5.4 Water Resource Optimization

Arlington Desalter (WMWD)
Riverside, CA

Recommendations

Based on the data from 2010 Urban Water Management Plans (UWMPs), the Santa Ana River Watershed is able to meet its demands in the average, single-year drought and multi-year drought scenarios while maintaining a reliability margin of 10%, or greater, to help offset future unknowns. The UWMPs assume that:

1. Future local precipitation patterns will be the same as past precipitation patterns (possible effects of climate change addressed later in the Chapter)
2. The predicted reliability of the State Water Project as taken from the Department of Water Resources (DWR) *The State Water Project Delivery Reliability Report 2009* (August 2010) is accurate
3. Imported water projections include possible effects of climate change
4. Imported water will be managed to store wet year supply for use during dry years
5. Future demands will match the estimated demand
6. The watershed will invest over $4 billion in water conservation and infrastructure projects
7. Significant investments will be made to improve the reliability of imported water supplies as detailed in Metropolitan Water District of Southern California's (MWDSC) 2010 Regional UWMP

Given the uncertainty in these assumptions, it is recommended that the Santa Ana River Watershed focus on the implementation of water management concepts marked with a ☑ over the next five years to achieve water supply reliability over the broadest area of the watershed at the most reasonable cost. Each of these concepts is described in more detail in the **Water Management Strategies and Watershed-wide Project/Program Concepts to Improve Water Supply Reliability** section of the Chapter.

Summary of Water Management Strategies and Watershed-wide Project/Program Concepts to Improve Water Supply Reliability

(☑ indicates a concept recommended for focus during the next planning cycle)

	Strategy Concept (in no particular order)	Status	Estimated Benefit
REDUCE DEMAND			
☑	Water rate structures that encourage conservation	Widely implemented	Help meet SBX7-7 required demand reductions
☑	Public education to encourage water conservation	Widely implemented	Help meet SBX7-7 required demand reductions
	Outdoor conservation	Widely implemented	Help meet SBX7-7 required demand reductions
	Reduce evapotranspiration	Conceptual	More investigation required
OPTIMIZE IMPORTED WATER			
	Wet year storage program	In process	Increases storage in watershed
☑	Bay Delta Conservation Plan[1]	In process	$730{,}000 \times 0.18 = 131{,}400$ Acre Feet per Year (AFY) and improved water quality
	Imported water banking	Widely implemented	Water in dry years
	Prevent invasive species from clogging infrastructure	In process	Consistent deliveries
STORMWATER CAPTURE			
☑	Enhanced Santa Ana River stormwater	In process	12,000 AFY
☑	Enhanced stormwater capture from tributaries of Santa Ana River	In process	28,000 AFY
☑	Riverside North Aquifer Storage and Recovery Project	In process	12,800 AFY
☑	Enhanced Santa Ana River stormwater capture at Prado Dam	Conceptual	10,000 AFY
☑	MS4 Credits	Conceptual	Increased stormwater capture
☑	Re-operate flood control facilities	In process	More investigation required
☑	Size flood control facilities for stormwater capture	Conceptual	Increased stormwater capture
☑	Forest First: Forest management for increased downstream stormwater capture	In process	Increased stormwater capture

[1] Assume average maximum entitlement for the State Water Project (SWP) increases from 60% to 78%.

	Development Standards that enhance stormwater capture	Conceptual	Increased stormwater capture
RECYCLE WATER			
☑	Recycled water exchange	Conceptual	Capital and energy savings ($100s millions), improved water quality
☑	Recycled water for potable use	Conceptual	More investigation required
	Recycle wastewater flowing to the ocean	In process	157,000 AFY
	Import recycled water from outside the watershed	Conceptual	More investigation
	Ocean Desalination[2]		54,000 AFY
	Recycled water use to offset potable demand	In process	This is widely implemented by several agencies and part of the projected water supply portfolio
INCREASE STORAGE			
☑	Surface Water Storage	In process	Helps offset drought and climate change
☑	Groundwater storage	In process	Helps offset drought and climate change
IMPLEMENT EMERGENCY MEASURES			
	Emergency Measures	In process	Preparation for catastrophic event
	Total		**405,200 AFY**

The climate and geography of the State of California present a unique challenge to the management and delivery of water. While most of the precipitation falls on the northern portion of the State, most of California's population resides in the semi-arid, southern portion of the State. Water is diverted, stored, and then transferred from the water-rich north when needed to the more arid central and southern sections of the state through the California State Water Project (SWP), the Central Valley Project (CVP), and the Los Angeles Aqueduct.

In addition to the projects that transport water from the north to the south, the southern coastal area relies on water imported through MWDSC's Colorado River Aqueduct (CRA). The U.S. Bureau of Reclamation and seven basin states manage the Colorado River (CR) system under the authority of the Secretary of the Interior and for the benefit of seven "basin states". California's share of the CR Supply is 4.4 million acre-feet (maf).

During most years the supply available to the region has been adequate for its needs. The region has gotten through the drier years by using water that was stored during wetter years.

[2]Poseidon Huntington Beach Ocean Water Desalination, 50 million gallons per day.

Even though the State's water supply is more than adequate for its population and economic needs, the laws of the State and Federal governments have allocated the majority of that supply for environmental purposes and made building new surface storage increasingly difficult and expensive. This has forced Californians to seek more creative and sustainable and often more expensive solutions to water resource management wherever possible.

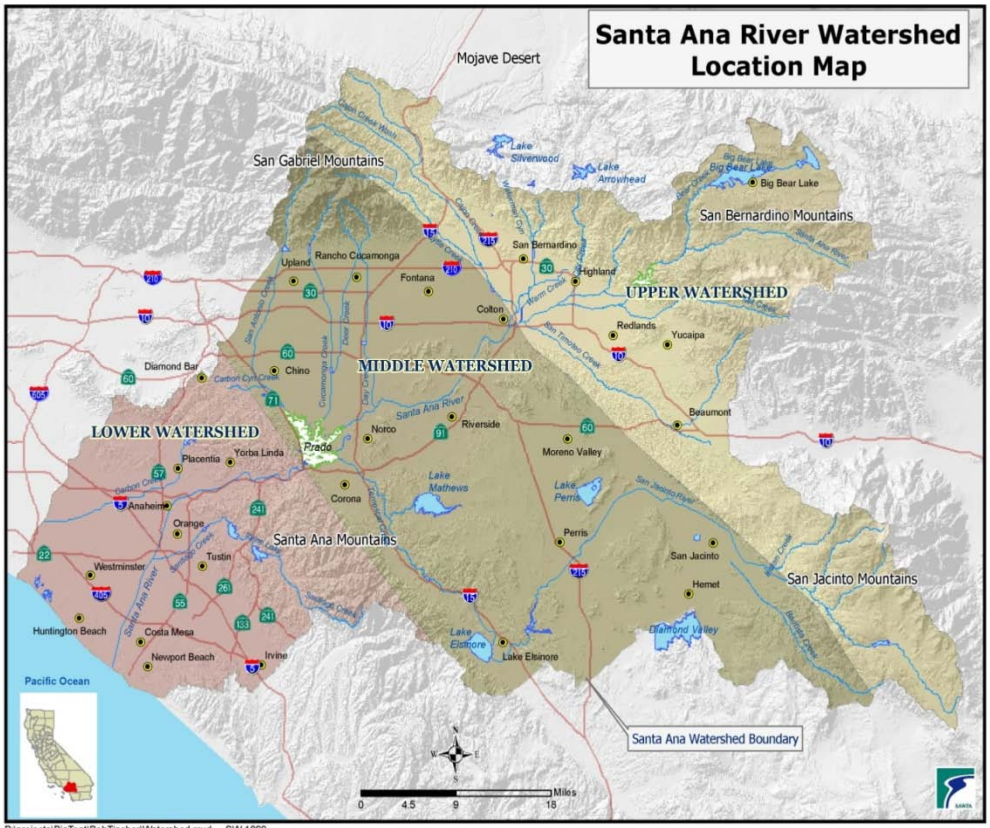
The Santa Ana River Watershed lies in semi-arid Southern California. Like many other areas, the watershed is carefully evaluating water supplies and demands and seeking creative, cost-effective strategies to provide a reliable water supply into the future. Water supply reliability in Southern California will be challenged by multi-year droughts, droughts on the CR, limited local water resources, the vulnerability of the Sacramento-San Joaquin River Bay-Delta, and the threat of climate change. In addition, vulnerabilities in regional and statewide infrastructure could increase due to major seismic events. Designing a diverse and flexible water resource management system that can meet these challenges will help to ensure water reliability and a sustainable and vibrant economy for the Watershed.

The One Water One Watershed (OWOW) collaborative process has facilitated the discussion of water management and sustainability throughout the Watershed. The key objective for water supply reliability is a cost-effective and diverse water supply and water storage portfolio that makes better use of existing facilities and supplies; improves overall water use efficiency; achieves a practical level of inter-connections and redundancy; and optimizes water storage for use during drought periods. This section of the plan focuses on how to maintain a robust and reliable water supply within the watershed.

Current Conditions

There are five principal wholesale agencies that form the Santa Ana Watershed Project Authority (SAWPA) and manage most of the water supplies within the watershed, both local and imported. In addition to these regional water agencies, the watershed also contains portions of four counties represented, as well as retail and wholesale water agencies. For purposes of this report, the analysis has been organized by three general areas: upper watershed, middle watershed, and lower watershed. These areas are subsets of the Santa Ana River Watershed (**Figure 5.4-1**). The regional water agencies within each general area are described below.

Figure 5.4-1 Watershed Areas



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Upper Watershed

San Bernardino Valley Municipal Water District (Valley District) is a State Water Contractor and provides imported water from the SWP to local retail agencies in its 325 square mile service area to supplement and enhance groundwater resources. Valley District's service area generally includes the cities and communities of San Bernardino, Colton, Loma Linda, Redlands, Rialto, Bloomington, Highland, Grand Terrace, and Yucaipa. Valley District is a member agency of SAWPA.

San Gorgonio Pass Water Agency (SGPWA) is a State Water Contractor, and provides imported water from the SWP to local retail agencies in its 225 square mile service area to supplement and enhance groundwater resources. SGPWA's Service area includes Calimesa, Beaumont, Banning, Cherry Valley, Cabazon, and Morongo Indian Reservation. The SGPWA service area straddles the Watershed, with its western two-thirds in the watershed and eastern one-third in the Whitewater River watershed.

Middle Watershed

Eastern Municipal Water District (EMWD) is a member agency of MWDSC and provides both water and sewer service throughout its 555 square mile service area. Major communities include Moreno Valley, Hemet, San Jacinto, Perris, Sun City, Menifee, Winchester, and parts of Temecula, and Murrieta. In addition to retail customers, EMWD wholesales water through seven local water agencies. EMWD is a member agency of SAWPA.

Western Municipal Water District (WMWD) is a member agency of MWDSC and provides water service throughout its 510 square mile service area in western Riverside County. Within its boundaries lie the communities of Jurupa, Rubidoux, Riverside, Norco, Corona, Elsinore Valley, and parts of Temecula. WMWD serves imported water directly to customers who are located in the unincorporated and non-water bearing areas around Lake Mathews and portions of the City of Riverside. Ten wholesale customers are served by WMWD with both CR and SWP water. WMWD is a member agency of SAWPA.

Inland Empire Utilities Agency (IEUA) is a member agency of MWDSC and provides water and sewer services to a 242 square mile area in the western portion of San Bernardino County. Within its boundaries lie the Cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga, and Upland. IEUA is a member agency of SAWPA. Also, the majority of the IEUA service area overlies the Chino Basin Watermaster boundary.

Chino Basin Watermaster (Watermaster) is a consensus-based organization facilitating the development and utilization of the Chino Groundwater Basin. The Watermaster consists of various entities pumping water from the Basin including cities, water districts, water companies, agricultural, commercial, and other private concerns. The Watermaster's mission is "to manage the Chino Groundwater Basin in the most beneficial manner and to equitably administer and enforce the provisions of the Chino Basin Watermaster Judgment", Case No. RCV 51010 (formerly Case No. SCV 164327).

Lower Watershed

Orange County Water District (OCWD) manages groundwater within its 355 square mile service area. Within its boundaries lie the Cities of Anaheim, Buena Park, Costa Mesa, Fountain Valley, Fullerton, Garden Grove, Huntington Beach, Irvine, La Palma, Los Alamitos, Newport Beach, Orange, Placentia, Santa Ana, Seal Beach, Stanton, Tustin, Villa Park, Westminster, and Yorba Linda. OCWD recharges the groundwater basin with surface water flows from the Santa Ana River and Santiago Creek, recycled water from the OCWD Groundwater Replenishment System (GWRS), and imported water which is purchased from the Municipal Water District of Orange County. OCWD is a member agency of SAWPA.

Municipal Water District of Orange County (MWDOC) is a member agency of MWDSC and sells imported water to 29 retail water agencies and cities in north and south Orange County. MWDOC also sells water to OCWD. MWDOC also straddles the Watershed, with its northernmost portion being in the Watershed and its southern portion being outside of the watershed.

Within each of these regional agencies, there are a number of retail water agencies. For purposes of brevity, these local agencies have not been individually listed in this report. However, these agencies did provide invaluable input into the OWOW process.

