2020 Urban Water Management Plan

DECEMBER 2021

TEMESCAL VALLEY WATER DISTRICT

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Prepared by Water Systems Consulting, Inc.

ACKNOWLEDGMENTS

Water Systems Consulting, Inc. would like to acknowledge the significant contributions of Jeff Pape, General Manager of Temescal Valley Water District.

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ACRONYMS & ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
AB	Assembly Bill
AF	Acre Foot
AFY	Acre Feet per Year
AHHG	Area of Historic High Groundwater
AMR	Automatic Meter Reader
APA	Administrative Procedures Act
AWWA	American Water Works Association
BMP	Best Management Practice
CALWARN	California Water/Wastewater Agency Response Network
CAT	Climate Action Team
CCF	Hundred Cubic Feet
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CFS	Cubic Feet per Second
CII	Commercial, Industrial, and Institutional
CIMIS	California Irrigation Management Irrigation System
CUWCC	California Urban Water Conservation Council
DCR	DWR SWP Delivery Capacity Report
DDW	SWRCB Division of Drinking Water
DMM	Demand Management Measure
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EPA	United States Environmental Protection Agency
ET	Evapotranspiration
ETo	Reference Evapotranspiration
GAC	Granulated Activated Carbon
GIS	Geographic Information System
GPCD	Gallons per Capita per Day
GPM	Gallons per Minute
HECW	High Efficiency Clothes Washer
HET	High Efficiency Toilet

LAFCO	Local Agency Formation Commission
MAF	Million Acre-Feet
MCL	Maximum Contaminant Level
MF	Multi-family
MG	Million Gallons
MGD	Million Gallons per Day
MOU	Memorandum of Understanding
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PCE	Perchloroethylene
PVC	Polyvinyl Chloride
QWEZ	Qualified Water Efficient Landscaper
RIX	Rapid Infiltration and Extraction
RPA	Reasonable and Prudent Alternative
RWQCB	Regional Water Quality Control Board
SBX7-7	Senate Bill 7 of Special Extended Session 7
SF	Single Family
SOI	Sphere of Influence
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TCE	Trichloroethylene
TVWD	Temescal Valley Water District
ULFT	Ultra-Low Flush Toilet
UV	Ultraviolet
UWMP	Urban Water Management Plan
UWMP Act	Urban Water Management Planning Act
VOC	Volatile Organic Compound
WBIC	Weather Based Irrigation Controller
WSCP	Water Shortage Contingency Plan
WFF	Water Filtration Facility
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

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2020 URBAN WATER MANAGEMENT PLAN

Introduction and Lay Description

This chapter provides a brief overview of the Temescal Valley Water District (TVWD) and the purpose of this Urban Water Management Plan (UWMP). It also describes how the UWMP is organized and how it relates to other local and regional planning efforts that TVWD is involved in.

1.1 The California Water Code

In 1983, the State of California Legislature (Legislature) enacted the Urban Water Management Planning Act (UWMP Act). The law required an urban water supplier that provides water for municipal purposes to more than 3,000 customers or serves more than 3,000 acre-feet (AF) annually to adopt an UWMP every five years demonstrating water supply reliability under normal as well as drought conditions.

Since the original UWMP Act was passed, it has undergone significant expansion, particularly since the completion of the 2015 UWMP. Prolonged droughts, groundwater overdraft, regulatory revisions, and changing climatic conditions affect the reliability of water supplies as well as the statewide water reliability overseen by California Department of Water Resources (DWR), the State Water Resources Control Board (State Water Board), and the Legislature. Accordingly, the UWMP Act has grown to address changing conditions, and the current requirements are found in Sections 10610-10656 and 10608 of the California Water Code (CWC).

IN THIS SECTION

- California Water Code
- UWMP Organization
- UWMP Relation to Other Efforts
- Demonstration of Consistency with the Delta Plan for Participants in Covered Actions

DWR provides guidance for urban water suppliers by publishing an Urban Water Management Plan Guidebook 2020 (Guidebook) (California Department of Water Resources, 2021), conducting workshops, developing tools, and providing program staff to help water suppliers prepare comprehensive and useful UWMPs, implement water conservation programs, and understand the requirements in the California Water Code. Suppliers prepare their own UWMPs in accordance with the requirements and submit them to DWR. DWR then reviews the plans to determine whether they have addressed the requirements identified in the California Water Code. DWR then submits a report to the Legislature summarizing the status of the plans for each five-year cycle.

The purpose of the UWMP is for water suppliers to evaluate their long-term resource planning and establish management measures to ensure adequate water supplies are available to meet existing and future demands. The UWMP provides a framework to help water suppliers maintain efficient use of urban water supplies, continue to promote conservation programs and policies, ensure that sufficient water supplies are available for future beneficial use, and provide a mechanism for response during drought conditions or other water supply interruptions.

The UWMP is a valuable planning tool used for multiple purposes including:

- Provides a standardized methodology for water utilities to assess their water resource needs and availability.
- Serves as a resource to the community and other interested parties regarding water supply and demand, conservation and other water related information.
- Provides a key source of information for cities and counties when considering approval of proposed new developments and preparing regional long-range planning documents such as city and county General Plans.
- Informs other regional water planning efforts.

This plan, which was prepared as set forth in the Guidebook and format established by the DWR, constitutes the 2020 UWMP for TVWD.

1.2 UWMP Organization and Lay Description

This UWMP is organized into ten (10) chapters and the contents of each chapter are briefly described in this section.

Chapter 1 – Introduction

The introduction provides a description of TVWD and background on the UWMP and the CWC. Water suppliers that serve more than 3,000 customers or 3,000 acre-feet-per-year (AFY) are required to prepare a UWMP. The UWMP is an important tool that details TVWD's system and service area, estimates supply and demand over a twenty-five-year period, and analyzes reliability during normal and dry conditions.

Chapter 2 – Plan Preparation

The UWMP is prepared based on guidance from DWR. This UWMP provides information in terms of calendar year (January 1st – December 31st) and in units of AFY. While preparing this UWMP, TVWD coordinated with other local agencies and sent notifications that the UWMP was being developed, and when it was available for review. TVWD also provided details pertaining to the public hearing and plan adoption meeting.

Chapter 3 – System Description

This chapter summarizes TVWD’s service area, climate, demographics, current and future land use.

Chapter 4 – Water Use Characterization

This chapter summarizes historical and future water use. Water use, or demand, is summarized by customer class. In 2020, 42% of the total water deliveries were to single-family customers. To estimate future demand, this UWMP was aligned with recently completed master plans for both TVWD’s potable and non-potable/recycled water system. The Recycled Water Master Plan identified 2030 as buildout; therefore, this UWMP uses the buildout demands identified in the master plans for 2030, after which demands are held constant through 2045. Projected 2025 demand was linearly interpolated between actual 2020 use and projected buildout demand in 2030.

Chapter 5 – SBX7-7 Baseline and Targets

Senate Bill x 7-7 (SBX7-7) was passed in 2009 and requires all water suppliers to increase water use efficiency and decrease per-capita water consumption by 20 percent by the year 2020. To meet this requirement, TVWD established a water use baseline and efficiency targets in the 2015 UWMP. This chapter discusses compliance and confirms that TVWD met its 2020 water use target of 199 gallons per capita per day (GPCD). Actual 2020 usage for TVWD was 178 GPCD, which is a 10% reduction from the baseline.

Chapter 6 – Water Supply Characterization

TVWD provides imported water to its potable customers and local non-potable groundwater and recycled water to its non-potable customers. Potable water is supplied through Western Municipal Water District (Western) who purchases State Water Project (SWP) water from Metropolitan Water District of Southern California (Metropolitan). Local non-potable groundwater is extracted from the Bedford-Coldwater subbasin and provided directly to customers for non-potable uses such as irrigation. TVWD also produces tertiary-treated recycled water at the Temescal Valley Water Reclamation Facility (TVWRF) and provides it directly to customers for non-potable uses. In the summer months, non-potable demands exceed the recycled water supply so non-potable groundwater is used as supplemental supply. Recycled water that cannot be directly used by customers, typically during winter months when demand is low, is disposed of into percolation ponds.

Chapter 7 – Water Service Reliability and Drought Risk Assessment

Future demand and supply were analyzed to evaluate supply reliability over the planning period. The UWMP analyzed conditions for a normal or average year, a single dry year, and a period of five consecutive dry years. In all scenarios, TVWD expects to meet customer demands. In addition, a Drought Risk Assessment was performed to analyze anticipated supply and demand for the next five years (2021-2025). The Drought Risk Assessment analysis determines that TVWD’s supplies are able to reliably meet customer demands.

Chapter 8 – Water Shortage Contingency Plan

The Water Shortage Contingency Plan (WSCP) is a detailed plan for how TVWD intends to predict and respond to foreseeable and unforeseeable water shortages, including guidance on declaring a water shortage stage and how to mitigate supply deficits. The WSCP defines six stages of water shortage and outlines the actions that could be taken during each stage. The WSCP serves as the operating manual that TVWD will use to prevent catastrophic service disruptions through proactive, rather than reactive, mitigation of any potential water shortages. This chapter summarized the WSCP and the full WSCP is included in Appendix F.

Chapter 9 – Demand Management Measures

This chapter summarizes the various demand management measures used to promote water conservation throughout TVWD. To participate in any of the rebate programs, interested customers should contact TVWD directly.

Chapter 10 – Plan Adoption, Submittal, and Implementation

This chapter summarizes the various requirements to adopt and submit a UWMP and WSCP. Details on public hearing dates, notification of the public and local agencies, and procedures to submit or amend a plan are discussed.

1.3 UWMP Relation to Other Efforts

The UWMP characterizes water use, estimates future demands and supply sources, and evaluates supply reliability for normal, single-dry, and consecutive dry years. The UWMP Act also requires reevaluation of TVWD's WSCP. Details on the WSCP are provided in Chapter 8.

Documents that were leveraged in preparation of this UWMP and how they overlap with the primary topics included in the UWMP are shown in Figure 1-1. The documents used most extensively in development of this UWMP include TVWD's 2019 Water Master Plan Update and 2020 Recycled Water Master Plan. In addition, information from Western and Metropolitan's 2020 UWMPs inform TVWD's reliability assessment for its potable system.

			PLAN TOPICS					
PLANNING DOCUMENT	PREPARED BY	DOCUMENT STATUS	SUPPLIES / RELIABILITY	DEMANDS / WATER USE EFFICIENCY	INFRASTRUCTURE	CLIMATE CHANGE	RISK & MITIGATION	WATER SHORTAGE AND EMERGENCY RESPONSE
TVWD 2020 UWMP	TVWD	■■■■■ This UWMP	✓	✓			✓	✓
Western Drought Contingency Plan	Western	■■■□□ To be completed in 2022	✓	✓	✓	✓	✓	✓
Western 2020 UWMP	Western	■■■■■ Completed in 2021	✓	✓		✓	✓	✓
Metropolitan 202 UWMP	Metropolitan	■■■■■ Completed in 2021	✓	✓		✓	✓	✓
Recycled Water Master Plan	TVWD	■■■■■ Completed in 2020	✓	✓	✓			
2019 Water Master Plan Update	TVWD	■■■■■ Completed in 2019	✓	✓	✓			
AWIA Risk and Resilience Assessment	TVWD	■■■■■ Completed in 2020	✓		✓		✓	✓
2015 Urban Water Management Plan	TVWD	■■■■■ Completed in 2019	✓	✓				✓

Figure 1-1. UWMP Relation to Other Planning Efforts.

1.4 Demonstration of Consistency with the Delta Plan for Participants in Covered Actions

The Delta Plan is a comprehensive, long-term, legally enforceable plan guiding how federal, state, and local agencies manage the Sacramento-San Joaquin Delta's (Delta's) water and environmental resources. The Delta Plan was adopted in 2013 by the Delta Stewardship Council. Delta Plan Policy WR P1 identifies UWMPs as the tool to demonstrate consistency with the state policy to reduce reliance on the Delta for a supplier that carries out or takes part in a covered action. A covered action may include activities such as a multiyear water transfer, conveyance facility, or new diversion that involves transferring water through, exporting water from, or using water in the Delta. As a supplier that receives imported water from the Delta through its wholesale supplier, TVWD is submitting information outlined in Appendix C of the DWR 2020 UWMP Guidebook (California Department of Water Resources, 2021).

To document and quantify supplies contributing to reduced reliance on the Delta watershed and improved regional self-reliance, a number of steps must be taken, including:

- Setting a baseline
- Documenting the change in delivery of Delta water
- Reporting results to show consistency with WR P1

DWR does not review this analysis as part of the UWMP approval process; therefore, this information is attached as Appendix A.

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2020 URBAN WATER MANAGEMENT PLAN

Plan Preparation

This plan was prepared using guidance from the Department of Water Resources' (DWR) Urban Water Management Plan Guidebook 2020 (2020 UWMP Guidebook). This chapter provides details regarding TVWD's UWMP preparation and the coordination and outreach efforts conducted.

A DWR review sheet checklist is provided in Appendix B.

2.1 Basis for Preparing a Plan

As mentioned in Chapter 1, the CWC requires Suppliers with 3,000 or more service connections or water deliveries in excess of 3,000 AFY to prepare an UWMP every five years. Details pertaining to TVWD's water system, such as public water system number, 2020 number of connections and volume of water supplied are provided in Table 2-1. In 2020, TVWD delivered 3,370 AFY of potable water to nearly 6,000 service connections; therefore, TVWD is required to prepare an UWMP. TVWD included data for all of calendar year 2020 in the development of this UWMP.

IN THIS SECTION

Table 2-1. DWR 2-1R Public Water Systems

PUBLIC WATER SYSTEM NUMBER	PUBLIC WATER SYSTEM NAME	NUMBER OF MUNICIPAL CONNECTIONS 2020	VOLUME OF WATER SUPPLIED 2020
CA3310074	TEMESCAL VALLEY WATER DISTRICT	5,955	3,370
-	**TOTAL:**	**5,955**	**3,370**

Reflects potable water connections and deliveries only.

Table 2-2. DWR 2-2 Plan Identification

TYPE OF PLAN	MEMBER OF RUWMP	MEMBER OF REGIONAL ALLIANCE	NAME OF RUWMP OR REGIONAL ALLIANCE
Individual UWMP	No		

Table 2-3. DWR 2-3 Agency Identification

TYPE OF SUPPLIER	YEAR TYPE	FIRST DAY OF YEAR		UNIT TYPE
Retailer	Calendar Years	**01**	**JAN**	Acre Feet (AF)

2.2 Coordination and Outreach

The UWMP Act requires a water purveyor to coordinate the preparation of its UWMP with other appropriate agencies in and around its service area. This includes other water suppliers that share a common source, water management agencies, and relevant public agencies. TVWD has prepared this UWMP in coordination with its wholesale provider, Western. TVWD also reached out to nearby agencies for input and regional consistency. All relevant entities, including the County of Riverside, were sent 60-day notices of preparation and consideration for adoption at a public hearing prior to the adoption of the 2020 UWMP. Copies of the letters and other correspondence are provided in Appendix C. Organizations notified of TVWD’s effort to update this UWMP are summarized in Table 2-5. The public hearing notices are provided in Appendix D.

