	WEAP-EBMUDSIM [model]
WCMP	Water Conservation Master Plan
WEAP	Water Evaluation And Planning [model]
WMP	Water Management Plan for the Upper Mokelumne Watershed
WOH	west-of-hills
WSMP	Water Supply Management Program
WTP	Water Treatment Plant
WY	Water Year (October 1 to September 30)

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