Water Sources

The Watershed gets about 50% of its water from local precipitation in the form of surface water and stored as groundwater. The Watershed imports about 30% of its water from the SWP and Colorado

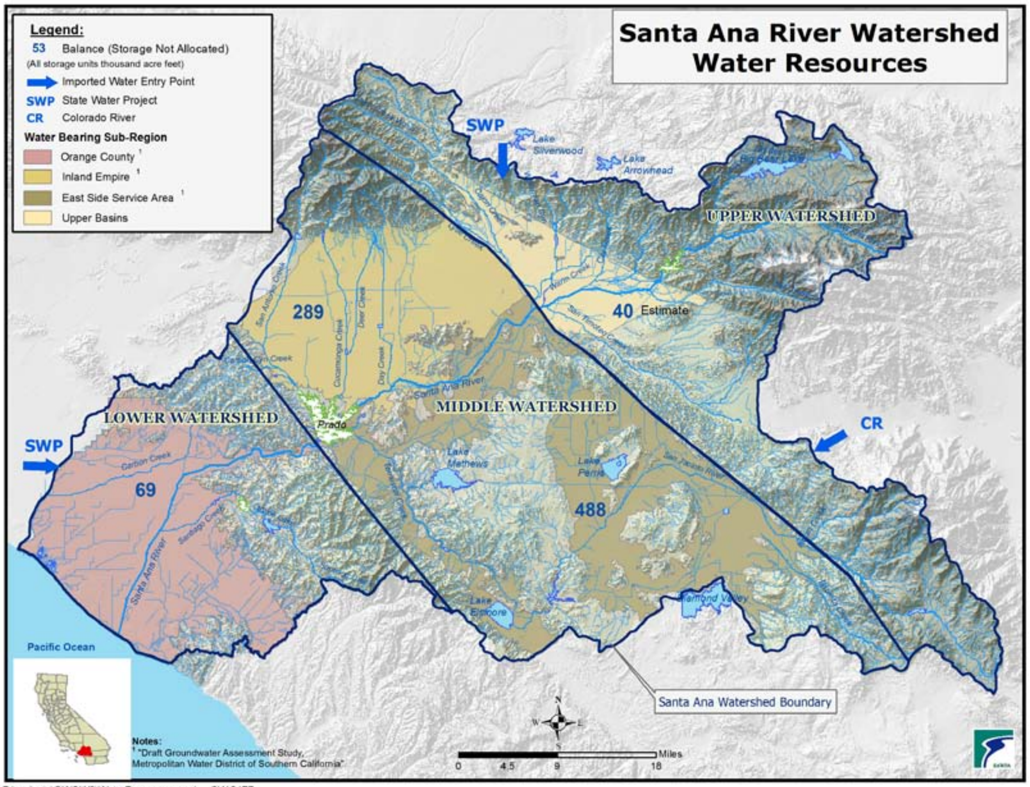
River. The remaining 20% of the Watershed's water supply is recycled water. Each of these sources are explored below.

Precipitation Stored as Groundwater

The underground pore space between soil granules provides a location to store water, referred to as groundwater, which can be later extracted using wells. To avoid double-counting water supplies, OWOW 2.0 limits the term groundwater to precipitation stored as groundwater. Imported water stored in the ground is classified as "imported water". The watershed's underground storage space functions essentially like a series of underground reservoirs. These underground reservoirs, or basins, range from a few hundred to over one thousand feet in thickness. Basins upstream from Prado Dam underlie about 1,200 square miles of the watershed, while basins downstream from Prado Dam underlie about 400 square miles of the watershed. Yields of nearly all of the basins within the watershed have been estimated using past hydrology and, for planning purposes, agencies have assumed that this past hydrology will continue to repeat itself and does not include any possible effects from climate change. Possible water resource effects from climate change are addressed later in this chapter and the possible overall effects of climate change are addressed in **Chapter 5.13 Energy and Environmental Impact Response**. Recognizing that hydrological patterns are expected to be altered due to climate change with subsequent impacts to demand and supplies, climate change impacts are discussed and addressed later in this chapter. Basin's safe yield is the amount of water that can be annually pumped from a basin on a permanent basis without emptying the basin.

In general, the watershed relies on precipitation stored as groundwater to provide about 50% of the water supply. **Figure 5.4-2** generally shows the larger groundwater basins within the watershed along with any available storage capacity (individual basins and sub-basins have been omitted for clarity). These basins provide storage space for local and imported water supplies that can be used during droughts or other shortages. The amount of storage space in the lower watershed is based on the storage volume that could be available in approximately eight out of ten years.

Figure 5.4-2 Groundwater Resources within the Watershed (Thousand acre-feet)



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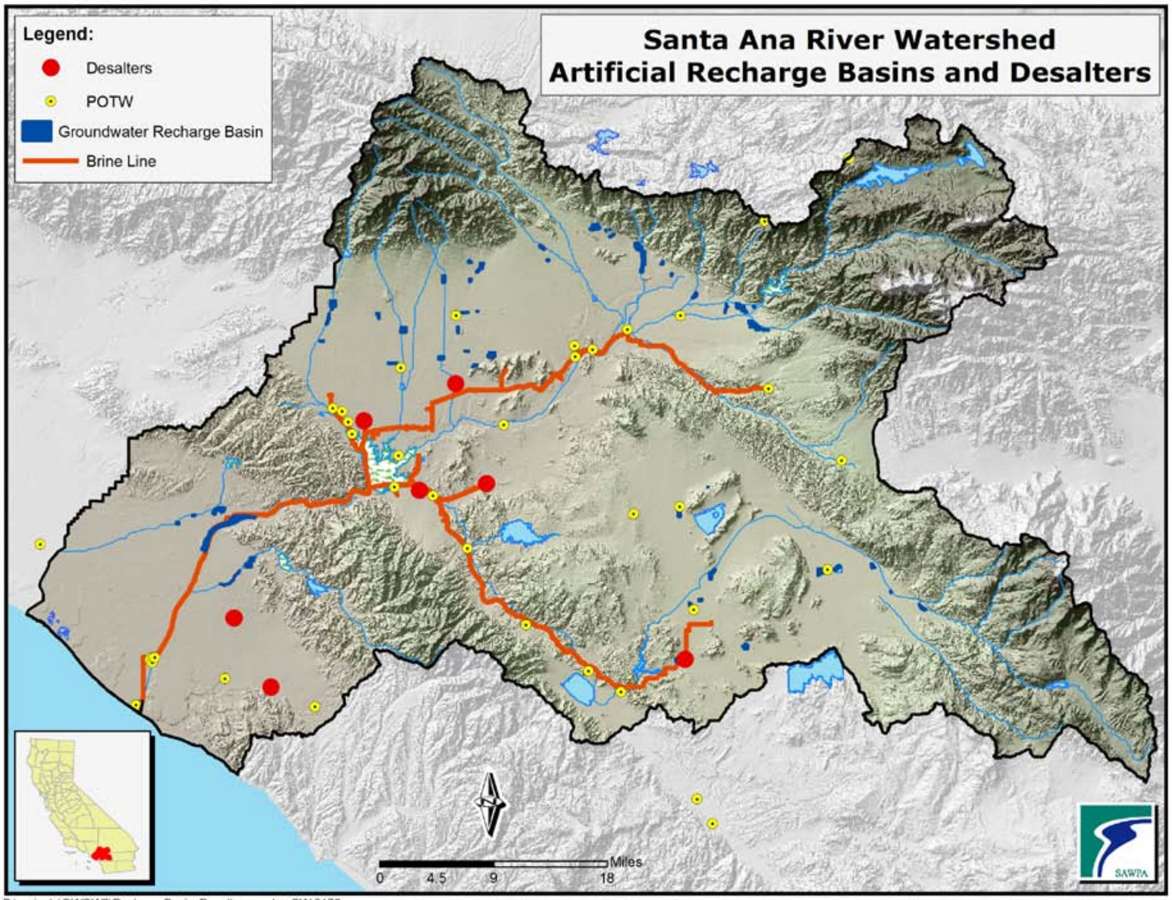
Artificial replenishment involves storing additional water in the basin(s), over and above precipitation stored as groundwater. The most common type of artificial replenishment is “spreading” water into open “pits”, or basins, and allowing it to soak into the ground down to the “water table”. Another commonly used method is called “in-lieu” replenishment. This method involves replacing groundwater with another source of water. This corresponding reduction in groundwater pumping results in less water being removed from the basin which effectively acts to replenish the groundwater supply. Finally, the most costly method of artificial replenishment is to inject the water into the basin using an injection well(s). Of the various methods available, artificial recharge the most common throughout the Watershed. **Figure 5.4-3** shows the locations of spreading basins in the watershed.

Figure 5.4-3 Artificial Recharge Basins and Desalters



One challenge to groundwater supplies in the watershed is poor water quality, typically due to total dissolved solids (TDS or salinity) and nitrates. These salts accumulate mostly through use and evaporation, but also are introduced to the water supply by way of agricultural fertilizers and septic tanks. Further, there are numerous forms of contamination found in the watershed, such as; TCE, PCE (commonly used solvents) and Perchlorate (fertilizer, fireworks and explosives). All these forms of contamination must be removed using various treatment methods before it can be introduced into the water supply system.

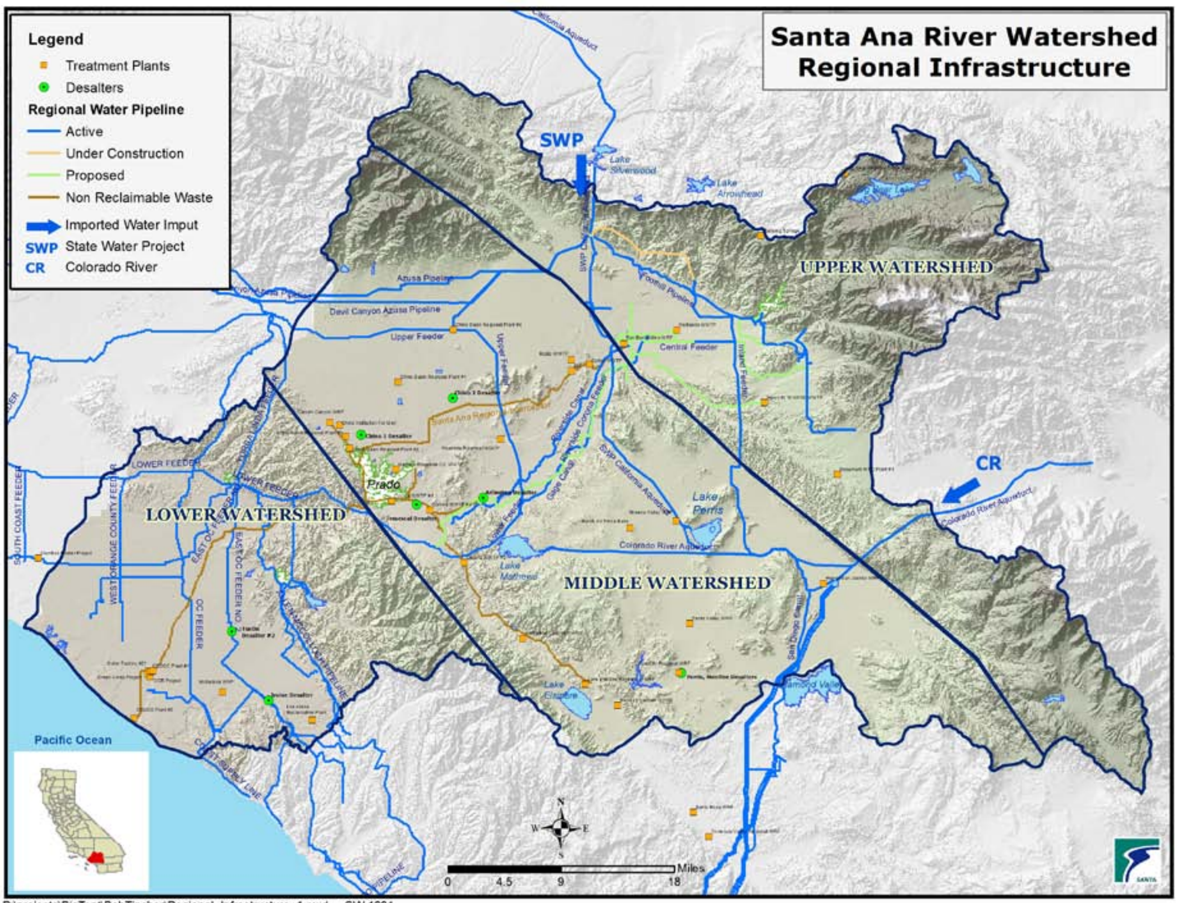
Precipitation as Surface Water

In 2005, the amount of precipitation that flowed from rivers and streams that was diverted and used accounted for approximately 5% of the total water supply. Local surface water is largely seasonal, meaning that most of the water comes in the "wet" or rainy season, and is dramatically reduced in the "dry" season to snowmelt, natural springs, and treated wastewater flows. Facilities, such as dams and flood control detention basins divert and slow storm runoff providing additional opportunity for groundwater replenishment. In the upper watershed, only a portion of storm runoff is being diverted and used as surface water. In other portions of the watershed, the exact opposite is true. Much of the runoff from the upper and middle watershed is captured by the U.S. Army Corps of Engineers' Prado Dam and later is used by the Lower Watershed. A similar opportunity is available in the upper watershed at the U.S. Army Corps of Engineers Seven Oaks Dam and other dams in the watershed.

Imported Water

The watershed relies upon imported water for about 1/3 of its water supply. Water is imported into the area by MWDSC (SWP and CR), SGPWA (SWP) and Valley District (SWP). Current and predicted reliability of the SWP was taken from DWR's *The State Water Project Delivery Reliability Report 2009* (August 2010). **Figure 5.4-4** shows the regional infrastructure and the entry points for the SWP and the CR.

Figure 5.4-4 Regional Infrastructure within the Watershed



As shown on **Figure 5.4-4**, there are significant regional pipelines (48 inch diameter and larger) and surface storage reservoirs in the watershed. These pipelines provide opportunities for water transfers, especially in an emergency situation. **Table 5.4-1** provides a list of surface water reservoirs in the watershed and their capacities.

Table 5.4-1 Surface Water Reservoir Capacities

Reservoir	Capacity (acre-feet)
Lake Arrowhead	48,000
Big Bear Lake	73,000
Diamond Valley Reservoir	800,000
Lake Elsinore	45,000
Canyon Lake	12,000
Lake Mathews	178,500
Lake Perris	120,000
Prado Dam	Flood control and conservation
Seven Oaks Dam	Flood control (conservation pending)
Lake Silverwood	74,970
Irvine Lake	25,000

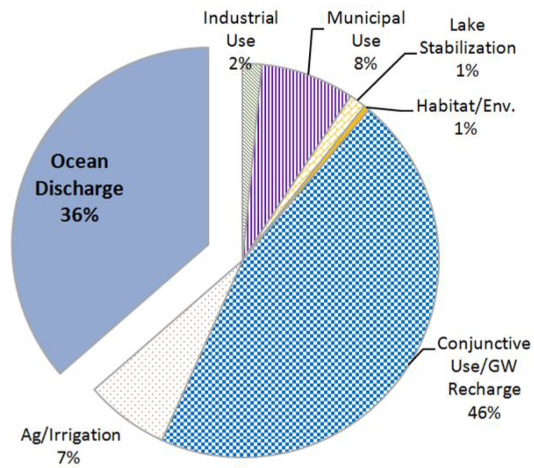
Recycled Water

Water recycling, also known as water reclamation or water reuse, is a reliable, economically feasible, and environmentally sensitive means to preserve the State's potable water resources, assist with drought mitigation, and reduce the demand on potable water supplies.

