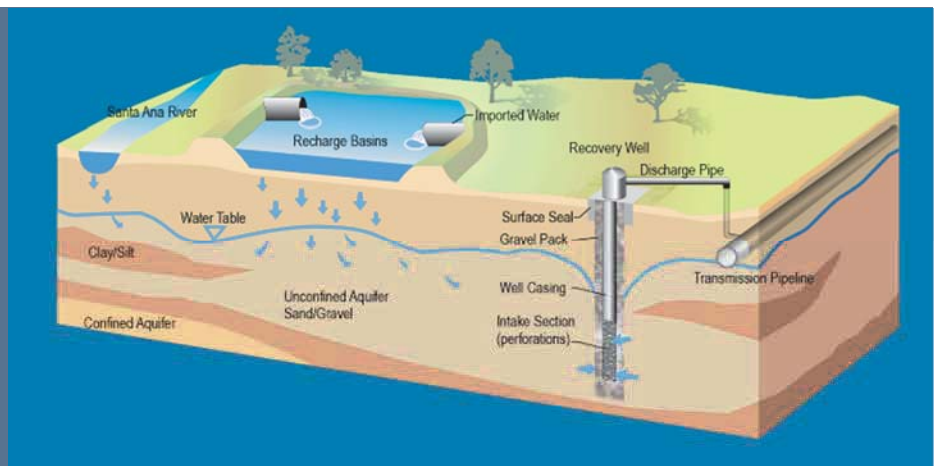
San Bernardino Valley Municipal Water District Central-Feeder – East Branch Extension Intertie Project

March 27, 2019



WaterSMART Drought Resiliency Grant Program FY2019

Bureau of Reclamation FOA No. BOR-DO-19-F003

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List of Acronyms

AF	Acre-feet
AFY	Acre-feet per year
AHHG	area of high historic groundwater
BHCUP	Bunker Hill Conjunctive Use Program
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
cfs	cubic feet per second
DUNS	Data Universal Number System
DWR	Department of Water Resources
EBX	East Branch Extension
ESA	Endangered Species Act
FOA	Funding Opportunity Announcement
FY	Fiscal Year
IRWMP	Integrated Regional Water Management Plan
N/A	Not Applicable
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OWOW	One Water One Watershed

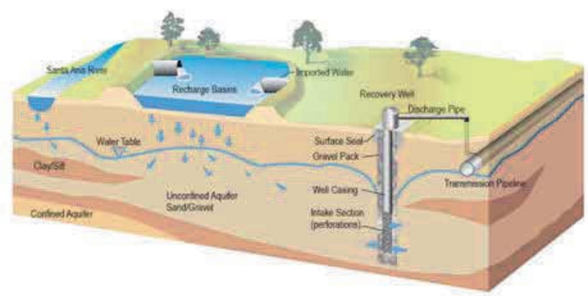
Reclamation, USBR	Bureau of Reclamation
RFP	Request for Proposal
RWQCB	Regional Water Quality Control Board
SAM	System of Award Management
SAR	Santa Ana River
SAWPA	Santa Ana Watershed Project Authority
SBBA	San Bernardino Basin Area
SBVMWD, Valley District	San Bernardino Valley Municipal Water District
SGPWA	San Gorgonio Pass Water Agency
SMWC	South Mesa Water Company
SWP	State Water Project
UWMP	Urban Water Management Plan
WSC	Water Systems Consulting, Inc.
YVWD	Yucaipa Valley Water District

Section 1: Technical Proposal and Evaluation Criteria

1.1 Executive Summary

Date:	March 27, 2019
Applicant:	San Bernardino Valley Municipal Water District
Applicant City, County, State:	San Bernardino, San Bernardino County, California
Project Name:	Central-Feeder East Branch Extension (EBX) Intertie Project

San Bernardino Valley Municipal Water District (Valley District) imports water into its service area through participation in the California State Water Project (SWP) and manages groundwater storage within its boundaries. It has specific responsibilities for monitoring groundwater supplies in its underlying groundwater basins and fulfills its responsibilities in a variety of ways, including importing water for direct delivery and groundwater recharge and by coordinating water deliveries to retail agencies throughout its service area. One of the foundational water management strategies for Valley District is conjunctive use, which has been generally described as using groundwater basins to store water that is available in wet years so that it is available to be pumped out during dry years (dry year yield). Valley District, in cooperation with water agencies throughout the Santa Ana River Watershed, and in cooperation with agencies within its service area have been developing a comprehensive conjunctive use program in the San Bernardino Basin Area (SBBA). One of the programs is called the Bunker Hill Conjunctive Use Program (BHCUP). The first phase of BHCUP will collectively store up to 64,500 acre-feet (AF) in the SBBA to provide up to 21,500 acre-feet per year (AFY) of dry-year yield for up to 3 consecutive years (SBVMWD, 2019). In anticipation of BHCUP, Valley District is constructing the first phase of the Central-Feeder System to move water from areas of historic high groundwater in the west to the eastern portion of the groundwater basin. Integral to the BHCUP is the proposed Central-Feeder – East Branch Extension (EBX) Intertie Project (Project), the focus of this grant. The Intertie Project includes approximately 500 linear feet (LF) of 24-inch to 60-inch diameter pipeline and appurtenances that will connect 3.2 miles of the Central-Feeder water transmission pipeline to the recently constructed east branch extension of the California Aqueduct in order to facilitate delivery of dry-year supplies stored in the Bunker Hill Basin to participants which currently include Yucaipa Valley Water District (YVWD), South Mesa Water Company (SMWC), and San Gorgonio Pass Water Agency (SGPWA). The Intertie will allow these project participants on the east to better manage up to 13,500 AFY. Figure 1 shows the service area boundaries of Valley District and the three project



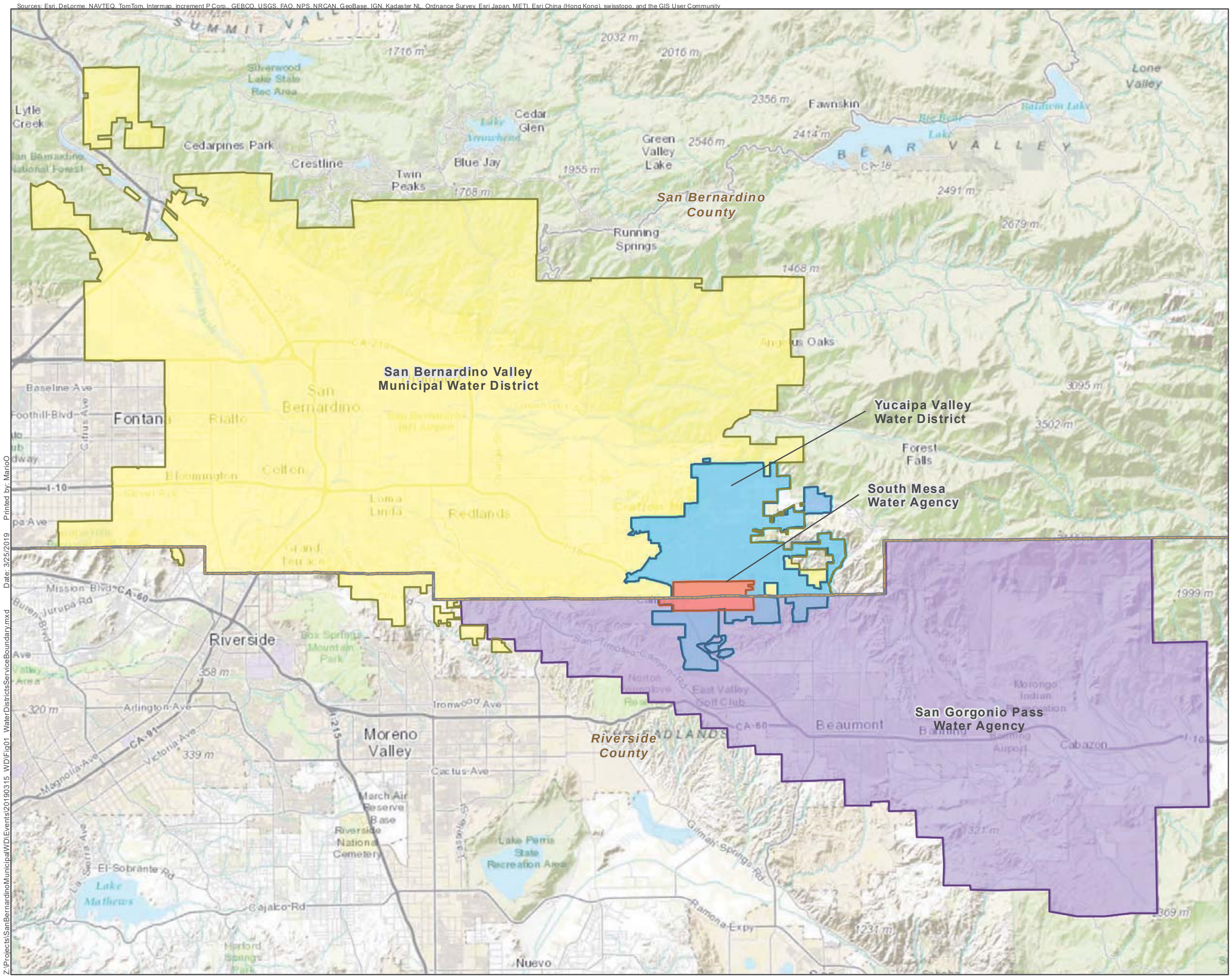
participants. Figure 2 provides a schematic of the project, and the SBBA groundwater basin boundary.

In summary, this project:

- Allows Valley District to operate a larger portion of the SBBA without exacerbating areas of high-groundwater.
- Allows interested agencies on the east end of the SBBA to take delivery of previously stored water supplies. Without the Intertie to connect the Central-Feeder to the EXB, there is no way to deliver water to users on the east end.
- In wet years, project participants would recharge available wet-year supplies, and in a dry year, they would request a like amount to be extracted from the basin which would be conveyed via the Intertie.
- Allows participating agencies to extract their previously stored supplies during dry years, up to 13,500 AF in any year, up to a total of 40,500 AF.

Funds requested from this grant, in the amount of $750,000 will help to complete final design and construction of the Intertie. The Project will be completed within 3 years of award of the grant. Construction is anticipated to begin in 2020.

The proposed project is not located on a Federal facility.



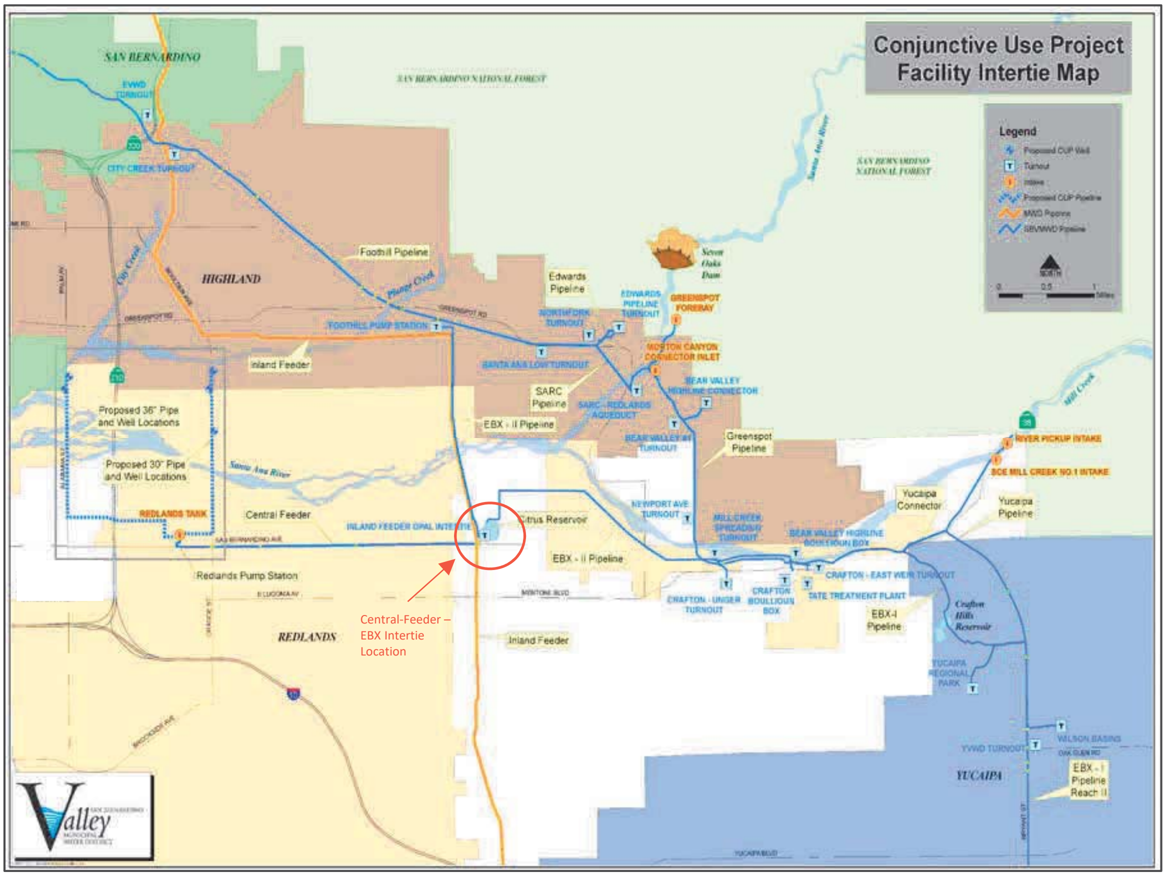
Kennedy/Jenks Consultants

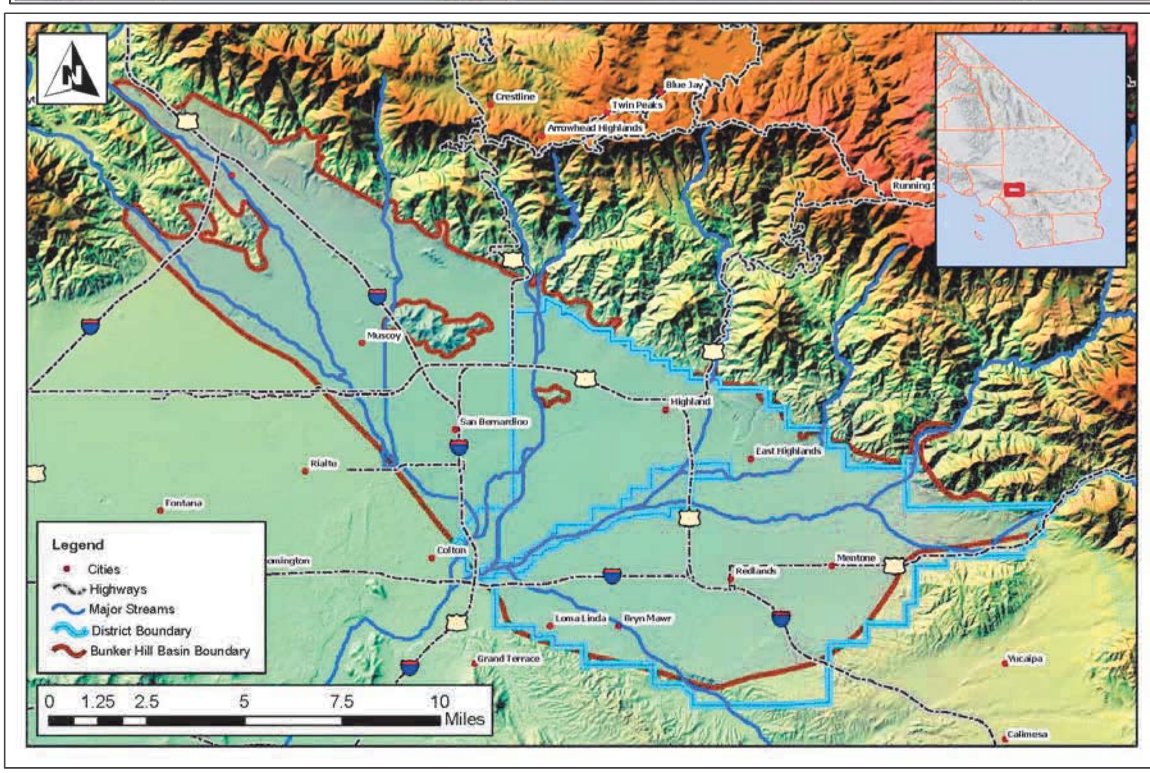
San Bernardino, California

Water Districts Service Boundary

KJ 1644222.00

Figure 1





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San Bernardino Valley Municipal Water District

Central-Feeder – EBX Intertie Project Location and the San Bernardino Basin Area

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Figure 2

1.2 Background Data

1.2.1 Proposed Project Location

Valley District's service area covers about 325 square miles in southwestern San Bernardino County, about 60 miles east of Los Angeles, CA. It spans the eastern two-thirds of the San Bernardino Valley, the Crafton Hills, and a portion of the Yucaipa Valley and includes the cities and communities of San Bernardino, Colton, Loma Linda, Redlands, Rialto, Fontana, Bloomington, Highland, East Highland, Grand Terrace, Mentone, and Yucaipa. Figure 1 shows the Valley District's service area, along with the service areas of the retail water purveyors.

The SBBA is located at the top of the Santa Ana River Watershed and receives all the surface water runoff from the headwaters of the Santa Ana River, Mill Creek, and a portion of that from the Lytle Creek area as well as smaller periodic flows from Plunge, City, Devil Canyon, Cajon and Elder Creeks. It is part of the inland valley called the San Bernardino Valley located in San Bernardino County, California and encompasses approximately 89,600 acres. Once past the Bunker Hill Basin, the Santa Ana River continues to flow southwesterly for approximately 60 miles until it reaches the Pacific Ocean. Figure 2 shows the SBBA boundary.

The Project will be constructed within the Valley District's service area. Detail of the Project is shown on Figure 2. The project specifically will be located at 9308 Opal Avenue, Mentone, CA 92359. The project latitude is 34.077800'N and longitude is 117.134001'W. The project will make dry-year yield available for YVWD, SMWC, and SGPWA, some of which are located outside of Valley District's service area (see Figure 2).

1.2.2 Water Supplies and Demands

Table 1 shows the number of service connections, water supplies and water use for Valley District and the project participants. Table 2 shows the supplies and demands for Valley District, and the project participants.

TABLE 1. PROJECT PARTICIPANT SERVICE CONNECTIONS, WATER SUPPLY SOURCES, AND WATER USES

Project Participants	No. of Service Connections (2015)	Water Supply Sources	Water Uses
Valley District	NA	SWP, GW	GW recharge
YVWD	12,304	GW, LSW, SWP, RW	SF, MF, CII, Other
SMWC	2,955	GW	AF, MF, CII, AG
SGPWA	NA	SWP	GW recharge

Notes:
SF Single-Family Residential; MF = Multi-Family Residential; CII = Commercial, Institutional, Industrial; AG = Agriculture; Other Construction water, fire service, landscape; GW Groundwater; LSW = Local Surface Water; SWP = Imported SWP; RW = Recycled Water

TABLE 2. PROJECT PARTICIPANT SUPPLY AND DEMAND DATA

	Normal Year (AFY)			Single-Dry Year (AFY)		
Project Participants	**2020 Supply**	**2020 Demand**	**2040 Demand**	**2020 Supply**	**2020 Demand**	**2040 Demand**
Valley District (1)	337,258	250,027	289,821	315,601	254,785	296,915
YVWD (2)	28,879	12,891	17,009	22,379	11,992	15,991
SMWC (3)	3,200	3,200	4,300	3,520	3,520	4,730
SGPWA (4)	14,500	13,200	27,700	2,600	1,600	9,200

Sources:
(1) Valley District 2015 Regional UWMP (WSC, 2016), Tables 2-6,2-8,4-1,4-3.
(2) Valley District 2015 Regional UWMP (WSC, 2016), Tables 2-6, 12-8, 12-36.
(3) 2015 Upper Santa Ana River IRWMP, Table 3-2 (assumes year 2035 for 2040) (RMC, 2015). Assumes single-dry year demands increase by 10%. Assumes supply equals demand.
(4) 2015 SGPWA UWMP, Tables 5-2, 5-3 (Kennedy Jenks, 2017).

1.2.3 Water Rights

In the 1960s, dry conditions resulted in the over-commitment of water resources in the Santa Ana River watershed which led to lawsuits between water users regarding both surface flows and groundwater. The lawsuits culminated in 1969 in the Orange County and Western Judgements. Under the terms of the judgments, Valley District became responsible for providing a portion of the specified Santa Ana River base flow to Orange County and for replenishing the SBBA under certain conditions. If the conditions of either judgment are not met by the natural water supply, including new conservation, Valley District is required to deliver supplemental water to offset the deficiency. The judgments resolved the major water rights issues that had prevented the development of long-term, regionwide water supply plans and established specific objectives for the management of the groundwater basins.

The Western Judgment establishes the natural safe yield of the SBBA to be 232,100 AFY for both surface water diversions and groundwater extractions. The Western Judgment allocates 64,862 AFY of the safe yield (approximately 28%) to the City of Riverside, Riverside Highland Water Company, Meeks & Daley Water Company, and Regents of the University of California (collectively referred to as the “plaintiffs”). The “non-plaintiff’s” (agencies within San Bernardino County) rights were defined in the Judgment as 167,238 AFY, which is approximately 72% of the safe yield. San Bernardino agencies are allowed to extract more than their 167,238 AFY right as long as they import and recharge a like amount of water into the basin. The Western-San Bernardino Watermaster provides an annual accounting of both the plaintiff and non-plaintiff extractions and comparison to the safe yield. The Watermaster bases the Valley District replenishment water requirement on the cumulative accounting of non-plaintiff extractions. If the cumulative extractions are less than the cumulative safe yield, there is a groundwater “credit” in the basin. In years when cumulative extractions are greater than their allocation, a “debit” is given. Recharge is also required to offset the export of water outside the SBBA in excess of the amount recorded during the base period (1959-1963). Credits are earned for any new supplies such as stormwater capture. Valley District can use these water credits to meet a portion of its legal obligation during dry years.

1.2.4 Water Delivery System

The EBX of the SWP is a combination of facilities built by Valley District and the State (i.e., Department of Water Resources [DWR]) and funded by Valley District and SGPWA. Valley District operates these facilities for DWR and SGPWA. The EBX makes deliveries from Devil Canyon east along the foothills of the San Bernardino Mountains and out to the SGPWA service area. Phase 2 of the EBX was completed in 2017. Phase 2 brought the capacity of the Extension to 17,300 AF, which will allow SGPWA to receive its maximum Table A amount and additional water to be provided to portions of Valley District’s service area.

In addition, Valley District has three pipelines that are not integrated into the SWP. These are the Baseline Feeder, Baseline Feeder Extension South, and Central-Feeder. The Baseline Feeder is a 48-inch pipeline that serves potable water from the SBBA to the City of Rialto, West Valley, and Riverside Highland Water Company. The Baseline Feeder Extension South is a 78-inch pipeline that will ultimately serve water from the SBBA throughout Valley District’s service area and on to Riverside County. The Central-Feeder is a 3.2-mile, water transmission pipeline which runs east/west roughly through the center of the District's service area. The Central-Feeder moves water from areas with high historic groundwater levels in the west to the eastern portion of the District service area via the Redlands Pump Station. Extension of the Central-Feeder and an additional pump station are planned for future construction. Through the Intertie (Project), the Central-Feeder will connect to the recently completed (2017) EBX-II pipeline to provide delivery to entities on the eastern end of the SBBA; YVWD, SMWC, and SGPWA.

1.2.5 Past Working Relationship with Reclamation

Valley District has not entered into any previous funding agreements with Reclamation. If awarded grant funds from this current solicitation, this will be Valley District’s first direct Reclamation grant, based on current staff's history and knowledge. Additionally, Valley District is one of five member agencies of the Santa Ana Watershed Project Authority (SAWPA) and is an active stakeholder in SAWPA’s One Water One Watershed (OWOW) Integrated Regional Water Management Plan (IRWMP). In 2010, Reclamation and SAWPA initiated the Santa Ana River Watershed Basin Study (USBR, 2013) to help SAWPA and its member agencies, including Valley District, identify data gaps, conduct tradeoff analyses, address the effects of climate change, and develop effective adaptation strategies. YVWD has also worked with Reclamation has received $1 million in funding from a FY2018 WaterSMART Water Use and Energy Efficiency Grant.

1.3 Background and Need

The East Branch of the California Aqueduct principally provides water to cities and farms in the Inland Empire, which includes San Bernardino and Riverside. The East Branch has been extended twice in order to bring SWP water to Yucaipa, Banning and other communities in the SGPWA service area. The extension project was a partnership between DWR, SGPWA, and Valley District.

Valley District has developed a “cooperative recharge program” that is being successfully implemented to help replenish groundwater, using both SWP water and local runoff. Valley District takes delivery of SWP water at the Devil Canyon Power Plant Afterbay, located within its northern boundary. The SWP water is conveyed 17 miles eastward to various spreading grounds and agricultural and wholesale domestic delivery points in the SBBA. Valley District also operates groundwater wells that pump from the SBBA. Over 60% of the water demands within its service area are met by groundwater and of that amount, over 70% comes from the SBBA. In 2015, the District pumped approximately 6,300 AF from the SBBA.

The Basin is uniquely constrained by shallow groundwater levels when the basin is too full. Accordingly, the management strategy developed for the Basin has been called the “tilted basin” concept. Management of groundwater levels under the tilted basin concept consists of recharging the basin along the foothills of the San Bernardino Mountains, farther upstream of the areas of high historic groundwater (AHHG). Recharging along the foothills increases the “travel time” to the Pressure Zone thereby delaying any possible high groundwater conditions. Part of this strategy also includes installing new wells in the basin through Valley District’s conjunctive use program, BHCUP, to help prevent the recurrence of high groundwater. Once water levels within the AHHG have been lowered, Valley District will be able to artificially recharge the basin through multiple spreading basins along the foothills with native water from the Santa Ana River or imported water from the SWP. The groundwater extraction and distribution facilities enable the SBBA to be used for conjunctive use, further protecting the region from drought.

The centerpiece of the Valley District conjunctive use facilities is the Central-Feeder System. Valley District has constructed the first phase of the Central-Feeder including the Redlands Pump Station and approximately 3.2 miles of 78-inch pipeline that connects to the Metropolitan Water District of Southern California Inland Feeder Pipeline, and ultimately, to the DWR East Branch Extension, Phase II System (EBX II). The first phase of the Central-Feeder System was completed in 2007 and is capable of conveying 50 cubic feet per second (cfs), or 36,000 AFY of pumped groundwater. The Central-Feeder is now ready to be used to convey water to users that have access to EBX II via the necessary Intertie that will connect the Central-Feeder System with the EBX. This is shown in Figure 2.