2.2.1 Wholesale and Retail Coordination

TVWD relies on potable water from Western to meet potable demands. Western supplies State Water Project (SWP) from Metropolitan Water District of Southern California (Metropolitan), through the Mills Gravity Line to TVWD. TVWD coordinated with Western during preparation of the UWMP, as shown in Table 2-4. TVWD also coordinated with other local agencies, as outlined in Table 2-5.

Table 2-4. DWR 2-4 Water Supplier Information Exchange

WHOLESALE WATER SUPPLIER NAME
Western Municipal Water District

Table 2-5. Agency Coordination.

AGENCY/ORGANIZATION	PARTICIPATED IN PLAN DEVELOPMENT	COMMENTED ON DRAFT	ATTENDED PUBLIC MEETINGS	WAS CONTACTED FOR ASSISTANCE	WAS NOTIFIED OF PLAN AVAILABILITY[1]	WAS SENT A NOTICE OF INTENTION TO ADOPT 60 DAYS PRIOR TO PUBLIC HEARING
Water Suppliers						
Western Municipal Water District					X	X
Elsinore Valley Municipal Water District					X	X
Public Agencies						
County of Riverside					X	X
City of Corona					X	X

[1] Was notified of availability of Draft UWMP and directed to an electronic copy of the draft plan on TVWD's website.

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2020 URBAN WATER MANAGEMENT PLAN

System Description

This chapter describes TVWD's service area, customers, and land uses, as well as population, demographics, and climate features.

IN THIS SECTION

- General Description
- Climate
- Population and Demographics
- Land Uses

TVWD, formerly known as Lee Lake Water District, was established in 1965 to provide water and wastewater services to residents within Temescal Valley. TVWD is a public agency governed by a Board of Directors consisting of five locally elected members. TVWD currently serves the communities of Wildrose, The Retreat, Montecito Ranch, Trilogy, Terramor, Sycamore Creek and Painted Hills, as well as commercial businesses along Temescal Canyon Road. Additional portions of TVWD's service area are either undeveloped, supplied from private wells, or supplied from the City of Corona or Elsinore Valley Municipal Water District (EVMWD).

3.1 General Service Area Description

Situated at the foothills of the Cleveland National Forest, TVWD is located in the Temescal Valley in western Riverside County. TVWD's service area is located between the Cities of Corona and Lake Elsinore and is bordered by the Santa Ana Mountains to the west and the Estelle Mountains to the east.

TVWD's developable service area consists of approximately 6,755 acres (roughly 10.5 square miles). TVWD provides water service to more than 16,000 residents. The service area boundary is provided in Figure 3-1.

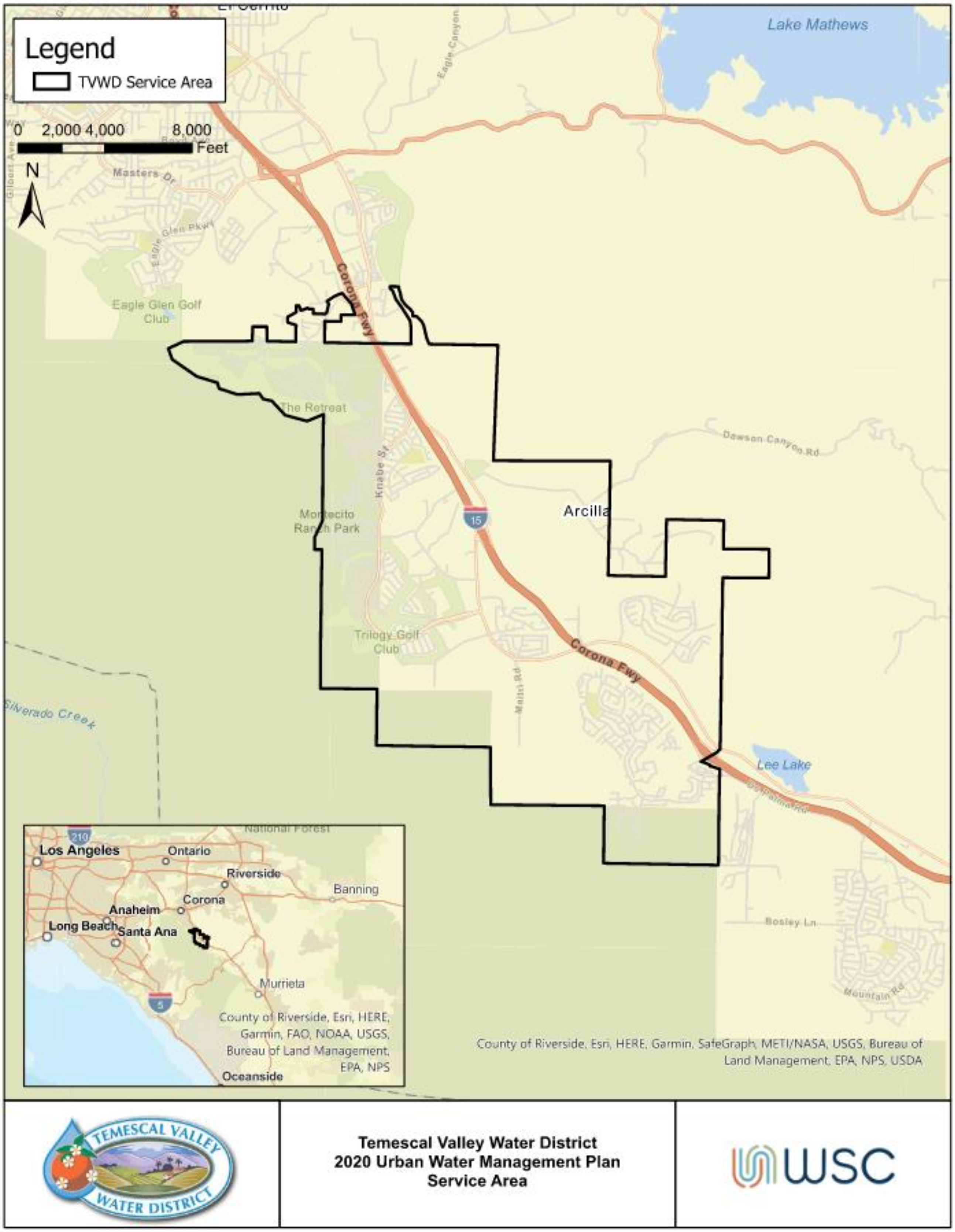

Figure 3-1. TVWD Service Area

3.2 Service Area Climate

TVWD's climate is characterized by typical hot, dry summers, and mild winters. Details on precipitation, temperature, and evapotranspiration (ETo) for TVWD's service area are provided in Table 3-1. Data shown is from the California Irrigation Management Information System (CIMIS) database for Station 44, located at the University of California, Riverside. This station was selected as it was closest to TVWD's service area.

As shown in Table 3-1, the warmest month of the year is August with an average temperature of 85.0 degrees Fahrenheit (°F), while the coldest month of the year is December with an average temperature of 59.8°F.

The annual average precipitation is approximately 8.8 inches. As shown in Table 3-1, the majority of rainfall occurs in the months of December through March. December is typically the wettest month with an average rainfall of approximately 2.3 inches.

Table 3-1. Historical Climate Data

	AVERAGE TEMPERATURE (°F) [1]	AVERAGE PRECIPITATION (IN.) [1]	AVERAGE STANDARD ETO (IN.) [1]
January	61.2	1.84	2.84
February	61.5	1.48	3.39
March	65.2	1.19	5.08
April	68.8	0.67	6.36
May	71.3	0.27	6.98
June	78.0	0.01	7.80
July	83.7	0.20	8.30
August	85.0	0.21	8.09
September	82.4	0.26	6.37
October	75.0	0.39	4.62
November	66.3	0.83	3.21
December	59.8	2.34	2.53

[1] CIMIS weather station 44 at UC Riverside; https://cimis.water.ca.gov/. Data from 2010 through 2020.

3.3 Service Area Population and Demographics

3.3.1 Service Area Population

Population estimates for TVWD's service area were developed using the DWR Population Tool for 2020. DWR has developed this GIS-based tool to estimate the population within a water agency's service area using census data and number of water service connections. The DWR Population Tool was used to intersect the service area boundary with census data to provide population estimates for 1990, 2000, and 2010. The DWR Population Tool uses the number of service connections in those prior census years, where available, to calculate a persons-per-connection factor, which is then projected forward to estimate population in a given year using the number of connections in that year. The service area population for 2020 was estimated using the number of 2010 and 2020 potable connections and a persons-per-connection factor of 2.84. It was estimated that the 2020 service area population is 16,919 people. Future population was estimated by applying the percentage of potable water demand growth (described in Section 4) to the 2020 population. Population projections are provided in Table 3-2.

Table 3-2. DWR 3-1R Current and Projected Population

	2020	2025	2030	2035	2040	2045
Population Served	16,919	25,868	29,242	29,242	29,242	29,242

3.3.2 Other Social, Economic, and Demographic Factors

Based on 2015-2019 data, the United States Census Bureau (Census) estimates 54% of households are composed of married couples with families. The median age of a resident within Temescal Valley is approximately 38 years old. Based on 2015-2019 Census data, 92% of people 25 years or older had at least graduated from high school and 29% obtained a bachelor's degree or higher. It was estimated that 8% of people did not complete high school.

Throughout Temescal Valley, approximately 59% of the working population (people ages 16 and over) were employed. Approximately 76% held a private wage or salary position, and 17% were employed by the federal, state, or local government. Educational services, health care and social assistance (21%) is the most common industry that Temescal Valley residents work in, followed by manufacturing (13%). The median household income was $108,934, while the median earnings for a full-time, year-round worker was $69,197 (United States Census Bureau, n.d.).

It was estimated that 4.5% of people within Temescal Valley were in poverty and that 2.3% of households participated in government assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP). Of the households that received SNAP, 48% had children under the age of 18 and 43% had one or more people over the age of 60 within the household. (United States Census Bureau, n.d.).

Census data reported that of the total population, an estimated 42.3% identified as White non-Hispanic and 34.7% as Hispanic. Of the people identifying as one race alone, 64.7% were White. Approximately 5.9% identified as two or more races. It was estimated that 28% of people at least 5 years or older spoke a language other than English at home. In addition to English, Spanish was the most common language and was spoken by 18.8% of people 5 years or older. Approximately 7% of people stated that they did not speak English "very well" (United States Census Bureau, n.d.).

3.4 Land Uses within Service Area

The Southern California Association of Governments (SCAG) prepares demographic forecasts based on land use data through an extensive process that emphasizes input from local planners in coordination with local or regional land use authorities, incorporating essential information to reflect anticipated future populations and land uses. SCAG's projections undergo extensive local review, incorporate zoning information from city and county general plans, and are supported by Environmental Impact Reports. The most recent set of land use data was developed as part of SCAG's most recent demographics and growth forecast, completed in late 2020. Land use within TVWD's service area was obtained from SCAG and is shown in Table 3-3 (Southern California Association of Governments, 2020).

Table 3-3. Existing General Plan Land Uses within TVWD

	ACRES	PERCENTAGE
Single Family Residential	2,162	29%
Multi-Family Residential	26	0%
Mixed Residential	470	6%
Commercial and Services	217	3%
Facilities	30	0%
Industrial	2,123	29%
Mixed Residential and Commercial	15	0%
Open Space and Recreation	1,636	22%
Water	157	2%
Other	602	8%
TOTAL	**7,439**	**100%**

Future land uses were estimated in the 2019 Water System Master Plan Update using existing specific plans, tentative maps, data from developers, and future land use from the County of Riverside General Plan (Dudek for Temescal Valley Water District, June 2019). Nearly 43% of TVWD's service area has been identified as open space. Most of the future open space area includes the mined area between Trilogy and Sycamore Creek. This area has also been designated as mineral resource in the County of Riverside's General Plan. Estimated future land use within TVWD's service area under an ultimate land use scenario is provided in Figure 3-2.

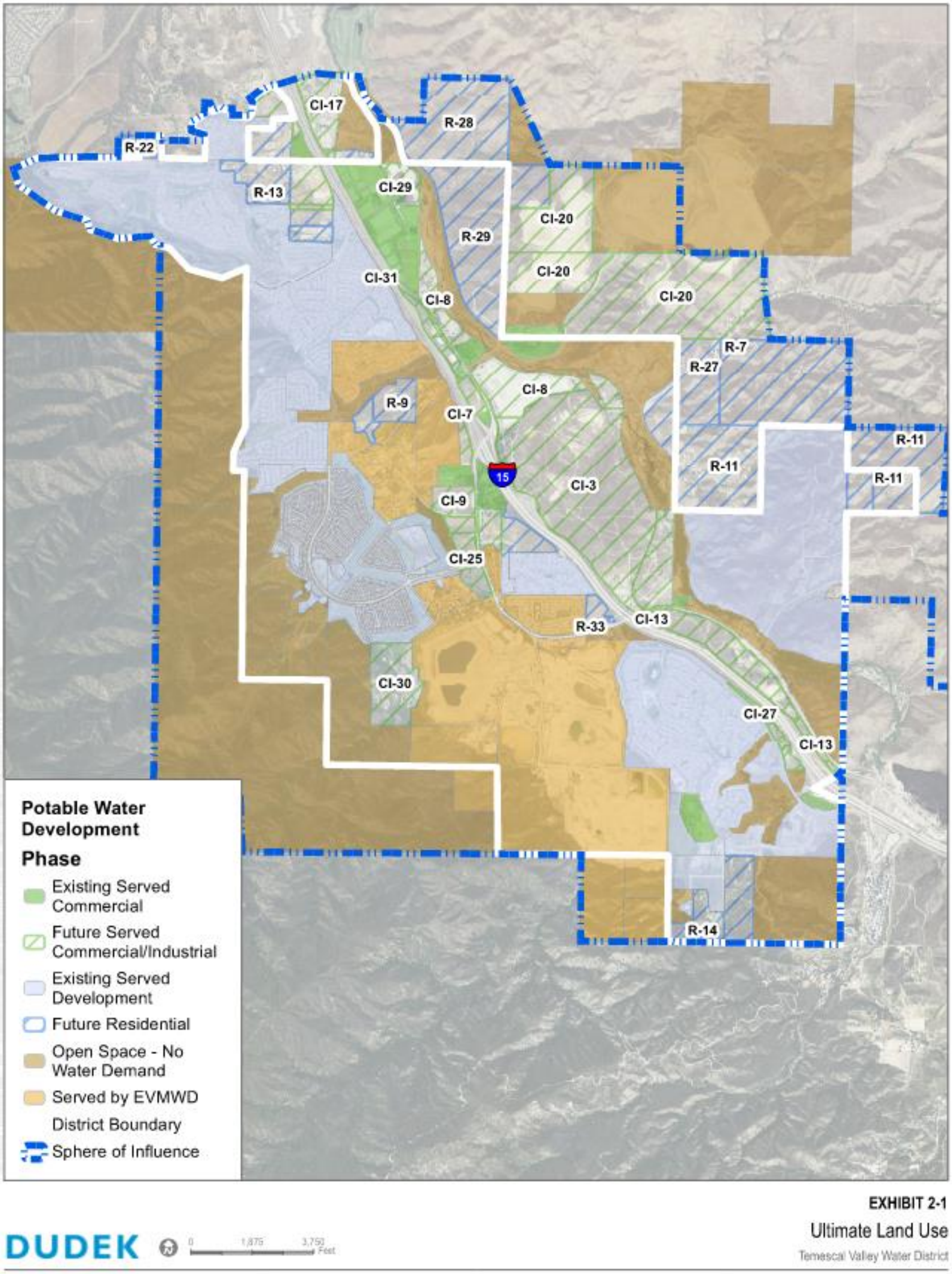

Figure 3-2. TVWD Ultimate Land Use (Dudek for Temescal Valley Water District, June 2019)

4

2020 URBAN WATER MANAGEMENT PLAN

Water Use Characterization

This chapter describes historical, current, and projected water uses for TVWD's service area. TVWD provides potable and non-potable/recycled water to customers. Between 2016 through 2020, TVWD customers used an average of 3,200 AFY of potable water and 2,800 AFY of non-potable/recycled water.