Statewide, over 669,000 (AF) of wastewater is recycled each year according to the State Water Resources Control Board (SWRCB). Currently, recycled water is used to irrigate agricultural crops, urban landscapes, golf courses, and freeway medians; replenish groundwater basins; flush toilets and urinals; and act as a barrier to sea water intrusion into freshwater groundwater basins. It is also increasingly used by industry in cooling processes, in new home and other construction, and for other purposes. In the future, the level of recycling will increase to help meet the needs of the State's burgeoning population.

Current Conditions in the Watershed

Figure 5.4-5 Current Rate of Recycled Water Use within the Watershed



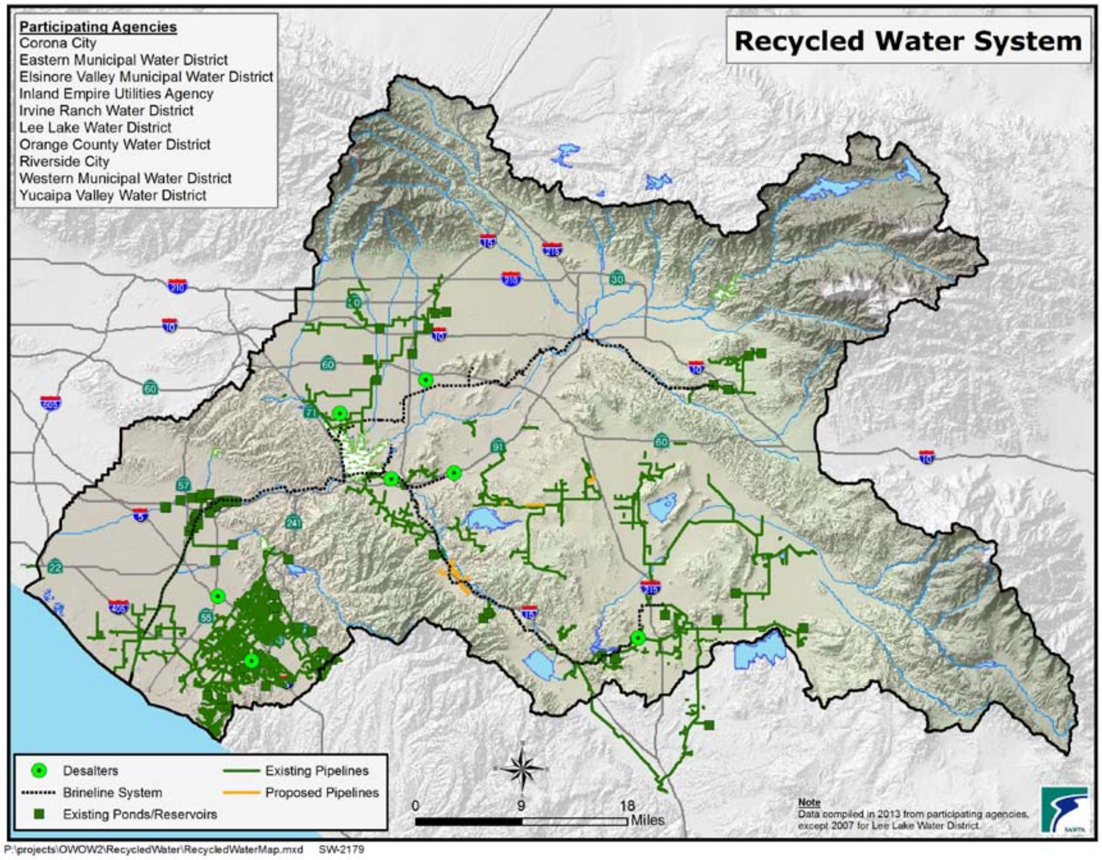
Recycled water has been used in the watershed for many years to supplement local and imported potable supplies. Water reclamation involves treating wastewater to State standards so that the water is safe for State-approved applications. Currently, over 285,000 AFY of recycled water is being used to meet groundwater recharge (72%), municipal (12%), agricultural irrigation (11%), lake stabilization (2%) , industrial (2%), and habitat and environmental (1%) water needs within the Santa Ana River Watershed (see **Figure 5.4-5**). The 285,000 AFY includes approximately 100,000 AFY of tertiary treated wastewater that flows down the Santa Ana River from San Bernardino and Riverside Counties that is recharged by OCWD in surface recharge basins in Anaheim and Orange. OCWD generally captures all of the river flows, except during periods of high storm flow. As seen in in **Figure 5.4-5** only 36% of recycled water in the watershed, or 157,000 AF is currenlty being discharged to the ocean.

The 100,000 AFY is considerably more than the 42,000 AF at Prado Dam required by the 1969 Orange County Judgment. As demands continue to increase and other supplies become less reliable, the upper and middle watershed have plans to increase recycling. Over time, any reduction in treated wastewater flow in the river would have to be replaced by OCWD recycling more of the wastewater that flows into the ocean, importing more water, desalting the ocean, or some other new source of supply. Tables 5a.8 through 5a.11 of **Appendix C** show the proposed increase in recycled water use in the upper watershed from 2015 through 2035.

Overall recycled water currently represents the third largest water supply source to the watershed, accounting for approximately 20% of total water demands. **Appendix C** includes information about existing and proposed treatment facilities, plant flow and recycled water use.

Figure 5.4-6 shows the recycled water systems in the watershed. Included in the display are existing and proposed recycled water pipelines, existing and proposed wastewater treatment plants, existing and proposed storage tanks, existing storage ponds, and the Inland Empire Brine Line. Agencies that provided map information include Big Bear Area Regional Wastewater Agency, City of Corona, City of Riverside, EMWD, EVMWD, IEUA, Irvine Ranch Water District, Lee Lake Water District (LLWD), Orange County Sanitation District (OCSD), OCWD, WMWD, and Yucaipa Valley Water District (YVWD).

Figure 5.4-6 Recycled Water Systems

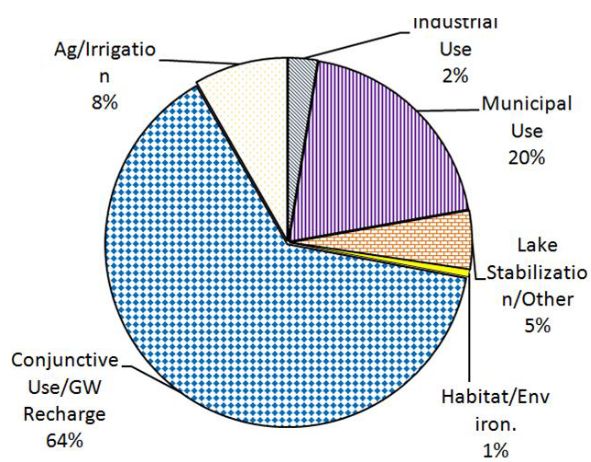


Proposed Recycled Use

As urban and suburban growth and development in the watershed continue, an increasing amount of recycled water will be available while the traditional demand by agricultural customers will decrease. This creates a challenge to establish a growing recycled water market for groundwater recharge, commercial, industrial, and institutional customers as well as developing innovative and creative markets elsewhere.

Current projections for 2035 indicate 432,000 AFY of water treatment plant flows will be recycled in the watershed, and 205,000 AFY discharged into the ocean. **Figure 5.4-7** depicts the estimated distribution of the recycled water in 2035.

Figure 5.4-6 Projected 2035 Rate of Recycle Water Use within the Watershed



Current Management Strategies

Current management strategies include the planned and conceptual recycled water projects as described below.

EMWD has completed a Recycled Water Strategic Plan to identify the preferred strategy to be pursued in developing its recycled water system through the year 2030. The principal goal of the Strategic Plan was to develop a preferred long term strategy for highest beneficial reuse of recycled water. EMWD's Recycled Water Strategic Plan recommended the Indirect Potable Reuse (IPR) Project, using advanced treated water for recharge of basins in the Hemet/San Jacinto Water Management Plan area. Currently, EMWD is working on a phase I planning study. This next step in the planning process consists of determining blending water strategy, brine disposal alternatives, salt balance considerations, regulatory requirements, facilities needs assessment & constraints analysis and program cost analysis. This phase will produce 5,000 AFY, and is scheduled to be completed in 2020.

City of Riverside - The SWRCB approved the City of Riverside's wastewater change petition on May 20, 2008. The primary condition of the Order requires that the City of Riverside discharge not less than 25,000 AFY of treated wastewater from its Regional Water Quality Control Plant to the Santa Ana River. The Order also modified the purpose of recycle water use to include municipal, industrial, and agricultural purposes and expanded the place of use to included areas within the City's limits, the City's water service area boundary, and within the boundary of the Jurupa Area Plan to reflect diversion of treated wastewater to recycled water use sites. To be able to meet these future projected needs without increasing the City of Riverside's reliance upon imported State Water purchases, it will be critical for the City of Riverside to significantly expand its use of the recycled water recently made available.

In addition to the description of the City of Riverside's recycled water efforts, the City of Riverside Public Utilities also received a master reclamation permit from the Regional Water Quality Control Board.

IEUA recently developed a Three Year Business Plan to rapidly expand the recycled water distribution system and increase recycled water use by 35,000 AFY. The capital program emphasizes increased system storage as well as distribution system piping and piping to reach high capacity recharge sites. The business strategy, while regional in nature, is founded on the principle of partnerships with IEUA member agencies, both from a water marketing standpoint and a capital facilities standpoint. The partnerships are having the effect of "supercharging" the capital program through conversion of member agency owned local potable water facilities to regional recycled water facilities.

LLWD has completed a recycled water master plan that will allow for the connection of the local parks and schools in the near future. They also have partnered with the City of Corona in its Ground Water Management Plan for the basins underlying LLWD's boundaries. LLWD currently is investigating potential groundwater recharge options.

OCWD and OCSD jointly developed the GWRS. In 2011, the GWRS produced 72,000 AF of recycled water. OCWD is constructing the Initial Expansion of the GWRS. This project will increase the amount of water produced by 31,000 AFY. When construction is completed in 2014, the total amount of water produced by the GWRS will be 103,000 AFY. OCWD is also evaluating an additional expansion of the

GWRS. Implementation of additional expansion of the GWRS would further reduce the amount of effluent discharged into the ocean. Because they reduce the amount of water discharged into the ocean, expansions of the GWRS are a new regional water source that would increase the net overall supply of water to the watershed.

City of Riverside in May 2013, the Regional Water Quality Control Board adopted Order No. R8-2013-0028 granting the City of Riverside Public Utilities a waste discharge requirements and master reclamation permit for distributing recycled water.

Valley District does not own or operate a wastewater treatment plant within its service area. However, recycled water is part of the region's water budget as they move toward the future. The City of San Bernardino Municipal Water Department is planning a "clean water factory" that may produce up to 14,000 AFY in the future.

WMWD expanded its recycled water portfolio with the expansion of the Western Water Recycling Facility (WWRF) in 2011. The plant is capable of producing up to three Million Gallons per Day (MGD) of tertiary-treated recycled water. Plans call for eventually expanding to five MGD.

WMWD possesses an extensive non-potable distribution system that includes both storage and pumping capabilities. This system functions as the backbone distribution system to expand use of recycled water (for irrigation) within its service area. One major commercial area (Meridian Business Center) and one large residential community already are dual-piped for recycled water use and a new Riverside Unified School District (RUSD) high school has been retrofitted to allow recycled water use. Two new large residential projects (including a golf course development) will be conditioned to install dual plumbing. WMWD also will work with RUSD to dual plumb new campuses, including a new middle school west of the Orangecrest area.

The City of Riverside is still working with WMWD to conduct joint planning for recycled water use. At this time, the City does not plan to deliver recycled water to Riverside's greenbelt. The system also will distribute non-potable groundwater through the legacy canal system thereby maximizing use of local water resources.

WMWD is working with the Riverside County Ben Clark Training Center to site a large recycled water storage impoundment on their facility located just south of Van Buren Boulevard and west of I-215. This proposed 600 AF impoundment would serve the County as a dive/water training facility while providing wet weather storage for recycled water produced by the WWRF, a truly unique and innovative use of recycled water.

Finally, WMWD is in the early stages of evaluating the use of recycled water to recharge local groundwater basins as a new source of supply. As total summer irrigation demands likely will exceed recycled water supply, recharge will probably be limited to winter months. Close coordination with the Regional Board and California Department of Public Health (CDPH) will be required.

YVWD adopted a Strategic Plan in August 2008, which outlines the methods used to maximize the use of recycled water to meet future water demands. This policy requires new homes to install dual water meters to provide potable water and non-potable water to each property. The use of recycled water delivered to residential and commercial properties for irrigation is expected to reduce future potable water demands by 50%-60% per equivalent dwelling unit. This policy will require YVWD to implement a salinity control program which will provide extremely high quality recycled water to new neighborhoods providing a sustainable water supply for the future.

Other reclamation projects in the watershed include innovative uses such as toilet and urinal flushing in high-rise buildings and schools as well as residential landscaping irrigation, as evidenced by recycled water programs in IRWD.

Barriers and Constraints

Challenges related to recycling projects include: regulatory requirements, brine line constraints, storage/seasonal constraints, financial constraints, water quality management, and public perception. They are discussed below.

Regulatory Requirements

An important component of maximizing local supplies is the ability to safely and efficiently regulate and permit recycled water use. California's laws governing the permitting of recycled water were established more than 20 years ago, and are in need of updating to communicate that recycled water is a valued commodity, not a waste. Additionally, the current permitting framework establishes multiple recycled water permitting paths and overlapping jurisdictions overseeing the process which has resulted in confusing, costly delays and often inconsistent requirements.

To address some of these concerns, the Recycled Water Act of 2013 is currently making its way through the legislative process with the support of many water agencies and water reuse proponents. This bill will address barrier to recycled water use. It will align recycled water spill reporting and incidental runoff in codes, and authorize SWRCB permitting of advanced treated water. Clear, comprehensive legislation is required to maximize the use of recycled water in the future and to further reduce reliance on imported water.

In November 2011, the CDPH released draft regulations regarding recycling water for public comment. These draft regulations pertain to groundwater replenishment with recycled water. CDPH reviewed the public comments and released another draft in March of 2013. The final proposed version will proceed through the formal regulation adoption process and will be subject to public review and comment as part of that process.

Storage/Seasonal Constraints

The recycled water supply is not dependent on weather patterns; supply is fairly constant throughout the year. For these reasons, recycled water is viewed as one of the most reliable sources of water in the Watershed. However, because recycled water is used primarily for irrigation purposes and associated seasonal demands, recycled water demands can be variable and are often affected by weather and the season. In some areas, demands increase in dry years. However, wet years generally pose a greater operational challenge as customer demand decreases and storage facilities fill. Storage during periods of low demand is necessary to meet high demand during other times of the year. The amount of available recycled water storage varies greatly between agencies. Some have little or no storage and others have thousands of AF of storage. Each agency's existing and proposed recycled water storage facility capacities, excluding groundwater basins, are shown in **Appendix C**.