1.4 Technical Project Description

The project is the final design and construction of the Central-Feeder – EBX Intertie.

1.4.1 Project Tasks and Deliverables

Task 1: Project Management

Project management will be provided by appropriate Valley District staff to ensure successful project implementation. Activities will include project oversight, securing contracts, managing consultants, and conducting meetings as necessary to discuss project progress. Valley District anticipates regular, quarterly grant administration reporting on project activities. Reporting activities are within Valley District's regular operations and practice.

Task 2: Design/Engineering

Fifty (50) % design plans and specifications for the project have been completed. Final design plans and specifications will be prepared including civil, structural, electrical, and mechanical systems. Final design will be complete by the end of 2019.

Deliverables: 100% Design Plans and Specifications for the Project.

Task 3: Environmental Documentation

Valley District will complete all environmental compliance activities associated with the Project, including but not limited to the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) processes, the Endangered Species Act (ESA), the National Historic Preservation Act, Clean Air Act, and Clean Water Act. Based on the nature and location of the Project, the Project is anticipated to be categorically exempt under California Code of Regulations (CCR), Title 14, §15301 "Existing Facilities." Valley District will prepare and file the Notice of Exemption. In relation to NEPA, the Project would correspondingly fall under a Categorical Exclusion.

Deliverables: Notice of Exemption and Categorical Exclusion.

Task 4: Permitting

The Project will require an encroachment permit from the County of San Bernardino as well as an encroachment permit from DWR as the Intertie will connect to SWP infrastructure regulated by DWR.

Deliverables: County Encroachment Permit, DWR State Encroachment Permit

Task 5: Equipment Procurement

Equipment procurement for materials and supplies will begin in November 2019. Valley District will issue requests for proposals to solicit bids for equipment purchases.

Deliverables: Finalize component lists for equipment. Purchase Orders. Receipts showing equipment delivery.

Task 6: Construction/Implementation

The Project consists of the following construction items:

Site improvements. Site improvements will include mobilization and demobilization of equipment at the site and staging area; traffic control; clearing and grubbing; fencing; and any necessary irrigation improvements.

Piping (including valves and meters). Installation of the Intertie will require approximately 502 LF of piping (diameter sizes between 24” to 60”) and associated valves and meters.

Concrete structures. To facilitate the new infrastructure three concrete structures will be built which include: a flow control vault structure; a guard valve vault; and a manhole structure.

Electrical and controls. The Project will require SCADA controls, process instrumentation controls, and new electrical work.

Deliverables: Bid documents, proof of advertisement, award of contract, notice to proceed, notice of completion.

IMPLEMENTATION SCHEDULE

Below is the Project Schedule by task. The Award Date is assumed to be July 2019. Valley District has vast experience with implementing projects similar to the one proposed. The Project will be completed within 3 years of project award, however full implementation is anticipated to occur sooner. See Table 3 for a schedule of project activities.

TABLE 3. SCHEDULE OF PROJECT ACTIVITIES

Task	Approximate Start Date	Approximate End Date
1. Project Management	April 2019	March 2021
2. Design/Engineering	May 2019	December 2019
3. Environmental Documentation	June 2019	December 2019
4. Permitting	September 2019	February 2020
5. Equipment Procurement	November 2019	June 2020
6. Construction/ Implementation	March 2020	March 2021

1.5 Performance Measures

The Project will allow for the delivery of more water for conjunctive use to benefit the agencies on the east end of the groundwater basin. In wet years, project participants would store water in the groundwater basin. In dry years, the participants would be able to extract a like amount which would be delivered via the Intertie connecting the Central-Feeder to the EBX.

Valley District meters the amount of water it delivers to retail agencies. In order to measure attainment of the water quantity benefit, Valley District will track how much water is recharged to the basin per the BHCUP conjunctive use program, i.e., tracking how much each project participant is “credited” for groundwater storage. During dry-years, when the project participants request their previously stored groundwater, Valley District would measure the dry-year extractions and report those numbers as well.

1.6 Evaluation Criteria

1.6.1 Evaluation Criterion A: Project Benefits

How will the project build long-term resilience to drought? How many years will the project continue to provide benefits?

The Project will build long-term resilience to drought in a number of ways. First, the Project will allow for the extraction of 13,500 AFY, for a three-year period, of groundwater from areas of the SBBA that have high groundwater levels, for distribution to entities on the east end of the watershed that may or may not have groundwater wells in the SBBA. Second, the Project helps to maintain the safe yield of the SBBA through the coordinated management of surface and groundwater supplies during both wet, and dry years. Third, the Project increases overall reliability by providing operational flexibility for groundwater production.

Benefits of this project could be provided indefinitely, assuming continued operation and functionality of the groundwater recharge infrastructure and continue proper management of the Basin in accordance with the Orange County and Western Judgements.

Will the project make additional water supplies available? If so, what is the estimated quantity of additional supply the project will provide and how was this estimate calculated?

Yes. The Project will enable Valley District to recharge and store SWP water when it is available in wet years in the SBBA on behalf of the project participants and make it available for users east of the Intertie for extraction in dry years. The Project will increase the storage available in the SBBA by 40,500 AF, thereby making 13,500 AFY of dry year supply available to project participants for up to three years.

What percentage of the total water supply does the additional water supply represent? How was this estimate calculated?

The Project will allow the participating agencies to store wet-year supplies for later extraction in a like amount in dry years. The amount each agency can store in a single year as compared to their overall normal (2020) years supplies is shown in Table 4.

TABLE 4. PROJECT SAVINGS DURING WET-YEARS

	2020 Normal Year Supply (AF)	Project Allocation (AF)	% of supply
YVWD	28,879	11,000	38%
SMWC	3,200	500	16%
SGPWA	14,500	2,000	14%
Total	46,579	13,500	

The Project will allow the participating agencies to extract their stored supplies in dry years. The amount each agency can extract in a single-dry year as compared to their overall single-dry year demand (2020) is shown in Table 5.

TABLE 5. DRY-YEAR DEMAND BENEFIT

	2020 Single-Dry Year Demand (AF)	Project Allocation (AF)	% of single-dry year demand
YVWD	11,992	11,000	92%
SMWC	3,520	500	14%
SGPWA	1,600	2,000	125%
Total	17,112	13,500	

Provide a brief qualitative description of the degree/significance of the benefits associated with the additional water supplies.

The Project will create a new stable water supply that will be available during drought periods. Based on the modeling results, with average SWP reliability (60%), the Basin storage can be maintained to meet the 2035 demands. This new water supply would reduce the water supply that would be imported from the SWP thereby having not only a local impact but also an impact on the watershed that supplies the SWP.

Will the project improve the management of water supplies?

The Project will improve the management of available SWP supplies, thereby increasing operational flexibility and local supply reliability, particularly during drought conditions. The Project helps to maintain the safe yield of the SBBA through the coordinated management of surface and groundwater supplies in wet years, so it can be relied up during dry years.

If so, how will the project increase efficiency or operational flexibility?

The Project improves water management by providing a constant stable new supply that can be counted on in drought periods. In addition, water managers, through the use of the Intertie, will have the improved ability to better manage and control local water supplies and deliver water to agencies on the east end of the groundwater basin.

What is the estimated quantity of water that will be better managed as a result of this project? What percentage of the total water supply does the water better managed represent? How were these estimates calculated?

During dry years, the project will allow for the extraction of 13,500 AFY from areas of the SBBA that have very high groundwater levels, and distribute that water to users on the east end of the Watershed. As shown in Table 2, the project participants will be able to collectively extract 13,500 AF of dry year supply, over a three-year dry period, from the conjunctive use program.

Provide a brief qualitative description of the degree/significance of anticipated benefits.

The Project, via the Intertie, will allow for water previously stored in the western end of the SBBA to be moved to users in the east end of the basin in dry years. As such, the Project helps to develop sustainable local water resources that will be available in the future particularly during periods of drought. The occurrence of long dry periods, characteristic of Southern California's climate, limit groundwater storage levels for years at a time, thus requiring collaborative and forward-thinking approaches on the part of the Basin water managers in order to conserve, enhance, and maximize groundwater for its highest and best use. The Project provides an incentive to agencies that may not have groundwater wells in the SBBA, to store wet-year supplies, knowing that it would be available for later delivery and extraction in dry-years. The Project preserves local flexibility in water supply management options and increases reliability during periods of drought.

Will the project make new information available to water managers?

Data regarding the flows within the basin, the amount of water delivered for recharge, and records of the amount extracted during dry years will be available to water managers to make sure the safe yield of the basin is managed and consistent with the Watermaster's requirements.

Will the project have benefits to fish, wildlife, or the environment?

The Project is not anticipated to have substantial direct benefits to fish, wildlife, or the environment. The Project will improve the quality and reliability of SWP for drinking water purposes and maximize the use of local water resources.

Additional project components listed on Pgs. 38-39 in the FOA are not applicable to the proposed Project.

1.6.2 Evaluation Criterion B: Drought Planning and Preparedness

Explain how the applicable plan addresses drought.

There are many planning documents that discuss the impacts of climate change, including drought, on Valley District's and the participants' water supply and demand. These documents (excerpts provided in Section 9) include the following:

The 2015 San Bernardino Valley Municipal Water District Regional Urban Water Management Plan (UWMP) (WSC, 2016) (see pages 1-23 to 1-25, 5-4 to 5-5, and 6-7). The Project is specifically addressed on page 5-4. The Plan also identifies stages of actions to be taken in response to water supply shortages and outlines specific water supply conditions applicable to each stage. This plan includes both Valley District and YVWD.

The 2015 Upper Santa Ana River Watershed IRWMP (RMC, 2015). On page ES-4 the IRWMP specifically identified interties in the water system as a means to meet the regional goal #1 of 'improving water supply reliability'. On page 4-13 the intertie is identified as a means to meet the Statewide Priority of Drought Preparedness and Climate Change Response Actions. Impacts and the effects of climate change on the water resources within the Watershed are discussed starting on page 2-61. This plan covers Valley District, YVWD, SGPWA, and SMWC.

2018 OWOW Plan for the Santa Ana River Watershed (SAWPA, 2019). On page 3-1 the OWOW Plan identifies becoming drought proof by 2040 as a vision for the Watershed. On page 4-44 the OWOW Plan identifies the key objective for water supply reliability is a cost-effective, 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 interconnections and redundancy; and optimizes water storage for use during drought periods. Section 5.4 of the Plan (starting on page 5-49) specifically addresses climate risk and response with regard to water management within the watershed. This plan covers Valley District, YVWD, and SGPWA.

Valley District's 2018 Regional Water Management Plan (BTAC, 2017) discusses the importance of improving water supply reliability during droughts (see Page 9). The Plan specifically says "To ensure adequate reliable water supply for the communities in the Upper SAR watershed during a prolonged drought, the overall basin management strategy will be to operate the basin under the "Tilted Basin Concept" such that the basin would begin a drought period in "as full as possible" condition. Keeping the basin relatively full and operating a conjunctive management program according to the "Tilted Basin Concept" also provides the added flexibility to reduce imports from the SWP when water quality is less desirable."

Lastly, drought is addressed in the Santa Ana Basin Study (USBR, 2013), which was a collaboration with USBR, SAWPA, and Valley District as one of five member agencies of the SAWPA Joint Powers Authority. That study specifically noted that drought conditions in the Colorado River Watershed, a primary source of imported water to the Santa Ana River Watershed, among other factors, threaten the future of the region's water resources. This plan includes all participant service areas.

Explain whether the drought plan was developed with input from multiple stakeholders.

All of the planning documents noted above were developed with input from multiple water resource management agencies and interested stakeholders. Many of the plans are complementary to one another, with many agencies participating actively in multiple plans.

Does the drought plan consider climate change impacts to water resources or drought?

Each of the planning documents noted above consider the effects of climate change on water resources, including drought. The Regional UWMP (WSC, 2016) and Upper Santa Ana River IRWMP (RMC, 2015) report that climate change modeling for the Santa Ana

River Watershed suggests that a changing climate will have multiple effects on the Region including: less precipitation as snow; increased precipitation as rain; a doubling of the number of high temperature days; and increased water demands for agriculture and irrigation. The Santa Ana Basin Study (USBR, 2013) found these specific impacts: annual surface water is likely to decrease; temperatures will increase which is likely to cause increased water demand and reservoir evaporation; natural recharge will decrease; and management actions such as reducing municipal and industrial water demands or increasing trans-basin water imports and recharge will be required to maintain current groundwater levels.

Describe how your proposed drought resiliency project is supported by an existing drought plan.

The Upper Santa Ana River Watershed IRWMP (RMC, 2015) identifies conjunctive use as a significant groundwater management need for the Region (pg. 4-2). The IRWMP also specifically sets a conjunctive use goal to increase storage in the Region by 10,000 AF (pg. 4-10).

Does the drought plan identify the proposed project as a potential mitigation or response action?

Yes. The Regional UWMP (WSC, 2016) identified interties to increase water supply availability (pg. 12-40). The Upper Santa Ana River IRWMP (RMC, 2015) includes interties between agencies and infrastructure as a means to prepare for disasters and to contribute to the regional goal of improving water supply reliability (pg. 4-8 and 4-10).

Does the proposed project implement a goal or need identified in the drought plan?

Yes. The Upper Santa Ana River IRWMP (RMC, 2015) includes interties between agencies and infrastructure as a means to prepare for disasters and to contribute to the regional goal of improving water supply reliability (pg. 4-8 and 4-10).

Describe how the proposed project is prioritized in the referenced drought plan?

Yes. The Project was submitted to the OWOW Plan (SAWPA, 2019). While the California IRWM Plan Standards encourages the prioritization of projects in each IRWM Plan, the OWOW Plan Update 2018 does not rank projects, because its list of projects is not competing against one another for anything. Projects included in the OWOW Plan Update 2018 will each in their way support achievement of the goals.

1.6.3 Evaluation Criterion C: Severity of Actual or Potential Drought Impacts to be Addressed by the Project

What are the ongoing or potential drought impacts to specific sectors in the project area if no action is taken, and how severe are those impacts?

Given the continuing, local drought conditions, groundwater storage levels are expected to continue to decrease without the augmentation of recharge. Other drought impacts include:

Agriculture – The region currently produces feed crops for the dairy industry and other food crops for consumption in Southern California, and beyond. These practices have a high potential to be interrupted or eliminated due to water quality and supply impacted by the drought.

Industrial – The region supplies water for various types of industries, including food & beverage, steel processing, and other beneficial industries. These industries rely on the water supply to operate and provide services, which helps maintain economic growth in the region.

Urban use – The service area currently has over 600,000 people that depend on these water supplies for food, families, business, etc. As further drought impacts continue, decreased water quality and supply availability may result in supply interruptions for customers.

Whether there are ongoing or potential environmental impacts.

The Project is the installation of infrastructure to connect the Central-Feeder pipeline system to the EBX. The area where the Intertie will be installed has been previously disturbed, already has water infrastructure, and no known sensitive habitat, species, or sensitive receptors are nearby.

Ongoing, past or potential, local, or economic losses associated with current drought conditions.

With decreased water supply and increased cost to supply treated water, local businesses and agencies are faced with financial impacts. As previously mentioned, the region serves residential, industrial, commercial, public and agricultural customers. The extreme drought conditions in our region will directly impact real estate values, businesses, and agencies financially, and has the potential to influence relocation of their customers to other areas. A detailed plan on drought-resiliency will benefit the region in terms of water sustainability and economy. State regulations related to required reduction of water usage has already impacted the local retail water agencies financially. Possible increases in water rates to make up for the financial loss caused by the regulation will have a domino effect on local business and residents in regard to profit and spending ability respectively.

Whether there are other drought-related impacts not identified above.

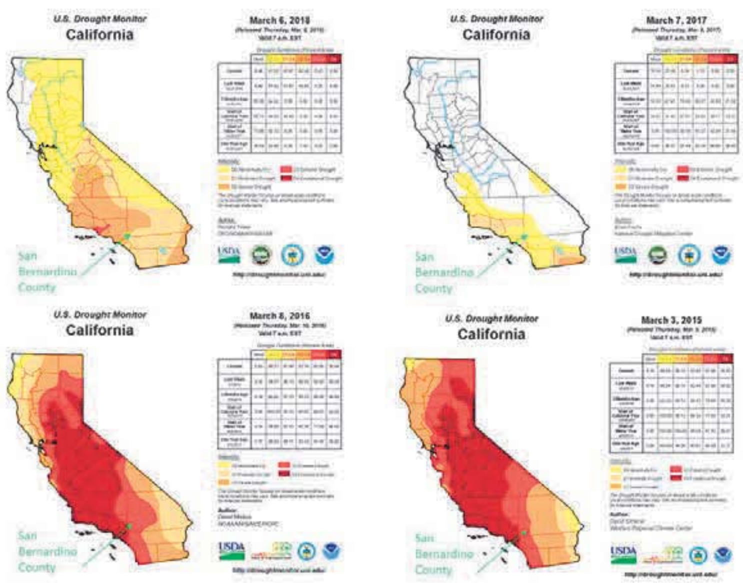
Yes, there are complex and real links between water and crises/conflict. While major known water resource concerns are identified above, as drought conditions worsen there is potential that water-related tensions develop. Collaborating with the region's water agencies and other stakeholders on a drought-resilient watershed initiatives like the project will help.

Describe existing or potential drought conditions in the project area.

San Bernardino County has experienced some of the most severe drought conditions nationwide since 2014 (U.S. Drought Monitor, California Drought Map, May 6, 2014).

Between 2015 and 2016 parts of the County were under conditions of "extreme drought" and "severe drought", according to the U.S Drought Monitor and as shown in Figure 3. Conditions lessened in 2017 with an above average wet year, however in 2018 conditions worsened back to a "severe drought". It is impossible to predict how drought conditions may improve or worsen in the next few years, however, severe drought conditions are certain to occur in the short-term and the long-term. Groundwater level declines as well as water quality impairments are anticipated to ensue as a direct result. It is for this reason, that Valley District is proactively taking steps to facilitate maximization of its groundwater supplies and ensure continued reliable drinking water deliveries.

Figure 3. California Drought Map Between 2015 and 2018



Is the project in an area that is currently or recently suffering from drought?

As noted above, San Bernardino County, within which the project is located, has experienced substantial drought conditions over the last 5 years, starting in 2014. During that time, all or parts of the County were under "extreme drought" and "severe drought" conditions. To date the County continues to experience "severe drought" conditions. See also response above and Figure 3.

Describe any projected increases to the severity or duration of drought in the project area resulting from climate change.

Climatologists have changed the way they view drought in years past and now recognize ongoing higher temperatures and longer drought conditions may be the "new normal" for California. Accordingly, climate change is one of the key factors that will have a substantial impact on water supplies. A study conducted by scientists at Stanford University entitled "Anthropogenic Warming Has Increased Drought Risk in California" has linked climate change with "more frequent occurrences of high temperatures and low precipitation that will lead to increased severe drought conditions". Droughts are expected to occur more frequently, more intensely, and last longer. The Natural Resources Defenses Council (NRDC) estimates that if nothing is done to address the implications associated with climate change, between the years 2025 and 2100, the cost of providing water to the western United States will increase from $200 billion to $950 billion per year.

1.6.4 Criterion D: Project Implementation

Describe the implementation plan of the proposed project.

The overall project schedule is provided in Section 1.4.1. As summarized in that Section, the Project is currently at 50% design. Final design and environmental documentation activities are anticipated to be completed by December 2019. Construction bids will be solicited upon completion of final design, beginning in March 2020. The Project is anticipated to be fully operational by March 2021.

Describe any permits that will be required, along with the process for obtaining such permits.

The Project will require an encroachment permit from the County of San Bernardino as well as an encroachment permit from DWR as the Intertie will connect to SWP infrastructure regulated by that agency. Valley District staff has worked with both the County and DWR to obtain these permits on other similar jobs.

Identify and describe any engineering or design work for the proposed project.

The Central-Feeder – EBX Intertie Project is part of the larger Bunker Hill Conjunctive Use Program which has been in the planning stages since 2012. The Program itself has been evaluated for feasibility and preliminary design is complete. Next steps will be final design, CEQA, and construction. Specifically, for the Intertie, design is currently at 50%.

Describe any new policies or administrative actions required to implement the project.

No new policies or administrative actions are required to construct the Intertie. A Memorandum of Understanding will provide the rules for participation in the overall BHCUP. Groundwater would continue to be managed by Valley District according to the Orange County and Western Judgements.

Describe how the environmental compliance estimate was developed.

Based on the nature and location of the proposed infrastructure, the Project is considered to be categorically exempt under CEQA. In relation to NEPA, the Project would correspondingly fall under a Categorical Exclusion. These exemptions are expected to have minimal costs.

1.6.5 Criterion E: Nexus to Reclamation

How is the proposed project connected to a Reclamation project or activity?

The Project service area covers the Valley District service area, the SBBA, and the service areas of potential project partners that include YVWD, SMWC, and SGPWA. Within this region there have been various Bureau of Reclamation-funded plans and projects that have been completed (see Table 2: Past Working Relationships with Reclamation). In addition, this project will assist Reclamation in their activities toward managing water in the west by improving a segment of California's water supply.

Will the project benefit any tribe(s)?

The San Manuel Band of Mission Indians and Morongo Band of Mission Indians are present throughout the region. Any improvements to water quality and water supply reliability through enhancements to the Central-Feeder – EBX facilities will directly benefit tribes within these communities.

Does the applicant receive Reclamation project water? Is the project on Reclamation project lands or involving Reclamation facilities?

No, Valley District does not receive Reclamation project water. The Project is not on Reclamation project lands and does not involve Reclamation facilities. The Project does reside in the Colorado River Basin and will contribute to the beneficial use of water resources within the Basin.

1.6.6 Criterion F: Department of the Interior Priorities

Utilizing our natural resources

The Project utilizes the natural storage capabilities of the underlying groundwater basin store water in the wet-years for extraction to meet demands in future dry years. The Project decreases the demand on imported SWP which reduces pumping requirements for the conveyance of imported water to Southern California. This energy savings ensures American Energy is available to meet our security and economic needs.

Restoring trust with local communities

The Project is part of a watershed-wide effort in the Upper Santa Ana Region to manage water resources in an efficient and reliable manner. The Project expands the lines of communication with local communities including city governments, school districts, and other community organizations regarding shared priorities related to water sustainability and reliability.

Striking a regulatory balance

By more efficiently managing local water supplies to meet water demands, the Project helps to reduce the potential for implementation of drought declarations and related regulatory requirements imposed upon industry and private citizens.

Modernizing our infrastructure

Implementing storage and intertie projects will improve the Region's resiliency against disasters such as earthquakes and other catastrophic events that could cause damage to water supply systems. Earthquakes can displace pipelines, interrupt power supply to pump stations and treatment facilities, and cause water service outages of local and SWP water. Increasing storage can provide reserves if there is an interruption of SWP water and interties can be used during an emergency to supply water from water systems that are not damaged. (Upper Santa Ana IRWMP Pg. 4-10).

Section 2: Environmental and Cultural Resources Compliance

Based on the nature and location of the Project, shown on the right, the Project is anticipated to be categorically exempt under CCR, Title 14, §15301 "Existing Facilities. The project would correspondingly fall under a NEPA categorical exclusion. However, should final design indicate the potential for an environmental impact, a Mitigated Negative Declaration/Environmental Assessment will be prepared to adequately provide environmental compliance.

Will the proposed project impact the surrounding environment (e.g., soil [dust], air, water [quality and quantity], animal habitat)? Please briefly describe all earth-disturbing work and any work that will affect the air, water, or animal habitat in the project area. Please also explain the impacts of such work on the surrounding environment and any steps that could be taken to minimize the impacts.

No, the proposed Project will be performed on Valley District property that is considered already disturbed and should pose minimal impact to the surrounding environment.

Are you aware of any species listed or proposed to be listed as a Federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by any activities associated with the proposed project?

No species listed or proposed to be listed as a Federal endangered or threatened species, or designated critical habitats are known to reside within the proposed Project area and it is not anticipated that there will be any impacts on such species. Regardless Valley District will conduct a thorough evaluation to ensure no harm or impacts come to these species. Impacts to animal habitat will be avoided by performing any vegetation removal and major construction outside of the nesting season and performing animal surveys to identify areas that need to be avoided. Valley District staff is familiar with working in this general area to operate and maintain the existing facilities.

Are there wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as "Waters of the United States?"

No, the Project would not affect riparian habitat, including federally protected wetlands, as there are none in the proposed Project area. No associated impacts would occur and no mitigation is required.

When was the water delivery system constructed?

The majority of the water delivery system was constructed by the late 1970s; however, some infrastructure continues to be constructed today as the service area is being built out.

Will the proposed project result in any modification of or effects to, individual features of an irrigation system (e.g., headgates, canals, or flumes)? If so, state when those features were constructed and describe the nature and timing of any extensive alterations or modifications to those features completed previously.

The Project will not result in any modification of or effect to individual features, such as head gates, canals, or flumes, of an irrigation system.

Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places? A cultural resources specialist at your local Reclamation office or the State Historic Preservation Office can assist in answering this question.

There are no buildings, structures, or features listed or eligible for listing on the National Register of Historic Places within the project area. There are such sites in Valley District's service area, however, they are not located in the project area.

Are there any known archeological sites in the proposed project area?

No, there are no known archeological sites in the Project area.

Will the proposed project have a disproportionately high and adverse effect on low income or minority populations?

No, the Project will not have any adverse effects on low income or minority populations.

Will the proposed project limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands?

No, the Project will not limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands.

Will the proposed project contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area?

No, the Project will not contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area.

Section 3: Project Budget

3.1 Funding Plan and Letters of Commitment

How you will make your contribution to the cost share requirement, such as monetary and/or in-kind contributions and source funds contributed by the applicant (e.g., reserve account, tax revenue, and/or assessments).

The estimated project cost for the Project is $1,796,796. With this application, Valley District is requesting approximately 42 percent of the total project costs, $750,000. Valley District proposes to fund the Project using Reclamation funding and funding from Capital Improvement Plan funds that are made up of revenue from Valley District's rate structure. The non-Federal share will be provided solely by Valley District.

Describe any donations or in-kind costs incurred before the anticipated Project start date that you seek to include as project costs. For each cost, identify:

- *The project expenditure and amount*
- *The date of cost incurrence*
- *How the expenditure benefits the project*
- *Provide the identify and amount of funding to be provided by funding partners, as well as the required letters of commitment*

Valley District began the Project in 2012 and has already completed feasibility studies and preliminary design (up to 50%) for the project. This work was done by the District's in-house engineering staff and it was completed prior to July 1, 2018. Accordingly, the cost for this work is not included within the project budget.