IN THIS SECTION

- Non-Potable vs. Potable Water Use
- Past, Current, and Projected Water Use by Sector
- Water Use for Lower Income Households

4.1 Non-Potable Versus Potable Water Use

TVWD provides potable, non-potable, and recycled water to its customers. Potable demands include water use for single-family, commercial, institutional-governmental, landscape, and construction uses. Non-potable uses include golf course irrigation and agricultural uses. Recycled water is also used for construction and irrigation purposes. TVWD typically operates its non-potable and recycled water systems separately but has the option to operate as a combined system. Therefore, historical trends include both non-potable and recycled water use. Projected non-potable demands are described in this chapter and projected recycled water demand is detailed in Chapter 6.

4.2 Past, Current, and Projected Water Use by Sector

TVWD provides water to nearly 6,300 customer accounts. In 2020, the largest customer category was single family residential customers that used approximately 42% of the total water used (potable and non-potable/recycled water). Non-potable and recycled water use accounted for 13% of total water use each, or 26% as a combined system.

4.2.1 Past and Current Water Use

Water use over the last five years has varied from approximately 5,300 AFY up to 6,400 AFY, as shown in Figure 4-1 and Table 4-1. Table 4-2 through Table 4-4 provide the breakdown of 2020 water use by customer class and by potable and non-potable systems.

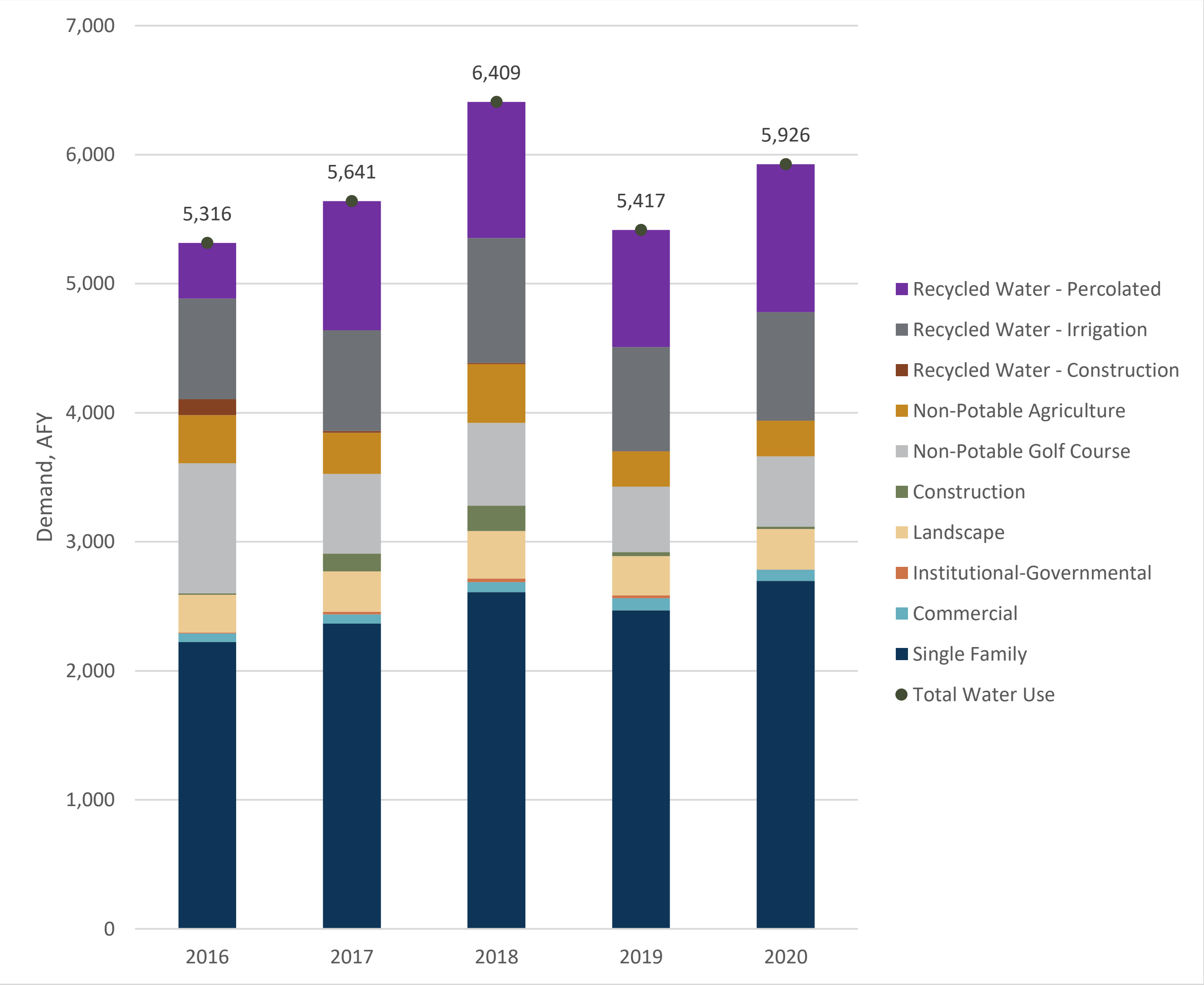

Figure 4-1. Past Water Use, AFY

Table 4-1. Past and Current Water Use by Customer Class, AFY

	2016	2017	2018	2019	2020
Single Family	2,224	2,366	2,610	2,470	2,698
Commercial	66	71	77	92	86
Institutional-Governmental	7	20	28	24	3
Landscape	295	314	368	304	312
Construction	9	138	198	30	19
POTABLE SUBTOTAL	**2,600**	**2,909**	**3,281**	**2,920**	**3,117**
Non-Potable Golf Course	1,009	616	641	508	545
Non-Potable Agriculture	373	320	457	271	278
Recycled Water Construction	124	13	8	2	0.31
Recycled Water Irrigation	779	781	967	807	840
Recycled Water Percolated	432	1,002	1,056	907	1,146
NON-POTABLE SUBTOTAL	**2,717**	**2,732**	**3,128**	**2,497**	**2,810**
TOTAL USE	**5,316**	**5,641**	**6,409**	**5,417**	**5,926**

Table 4-2. DWR 4-1R Actual Demands for Water

USE TYPE	ADDITIONAL DESCRIPTION	LEVEL OF TREATMENT WHEN DELIVERED	2020 VOLUME
Single Family		Drinking Water	2,698
Commercial		Drinking Water	86
Institutional/Governmental		Drinking Water	3
Landscape		Drinking Water	312
Other	Construction	Drinking Water	19
Losses[1]		Drinking Water	253
Other	Golf Course	Raw Water	545
Agricultural irrigation		Raw Water	278
Losses[1]		Raw Water	334
Landscape	Recycled water demand met by raw, non-potable groundwater	Raw Water	685
-		**TOTAL:**	**5,213**

[1] Refer to section 4.2.2 for a detailed explanation on losses.

Table 4-3. DWR 4-1R Actual Demands for Water: Potable

USE TYPE	ADDITIONAL DESCRIPTION	LEVEL OF TREATMENT WHEN DELIVERED	2020 VOLUME
Single Family		Drinking Water	2,698
Commercial		Drinking Water	86
Institutional/Governmental		Drinking Water	3
Landscape		Drinking Water	312
Other	Construction	Drinking Water	19
Losses[1]		Drinking Water	253
-		**TOTAL:**	**3,371**

[1] Refer to section 4.2.2 for a detailed explanation on losses.

Table 4-4. DWR 4-1R Actual Demands for Water: Non-Potable

USE TYPE	ADDITIONAL DESCRIPTION	LEVEL OF TREATMENT WHEN DELIVERED	2020 VOLUME
Other	Golf Course	Raw Water	545
Agricultural irrigation		Raw Water	278
Losses[1]		Raw Water	334
Landscape	Recycled water demand met by raw, non-potable groundwater	Raw Water	685
-		**TOTAL:**	**1,842**

[1] Refer to section 4.2.2 for a detailed explanation on losses.

4.2.2 Distribution System Water Losses

There are two types of water losses considered in the preparation of a water loss audit, apparent losses and real losses. Apparent losses are losses attributed to meter inaccuracies or data management (e.g., losses due to how water is accounted for or measured), while real losses are physical losses of water. Sources of distribution system water loss include:

- Meter Inaccuracies - meters can under-represent actual consumption in the water system
- Leaks from water lines - Leakage from water pipes is a common occurrence in water systems. A significant number of leaks remain undetected over long periods of time as they are very small; however, these small leaks contribute to the overall water loss. Aging pipes typically have more leaks.
- Water used for flushing and fire hydrant operations
- Unauthorized uses or theft of water
- Unrecorded water uses when reservoirs overflow

TVWD has completed annual water loss audits following the procedures outlined by the American Water Works Association (AWWA) to identify and quantify system losses within its potable system. Historical potable water loss is summarized in Table 4-5.

Table 4-5. DWR 4-4R 12 Month Water Loss Audit Reporting

REPORT PERIOD START DATE		VOLUME OF WATER LOSS, AFY
MM	YYYY	
7	2016	241
7	2017	158
7	2018	121
7	2019	293
1	2020	253

Taken from the field "Non-Revenue Water" (a combination of apparent losses and real losses, unbilled metered, and unbilled unmetered losses) from the AWWA worksheet.
Water losses for 2020 were estimated and based on the total potable production less total billed consumption.

For the purposes of projecting future demands, TVWD's potable system is assumed to maintain an 8% water loss, as experienced in 2020. In early 2021, TVWD identified several areas with small leaks that were quickly corrected. As a result, TVWD's potable water loss has been reduced to 5%.

TVWD's non-potable system has experienced approximately 28% water loss in the past two years. It is anticipated that majority of TVWD's non-potable losses stem from inaccurate well meters. TVWD has considered replacing well meters in the near future. In addition, water is commonly lost through a 2.5-mile gravity mainline that is approximately 100-years old. TVWD has considered upgrades to this mainline and has determined the cost to upgrade as too expensive at this time. Despite the data shown above, TVWD estimates that losses are likely closer to the 100-150 AFY range (approximately 14%) for its non-potable system.

Losses within the recycled water system are minimal. Any non-used recycled water is percolated into the groundwater basin; however, meters measuring percolation are not always accurate. Therefore, percolated recycled water is assumed as the total recycled water produced less consumed directly by customers.

The State Water Board is currently preparing performance standards for distribution system water loss. These standards are still being reviewed and finalized with stakeholder input. TVWD is committed to managing system water losses to reduce water waste and will endeavor to meet the future water loss performance standard once adopted by the State Water Board. A discussion of current and planned programs to manage water loss are included in Chapter 9, Demand Management Measures.

4.2.3 Projected Water Use

TVWD recently completed master plans for both its potable and non-potable/recycled water system. TVWD's 2019 Water Master Plan (WMP) and 2020 Recycled Water Master Plan (RWMP) analyzed future development and included demand projections. The WMP identified future demand for 2025, based on a list of developments and discussion with various developers, and an ultimate demand scenario for buildout. The RWMP estimates that buildout within TVWD is likely to occur by 2030. To remain consistent with both master plans, this UWMP assumes 2030 as buildout. As a result, demands after 2030 are assumed constant. To estimate 2025 non-potable and recycled water demand, a linear interpolation was applied between actual 2020 use and estimated buildout demand in 2030. To determine the projected demand by customer class, the percentage each customer class used in 2020 was applied to the total projected demand throughout the planning period. It was assumed TVWD's potable system would maintain an 8% loss rate and the non-potable system would maintain a 29% loss rate (although non-potable losses are likely lower and stem from meter inaccuracies). Projected demands are provided in Figure 4-2 and summarized by customer class in the following tables.

In 2018, the legislature enacted SB 606 and AB 1668, which provide for implementation of a water budget-based approach to establishing new urban water use objectives for water suppliers. The series of water use efficiency standards that will inform calculation of TVWD's new water use objective are still under development and will take effect in 2023. Once the new standards have been established, TVWD will reevaluate customer demands and identify approaches to comply with the new standard, which will be incorporated into the next UWMP prepared in 2025. TVWD is committed to promoting water use efficiency when possible and will continue to implement programs intended to reduce demands and support sustainable use of supplies.

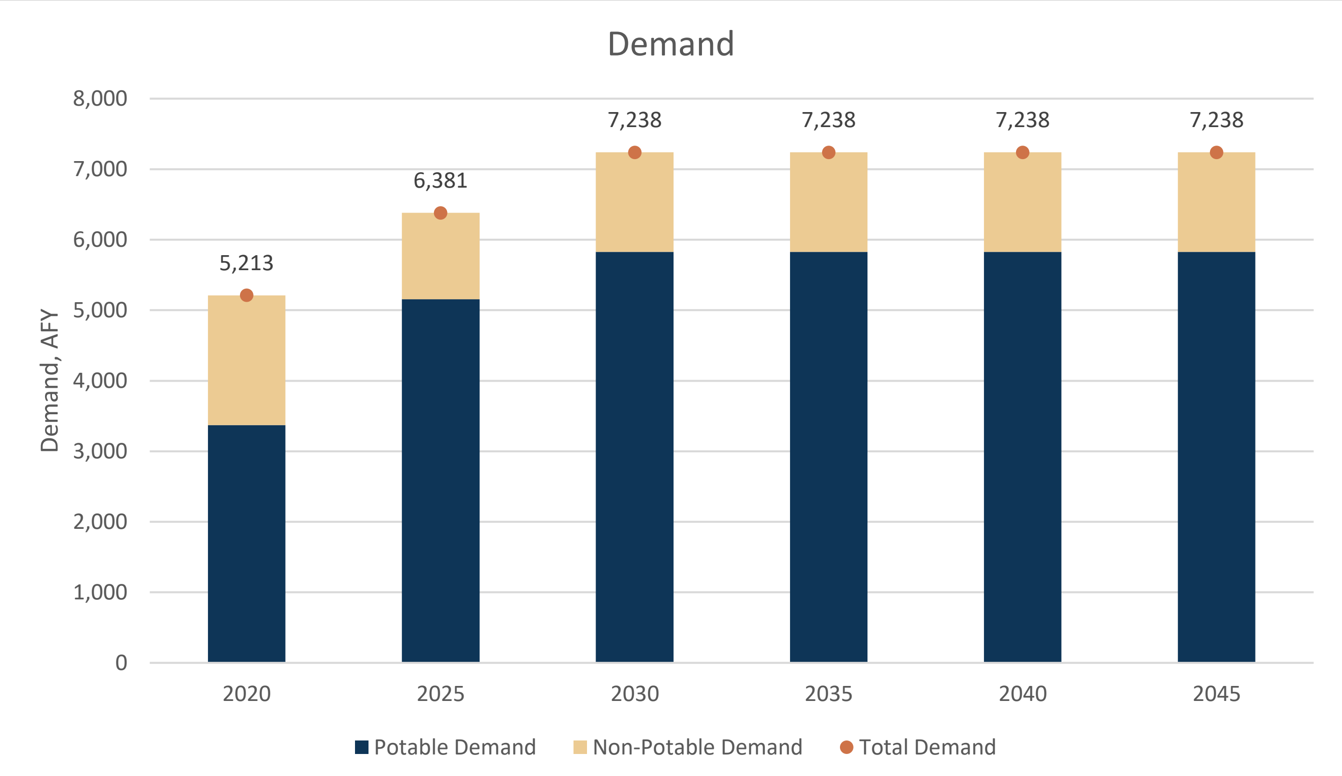

Figure 4-2. Projected Demand, AFY

Table 4-6. DWR 4-2R Projected Demands for Water

USE TYPE	ADDITIONAL DESCRIPTION	PROJECTED WATER USE 2025	2030	2035	2040	2045
Single Family		4,125	4,663	4,663	4,663	4,663
Commercial		132	149	149	149	149
Institutional/Governmental		5	5	5	5	5
Landscape		477	540	540	540	540
Other	Construction	29	33	33	33	33
Losses	Potable	387	438	438	438	438
Landscape	Golf Course Irrigation-Non-Potable	629	724	724	724	724
Agricultural irrigation	Non-Potable	321	370	370	370	370
Losses	Non-Potable	276	316	316	316	316
-	**TOTAL:**	**6,381**	**7,238**	**7,238**	**7,238**	**7,238**