Financial Constraints

The cost of infrastructure to produce, store, and distribute recycled water is expensive. Given that demands for recycled water are more scattered throughout communities, recycled water distribution pipelines are built only where demands justify the expense and where customers agree to use recycled water. This is especially true where sites need to be retrofitted to use recycled water as opposed to newly constructed sites where rules may dictate its use. Other issues include the cost of recycled water use to the customers as well as administration of the recycled water system by both the distributor and user. Because of the cost, there are sites where there may be willing customers but no infrastructure to serve them. Grant funds and other forms of financial aid can help make some projects viable, but other projects still may not be financially viable.

Other issues include the cost of recycled water use to the customers as well as administration of the recycled water system by both the distributor and user. Many agencies are unable to charge the true cost to produce this high quality water due to the stigma attached.

Costs associated with recycled water use could include retrofitting of existing systems, required inspections and cross-connection shutdown testing, employee training, and use site maintenance. Administrative requirements include extensive permitting, recordkeeping, and reporting requirements.

Each use area also must have a Site Supervisor knowledgeable of the use area system and recycled water use restrictions. The Site Supervisor must be available at all times to correct any condition that does not conform to use area requirements specified by regulations and the recycled water distributor.

Water Quality Management

Higher TDS source water, such as the Colorado River (up to 650 mg/l average) adds cost because TDS removal, or demineralization, requires energy intensive reverse osmosis. Residential use of water typically adds 200 to 300 mg/L of TDS to the wastewater stream, and self-regenerating water softeners can add another 60 to 100 mg/L. If an area receives CR water with a TDS of 650 mg/L, and residents add 300 mg/L through normal use, the recycling facility will produce water with a TDS concentration of 950 mg/L. This would not meet basin plan objectives anywhere in the watershed. It is also problematic for industrial customers and virtually unusable for many agricultural customers which limit the marketability. Nutrients such as nitrate present similar issues as TDS.

Public Perception

Public perception of recycled water is changing! One successful example of this is OCWD's GWRS project that undergoes an advanced treatment process including two membrane filtration systems – microfiltration and reverse osmosis, and treatment by ultraviolet light and hydrogen peroxide. Once purified, the water is sent to recharge basins where it seeps into the ground, like rain, and blends with groundwater. The GWRS provides a new drought-proof water source for northern and central Orange County, reducing reliance on imported water. Additionally, the GWRS will save additional funds in the future by improving the quality of the water in the Orange County groundwater basin. This successful effort utilized widespread public outreach activities involving the scientific, political, and other communities to assist in informing the public and addressing potential public perception issues.

Evaluate Water Supply Reliability

Water supply reliability for the Watershed was evaluated using the scenarios given in the Urban Water Management Planning Act (**Table 5.4-2**) and using some additional scenarios developed by the Water Resource Optimization Pillar (**Table 5.4-3**).

Table 5.4-2 Water Supply Reliability Scenarios Provided in the Act

Scenario	Description
Average conditions*	What are the water supply reliability vulnerabilities given average supplies to the region?
Single year drought*[1]	What are the water supply reliability vulnerabilities given a single year of drought?
Multi-year drought*[1]	What are the water supply reliability vulnerabilities given a multi-year drought?
50% reduction in imported water supplies*[1]	What are the water supply reliability vulnerabilities if the Watershed loses 50% of imported water supplies?
Natural Disaster	What are the water supply reliability vulnerabilities if a catastrophic interruption occurs due to an earthquake or other disaster?

Table 5.4-3 Additional Water Supply Reliability Scenarios Evaluated as part of the OWOW Process

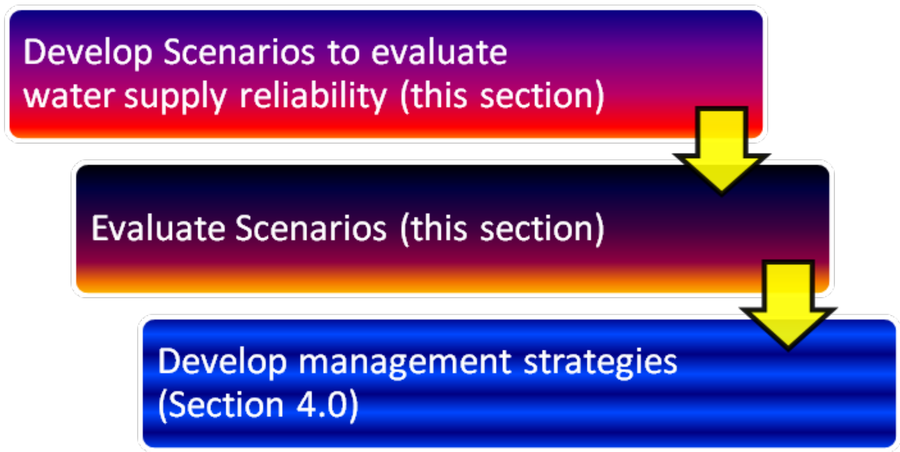
Scenario	Description
Climate Change	What are the water supply reliability vulnerabilities given the assumed effects of climate change as presented in the Draft 2007 State Water
Zebra and/or Quagga Mussels	What are the water supply reliability vulnerabilities of the Zebra Mussel and/or the Quagga Mussel were to infiltrate the SWP?
Sediment Transport	How does sediment transport at Seven Oaks Dam and/or Prado Dam affect water supply reliability?
Wildfire	How does the threat of wildfire affect water supply reliability?
Channel Armoring	How does channel armoring in the Santa Ana River affect water supply reliability?
Water quality degradation	How does water quality degradation affect water supply reliability?
Terrorism	How does terrorism affect water supply reliability?

*Scenario presented in the Catastrophic Interruption, Urban Water Management Planning Act.

Collectively, **Tables 5.4-2** and **5.4-3** provide a complete list of the evaluated scenarios.

All of the scenarios pose a threat to water supply reliability. The evaluation consisted of analyzing anticipated water supplies for each of these scenarios to determine if they are adequate to meet the anticipated demands. If anticipated demands are less than anticipated supplies, the system is deemed reliable. If anticipated demands are greater than anticipated supplies, water management strategies will need to be developed to offset these deficits. **Figure 5.4-8** provides an overview of the evaluation process.

Figure 5.4-7. Overview of the Water Supply Reliability Evaluation Process



The scenarios analyzed in this document represent a “snapshot” in time. As new challenges and constraints to water supply reliability are identified, they will require evaluation.

Evaluation of Water Supply Reliability Scenarios

Every urban water supplier that either provides over 3,000 acre-feet of water annually or serves more than 3,000 or more connections is required to assess the reliability of its water sources over a 20-year planning horizon considering normal, dry, multiple dry years and other scenarios. The scenarios evaluated in OWOW are summarized in **Table 5.4-4**. The assessment of water sources is reported in an UWMP, which is to be prepared every 5 years and submitted to DWR. DWR reviews the UWMPs to ensure they have completed the requirements from the Urban Water Management Planning Act (Division 6 Part 2.6 of the Water Code §10610 - 10656). Current and predicted reliability of the State Water Project used in the UWMPs was taken from the Department of Water Resources *The State Water Project Delivery Reliability Report 2009* (August 2010).

In November 2009, SB X7-7 (Steinberg) was passed requiring urban water suppliers to reduce per capita use 10% by 2015 and 20% by 2020. This required reduction in per capita consumption is reflected in the 2010 UWMPs which were used to evaluate water supply reliability for the watershed. This legislation results in a significant reduction in demand since OWOW 1.0 which eliminated the deficit between supplies and demands shown in OWOW 1.0. In each of the UWMP scenarios, the watershed is able to meet its projected demands plus the 10% Reliability Margin with the projected supplies. However, it is important to recognize that both the reduced demand and anticipated supplies are dependent upon a significant public investment. In the Proposition 84 process, the total estimated cost for projects that reduce demand and improve supply is over $4 billion and that does not include ongoing operations and maintenance costs.

To eliminate the potential for "double-counting", OWOW supplies are characterized by their source. For example, imported water recharged into a groundwater basin would be labeled "imported water" rather than "groundwater".

Table 5.4-4 Summary of Water Supply Reliability Scenarios

Short-term Impacts	Long-term Impacts
Catastrophic Interruption	Average Hydrologic Conditions
Earthquake[1]	
Power outage[1]	Single-year Drought Hydrologic Conditions
Mussels[1]	
Wildfire[1]	Multi-year Drought Hydrologic Conditions
Water quality degradation	
Terrorism[1]	Climate Change[1]
	Sediment Transport[1]

1 Actual effects uncertain.

Reliability Margin

There are many hydrologic uncertainties including future weather patterns, the effects of climate change and possible legal restrictions that could be placed on water supplies such as past restrictions placed on the SWP. To help prepare for these and any other uncertainties, it is recommended that supplies exceed demands thereby providing a buffer, or "reliability margin". For the OWOW process, this reliability margin was established at 10% to be consistent with other water budgets in the watershed.

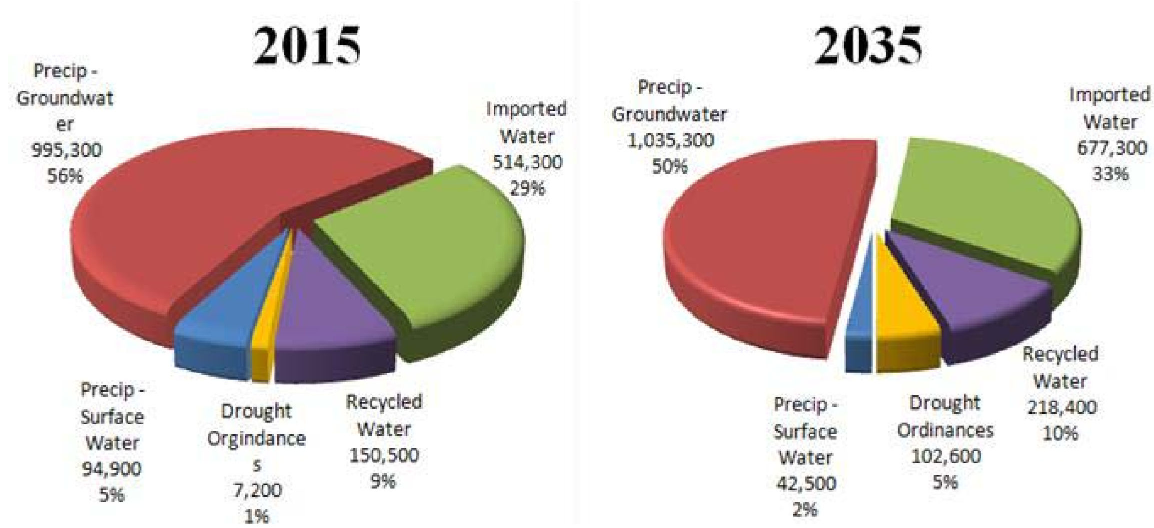
Average Year (Baseline)

Evaluating average water supplies provides a "baseline" for comparison purposes. **Figure 5.4-9** summarizes the data for 2010 and 2035, which is based upon the UWMPs but also includes the following proposed stormwater capture projects that were not included in the UWMPs:

Table 5.4-5 Stormwater Capture Projects Not Included in UWMPs but Included in OWOW Water Budget

Project	Amount (AF/Y)		
	IEUA	SBVMWD	WMWD/RPU
Chino Basin Recharge Master Plan	5,000		
Stormwater capture along the tributaries of the Santa Ana River (Active Recharge Project)		20,000	8,000
Riverside North [Basin] Aquifer Storage and Recovery Project	5,000	5,000	5,000
Total	10,000	25,000	13,000

Figure 5.4-8 Summary of Water Supply Estimated from UWMP Data for 2015 and 2035



Local precipitation presently meets about 60% of the demand and, due to increasing demand over time, is projected to meet about 50% of the demand in 2035. Other sources of supply and/or conservation measures are needed to meet the remaining 40% and 50% of demands, respectively. Although "drought ordinances" result in a reduction in demand, they have been presented as a supply to add emphasis and ensure they are not overlooked.

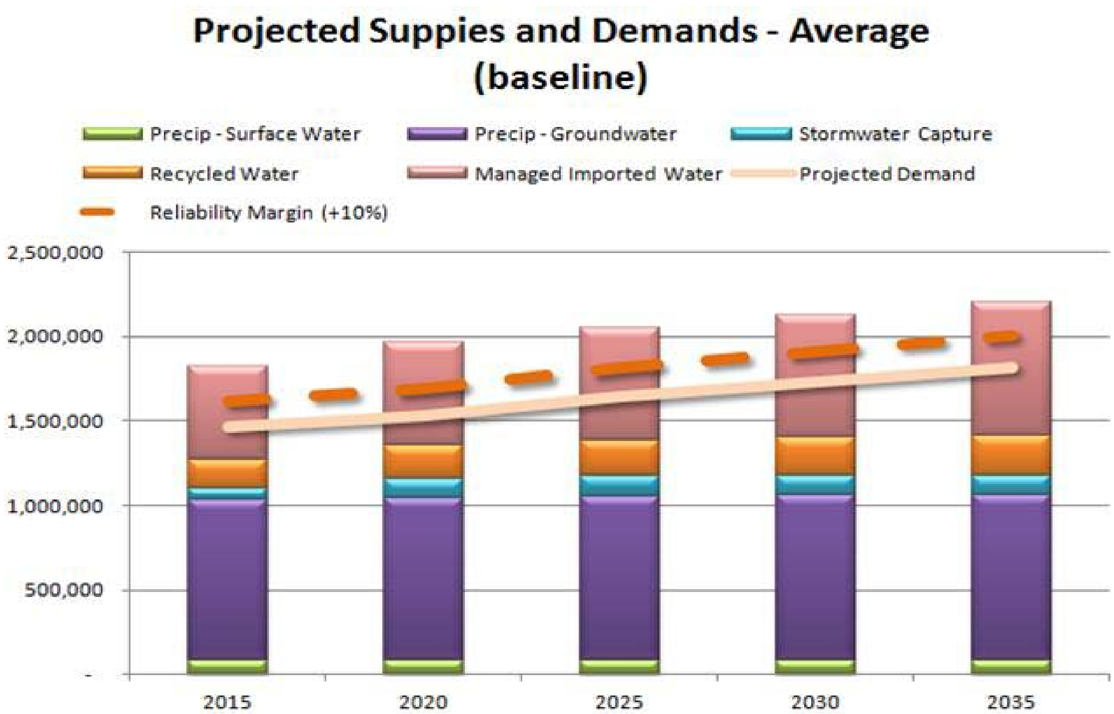
Given average hydrologic conditions, **Figure 5.4-10** shows that the watershed will be able to meet its needs through 2035 with a reliability margin of 15% in 2035. However, although the watershed, as a whole, will be able to meet demands, the SGPWA is projecting a 16,500 AF deficit. So, the watershed will need to work together to help overcome this deficit. The overall projections based on the UWMP data are positive and are generally based on the following assumptions:

1. Future local precipitation patterns will be the same as past precipitation patterns (possible effects of climate change addressed later in the chapter)

2. The predicted reliability of the State Water Project as taken from the Department of Water Resources *The State Water Project Delivery Reliability Report 2009* (August 2010) is accurate
3. Imported water projections include possible effects of climate change
4. Imported water will be managed to store wet year supply for use during dry years
5. Future demands will match the estimated demand
6. The watershed will invest over $4 billion in water conservation and infrastructure projects
7. Significant investments will be made to improve the reliability of imported water supplies as detailed in MWDSC's 2010 Regional UWMP

Given these unknowns, the watershed should continue to strive toward efficiency and toward projects that provide redundancy in case hydrologic projections are incorrect.