Describe any funding requested or received from other Federal partners

No funding has been requested or received from other Federal partners.

Describe any pending funding requests that have not yet been approved and explain how the project will be affected if such funding is denied.

There are no other outstanding funding requests. If funding for the Project is denied, the project schedule will be delayed. Table 6 below provides the total cost of the project. There are no third-party contributions.

TABLE 6. TOTAL PROJECT COST

Source	Amount
Costs to be reimbursed with the requested Federal funding	$750,000
Costs to be paid by the applicant	$1,046,796
Value of third-party contributions	$0
Total Project Cost	**$1,796,796**

Table 7 below summarizes all funding sources (non-Federal and Federal) for the Project.

TABLE 7. SUMMARY OF NON-FEDERAL AND FEDERAL FUNDING SOURCES

Funding Sources	Funding Amount
Non-Federal Entities	
Valley District	$1,046,796
Non-Federal Subtotal	**$1,046,796**
Other Federal Entities	$0
Other Federal Subtotal	**$0**
Requested Reclamation Funding	**$750,000**

3.2 Budget Proposal

The Project Budget consists of costs associated with the implementation of the Project and fall within various budget categories, including equipment, supplies, materials, contractual and/or implementation, among others. The budget proposal is provided in Table 8, which reflects all budget categories listed in the Funding Opportunity Announcement (FOA). The budget items included in the table are described in detail below.

TABLE 8. BUDGET PROPOSAL

Budget Item Description	Computation		Qty. Type	Total Cost
	$/Unit	Quantity		
Salaries and Wages, Fringe Benefits and Travel				
Not applicable	-	0	-	$ -
Equipment, Materials, and Supplies				
Piping (Including Valve & Meters)				
60" diameter piping	$ 800	282	LF	$ 225,600
42" diameter piping	$ 600	113	LF	$ 67,800
24" diameter piping	$ 300	107	LF	$ 32,100
Misc. process piping (1/2" to 4")	$ 15,000	1	LS	$ 15,000
Valves and meters (1/2" to 42")	$ 205,000	1	LS	$ 205,000
Concrete Structures				
Flow Control Vault Structure	$ 375	597	SF	$ 223,875

Guard Valve Vault	$ 375	232	SF	$ 87,000
Manhole Structure	$ 275	87	SF	$ 23,925
Electrical and Controls				
SCADA Controls	$ 75,000	1	LS	$ 75,000
Process Instrumentation	$ 12,000	1	LS	$ 12,000
Electrical	$ 125,000	1	LS	$ 125,000
			Subtotal Supplies and Materials	*$ 1,092,300*
Contractual/Construction				
Final Design	Engineers Estimate			$ 146,000
Mobilization, Demobilization, Bonds and Insurance	$ 82,000	1	LS	$ 82,000
Traffic Control	$25,000	1	LS	$ 25,000
Clear & Grub	$ 10,000	1	LS	$ 10,000
Grading (Trench)	$ 25	9400	CY	$ 235,000
Fencing	$ 100	70	LF	$ 7,000
Irrigation	$ 8,000	1	LS	$ 8,000
			Subtotal Contractual/Construction	*$ 513,000*
Other/Environmental and Regulatory Compliance				
Environmental	Engineers Estimate			$ 30,000
Permitting	Engineers Estimate			$ 16,000
Contingency	10% construction cost			$ 145,496
			Subtotal Other/Environmental and Regulatory	*$ 191,496*
			Total Direct Costs	**$ 1,796,796**
Indirect Costs				
Not Applicable				$ -
			Total Estimated Project Costs	**$ 1,796,796**

Notes: This budget assumes Reclamation funding will be used to fund $750,000 of supply and materials costs, with all remaining costs the responsibility of Valley District.

3.2.1 Salaries, Wages, and Fringe Benefits

The majority of project work will be conducted by specialized contractors. For this reason, Valley District will not be seeking reimbursement for Valley District's staff time spent on the project. Fringe benefits are not included in the overall project budget.

3.2.2 Travel

Valley District staff anticipate visiting the project site periodically during construction but travel to Valley District's facilities is a part of normal activity for Valley District staff and no reimbursement or match for staff travel is being sought. It is not known at this time whether consultant costs for travel will be required. If so, those costs would be included within the "contractual" budget category with any consultant/contractor cost estimates.

3.2.3 Equipment, Materials and Supplies

The Project will require piping (including valves and meters), concrete structures, and installation of electrical hardware and controls. All supplies are related to construction.

3.2.4 Contractual

Contractual/Construction work to be performed by contractors is described in Section 1.4 of this application. Consultants/contractors are anticipated to be used to perform final design, project mobilization and demobilization, traffic control, clearing and grubbing, grading, fencing, and irrigation installation. A contractor may also be utilized as an independent construction manager, who will also have responsibility for labor compliance during construction. Cost estimates are based on past experience with other projects in the same geographic area and are considered fair and reasonable.

3.2.5 Environmental and Regulatory Compliance Costs

Valley District will hire a contractor to validate the CEQA/NEPA exemption/exclusion assumption and will review the project in the context of the Clean Water Act, Endangered Species Act, National Historic Preservation Act, and to undertake any needed consultation with tribes and the State Historic Preservation Office.

In addition, two encroachment permits will need to be obtained, on from the County of San Bernardino, and one from DWR, for implementation of the project.

Total environmental and regulatory compliance costs are based on similar permits previously obtained by Valley District for similar projects.

3.2.6 Other Expenses

Valley District anticipates regular, quarterly reporting on project activities. Reporting activities are within Valley District's regular operations and practice. During construction, reporting will be the responsibility of the Construction Administration Consultant. No other expenses are anticipated that are not captured under the above categories.

3.2.7 Indirect Costs

No indirect costs are included in the proposed budget.

3.3 Total Costs

The total cost of the Project is **$1,796,796**. Funding sources for the project currently include funding from Valley District and requested funding from Reclamation. Valley District is requesting $750,000 in funding from Reclamation to fund the Project. This represents 42% of the total project costs. No other Federal funding has been requested or received for the Project.

Section 4: Required Permits and Approvals

Anticipated permits for the Project include the following:

- County of San Bernardino Encroachment Permit
- DWR Encroachment Permit

Section 5: Unique Entity Identifier and System for Award Management

Valley District is registered in the System for Award Management (SAM) and will maintain an active SAM registration during the period of any federal assistance agreement.

Valley District's DUNS number is 054797683.

Valley District's entity identifier number in SAM is SBVMWD009.

Section 6: References

Basin Technical Advisory Committee (BTAC). 2017. 2018 Regional Water Management Plan. December.

Bureau of Reclamation (Reclamation). 2013. Summary Report, Santa Ana Watershed Basin Study. September.

Kennedy Jenks. 2017. 2015 Urban Water Management Plan for San Gorgonio Pass Water Agency. March.

Miro, Michelle E., et. al. 2018. Estimating Future Water Demand for San Bernardino Valley Municipal Water District. December.

RMC Water and Environment. 2015. Upper Santa Ana River Watershed Integrated Regional Water Management Plan. January.

Santa Ana Watershed Protection Authority (SAWPA). 2019. One Water One Watershed Plan Update 2018. January.

San Bernardino Valley Municipal Water District (SBVMWD). 2019. Bunker Hill Conjunctive Use Project (Presentation). March.

______. 2013a. Bunker Hill Conjunctive Use Project Concept Paper. September.

______. 2013b. Bunker Hill Conjunctive Use Project (Presentation). March.

______. 2013c. Plans for the Construction of Central-Feeder – EBX Intertie, 50% Civil Review Drawings. September.

San Bernardino Valley Water Conservation District. 2019. Engineering Investigation of the Bunker Hill Basin 2017-2018. February.

USBR, 2013. Santa Ana Watershed Basin Study. September. Available at: https://www.usbr.gov/watersmart/bsp/docs/finalreport/SantaAnaWatershed/SantaAnaBasinStudySummaryReport.pdf.

U.S. Drought Monitor. U.S. Drought Monitor Map Archive. Available at: https://droughtmonitor.unl.edu/Maps/MapArchive.aspx. Accessed March 2019.

Water Systems Consulting, Inc. (WSC). 2016. 2015 San Bernardino Valley Regional Urban Water Management Plan. June.

Section 7: Letters of Support and Commitment

Two letters of support are provided from the following project participants:

- Yucaipa Valley Water District
- San Gorgonio Pass Water Agency

Yucaipa Valley Water District

12770 Second Street • Post Office Box 730 • Yucaipa, California 92399-0730
(909) 797-5117 • Fax: (909) 797-6381 • www.yvwd.dst.ca.us

March 13, 2019

Douglas Headrick, General Manager
San Bernardino Valley Municipal Water District
380 E Vanderbilt Way
San Bernardino, CA 92408

Subject: Support Letter for Central Feeder – East Branch Extension Intertie Project

Dear Mr. Headrick:

Yucaipa Valley Water District (YVWD) supports San Bernardino Valley Municipal Water District's (SBVMWD) plan to construct the Central Feeder – East Branch Extension Intertie Project (Project). This intertie is an integral part of the Bunker Hill Conjunctive Use Program, which is utilizing the Bunker Hill Basin to store water when it is available in wet years so that it can be used during dry years. This intertie will facilitate delivery of the water supply stored in the Bunker Hill Basin to east of SBVMWD's service area including the area served by YVWD. This Project provides additional water supply reliability and addresses the impacts of climate change, particularly drought, through actively managing the region's water supply resources.

YVWD appreciates SBVMWD being proactive in implementing projects to address the region's water supply issues and to ensure the required facilities are in place. The proposed Project represents a significant effort by SBVMWD to construct the necessary infrastructure to manage water resources regionally and mitigating the impacts of climate change and drought.

Sincerely,

Joseph Zoba
General Manager

Enclosure

San Gorgonio Pass Water Agency
A California State Water Project Contractor
1210 Beaumont Avenue • Beaumont, CA 92223
Phone (951) 845-2577 • Fax (951) 845-0281

March 13, 2019

Douglas Headrick, General Manager
San Bernardino Valley Municipal Water District
380 E Vanderbilt Way
San Bernardino, CA 92408

Subject: Support Letter for Central Feeder – East Branch Extension Intertie Project

Dear Mr. Headrick:

San Gorgonio Pass Water Agency (Agency) supports San Bernardino Valley Municipal Water District's (SBVMWD) plan to construct the Central Feeder – East Branch Extension Intertie Project (Project). This intertie is an integral part of the Bunker Hill Conjunctive Use Program, which is utilizing the Bunker Hill Basin to store water when it is available in wet years so that it can be used during dry years. This intertie will facilitate delivery of the water supply stored in the Bunker Hill Basin to east of Valley District's service area including the area served by the Agency. This Project provides additional water supply reliability and addresses the impacts of climate change, particularly drought, through actively managing the region's water supply resources.

The Agency appreciates SBVMWD being proactive in implementing projects to address the region's water supply issues. The proposed Project represents a significant effort by SBVMWD to construct the necessary infrastructure to manage water resources regionally and mitigating the impacts of climate change and drought.

Sincerely,

Jeff Davis
General Manager

Section 8: Official Resolution

A draft official resolution authorizing Valley District's Board of Directors to submit this grant application, commit to the financial and legal obligations, and negotiate and execute the grant agreement is provided.

The resolution was approved by the Board of Directors on March 19, 2019.

RESOLUTION 1083

RESOLUTION OF THE BOARD OF DIRECTORS OF SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT AUTHORIZING THE DISTRICT'S APPLICATION FOR THE BUREAU OF RECLAMATION WATERSMART: DROUGHT RESILIENCY PROJECTS FOR FISCAL YEAR 2019

WHEREAS, San Bernardino Valley Municipal Water District ("Valley District") is a municipal water district established pursuant to Section 71000 et seq. of the California Water Code.

WHEREAS, imported water supply in the San Bernardino area is facing a growing list of challenges associated with a prolonged drought, regulatory cutbacks on State Water Project deliveries, Delta instability, climate change, aging infrastructure, and growing population; and,

WHEREAS, the United States Department of the Interior, Bureau of Reclamation under the WaterSMART: Drought Resiliency Projects for Fiscal Year 2019 will make funding available to qualifying applicants; and

WHEREAS, the Board of Directors of Valley District has identified a project that exemplifies the objectives of the WaterSMART Grant in the Central Feeder East Branch Extension Intertie; and

WHEREAS, Valley District agrees to the administration and cost sharing requirements of the WaterSMART Grant criteria.

NOW, THEREFORE, be it resolved by the Board of Directors of Valley District as follows:

Section 1 The District is hereby authorized to receive, if awarded, the WaterSMART: Drought Resiliency Projects for Fiscal Year 2019 funding in the amount of $750,000 and will make a good faith effort to enter into a cooperative agreement with Reclamation for the receipt and administration of said grant funds.

Section 2 The General Manager, or his designee, is hereby authorized to take any and all action which may be necessary for the completion and execution of the project agreement and to take any and all other action which may be necessary for the receipt and administration of the grant funding in accordance with the requirements of the Bureau of Reclamation.

Section 3 This resolution officially becomes a component part of Valley District's grant application.

Section 4 The Board of Directors has reviewed and supports the application to be submitted.

Section 5 Valley District is capable of providing the amount of funding and/or in-kind contributions specified in the grant application funding plan.

Section 6 This Resolution shall be effective as of the date of adoption.

ADOPTED this 19th day of March, 2019.

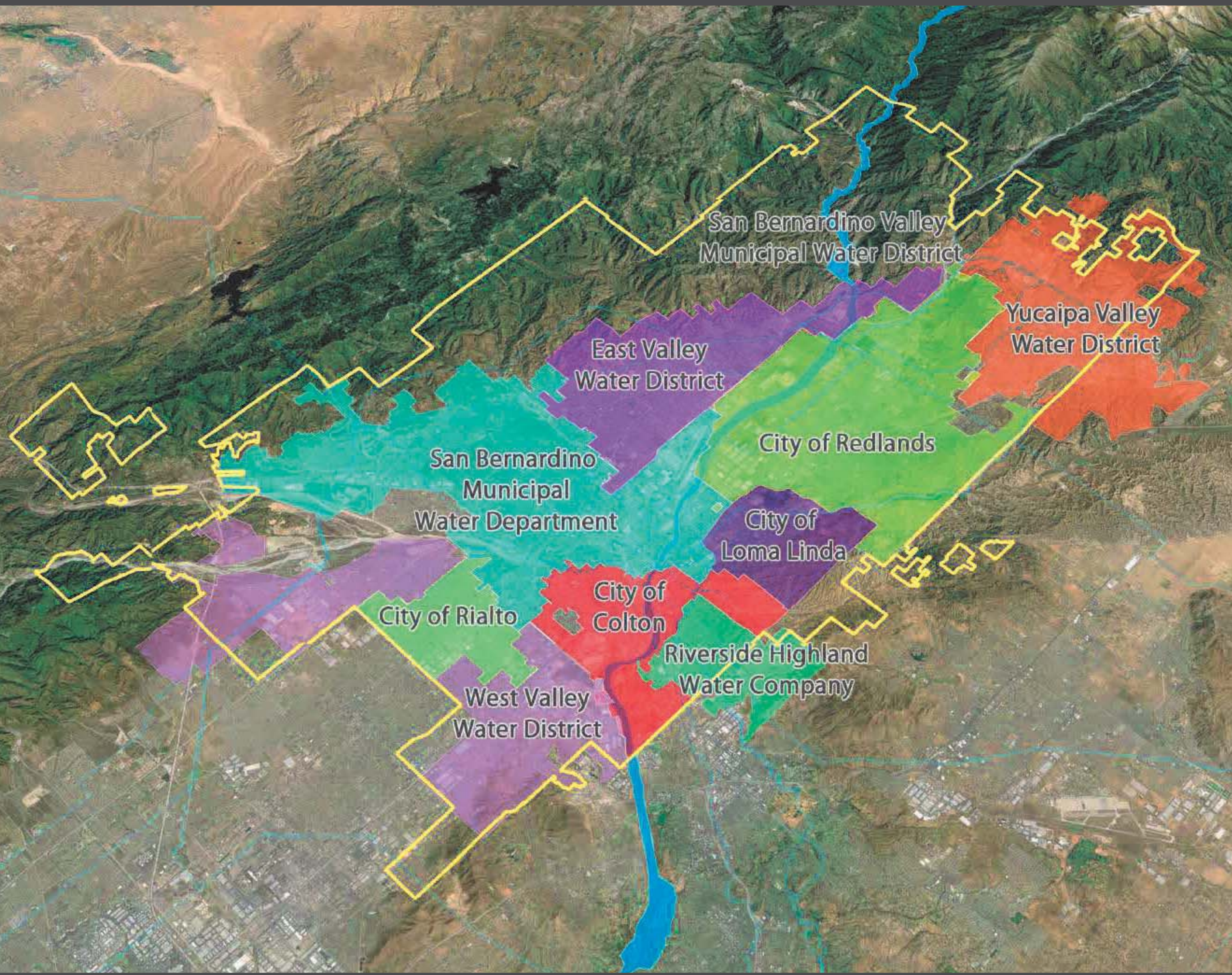
T. Milford Harrison
President

Douglas D. Headrick
Secretary

Section 9: Drought Contingency Plan Information

2015 San Bernardino Valley Regional

Urban Water Management Plan



• June 2016•

WSC
WATER SYSTEMS CONSULTING, INC.

Table 1-2 Climatological Data

	Mountain[1]			Valley[2]		
Month	**Average Temperature (°F)**	**Average Precipitation (in.)**	**Average Standard ETo (in.)**	**Average Temperature (°F)**	**Average Precipitation (in.)**	**Average Standard ETo (in.)**
January	34.1	4.49	1.94	52.4	3.22	2.53
February	35.2	4.09	2.39	54.6	3.25	2.87
March	38.0	3.06	4.03	56.7	2.86	4.30
April	43.0	1.32	5.22	60.9	1.29	5.38
May	50.7	0.48	6.67	65.6	0.47	5.82
June	58.4	0.14	7.06	71.3	0.09	6.76
July	64.2	0.74	6.44	77.7	0.04	7.38
August	63.3	0.97	5.92	77.7	0.15	7.09
September	57.5	0.53	4.80	73.9	0.33	5.51
October	48.8	0.82	3.67	66.5	0.71	3.97
November	39.9	2.00	2.27	58.6	1.32	2.89
December	34.0	3.21	1.60	53.3	2.38	2.38
Total		21.85	52.01		16.11	56.88

Notes: [1]Mountain precipitation and temperature for NOAA weather station 040741 in Big Bear Lake; data from 1960 through 2015; http://wrcc.dri.edu; ETo data for CIMIS weather station 199 in Big Bear Lake; http://wwwcimis.water.ca.gov/
[2]Valley precipitation and temperature for NOAA weather station 047723 in San Bernardino; data from 1893 through 2004; http//wrcc.dri.edu; ETo data for CIMIS weather station 44 at University of California, Riverside; http://wwwcimis.water.ca.gov/

1.6.2 Potential Effects of Global Climate Change

A topic of growing concern for water planners and managers is climate change and the potential impacts it could have on California's future water supplies. The Upper Santa Ana River Watershed Integrated Regional Water Management Plan (IRWMP) included an assessment of the potential impacts of climate change. The IRWMP Climate Change Vulnerability Assessment Checklist is included in Appendix F of this Plan. A summary of the IRWMP discussion is included here.

Recent climate change modeling for the SAR watershed suggests that a changing climate will have multiple effects on the Region. Adaptation and mitigation measures will be necessary to account for these effects.

The IRWM Region's currently consistent climate with hot summers and cool winters with mild precipitation, and rain in low elevations with snow in higher elevations, would change as temperatures increase, resulting in less precipitation as snow which would affect the snow pack. Increased precipitation as rain would make it more difficult to capture storm flows and store them for drier periods.

The Intergovernmental Panel on Climate Change has vetted and approved 112 climate models based on projections in greenhouse gas emissions and associated changes in precipitation and temperature. The models show that in the future the number of days over 95°F will increase in multiple locations. The Region chose two cities with different temperature ranges to compare the increase across the entire watershed. The cities of Riverside and Big Bear were used to see the projections of the number of days that would be above 95°F. The results are shown in Table 1-3.

Table 1-3 Days per Year exceeding 95°F

City	Historical (°F)	2020 (°F)	2050 (°F)	2070 (°F)
Riverside	43	58	72	82
Big Bear	0	0	2	4

The number of high temperature days in Riverside is expected to double between the present and 2070. Similar increases in temperature can be anticipated throughout Valley District's service area. These increased temperature levels will increase water demands across the watershed mainly for agricultural and irrigation purposes. The higher temperature days in Big Bear have the potential to affect the forest ecosystem and the snow related recreational activities in the area.

The forest ecosystems in the San Bernardino National Forest are currently on the decline. Alpine and subalpine forests are anticipated to decrease in area by fifty to seventy percent by 2100. It is believed that increased greenhouse gas emissions are a primary factor contributing to the decline of these fragile ecosystems.

While high elevation ecosystems decline, the severity of future floods is likely to increase. The likelihood of a 200-year storm event or longer is anticipated to be significantly higher in 2070. This increases the potential for negative impacts on nearby infrastructure. Furthermore, storms are expected to be more severe but less frequent. Despite these assumptions, the aftermath of a severe storm is highly variable.

In addition to changes in ecosystems and storm severity, warmer temperatures may also decrease the annual amount of snowfall and increase the instance of rain in higher elevations. This alteration of precipitation type is likely to cause negative impacts for snow-related recreational activities characteristic of the area's ski resorts. From a local standpoint, Big Bear and Snow Valley both lie below 3000 meters above MSL and are anticipated to experience a decline in snowpack by 2070. Furthermore, it is projected that there will be a decrease in overall winter precipitation of the area by 2070. On a larger scale, the increased temperatures could affect the Sierra Nevada Mountains in a similar way, threatening the reliability of the SWP.

1.6.3 Addressing Climate Change

Climate change can be addressed in two ways, mitigation and adaptation. Mitigation focuses on reducing the carbon emissions for water treatment and transportation. Decreasing carbon emissions for water treatment and transportation may also result in reduced energy costs for water purveyors. These measures will also help in compliance of the California Global Warming Solutions Act (Assembly Bill 32 or AB 32). Adaptation addresses operational changes that need to be made in order to accommodate the increasing temperatures, the increased possibility for severe flooding, and the decreasing precipitation as snow predicted by the climate models.

Plans for greenhouse gas mitigation focus on the relationship between water and energy. This relationship can be quantified and projections for future trends can be developed. The California Global Warming Solutions Act requires greenhouse gas levels to be reduced to their 1990 level by the year 2020.

A Greenhouse Gas Emissions Calculator was developed as part of a Basin Study of the Santa Ana River in a partnership between the Santa Ana Watershed Project Authority (SAWPA) and the United States Bureau of Reclamation (Reclamation). The calculator showed that for the Upper SAR watershed, the most appropriate ways to effectively reduce the volume of carbon emissions related to water treatment and meet AB 32 goals would be to reduce imported water usage and increase local supply usage and water use efficiency.

Finally, Valley District has identified alternative conveyance facilities which could be used in the event of a failure of one of Valley District's pipelines. For example, Valley District has an agreement with Metropolitan Water District of Southern California which could allow the use of the Inland Feeder Pipeline to bypass a large portion of the District's primary delivery pipeline, the Foothill Pipeline.

Table 5-1. System Interties between Retail Agencies

Agencies	Direction	Capacity (MGD)
City of San Bernardino/East Valley Water District	Either	4
City of San Bernardino/City of Riverside	To San Bernardino	2
City of San Bernardino/West Valley Water District	Either	3
City of San Bernardino/Loma Linda	To Loma Linda	5
City of San Bernardino/Colton	To Colton	3
City of San Bernardino/Rialto	Either	3.6
City of San Bernardino/Riverside Highland Water Company	To Riverside Highland Water Company	3
Fontana/Cucamonga Valley	Either	3.6
West Valley Water District/Fontana	Either	
West Valley Water District/Rialto	Either	
West Valley Water District/Colton	To Colton	
City of Redlands/City of Loma Linda	To Loma Linda	1
Source: 2015 IRWMP		

All of the retail agencies that are included in this RUWMP are also members of the BTAC. The BTAC works together on an annual basis to review water supplies and evaluate how to prioritize and distribute any shortage of SWP supplies. During a shortage, it is anticipated that the first priority for any SWP water would be direct deliveries.

5.3.3 Strategies to Improve Regional Preparedness

Based on the recommendations in the 2015 IRWMP, the following strategies were identified to enhance regional disaster preparedness.

- Valley District is planning to implement seismic improvements for high priority facilities, including the Foothill Pipeline, Santa Ana River Connector, Morton Canyon Connector, and Greenspot pipeline.
- Projects are proposed that could provide production and conveyance system redundancies for regional facilities. These include:
    - The BHCUP, which could provide backup well production capacity needed for retail water agencies when SWP supplies have been severed.
    - The Central Feeder/EBX2 Intertie, which provides an additional connection between Valley District's system and DWR's system, and could be used to bypass a portion of Valley District's conveyance system in the event of failure.
- Consider the opportunities that Big Bear Lake presents as an emergency source of water after an earthquake that interrupts SWP deliveries for many weeks.

- A catastrophic earthquake may cause loss of electricity for an indeterminate amount of time. In order to ensure water supplies in the immediate aftermath and weeks following a major earthquake, it is critical to have back-up generators or internal combustion engines for important production wells throughout the Region.
- Valley District is also developing a storage program to help meet direct delivery demands during a shortage on the SWP. The current storage program includes the DWR Carryover Storage Program, the Yuba Accord and the DWR Dry Year Water Transfer Program. Valley District is also evaluating "upstream" groundwater banks located along the California Aqueduct.

5.3.4 General Response Strategies

The San Andreas Fault, which traverses the length of the southern San Joaquin Valley, could impact the State Water Project. The California Division of Mines and Geology has stated that two of the aqueduct systems that import water to southern California (including the California Aqueduct) could be ruptured by displacement on the San Andreas Fault. The situation would be further complicated by physical damage to pumping equipment and local loss of electrical power.

DWR has an Aqueduct Outage Plan for restoring the California Aqueduct to service should a major break occur, which it estimates would take approximately four months to repair. Limitations on supplies of groundwater and/or imported water for an extended period, due to power outages and/or equipment damage, could result in severe water shortages until the supplies could be restored.

The public would be asked to reduce consumption to minimum health and safety levels, extending the supply in treated water storage a number of days. This would provide sufficient time to restore a significant amount of groundwater production. After the groundwater supply is restored, the pumping capacity of the retail purveyors could meet the reduced demand until such time that the imported water supply was reestablished. Updates on the water situation would be made as often as necessary.