Table 4-7. DWR 4-2R Projected Demands for Water: Potable

USE TYPE	ADDITIONAL DESCRIPTION	PROJECTED WATER USE 2025	2030	2035	2040	2045
Single Family		4,125	4,663	4,663	4,663	4,663
Commercial		132	149	149	149	149
Institutional/Governmental		5	5	5	5	5
Landscape		477	540	540	540	540
Other	Construction	29	33	33	33	33
Losses		387	438	438	438	438
-	**TOTAL:**	**5,155**	**5,828**	**5,828**	**5,828**	**5,828**

Table 4-8. DWR 4-2R Projected Demands for Water: Non-Potable

USE TYPE	ADDITIONAL DESCRIPTION	PROJECTED WATER USE 2025	2030	2035	2040	2045
Landscape	Golf Course Irrigation-Non-Potable	629	724	724	724	724
Agricultural irrigation	Non-Potable	321	370	370	370	370
Losses	Non-Potable	276	316	316	316	316
-	**TOTAL:**	**1,226**	**1,410**	**1,410**	**1,410**	**1,410**

Table 4-9. DWR 4-3R Total Gross Water Use

	2020	2025	2030	2035	2040	2045
Potable and Raw Water From Table 4-1R and 4-2R	5,213	6,381	7,238	7,238	7,238	7,238
Recycled Water Demand* From Table 6-4R	1,302	1,517	2,203	2,203	2,203	2,203
Total Water Use:	**6,515**	**7,898**	**9,441**	**9,441**	**9,441**	**9,441**
*Recycled water demand discussed in Section 6.						

Table 4-10. DWR 4-3R Total Gross Water Use: Potable

	2020	2025	2030	2035	2040	2045
Potable and Raw Water From Table 4-1R and 4-2R	3,371	5,155	5,828	5,828	5,828	5,828
TOTAL WATER USE	**3,371**	**5,155**	**5,828**	**5,828**	**5,828**	**5,828**

Table 4-11. DWR 4-3R Total Gross Water Use: Non-Potable

	2020	2025	2030	2035	2040	2045
Recycled Water Demand* From Table 6-4R	1,302	1,517	2,203	2,203	2,203	2,203
Raw and Other Non-Potable From Table 4-1R and 4-2R	1,842	1,226	1,410	1,410	1,410	1,410
Total Water Use	**3,144**	**2,742**	**3,613**	**3,613**	**3,613**	**3,613**
*Recycled water demand discussed in Section 6.						

4.2.4 Characteristic Five-Year Water Use

In addition to past and projected uses, the UWMP more closely analyzes anticipated conditions for the next five years (2021 – 2025). Demands for the next five years are provided in Table 4-12 and shown in Figure 4-3. The demand projections established in this chapter assume typical, unconstrained demand, free from other influential factors like conservation savings. Based on the projections established above, TVWD anticipates that demands may increase annually by 5% system-wide.

Table 4-12. Projected System Demand for the Next Five Years, AFY

	2021	2022	2023	2024	2025
Potable	3,669	3,994	4,349	4,735	5,155
Non-Potable	1,179	1,184	1,198	1,211	1,226
Recycled Water	946	1,064	1,198	1,348	1,517
TOTAL DEMAND	**5,785**	**6,242**	**6,744**	**7,294**	**7,898**

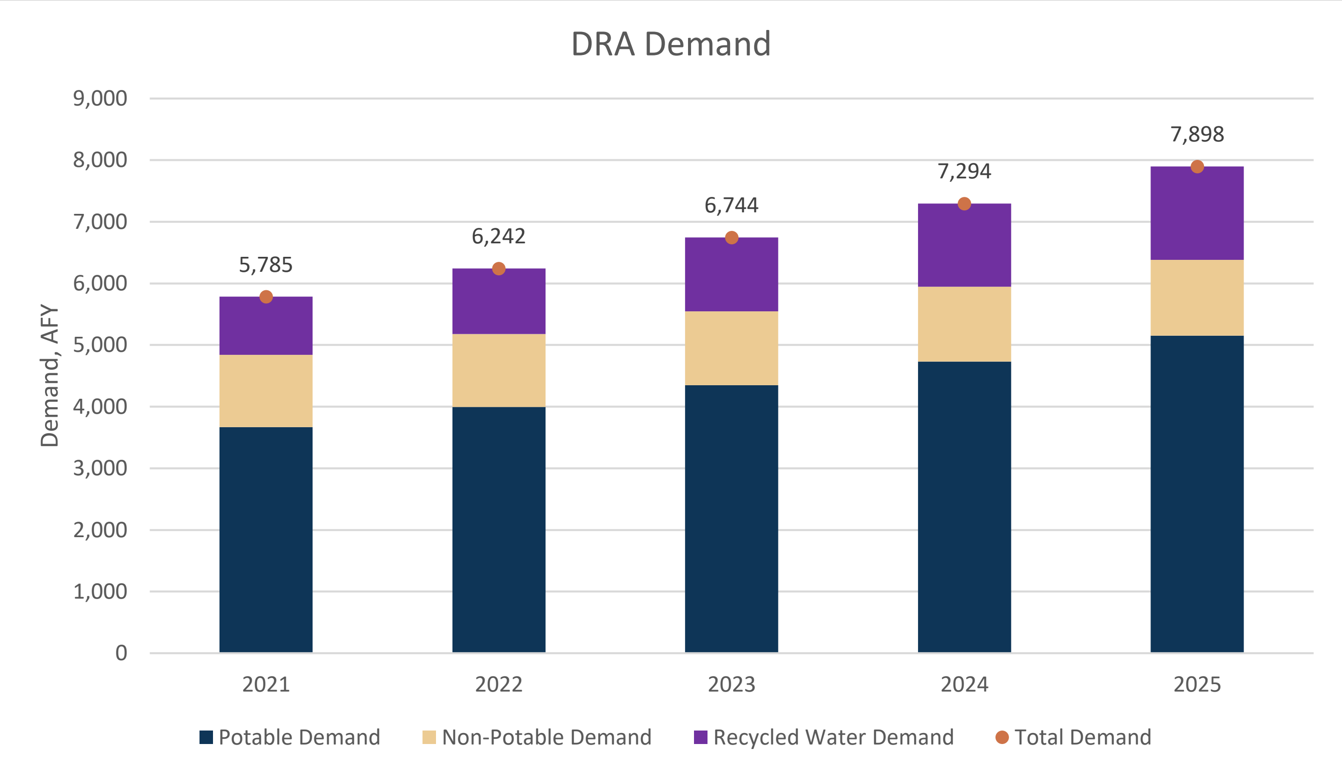

Figure 4-3. Demand for the Next Five Years, AFY

4.3 Water Use for Lower Income Households

SCAG has recently developed its 6th cycle Regional Housing Needs Assessment (RHNA) for its jurisdiction, which includes TVWD. TVWD falls within unincorporated Riverside County. SCAG identified nearly 17,000 very-low and low-income housing units, which account for 42% of the total housing within unincorporated Riverside County (Southern California Association of Governments, March 2021). However, it is estimated that households within TVWD have a median income of $108,934, and therefore fall within the above-moderate range identified in the Riverside County RHNA (Placeworks and Michael Baker International for the County of Riverside, July 2021). Based on this, it is likely that the portion of lower income households in the TVWD service area is lower than the 42% of total unincorporated areas in the county. However, since it is unknown where exactly the distribution of low-income housing occurs in unincorporated Riverside County, TVWD assumes the county wide value of 42% of single-family demands pertain to low-income households as a conservative estimate. The demands for all households, including lower income households, are included in the total demands are provided in Table 4-6 above.

Table 4-13. DWR 4-5R Inclusion in Water Use Projections

Are Future Water Savings Included in Projections? Refer to Appendix K of UWMP Guidebook.	No
Are Lower Income Residential Demands Included in Projections?	Yes

5

2020 URBAN WATER MANAGEMENT PLAN

SBX7-7 Baseline, Targets and 2020 Compliance

This section describes TVWD's urban water use targets, as required by the Water Conservation Bill of 2009 (Senate Bill x 7-7). TVWD's projected water use and water use efficiency goals surpass the Senate Bill x 7-7 water use efficiency targets as described in this section.

IN THIS SECTION

- Updated Calculations
- Baselines & Targets
- 2020 Compliance

Senate Bill x 7-7 (SBX7-7) was incorporated into the UWMP Act in 2009 and requires that all water suppliers increase water use efficiency with the overall goal to decrease per-capita water consumption within the state by 20 percent by the year 2020. SBX7-7 required DWR to develop certain criteria, methods, and standard reporting forms through a public process that could be used by water suppliers to establish their baseline water use and determine their water conservation targets. SBX7-7 and the Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use (SBX7-7 Guidebook) (California Department of Water Resources, February 2016) specify methodologies for determining the baseline water demand, 2015 interim urban water use target and the 2020 urban water use target for TVWD as described in the following sections. TVWD's 2015 interim water use target was calculated as 224 gallons per capita per day (GPCD) and the final 2020 target water was calculated as 199 GPCD. The baseline periods used to set average baseline gpcd and targets included the 10-year period from 1998 through 2007 and the 5-year period from 2003 through 2007.

5.1 Updated Calculations from 2015 UWMP to the 2020 UWMP

TVWD did not need to update its baseline or target calculations for the 2020 UWMP, as the service area has remained constant and there was no desire to update the SBX7-7 methodology for determining the 2020 target. The target method and baseline selected to develop the 2020 target are discussed below.

5.2 Baselines and Target Summary

TVWD utilized a 10-year baseline period from 1998 to 2007 and a five-year baseline period from 2003 to 2007 to determine the 2020 water use target. TVWD's baseline and 2020 target was calculated in the 2015 UWMP and has not changed for this plan. More details on the development of the baselines and target can be found in the 2015 UWMP. DWR provided four different methods to establish water conservation targets that are summarized in the 2015 UWMP. TVWD chose Method 1. To calculate the target using Method 1, 80% of the baseline daily per capita use was calculated (249 GPCD). Therefore, the 2020 target = 249*0.80 = 199 GPCD.

TVWD's final 2020 target water use was calculated as 199 GPCD, as shown in Table 5-1.

Table 5-1. DWR 5-1R Baselines and Targets Summary

BASELINE PERIOD	START YEAR	END YEAR	AVERAGE BASELINE GPCD*	CONFIRMED 2020 TARGET *
10-15 Year	1998	2007	249	199
5 Year	2003	2007	280	

*All values are in Gallons per Capita per Day (GPCD)

* All cells in this table are populated manually from the supplier's SBX7-7 Verification Form.

5.3 2020 Compliance Daily Per-Capita Water Use (GPCD)

The calculated usage for 2020 is 178 GPCD, which meets TVWD's target of 199 GPCD by 2020, as shown in Table 5-2. This is based on 2020 total potable water use of 3,370 AFY and a 2020 population estimate of 16,919 based on DWR's Population Tool. TVWD exceeded the 2020 target and achieved a 28% reduction in per capita water use.

Table 5-2. DWR 5-2R 2020 Compliance

ACTUAL 2020 GPCD*	OPTIONAL ADJUSTMENTS TO 2020 GPCD					2020 GPCD CONFIRMED TARGET GPCD	SUPPLIER ACHIEVED TARGETED REDUCTION IN 2020
	EXTRAORDINARY EVENTS*	ECONOMIC ADJUSTMENT*	WEATHER NORMALIZATION*	TOTAL ADJUSTMENTS*	ADJUSTED 2020 GPCD*		
178					178	199	Yes

6

2020 URBAN WATER MANAGEMENT PLAN

Water Supply Characterization

This section describes TVWD's water supplies. TVWD imports potable water through Western and provides local non-potable groundwater and recycled water within its service area.

IN THIS SECTION

- Water Supply Overview
- Water Supply Characterization
- Energy Intensity

6.1 Water Supply Overview

TVWD first began receiving imported water in 1992 and continues to fully rely on imported water to meet potable demands. Imported potable water is provided by Metropolitan through Western. Western, TVWD's wholesale supplier, delivers imported water through the Mills Gravity Line to TVWD's single turnout.

TVWD also provides non-potable groundwater to meet agricultural and irrigation demands. Non-potable groundwater is produced from the Bedford and Coldwater subbasins. TVWD has also invested in local recycled water to create a reliable, drought proof supply and decrease reliance on local, non-potable groundwater. TVWD prioritizes the use of recycled water whenever possible and supplements with non-potable groundwater when needed to meet irrigation demands. Any unused recycled water is percolated into the groundwater basin.

6.2 Water Supply Characterization

In this section, TVWD's various supplies are described in detail.

6.2.1 Purchased or Imported Water

TVWD receives all its potable water supply from Metropolitan through Western. Metropolitan was formed in 1928 to develop, store, and distribute water for domestic and municipal purposes to the residents of Southern California. Today, the Metropolitan service area stretches across the Southern California coastal plain, serves 26 member agencies, and includes portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties.

Metropolitan delivers supply to member agencies from two sources, the Colorado River Aqueduct (CRA), which it owns and operates, and the State Water Project (SWP), owned and operated by DWR. The supply mix provided to member agencies varies depending on the availability of SWP supplies, which varies every year, much more significantly than the Colorado River supply. During the recent drought, water allocations from the SWP were significantly reduced, leading to a greater proportion of Colorado River supplies in Metropolitan's supply mix. Additional information about Metropolitan and their water sources is provided in Metropolitan's 2020 UWMP.