Figure 5.4-9 Comparison of Total Supply (by source) versus the Projected Demand

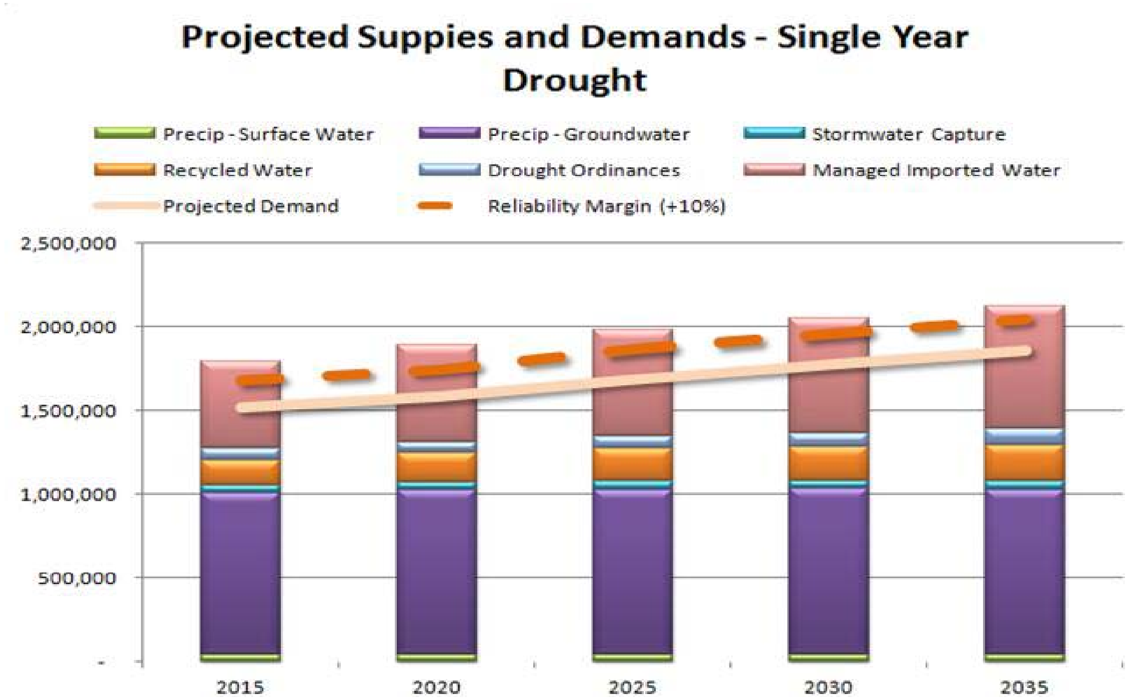


Single-Year Drought

Figure 5.4-11 summarizes the UWMP data for a single year drought. Nearly all of the water agencies defined the single-year drought as the year that they historically received the lowest amount of imported water. The watershed will be able to meet its demands in a single year drought with a reliability margin of 11% in 2035. The watershed is able to make it through a single year drought by relying on the various imported water storage programs that store water when it is available during wet periods for use during drought periods and on recycled water which is not impacted by weather. Although the watershed, as a whole, has enough supply to meet demand during a single year drought, the SGPWA projects a shortage of 27,000 AF in a single year of drought. Much of this deficit would be met by taking groundwater out of storage in the SGPWA service area. The overall projections based on the UWMP data are positive and are generally based on the same seven assumptions listed above.

Given these unknowns, the watershed should continue to strive toward efficiency and toward projects that provide redundancy in case hydrologic projections are incorrect.

Figure 5.4-10 Anticipated Supply (by source) versus Projected Demand for a Single Year of Drought



Multi-Year Drought

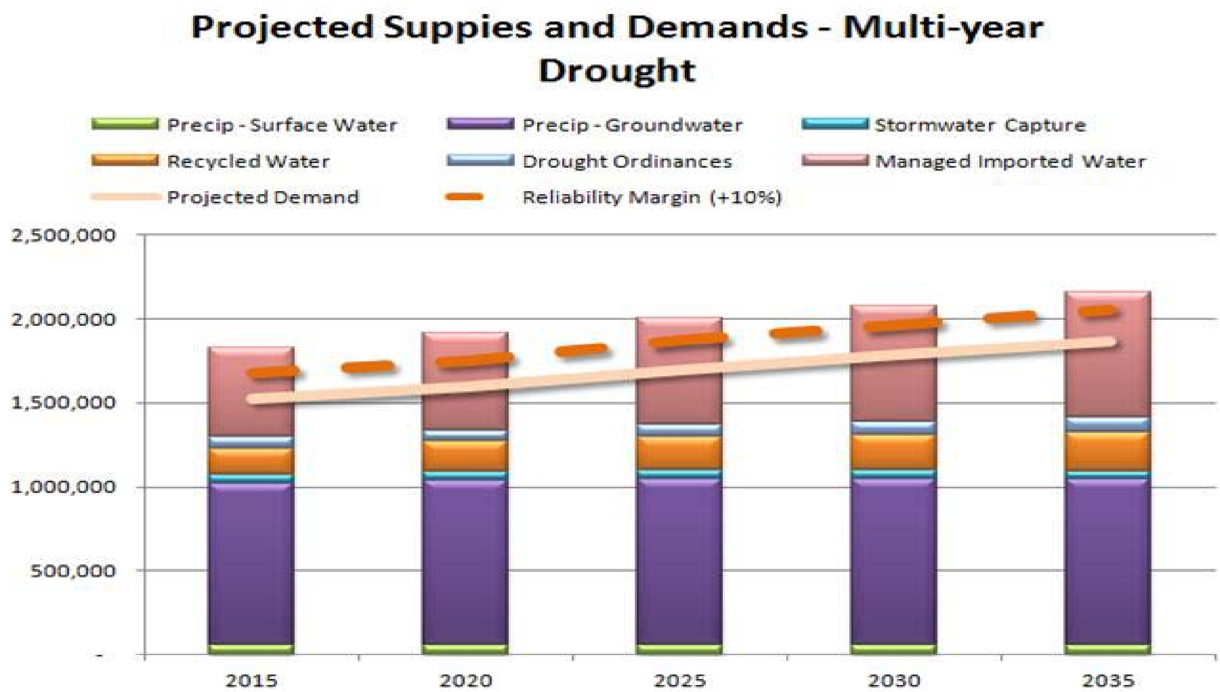
This scenario evaluates the water supply reliability for the Watershed assuming a multi-year (3 year) drought. Nearly all of the water agencies chose a3 year period that had the lowest, historic delivery of imported water.

Figure 5.4-12 summarizes the UWMP data for a multi-year drought and shows that the watershed will be able to meet demands with a reliability margin of 13% in 2035, higher than a single year drought. Although a 3 year drought lasts longer, the average entitlement available during multi-year drought is slightly higher than the entitlement available during a single year drought. The watershed is able to meet its needs during a multi-year drought due mostly to the storage programs implemented by MWDSC, Valley District, SGPWA, and others. However, despite the overall ability to meet demand, SGPWA is expecting a deficit of about 23,000 AF during a multi-year drought. Much of this would be met by withdrawing groundwater from storage in the SGPWA service area.[3] The overall projections based on the UWMP data are positive and are generally based on the seven assumptions listed above.

[3] Upper Santa Ana River Watershed Integrated Regional Water Management Plan, Table 3-12, November 2007, pg. 3-20.

Given these unknowns, the watershed should continue to strive toward efficiency and toward projects that provide redundancy in case hydrologic projections are incorrect.

Figure 5.4-11 Projected Supply (by source) versus Projected Demand during a Multi-Year Drought



Evaluate a Short-term 50% Reduction in Imported Water Supplies

One of the scenarios water agencies must evaluate as part of their UWMP is a 50% reduction in supplies. To maintain consistency with this requirement, it was decided to evaluate a 50% reduction in imported water supplies for the watershed. However, both a single year drought and multi-year drought result in greater reductions in imported water supplies than 50%. Since both the single-year drought and multi-year drought scenarios reduce imported water supplies more than 50%, this scenario is less conservative and, therefore, did not warrant detailed evaluation.

Evaluate a Catastrophic Interruption in Water Supplies

The water system that serves both local and imported water to the watershed is made up of a variety of facilities including pipes, canals, and levees that are all susceptible to damage or failure from a catastrophic event. The catastrophic events that were evaluated as part of the OWOW process are earthquake, Delta levee failure, power failure, wildfire, and terrorism. While catastrophic events may not be avoided entirely, measures can be developed and set in place to minimize the interruption to water service following a catastrophic event. These measures include: assessing the vulnerability of systems, quantifying available resources, determining optimal use of resources, increasing the flexibility of distribution systems, increasing regional coordination and establishing repair priorities.

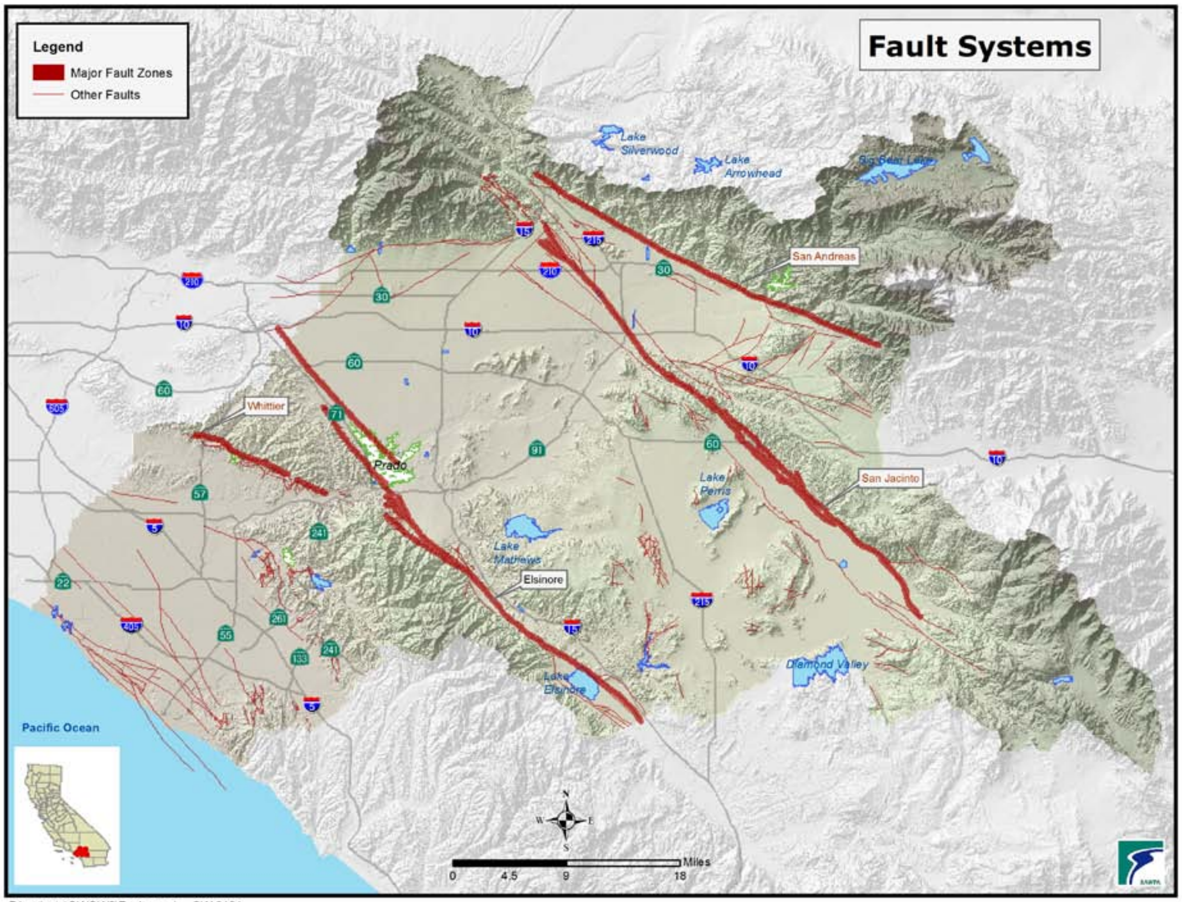
Evaluate the Effect of an Earthquake on Water Supplies

The watershed is located within a seismically active region of Southern California. As shown on **Figure 5.4-13**, six active major earthquake faults and a number of smaller faults extend through the Watershed. As shown on **Table 5.4-6**, a seismic event along one of the major active faults within the Watershed could result in an earthquake in the range of magnitude 6.0 to 8.0 on the Richter Scale.

Table 5.4-6 Estimated Maximum Richter Magnitude for Various Faults in the Watershed

Fault	Maximum Magnitude
San Andreas	8.0
San Jacinto	7.5
Elsinore	6.8
Chino	6.5
Whittier	6.8
Peralta Hills	6.6
Puente Hills	7.5
Newport/Inglewood	6.9

Figure 5.4-12 Major Earthquake Faults in the Watershed



P:\projects\OWOW2\Faults.mxd SW-2184

Depending on the intensity of the earthquake and location of the epicenter, catastrophic damage and interruptions of water service could occur throughout the watershed. Regional water conveyance systems, including the CRA; the Upper, Lower and Coastal Feeder Systems; as well as the East Branch of the California Aqueduct (also known as Foothill Pipeline) could sustain significant damage from a major earthquake that would interrupt the delivery of imported water supplies to the watershed. It also would make it difficult to transport water regionally within the watershed. Additionally, damage could occur to local water transmission systems operated by retail water agencies within the watershed, such as the Gage Transmission Main, Waterman Transmission Main, and the Riverside Canal. In addition to the potential damage to transmission facilities, damage also could occur to groundwater pumping facilities, water storage facilities, and water treatment plants as a result of seismic shaking impacts and/or from liquefaction impacts in areas that have high groundwater tables.