Valley District's water sources are generally of good quality, and no insurmountable problems resulting from industrial or agricultural contamination are foreseen. If contamination did result from a toxic spill or similar accident, the contamination would be isolated and should not significantly impact the total water supply. In addition, such an event would be covered by the purveyors Emergency Response Plan.

5.3.5 SWP Emergency Outage Scenarios

In addition to earthquakes, the SWP could experience other emergency outage scenarios. Past examples include slippage of aqueduct side panels into the California Aqueduct near Patterson in the mid-1990s, the Arroyo Pasajero flood event in 1995 (which also destroyed part of Interstate 5 near Los Banos) and various subsidence repairs needed along the East Branch of the Aqueduct since the 1980s. All these outages were short-term in nature (on the order of

6.5 Water Shortage Contingency Plan

Water supplies may be interrupted or reduced significantly in a number of ways, such as drought which limits supplies, a fire or earthquake which damage delivery or storage facilities, chemical spill, or a regional power outage. Section 5 of this UWMP describes water shortage contingency planning for regional water supply sources.

6.6 Supply and Demand Comparisons

The UWMP Act requires urban water suppliers assess water supply reliability by comparing total projected water use with the expected water supply over the next 20 years in 5-year increments. The UWMP Act also requires an assessment of single-dry year and multiple-dry years. These comparisons for the Valley District are presented in Chapter 4 of this UWMP.

6.7 Adoption

Valley District, on behalf of the retail agencies, sent letters to cities and counties, as well as other water agencies, notifying them of RUWMP preparation and soliciting input to the Plan. Notification letters were sent in February and March 2016. Each agency published hearing notices consistent with UWMP Act requirements. Hearings were conducted by each agency regarding the selection of water use targets, the implementation plan for complying with SB X7-7, and the potential economic impacts of complying with SB X7-7.

Valley District held a public hearing to present the draft RUWMP. Valley District provided notice of the public hearing to the cities and counties to which it provides water. These agencies are identified in Appendix C.

Legal public notices for the public hearing were published in the local newspapers and posted at Valley District offices and on the Valley District website. The notice that was published in advance of the public hearing is attached as Appendix C.

Copies of the draft RUWMP were available at the Valley District office located at 380 E Vanderbilt Way, San Bernardino CA 92408 or as a PDF on the Valley District website prior to the public hearing.

The draft Final RUWMP was presented to the Board at a public hearing on June 21, 2016.

The draft Final RUWMP was presented to the Board for adoption on June 21, 2016.

A copy of the resolution adopting the RUWMP is attached as Appendix D.

- Initiate remaining planning and preparation for Mandatory Stage.

YVWD Internal Operations for Voluntary Stage

- Continue actions listed in the Advisory Stage.
- Eliminate all operating system water uses determined not to be essential to maintain water quality such as pipeline flushing, reservoir overflows; complete cleaning of any reservoirs known to be vulnerable to warm weather taste and odor concerns.
- Increase water quality monitoring actions.
- Implement staffing reassignments as needed, and plan staffing changes which may be needed for the Mandatory Stage, including staff to enforce mandatory restrictions.

Supply and Demand Management Actions

- Issue a request that non-recirculating fountains be turned off*
- Restrict construction meters to only essential purposes*
- Activate any existing interties to increase supply availability*
- Request that Fire Department limit training exercises that use water.
- Request that City agencies eliminate washing fleet vehicles unless recycling car washes are used.
- Request that hosing sidewalks, driveways, parking lots, etc. be limited to situations that require it for public health and safety.
- Have YVWD field personnel "tag" observed obvious water waste such as hoses without shutoff nozzles, gutter flooding, etc. with notice that informs customer about the supply conditions and need to conserve.
- Evaluate ability to accelerate or enhance or expand long term conservation programs; implement as appropriate.

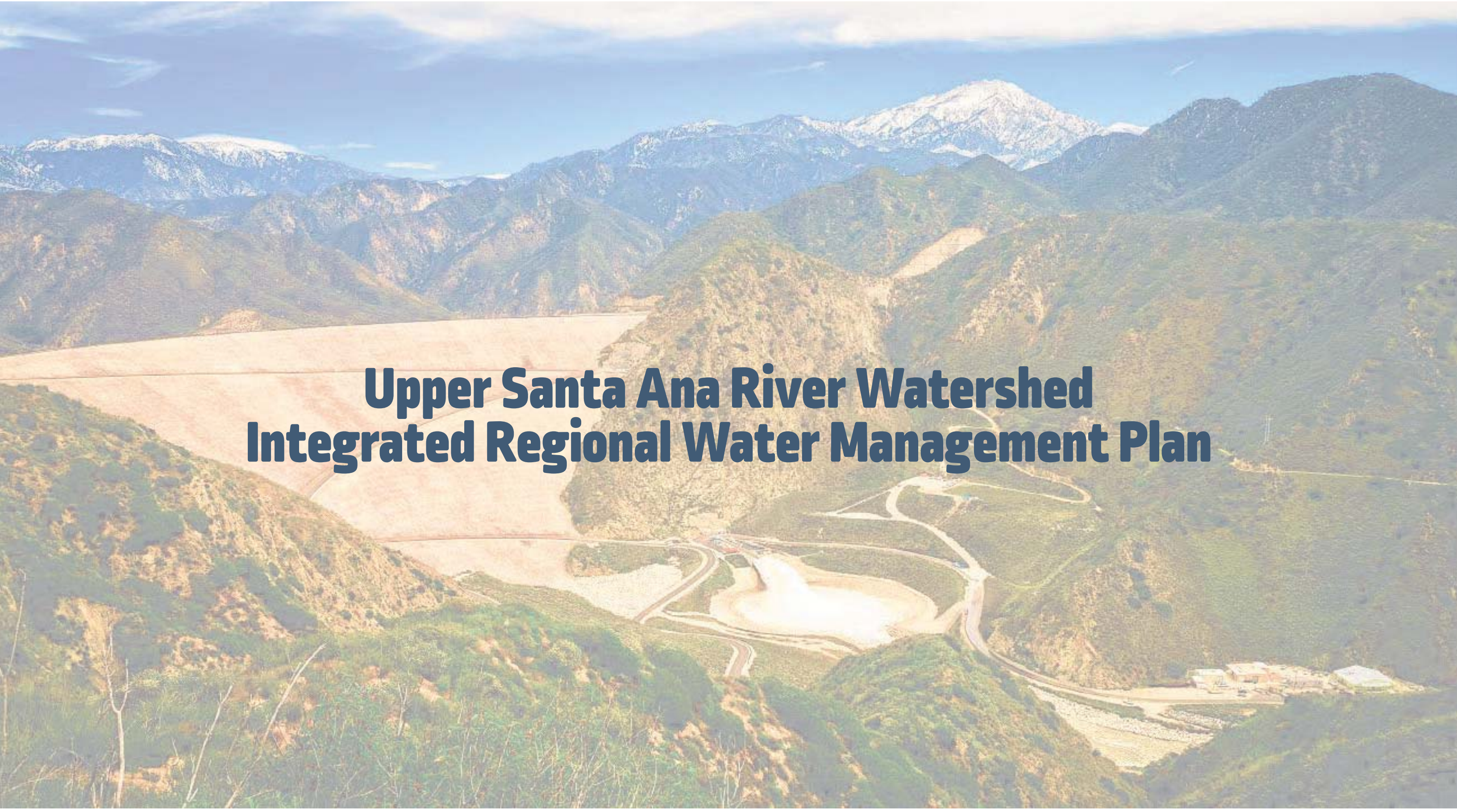
12.8.1.4 Mandatory Stage – Water Shortage Emergency: Mandatory Conservation Measures

If the Voluntary Stage does not result in the reduction needed, the Mandatory Stage prohibits or limits certain actions. This stage would be accompanied by an enforcement plan, which could include fines for repeated violation.

Objectives

- To achieve targeted consumption reduction goals by restricting defined water uses.
- To ensure that adequate water supply will be available during the duration of the situation to protect public health and safety.

Upper Santa Ana River Watershed
Integrated Regional Water Management Plan



January 2015

Goals, Objectives and Strategies

The BTAC developed a series of goals to help the USARW IRWM Region overcome the variety of issues and challenges. In addition, BTAC established measureable objectives, or targets, they hope to achieve over the next 5-year planning cycle. These goals and objectives are listed below.

USARW IRWM Region Water Management Goals and Objectives

Goal	Objectives
Goal #1: Improve Water Supply Reliability	1a: Reduce demand 20% by 2020
	1b: Increase utilization of local supplies by 23,000 AFY • Stormwater: 20,000 AFY • Recycled Water: 3,000 AFY
	1c: Increase storage by 10,000 AF
	1d: Prepare for disasters by implementing 2 new interties between water agencies
	1e: Monitor and adaptively manage climate change impacts by implementing 3 projects that reduce energy demands
	1f: Ensure equivalent water supply services for DACs
Goal #2: Balance Flood Management and Increase Stormwater Recharge	2a: Utilize 500 acres of flood control retention/detention basins that are not currently used for recharge
	2b: Reduce FEMA reported flood area
	2c: Ensure equivalent implementation of flood projects in DAC areas and implement at least 1 flood control project in a DAC area
Goal #3: Improve Water Quality	3a: Ensure no violations of drinking water quality standards
	3b: Improve surface and groundwater quality by treating 3,000 AFY of water supply
	3c: Manage total dissolved solids and nitrogen in groundwater
	3d: Ensure equivalent water quality services for DACs
Goal #4: Improve Habitat and Open Space	4a: Improve habitat and open space by 1,200 acres
	4b: Identify "multi-use" opportunities to increase recreation and public access and identify at least 1 multi-use project

Table 4-2: Comparison between IRWM Plan Objectives and Statewide Priorities

Upper SAR Watershed IRWM Plan Objectives	Statewide Priorities							
	Drought Preparedness	Use and Reuse Water More Efficiently	Climate Change Response Actions	Expand Environmental Stewardship	Practice Integrated Flood Management	Protect Surface Water and Groundwater Quality	Improve Tribal Water and Natural Resources	Ensure Equitable Distribution of Benefits
1a: Reduce demand 20% by 2020.	●	●	●	○		○	○	○
1b: Increase utilization of local supplies by 23,000 AFY (stormwater: 20,000 AFY and recycled water: 3,000 AFY).	●	●	●	○	○	○	○	○
1c: Increase storage by 10,000 AF.	●	○	●	○		○	○	○
1d: Prepare for disasters by implementing two new interties between water agencies.	●	○	●		○		○	○
1e: Monitor and adaptively manage climate change impacts by implementing three projects that reduce energy demands.	○	○	●	○	○	○	○	○
1f: Ensure equivalent water supply services for DACs	●	○	○	○	○		○	●
2a: Utilize 500 acres of flood control retention/detention basins that are not actively used for recharge.	●	●	○	○	●	○	○	○
2b: Reduce FEMA reported flood area.			○	○	●	○	○	○
2c: Ensure equivalent implementation of flood projects in DAC areas and implement at least one flood project in a DAC area.			○	○		○	○	●
3a: Ensure no violations of drinking water quality standards.			○	○		●	○	○
3b: Improve surface and groundwater quality by treating 3,000 AFY.			○	○		●	○	○
3c: Manage total dissolved solids and nitrogen in groundwater.			○			●	○	○
3d: Ensure equivalent water quality services for DACs.			○	○		●	○	●
4a: Improve habitat and open space by 1,200 acres.			○	●	○	○	○	○
4b: Identify "multi-use" opportunities to increase recreation and public access and identify at least one multi-use project.			○	●	○		○	○

● IRWM Plan objective directly supports the listed Statewide Priority
○ IRWM Plan objective can indirectly support the listed Statewide Priority

In these areas affordability can be a challenge which providers have special programs to assist residents and special grants may be available to households near the poverty level.

2.9.2 Native American Tribes

Various tribes of Native Americans inhabited the Region in the past. Today, the San Manuel Band of Mission Indians and Morongo Band of Mission Indians are present in the region.

2.10 Climate

2.10.1 Existing Climate

Climate in the IRWM Region is characterized by relatively hot, dry summers and cool winters with intermittent precipitation. The largest portion (73%) of average annual precipitation occurs during December through March and rainless periods of several months are common in the summer. Precipitation is nearly always in the form of rain in the lower elevations and mostly in the form of snow above about 6,000 feet mean sea level (msl) in the San Bernardino Mountains. Mean annual precipitation ranges from about 12 inches in the vicinity of Riverside, to about 20 inches at the base of the San Bernardino Mountains, to more than 35 inches along the crest of the mountains.

The historical record indicates that a period of above-average or below-average precipitation can last more than 30 years, such as the recent dry period that extended from 1947 to 1977. The Region has been experiencing an ongoing drought since 2005.

Three types of storms produce precipitation in the SAR watershed: general winter storms, local storms, and general summer storms. General winter storms usually occur from December through March. They originate over the Pacific Ocean as a result of the interaction between polar Pacific and tropical Pacific air masses and move eastward over the basin. These storms, which often last for several days, reflect orographic (i.e., land elevation) influences and are accompanied by widespread precipitation in the form of rain and, at higher elevations, snow. Local storms cover small areas, but can result in high intensity precipitation for durations of approximately six hours. These storms can occur any time of the year, either as isolated events or as part of a general storm, and those occurring during the winter are generally associated with frontal systems (a "front" is the interface between air masses of different temperatures or densities). General summer storms can occur in the late summer and early fall months in the San Bernardino area, although they are infrequent.

The Region has an annual precipitation that ranges from 12 inches in low areas to 40 inches along the crest of the mountains.

2.10.2 Impacts and Effects of Climate Change

Recent climate change modeling for the SAR watershed (see Appendix E) suggests that a changing climate will have multiple effects on the Region. Adaptation and mitigation measures will be necessary to account for these effects.

Predicted Impacts and Effects of Climate Change

The IRWM Region's currently consistent climate with hot summers and cool winters with mild precipitation, and rain in low elevations with snow in higher elevations would change as temperatures increase, resulting in less precipitation as snow which would affect the snow pack. Increased precipitation as rain would make it more difficult to capture storm flows and store them for drier periods.

The Intergovernmental Panel on Climate Change has vetted and approved 112 climate models based on projections in greenhouse gas emissions and associated changes in precipitation and temperature. These models make use of various greenhouse gas emissions scenarios based on population growth and economic activity. Global climate models used in the study were scaled down to 12 kilometer grids to make them relevant for regional analysis. The down-scaled global climate model projections are produced by internationally recognized climate modeling centers around the world and make use of greenhouse gas emissions scenarios, which include assumptions of projected population growth and economic activity. Projected climate variables, including daily precipitation, minimum temperature, maximum temperature and wind speed were included, as well as historical model simulations over the period from 1950 to 1999. Final products included data sets at key locations for precipitation, temperature, evapotranspiration, April 1st Snow Water Equivalent, and stream flow.

The models show that in the future the number of days over 95°F will increase in multiple locations. The Region chose two cities with different temperature ranges to compare the increase across the entire watershed. The cities of Riverside, and Big Bear were used to see the projections of the number of days that would be above 95°F and the results are shown in Table 2-20.

Table 2-20: Days per Year Exceeding 95°F

City	Historical (°F)	2020 (°F)	2050 (°F)	2070 (°F)
Riverside	43	58	72	82
Big Bear	0	0	2	4

The numbers of high temperature days in Riverside are believed to double between the present and 2070. Similar increases in temperature can be anticipated throughout the inland valleys. These increased temperature levels will increase water demands across the watershed mainly for agricultural and irrigation purposes. The higher temperature days in Big Bear have the potential to affect the forest ecosystem and the snow related recreational activities in the area.

The forest ecosystems in the San Bernardino National Forest are currently on the decline. Alpine and subalpine forests are anticipated to decrease in area by fifty to seventy percent by 2100. It is believed that the increased greenhouse gas emissions calculated above are a primary factor contributing to the decline of these fragile ecosystems.

While high elevation ecosystems decrease, the severity of future floods is likely to increase. The likelihood of a 200 year storm event or longer is anticipated to be significantly higher in 2070. This increases the potential for negative impacts on nearby infrastructure. Furthermore, storms are expected to be more severe but less frequent. Despite these assumptions, the aftermath of a severe storm is highly variable. It is known that there are significant variability's in the results of storm severity.

In addition to changes in ecosystems and storm severity, warmer temperatures may also decrease the annual amount of snow fall and increase the instance of rain in higher elevations. This alteration of precipitation type is likely to cause negative impacts for snow related recreational activities characteristic of the area's ski resorts. From a local standpoint, Big Bear and Snow Valley both lie below 3000 m and are anticipated to experience a decline in snowpack by 2070. Furthermore, it is projected that there will be a decrease in overall winter precipitation of the area by 2070. On a larger scale, the increased temperatures could affect the Sierras in a similar way, threatening the reliability of the SWP.

Addressing Climate Change

Climate change can be addressed in two ways, mitigation and adaptation. Mitigation focuses on reducing the carbon emissions for water treatment and transportation. Decreasing carbon emissions for water treatment and transportation may also result in reduced energy costs for water purveyors. These measures will also help in compliance of the California Global Warming Solutions Act (Assembly Bill 32 or AB 32).

Adaptation addresses operational changes that need to be made in order to accommodate the increasing temperatures, the increased possibility for severe flooding and the decreasing precipitation as snow predicted by the climate models.

Plans for greenhouse gas mitigation focus on the relationship between water and energy. This relationship can be quantified and projections for future trends can be developed. The California Global Warming Solutions Act requires greenhouse gas levels to be reduced to the 1990 level by the year 2020. A Greenhouse Gas Emissions Calculator was used to calculate the current emissions levels and this spreadsheet tool will be used to create predictions for future emissions levels.

The Greenhouse Gas Emissions Calculator was developed as part of a Basin Study of the Santa Ana River in a partnership between SAWPA and Reclamation. The calculator showed that for the Upper SAR watershed, the most appropriate ways to effectively reduce the volume of carbon emissions related to water treatment and meet AB 32 goals would be to reduce imported water usage, and increase local supply usage and water use efficiency.

Groundwater Management

Precipitation stored as groundwater is a major source of water supply in the IRWM Region. At times, parts of the Region can experience high groundwater levels that must be managed in order to reduce the risk of liquefaction. Additionally, preserving and improving water quality in the groundwater basins is important to maintaining safe drinking water quality.

Due to the significance of groundwater management in the IRWM Region, the following three groundwater management needs were established for the Region:

1. *Maximize Conjunctive Use*: The BTAC has developed Conjunctive Use Guidelines for the SBBA that are intended to optimize the storage potential in this basin. Conjunctive use potential should also be evaluated for the other basins in the Region.
2. *Reduce the Risk of Liquefaction*: A significant portion of the SBBA—generally, the downtown and southern portions of the City of San Bernardino—is an area of historically high groundwater. Groundwater levels in this area have been artesian in the past. When high groundwater is combined with the thick layer of sand in the aquifer it can cause liquefaction in an earthquake.
3. *Protect Groundwater Quality*: Groundwater management is currently influenced by the presence of contamination plumes. Most of these plumes resulted from historic military and industrial operations in the Region.

Because groundwater is such an important supply for the Region, these needs were incorporated into the overall IRWM Objectives.

Water Quality

Groundwater quality in the Upper SAR watershed is generally good, though there are a number of contamination plumes in the upper watershed that are in the process of being remediated. Water quality impacts in the Region are largely due to the presence of the defense industry and agriculture. In the past, the defense industry routinely dumped solvents onto the ground which soaked into the groundwater. Agriculture resulted in an accumulation of salts that are now in the unsaturated soils overlying groundwater basins (now defined in the Basin Plan as groundwater management zones). These salts will degrade groundwater quality over time.

Currently, the primary groundwater quality concerns in the IRWM Region include TDS, nitrogen, PCE, TCE, and perchlorate. Additionally, some surface waters in the Region are on the State's 303(d) list for pathogens, nutrients, metals, sediment, and/or PCBs. Implementing projects that protect and improve water quality in the Region is important to protecting drinking water quality as well as protecting water quality in downstream areas.

Flood Management

The management of storm waters that flow through the San Bernardino Valley has been an ongoing challenge since the SBCFCD was created in 1939. Multiple flooding events, some with the loss of life, have occurred in the intervening years. One of the primary purposes of the SBCFCD is to manage flood waters and natural stream flow for the protection of residents, public and private properties and the utilities that are vital for the communities.

Table 4-1: Upper SAR Watershed IRWM Region Objectives

Goal #1: Improve Water Supply Reliability	1a: Reduce demand 20% by 2020
	1b: Increase utilization of local supplies by 23,000 AFY • Stormwater: 20,000 AFY • Recycled Water: 3,000 AFY
	1c: Increase storage by 10,000 AF
	1d: Prepare for disasters by implementing 2 new interties between water agencies
	1e: Monitor and adaptively manage climate change impacts by implementing 3 projects that reduce energy demands
	1f: Ensure equivalent water supply services for DACs
Goal #2: Balance Flood Management and Increase Stormwater Recharge	2a: Utilize 500 acres of flood control retention/detention basins that are not currently used for recharge
	2b: Reduce FEMA reported flood area
	2c: Ensure equivalent implementation of flood projects in DAC areas and implement at least 1 flood control project in a DAC area
Goal #3: Improve Water Quality	3a: Ensure no violations of drinking water quality standards
	3b: Improve surface and groundwater quality by treating 3,000 AFY of water supply
	3c: Manage total dissolved solids and nitrogen in groundwater
	3d: Ensure equivalent water quality services for DACs
Goal #4: Improve Habitat and Open Space	4a: Improve habitat and open space by 1,200 acres
	4b: Identify "multi-use" opportunities to increase recreation and public access and identify at least 1 multi-use project

Objective 1c: Increase storage by 10,000 AF.

Storing water, primarily in groundwater basins, in wet years for later use during dry periods (conjunctive use) is a foundational strategy to help improve water supply reliability. Through the Valley District Cooperative Recharge Program, retail agencies in the Valley District service area store imported water during wet years so that it is available in dry years. Since 2008, nearly 107,000 AF has been stored under this program. However, the area will need to increase this amount, over time, to help offset increasing demands and other uncertainties. The preferred storage location is in local groundwater basins to reduce evaporative losses and transportation costs, though storage can also occur in upstream locations or the Central Valley. Storing water locally has the advantage of improving reliability by reducing the vulnerabilities associated with transporting the water from other agencies' jurisdictions, but this objective also includes increasing storage outside the Region.

The Cuttle Weir is a concrete and rock diversion structure owned by the San Bernardino Valley Water Conservation District and is used to divert water from the Santa Ana River to the Conservation District's Santa Ana River Spreading Grounds for artificial recharge of the SBBA. The Seven Oaks Dam can be seen in the background.

Objective 1d: Prepare for disasters by implementing two new interties between water agencies.

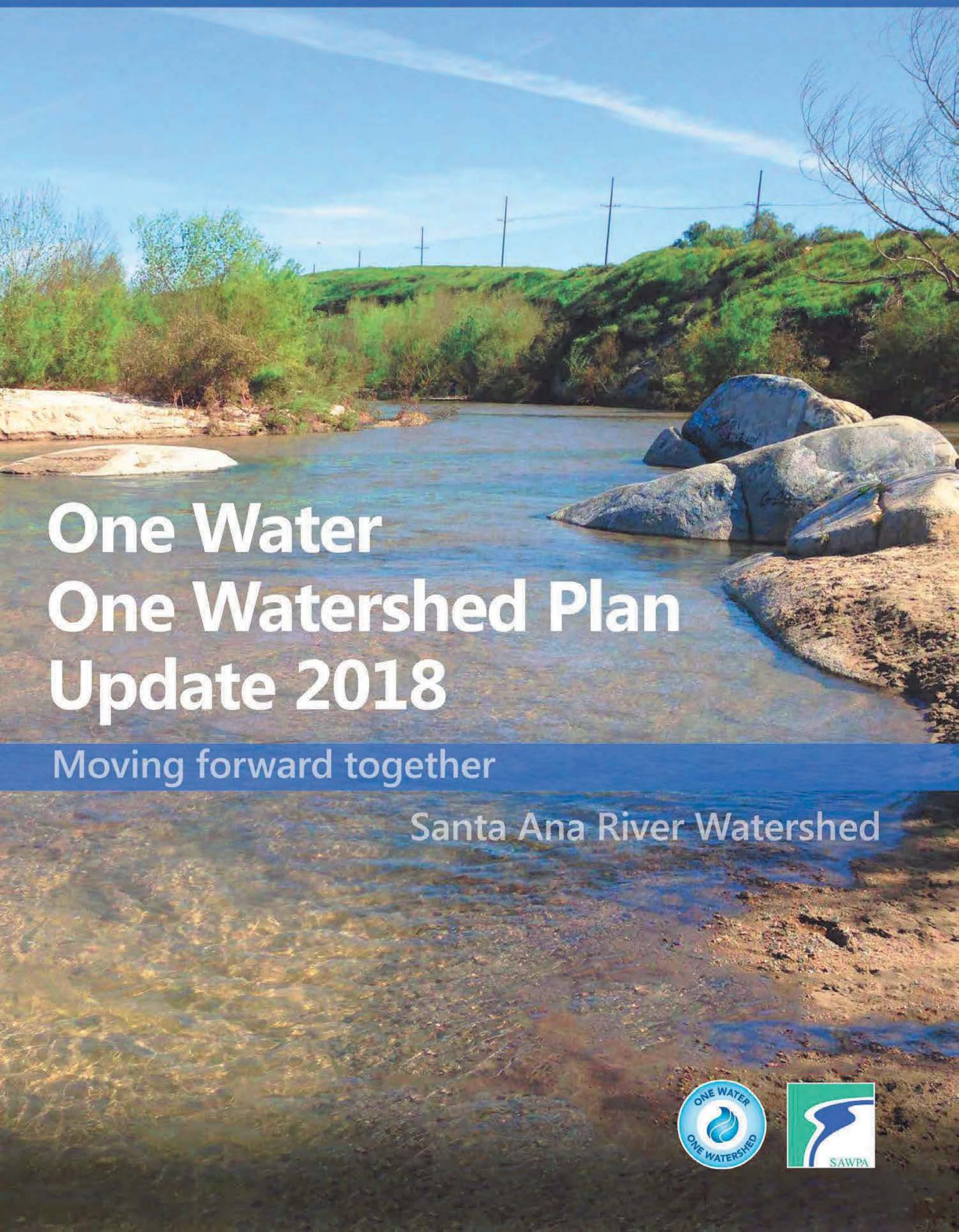
Implementing storage and intertie projects will improve the Region's resiliency against disasters such as earthquakes and other catastrophic events that could cause damage to water supply systems. Earthquakes can displace pipelines, interrupt power supply to pump stations and treatment facilities, and cause water service outages of local and SWP water. Increasing storage can provide reserves if there is an interruption of SWP water and interties can be used during an emergency to supply water from water systems that are not damaged.