Western imports water from Metropolitan through the Henry J. Mills Water Filtration Plant, where it is treated to potable quality then conveyed through the Mills Gravity Line to TVWD through the Temescal Valley Pipeline. TVWD has two separate meters for its single connection to the Mills Gravity Line called WR-27– a 24-inch diameter flow control valve and a 10-inch diameter bypass and sleeve valve assembly. This turnout has a rated capacity of 26 cubic feet per second (cfs), and TVWD owns 14.6 cfs of capacity. TVWD relies on imported water through Western to meet 100% of its potable demands and assumes a 10% potable supply buffer over the planning period. Figure 6-1 shows the infrastructure used to provide TVWD with imported water.

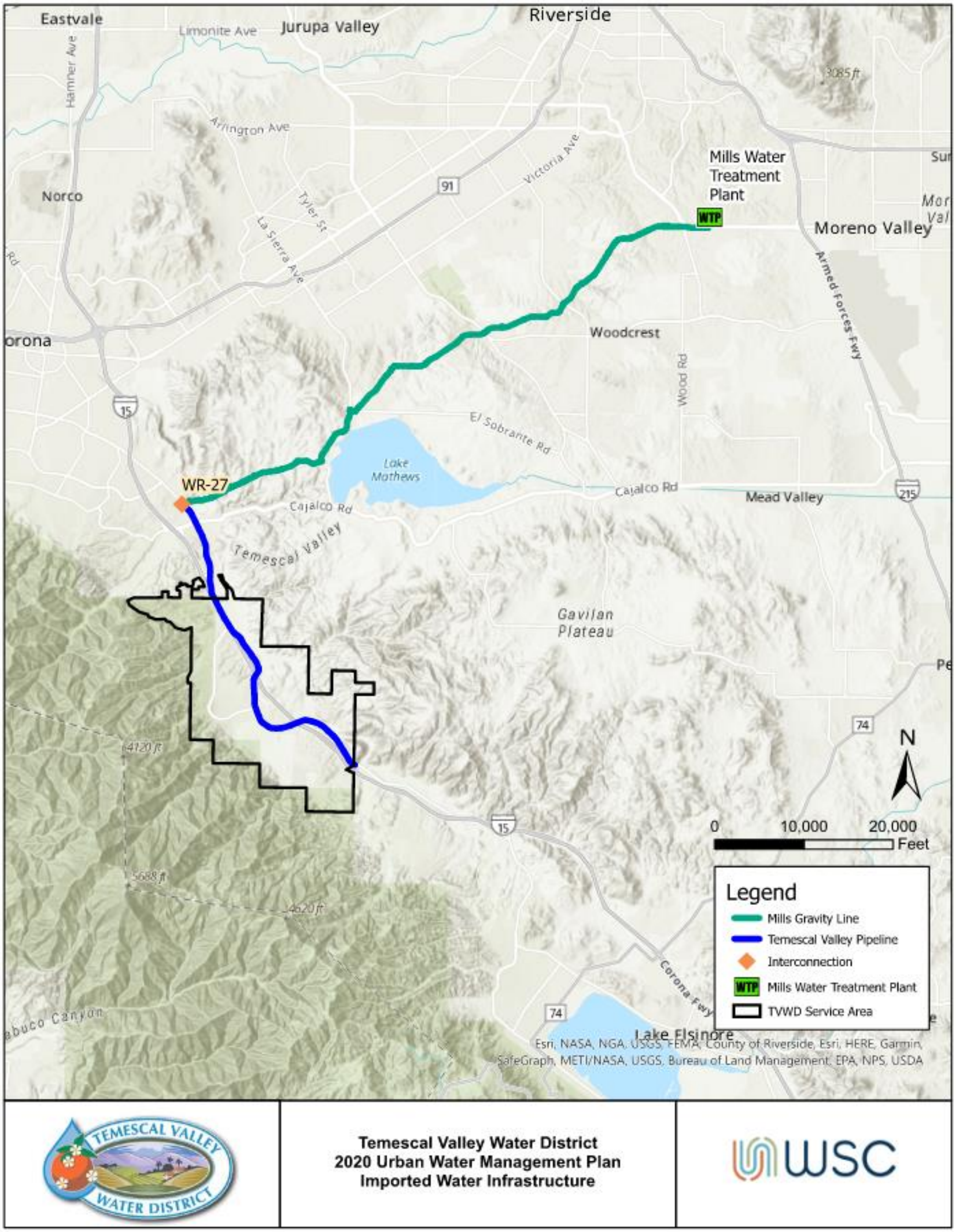

Figure 6-1. Imported Water Infrastructure

6.2.2 Groundwater

TVWD provides local groundwater from the Bedford-Coldwater Subbasin as a non-potable supply source. The Bedford-Coldwater subbasin is part of the Elsinore Basin, designated by DWR as Basin Number 8-004. The extents of the Bedford-Coldwater Subbasin and respective management zones are shown in Figure 6-2.

6.2.2.1 Basin Description

The Bedford-Coldwater Subbasin is the northernmost subbasin in the Elsinore Basin. In 2016, as part of compliance with the Sustainable Groundwater Management Act (SGMA), TVWD collaborated with EVMWD and the City of Corona to formally modify the Elsinore Basin boundary. This update partitioned the Elsinore Basin into two subbasins: the Elsinore Valley Subbasin and the Bedford-Coldwater Subbasin.

The Bedford-Coldwater Subbasin is separated from the Elsinore Valley Subbasin to the northwest by a groundwater divide near the Bedford Wash. The Bedford-Coldwater Subbasin is bounded by the Estelle Mountains to the east, the Santa Ana Mountains to the west, and the Elsinore Valley subbasin to the south (California Department of Water Resources).

TVWD is part of the Bedford-Coldwater Groundwater Sustainability Authority (BCGSA), which serves as the Groundwater Sustainability Agency (GSA) for the Bedford-Coldwater Subbasin, developed in response to the SGMA. DWR has classified the Bedford-Coldwater Subbasin as a very low priority basin, and at this time, it is not critically threatened by various factors that reduce reliability. However, the BCGSA has recently completed a groundwater sustainability plan to ensure that the Bedford-Coldwater Subbasin remains protected and continues to be a reliable water supply source.

Groundwater quality can vary in the Bedford-Coldwater Subbasin but is typically high in total dissolved solids (TDS) and sulfite. TDS ranges from 650 milligrams per liter (mg/L) to 900 mg/L, while sulfite generally ranges from less than 100 mg/L to over 450 mg/L. Although water quality testing is limited in these wells, they are known to have exceeded nitrate concentration limits for potable water (45 mg/l) (RMC and Woodard & Curran for Temescal Valley Water District, 2019).

The Bedford-Coldwater Subbasin is further divided into the Bedford Groundwater Management Zone (GMZ) and the Coldwater GMZ, as shown in Figure 6-2. TVWD owns and operates three wells within the Bedford GMZ, all of which are used to supply TVWD's recycled water system, and four wells within the Coldwater GMZ, all of which are used to supply TVWD's non-potable system.

6.2.2.2 Past Five Years

TVWD extracts groundwater from the Bedford-Coldwater Subbasin to meet non-potable demands and augment recycled water supply. Historical groundwater extractions from 2016 through 2020 are provided in Table 6-1.

Table 6-1. DWR 6-1R Groundwater Volume Pumped

GROUNDWATER TYPE	LOCATION OR BASIN NAME	2016	2017	2018	2019	2020
Alluvial Basin	Bedford-Coldwater Subbasin (Elsinore Basin)	1,020	1,933	1,874	1,656	1,842
-	**TOTAL:**	**1,020**	**1,933**	**1,874**	**1,656**	**1,842**

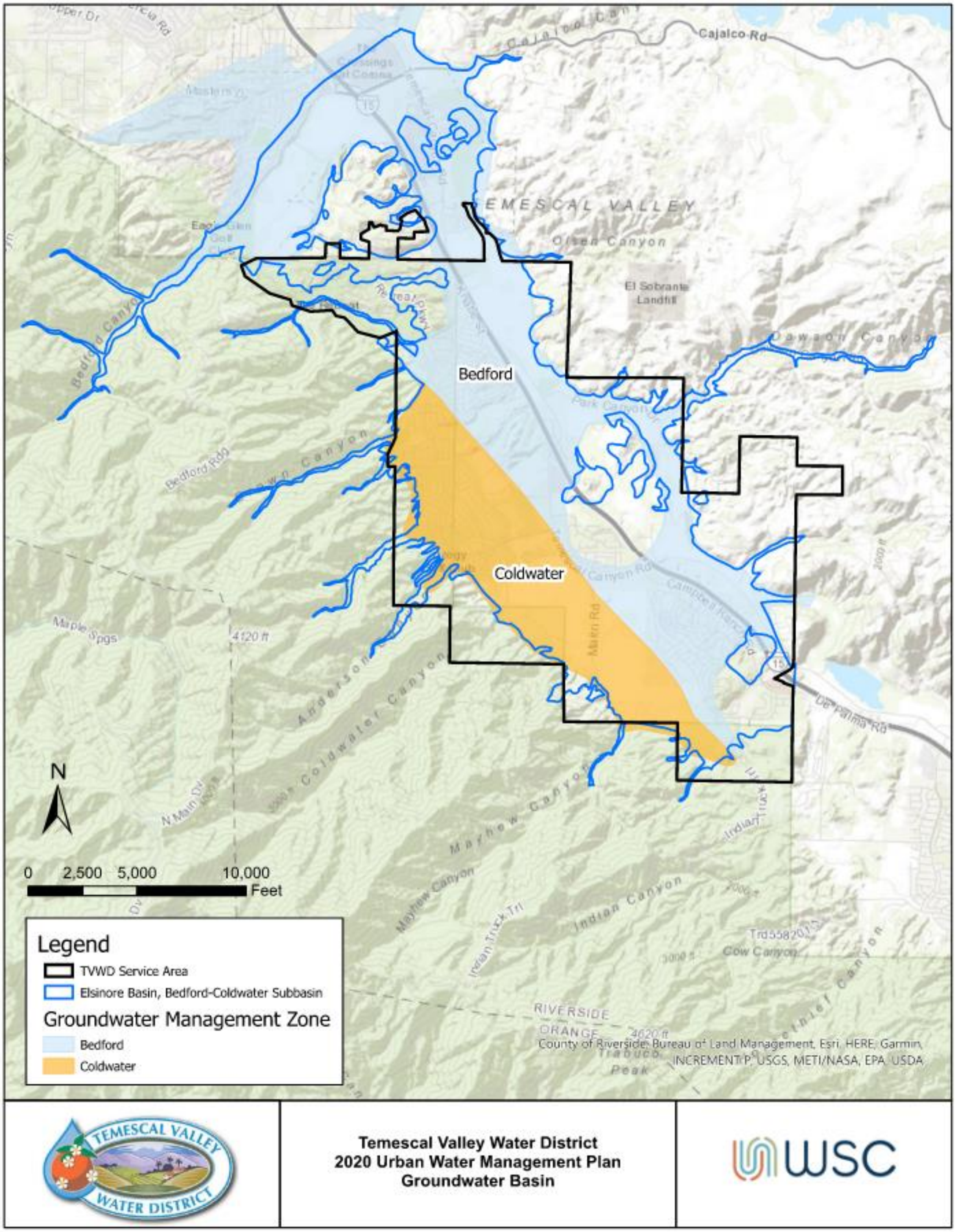

Figure 6-2. Groundwater Basins

6.2.3 Surface Water

TVWD does not utilize any surface water sources. Treated imported surface water is considered Imported Water and described in Section 6.2.1.

6.2.4 Stormwater

TVWD does not utilize any stormwater sources.

6.2.5 Wastewater and Recycled Water

TVWD owns and operates the Temescal Valley Water Reclamation Facility (TVWRF) that is used to supply recycled water throughout TVWD's recycled water system. TVWD's recycled water system is interconnected with the non-potable system and may be operated as a combined or split system. Recycled water use throughout TVWD's service area is regulated by the California Regional Water Quality Control Board (RWQCB) and TVWD is only permitted to use recycled water in the areas of their system that overlie the Bedford GMZ. Due to groundwater water quality constraints, TVWD cannot use recycled water in areas overlying the Coldwater GMZ. Recycled water generated from the TVWRF is treated to Title 22 standards.

6.2.5.1 Past Five Years

The TVWRF has produced an average of 1,145 AFY of recycled water from 2016 through 2020. Recycled water production over the last five years is provided in Table 6-2.

Table 6-2. Recycled Water Production 2016 – 2020

	2016	2017	2018	2019	2020
Recycled Water	1,047	1,115	1,121	1,138	1,302

6.2.5.2 Wastewater Collection, Treatment, and Disposal

TVWD's wastewater collection system conveys untreated wastewater to the TVWRF. The TVWRF was constructed in 1991 and produces approximately 1 million gallons per day (MGD) of recycled water. Currently, the TVWRF is being expanded to 2.25 MGD.

The TVWRF operates as an activated sludge treatment process, consisting of influent pumping, grit removal, and sequential batch reactors. The effluent is treated to the tertiary standard, consisting of rapid mix, flocculation, and sand filtration, followed by chlorine disinfection prior to release into the recycled water distribution system. At times when recycled water supplies cannot be used for irrigation, a portion of the recycled water generated may also be dechlorinated and percolated into the ground (Dudek for Temescal Valley Water District, November 2020). Table 6-3 and Table 6-4 summarize the amount of wastewater collected, treated, and discharged within TVWD in 2020.

Table 6-3. DWR 6-2R Wastewater Collected within Service Area in 2020

The supplier will complete the table.

Percentage of 2020 service area covered by wastewater collection system (optional):

Percentage of 2020 service area population covered by wastewater collection system (optional):

WASTEWATER COLLECTION			RECIPIENT OF COLLECTED WASTEWATER			
NAME OF WASTEWATER COLLECTION AGENCY	WASTEWATER VOLUME METERED OR ESTIMATED	WASTEWATER VOLUME COLLECTED FROM UWMP SERVICE AREA IN 2020	NAME OF WASTEWATER AGENCY RECEIVING COLLECTED WASTEWATER	WASTEWATER TREATMENT PLANT NAME	WASTEWATER TREATMENT PLANT LOCATED WITHIN UWMP AREA	WWTP OPERATION CONTRACTED TO A THIRD PARTY
Temescal Valley Water District	Estimated	1,302	Temescal Valley Water District	Temescal Valley Water Reclamation Facility	Yes	No
-	**TOTAL:**	**1,302**				

Table 6-4. DWR 6-3R Wastewater Treatment and Discharge within Service Area in 2020

The supplier will complete the table.

							2020 VOLUMES				
WASTEWATER TREATMENT PLANT NAME	DISCHARGE LOCATION NAME OR IDENTIFIER	DISCHARGE LOCATION DESCRIPTION	WASTEWATER DISCHARGE ID NUMBER	METHOD OF DISPOSAL	PLANT TREATS WASTEWATER GENERATED OUTSIDE THE SERVICE AREA	TREATMENT LEVEL	WASTEWATER TREATED	DISCHARGED TREATED WASTEWATER	RECYCLED WITHIN SERVICE AREA	RECYCLED OUTSIDE OF SERVICE AREA	INSTREAM FLOW PERMIT REQUIREMENT
Temescal Valley Water Reclamation Facility	Recycled water customers or Bedford GMZ	Landscape or groundwater disposal		Percolation ponds	No	Tertiary	1,302	1,147	155		
-						**TOTAL:**	**1,302**	**1,147**[1]	**155**	**-**	**-**

[1] All treated wastewater was discharged to percolation ponds in 2020.