Based upon past seismic events, it is assumed that the impacts of a seismic event will be short-term. Due to the uncertainty tied to seismic events (magnitude, epicenter, etc.), it is not possible to determine the exact impact of a seismic event on water supply. However, the watershed can implement strategies that will better prepare the watershed for such an event. These strategies are provided in the *Management Strategies to Improve Water Supply Reliability* section.

Evaluate a Delta Levee Failure on Water Supplies

The Sacramento-San Joaquin Delta is a region where two of California's largest rivers, the Sacramento River and the San Joaquin River meet. It is the hub of the State's water supply system. About two-thirds of all California residents and millions of acres of irrigated farmland rely on the Delta for water from the SWP and the Federal Central Valley Project. The structural integrity of the delta levee system is vital to maintain water supplies to southern California. However, the Delta levee system is aging and a considerable amount of the land along the Delta levee system has subsided below sea level. The earthen levees are subject to risk from earthquakes, flooding and salt water intrusion. Catastrophic damage sustained by the levees would result in interruptions to SWP supplies to the Watershed due mostly to saltwater intrusion. The New Orleans levee failures resulting from Hurricane Katrina on August 29, 2005 particularly prompted awareness of the severe consequences and export outages that would occur with catastrophic multi-island levee failures resulting from a severe earthquake in the Sacramento-San Joaquin Delta region.

A severe earthquake in the Delta region of a frequency similar to a Hurricane Katrina would result in multiple levee breaches and slumping causing multi-island failures. There would be extensive levee slumping and overtopping resulting from liquefaction of levee foundations, severely hampering levee restoration efforts. This failure scenario would allow excessive salinity to enter the central and south Delta increasing salinity at the export pumps significantly beyond levels for municipal and agricultural uses. The difficulty in restoring water quality at the pumps is driven by the inability to displace saline water out of that region.

For example, a June 2005 report by Jack Benjamin and Associates in association with Resource Management Associates and Economic Insights (Preliminary Seismic Risk Analysis Associated with Levee Failures in the Sacramento – San Joaquin Delta June 2005) indicates a 6.5 earthquake in the western Delta would generate a 21-island failure and a 28-month duration water supply disruption in the Delta to restore levees in their current state. There is a 66% probability that a 6.5 magnitude earthquake will occur in the Delta region by 2032 or within the next 20 years (United States Geological Survey Delta Seismic Risk Report 2005). Further, one or more dry years immediately before or within the disruption period would substantially increase economic impacts and may lengthen the disruption period due to less availability of fresh waters within the Delta.

Determining the length of time water supplies will be shut down by severe earthquakes is influenced by a combination of complicated hydrodynamic, emergency response, water operations, and water treatment and geotechnical factors.   In 2005, DWR released a study that estimated Delta levee failure resulting from a 6.5 magnitude earthquake would eliminate deliveries on the SWP for 28 months[4]. Assuming a 28 month repair period, the effects of this catastrophic interruption would be very similar to a multi-year drought. Thus, the strategies that are implemented to offset the effects of a multi-year

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[4] Jack R. Benjamin & Associates, Inc. in association withResource Management Associates and Economic Insights, Preliminary Seismic Risk Analysis Associated with Levee Failures in the Sacramento – San Joaquin Delta, June 2005, Page 18.

drought also would be helpful to offset this event. Should the levee failure(s) occur after a drought period when stored water supplies are severely depleted, other emergency strategies would need to be implemented, such as extreme conservation and mandatory rationing.

In 2011, an independent analysis of impacts to levees along the Middle River emergency freshwater pathway have been performed by URS under contract to MWDSC considering all seismic hazards relevant to the central Delta pathway region (Estimated Levee Displacement Pathway Alignment, Sacramento - San Joaquin Delta, California July 2011). The analyses indicates that levee slumping in excess of ten feet can occur from an earthquake with a frequency of a hurricane Katrina resulting from liquefaction of loose sand levee foundations, placing the levees below high tide elevation and severely hampering restoration efforts. More recent RMA analyses supporting the preparation of the 2012 DWR Delta Flood Emergency Preparedness, Response and Recovery plan studies suggest that, depending on hydrologic conditions, several years would be required for a catastrophic multi-island levee failure to restore salinity concentrations necessary for municipal water quality needs at the export pumps. RMA analyses contained in the February 2007 Moffat & Nichol report (Delta Emergency Preparedness, A Feasibility Plan for Protecting the State's Water Supplies during a Catastrophic Collapse of Multiple Delta Islands) indicate that reservoir releases alone could not restore water quality at the export pumps adequate for municipal use.

The MWDSC Board has sought a comprehensive emergency preparedness and response strategy to safeguard water exports from the Delta. On April 10, 2007 the Board approved a strategy to respond to a plausible multiple-island failure scenario by restoring an emergency freshwater pathway through the Delta generally along Middle River to water export facilities in the south Delta in approximately 6-months. This strategy has been accepted by DWR in their preparation of a Delta Flood Emergency Preparedness and Response Plan (EPRRP) due for publishing in 2012 in coordination with the U.S. Army Corps of Engineers. This Plan covers a wide range of emergency response strategies ranging from isolated levee failures, up to and including catastrophic multiple-island failures causing severe water export disruptions. MWDSC has also promoted levee improvements on pathway levees to reduce levee slumping and breaches, as well as advance placement of redundant materials stockpiles such as rock and sheet pile for the reliable closure of breaches to ensure freshwater pathway restoration. Both pathway levee improvements and preparedness stockpiles have been initiated and will continue to completion in the next several years.

Evaluate a Power Failure on Water Supplies

Power failure can occur as isolated incidents or as part of larger event such as a regional power grid failure caused by a catastrophic event. During a large-scale power failure, water conveyance systems, water treatments plants, and ground water pumping wells could cease to operate.

Most power officials believe that under a scenario when only a portion of the regional power grid fails, the loss of power should not extend beyond 24 hours. However, under a scenario where all three grids of the North American Grid fail, the loss of power could extend for days. Depending on how much of the grid is lost and the length of time it takes to repair, the loss of power could have a profound impact on water delivery.

Power failure likely would have a short-term impact on water supply reliability. Due to the uncertainty of this scenario, it is not possible to determine the exact impact. However, the same strategies that will help to prepare for an earthquake will help prepare for such an event. These strategies are provided in the *Management Strategies to Improve Water Supply Reliability* section.

Evaluate Wildfire on Water Supplies

Wildfire can damage water delivery facilities or the power infrastructure used by water facilities. In addition, the loss of vegetation resulting from a wildfire can change runoff patterns, increase sediment, and reduce water storage. There also are potential water quality concerns associated with ash falling into surface reservoirs, which could overwhelm filtration plants as turbidities increase by orders of magnitude.

The effects of wildfire likely will have a short-term impact on water supply. Possible effects are loss of vegetation, change in runoff patterns, increased sedimentation, reduced natural water storage, and ash falling into surface reservoirs. Due to the uncertainty of this scenario, it is not possible to determine the exact impacts. However, the same strategies that will help to prepare for an earthquake will help prepare for such an event. These strategies are provided in the *Management Strategies to Improve Water Supply Reliability* section.

Evaluate the Effects of Terrorism on Water Supplies

There is always a possibility that water infrastructure could be targeted by terrorists. Water agencies have responded to this potential threat by reducing public access to water infrastructure or even the information about infrastructure. They have also responded by increasing security measures at their facilities.

The effects of a terrorist attack likely will cause short-term reduction in water supply reliability. Due to the uncertainty of this scenario, it is not possible to determine the exact impacts. However, the same strategies that will help to prepare for an earthquake will help prepare for such an event. These strategies are provided in Management *Strategies to Improve Water Supply Reliability.*

Evaluate Delta Flow Restrictions on Water Supplies

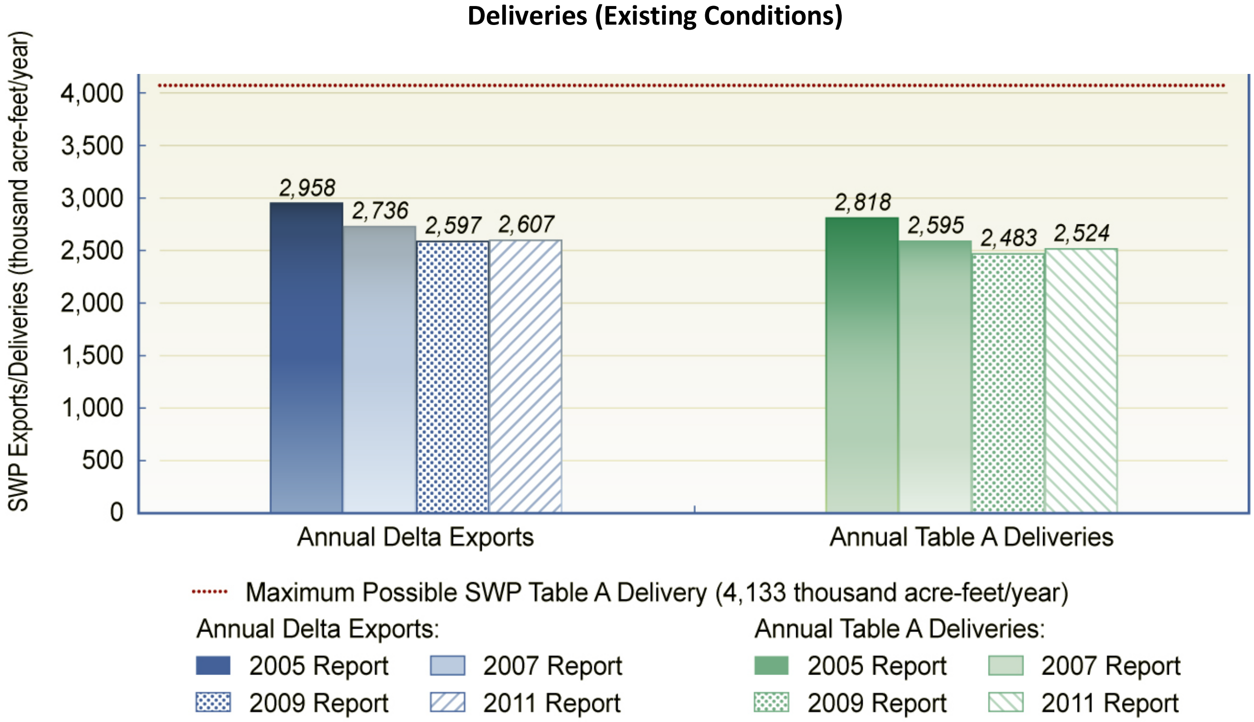
On December 14, 2007, U.S. District Judge Oliver Wanger issued an Interim Remedial Order to protect the threatened Delta smelt, which restricted water exports from the Delta to agricultural and urban customers of the SWP and CVP. In December 2008, the U.S. Fish and Wildlife Service issued a biological opinion covering Project effects on Delta smelt. In June 2009, the National Marine Fisheries Service issued a biological opinion covering Project effects on winter-run and spring-run Chinook salmon, steelhead, green sturgeon, and killer whales. The biological opinions replaced opinions issued earlier by the federal agencies.

The 2008 and 2009 biological opinions were issued shortly before and shortly after the Governor proclaimed a statewide water shortage state of emergency in February 2009, amid the threat of a third consecutive dry year. Both opinions have been subject to considerable litigation. Recent Court decisions and settlements have changed specific operational rules in 2011-12, and both opinions have been remanded to the agencies for further review and analysis.

The impacts of the above decisions were analyzed by DWR in The State Water Project Delivery Reliability Report 2009 which was used in the 2010 UWMPs.

DWR has also released a draft update titled "The State Water Project DRAFT Delivery Reliability Report 2011". As shown in the **Figure 5.4-14**, estimated average annual Delta exports and SWP Table A water deliveries have generally decreased since 2005 but are slightly up as compared with 2009. Under existing conditions, average annual Delta exports have decreased since 2005 from 2,960 thousand acre-feet per year (taf/year) to 2,610 taf/year in 2011, a decrease of 350 taf or 12%. Similarly, average annual Table A deliveries have decreased since 2005 from 2,820 taf/year to 2,520 taf/year in 2011, a decrease of 300 taf or 10%.

Figure 5.4-13 Trends in Estimated Average Annual Delta Exports and SWP Table A Water Deliveries (Existing Conditions)



A number of water agencies, federal and state resources agencies and non-governmental organizations are currently engaged in the development of a Bay Delta Conservation Plan (BDCP). An explanation of the BDCP is provided later in this chapter.

Evaluate Climate Change on Water Supplies

Temperature data suggest that California's climate is getting warmer. This phenomenon is being referred to as "climate change". Climate change could have an impact on water supply reliability. In a recent report, the U.S. Bureau of Reclamation provides potential impacts including reduction in snow pack, changes in the timing and amount of runoff, changes in the frequency and magnitude of extreme storm events, increased watershed vegetation demands due to higher evapotranspiration rates, changes in future agriculture and urban water demands, changes in sea level rise, and increased potential for salt water intrusion to the Sacramento-San Joaquin Delta and groundwater basins near the coast.

From a water management perspective, the strategies that increase reliability without climate change will also increase reliability with climate change. As a result, there are no specific strategies targeting climate change. To plan for this and other unknowns, the Watershed has implemented a "reliability margin" of 10%. More discussion about climate change impacts are included in the Energy and Environmental Impact Response pillar chapter later in this OWOW 2.0 report.

Evaluate the Impact of Quagga and/or Zebra Mussels on Water Supplies

Quagga mussels (*Dreissenabugensis*) were discovered in Lake Mead in January 2007 and rapidly spread throughout the lower Colorado River and Metropolitan's CRA system. Quagga mussels are indigenous to the Ukraine and are a related species to the better-known zebra mussels (*Dreissenapolymorpha*). Similar to the zebra mussel, which was most likely introduced to the Great Lakes in the late 1980s via ship ballast water, Quagga mussels were introduced to Lake Mead most probably through the translocation of boats. Although the introduction of these two species into drinking water supplies does not typically result in violation of drinking water standards, invasive mussel infestations can adversely impact aquatic environments. Two areas of relevance for aquatic environments used as sources of drinking water are the potential for clogging of intakes and raw water conveyance systems via attachment of high numbers of mussels to surfaces and a long-term potential for rendering lakes more susceptible to deleterious algae blooms. Control of mussel infestations can cost water conveyance systems millions of dollars annually in facility improvements and/or maintenance. Quagga mussels have infested water conveyance systems linked to the lower Colorado River. There is concern that Quagga mussels could become more widespread and infest the State Water Project System and other watersheds by boats and watercraft vehicles. Preventive measures implemented include boat inspections prior to entering un-infested water bodies and decontamination (clean, drain and dry) of vessels departed infested water bodies.