Objective 1e: Monitor and adaptively manage climate change impacts by implementing three projects that reduce energy demands.

Generally, there is great uncertainty in the magnitude, timing, and location of precipitation and runoff changes associated with climate change. However, it is generally agreed that climate change could change runoff patterns. There is also a great level of uncertainty in the reduction, if any, in water supply due to climate change for Southern California and for USARW, in particular. The strategies identified to improve water supply reliability would also be useful in mitigating potential impacts from climate change. Therefore, the Region has decided to continue to implement the various water supply reliability strategies while monitoring actual conditions. When actual conditions warrant, the IRWM Program will adapt, as necessary, by changing its strategies or developing new strategies. Another way the IRWM Region is preparing for climate change is by ensuring supplies exceed demands by at least 10% (reliability margin).

Objective 1f: Ensure equivalent water supply services for DACs

Supporting water supply projects that benefit DACs is an important aspect in maintaining water supply reliability. The Region strives to maintain equitable water supply services for DACs, and will continue to do so in the future.



One Water One Watershed Plan Update 2018

Moving forward together

Santa Ana River Watershed

3. OWOW VISION, GOALS, AND OBJECTIVES

3.1. VISION

To guide the development of the initial One Water One Watershed (OWOW) Plan, the Santa Ana Watershed Project Authority (SAWPA), working with the Steering Committee and Pillars, established a vision along with goals and objectives for the Santa Ana River Watershed (watershed) that would allow a holistic approach to resource management. This initial vision has been adjusted over time with each successive OWOW Plan.

The vision of the OWOW Program is a Santa Ana River watershed that:

- Is sustainable, droughtproof, and salt balanced by 2040
- Avoids and removes interruptions to natural hydrology, protecting water resources for all
- Uses water used efficiently, supporting economic and environmental vitality
- Is adapted to acute and chronic climate risk and reduces carbon emissions
- Works to diminish environmental injustices
- Encourages a watershed ethic at the institutional and personal level

3.1.1. SHARED UNDERSTANDINGS

The stakeholders who gathered to develop the OWOW Plan created a set of shared understandings to help frame their collaborative planning and implementation efforts. The statements below remain at the core of the collaboration that is the OWOW Program.

- All water in the Santa Ana River Watershed is a precious resource. Climate change, continuing Colorado River drought, questions about the Sacramento–San Joaquin Bay Delta's vulnerability and its ability to reliably deliver water to Southern California, and interruptions to the hydrologic cycle as the result of our own successful growth and development will stress our ability to manage water and maintain the health of our watershed for economic and environmental sustainability.
- We are committed to investing time and resources for high-quality planning, both long range and short range, to ensure the best possible outcome and to achieve the vision of the Santa Ana River Watershed as droughtproof and salt balanced with continued economic and environmental vitality.
- As major conceptual changes are being considered, the quality of life of the residents must be protected, and the economic impact of a recommended change must be understood before implementation.
- To meet these challenges, the leadership in the watershed must consider significant review of current practices and expectations. The best solutions will likely engender new ways of thinking about water use and its value.

Table 4.1-1. Climate Change Impacts under the OWOW 2.0 Plan

Water Management Sector	Climate Change Impacts
Flooding	• Increased flash flooding and inland flooding damage • Increased coastal flooding and inundation of coastal community storm drains • Damage to coastal community sewer systems from sea-level rise
Ecosystem and Habitat	• Damage to coastal ecosystems and habitats • Adverse impacts to threatened and sensitive species from reduced terrestrial flows and sea-level rise

Generally, it became clear that to properly prioritize climate vulnerabilities the spatial variability of the watershed must be considered. The known vulnerabilities are each a high priority somewhere in the watershed. Increased incidence of wildfire and sea-level rise are both vulnerabilities in the Santa Ana River Watershed, but they are of a higher priority in the parts of the watershed where they are more likely to manifest.

At the coast, sea-level rise will impact land use, recreation and its important economic benefits, and the management of groundwater basins. Moving upstream, flashier precipitation events are expected to impact localized flooding, larger-scale flood risk management, and the challenges related to nonpoint-source pollution in urban runoff. Communities of vulnerable populations (low-income, elderly, youth) will be impacted be increased extreme heat, particularly an increase in night-time high temperatures. Urban heat island effects will become more pronounced by extreme heat days and the growth of developed landscape. Still further upstream, the wildland–urban interface will likely confront additional incidents of wildfire followed by slope instability. In the upper watershed, forest and meadows will be stressed by changes in precipitation and temperature which in turn will produce impacts down the entire watershed, in addition to burdening significant species and open space recreation.

Because climate risk is systemic across the watershed, this OWOW Plan Update 2018 considers climate adaptation and mitigation as critical to all aspects of implementation. Water and watershed projects today must be resilient to the changing conditions of climate and respond directly to minimize the risk the watershed and its communities face from the projected climate impacts. For this reason, the OWOW Program has adopted an eligibility criterion for projects seeking IRWM grant funding where they must be resilient to the changing future conditions which include the impacts of climate.

The nature of the climate vulnerabilities is also acknowledged in OWOW Plan Update 2018 as impacting the speed or scale that known challenges are faced by the watershed. What this means is that most projects that would be done to improve the reliability, effectiveness, or efficiency of water and watershed systems are the same projects that should be undertaken to diminish climate vulnerabilities. Preparing for drought, managing urban nonpoint pollution, protecting habitat or species … these are all efforts that are needed with or without projected climate change impacts.

The two vulnerabilities that are slightly different are sea-level rise, and the public health impacts of increased heat. Sea-level rise adaptation is a critical need for the coastal communities of the watershed, and attention must be paid by all watershed communities to the potential impact of sea-level rise on the imported water flows from the Sacramento–San Joaquin Bay Delta (Delta).

The OWOW Plan Update 2018 acknowledges the public health challenges that increased heat may bring to the watershed, but has not yet grappled with how integrated water management will be impacted or can be supportive of adaptation to these challenges. Future work is needed among watershed managers, public health professionals, and the community at large.

Key to overcoming the impacts of climate change in the watershed will be collaborative adaptive management, which is fundamental to the OWOW Program, and a well-established way of working in the watershed at multiple scales. The OWOW Plan Update 2018 includes important feedback mechanisms to the decision makers and stakeholders about progress towards the shared goals. The OWOW Plan Update 2018 makes a commitment to the cycle of analysis, planning, implementation, and monitoring whereby stubborn challenges and missed opportunities can be identified and engaged with.

4.1.2. HYDROLOGY AND GEOMORPHOLOGY

The flow of water in the streams of the Santa Ana River watershed is significantly different today than prior to the installation of flood management and water supply infrastructure. Only 20% of the Santa Ana River is a concrete channel, mostly near the mouth of the river in Orange County. Runoff from irrigated landscapes and discharge from wastewater treatment plants change the volume, timing, and frequency of historical surface flows, supporting perennial base flow in many parts of the developed Santa Ana River stream network. Historically, as populations increased, urban runoff and wastewater flows increased on the Santa Ana River. Between 1970 and 2000, the total average volume rose from less than 50,000 to more than 146,000 acre-feet per year (AFY), as measured at Prado Dam. Estimated future discharges of water from publicly owned treatment plants to the Santa Ana River are expected to decline due to conservation and increased recycling. This, along with reductions in rising groundwater, means that projected Santa Ana River base flows reaching Prado Dam are significantly lower that what occurred from the early 1990s to 2005 (OCWD Long-Term Facilities Update 2014, page 2-16). As a result of their modeling, the Orange County Water District (OCWD) developed three base flow projections, as shown in Figure 4.1-2.

Rivers and streams are very dynamic, and much more than water flows in them. The movement of materials, energy, and organisms associated with the streams, riparian areas, and adjoining upland environments depends on the movement of water within the watershed. To the extent that this movement is altered by human action, the system can become dysfunctional for species that depend on it, reducing ecosystem functionality.

5.4. CLIMATE RISK AND RESPONSE

Climate change and the acute impacts the watershed is experiencing, as well as predicted future impacts, are best addressed by an adaptive management effort inclusive of thoughtful planning, meaningful action, coordinated implementation and shared monitoring. The Climate Risk and Response Pillar developed and actionable, salient, and visionary set of recommendations that have resonance on its own as well as in the context of the overall OWOW Program. The concepts, management, and policy strategies developed in this Pillar also have a complement in the Disadvantaged Communities and Tribal Communities Pillar as well as many other OWOW Plan Update 2018 Pillars. Moreover, it is the intent of this Pillar to inform individuals, policy makers, and decision makers alike, in such a way that the Pillar's work can be easily shared and incorporated into other planning or policy documents.

This Pillar focuses on the identification of climate risks and the development of appropriate responses to those risks through recommended management and policy strategies. Progress toward the application of the recommended management and policy strategies will support the attainment of OWOW Plan Update 2018 goals and aid the watershed's adaptation to climate changes and mitigation of carbon pollution.

Understanding climate change impacts to water resources and planning for mitigation and adaptation are fundamentally important in ensuring the resilience of water resources and protecting water quality. Implementation of pollution prevention measures and stormwater management BMPs will reduce the impact of climate change on water quality and therefore on overall water resource resilience. Urban water use efficiency programs are important tools for decreasing water and energy use, contributing to water resource resilience and mitigating the effects of climate change on water supply availability. The development of these programs must incorporate the preservation of climate-adaptive green infrastructure and desirable landscapes that help reduce the effects of climate change and protect water quality. Consideration of energy intensity in the development of critical infrastructure can reduce carbon pollution from water resource management and support the goal of improved water resource resilience. Consideration of existing California sea-level rise risk assessments will direct projects, programs, and policies to diminish the threats to local communities and imported water supply reliability.

The climate risks faced by the communities of the watershed are numerous, but in most cases resolve in different priorities at different locations. For instance, increased wildfire risk is predominantly faced by the urban–wildland interface communities of the watershed, and by those tasked with managing the forests and open spaces. Increased heat and the danger it poses for vulnerable populations will be felt across the watershed, but the growing large populations of the inland valleys in San Bernardino and Riverside Counties will be increasingly at risk to this phenomenon, while coastal and mountain communities must be less so. Also considered are the secondary impacts caused by the urban heat island effect, including but not limited to increased evapotranspiration, decreased water quality, and increased morbidity and mortality among vulnerable populations.

For this reason, a simple list of prioritized vulnerabilities is not provided as part of the OWOW Plan Update 2018. At the scale of the Santa Ana River Watershed, the proper regional management strategy is to be supportive of local decision makers prioritizing their vulnerabilities, and then collectively supporting Climate Response at the scale of the vulnerability. All of the climate-related vulnerabilities faced by the watershed are feasibly managed by the recommended strategies in this section, and through the work of the other Pillars, although some will be more challenging than others.

For many years the uncertainty of climate change impacts has driven much of the planning efforts to prepare for the future. The challenges of planning in the context of deep uncertainty are great, and currently the object of significant academic and high-level attention (for more, visit http://www.deepuncertainty.org/). Though uncertainty is considered a necessary factor in climate planning, for efforts like the OWOW Plan Update 2018, it is less significant to have the sophisticated long-term modeling and technical analyses. The OWOW Plan itself structures a collective effort at the scale of the watershed and is by itself a small piece of the overall management of the watershed. In the OWOW Program are linkages between other efforts, recommendations for prioritization and new ways of acting. With goals in 2040, the near-term challenges at the scale of the watershed are of higher priority than those which accumulate out 50 or 100 years. Long-term planning is for agencies with programs, projects, and infrastructure that will maintain for the long-term. Below, in the recommendations, are suggestions for strengthening response to deep uncertainty.

Efforts in the OWOW Plan Update 2018, led by this Pillar workgroup, admit that the expected changes in climate are now must less uncertain than has previously been considered. Changes in sea level, precipitation, temperature—these are all here today. For this reason most of the recommendations below are about how to prioritize the work of today to respond to the changes already in place.

Climate change is a risk that all watershed communities face, and the appropriate responses are in part local, and for the most part demand a recommitment to efforts already underway. This Pillar reviewed the following tools as it developed its contribution to the OWOW Plan Update 2018:

- Climate Change Handbook for Regional Water Planning (2011)
- Managing an Uncertain Future: Climate Change Adaptation Strategies for California Water (2008)
- Safeguarding California (2009)
- Climate Change Scoping Plan (2017)
- Cal-Adapt website (tools and resources)

Below are recommended management strategies that were developed to facilitate progress toward the goals of the watershed. They are intended to be easily implemented. Please note that these management strategies are not listed in any particular order or level of priority.

5.4.1. RECOMMENDED MANAGEMENT STRATEGIES

Prevent pollution and increase stormwater capture.

Climate change threatens water quality due to changes in the amount, intensity, timing, quality, and variability of runoff and recharge. Pollution prevention and stormwater capture are important strategies to address climate risk to water quality and to improve the long-term viability of local water resources.

Prevent pollution and increase stormwater capture aimed at increasing water quality by:

- As appropriate, routinely updating or developing new water quality management plans (WQMPs) (e.g., a standard urban stormwater mitigation plan) to ensure they are structured to match the expected conditions under climate change
- Increasing the frequency and management of sediment in flood control structures and water supply facilities

Increase urban water use efficiency and conservation.

Increasing urban water use efficiency and conservation are valuable and widely adopted tools for responding to the likelihood of more frequent drought periods under climate change. Efficient or conserved use also diminishes the carbon pollution associated with providing and heating water. It is likely, though, that the success of these programs will themselves be burdened by climate change impacts.

It is recommended that water use efficiency and water conservation programs consider the impacts of climate change by:

- Developing efficiency and conservation programs that factor in the impact of increased heat on evapotranspiration and the resulting impacts to desirable landscapes
- Ensuring that conservation programs do not damage climate-adaptive green infrastructure (e.g., urban trees, bioswales) through interagency or interdepartmental coordination and collaboration

Create and meet greenhouse gas reduction targets.

Under climate change it is important to consider both the energy and water intensity of projects and programs. Since energy production and use require water, and water production and use require energy, then it follows that projects and programs that depend on one also depend on the other. Reducing both energy and water use helps to mitigate carbon pollution and adapt to less reliable water and energy supplies.

It is recommended that energy intensity and water supply availability be considered in the development of critical water infrastructure by:

- Relying on the guidance and striving toward the goals provided by the California Air Resources Board in the AB 32 Scoping Document.
- Quantifying the energy intensity of alternatives when planning critical infrastructure
- Ensuring the sufficiency of water supply under climate change when planning critical infrastructure
- Making decarbonization a priority of future investments in water and wastewater conveyance
- Monitoring energy consumption and production in relation to system performance objectives under different supply scenarios
- Developing greenhouse gas (GHG) emissions targets and implementing programs to achieve reductions for water management operations
- Participating in voluntary registries for GHG emissions from the energy use associated with water
- Educating leaders and community members on the GHG value of water conservation (see Spang et al. 2018)

Assess risks of sea-level rise.

Sea-level rise has the potential to negatively affect water supply conditions both locally through impacts to coastal aquifers, and on imported water through impacts to the Sacramento–San Joaquin Bay Delta (Delta). A key component of understanding climate risk and developing appropriate response is to consider the impacts of sea-level rise.

It is recommended that managers, using updated tools, consider vulnerabilities to sea-level rise by:

- Ensuring sea-level rise projections are part of flood risk management analyses of discharge from critical drainage infrastructure
- Engaging with land-use authorities to consider coastal strategies for adapting to sea-level rise, particularly in cases where coastal water supply or sanitation infrastructure is at risk
- Analyzing the risk of sea-level rise impacts on imported water flows to prioritize collaboration and investment in reliability of imported flows

Address and mitigate public health risks in the context of climate change.

Climate change will result in increased health risks through more extreme and persistent weather events, increased temperatures, and decreased water supply reliability. Members of disadvantaged communities, particularly individuals experiencing homelessness, are disproportionately at risk.

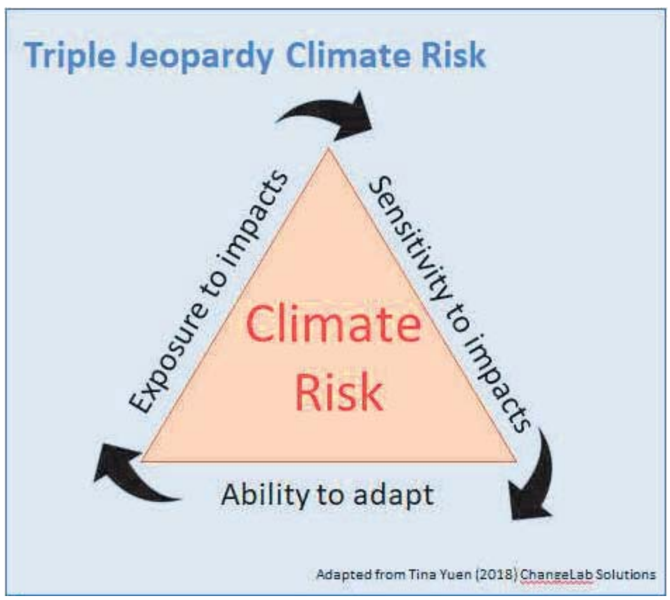
Consideration and mitigation of public health risks, particularly for members of the most vulnerable communities, will be an important component of climate adaptation.

It is recommended that efforts protect public health in the context of climate change by:

- Providing targeted education for all communities about best practices for staying hydrated and safe in more intense and frequent high heat events
- Developing programs and funding to ensure that all people have access to clean water
- Working with public health agencies, the air pollution management district, and vector control agencies to ensure that water management projects and programs do not support the spread of disease
- Developing or strengthening relationships with public health agencies to align programmatic activities, education efforts, and emergency response

Confront disproportionate climate risk.

Environmental health inequities associated with climate change stem from historic planning decisions that have resulted in unequal burdens faced by communities of color and lower socioeconomic status. One challenge described by the World Health Organization is that the communities facing greater risks are less involved in policy development due to the perception that public agencies are uninterested in the concerns and needs of that community (Torres 2013). An essential step in diminishing disproportional climate risk is building trust between members of disadvantaged communities and public agencies before the impacts of climate change are fully realized (Prevention Institute 2011).



The Climate Risk and Resilience Pillar considered the inequities in climate change impacts among different socioeconomic populations, acknowledging that it is of growing concern to public policy. A community's potential climate risk is a function of its exposure to climate impacts, sensitivity to those impacts, and ability to adapt (USDN 2017). Without intervention, this "triple jeopardy climate risk" cycle generates a feedback loop whereby policy inequities contribute to an enhanced exposure to risks, increasing the community's sensitivity to risk and reducing their ability to adapt. The reduced ability to adapt can increase the community's exposure and sensitivity to risk, making each underlying challenge more difficult to resolve.

Support ecosystem functions.

Healthy ecosystems provide important functions for climate mitigation and adaptation. Consideration and mitigation of altered habitat ranges due to increased temperatures will be critical in protecting and preserving the functions that these ecosystems provide.

It is recommended that efforts support ecosystem function for climate change mitigation and adaptation by:

- Supporting altered habitat ranges of native plant and animal species affected by climate change when implementing projects and programs, including monitoring altered habitat ranges, identifying and inventorying altered habitat ranges through collaborative planning, and if analysis has been done on altered habitat ranges, considering it in project planning
- Valuing the ecosystem benefits of fully functioning coastal and inland wetlands and meadows for mitigation, adaptation, and avoidance strategies

Manage forestry and fuels.

Forests are an important resource because they capture, treat, and infiltrate a majority of the rain that falls within the watershed. Climate change will increase stresses on forests, and continued forest management will be critical to preserving the forest as a resource for water management.

It is recommended to preserve and protect natural and urban forest health to diminish negative climate impacts by:

- Encouraging conservation programs in the watershed, particularly those that help buffer water supply sources from climate change impacts
- Creating plans to restore, sustain, and enhance forest health and watershed function
- Promoting natural and urban forest projects that adapt forests and communities to the impacts of climate change

Apply spatial prioritization.

The known vulnerabilities in the watershed will each have a spatial dimension to where they will most likely result in impacts. It is recommended that land and water managers explore the existing tools created by the State of California and others that support an understanding of which vulnerabilities are most likely to impact their operations or service area. Prioritization should be a spatial analysis, whereby managers at the urban–wildland interface, for instance, focus on the increasing incidents of wildfire and slope instability, and managers at the coast prioritize sea-level rise.

Climate projections now suggest increased heat and its impact on human health, infrastructure systems, energy and water demand, green infrastructure, and open space, may be a unifying challenge across the watershed. It is recommended that water and land managers initiate partnerships with energy and public health sectors to consider an integrated approach to preparing for and mitigating the impacts of increased heat.

It is recommended that additional spatial climate impact modeling be undertaken at the scale of the Santa Ana River Watershed, or at the scale of the three counties. Downscale modeling undertaken by UCLA for the Greater Los Angeles Region has been extremely influential in city- and county-level policy. A similar effort at the three-county (or watershed) scale would undoubtedly be of use for adaptation and mitigation efforts.

Develop climate-informed projects and programs.

Climate change will have multiple interrelated impacts on the watershed. Programs and projects must be developed in the context of this suite of impacts to help avoid unforeseen consequences. In addition, capital projects must consider climate change impacts during the design phase to help ensure that project outcomes are not undermined by climate change during their lifespan.

- It is recommended to minimize unintended consequences of projects and programs in the context of climate change by:
    - Making decisions that consider how climate change will affect program and project outcomes, including consequences of the program/project that would occur because of or be exacerbated by climate change (e.g., if a project would decrease river flows, the project-related decrease in flow should be considered in addition to decreased flows resulting from climate change)
- It is also recommended to consider climate change projections within the lifespan of capital investments by:
    - Making capital investments that consider climate projections within their lifespan to ensure that they will be climate resilient and withstand the projected impacts of climate change (e.g., construction of infrastructure along coasts should consider the impacts of sea-level rise and ensure that project design can withstand climate change impacts projected to occur within the lifespan of the infrastructure)

Increase local and sustainable food production.

Climate change will have an impact on the amount of rainfall, average temperature, the types of pests and diseases, and the atmospheric carbon dioxide (CO_2) and ground level ozone (O_3) concentration. Climate change will also affect the types of crops that can be grown and the ranges where crops can be cultivated. Ensuring a sustainable local food supply increases food stability and security, and plays a role in mitigating carbon pollution by diminishing emissions from transportation of food.

It is recommended to increase local and sustainable food production by:

- Encouraging and incentivizing sustainable, local food systems and practices that can be continued without depleting non-renewable resources, that do not cause harm to the ecosystem, and that do not create or social or economic exacerbate inequities

- Encouraging and incentivizing individual, school, and community sustainable gardening programs
- Identifying open spaces and lands for local and sustainable food crop cultivation

Support local recreational areas and opportunities.

Impacts of climate change on recreational areas include: depletion of fresh water, depletion of snowpack, depletion of coastal and non-coastal wetlands, and loss of urban and wild forest lands.

It is recommended to plan for adaptation of existing recreational areas and opportunities that will undoubtedly be changed by climate change impacts.

- Ski areas in the watershed face the possibility of permanently snow-free and above-freezing temperatures. This will have economic impacts on owners, the workforce, and the broader economy.
- The National Forests trees species are under multiple and mutually reinforcing climate risks, including drought, invasive pests, and carbon starvation. The National Forests of the watershed host millions of visitors per year.
- The coastal beaches of Orange County are an important recreational and economic asset in the watershed, and sea-level rise is accepted to decrease the benefits of the coast (recreation, habitat, spending, and tax revenue). There will be increased costs of maintaining the beaches in the face of sea-level rise (see California's Fourth Climate Change Assessment, page 51).

5.4.2. RECOMMENDED POLICY STRATEGIES

Policy change at the local, regional, and state level help support the adoption of strategies to improve climate risk and response planning in the watershed. Participating stakeholders believe that those who can advocate for or undertake policy changes in support of climate mitigation and adaptation in the watershed are able to support the implementation of the recommended management strategies through the following recommendations:

- Strategies for financing capital investments, as well as operations and maintenance, must factor in climate risk. With risk priced into these strategies, funding will better be able to support the transition to climate-smart innovative technologies, engineering solutions, and natural infrastructures.
- The widely used principle of integrated water management that consists of incentivizing or demanding partnership models that leverage resources and ensure that duplication and working at cross-purposes is eliminated is itself an extremely effective climate response, and must be pursued widely.
- Explaining the need for and benefit of climate-adaptive projects and programs should be made a key effort of public engagement and outreach.

- Tribal communities must be included and actively involved in the planning and implementation process.

Statewide tools that can be used to consider adaptation strategies and facilitate resilience planning include California Coastal Commission's guidance for local coastal planning, CNRA's climate adaptation planning guide for local communities (2009 California Climate Adaptation Strategy; CNRA 2009); CEQA requirements; the State Board's Climate Change program (State Board 2018), and the DWR's "Potential Climate Change Vulnerabilities and Adaptation Strategies for Tribal Communities" (DWR 2014).

5.4.3. BASIS FOR RECOMMENDATIONS

To help assess possible long-term effects of climate change, SAWPA and the U.S. Department of the Interior Bureau of Reclamation (Reclamation) entered into a partnership in spring 2011 under the SECURE Water Act (Title IX, Subtitle F of Public Law 111-11) through the U.S. Department of the Interior's WaterSMART (Sustain and Manage America's Resources for Tomorrow) program and used Reclamation's West-Wide Climate Risk Assessment (Reclamation 2018) to help conduct a thorough climate change analysis for the watershed.

Key findings in Reclamation's Technical Memorandum (TM) No. 1, Climate Change Analysis for the Santa Ana River Watershed (Appendix H), were used in this update and to evaluate new research information on climate change implications for the watershed. In support of the OWOW Plan Update 2018, Reclamation was contracted to perform additional hydroclimate analysis, including research and literature review related. These analyses broadly follow the methodologies used for the watershed basin study. This work is summarized in TM No. 1 and included as Appendix H.

Additional effort was made to refer to local, regional, state, and federal climate planning. As is now well established across a variety of planning and research efforts, climate change is projected to affect many aspects of water resources management in the watershed. Local climate planning in the watershed is still nascent, and the OWOW Program has long been supportive of additional work in partnership with municipalities and counties. The work required as part of general planning by 2021 is an opportunity for the watershed agencies to engage with local climate planning. Because the region is still unevenly covered by climate planning, for the most part this section and the OWOW Plan Update 2018 more generally relied on statewide data and planning tools.