6.2.5.3 Recycled Water System Description

TVWD provides recycled water using 8.3 miles of recycled water and non-potable water pipelines, seven (7) groundwater wells, and two (2) pump stations (Dudek for Temescal Valley Water District, November 2020).

As mentioned, the system can be operated in two modes: as a single, combined non-potable system supplied by groundwater wells only, or as separate non-potable and recycled water systems where the non-potable system serves only groundwater to the Coldwater GMZ and the recycled water system serves recycled water supplemented with non-potable groundwater to the Bedford GMZ. Typically, TVWD operates the system as a separate recycled water and non-potable system, and excess recycled water is percolated into the Bedford GMZ. When recycled water demands exceed supply availability, TVWD supplements the recycled water with non-potable groundwater (Dudek for Temescal Valley Water District, November 2020).

6.2.5.4 Potential, Current, and Projected Recycled Water Uses

Recycled water provided by TVWD is used by a limited number of customers, primarily those with large outdoor irrigation needs. TVWD anticipates future recycled water use will expand to additional customers as TVWD’s service area continues to develop. In addition, TVWD has approved recycled water for landscape irrigation (parks/playgrounds, golf courses, residential landscaping, commercial/industrial landscaping, freeway landscaping, open space/median strips), agricultural irrigation, construction dust control/compaction, industrial uses, commercial car washes, commercial laundries, fountains/water features, and sewer flushing/street sweeping uses. TVWD anticipates that of the approved uses, the bulk of its recycled water customers will use it for landscape irrigation. Currently, TVWD primarily projects recycled water to be used for irrigation or percolated into the ground, with minimal recycled water used for construction (approximately 4 AF). A breakdown of recycled water use in 2020 and projected future use is provided in Figure 6-3 and Table 6-5. TVWD’s RWMP projected recycled water demands at buildout, assumed to occur in 2030 (Dudek for Temescal Valley Water District, November 2020). As a result, demands after 2030 are assumed to remain constant. To project 2025 demand, a linear interpolation was applied between actual 2020 use and projected 2030 demand.

Recycled water availability is estimated to fluctuate seasonally; therefore, recycled water demands shown in this section may be met with supplemental non-potable groundwater sources. Table 6-6 provides a comparison of the 2020 projected recycled water use developed in the 2015 UWMP to actual 2020 use.

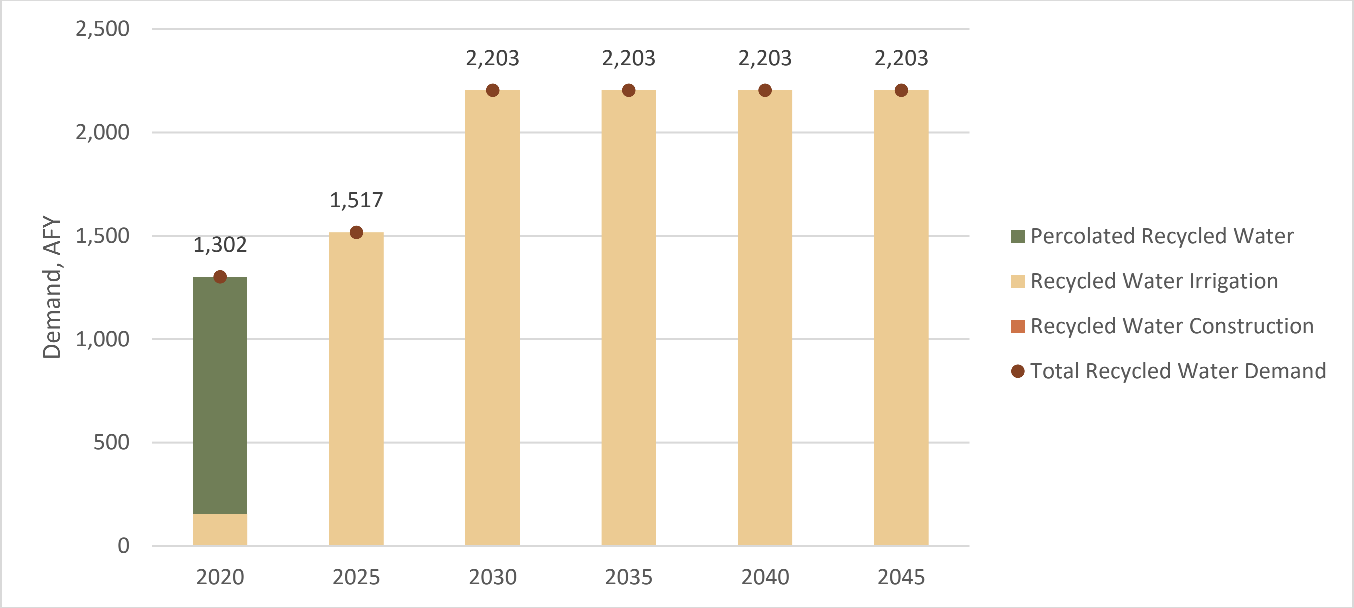

Figure 6-3. Current and Projected Recycled Water Demand

Figure represents total demand within the recycled water system, some of which may be met by non-potable groundwater due to seasonal recycled water availability.

Table 6-5. DWR 6-4R Recycled Water within Service Area in 2020

The supplier will complete the table.

Name of Supplier Producing (Treating) the Recycled Water:	Temescal Valley Water District
Name of Supplier Operating the Recycled Water Distribution System:	Temescal Valley Water District
Supplemental Volume of Water Added in 2020:	
Source of 2020 Supplemental Water:	Temescal Valley Water Reclamation Facility

BENEFICIAL USE TYPE	POTENTIAL BENEFICIAL USES OF RECYCLED WATER	AMOUNT OF POTENTIAL USES OF RECYCLED WATER	GENERAL DESCRIPTION OF 2020 USES	LEVEL OF TREATMENT	2020	2025	2030	2035	2040	2045
COMMERCIAL USE			Construction	Tertiary	-	2	4	4	4	4
LANDSCAPE IRRIGATION			Irrigation	Tertiary	155	1,515	2,199	2,199	2,199	2,199
OTHER			Percolated Recycled Water	Tertiary	1,147					
-				**TOTAL:**	**1,302**	**1,517**	**2,203**	**2,203**	**2,203**	**2,203**

Table 6-6. DWR 6-5R 2015 Recycled Water Use Projection Compared to 2020 Actual

The supplier will complete the table.

BENEFICIAL USE TYPE	2015 PROJECTION FOR 2020	2020 ACTUAL USE
AGRICULTURAL IRRIGATION		
LANDSCAPE IRRIGATION (EXCLUDES GOLF COURSES)	977	155
GOLF COURSE IRRIGATION	899	
COMMERCIAL USE		
INDUSTRIAL USE	20	
GEOTHERMAL AND OTHER ENERGY PRODUCTION		
SEAWATER INTRUSION BARRIER		
RECREATIONAL IMPOUNDMENT		
WETLANDS OR WILDLIFE HABITAT		
GROUNDWATER RECHARGE (IPR)*		
SURFACE WATER AUGMENTATION (IPR)*		
DIRECT POTABLE REUSE		
OTHER	181	1,147[1]
TOTAL:	**2,077**	**1,302**

[1] Percolated recycled water.

6.2.5.5 Actions to Exchange and Optimize Future Recycled Water Use

TVWD's recycled water policy mandates the use of recycled water where feasible, and future developments are anticipated to include dual plumbing or otherwise be designed to maximize use of recycled water where feasible. As a result, new developments are allocated recycled water for irrigation during the approval process (Dudek for Temescal Valley Water District, November 2020). The expected increase of recycled water use by 2025 was estimated by comparing the projected use in 2025 to current 2020 use from Table 6-5.

Table 6-7. DWR 6-6R Methods to Expand Future Recycled Water Use

The supplier will complete the table below.

NAME OF ACTION	DESCRIPTION	PLANNED IMPLEMENTATION YEAR	EXPECTED INCREASE OF RECYCLED WATER USE, AFY
Future Development	Future development anticipated to include dual plumbing systems and require recycled water for irrigation.	2021	521

6.2.6 Desalinated Water Opportunities

TVWD does not currently use desalinated water nor anticipate any desalinated water opportunities.

6.2.7 Water Exchanges and Transfers

TVWD does not currently exchange or transfer any water to other water agencies. TVWD has an emergency intertie with EVMWD and another with the City of Corona, for use if necessary.

6.2.8 Future Water Projects

At this time, TVWD does not anticipate any future water projects that will increase its potable supply. However, TVWD plans to construct an additional well to increase supply for its recycled water/non-potable system, as summarized in Table 6-8 (Dudek for Temescal Valley Water District, November 2020).

Table 6-8. DWR 6-7R Expected Future Water Supply Projects or Programs

NAME OF FUTURE PROJECTS OR PROGRAMS	JOINT PROJECT WITH OTHER SUPPLIERS	AGENCY NAME	DESCRIPTION	PLANNED IMPLEMENTATION YEAR	PLANNED FOR USE IN YEAR TYPE	EXPECTED INCREASE IN WATER SUPPLY TO SUPPLIER, AFY
300 gpm Groundwater Well and appurtenances	No		Increased non-potable supply		All Year Types	Up to 483

6.2.9 Summary of Existing and Planned Sources of Water

TVWD utilizes imported potable water and local non-potable water and recycled water to meet its customer’s demands. TVWD anticipates continuing to use these sources well into the future. Table 6-9 summarizes the amount of water used by each source and Table 6-10 summarizes projected future supply by source.

Table 6-9. DWR 6-8R Actual Water Supplies

		2020	
WATER SUPPLY	ADDITIONAL DETAIL ON WATER SUPPLY	ACTUAL VOLUME, AFY	WATER QUALITY
Purchased or Imported Water	Western	3,370	Drinking Water
Groundwater (not desalinated)		1,843	Other Non-Potable Water
Recycled Water		1,302	Recycled Water
-	**TOTAL:**	**6,515**	

Table 6-10. DWR 6-9R Projected Water Supplies

		PROJECTED WATER SUPPLY, AFY				
		2025	2030	2035	2040	2045
WATER SUPPLY	ADDITIONAL DETAIL ON WATER SUPPLY	REASONABLY AVAILABLE VOLUME	REASONABLY AVAILABLE VOLUME	REASONABLY AVAILABLE VOLUME	REASONABLY AVAILABLE VOLUME	REASONABLY AVAILABLE VOLUME
Purchased or Imported Water[1]	Western	5,671	6,411	6,411	6,411	6,411
Groundwater (not desalinated)[2]		1,363	1,779	1,779	1,779	1,779
Recycled Water[3]		1,992	2,099	2,099	2,099	2,099
-	**TOTAL:**	**9,026**	**10,289**	**10,289**	**10,289**	**10,289**

[1] 2025 and buildout demand identified in WMP as planned development with a 10% buffer. Buildout assumed to occur in 2030 and held constant over the planning period.

[2] Projected groundwater needs to meet non-potable demand or augment recycled water supply.

[3] Recycled water supply based on RWMP.

6.2.10 Special Conditions

6.2.10.1 Climate Change Effects

As part of this UWMP, TVWD considered the impacts of climate change on future water supplies and demands and water supply reliability. There are several studies that evaluate the potential impacts of climate change within the region.

Santa Ana Watershed Basin Study

The Santa Ana Watershed Project Authority (SAWPA) and the United States Bureau of Reclamation (USBR) completed the Santa Ana Watershed Basin Study (Basin Study) in 2013 as a complementary study to SAWPA's Integrated Regional Water Management planning process for the Santa Ana Watershed. As part of the Basin Study, USBR prepared a Climate Change Analysis for the Santa Ana River Watershed, included as Appendix E. The analysis evaluated frequently asked questions reading impacts to climate change on the Santa Ana River Watershed. The key findings most relevant to water supply reliability are (U.S Department of the Interior Bureau of Reclmanation, August 2013):

- 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;
- More precipitation will fall as rain instead of snow;
- 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 recharge will be required to maintain current groundwater levels.

Metropolitan 2020 UWMP

In its 2020 UWMP, Metropolitan addresses the uncertainties of climate change on water supply planning, identifying several areas of concern:

- Reduction in Sierra Nevada snowpack;
- Increased intensity and frequency of extreme weather events;
- Prolonged drought periods;
- Water quality issues associated with increase in wildfires;
- Changes in runoff pattern and amount; and
- Rising sea levels resulting in:
  - Impacts to coastal groundwater basins due to seawater intrusion;
  - Increased risk of damage from storms, high-tide events, and the erosion of levees; and
  - Potential pumping cutbacks on the SWP

Hydrologic variability, potential climate change, and regulatory risk are embedded in Metropolitan's modeling efforts. Metropolitan's modeling utilizes historical hydrologic conditions from 1992 to 2017 to simulate expected demands on Metropolitan supplies, as well as capacities and constraints of its storage facilities and supply program. The Water Reliability Assessment and the Drought Risk Assessment in Metropolitan's Draft 2020 UWMP demonstrates that Metropolitan is able to mitigate the challenges posed by hydrologic variability, potential climate change, and regulatory risk on its imported supply sources through the significant storage capabilities it has developed over the last two decades, both dry-year and emergency storage (Metropolitan Water District of Southern California, 2021).

Metropolitan's 2020 IRP, which is currently under development, is further addressing ways to account for and mitigate the uncertainties associated with climate change.

Western Drought Contingency Plan – Climate Change Vulnerability Assessment

TVWD is currently participating in a Drought Task Force as part of Western's effort to develop a regional Drought Contingency Plan (DCP). As part of the ongoing DCP, a Climate Change Vulnerability Assessment (CCVA) for Western's service area (which includes TVWD) was prepared to improve the understanding of climate change impacts on future water demand and local water supplies within Western's wholesale service area during normal and drought periods (GEI Consultants, April 2021). The CCVA technical memorandum provides details on the climate model data sources, climate analysis approach, calculation of the various supply and demand change factors.

DWR has developed statewide climate change datasets for use in water resource planning that depict climate conditions in California under historical and future climate conditions. The DWR climate data used in the CCVA was assembled from 20 global climate models, to best represent anticipated climate conditions in California. The CCVA analysis was based on the median projected change from the majority of the selected climate models. DWR's California specific data is broken down into grid cells that are approximately 1/16th degree (approximately 3.75 miles) for the entire state. Each grid cell contains monthly time series based on 1915 to 2011 used to forecast future precipitation and evapotranspiration (ET) under 2030 and 2070 climate conditions.

Based on the timeseries data, climate change factors pertaining to supply and demand for normal, single dry, and 5-year dry periods were determined. The change factors represent the ratio of a simulated future value to the corresponding simulated historical value. The time series for precipitation and corresponding change factor can be used to estimate changes in supply while the time series for evapotranspiration and corresponding change factor can be used to estimate changes in demand. The results of the CCVA show:

- Decreases in water supplies from the Santa Ana and Santa Margarita River basins under normal and drought conditions
- Decreases in precipitation and increases in surface water evaporation resulting from increased temperatures
- Smaller decreases in precipitation and natural groundwater recharge under normal and multi-year drought conditions. Results for a single-dry year anticipate slightly wetter future conditions compared to the 2020 baseline
- Precipitation will occur during shorter rainy seasons at a higher intensity
- Increases in outdoor water use under normal and drought conditions resulting from increased temperatures and higher ET rates

As part of the ongoing DCP development, Western plans to analyze the extreme climate scenarios developed by DWR to characterize the range of potential impacts of climate change for the purposes of developing drought response and mitigation measures for the DCP, which will be completed in 2022.