Evaluate the Effects of Santa Ana River Channel Armoring and Sediment Transport

The Santa Ana River is a productive recharge "facility" that helps replenish the Watershed's groundwater basins. The transport and deposition of sediment along the Santa Ana River is critical to maintaining existing groundwater recharge capacity. A sandy river bottom allows surface water to percolate easily into the groundwater basin and maximizes recharge rates. If this process is interrupted, the amount of recharge can be reduced.

The transport and disposition of sand within the Santa Ana River is interrupted when it is trapped by both the Seven Oaks Dam and Prado Dam. Seven Oaks Dam traps sediment at the base of the San Bernardino Mountains while Prado Dam traps sediment just upstream of Orange County. This entrapment of the sand causes negative impacts on the recharge capacity of the riverbed.

In addition, as the sand washes away and no longer is being replaced by sand from upstream, the river bottom gradually transitions from a "soft" bottom to a coarser bottom that includes heavier material such as gravel and cobbles. The gravel and cobbles eventually interlock with fine sediments and form an "armored" layer. This process is referred to as "channel armoring," which can reduce the recharge rate of the river. A Groundwater Recharge Study prepared by OCWD estimates that the armoring of the Santa Ana River has resulted in a loss of percolation of about 1% per year. With a long-term degradation of recharge rates, longer stretches of the river would be needed to recharge the same amount of water that is recharged today or some other kind of mitigation would be required.

Additionally, sediment loading behind the two dams can reduce surface water storage volumes. The continued build up of sediment behind the dams will reduce the overall storage capacity of the dams, which will, in turn, reduce the amount of storm flow that can be temporarily stored and released for groundwater recharge.

Channel armoring could reduce recharge rates along the Santa Ana River. Sediment transport could reduce storage volumes behind Prado Dam and Seven Oaks Dam thereby reducing the amount of stormwater that can be captured and used.

Evaluate the Effects of Water Quality Degradation on Water Supplies

Water supply reliability in the Watershed can be improved by reinstating local water resources that have been avoided due to poor water quality. For example, some groundwater basins in the Watershed have been impacted by high concentrations of salts. In the past, rather than pump and treat this poorer quality water, many groundwater producers chose to replace it with another source(s) of water that did not require treatment. This same approach also has been used in groundwater basins that were polluted by volatile, organic compounds and other contaminants. If, instead, these local resources were to be treated and used, they effectively would become "new" sources of water within the watershed which would act to increase water supply reliability. Water supply reliability can be increased if water resources that were avoided in the past due to poorer water quality are, instead, treated and utilized.

Summary of Evaluation Results

The water supply reliability scenarios that were evaluated as part of this analysis can be divided into two general categories, short-term impacts and long-term impacts. **Table 5.4-4** summarizes the two general categories. Those in the short-term category are difficult to quantify. Those in the long-term category are more easily quantified with the exception of climate change, sediment transport and channel armoring which are still under investigation. However, all of the recommended water management strategies to help the watershed overcome the long-term impacts will also help the watershed endure the short-term impacts.

Based on the data from 2010 UWMPs, the watershed is able to meet its demands in the average, single-year drought and multi-year drought scenarios while maintaining a reliability margin of 10%, or greater, to help offset future unknowns. These results assume that:

8. Planned infrastructure will be constructed
9. Demand projections are correct
10. It will rain locally the same in the future as it did in the past
11. The watershed will continue to manage imported supplies by storing water in wet years for later use during droughts

Given the uncertainty in these assumptions, it is recommended that the watershed continue to invest in planned infrastructure projects and that it implement a broad range of management strategies to diversify supplies thereby enhancing water supply reliability.

Water Management Strategies and Watershed-wide Project/Program Concepts to Improve Water Supply Reliability

To increase reliability, the following water management strategies are recommended:

Reduce Demand
Stormwater Capture
Optimize Imported Water
Recycle Water
Increase storage
Implement emergency measures

Each of these strategies enhances reliability to offset unknowns.

Water agencies throughout the watershed are implementing one, or more, of these strategies for their individual service areas. The goal of OWOW 2.0 was to develop watershed-wide project/program concepts, based on these strategies, which would increase water supply reliability throughout the watershed while reducing costs. The following sections discuss a number of watershed-wide project/program concepts organized by water management strategy. Some of the concepts build on OWOW 1.0 and some are new for OWOW 2.0. The concepts marked with a ☑ are recommended for focus over the next five years.

Reduce Demand

One of the ways the watershed can increase water supply reliability is to reduce demand, wherever possible, by using water more efficiently. The following concepts are recommended for the watershed:

☑*Water Rate structures that encourage conservation* *Estimated benefit: Help achieve a 20% demand reduction by 2020.*

Water rates that increase as consumption increases have been shown to reduce consumption. While many of the retail water agencies have this type of rate structure in place, there are still agencies in the watershed that do not have this type of rate structure.

☑*Public education to encourage water conservation*

Estimated benefit: Help achieve a 20% demand reduction by 2020.

Educating the public on the State and watershed's water supply system is a crucial component to implementing permanent change in water use habits. If the public understands the water supply situation, they will understand the need to raise rates, change water use habits permanently and continue investing in the Watershed's water supplies.

Outdoor conservation

Estimated benefit: Help achieve a 20% demand reduction by 2020.

The upper and middle watershed uses 60 – 70% of its water outdoors. A significant number of outdoor water use efficiency programs are already in place. The watershed has made considerable progress in this area through the Inland Empire Garden Friendly, and other, programs. More details about this and other suggested water conservations measures are discussed in the Water Use Efficiency Pillar chapter later in the OWOW 2.0 Plan.

Reduce evapotranspiration

Estimated benefit: More investigation required

One of the only measurable "losses" in the Watershed is evapotranspiration. Evapotranspiration is the combined water loss associated with evaporation and transpiration. Evaporation is the movement of water to the air from the land surface and water bodies. Transpiration is the movement of water into plants and the subsequent loss of water as vapor through its leaves. The losses associated with evaporation might be reduced by developing and implementing specific programs to increase the amount of shaded area such as planting trees or constructing shade structures. However, more analysis is required to estimate savings and determine whether the increased water use by any new shade trees would offset any potential decrease in evaporation associated with their shade. This strategy would be most appropriate in the areas of the watershed with the highest evaporation rates, namely the upper and middle Watershed.

Optimize Imported Water

The Watershed is dependent upon imported water to meet approximately one-third of its needs into the future. However, the reliability of this source of water has proven to be less certain, at times, due to unforeseen circumstances such as the "Delta Smelt Decision" in 2007. This historic decision resulted in one of the single largest court-ordered SWP delivery reductions in state history to protect the endangered Sacramento/San Joaquin Delta smelt (fish). As a result of this and other problems in the

Delta, the SWP operates below its delivery capacity. However, the Watershed may be able to implement strategies that could help offset the various uncertainties, and possibly even increase the amount of imported water available to the watershed.

☑*Wet Year Imported Water Storage Program*

Estimated benefit: Improved reliability and reduced cost by storing water locally.

This concept was introduced in OWOW 1.0 as "Base Load Off of Imported Water" and involves storing imported water (primarily SWP water) in wet years for later use in dry years. This not only improves water supply reliability but could also reduce costs by dramatically reducing the amount of imported water that is purchased during dry years when the "market rate" is the highest. The watershed has made strong progress on this strategy. The largest State Water Contractor for the watershed, MWDSC, has had a wet year storage program for many years that stores water in surface reservoirs and groundwater basins including the Central Valley during wet years for later use in dry years. San Bernardino Valley Municipal Water District, the State Water Contractor serving the upper watershed, has stored over 100,000 acre-feet of imported water in the San Bernardino Basin Area since 2008.

The Pillar explored the possibility of improving this concept by changing the MWDSC storage location from the Central Valley to the watershed. The most likely and effective way to change the storage location would be for the MWDSC member agencies (4 of the 5 SAWPA agencies) in the watershed to purchase more imported water during wet years when they typically purchase less, if any, imported water due to its higher cost. The Pillar worked on a possible MWDSC payment structure that would lower member agencies costs during wet years but result in full compensation to MWDSC in the dry year when the water is used. MWDSC currently offers a similar groundwater storage program titled "Conjunctive Use Program (CUP)".

The proposed payment structure was compared to the existing CUP program. The evaluation assumed a 120,000 AF storage program (imported water and storage capacity of approximately 60,000 AFY and 40,000 AFY of groundwater pumping capacity) and was based on a 10 year cycle consisting of 2 wet years, 3 dry years and 5 normal years. **Table 5.4-7** below compares the MWDSC CUP program to the proposed Program (key differences are bolded).

Table 5.4-7 Term Comparison between MWD's CUP Program and Proposed Program

Component	MWD CUP	Proposed Program
"Put" Capacity	60,000 AFY	60,000 AFY
"Take" Capacity	40,000 AFY	40,000 AFY
Program Storage Capacity	120,000 AF	120,000 AF
Storage/Extraction Capital Cost	None	Paid by member agency

Annual Administration Costs	None	None
Program Term	25 years	25 years
Storage Losses	Varies by basin	Varies by basin
Total Payment at Time of "Put"	None	• MWDSC Variable Supply Cost • MWDSC Variable Treatment Cost • Watershed Incentive
Total Payment at Time of "Take"	• MWDSC Tier 1 (at time of extraction)	• MWDSC Tier 1 (at delivery) less "Put" Payment

A preliminary economic analysis suggested that the revenue from the proposed program was comparable to the existing MWD CUP program. However, the proposed program would result in water being stored in the watershed which could increase participation and thereby increase the amount of water in storage within the watershed.

☑*Bay Delta Conservation Plan*

Estimated benefit: Would restore the reliability of the SWP to 78% from 60% which equates to about 131,400 acre-feet per year for the watershed.

The proposed BDCP offers a solution that would restore reliability to the SWP. Nearly all of the reduction of imported water deliveries through the SWP is due to environmental and other problems in the Delta. The proposed solution which will achieve the "coequal goals" of improving the health of the ecological system as a whole while also protecting SWP deliveries (SWP deliveries are less than 20% of the total flow through the Delta) is to transport SWP deliveries "around" or "under" the Delta in some sort of "Delta conveyance facility." Not only would this "Delta conveyance facility" increase the reliability of deliveries, but it would also improve SWP water quality in the form of lower Total Dissolved Solids (TDS). The decrease in TDS will reduce water recycling costs. The BDCP which is being prepared by a group of local water agencies, environmental and conservation organizations, state and federal agencies, and other interest groups includes such a facility. When complete, the BDCP will provide the basis for the issuance of endangered species permits for the operation of the state and federal water projects. Implementation of the plan will occur over a 50 year time frame.

Imported Water Banking

Estimated benefit: Dry year supply.

Although the watershed has significant groundwater storage, it is not easily accessible to the entire watershed. In some cases, it may be more efficient to participate in a groundwater storage opportunity outside the watershed. These storage opportunities are often referred to as “water banks” and are located throughout the State.

The wholesale water agency that covers 80% of the watershed, MWDSC, already has significant water banking throughout the state. Since OWOW 1.0, the upper watershed has participated in a water bank in the central valley and in Big Bear Lake to help keep surface water treatment plants operational during drought periods. The watershed has made significant progress in this area.

Prevent Invasive Species from Clogging Infrastructure

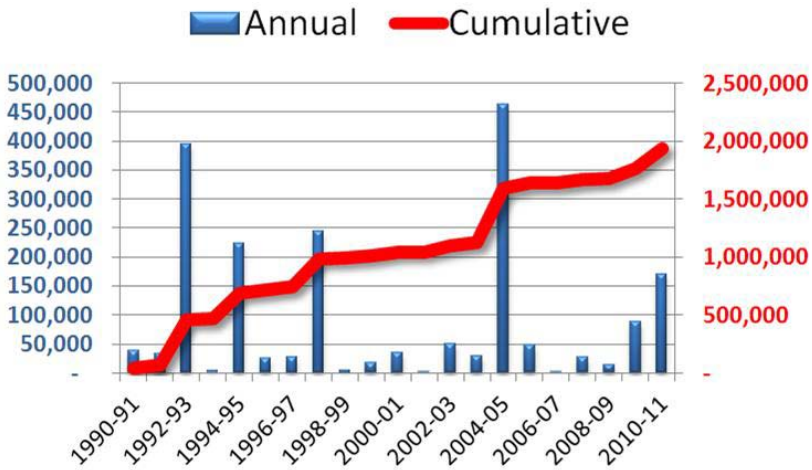
Estimated benefit: Consistent deliveries.

Quagga Mussels and the closely related Zebra Mussels are small shellfish, usually less than half inch in size. Once only found in the Great Lakes, the Quagga Mussel has now been discovered in Lake Mead, the CRA, and a local reservoir in San Diego County. They will live and reproduce in pipes causing them to clog. Once they are established, they are very difficult to eradicate. Quagga Mussels can be controlled by super chlorination and drying out, sometimes requiring the temporary drawing down of water supplies. The additional maintenance costs associated with controlling these mussels could cost tens of millions of dollars a year. There is concern that Quagga Mussels could become more widespread and migrate into the watershed through untreated water pipelines or larvae carried on boats and other watercraft. The watershed should participate in any programs, such as the one initiated by MWDSC, which target the prevention of these species from entering water infrastructure.

Stormwater Capture

Capturing stormwater runoff within the Watershed is challenging due to the “flashy” hydrology. The watershed tends to be either extremely wet or extremely dry. **Figure 5.4-15** shows how much stormwater has gone to the Pacific Ocean since 1990. As the figure shows, most of the un-captured flow came during “flood” years when it was nearly impossible to capture. However, even if these flood years are removed, there is still an opportunity to capture more stormwater throughout the watershed.