A critical first step to preventing, mitigating, and adapting to those impacts is identifying key water sector vulnerabilities. A climate change vulnerability assessment was conducted as part of the OWOW 2.0 Plan, including the prioritization of vulnerabilities. This effort is described in detail in Appendix G of the OWOW 2.0 Plan. The watershed vulnerability assessment checklist is included as Appendix I to this OWOW Plan Update 2018. Table 5.4-1 presents a summary of key vulnerabilities relative to the watershed first identified in the OWOW 2.0 Plan, with additions from the work of the

Climate Risk and Response Pillar workgroup during this update, and inclusive of the Resource Management Strategies associated with each.

Table 5.4-1. Watershed Vulnerabilities to Climate Change

Category	Vulnerability	Resource Management Strategies
Water supply	Insufficient local water supply	Agricultural Lands Stewardship Agricultural Water Use Efficiency Conjunctive Management and Groundwater Storage Conveyance – Regional/Local Desalination Economic Incentives (Loans, Grants, and Water Pricing) Ecosystem Restoration Forest Management Groundwater Remediation/Aquifer Remediation Land Use Planning and Management Matching Quality to Use Outreach and Engagement Recharge Area Protection Recycled Municipal Water Salt and Salinity Management System Reoperation Urban Runoff Management Urban Water Use Efficiency Water Transfers Watershed Management
	Increased dependence on a less reliable imported supply	Conjunctive Management and Groundwater Storage Conveyance – Delta Conveyance – Regional/local Desalination Economic Incentives (Loans, Grants, and Water Pricing) Ecosystem Restoration Forest Management Groundwater Remediation/Aquifer Remediation Matching Quality to Use Outreach and Engagement Recharge Area Protection Recycled Municipal Water Salt and Salinity Management Sediment Management Surface Storage – Regional/Local System Reoperation Urban Water Use Efficiency Water Transfers Watershed Management
	Inability to meet water demand during droughts	Agricultural Lands Stewardship Agricultural Water Use Efficiency Conjunctive Management and Groundwater Storage Crop Idling for Water Transfers

Table 5.4-1. Watershed Vulnerabilities to Climate Change

Category	Vulnerability	Resource Management Strategies
		Irrigated Land Retirement Desalination Economic Incentives (Loans, Grants, and Water Pricing) Ecosystem Restoration Forest Management Groundwater Remediation/Aquifer Remediation Matching Quality to Use Outreach and Engagement* Recharge Area Protection Recycled Municipal Water Salt and Salinity Management Sediment Management Surface Storage – Regional/Local System Reoperation Urban Runoff Management Urban Water Use Efficiency Water Transfers Watershed Management
	Shortage in long-term operational water storage capacity	Conjunctive Management and Groundwater Storage Conveyance – Delta Conveyance – Regional/Local Desalination Economic Incentives (Loans, Grants, and Water Pricing) Ecosystem Restoration Forest Management Groundwater Remediation/Aquifer Remediation Land Use Planning and Management Recharge Area Protection Recycled Municipal Water Salt and Salinity Management Sediment Management Surface Storage – CALFED Surface Storage – Regional/Local System Reoperation Urban Runoff Management Urban Water Use Efficiency Water Transfers
Water quality	Increased poor water quality	Desalination Economic Incentives (Loans, Grants, and Water Pricing) Ecosystem Restoration Forest Management Groundwater Remediation/Aquifer Remediation Land Use Planning and Management Outreach and Engagement* Pollution Prevention Recycled Municipal Water Salt and Salinity Management

Table 5.4-1. Watershed Vulnerabilities to Climate Change

Category	Vulnerability	Resource Management Strategies
		Urban Runoff Management Urban Water Use Efficiency Watershed Management
	Increased water treatment needs	Conveyance – Delta Conveyance – Regional/Local Desalination Drinking Water Treatment and Distribution Economic Incentives (Loans, Grants, and Water Pricing) Groundwater Remediation/Aquifer Remediation Matching Quality to Use Outreach and Engagement Pollution Prevention Recycled Municipal Water Salt and Salinity Management Sediment Management Urban Water Use Efficiency
Flooding	Increased flash flooding and inland flooding damage	Conjunctive Management and Groundwater Storage Ecosystem Restoration Flood Risk Management Forest Management Land Use Planning and Management Outreach and Engagement Recharge Area Protection Sediment Management System Reoperation Urban Runoff Management Water and Culture Water-Dependent Recreation Watershed Management
	Increased coastal flooding and inundation of coastal community storm drains from sea-level rise and greater precipitation rates	Ecosystem Restoration Flood Risk Management Land Use Planning and Management Outreach and Engagement Sediment Management System Reoperation Urban Runoff Management Water and Culture Water-Dependent Recreation Watershed Management
	Damage to coastal community sewer systems and recreational assets from sea-level rise	Ecosystem Restoration Flood Risk Management Land Use Planning and Management Outreach and Engagement Salt and Salinity Management Sediment Management System Reoperation

Table 5.4-1. Watershed Vulnerabilities to Climate Change

Category	Vulnerability	Resource Management Strategies
		Urban Runoff Management Water and Culture Water-Dependent Recreation Watershed Management
Ecosystem and habitat	Damage to coastal ecosystems and habitats	Ecosystem Restoration Flood Risk Management Land Use Planning and Management Outreach and Engagement Salt and Salinity Management Sediment Management System Reoperation Urban Runoff Management Water and Culture Water-Dependent Recreation Watershed Management
	Increased stress on forested lands	Ecosystem Restoration Flood Risk Management Forest Management Land Use Planning and Management Outreach and Engagement Sediment Management System Reoperation Water and Culture Water-Dependent Recreation Watershed Management
	Adverse impacts to threatened and sensitive species from reduced terrestrial flows, sea-level rise, and changed ocean chemistry	Agricultural Lands Stewardship Ecosystem Restoration Flood Risk Management Forest Management Land Use Planning and Management Outreach and Engagement Pollution Prevention Recharge Area Protection Salt and Salinity Management Sediment Management Surface Storage – Regional/Local System Reoperation Urban Runoff Management Water and Culture Water-Dependent Recreation Watershed Management
Human health and well-being	Increased incident of dangerous extreme heat	Ecosystem Restoration Forest Management Land Use Planning and Management Outreach and Engagement Water and Culture

Table 5.4-1. Watershed Vulnerabilities to Climate Change

Category	Vulnerability	Resource Management Strategies
		Water-Dependent Recreation Watershed Management
	Loss of recreational opportunities	Agricultural Lands Stewardship Economic Incentives (Loans, Grants, and Water Pricing) Ecosystem Restoration Forest Management Land Use Planning and Management Outreach and Engagement Pollution Prevention Recharge Area Protection Water and Culture Water-Dependent Recreation Watershed Management
	Decreased reliability of water supplies	Conjunctive Management and Groundwater Storage Conveyance – Delta Conveyance – Regional/Local Desalination Drinking Water Treatment and Distribution Economic Incentives (Loans, Grants, and Water Pricing) Ecosystem Restoration Forest Management Groundwater Remediation/Aquifer Remediation Land Use Planning and Management Matching Quality to Use Outreach and Engagement Pollution Prevention Recharge Area Protection Recycled Municipal Water Salt and Salinity Management Sediment Management Surface Storage – Regional/Local System Reoperation Urban Runoff Management Urban Water Use Efficiency Water and Culture Water Transfers Water-Dependent Recreation Watershed Management
	Burden of increased costs for water and watershed management	Conjunctive Management and Groundwater Storage Economic Incentives (Loans, Grants, and Water Pricing) Land Use Planning and Management Matching Quality to Use Outreach and Engagement Recycled Municipal Water System Reoperation Urban Water Use Efficiency

Table 5.4-1. Watershed Vulnerabilities to Climate Change

Category	Vulnerability	Resource Management Strategies
		Water and Culture Watershed Management

In response to these climate change vulnerabilities, in the OWOW 2.0 Plan the watershed identified the following proposed actions under a "no regrets strategy": urban water use efficiency, improved system conveyance, groundwater management, pollution prevention, stormwater BMPs, and forestry management. For the OWOW Plan Update 2018, this Pillar revisited and updated these strategies in the context of current conditions and key findings from Reclamation's updated climate change analysis (Appendix H). Consideration of water–energy nexus, risk assessment of sea-level rise, consideration of public health risks, supporting ecosystem functions, and consideration of all possible consequences of projects and programs were added.

Pollution Prevention and Stormwater Management

Analysis conducted by Reclamation indicates an increased risk of severe floods and a likelihood of longer and more severe fire season in the future as a result of climate change. More sudden, extreme storms and larger, more frequent wildfires will likely increase sediment flows within the watershed. Managing these flows through flood control structures and water supply facilities is critical to mitigating the effects of climate change on water quality.

Development activities typically change pre-development hydrologic conditions by altering drainage patterns and increasing impervious area, which can increase the rate and volume of runoff during storm events. Development, therefore, has the potential to compound the negative effects of climate change and lead to even greater threats to water quality. Implementing stormwater BMPs reduces storm runoff and pollution. In addition, BMPs improve groundwater recharge, improve air quality, reduce heat island effect, and decrease asphalt exposure to sun.

Project-specific water quality management plans (WQMPs) are important tools for quantifying and managing the water quality impacts of new development and significant redevelopment projects through the implementation of BMPs. The Municipal Separate Storm Sewer System (MS4) Permit adopted by the Santa Ana Regional Water Quality Control Board and issued to San Bernardino County for the upper and middle Santa Ana River Watershed, requires all new development and significant redevelopment projects to incorporate low-impact development BMPs. The development of project-specific WQMPs requires that hydrologic analysis for the 2-year storm event be conducted for the project site. For WQMPs to effectively mitigate the effects of climate change, it is fundamentally important that the expected conditions under climate change be reflected in the WQMP guidelines. For the BMPs resulting from the analysis to adequately manage stormwater and prevent pollution in the future, the 2-year flood event used to conduct runoff analysis must be based on conditions under climate change.

Urban Water Use Efficiency

Reclamation found that given the changes in precipitation and temperature that are expected under climate change, "a water shortage worse than the 1977 drought could occur one out of every six to eight years by the middle of the 21st century and one out of every two to four years by the end of 21st century" (Reclamation 2013, page 15). Urban water use efficiency is widely viewed as a fundamentally important method for responding to the likelihood of more frequent drought periods under climate change and improving water supply reliability. Legislation at the state level has mandated improved water use efficiency. Local agencies in California were required to adopt the Model Water Efficient Landscape Ordinance, or their own water efficient landscape ordinance that was at least as stringent, by December 1, 2015. The Model Water Efficient Landscape Ordinance promotes efficient water use in new and retrofitted landscapes through requirements of plant types, limits on turf areas, and mulch requirements. SB X7-7 was enacted in 2009 and mandates water conservation targets and efficiency improvements for urban and agricultural supplies. A central requirement of SBX7-7 is the reduction of per capita urban water use by 20% by the year 2020. Conservation of existing water supplies is of utmost importance to the growing population of the watershed. A representative analysis from Orange County shows that per capita water use will need to be reduced from the current rate of about 175 gallons per day to about 98 gallons per day by 2030.

Efficiency programs that focus on water conservation as a means for climate change mitigation and adaptation must consider the full suite of climate change impacts to ensure program success. For instance, developers of urban water use efficiency and conservation programs must factor in the impact of increased heat on evapotranspiration and the resulting impacts to desirable landscapes. If program designers fail to consider the effect of increased heat on evapotranspiration, then desirable landscapes may be underwatered and suffer negative impacts as a result.

In addition, conservation programs have the potential to negatively impact other means for climate adaptation and mitigation. For instance, before we implement water efficiency and conservation programs, we must consider the potential impacts to climate-adaptive green infrastructure. Green infrastructure, such as urban trees and bioswales, provides important climate change adaptation benefits, including reducing the heat island effect and providing habitat. We should ensure that water efficiency and conservation programs do not cause unintended negative impacts to green infrastructure that would damage climate resilience.

Consideration of Water–Energy Nexus

Water use and energy use are inextricably linked: energy production requires water use (for processing raw materials, generating electricity, etc.) and water production requires energy use (for pumping, treatment, conveyance, etc.). The development of critical infrastructure should consider the energy intensity of project alternatives and ensure sufficient water supply availability under climate change.

There are numerous innovative approaches for decreasing the net energy use and system losses of water conveyance and storage, including shade balls, in-conduit micro-hydro, solar shade structures over open-water conveyance channels, and pumped-storage strategies.

The OWOW 2.0 Plan included specific implementation actions for watershed stakeholders to help reduce energy consumption and ensure AB 32 Global Warming Solutions Act compliance. The recommended management strategies presented in this Pillar section provide additional tools to reduce energy and water use intensity.

Sea-Level Rise Risk Assessment

The California coast is subject to increasing hazards from sea-level rise caused by climate change. Higher sea levels would increase the frequency of coastal flooding, as well as its extent inland; prevent stormwater from draining to the ocean and bays, thus further increasing inland flooding; and accelerate erosion along the shoreline. Sea-level rise exacerbates coastal flooding when combined with occurrences of extreme storm events and high tides, in addition to other additive factors such as storm surge and wave run-up. Existing oceanic and atmospheric processes, such as the El Niño events and atmospheric rivers, have already caused significant damage to the coastlines of Southern California and resulted in high repair costs. Scientists recognize that the combination of extreme events with sea-level rise will likely cause more coastal damage.

Coastal communities are most vulnerable to rising sea levels. Critical infrastructure, homes, and other types of development are exposed to coastal flooding. In addition to coastal inundation, erosion, and stormwater drainage being pushed further inland, there is increased potential for loss of coastal marshes, wetlands, and beaches, as well as the possibility of saltwater intrusion into coastal aquifers as a result of sea-level rise. Staffing and financial resources are already being spent on salinity barriers to protect Orange County aquifers and on continual maintenance for Bolsa Chica and other important wetlands and marshes along the Orange County coastline.

Coastal Aquifers

OCWD conducted a study to evaluate the potential effects of projected sea-level rise on coastal Orange County groundwater conditions. Two locations near the Talbert and Alamitos seawater intrusion injection barriers were selected for analysis. The model for the analysis used data from well logs, aquifer pump tests, groundwater elevation measurements, hand-drawn contour maps, geologic cross sections, water budget spreadsheets, and other data stored in OCWD's Water Resources Management System database.

Regional mean sea level along the Southern California coast is projected to rise by 1.5 to 12 inches by 2030, 5 to 24 inches by 2050, and 16 to 66 inches by 2100. The analysis carried out by OCWD found that the Talbert Barrier would be effective at preventing seawater intrusions through the Talbert Gap for a sea-level rise of less than 3 feet. In the case of the Alamitos Barrier, seawater intrusion through the Alamitos Gap would likely be prevented once current plans to construct additional injection wells are implemented. At both barriers, however, shallow groundwater concerns could limit injection rates and thus reduce the effectiveness of the barriers in preventing seawater intrusion with rising sea levels.

State Water Project

Approximately 30% of the water supply in the watershed is imported from the SWP. Reclamation's analysis found an increased potential for saltwater intrusion in the Delta as a result of climate change. Saltwater intrusion into the Delta would negatively impact the ability of the SWP to move water through the Delta to Southern California. Management of the Delta is outside the authority of agencies, cities, and counties in the watershed; however, because of the criticality of the SWP, it is appropriate for watershed stakeholders to be engaged with state policy related to the Delta and ensuring that the SWP is made less vulnerable to sea-level rise.

Consideration of Public Health Risks

Climate change has important public health implications for all residents of the watershed. The Fourth California Climate Assessment enumerates the public health impacts as "far-reaching, including direct and indirect impacts related to extreme heat, poor air quality, wildfires, infectious diseases, floods and mudslides, mental health concerns, and increasing disparities caused by disproportionate impacts to vulnerable populations" (Los Angeles Region Report, page 21.)

The Climate Risk and Response Pillar workgroup considered the inequities in climate change impacts (sometimes referred to as a *climate gap*) among different socioeconomic populations, knowing it is of growing concern in climate research. A literature review on the climate gap in California discusses the disproportionate impacts of climate change on the members of socially and economically disadvantaged communities (Shonkoff et al. 2011). Environmental health inequities associated with climate change stem from differences in ability to anticipate, cope with, resist, and recover from the impact of climate-driven weather events.

Threats to Individuals Experiencing Homelessness

Increased health risks due to climate change are not distributed equally among communities. Those who lack shelter, basic resources, and support networks are among the most vulnerable individuals in our communities. In 2009, Brodie Ramin of the University of Ottawa and Tomislav Svoboda of the University of Toronto published "Health of the Homeless and Climate Change" in the *Journal of Urban Health*, which examined intersections with climate change and issues affecting the health of individuals experiencing homelessness. The researchers concluded that the rate of death and illness could be greater in communities of people experiencing homelessness because they generally have higher rates of underlying disease, experience greater exposure to and poorer protection from the elements and occupy high-risk urban areas. When those stressors are made worse or more unpredictable by climate change, shelters see a spike in visitors, and service providers can become overwhelmed. During Southern California's historic heat wave in the summer of 2016, Los Angeles city managers and the Centers for Disease Control said that vulnerable populations such as people who are experiencing homelessness have a much higher risk of heat-related health problems than people in the same community who have permanent access to shelter.

Urban air pollution from vehicle exhaust and particulate matter exists mostly outside, making those who cannot go inside more likely to suffer from lung and heart disease caused or worsened by air pollutants. The vast majority of individuals experiencing homelessness live in cities, where the urban heat island effect can magnify the disproportionate impacts heat waves can have on those who cannot easily seek relief. Because so much of their time is spent outside, members of the community who are experiencing homelessness are also more vulnerable to vector-borne diseases.

Individuals experiencing homelessness are also more vulnerable to environmental hazards like floods and storms because they are more likely to occupy marginal areas. Extreme weather events like storms, floods, and fires can threaten entire cities, but people experiencing homelessness suffer disproportionately compared to the general population due to reduced access to shelter and transportation. After a natural disaster, these individuals may also find themselves low on the priority list of who gets help, and the places that would normally assist them will most likely have more to do than they can handle, according to New York University sociologist E. Klinenberg (Koronowski 2016).

Severe and Continuous High-Temperature Events

Increased temperatures, including more frequent and severe heat waves as a result of climate change, lead to increased health risks. In addition to direct health risks associated with increased heat, the Reclamation Study (TM No. 1) describes how increases in heat can also lead to additional air pollution in urban areas, leading to additional health risks. The Intergovernmental Panel on Climate Change concluded in their 2007 Fourth Assessment Report that "hot extremes" and heat waves have a greater than 90% probability of increasing as our climate continues to change. All climate projections from the Reclamation Study (TM No. 1) demonstrated clear increasing temperature trends. Increasing temperatures will result in a greater number of days above 95°F in the future. By 2070, it is projected that the number of days above 95°F will quadruple in Anaheim (from 4 days to 16 days) and nearly double in Riverside (from 43 days to 82 days). The number of days above 95°F in Big Bear City is projected to increase from 0 days historically to 4 days in 2070. This a public health issue for communities that are more vulnerable in extreme heat situations, like the elderly, young children, and those without sufficient air conditioning, including people experiencing homelessness.

Vector and Disease Shifts

Vector-borne diseases are illnesses that are transmitted to humans by bite or sting; in Southern California, vectors include mosquitoes, ticks, and fleas. These vectors can carry infective microorganisms (pathogens) such as viruses, bacteria, and protozoa, which can be transferred from one carrier (host) to another. In the United States, there are currently 14 vector-borne diseases that are of national public health concern. The seasonality, distribution, and prevalence of vector-borne diseases are influenced significantly by climate factors, primarily high and low temperature extremes and precipitation patterns.

Climate change can result in modified weather patterns and an increase in extreme events, which can affect disease outbreak by altering biological variables such as vector population size and density, vector survival rates, the relative abundance of disease-carrying hosts, and pathogen reproduction rates. Collectively, these changes may contribute to an increase in the risk of a pathogen being carried to humans.

Climate change is likely to have both short- and long-term effects on vector-borne disease transmission and infection patterns, affecting both seasonal risk and broad geographic patterns in disease occurrence over decades. However, models for predicting the effects of climate change on vector-borne diseases are subject to a high degree of uncertainty, largely due to two factors: (1) vector-borne diseases have complex transmission cycles that involve intermediate hosts as well as vectors and humans and (2) in addition to climate change, other significant social and environmental factors drive vector-borne disease transmission. For example, although climate variability and climate change both alter the transmission of vector-borne diseases, they will likely also interact with many other factors, including how pathogens adapt and change, the availability of hosts, changing ecosystems and land use, demographics, human behavior, and adaptive capacity. These complex interactions make it difficult to predict the effects of climate change on vector-borne diseases. It is expected that individuals experiencing homelessness will continue to be disproportionately impacted by any increases in vector-borne diseases.

Supporting Ecosystem Functions

Shifts in climate will affect the distribution of living organisms, including people, animals, and plants. The Reclamation Study (TM No. 1) discusses that even with variability between climate-change scenarios, all projections include rising temperatures and increasing levels of atmospheric carbon dioxide. As projects are developed in the watershed, they will take into consideration the projected changes in temperature, existing analysis, and monitoring efforts.

Plants

As temperature increases and water availability decreases, some plant species will shift to habitat that was previously populated by riparian (riverside or river-dependent) species and other plants will shift to higher elevations. As temperatures rise, increased air-conditioner use will result in increased carbon emissions. Increased frequency of wildfires and pest infestations may also be caused by warmer temperatures, further stressing ecosystems and increasing competition between native and invasive plant species. SAWPA’s Arundo Habitat Management Task Force combats the spread of invasive giant reed (Arundo; *Arundo donax*) in partnership with the Riverside County

Regional Park and Open Space District. The goal of the task force is to eliminate Arundo from the watershed. To date, 3,000 acres of Arundo have been removed and replaced with native plants, providing approximately 10,000 additional feet of water per year. The Santa Ana River Mitigation Bank furthers the task force efforts by providing mitigation credits for removing Arundo and other water-intensive invasive plant species in lieu of individual project mitigation. Additional restoration, forestry, and fire fuel management projects will assist in climate adaptation and support continued viability of valuable forest and riparian ecosystems.

Animals

As drier conditions reduce the amount of available water, some animals will be more likely to come to residential areas for water and food, thereby creating human–animal conflict. Other local animal species will shift to stay within their preferred weather range, whether by changing location within the region, leaving the region, or moving into the region. It is projected that animals will move north from Central America and Mexico. Another issue that may have some local effect on species richness and diversity is climate change's effects on the migration of songbirds. Climate change is affecting when these species migrate, causing the birds to not be at their breeding grounds during critical periods. Implementing projects that recognize and plan for altered habitat ranges for native animals will support continued habitat and healthy ecosystems in the watershed.

People

There is an expectation that populations and industrial areas will shift. Sea-level rise may affect housing distribution or construction design in storm-surge-prone areas of the Orange County coastline. Fires may affect housing distribution or construction materials in forested areas, particularly in the San Bernardino National Forest. In terms of climate-change-related human migration, Governor Brown has suggested that people will migrate to California, and Oregon officials have talked about Californians migrating to Oregon (which has had its own climate-change-related challenges). It is not clear how climate change will impact the watershed in terms of climate-change migration into and out of the region or climate-change gentrification or decline of communities. Bringing climate change analysis and predictions to the forefront of project planning will support the continued viability of communities in the watershed.

Forestry and Fuels Management

Urban and natural forests provide many climate-buffering ecosystem functions. Climate change may degrade the health of natural and urban forests, which are an important part of the water supply and public health system. There are climate adaptation plans in place for natural landscapes (e.g., the Southern California Climate Adaptation Project—see http://www.cakex.org/case-studies/southern-california-climate-adaptation-project), which should be widely supported and implemented. Continued coordination with statewide programs will be important for the promotion of watershed-based forest projects that combat climate change. The California Department of Forestry and Fire Protection is tasked with developing urban forest canopy goals and strategies to attain them, supporting community efforts to adopt these goals and strategies in their own plans, and implementing the strategies to achieve the goals (see CAL FIRE urban forestry webpage at http://www.fire.ca.gov/resource_mgt/resource_mgt_urbanforestry).

The U.S. Department of Agriculture Forest Service (Forest Service) and SAWPA have collaborated on plans to restore, sustain, and enhance forest health, including the Forest First initiative. In 2017, to continue this relationship, the Forest Service's San Bernardino National Forest and Cleveland National Forest and SAWPA created a new MOU (17-MOU-11051200-009) to further improve the health and resiliency of the subwatersheds that are critical to delivering quality water supplies to neighboring communities. As home to the headwaters of the Santa Ana River, the National Forests encompass approximately 30% of the watershed's land mass. These forest areas also receive 90% of the watershed's annual precipitation. Forest management practices have direct effects on both water quality and quantity, particularly relative to forest fires and their effects on soil erosion and water storage. The collaborative efforts in the Forest First initiative include four main watershed restoration strategies that provide significant benefits to downstream water supply and quality:

Strategy 1. Forest fuels management, which would focus on reducing understory growth that can contribute to the intensity of fires, making them more devastating and difficult to fight.

Strategy 2. Restoration of chaparral plant communities in areas that have not recovered due to repeated fires, and where native vegetation has been replaced by grasses that increase runoff, instead of the chaparral capturing and dispersing rainfall, and allowing moisture to percolate and recharge groundwater basins.

Strategy 3. Meadow restoration that would involve returning water that had been converted to conveyance back to a meadow sheet flow so that the meadow can function in a natural groundwater recharge capacity.

Strategy 4. Retrofitting roads to reduce water conveyance, reduce fire risk, and increase the number of fire breaks.

Further details on this initiative are available on SAWPA's website at http://www.sawpa.org/task-forces/forest-first/.

This "no regrets strategy" analysis allows SAWPA, its member agencies, and key stakeholders to assess proposed projects and specific adaptation strategies, and the associated costs and benefits in terms of productivity, mitigation potential, resilience, and sustainability. The most promising projects and strategies can then become part of SAWPA's toolbox of climate change adaptation strategies. SAWPA's "no regrets strategy" will, however, tend to encourage incremental adaptation responses as opposed to more expansive adaptation responses.

Individual forest management and adaptation projects can be cost-effective solutions to improved water resource management in the face of climate change. The *Technical Memorandum on*

Methodology to Estimate Economic Benefits of Forest Restoration Projects (Cardno ENTRIX 2012) describes the methods used to estimate the cost savings to the watershed from forest thinning and forest road retrofitting projects. The analysis included some level of uncertainty, but it did not account for future climate scenarios. Therefore, taking into account future climate scenarios that include increased frequency and intensity of forest fires, cost savings resulting from reduced fire risk due to forest thinning and forest road improvement projects are expected to increase.