Climate change can also impact water resources indirectly. For example, wildfire hazards are projected to increase in southern California with climate change. Wildfires can impact water resources by increasing water requirements for firefighting, changing surface vegetation and runoff patterns in burn areas, causing debris flows, and increasing siltation of reservoirs and hydraulic structures.

6.2.10.2 Other Locally Applicable Criteria

As mentioned above, the BCGSA has recently completed a GSP for the Bedford-Coldwater Subbasin in accordance with SGMA. TVWD will continue to actively participate in the GSP effort to ensure coordination between basin users and the reliability of local groundwater.

6.3 Energy Intensity

TVWD monitors energy usage at its facilities. In 2020, TVWD utilized approximately 1.4 million kilowatts (kW) of energy to provide imported potable water throughout its service area through various booster pumps and extract non-potable groundwater. Energy used upstream of TVWD's turnout to convey and treat imported water is not included in this analysis. It is estimated that TVWD's energy intensity is 268.6 kWH/AF, as shown in Table 6-11.

Table 6-11. DWR O-1B Recommended Energy Reporting - Total Utility Approach

URBAN WATER SUPPLIER:	Temescal Valley Water District			
Water Delivery Product (If delivering more than one type of product use Table O-1C): Multiple Products (unable to use table O-1C)				
ENTER START DATE FOR REPORTING PERIOD	1/1/2020	**URBAN WATER SUPPLIER OPERATIONAL CONTROL**		
END DATE	12/30/2020			
		SUM OF ALL WATER MANAGEMENT PROCESSES	**NON-CONSEQUENTIAL HYDROPOWER**	
Water Volume Units Used: AF		**TOTAL UTILITY**	**HYDROPOWER**	**NET UTILITY**
Volume of Water Entering Process (AF)		5,212	0	5,212
Energy Consumed (kWh)		1,400,000	0	1,400,000
ENERGY INTENSITY (KWH/AF)		**268.6**	**0.0**	**268.6**
Quantity of Self-Generated Renewable Energy:				
Data Quality (Estimate, Metered Data, Combination of Estimates and Metered Data): Estimate				
Data Quality Narrative:				
Narrative: Energy usage reflects energy used to boost imported potable water throughout TVWD's service area and energy used to produce non-potable groundwater. Energy usage is estimated based on total energy cost and a factor of $0.08/AF. Energy used to produce or convey recycled water is not included in this analysis.				

7

2020 URBAN WATER MANAGEMENT PLAN

Water Service Reliability and Drought Risk Assessment

This chapter describes the reliability of TVWD's water supplies, both potable and non-potable. The essential findings are that TVWD can reliably meet its customer's demands based on demand and supply projections, including during a 5-year drought.

This chapter analyzes TVWD's water supply reliability for a normal, single dry year, and multiple-dry years through 2045, followed by a Drought Risk Assessment for 2021 to 2025.

TVWD has also prepared a comprehensive Water Shortage Contingency Plan to provide reliability in the event of a water shortage, presented in Appendix F.

IN THIS SECTION

- Water Service Reliability Assessment
- Drought Risk Assessment

7.1 Water Service Reliability Assessment

This section describes constraints to TVWD's water supply and includes an analysis of TVWD's supply reliability.

7.1.1 Constraints on Water Sources

As described in Chapter 6, TVWD has several supply sources available (imported water, local groundwater, and recycled water) to meet customer demands during normal, single-dry, and multiple-dry years. These supply sources may be impacted by climatic and hydrologic conditions, water quality, and legal restrictions, as well as the potential for interruption of supply driven by catastrophic events.

7.1.1.1 Imported Water Supply Reliability

TVWD imports water from Metropolitan through Western to meet 100% of its potable demands; therefore, TVWD's imported water supply reliability mimics that of Western and Metropolitan's 2020 UWMP analysis. Metropolitan described several challenges in providing adequate, reliable, and high-quality supplemental water supplies along with potential management measures in the Metropolitan 2020 UWMP. Potential constraints to Metropolitan's supplies and associated supply reliability include:

Drought

The water conditions that the region faced leading up to 2020 were characterized by alternating scarcity and abundance. While investments in storage and flexible operations have prepared Metropolitan to capitalize on available supplies in wet years and manage through drought years, drought challenges remain. The Colorado River Basin has historically experienced large swings in annual hydrologic conditions and has exhibited a drying trend over the last 21 years. Changes in this period have been mitigated by actions taken by Metropolitan in cooperation with the Bureau of Reclamation and the other Basin States to maintain system storage, avoiding a shortage declaration. At the close of 2020, however, system storage was at or near its lowest since 2000, so there is less water available to buffer future dry conditions. The Sacramento-San Joaquin Delta (Bay-Delta) has suffered reduced flows and rising temperatures and SWP supplies have been significantly reduced at times, with a record low allocation of 5 percent in 2014 and again in 2021. It is anticipated that 2022 may be another dry year. Metropolitan plans to utilize stored water and Colorado River supplies to meet customer demands for the remainder of 2021 and the beginning of 2022. As part of proactive management, Metropolitan continues to plan for dry years and explore efforts to access emergency supplies. Possible solutions include accessing DWR's emergency supplies in southern SWP reservoirs and replenish these reservoirs once allocations are available again, temporarily treat and use stored groundwater along the California Aqueduct, and continued water conservation efforts (Adel Hagekhalil, Metropolitan Water District of Southern California, 2021).

Environmental/Ecological Needs (Operational Constraints)

Sensitive species in the Bay-Delta system require base flows for survival; these flows are threatened by drought and other factors, reducing the volume of water available for pumping to the SWP. As species become further stressed, environmental demands on Bay-Delta water may increase. Operational constraints will likely continue until a long-term solution to the problems in the Bay-Delta is identified and implemented.

Climate Change

Climate change is anticipated to increase the frequency and intensity of droughts and flooding, reduce Sierra Nevada snowpack, change runoff pattern and amount, raise average temperatures, and raise sea levels. These effects may reduce the availability of supplies in the Bay-Delta and Colorado River systems. Sea level rise poses a significant challenge to the salt balance in the Bay-Delta and could result in pumping restrictions. Sea level rise also increases the vulnerability of the Bay-Delta supply to seismic events.

Threats to Infrastructure

Metropolitan's imported supplies must travel across large distances to reach turnouts where local agencies are able to access the water. California is a seismically active state and prone to wildfires, which could damage imported water infrastructure anywhere along the SWP or Colorado River Aqueduct in such a manner as to disrupt supply availability. California is also a large state with a large economy, housing some major industries and defense installations. This makes it a potential target for acts of terrorism, including potential threats to its water supplies and infrastructure.

Water Quality

Water quality challenges, such as salinity, algae toxins, disinfection byproduct precursors, nutrients, and the identification of constituents of emerging concern, have the potential to impact imported water supplies. To date, Metropolitan has not identified any water quality risks that cannot be mitigated. Salinity, particularly Colorado River supplies, is a significant issue, but Metropolitan anticipates the only constraint will be the need to blend Colorado River water with SWP supplies to meet salinity needs.

Metropolitan's 2020 UWMP describes a variety of past and ongoing actions to address these water supply challenges to maintain water reliability within its service area. Metropolitan's proactive measures include:

Continued Water Conservation

Metropolitan supports financial incentives, education, outreach programs and appliance/plumbing standards at both the regional and local level. Metropolitan also works with member and local agencies, including Western, to help identify opportunities and procure grant funding for conservation programs.

Increasing Local Resources

Since 1982, Metropolitan has assisted local agencies in the development of water recycling and groundwater recovery under the Local Resources Program (LRP). The LRP program has been expanded to provide incentives for on-site recycled water retrofit costs and development of other water resources including seawater desalination and stormwater.

Augmenting Water Supplies

Augmenting water supplies through water transfers and exchanges is an element of Metropolitan's Integrated Resources Plan (IRP) to mitigate water shortages during dry periods.

Increasing Storage Programs

Metropolitan has a number of storage programs with water agencies along the California Aqueduct that would allow it to store SWP supplies during surplus conditions and to have stored water returned when needed. Metropolitan has invested in infrastructure to allow more effective use of stored water when needed and has also developed additional storage programs.

Modifying Metropolitan’s Distribution System

Driven by the historic low SWP allocation in 2014, Metropolitan and several member agencies have made operational and system modifications to enhance operational flexibility and efficient delivery of Colorado River, SWP, and in-region supplies within Metropolitan’s service area. Within Western’s service area, the Inland Feeder-Lakeview Pipeline Intertie, which was completed in 2016 and allows for delivery of water from Diamond Valley Lake to Mills WTP, increases Western’s imported water supply reliability. This intertie enables the Mills WTP to withstand an extended interruption of supplies from the California Aqueduct East Branch. The intertie also provides delivery flexibility to handle any required repairs by DWR to the Santa Ana Valley Pipeline north segment.

Implementing Shortage Response Actions (when needed)

Metropolitan developed a Water Shortage Contingency Plan (WSCP) to be consistent with elements of the existing Metropolitan Water Surplus and Drought Management Plan (WSDM) and Water Supply Allocation Plan (WSAP). If needed, Metropolitan will implement shortage response actions to distribute limited imported supplies and preserve storage reserves.

Pursuing Long-term Solutions in the Bay-Delta

Metropolitan adopted a Delta action plan in June 2007 that includes a long-term Delta Plan. The long-term action plan recognizes three basic elements that must be addressed: Delta ecosystem restoration, water supply conveyance, and flood control protection and storage development.

Maintaining Water Quality

Metropolitan responds to water quality concerns by protecting the quality of the source water, developing water management programs that maintain and enhance water quality, and changing water treatment protocols or blending.

Planning for Climate Change

In addition to many other activities related to climate change, Metropolitan is currently developing an updated 2020 Integrated Resources Plan (IRP), which recognizes risks and uncertainties from climate change and other sources. Metropolitan has established an intensive, comprehensive technical process to identify key vulnerabilities to regional reliability, including climate change. This Robust Decision Making (RDM) approach was used with both the 2015 and 2010 IRP Updates. This methodology can show how vulnerable the region’s reliability is to longer-term risks such as climate change and can also establish “signposts” that can be monitored to see when critical changes may be happening.

This integrated planning effort has resulted in the following documents:

1996, 2004, 2010, 2015, and 2020 Integrated Resources Plans (IRP)

Metropolitan’s IRP process assessed potential future regional demand projections based upon anticipated population and economic growth as well as conservation potential. The IRP also includes regional supply strategies and implementation plans to better manage resources, meet anticipated demand, increase overall system reliability, and adapt to the effects of climate change. Metropolitan is currently preparing the 2020 IRP.

1999 Water Surplus and Drought Management Plan

The Water Surplus and Drought Management Plan provides the policy guidance to manage the region's water supplies by integrating the operating activities of supply surplus and shortage to achieve the reliability goals of the IRP.

7.1.1.2 Groundwater Supply Reliability

Groundwater from the Bedford-Coldwater Subbasin is high in TDS and sulfites and is therefore only used for non-potable applications in conjunction with recycled water. The Bedford-Coldwater subbasin is classified by DWR as a very low-priority basin under SGMA. However, to ensure reliability, the BCGSA has recently completed a GSP to maintain sustainability within the region.

Some potential constraints to groundwater supply reliability include:

Drought

The effects of a local drought are not immediately recognized since the local groundwater basins have storage capacity to support continued use during dry periods. However, groundwater supply availability does become threatened when long term recharge and inflow decreases.

Overdraft

Under extended supply pressures, groundwater basins can enter overdraft conditions, which can have a series of consequences including subsidence. Overdraft can also exacerbate or create water quality issues by reducing the assimilative capacity of the basin or requiring wells to tap into lower quality water that may be present in other parts of the basin. Because of the very low priority designation and BCGSA efforts, it is not expected that the Bedford-Coldwater subbasin will experience overdraft in the future. The GSP concludes that despite the various outflows, the Bedford-Coldwater subbasin is expected to have a positive change in storage under future conditions. Future increases in storage are anticipated to result from effective groundwater management and increased imported water use in the subbasin (Todd Groundwater, H&H Water Resources, & Stantec, November 2021).

Climate Change

Climate change could increase the potential for overdraft by increasing demand, reducing other sources of supply, and reducing natural recharge and inflows from surface water and precipitation.

Regional Growth

Population growth could increase demands on groundwater supplies, potentially creating risk of overdraft. Regional growth could also increase the amount of contaminants entering groundwater basins, either as a result of increased urban runoff or industrial or other activities. Growth can also impact recharge areas by expanding impervious surfaces into areas that would otherwise represent entry points for surface water recharging local aquifers.

Water Quality

Some water quality issues are naturally occurring, while others are a result of human actions. Decreased quality of groundwater poses threats to supplies that can be mitigated but require additional costs to treat. Currently, groundwater is used for non-potable applications only and the quality is suitable for the locations and use types and treatment is not required.

Due to the availability of groundwater storage and the sustainable management practices, TVWD's groundwater supply is generally considered reliable, even in the face of the constraints identified here.

7.1.1.3 Recycled Water Supply Reliability

TVWD's recycled water supply is not expected to be affected by climatic factors because source wastewater flows coming from indoor use are generally not impacted by temperature and precipitation. Recycled water supplies will increase with growth; however, reduced urban water use standards currently under development could result in reduced recycled water supplies.

7.1.2 Water Service Reliability

This section presents TVWD's expected water supply reliability for a normal year, single dry year, and five consecutive dry years, including projections for 2025, 2030, 2035, 2040, and 2045.

7.1.2.1 Year Type Characterization

The water service reliability and Drought Risk Assessment analyze supply over several water years: normal, single dry, and multiple dry years. Local groundwater and recycled water supplies are not expected to change under the various year types, so TVWD has elected to use the same years identified in Metropolitan's, and subsequently Western's, UWMPs for normal, single-dry, and multiple-dry years for both imported and local supplies in this analysis. DWR defines these years as:

Normal Year

This represents the water supplies a supplier considers available during normal conditions. This could be a single year or averaged range of years that most closely represents the average water supply available. Metropolitan uses an average from 1922 to 2017 to establish normal year supply availability.

Single Dry Year

The single dry year is recommended to be the year that represents the lowest water supply available. Metropolitan has identified 1977 as the single driest year.

Five-consecutive Dry Year

This represents the driest five-year historical sequence for the Supplier, which may be the lowest average water supply available for five years in a row. Metropolitan has identified 1988 through 1992 as the greatest 5-year drought period.

TVWD demands are assumed to be consistent during normal years, single dry, and multiple dry years. As discussed in Chapter 6, TVWD may purchase additional imported water from Western, if needed. A summary of the various water year scenarios, base years, and percent of average supply are provided in Table 7-1. Results of the water service reliability assessment are provided in Table 7-2 through Table 7-10.

Table 7-1. DWR 7-1R Basis for Water Year Data (Reliability Assessment)

Quantification of available supplies is provided in this table as either volume only, percent only, or both.

-		AVAILABLE SUPPLY IF YEAR TYPE REPEATS
YEAR TYPE	**BASE YEAR**	**PERCENT OF AVERAGE SUPPLY**
Average Year	1922 - 2017	100%
Single-Dry Year	1977	100%
Consecutive Dry Years 1st Year	1988	100%
Consecutive Dry Years 2nd Year	1989	100%
Consecutive Dry Years 3rd Year	1990	100%
Consecutive Dry Years 4th Year	1991	100%
Consecutive Dry Years 5th Year	1992	100%

Applies to both imported and local supplies.