Figure 5.4-15 Stormwater Flow Lost to the Ocean since 1990



Because stormwater originates in the mountains, it can be diverted at high elevation enabling it to be delivered by gravity thereby saving energy costs. Diverting it higher in the watershed also provides the opportunity to use the water more than once before it reaches the ocean. In addition to the low energy cost, this water is also high quality, which helps the Watershed achieve both surface water and groundwater quality objectives established by State and Federal agencies. The watershed is currently working on the following projects that will use more local stormwater. More details on many of these projects, though briefly described below, are covered in greater detail **Chapter 5.8 Stormwater: Resource and Risk Management** later in the OWOW 2.0 Plan report.

☑*Enhanced Santa Ana River stormwater capture below Seven Oaks Dam*

Estimated benefit: 12,000 acre-feet per year.

The upper watershed has obtained a water right for the additional stormwater detained by Seven Oaks Dam and is presently designing facilities that will enable the diversion of up to 500 cfs and up to 80,000 acre-feet per year.

☑*Enhanced stormwater capture from the tributaries of the Santa Ana River*

Estimated benefit: 28,000 acre-feet per year.

The upper watershed has completed the conceptual design of improvements and operational changes that result in additional stormwater capture from the tributaries of the Santa Ana River.

☑*Riverside Basin Aquifer Storage and Recovery Project*

Estimated benefit: 28,000 acre-feet per year.

Riverside Public utilities, in partnership with Valley District and others are developing a design for a rubber dam that would cross the Santa Ana River and be used to divert flows into off-stream recharge basins.

☑*Enhanced Santa Ana River stormwater capture at Prado Dam*

Estimated benefit: 10,000 acre-feet per year.

The lower watershed is evaluating the feasibility of increasing the Prado flood season water storage elevation from 498 MSL to 505. After the Santa Ana River Mainstem flood control project is completed in approximately 2022, it may be possible to store water to higher elevations in Prado Dam for water conservation. A preliminary economic analysis of storing water to elevation 510 feet and 514 feet is summarized in **Table 5.4-8** below.

Table 5.4-8 Preliminary Economic Analysis - Enhanced Stormwater Capture at Prado Dam

Category	Storage to 510 feet	Storage to 514 feet
Estimated capital cost[1]	$54M	$125M
Estimated annual operations and maintenance cost	$300,000	$400,000
Estimated water yield (acre-feet per year)[2]	5,000	10,000
Estimated cost per acre-feet[3]	$600	$700

[1] Includes environmental mitigation

[2] Estimated water yield in comparison to year-round 505 ft storage

[3] Based on capital cost repayment over 30 years at 5% interest

☑*MS4 Credits*

Estimated benefit: Increased reliability by utilizing more local stormwater.

The Municipal Separate Storm Sewer Systems (MS4) permit process is intended, among other things, to increase the amount of stormwater captured and recharged in the watershed. These permits require the owner to construct their project in such a way to recharge stormwater on their site. However, in some cases, it may be more ideal from a water management perspective to recharge the stormwater somewhere upstream. One way to introduce flexibility into this process would be to allow owners to purchase "MS4 Credits" that could be applied to recharge projects in other locations. There may also be an opportunity to allow these credits to be used throughout the watershed. For example, a project in Orange County could purchase credits that could be used for a project in the upper watershed.

☑*Re-operate flood control facilities*

Estimated benefit: More investigation required.

Working with flood control agencies to re-operate flood control facilities with the goal of increasing stormwater capture increasing flood get away capacity and revising decades old storage curves. For example, when weather forecasts do not show any impending storms, the flood control agencies may be able to release stormwater at a slower rate. This relatively minor operational change would make stormwater flows easier to capture and put to use. It also would result in impounding the water longer, which would increase artificial recharge during the "holding period". This strategy has already been successfully implemented in some portions of the watershed.

☑*Size flood control facilities for stormwater capture*

Estimated benefit: Increased reliability by utilizing more local stormwater.

Another way to increase stormwater capture would be to work with flood control agencies to increase the size of existing, or new, detention basins. Larger detention basins would slow the flow and increase the recharge area, which would increase the amount of stormwater that is artificially recharged. In addition to this increased recharge, the larger basins also would provide greater flood protection. A related strategy would be to construct additional surface water reservoirs within the watershed. Unlike detention basins, which need to be drained every year before the flood season, surface water reservoirs provide the added flexibility of allowing the water to be stored until it is needed. In addition, surface water reservoirs also provide a storage location(s) for other sources of water such as imported water. Although effective, both of these strategies would be viable only in areas of the watershed that have vacant land.

☑*Forest First: Forest management for increased downstream stormwater capture*

Estimated benefit: Increased reliability by utilizing more local stormwater.

Another way to increase stormwater capture would be to work under the Forest First MOU with SAWPA to support collaborative projects among the U.S. Forest Service and downstream flood control and groundwater management agencies to support forest management including a) fuels reduction, b) chaparral restoration, c) meadows restoration, and 4) forest maintenance road runoff control. With collaboration between upstream and downstream parties, water flows from the forest may be spread more evenly over the hydrograph cycle allowing for slower and more even flows from the forest lands to the plains resulting in increased recharge. This will also result in less sediment transport particularly after forest burn events and water quality improvement downstream.

☑*Development Standards that enhance stormwater capture*

Estimated benefit: Increased reliability by utilizing more local stormwater.

Another strategy to increase stormwater capture would be to implement new development standards that promote the construction of infrastructure that increases the infiltration of stormwater such as porous concrete, infiltration galleries, and perforated pipelines. These facilities could be implemented in public areas such as parking lots, schoolyards, parks and greenbelts, as well as private areas, by establishing a requirement in local development codes.

Recycle Water

Treating and reusing wastewater, referred to as "recycled water", provides the most reliable sources of water in the watershed. Wherever recycled water can be put to use, it effectively replaces a like amount of potable water. Over the years, the watershed has seen significant accomplishments in the development of recycled water. In fact, at present, nearly all of the recycled water from the upper and middle watershed is being discharged into the Santa Ana River and is being reused at various locations downstream. In the future, the upper and middle watershed plan to develop enhanced recycling programs that could change the place of use for much of this resource. Should enhanced recycling occur in the upper and middle watershed, it would reduce the amount of recycled water flowing to the lower watershed. This could be offset in the lower watershed by increasing water recycling, increasing conservation measures, desalting the ocean and/or purchasing more imported water. There may also be an opportunity for the upper, middle and lower watersheds to leave their treated wastewater in the river in exchange for the lower watershed providing a "replacement" source, of like quantity and reliability, to the upper and middle watershed. This concept was first introduced in OWOW 1.0 and has been further developed in OWOW 2.0 as "Recycled Water Exchange".

☑*Recycled Water Exchange*

Estimated benefit: Although many details would need to be worked out, this type of concept could potentially save the watershed nearly $1/2 billion in capital costs and, perhaps even more, in energy costs not to mention the potential to reduce the amount of salt imported into the watershed.

This concept was first introduced in OWOW 1.0 and could save the watershed nearly $1 billion in facilities and, perhaps even more, in energy costs. The upper watershed currently delivers nearly all of its treated wastewater effluent to the lower watershed via the Santa Ana River. The Lower Watershed uses the effluent to recharge its groundwater basin and reduce the need for imported water.

This concept would exchange treated wastewater from the upper watershed for a like amount of imported water delivered to the upper watershed. The following summarizes this concept:

- *Treated wastewater flows remain in the river for lower watershed*– The Upper Watershed would continue to deliver treated wastewater to the Lower Watershed via the Santa Ana River instead of developing recycled water programs (the concept seems most feasible in areas without mature recycled water programs).
- *Lower watershed provides imported water Upper Watershed* – The Lower Watershed would essentially change the place of delivery for some of the imported water they are already planning to

import to the Upper Watershed which would replace the treated wastewater flowing from the Upper Watershed.

- *Comparable reliability* – Recycled water is 100% reliable and imported water is about 60% reliable. This concept would mitigate the reduced in reliability to the upper watershed by <u>storing imported water in the upper watershed, or some other water bank, during wet years for later use in dry years.</u>

A preliminary evaluation of this concept identified the following benefits as compared to current plans:

- *Less salt* – under this Program, the lower watershed would provide imported water to the upper watershed. The only source of imported water available to the upper watershed is SWP which is higher quality than Colorado River and many of the existing groundwater basins in the Watershed. To the extent that SWP water delivered to the upper watershed replaces CR water delivered to the lower watershed and/or is stored in a basin of lower water quality, there could be a water quality improvement in the watershed.
- *1/3 Return on investment*– under this program, the lower watershed essentially changes the place of delivery for imported water from the lower watershed to the upper watershed. Since approximately 1/3 of every acre-foot delivered to the upper watershed ends up as treated wastewater and back in the river, the lower watershed essentially receives 1 - 1/3 acre-feet for every acre-foot delivered, a 33% return on investment!
- *Lower cost – less energy* – The energy required to produce recycled water and to pump it up to higher elevation where it can be used throughout a water system is substantial. This concept would eliminate these energy costs. Since the imported water delivered to the upper watershed from the lower watershed would have been imported anyway, there is no increase in energy associated with this component of the concept.
- *Dry Year Reliability* – Recycled water is 100% reliable which benefits the lower watershed. Although imported water is only about 60% reliable, it can be stored in wet years so that it is available in dry years to improve the reliability. Thus, both the Upper and the lower watershed end up with a reliable supply.

☑*Recycled Water for Potable Use*

Estimated benefit: Improved reliability by increasing the amount of times water can be used

Legislation will be required to allow recycled water to be used for potable use. The watershed should work together to promote such legislation.

☑*Recycle sewage effluent from Orange County Sanitation District Plants No. 1 and No. 2 that is currently flowing to the ocean*

Estimated benefit: 157,000 acre-feet per year

As presented in the Recycled Water section of this chapter, OCSD expects to "dispose" of effluent into the ocean each year from its Plant No. 1. This effluent could be treated and used for a variety of purposes including the offset of any reduction in recycled water flows to the lower watershed due to recycling in the upper and middle watersheds.

As presented in the Recycled Water section of this chapter, by 2030 the Orange County Sanitation District expects to "dispose" of effluent into the ocean each year from its Plant No. 2. However, based on current Department of Public Health (DPH) requirements, this water cannot be recycled because it includes the effluent from the Inland Empire Brine Line which contains discharges from the String fellow Hazardous Waste Site, and other sources that would require further characterization by DPH. The Watershed should consider working with DPH on a strategy that would allow this effluent to be recycled.

Importation of recycled water from outside the Watershed

There may be opportunities to import recycled water from outside the Watershed. Any recycled water imported into the watershed would be viewed as a new supply.

Recycled water use to offset potable demand

This is widely implemented by several agencies and part of the projected water supply portfolio

Desalt the Pacific Ocean

Estimated benefit: 54,000 acre-feet per year

The lower watershed borders the Pacific Ocean and while ocean desalination generally is considered technically and institutionally feasible, it is also expensive both in capital and operational costs and is subject to significant regulatory scrutiny depending upon the environmental impact of the specific project. It also requires significant base loaded energy that is costly. Over the last five years, a number of water agencies have been investing significant effort and funds in ocean desalination program development work. There are currently two sites along coastal Orange County that have completed extensive exploratory work and permit approvals to construct desalination facilities but to date neither completely permitted or successful in securing contracts for the supply.

The cost of this water is significantly more expensive than any other current source of supply. For this reason, the watershed should focus on the other strategies.

Increase Storage

In general, the hydrology for the watershed can be characterized by a short series of wet years followed by a longer series of dry years. When the wet years come, they tend to be really wet, or "flood" type years. Thus, a fundamental water management challenge for the watershed is to capture the water during wet years, when it is plentiful, and store it for later use during dry years. The water may be stored in surface water reservoirs or the groundwater basins within the watershed.

☑*Surface Water Storage*

Estimated benefit: Helps offset the effects of drought, climate change and emergencies

As shown in **Table 5.4-1**, the watershed is fortunate to have a number of surface water reservoirs. However, additional surface storage space would allow the capture of additional stormwater and "unused" imported water. Not only do surface water reservoirs provide a location to store water when it is available, but they also enhance reliability during a disaster. Therefore, the Watershed should work toward increasing surface water storage both inside and outside the region. Due to the fast development within the watershed, the number of potential reservoir sites inside the watershed continues to diminish every year. Potential surface storage opportunities outside of the watershed would include any additional reservoirs constructed as part of the SWP and/or the CRA.

☑*Groundwater Storage*

Estimated benefit: Helps offset the effects of drought and climate change

In addition to additional surface water storage, the watershed also should pursue the utilization of any unused groundwater storage in the watershed. Like a surface water reservoir, these underground reservoirs provide a place to store wet year supplies for later use during extended drought periods.

Some groundwater basins in the middle and lower watershed have been abandoned or have not been fully utilized due to high salt content, contamination, color, odor or some other concern. Projects to pump and treat water in these basins, or portions thereof, provide restoration of groundwater storage that may not have been historically available for municipal use. In addition to recovering the storage space, it could also result in new yield.

Emergency Measures Strategies

Estimated benefit: Improved recovery time following a disaster

Despite careful planning, there will still be catastrophic events and unforeseen circumstances. Although the timing and extent of such events or circumstances are unknown, the following strategies will help the watershed prepare for the unknown.

Local Emergency Plans

Each of the water agencies within the Watershed must have an emergency plan that complies with both the Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS).

Mutual Aid and Coordination

All of the water agencies should have mutual aid agreements in place. One mutual aid option used by many of the water agencies is to join the California Water/Wastewater Agency Response Network (Cal

WARN), www.calwarn.org. CalWARN provides a "standard" mutual aid agreement, and also maintains a database of personnel and equipment that could be made available during an emergency. It is recommended that each of the water agencies in the Watershed join CalWARN and "upload" their personnel and equipment data. In addition to participating in mutual aid agreements, the water agencies also may want to consider additional coordination with one another through a regional group. Two such groups already have been formed in the Watershed: Water Emergency Response Organization of Orange County (WEROC), and the Emergency Response Network of the Inland Empire (ERNIE). Water agencies should consider partnering with one of these groups or, perhaps, forming an additional group, if necessary.

System Interconnections

Wherever possible, water agencies should pursue interconnections to increase redundancy and provide aid during an emergency situation.

Extraordinary Conservation

"Extraordinary" conservation would be required following an extreme catastrophic event such as an earthquake. In these situations, the only way demands can be met is by asking the public to implement extraordinary conservation measures such as halting all outside irrigation, limiting the frequency of bathing, etc. In the upper Watershed, outside uses account for nearly 70% of water use. Thus, this type of extreme conservation could reduce demands in the upper watershed by the same amount.

Optimize Outside Funding Opportunities

The watershed is encouraged to work together to maximize outside funding opportunities that provide the greatest overall benefit to the watershed.

References

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