SAWPA will continue to encourage conservation programs in the watershed, particularly those that help buffer water supply sources from climate change impacts. These projects could include forest thinning, fuel management, and sediment management projects in natural forest, as well as urban forest enhancement projects that increase carbon sequestration. Continued monitoring and analysis of tree health, forest fire risk, and climate projections will be important factors to consider in the planning of programs in the watershed.

Climate-Informed Project and Program Development

The California Attorney General's Office acknowledges that there is nothing speculative about climate change and requires general plans, CEQA documents, and projects to incorporate consideration of GHG emissions. Climate change is a topic that affects all aspects of general plans, including each of the requisite elements: land use, circulation, housing, conservation, open space, noise, safety, environmental justice, and air quality. The state Office of Planning and Research released new general plan guidelines in 2017 that require GHGs and climate adaptation to be addressed in the requisite safety element (OPR 2017). Therefore, all jurisdictions in the state require discussion, consideration, assessment, and actions to mitigate and adapt to climate change.

Any action taken in response to climate risk has the potential to cause unintended consequences that may weaken climate response in other areas. For example, water conservation programs may have the unintended consequence of weakening or even killing trees and desirable landscapes that provide climate change adaptation benefits, including reducing the impact of increased temperatures, promoting infiltration of runoff, and providing habitats for sensitive species. Projects and program developers should strive to identify unintended consequences in the context of climate change and to minimize or eliminate those impacts within the project or program.

Projects that involve the development of capital investments should include evaluation of how climate change could impact the project during its lifespan. Projects should consider climate change impacts during the design phase to ensure that the project will withstand the potential impacts of climate change. For instance, new infrastructure development, or the retrofit of existing infrastructure, in coastal areas must factor the impacts of projected sea-level rise. Failure to anticipate the impacts of climate change on capital investment projects may significantly alter the lifespan of the project and have far-reaching consequences.

Economic Burden

Climate-resilient capital investments consider climate projections to ensure that projects can withstand the impacts of climate change. One important impact to consider is the economic impact associated with climate projections. The number of severe storms has increased dramatically in the last decade, increasing more than fourfold compared to the 1990s. Drought events have almost doubled in number in the last decade, compared to the 1980s and 1990s. As a result of severe storms and hurricanes, flooding events in the last decade have nearly doubled compared to the 1990s. The cost from these weather events influenced by human-induced climate change, with at least $1 billion each in economic losses and damages, has significantly escalated: from $145.7 billion in the 1980s and $211.3 billion in the 1990s to $418.4 billion in the last decade—double what it was in the 1990s and almost triple what it was in the 1980s (FEU-US 2018).

5.4.4. BUREAU OF RECLAMATION ANALYSIS

Appendix H contains new analyses from Reclamation, driven by the update of the climate model since the previous OWOW planning effort. Using updated climate modeling, Reclamation provided answers to the following questions:

- What will be the climate impacts on the ski industry in Big Bear?
- What are the projected climate change impacts on chaparral and forest ecosystems?
- What are current and expected climate change impacts on forest and urban trees in this watershed?
- What are the expected changes in extreme temperatures?
- How will groundwater and water supplies be impacted by projected climate change?
- How will inland water bodies be impacted by changed precipitation patterns?
- How will climate change impact wildfire patterns in the watershed?

Most interestingly, some projections have changed from the previous modeling efforts in the OWOW 2.0 Plan. New modeling suggests that precipitation patterns will change in such a way that the amount of surface flows in streams and into inland water bodies will increase. Using the current modeling, a larger range of variability in groundwater levels was found, despite additional surface flows being predicted. A response to each of the questions above is provided in Appendix H.

5.4.5. INTEGRATION WITH OTHER PILLARS

It is the policy of the OWOW Program that as more effects of Climate Change manifest, new tools are developed, and new information becomes available, the OWOW Plan Update 2018 will revisit climate vulnerabilities and reevaluate Recommended Management Strategies. This adaptive management approach will inform the work of other Pillars, particularly those integrated with the Climate Change Pillar.

5.4.6. CONTRIBUTORS – CLIMATE RISK AND RESPONSE

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Chair	
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December 2017

BTAC Approved December 4, 2017

The following sections of this document were taken from the Integrated Plan and are provided for reference. The appendices of this document contain the technical information on which the BTAC's recommendations are based.

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The Western Judgment identifies regional representative agencies to be responsible, on behalf of the numerous parties bound thereby, for implementing the replenishment obligations and other requirements of the judgment. The representative entities for the Western Judgment are Valley District and Western. Valley District is solely responsible for providing replenishment of the SBBA if extractions exceed the safe yield of the basin. The court-appointed Watermaster includes representatives from Valley District and Western. The proposed basin management process could be under the authority of the Valley District and Western Boards of Directors with inputs from other significant producers.

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The Integrated Plan established the BTAC membership as the staff representatives from plaintiffs and non-plaintiffs of the Western Judgment. Since the Integrated Plan was adopted, the BTAC has unanimously decided to include any other agencies that wish to participate in the development of the regional water management plan. The BTAC will meet as often as needed to effectively "operate" the regional water resources within Valley District on a real-time basis and to address any other technical issues related to basin management. The BTAC strives to make decisions by consensus.

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The Basin Management Objectives (BMOs) formulated for the SBBA are the driving force in developing strategies for the basin management plan. The BMOs are as follows:

- Improve water supply reliability during droughts,
- Protect water quality,
- Reduce risk of liquefaction, and
- Avoid impact from and to the contaminant plumes.

To ensure adequate reliable water supply for the communities in the Upper SAR watershed during a prolonged drought, the overall basin management strategy will be to operate the basin under the "Tilted Basin Concept" such that the basin would begin a drought period in "as full as possible" condition. Keeping the basin relatively full and operating a conjunctive management program according to the "Tilted Basin Concept" also provides the added flexibility to reduce imports from the SWP when water quality is less desirable. This overarching management strategy will be followed by the BTAC as they draft the basin management plan. Some of the specific management strategies that could contribute to improving water supply reliability during a drought are as follows:

- Retailers could take direct deliveries of SW water when available instead of producing water from their wells. This reduces the amount of water withdrawn from the groundwater basin, which is equivalent to recharging the basin. This strategy will require participation by the water agencies and may require the construction of new water treatment plants or upgrades to existing plants.

- Recharge as much SW water as possible when available. This will likely result in spreading water in wet years, which has not occurred as much in the past. It may also require upgrading the existing spreading grounds.

- Prepare, to the extent possible, for the high groundwater condition that may be created by maintaining a "full basin" when a wet year arrives.

    - Implement an agreement(s) with groundwater producers within the AHHG, or Area of Historic High Groundwater (AHHG, see "Summary of Index Well Hydrographs, Bunker Hill and Yucaipa Groundwater Basins" map in Appendix D), to maximize production from the AHHG as much as practicable during unacceptably high groundwater level conditions.

    - Construct additional facilities to pump and convey large quantities of water from the AHHG for use outside the AHHG.

The San Bernardino Basin Area Management Plan will be developed in consideration of this overall management strategy and the BMOs.

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The annual basin management plan for the SBBA will meet the requirements identified in the following legal documents:

1. Western Judgment – April 1969
2. Seven Oaks Accord – July 2004
3. Settlement Agreement between SBVWCD, Valley District, and Western – August 2005
4. MOU between City of Riverside, Valley District, and Western – September 2005
5. Agreement between City of Riverside, Valley District, and Western – March 2007
6. Cooperative Agreement to Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basin, June 2007
7. Consent Decree, City of San Bernardino v. United States of America, CV 96-8867 and CV 96-5205 (Consolidated).

A summary of the pertinent basin management information from each of these documents is provided below.

RECLAMATION

Managing Water in the West

Summary Report

Santa Ana Watershed Basin Study

U.S. Department of the Interior
Bureau of Reclamation

September 2013

4.0 Climate Change Analysis

The climate change TM associated with the Santa Ana Watershed Basin Study explains the methods used to develop an analysis of potential implications of the changing climate, and describes how those implications might affect issues of importance to the SARW. More specifics on Reclamation's climate change analysis for the SARW are available in TM 1: *Climate Change Analysis*.

In 2009, the OWOW 1.0 Plan addressed the impacts of climate change on the watershed on a very broad scale based on the available science at the time. Climate change science has and continues to evolve; however, incontrovertible evidence suggests that changing weather patterns can have a profound impact on California and within the SARW.

SAWPA, its five member agencies, and key water sector stakeholders know that warmer temperatures, altered patterns of precipitation and runoff, and rising sea levels are, in all likelihood, going to continue to increase and may potentially compromise local and imported water supplies and SARW's environmental resources, and challenge the sustainability of SARW communities. SARW's water sector managers are aware of these unfolding events and are working toward developing adaptation strategies as they assess impacts on local water supply, infrastructure, and imported water sources, including the SWP.

Responding to climate change within the SARW presents significant challenges. Climate change impacts and vulnerabilities vary in each SARW sub-region, and the resources available to each water agency to effectively respond to climate change also differ.

In light of climate change, prolonged drought conditions, potential economic growth, and population projections, a strong concern exists to ensure an adequate water supply will be available to meet SARW's future water demands. The OWOW 2.0 Plan – through this Basin Study – is incorporating existing regional and local planning studies within the watershed; sustaining the innovative "bottom up" approach to regional water resources management planning; ensuring an integrated, collaborative approach; using science and technology to assess climate change and greenhouse emissions effects; facilitating watershed adaptation planning; and expanding outreach to all major water uses and stakeholders.

Regional solutions and integrated projects, such as those proposed through the OWOW 1.0 and 2.0 Call for Projects, are vital to SARW's future and key to addressing and developing necessary adaptation strategies to help combat effects of climate change. Reclamation's TM 1 developed during this Study explains the methods used to analyze potential implications of changing climate, and how those implications might affect issues of importance to SAWPA and the SARW.

This analysis is vital to planning for climate change to meet future water demands.

Global climate models (GCMs) used in this study were downscaled to 12-kilometer grids to make them relevant for regional analysis. The downscaled GCM projections are produced by internationally recognized climate modeling centers around the world and make use of greenhouse gas (GHG) emissions scenarios, which include assumptions of projected population growth and economic activity.

Future water supply was analyzed for the SARW using the downscaled GCMs and a hydrologic model to project streamflow using 112 different projections of future climate. Projected climate variables, including daily precipitation, minimum temperature, maximum temperature, and wind speed were included, as well as historical model simulations over the period 1950-1999. Final products include data sets at key locations for precipitation, temperature, evapotranspiration, April 1st Snow Water Equivalent (SWE), and streamflow.

Figure 6: Mill Creek, one of the major tributaries of the Santa Ana River in the San Bernardino Mountains (Source: http://www.iewaterkeeper.org/photogallery.html)

These data sets were used to develop key findings for the following frequently asked questions regarding impacts of climate change on the watershed. (These are attached to this Summary Report as *Appendix A*):

Will surface water supply decrease?

- Annual surface water is likely to decrease over future periods.
- Precipitation shows somewhat long-term decreasing trends.
- Temperature will increase, which is likely to cause increased water demand and reservoir evaporation.
- April 1st SWE will decrease.

Will groundwater availability be reduced?

- Groundwater currently provides approximately 54% of total water supply in an average year, and groundwater use is projected to increase over the next 20 years.

- Projected decreases in precipitation and increases in temperature will decrease natural recharge throughout the basin.
- Management actions such as reducing municipal and industrial water demands or increasing trans-basin water imports and recharge will be required to maintain current groundwater levels.
- A basin-scale groundwater screening tool was developed to facilitate analysis of basin-scale effects of conservation, increasing imported supply, changing agricultural land use, and other factors that impact basin-scale groundwater conditions.

Is Lake Elsinore in danger of drying up?

- Lake Elsinore has less than a 10% chance of drying up by 2099.
- In the 2000-2049 period, Lake Elsinore has a greater than 75% chance of meeting the minimum elevation goal of 1,240 ft.
- In the future period 2050-2099, Lake Elsinore has less than a 50% chance of meeting the minimum elevation goal of 1,240 ft.
- There is less than a 25% chance that Lake Elsinore will drop below low lake levels (1,234 ft) in either period.
- The Elsinore Valley Municipal Water District project does aid in stabilizing lake levels; however, for the period 2050-2099, additional measures will likely be required to help meet the minimum elevation goal of 1,240 ft.

Will the region continue to support an alpine climate and how will the Jeffrey Pine ecosystem be impacted?

- Warmer temperatures will likely cause Jeffrey pines to move to higher elevations and may decrease their total habitat.
- Forest health may also be influenced by changes in the magnitude and frequency of wildfires or infestations.
- Alpine ecosystems are vulnerable to climate change because they have little ability to expand to higher elevations.
- Across the State it is projected that alpine forests will decrease in area by 50-70% by 2100.

Will skiing at Big Bear Mountain Resorts be sustained?

- Simulations indicate significant decreases in April 1st snowpack that amplify throughout the 21st century.
- Warmer temperatures will also result in a delayed onset and shortened ski season.
- Lower elevations are most vulnerable to increasing temperatures.
- Both Big Bear Mountain Resorts lie below 3,000 meters and are projected to experience declining snowpack that could exceed 70% by 2070.

How many additional days over 95°F are expected in Anaheim, Riverside and Big Bear City?

- All the climate projections demonstrate clear increasing temperature trends.
- Increasing temperatures will result in a greater number of days above 95°F in the future.
- The number of days above 95°F gets progressively larger for all cities advancing into the future.
- By 2070 it is projected that the number of days above 95°F will quadruple in Anaheim (4 to 16 days) and nearly double in Riverside (43 to 82 days). The number of days above 95°F at Big Bear City is projected to increase from 0 days historically to 4 days in 2070.

Figure 7: Santa Ana River in Los Angeles State Historic Park
(Source: http://lashp.wordpress.com/2009/07/07/empty-nest-concrete-river-and-lashp/santaana/)

Will floods become more severe and threaten flood infrastructure?

- Simulations indicate a significant increase in flow for 200-year storm events in the future.
- The likelihood of experiencing what was historically a 200-year event will nearly double (i.e. the 200-year historical event is likely to be closer to a 100-year event in the future).
- Findings indicate an increased risk of severe floods in the future, though there is large variability between climate simulations.

How will climate change and sea level rise affect coastal communities and beaches?

- Climate change will contribute to global Sea Level Rise (SLR) through melting of glaciers and ice caps and thermal expansion of ocean waters, both of which increase the volume of ocean water.
- Regional SLR may be higher or lower than global SLR due to effects of regional ocean and atmospheric circulation.
- Average sea levels along the Southern California coast are projected to rise by 5 to 24 inches by 2050 and 16 to 66 inches by 2100.
- SLR is likely to inundate beaches and coastal wetlands and may increase coastal erosion. Effects on local beaches depend on changes in coastal ocean currents and storm intensity, which are highly uncertain at this time.
- SLR will increase the area at risk of inundation due to a 100-year flood event.
- Existing barriers are sufficient to deter seawater intrusion at Talbert and Alamitos gaps under a 3-foot rise in sea levels. However, operation of barriers under SLR may be constrained by shallow groundwater concerns.

As climate science continues to evolve, periodic reanalysis and evaluation will be needed to inform the decision-making process.

4.1 Water Supply and Demand Summary

Table 1 shown below is a summary of the projected effects of climate change on a variety of hydroclimate metrics for three future periods (above the most downstream location, Santa Ana River at Adams St. Bridge). Table 2 shows a summary of projected water demands out to 2050.

Table 1: Summary of Effects of Climate Change on Supply

Hydroclimate Metric (change from 1990s)	2020s	2050s	2070s
Precipitation (%)	0.67	-5.41	-8.09
Mean Temperature (^{o}F)	1.22	3.11	4.1
April 1st SWE (%)	-38.93	-80.4	-93.07
Annual Runoff (%)	2.6	-10.08	-14.61
Dec-Mar Runoff (%)	9.82	-3.01	-6.38
Apr-Jul Runoff (%)	-6.35	-25.24	-31.39

Table 2: Summary of Water Demand for the Santa Ana River Watershed

	1990	2000	2010	Present	2020	2030	2040	2050
Demand (MAFY)	0.924	1.121	1.298	1.339	1.503	1.723	1.958	2.178

Imported water for the SARW will also likely be affected by the changing climate. The 2011 SWP Reliability report projects a temperature increase of 1.3° to 4.0 °F by mid-century and 2.7° to 8.1° F by the end of the 21st century. It predicts that increased temperatures will lead to less snowfall at lower elevations and decreased snowpack. By mid-century it predicts that Sierra Nevada snowpack will reduce by 25% to 40% of its historical average. Decreased snowpack is projected to be greater in the northern Sierra Nevada, closer to the origin of SWP water, than in the southern Sierra Nevada. Furthermore, an increase in "rain on snow" events may lead to earlier runoff.

Given these changes, a water shortage worse than the 1977 drought could occur one out of every six to eight years by the middle of the 21st century and one out of every two to four years by the end of 21st century. Also, warmer temperatures might lead to increased demand. This factor, combined with declining flows, will likely lead to decreased carryover storage from year to year. Alternative water supply options such as recycled water, rainwater harvesting, and desalination may need to be relied upon in order to meet the continually growing demand.

4.2 Sea Level Rise Impacts

Climate change will contribute to global SLR through melting of glaciers and ice caps and thermal expansion of ocean waters, both of which increase the volume of water in the oceans. Regional SLR may be higher or lower than global SLR due to effects of regional ocean and atmospheric circulation.

California's 2,000 miles of coastline has experienced just under eight inches of sea level rise over the past decade, a number that is likely to increase drastically as the climate continues to change. Critical infrastructure, such as roads, hospitals, schools, emergency facilities, wastewater treatment plants, powerplants, and more will also be at increased risk of inundation, as are vast areas of wetlands and other natural ecosystems.

Flooding and erosion already pose a threat to communities along the California coast and there is compelling evidence that these risks will increase in the future. In areas where the coast erodes easily, sea level rise will likely accelerate shoreline recession due to erosion. Erosion of some barrier dunes may expose previously protected areas to flooding.

Within the SARW, Orange County Water District (OCWD) conducted a study to evaluate the potential effects of projected sea level rise on coastal Orange County groundwater conditions. Two locations were selected near the Talbert and Alamitos seawater intrusion injection barriers for analysis. The model for the analysis used data from well logs, aquifer pump tests, groundwater elevation measurements, hand-drawn contour maps, geologic cross sections, water budget spreadsheets, and other data stored in OCWD's Water Resources Management System (WRMS) database.

The results showed that regional mean sea level along the southern California coast is projected to rise by 1.5 to 12 inches by 2030, 5 to 24 inches by 2050, and 16 to 66 inches by 2100. Inundation due to SLR is likely to reduce the area of beaches and wetlands along the southern California coast. In addition, SLR is likely to increase erosion of sea cliffs, bluffs, sand bars, dunes, and beaches along the California coast. However, the overall effects of climate change on local beaches will depend on changes in coastal ocean currents and storm intensities, which are less certain at this time.

SLR is likely to increase the coastal area vulnerable to flooding during storm events. Also, detailed analysis carried out by OCWD found that the Talbert Barrier would be effective at preventing seawater intrusions through the Talbert Gap under a 3-foot sea level rise. In the case of the Alamitos Barrier, seawater intrusion through the Alamitos Gap would likely be prevented once current plans to construct additional injection wells are implemented. At both barriers, however, shallow groundwater concerns could limit injection rates and thus reduce the effectiveness of the barriers.

Figure 8: Santa Ana River outlet at the Pacific Ocean
(Source: http://geology.campus.ad.csulb.edu/people/bperry/AerialPhotosSoCal/HuntBeachToCostaMesa.htm)

4.3 Addressing Climate Change

Reclamation's climate change analysis provided SAWPA, its member agencies, key stakeholders, and OWOW Plan participants specific information necessary to plan, assess, and rank proposed Proposition (Prop) 84 grant-funded projects within the Watershed. (Prop 84, the Safe Drinking Water Bond Act, provides funds to water quality improvement projects that protect drinking water supplies.) These projects must also address reductions to GHG emissions within their water management activities. Projects were also given a performance measure to help determine how effectively the criteria were addressed, which helped with SAWPA's ranking process. The table below outlines the climate change analysis provided by Reclamation that was also included in update of the OWOW 2.0 Plan.

Table 3: OWOW 2.0 Plan Climate Change Information

OWOW Plan Section	Climate Change Information Included
SARW Description	Describes likely climate change impacts in SARW, determined by a vulnerability assessment (attached to this Summary Report as Appendix B)
OWOW Objectives	Adaptation to climate change: • Addresses adapting to changes in amounts, intensity, timing, quality and variability of precipitation, runoff, and recharge. • Considers SLR effects on water supply and other water resource conditions (e.g., recreation, habitat) and identify suitable adaptation measures. Consider Ocean Protection Council's SLR Policy. Reducing emissions (mitigation of GHG): • Reduces carbon consumption, embedded energy in water, and GHG emissions. • Strategies adopted by California Air Resources Board in its AB32 Scoping Plan, including innovative applications. • Options for carbon sequestration where options are integrally (direct or indirect) tied to OWOW objectives.

Resource Management Strategies	Identifies and implements adaptation strategies that address SARW specific or local climate change contributions or impacts.
Project Review Process	Includes these factors: • Project contribution to adapt to climate change; and • Project contribution in reducing GHGs, compared to the alternative.
Local Water Planning to OWOW	Considers and incorporates water management issues and climate change adaptation and mitigation strategies from local plans into OWOW.
Relation to Local Land Use Planning	Demonstrates information sharing and collaboration with regional land use planning in order to manage multiple water demands through the state (as described in California Water Plan Update 2009), adapt water management systems to climate change, and potentially offset climate change impacts to water supply.
Plan Performance and Monitoring	Contains policies and procedures that promote adaptive management.
Coordination	Considers the following: •Stay involved in California Natural Resources Agency Adaptation Strategy process, and • Join The California Registry (www.theclimateregistry.org)

(Source: DWR's 2012 Prop 84 and Prop 1E IRWM Guidelines, Appendix C, Table 7)

4.4 Greenhouse Gas Reduction

Climate change threatens California's natural environment, economic prosperity, public health, and quality of life. Recognizing the need for action, California has put in place ambitious emission reduction goals in the form of Assembly Bill (AB) 32, the Global Warming Solutions Act. By requiring in law a reduction in GHG emissions, California has set the stage to transition to a sustainable, clean energy future. AB 32 directly links GHG emissions and climate change, provides a timeline for statewide GHG emissions reduction, requires quantitative accounting of GHG emissions, and enforces disclosure of GHG emissions from every major sector in the state.

AB 32 requires that every major sector in California reduce its GHG emissions to 1990 levels by 2020, and to 80% below the 1990 levels by 2050, shown below in Figure 9. These targets were developed from the levels of reduction climate scientists agree is required to stabilize our climate. The red line represents the projected GHG emissions out to 2050, if no action is taken. In order to reach the GHG emissions target set by AB 32 for 2020, a reduction of approximately 30% is required from the 'no action' scenario.

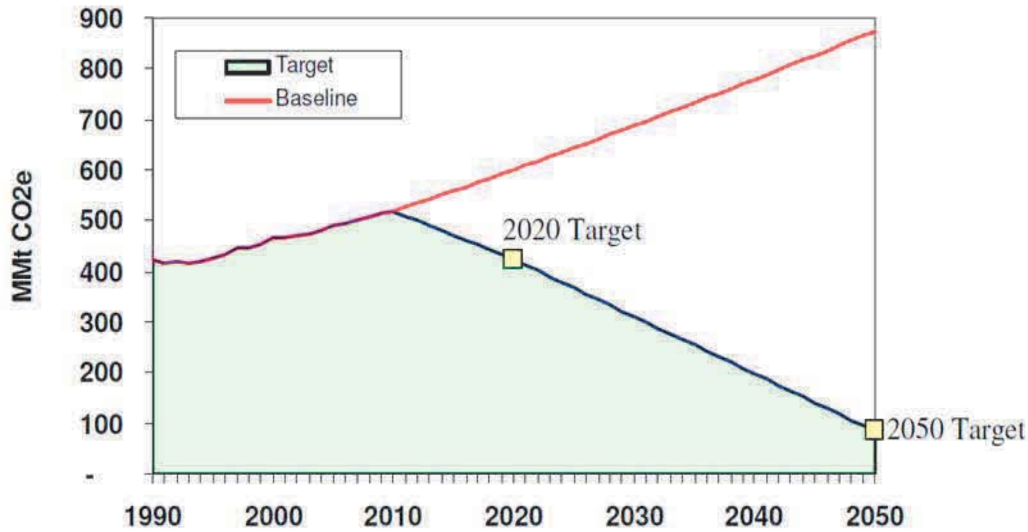


Figure 9: AB 32 GHG Emission Reduction Targets

Each water agency must address its carbon footprint to help the region meet the compliance requirements spelled out in AB 32. GHG emissions related to water consumption in the region must be continually measured and reported. A GHG Emissions Calculator developed by Reclamation as part of this Basin Study will help the water sector meet these mandated requirements that drive compliance with projected GHG targets out to 2050. The Calculator allows users within the SARW to easily and quickly evaluate how their water management decisions affect their water demand, energy use, and GHG emissions. More specifics on this tool are in *Reclamation's GHG Emissions Calculator for the Water Sector: User's Manual* (TM 2).

TM 2 explains the methods used to develop the calculator and provides instructions on how to use it by introducing examples. The examples focus on the SARW and demonstrate how to develop a GHG emissions baseline, evaluate what actions are required to meet specific GHG emission reduction goals, and illustrate how the GHG Emissions Calculator can be used to analyze projects.

The GHG analysis was designed to take advantage of best available datasets and modeling tools and to follow methodologies documented in peer-reviewed literature. However, there are a number of analytical uncertainties that are not reflected in Reclamation's GHG Emission analysis, including uncertainties associated with the following analytical areas that can be grouped under two categories—climate projection information and assessing hydrologic impacts that inform many of the Study FAQs.

The OWOW 2.0 Plan examines current climate change projections to determine potential impacts, assesses water resource vulnerabilities, and develops a series of strategies that can be used in projects to adapt to climate change and mitigate GHGs.

The table below lists suggested implementation actions for SARW stakeholders that can help reduce energy consumption and ensure AB 32 compliance.

Table 4: AB 32 Global Warming Solutions Act Compliance

Action	Ways and Means
Inventory the Water Sector	Calculate the watershed's carbon footprint
Promote Electricity Conservation	Use appliances and vehicles that are efficient; weatherization; implement temperature controls (on A/C and heating units); turn off lights; install CFP bulbs; install LCD computer screens; and use natural light.
Promote Water Conservation	Reduce urban and ag water demands; build resilient communities; integrate water resources management practices; and promote project collaboration and partnerships.
Promote Alternative Energy Use	Install solar, wind, geothermal, tidal, and biomass fuel capacity; and implement any hydropower capabilities.
Implement Offsets	Purchase carbon offsets; plant trees; promote innovative approaches and solutions that foster community vitality, environmental quality, and economic prosperity.
Review or Implement Effective Policies	Conduct a gap analysis on the watershed's policies on dealing with Greenhouse Gas Emissions; create an energy solutions campaign - save energy, reduce your carbon footprint; review applicable laws and ordinances; and promote and implement energy efficiencies and sound conservation practices.

(Source: Climate Adaptation Knowledge Exchange, see: www.cakex.org)

4.5 Vulnerabilities

To help SAWPA determine potential watershed vulnerabilities, SAWPA's Energy and Environmental Impact Response Pillar assessed Reclamation's *Climate Change Analysis*, and all applicable climate change technical data compiled about the SARW and its projected outlook through the year 2099. Reclamation used existing or new climate change models and other resources to help look beyond what SAWPA described in the OWOW 1.0 Plan and evaluated the amount, intensity, quality, variability of runoff, recharge, and imported water deliveries to the watershed that will potentially result from climate change.

Climate change is projected to affect many aspects of water resources management in the SARW. A critical first step to help prevent and/or mitigate those impacts is identifying key water sector vulnerabilities. Below is a summary of four key vulnerabilities in the Santa Ana Watershed (also see Appendix B):

Water Supply
- Insufficient local water supply
- Increased dependence on imported supply
- Inability to meet water demand during droughts
- Shortage in long-term operational water storage capacity

Water Quality
- Poor water quality
- Increased water treatment needs

Flooding
- Increased flash flooding and inland flooding damage
- Increased coastal flooding and inundation of coastal community storm drains
- Damage to coastal community sewer systems from sea level rise

Ecosystem and Habitat
- Damage to coastal ecosystems and habitats
- Adverse impacts to threatened and sensitive species from reduced terrestrial flows and sea level rise

Reclamation also coordinated directly with OCWD on SLR modeling in Orange County that was conducted to help assess potential impacts to the OCWD seawater intrusion barrier infrastructure and groundwater basins. Another part of critical criteria in addressing SARW's vulnerabilities is addressing GHG emissions from water operations.

4.6 Climate Change Adaptation Strategies

Climate adaptation strategies were developed through a consultative process involving Reclamation and SAWPA staff, and three members of the Energy and Environmental Impact Response Pillar.

By identifying SARW's vulnerabilities (listed as a 'checklist' in Appendix B), SAWPA staff, its member agencies, and key water sector stakeholders can work toward implementing the necessary actions needed to address, adapt to and mitigate the projected effects of climate change. Detailed in the table below are adaptation strategies that will be addressed in OWOW 2.0 Plan activities.

Table 5: SARW Adaptation Strategies

SARW Adaptation Activities	Description
Reduce Demand	Promote the State's 20x2020 Water Conservation Plan in the watershed.
Improve Operational Efficiency	Promote systems reoperations, water transfers, and improved local and regional water conveyance. Optimize operational efficiency, promote water transfers, and develop regional water projects.
Increase Water Supply	Promote conjunctive management and groundwater storage; consider brackish and ocean desalination opportunities and more recycled water use, and local and regional surface storage opportunities. Identify watershed supply sources and increase storage capacity, and improve surface water operating efficiencies.
Land Fallowing	Implement land-use policies that address and reduce ag and urban water use; improve flood and fire risk management; identify ecosystems vulnerabilities, and ways/means to improve water quality. Reduce ag and landscape water demand, promote xeriscape, and improve water supply reliability.
Reduce Coastal Infrastructure Threats	Plan for SLR; optimize coastal infrastructure system operations; maintain and improve infrastructure; and reduce impacts of flooding on habitat and water quality.
Resource Stewardship	Improve management of watershed lands, wildlife, and water resources through conservation, preservation, and ecosystem restoration.

Improve Water Quality	Improve drinking water treatment, distribution, and groundwater use. Improve stormwater capture practices; address urban landscape improvements and urban runoff management; improve salinity management practices; implement groundwater remediation and pollution prevention practices.
AB 32 Compliance	Develop methodology for quantifying energy intensity of SARW water supplies and uses. Perform carbon footprint assessment and use the GHG Calculator Tool to identify additional opportunities for reducing carbon emissions.
Public education	Increase public outreach and education through the OWOW process

4.6.1 Tradeoff Analysis

Based on the OWOW 2.0 Plan Energy and Environmental Impact Response Pillar's review and analysis of Reclamation's *Climate Change Analysis* TM, the SARW is potentially highly sensitive to climate change, with a particular vulnerability to changes in its precipitation, temperature, evapotranspiration, snow water equivalent, and streamflow. A Tradeoff Analysis was employed to assess the various climate change adaptation strategies noted in the OWOW 2.0 Plan update.

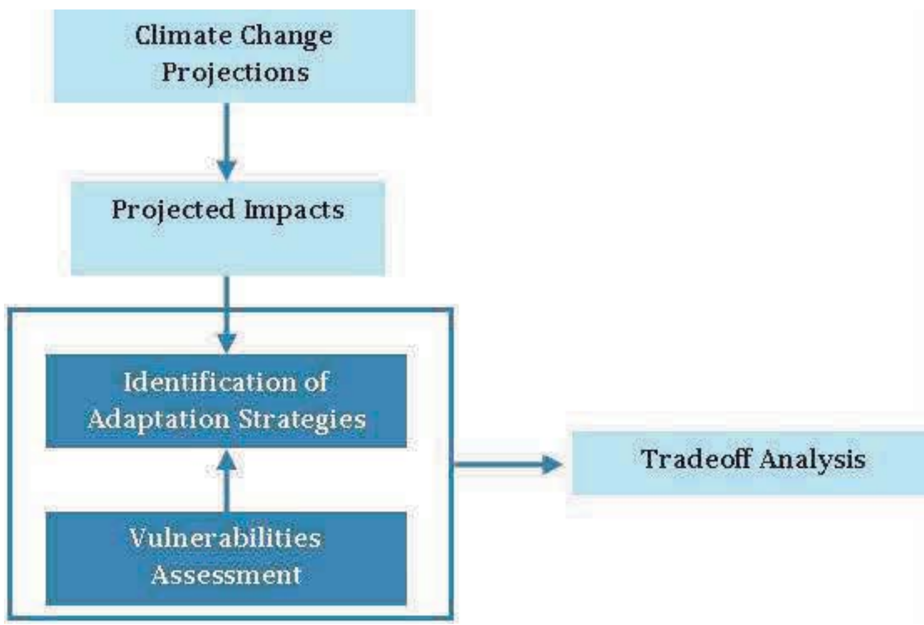


Figure 10: Tradeoff Analysis Methodology

Adaptation strategies (listed in Table 5) were cross-referenced with the vulnerability issues (see Section 4.5) discussed above to determine the number and type of climate change vulnerabilities that can be addressed. This interaction is shown in Table 6.

Table 6: Cross-reference of vulnerability and adaptation strategies

		Vulnerability			
		Water Supply	Water Quality	Flood	Ecosystem
Adaptation Strategies	Reduce Demand	✓	✓	-	✓
	Improve Operational Efficiency	✓	✓	✓	✓
	Increase Water Supply	✓	✓	-	✓
	Land Fallowing	✓	✓	-	✓
	Reduce Coastal Infrastructure Threat	-	✓	✓	✓
	Resource Stewardship	✓	✓	✓	✓
	Improve Water Quality	✓	✓	-	✓
	AB32 Compliance	✓	✓	✓	✓
	Public Education	✓	✓	✓	✓

In this table, the adaptation strategy that will address a vulnerability is marked with a checkmark (✓). Analysis of this table shows that four adaptation strategies – improve operational efficiency, resource stewardship, AB32 compliance, and public education – would address the four key vulnerabilities in the watershed.

These four adaptation strategies collectively form what is referred to as the 'no regrets strategy,' a strategy which argues that energy-saving measures should be undertaken immediately to help reduce climate change impacts. Such a strategy is one that would provide benefits in the present while also reducing vulnerability to future climate change impacts. If immediately implemented, such a strategy may provide some benefit even under the uncertainty of climate change projections. Specific actions under the 'no regrets strategy' are listed in Table 7.

Table 7: Proposed actions in the 'no regrets strategy'

	Proposed Action			
	Improve Operational Efficiency	Resource Stewardship	AB32 Compliance	Public Education
Urban Water Use Efficiency	✓	✓	✓	✓
Improved Conveyance System	✓	✓	✓	✓
GW Management	✓	✓	✓	✓
Pollution Prevention	✓	✓	✓	✓
Stormwater BMP	✓	✓	✓	✓
Forestry Management	✓	✓	✓	✓

(Source of 'no regrets': http://economics.socialsciencedictionary.com/Environmental-Economics-Dictionary/No_Regrets_Strategy)

Description of individual proposed actions under the 'no regrets strategy' is given below.

4.6.1.0 Urban Water Use Efficiency

Conservation of existing water supplies is of utmost importance to a growing population in the SARW. A representative analysis from Orange County (see TM 1, Chapter 5, Section 5.3) shows that per capita water use will need to be reduced from the current value of about 175 gpd (gallons per day) to about 98 gpd by 2030.

4.6.1.1 Improved Conveyance Systems

By increasing the efficiency of local and regional conveyance systems, water can be moved at a decreased cost. This is particularly important in the context of being compliant with the AB32 legislation, and is related to urban water use efficiency. With reduced per capita water use (see Orange County example in TM 1, Chapter 5, Section 5.3), greenhouse gas emissions (mtCO2e) can be reduced from the current level of about 120,000 mtCO2 to about 75,000 mtCO2e by 2030.

4.6.1.2 Groundwater Management

By taking into account the balance between groundwater and surface water, managers can improve long-term viability of each resource. Reclamation developed a Groundwater Screening Tool (included in TM 2) to evaluate impacts to groundwater from a changing climate, and to evaluate effective conjunctive surface water groundwater management. The groundwater screening tool was applied to four groundwater basins (Orange County, Upper Santa Ana Valley, San Jacinto, and Elsinore) within the watershed. As an example, potential actions to avoid projected water level declines in Orange County are listed below. Each alternative listed will protect against groundwater declines through 2060.

- Reduce M&I demand with a gradual reduction of approx. 15% by 2020 (i.e., reduce per capita use from ~175 gpd in 2010 to ~150 gallons per day by 2020 to ~98 gpd by 2030).
- Increase local water supplies by ~75,000 af per year through recycled water treatment capacity, development of seawater desalination capacity, and increase stormwater capture efficiency.
- Increase imports from the Colorado River Aqueduct and State Water Project gradually from ~30,000 acre-feet (af) per year to ~105,000 af per year (this may not be feasible due to cost, greenhouse gas emissions, or availability).
- Reduce summertime groundwater pumping.

4.6.1.3 Pollution Prevention

Preventing and remediating polluted water resources improves quality for users and improves long term viability of local resources. This includes improved salt management in brackish desalinization and water reuse systems in the Santa Ana River Watershed. Specific alternatives analyzed (see *Inland Empire Interceptor [IEI] Appraisal Analysis* TM 3) include:

- Modification to the existing Brine Line system.
- Salton Sea considerations including, restoration plans, salt load and increased water supply to Salton Sea.
- Brine pre-treatment strategies.
- Alternative pipeline alignments including easement, right of way, and designs.
- Remediate polluted groundwater to reduce treatment of larger quantities of migrating water (future avoided costs).

Further details on water quality and salinity impacts regarding concentrations and costs are presented in the IEI TM 3.

4.6.1.4 Stormwater Best Management Practices (BMP)

Implementing stormwater BMPs reduces storm runoff and pollution, improves groundwater recharge, improves air quality, reduces heat island effect, and decreases sun exposure to asphalt. Best Management Practices will continue to be required in the Watershed. SAWPA member agencies and flood control districts, and the Regional Water Quality Control Board will continue to enforce BMPs.

4.6.1.5 Forestry Management

Create plans to restore, sustain and enhance forest health and watershed functions within forests. As part of forest management, SAWPA has initiated a Forest First initiative in collaboration with the U.S. Forest Service. As home to the headwaters of the Santa Ana River, the San Bernardino and Cleveland national forests encompass approximately 33% of the Santa Ana watershed's land mass. These forest areas also receive 90% of annual precipitation. Forest management practices have direct effects on both water quality and quantity, particularly relative to forest fires and the consequential effects of soil erosion and water storage.

The collaborative efforts in the Forest First plan include four main watershed restoration strategies that would provide significant benefits to downstream water supply and quality. The first of these strategies includes forest fuels management, which would focus on reducing understory growth that can contribute to the intensity of fires, making them more devastating and difficult to fight. The second strategy involves restoration of chaparral plant communities in areas that have not recovered due to repeated fires, and where native vegetation has been replaced by grasses that increase runoff, instead of the chaparral capturing and dispersing rainfall, and allowing moisture to percolate and recharge groundwater basins. The third strategy is meadow restoration that would involve returning water that had been converted to conveyance back to a meadow sheet flow so that the meadow can function in a natural groundwater recharge capacity. The last strategy involves retrofitting roads in order to reduce water conveyance, reduce fire risk, and increase the number of fire breaks.

Further details on this initiative are available at: http://www.sawpa.org/owow/projects/forest-first/.

This analysis of the 'no regrets strategy' allows SAWPA, its member agencies, and key stakeholders an opportunity to assess proposed Prop 84 projects and specific adaptation strategies and the cost and benefits in terms of productivity, mitigation potential, resilience, and sustainability. The most promising projects and strategies can then become part of SAWPA's toolbox of climate change adaptation strategies. SAWPA's 'no regret strategies' will, however, tend to encourage incremental adaptation responses as opposed to more expansive adaptation responses.

4.6.2 Additional Strategies

Beyond ‘no regrets strategies’ a group of actions under what could be referred to as ‘low regrets strategies’ can be formulated. ‘Low regrets strategies’ are designed to facilitate adaptation with respect to climate change predictions. These strategies are marginally more costly than ‘no regrets strategies’ and have a stronger reliance upon climate change predictions, especially more severe scenario predictions. As such, they provide a scientifically conservative approach to public health and safety in terms of water supply.

‘Low regret strategies’ are important to consider in terms of a planning horizon. For example, such strategies for SAWPA might include changing the design of infrastructure that is intended to last many years to a design that, despite an incremental cost increase, will serve its intended purpose even under an increased risk climate change model.

Table 8: Low regrets strategies

Low Regrets Strategy	Description
Emissions Targets	Conduct a survey of emissions generated from all water related operations and plan for a specific reduction in carbon emissions.
Expanded Flood Control Infrastructure	Climate change projections call for an increase in the intensity of storms and existing infrastructure may not be effective.
Solar Projects for Water Conveyance Systems	Using solar power as part of a renewable energy portfolio helps water districts control variable costs as well as decrease carbon emissions.
Consider high SLR Model Predictions and Build New Infrastructure Accordingly	When in the planning process for building new water related infrastructure, deliberately plan for SLR and design the project accordingly.
Expansion of Wetlands	By expanding natural wetlands project areas, sea level rise will not inundate existing wetlands. In addition, wetlands provide carbon reduction benefits, water filtration benefits, heat island reduction and habitat benefits.

4.7 SARW System Reliability and Risk Assessment

Under the SECURE Water Act Section 9503(b)(2), the Climate Change analysis developed by Reclamation in TM 1, Section 3 – *Water Supply and Demand Projections* assesses specific risks to SAWR’s water supplies, including those related to:

- changes in snowpack;
- changes in the timing and quantity of runoff;
- changes in groundwater recharge and discharge; and
- any increase in the demand for water as a result of increasing temperatures and the rate of reservoir evaporation.

The impetus for effective integrated water and related resources management in the SARW is the recognition that the following factors threaten the future of the region's water resources:

- Drought conditions in the Colorado River Watershed, a primary source of imported water to the Santa Ana River Watershed
- Unpredictability of future water imports from the San Joaquin-Bay Delta and Colorado River Watershed due to uncertainties in water availability and changing water management requirements
- Continued population growth and development that puts further stress on the natural hydrology of the watershed and increases the need for additional assured water supplies
- Uncertainties of climate change and its associated hydrologic variability

This Basin Study and Reclamation's collaborative work effort with SAWPA, its member agencies and stakeholders on updating the OWOW Plan are the watershed's preliminary answer to these threats. The Plan envisions stakeholders taking an active role in creating a watershed that:

- Is sustainable, drought-proofed and salt-balanced by 2030
- Protects its water resources and uses water efficiently
- Supports economic and environmental viability
- Mitigates and adapts to a changing climate
- Corrects environmental justice deficiencies
- Minimizes interruptions to natural hydrology
- Creates a new water ethic at both institutional and personal levels

4.8 Next Steps

Several tools have been developed by Reclamation for SAWPA, its member agencies and key water sector stakeholders to address the effects of climate change and plan ways to adapt or mitigate those potential impacts. Adaptation is the key component in the toolbox to help water resources planners and water sector decision-makers thoroughly understand and evaluate potential vulnerabilities from climate change impacts.

Research on climate change impacts is still evolving and as new findings are developed, they are shared throughout the SARW and California. Reclamation will continue to explore innovative quantitative tools to help assess vulnerabilities and conduct decision support analysis to help SAWPA progress toward addressing climate change impacts in SARW. Actions that have been productive, and will continue to be in working toward this goal include:

- Aggregation of climate change knowledge from state and federal research;
- Further assess No and Low Regret strategies;
- Develop a centralized a clearinghouse of information and lessons learned for member agencies;
- Offer web-based and workshop-delivered information on climate change impacts for the SARW;
- Create adaptation strategies and share that information with the water sector;
- Conduct webinars to further collaboration among water agencies;
- Develop regional case studies to discuss implementation actions;
- Bring additional agencies and officials into the discussion;
- Encourage innovative projects and search for flexibility;
- Seek to use evaluation studies/economic analysis as part of the message;
- Examine co-benefits to gain more support;
- Ensure disadvantaged and tribal communities have roles in the planning;
- Continue to involve key watershed stakeholders;
- Explore supportive resources/connections: Water Research Foundation, Water Environment Federation, Climate Ready Estuaries; and
- Collaborate whenever possible.

RESOLUTION 1083

RESOLUTION OF THE BOARD OF DIRECTORS OF SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT AUTHORIZING THE DISTRICT'S APPLICATION FOR THE BUREAU OF RECLAMATION WATERSMART: DROUGHT RESILIENCY PROJECTS FOR FISCAL YEAR 2019

WHEREAS, San Bernardino Valley Municipal Water District ("Valley District") is a municipal water district established pursuant to Section 71000 et seq. of the California Water Code.

WHEREAS, imported water supply in the San Bernardino area is facing a growing list of challenges associated with a prolonged drought, regulatory cutbacks on State Water Project deliveries, Delta instability, climate change, aging infrastructure, and growing population; and,

WHEREAS, the United States Department of the Interior, Bureau of Reclamation under the WaterSMART: Drought Resiliency Projects for Fiscal Year 2019 will make funding available to qualifying applicants; and

WHEREAS, the Board of Directors of Valley District has identified a project that exemplifies the objectives of the WaterSMART Grant in the Central Feeder East Branch Extension Intertie; and

WHEREAS, Valley District agrees to the administration and cost sharing requirements of the WaterSMART Grant criteria.

NOW, THEREFORE, be it resolved by the Board of Directors of Valley District as follows:

Section 1 The District is hereby authorized to receive, if awarded, the WaterSMART: Drought Resiliency Projects for Fiscal Year 2019 funding in the amount of $750,000 and will make a good faith effort to enter into a cooperative agreement with Reclamation for the receipt and administration of said grant funds.

Section 2 The General Manager, or his designee, is hereby authorized to take any and all action which may be necessary for the completion and execution of the project agreement and to take any and all other action which may be necessary for the receipt and administration of the grant funding in accordance with the requirements of the Bureau of Reclamation.

<u>Section 3</u> This resolution officially becomes a component part of Valley District's grant application.

<u>Section 4</u> The Board of Directors has reviewed and supports the application to be submitted.

<u>Section 5</u> Valley District is capable of providing the amount of funding and/or in-kind contributions specified in the grant application funding plan.

<u>Section 6</u> This Resolution shall be effective as of the date of adoption.

ADOPTED this 19th day of March, 2019.

T. Milford Harrison
President

Douglas D. Headrick
Secretary

San Gorgonio Pass Water Agency
A California State Water Project Contractor
1210 Beaumont Avenue • Beaumont, CA 92223
Phone (951) 845-2577 • Fax (951) 845-0281

March 13, 2019

Douglas Headrick, General Manager
San Bernardino Valley Municipal Water District
380 E Vanderbilt Way
San Bernardino, CA 92408

Subject: Support Letter for Central Feeder – East Branch Extension Intertie Project

Dear Mr. Headrick:

San Gorgonio Pass Water Agency (Agency) supports San Bernardino Valley Municipal Water District's (SBVMWD) plan to construct the Central Feeder – East Branch Extension Intertie Project (Project). This intertie is an integral part of the Bunker Hill Conjunctive Use Program, which is utilizing the Bunker Hill Basin to store water when it is available in wet years so that it can be used during dry years. This intertie will facilitate delivery of the water supply stored in the Bunker Hill Basin to east of Valley District's service area including the area served by the Agency. This Project provides additional water supply reliability and addresses the impacts of climate change, particularly drought, through actively managing the region's water supply resources.

The Agency appreciates SBVMWD being proactive in implementing projects to address the region's water supply issues. The proposed Project represents a significant effort by SBVMWD to construct the necessary infrastructure to manage water resources regionally and mitigating the impacts of climate change and drought.

Sincerely,

Jeff Davis

Jeff Davis
General Manager

Yucaipa Valley Water District

12770 Second Street • Post Office Box 730 • Yucaipa, California 92399-0730
(909) 797-5117 • Fax: (909) 797-6381 • www.yvwd.dst.ca.us

March 13, 2019

Douglas Headrick, General Manager
San Bernardino Valley Municipal Water District
380 E Vanderbilt Way
San Bernardino, CA 92408

Subject: Support Letter for Central Feeder – East Branch Extension Intertie Project

Dear Mr. Headrick:

Yucaipa Valley Water District (YVWD) supports San Bernardino Valley Municipal Water District's (SBVMWD) plan to construct the Central Feeder – East Branch Extension Intertie Project (Project). This intertie is an integral part of the Bunker Hill Conjunctive Use Program, which is utilizing the Bunker Hill Basin to store water when it is available in wet years so that it can be used during dry years. This intertie will facilitate delivery of the water supply stored in the Bunker Hill Basin to east of SBVMWD's service area including the area served by YVWD. This Project provides additional water supply reliability and addresses the impacts of climate change, particularly drought, through actively managing the region's water supply resources.

YVWD appreciates SBVMWD being proactive in implementing projects to address the region's water supply issues and to ensure the required facilities are in place. The proposed Project represents a significant effort by SBVMWD to construct the necessary infrastructure to manage water resources regionally and mitigating the impacts of climate change and drought.

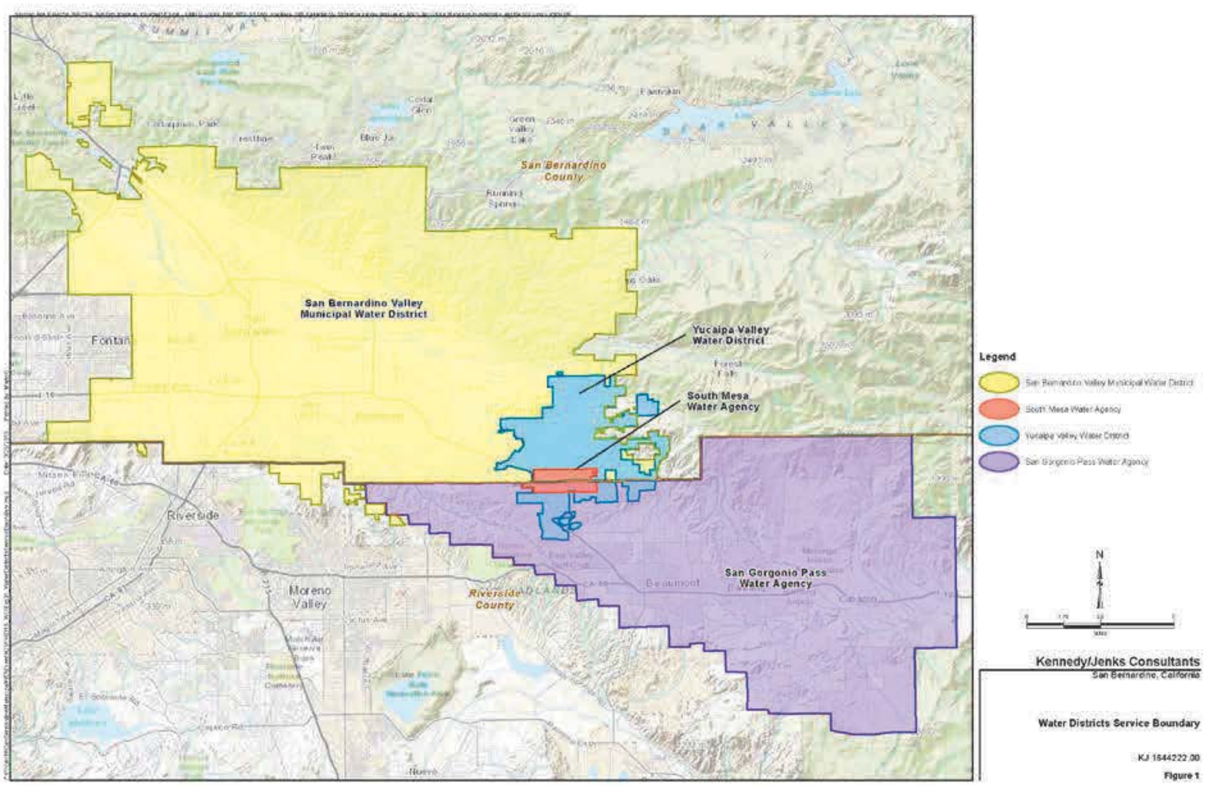
Sincerely,

Joseph Zoba
General Manager

Enclosure

Areas Affected by Project:

Areas within San Bernardino County. Specifically, the service areas of San Bernardino Valley Municipal Water District, Yucaipa Valley Water District, South Mesa Water Company, and San Gorgonio Pass Water Agency.



List of Congressional Districts of:

Applicant and Project: CA-8, CA-31