7.1.2.2 Water Service Reliability Analysis

Normal supply and demand projections were developed in Chapter 4 and Chapter 6 and form the basis of this reliability analysis. Due to TVWD's conservation program, demands are assumed to be consistent in normal, single dry and multiple dry years.

As described in this UWMP, TVWD uses imported water from Western to meet 100% of its potable demands. The primary constraint on the availability of imported water supplies has been in extreme drought conditions. As described above, Metropolitan has made substantial investments to increase imported water supply reliability during periods of extended drought. As a result, Metropolitan's 2020 UWMP projects the ability to meet all imported water demands under normal, single dry year, and multiple dry year conditions. Western is not limited to a particular volume of imported water and Metropolitan's 2020 UWMP shows a substantial surplus of supplies under all conditions. Therefore, Western's 2020 UWMP also shows the ability to meet all imported demands in all year types and states that Western expects to have access to additional imported water supplies to provide to its wholesale customers, including TVWD, if needed.

Local groundwater and recycled water supplies are not expected to be reduced in dry years.

The reliability assessment for each year type and supply sources is presented in the following sections.

Water Service Reliability – Normal Year

Table 7-2. DWR 7-2R Normal Year Supply and Demand Comparison

	2025	2030	2035	2040	2045
Supply Totals From Table 6-9R	9,026	10,289	10,289	10,289	10,289
Demand Totals From Table 4-3R	7,898	9,441	9,441	9,441	9,441
DIFFERENCE:	**1,128**	**848**	**848**	**848**	**848**

Table 7-3. DWR 7-2R Normal Year Supply and Demand Comparison: Potable

	2025	2030	2035	2040	2045
Supply Totals From Optional Table 6-9R	5,671	6,411	6,411	6,411	6,411
Demand Totals From Optional Table 4-3R	5,155	5,828	5,828	5,828	5,828
DIFFERENCE:	**516**	**583**	**583**	**583**	**583**

Table 7-4. DWR 7-2R Normal Year Supply and Demand Comparison: Non-Potable

	2025	2030	2035	2040	2045
Supply Totals From Optional Table 6-9R	3,355	3,878	3,878	3,878	3,878
Demand Totals From Optional Table 4-3R	2,743	3,613	3,613	3,613	3,613
DIFFERENCE:	**612**	**265**	**265**	**265**	**265**

Water Service Reliability – Single Dry Year

Table 7-5. DWR 7-3R Single Dry Year Supply and Demand Comparison

	2025	2030	2035	2040	2045
Supply Totals	9,026	10,289	10,289	10,289	10,289
Demand Totals	7,898	9,441	9,441	9,441	9,441
DIFFERENCE:	**1,128**	**848**	**848**	**848**	**848**

Table 7-6. DWR 7-3R Single Dry Year Supply and Demand Comparison: Potable

	2025	2030	2035	2040	2045
Supply Totals	5,671	6,411	6,411	6,411	6,411
Demand Totals	5,155	5,828	5,828	5,828	5,828
DIFFERENCE:	**516**	**583**	**583**	**583**	**583**

Table 7-7. DWR 7-3R Single Dry Year Supply and Demand Comparison: Non-Potable

	2025	2030	2035	2040	2045
Supply Totals	3,355	3,878	3,878	3,878	3,878
Demand Totals	2,743	3,613	3,613	3,613	3,613
DIFFERENCE:	**612**	**265**	**265**	**265**	**265**

Water Service Reliability – Five Consecutive Dry Years

Table 7-8. DWR 7-4R Multiple Dry Years Supply and Demand Comparison

		2025	2030	2035	2040	2045
First Year	Supply Totals	9,026	10,289	10,289	10,289	10,289
	Demand Totals	7,898	9,441	9,441	9,441	9,441
-	**DIFFERENCE:**	**1,128**	**848**	**848**	**848**	**848**
Second Year	Supply Totals	9,026	10,289	10,289	10,289	10,289
	Demand Totals	7,898	9,441	9,441	9,441	9,441
-	**DIFFERENCE:**	**1,128**	**848**	**848**	**848**	**848**
Third Year	Supply Totals	9,026	10,289	10,289	10,289	10,289
	Demand Totals	7,898	9,441	9,441	9,441	9,441
-	**DIFFERENCE:**	**1,128**	**848**	**848**	**848**	**848**
Fourth Year	Supply Totals	9,026	10,289	10,289	10,289	10,289
	Demand Totals	7,898	9,441	9,441	9,441	9,441
-	**DIFFERENCE:**	**1,128**	**848**	**848**	**848**	**848**
Fifth Year	Supply Totals	9,026	10,289	10,289	10,289	10,289
	Demand Totals	7,898	9,441	9,441	9,441	9,441
-	**DIFFERENCE:**	**1,128**	**848**	**848**	**848**	**848**

Table 7-9. DWR 7-4R Multiple Dry Years Supply and Demand Comparison: Potable

		2025	2030	2035	2040	2045
First Year	Supply Totals	5,671	6,411	6,411	6,411	6,411
	Demand Totals	5,155	5,828	5,828	5,828	5,828
-	**DIFFERENCE:**	**516**	**583**	**583**	**583**	**583**
Second Year	Supply Totals	5,671	6,411	6,411	6,411	6,411
	Demand Totals	5,155	5,828	5,828	5,828	5,828
-	**DIFFERENCE:**	**516**	**583**	**583**	**583**	**583**
Third Year	Supply Totals	5,671	6,411	6,411	6,411	6,411
	Demand Totals	5,155	5,828	5,828	5,828	5,828
-	**DIFFERENCE:**	**516**	**583**	**583**	**583**	**583**
Fourth Year	Supply Totals	5,671	6,411	6,411	6,411	6,411
	Demand Totals	5,155	5,828	5,828	5,828	5,828
-	**DIFFERENCE:**	**516**	**583**	**583**	**583**	**583**
Fifth Year	Supply Totals	5,671	6,411	6,411	6,411	6,411
	Demand Totals	5,155	5,828	5,828	5,828	5,828
-	**DIFFERENCE:**	**516**	**583**	**583**	**583**	**583**

Table 7-10. DWR 7-4R Multiple Dry Years Supply and Demand Comparison: Non-Potable

		2025	2030	2035	2040	2045
First	Supply Totals	3,355	3,878	3,878	3,878	3,878
Year	Demand Totals	2,743	3,613	3,613	3,613	3,613
-	**DIFFERENCE:**	**612**	**265**	**265**	**265**	**265**
Second	Supply Totals	3,355	3,878	3,878	3,878	3,878
Year	Demand Totals	2,743	3,613	3,613	3,613	3,613
-	**DIFFERENCE:**	**612**	**265**	**265**	**265**	**265**
Third	Supply Totals	3,355	3,878	3,878	3,878	3,878
Year	Demand Totals	2,743	3,613	3,613	3,613	3,613
-	**DIFFERENCE:**	**612**	**265**	**265**	**265**	**265**
Fourth	Supply Totals	3,355	3,878	3,878	3,878	3,878
Year	Demand Totals	2,743	3,613	3,613	3,613	3,613
-	**DIFFERENCE:**	**612**	**265**	**265**	**265**	**265**
Fifth	Supply Totals	3,355	3,878	3,878	3,878	3,878
Year	Demand Totals	2,743	3,613	3,613	3,613	3,613
-	**DIFFERENCE:**	**612**	**265**	**265**	**265**	**265**

7.1.3 Descriptions of Management Tools and Options

TVWD continues to promote conservation and overall has used the same amount of potable water to serve a larger population, as growth has occurred. TVWD continues to work with Western to promote regional efficiency. In addition, TVWD, when appropriate, provides recycled water to offset potable water needs. TVWD continues to develop its recycled water system and maximize recycled water use.

7.2 Drought Risk Assessment

The Drought Risk Assessment (DRA) focuses on a drought scenario that could potentially occur within the next five years (2021-2025) and provides a snapshot of the anticipated surplus or deficit if a drought were to occur.

7.2.1 Data, Methods, and Basis for Water Shortage Condition

The data, methods, and basis for a water shortage condition were identified using typical normal year supply and demand, as developed in Chapters 4 and 6. To estimate demands for 2021 through 2025, a straight-line interpolation was applied from the actual 2020 demand to the projected 2025 demand. The demands for the DRA's five-consecutive dry years were based on the normal demand and assume that demands will not increase in dry years due to successful conservation practices. Projected potable, non-potable, and recycled water demand are shown in Figure 7-1.

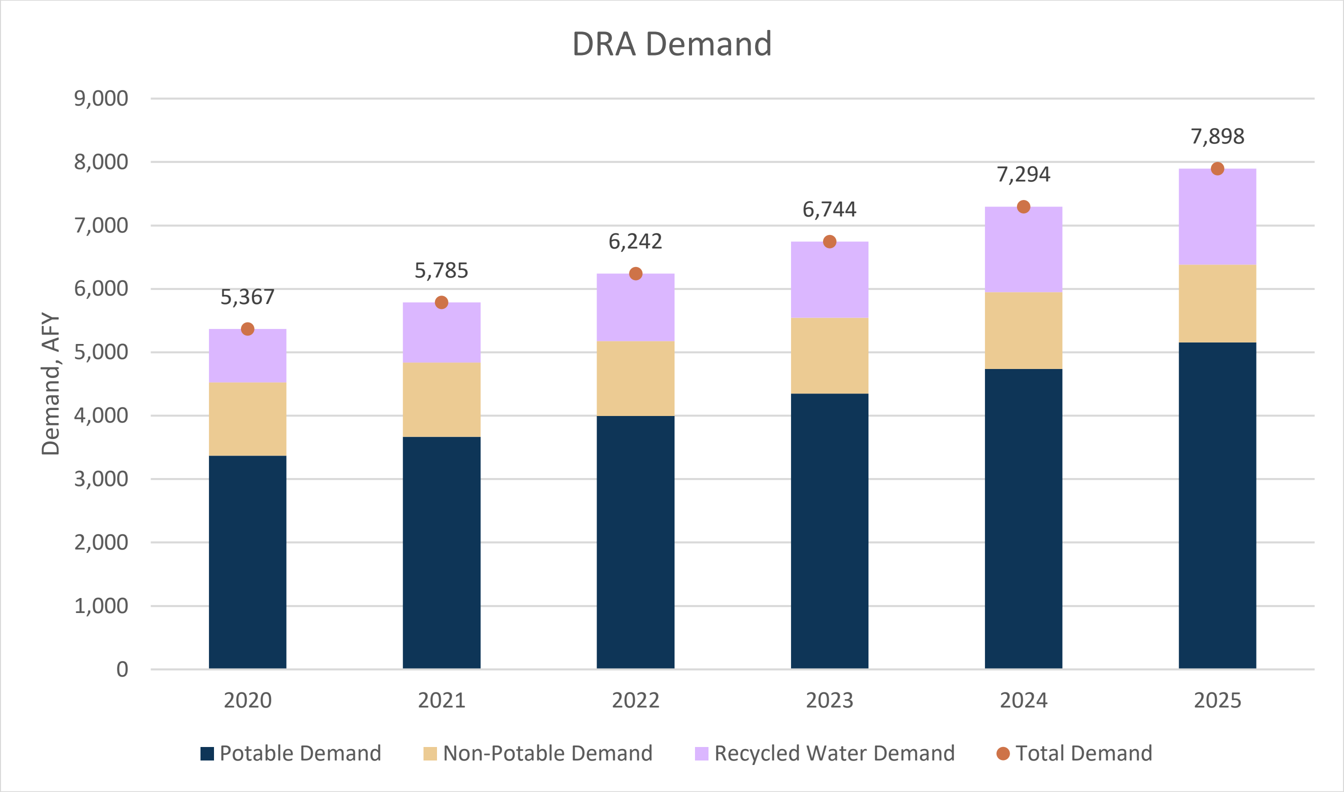

Figure 7-1. DRA Demands

7.2.2 DRA Water Source Reliability

As mentioned previously, TVWD utilizes less water than its turnout capacity allocation and may purchase additional imported water if needed. In addition, both Western and Metropolitan anticipate meeting customer demands over the planning period, including in a 5-year drought. As described in Metropolitan and Western's UWMPs, Metropolitan anticipates a potential shortage in 2021 and 2023 and will implement response actions, including drawing water from storage, to meet anticipated demands. With a potential surplus estimated for years 2022, 2024, and 2025, no water service reliability concern is anticipated, and no shortfall mitigation measures are expected to be exercised by Metropolitan. Based on the results of Metropolitan's and Western's DRAs, it is expected that sufficient supply is available to meet demands. As a result, TVWD anticipates no reliability concerns within its potable system over the next five years.

TVWD also does not expect any reliability concerns within its non-potable and recycled water systems. Recycled water is considered a drought-proof supply, as it is generated from indoor water uses. Local groundwater from the Bedford-Coldwater Subbasin is considered reliable because TVWD's extractions are relatively small, the groundwater basin provides storage capacity, and the BCGSA efforts will be designed to maintain sustainability into the future. As TVWD approaches buildout, it is anticipated that additional recycled water will be used, and non-potable groundwater use may be reduced.

Results of the DRA are provided below in Table 7-11 through Table 7-13.

Table 7-11. DWR 7-5 Five-Year Drought Risk Assessment Tables to Address Water Code Section 10635(b)

2021	Gross Water Use	5,785
	Total Supplies	6,152
	Surplus/Shortfall without WSCP Action	367
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2022	Gross Water Use	6,242
	Total Supplies	6,642
	Surplus/Shortfall without WSCP Action	400
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2023	Gross Water Use	6,744
	Total Supplies	7,179
	Surplus/Shortfall without WSCP Action	435
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2024	Gross Water Use	7,294
	Total Supplies	7,767
	Surplus/Shortfall without WSCP Action	473
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2025	Gross Water Use	7,898
	Total Supplies	9,026
	Surplus/Shortfall without WSCP Action	1,128
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%

For the purposes of the DRA, it is assumed that non-potable and recycled water supply is equal to the non-potable and recycled water demand. Due to seasonal demand variations, TVWD will have additional surplus recycled water supply in 2021-2024 that will be percolated in off-peak demand months, but it is not practical to estimate the amount of surplus so it is excluded from this analysis to be conservative.

Table 7-12. DWR 7-5 Five-Year Drought Risk Assessment Tables to Address Water Code Section 10635(b): Potable

2021	Gross Water Use	3,669
	Total Supplies	4,036
	Surplus/Shortfall without WSCP Action	367
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2022	Gross Water Use	3,994
	Total Supplies	4,393
	Surplus/Shortfall without WSCP Action	399
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2023	Gross Water Use	4,349
	Total Supplies	4,784
	Surplus/Shortfall without WSCP Action	435
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2024	Gross Water Use	4,735
	Total Supplies	5,209
	Surplus/Shortfall without WSCP Action	474
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2025	Gross Water Use	5,155
	Total Supplies	5,671
	Surplus/Shortfall without WSCP Action	516
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%

Table 7-13. DWR 7-5 Five-Year Drought Risk Assessment Tables to Address Water Code Section 10635(b): Non-Potable

2021	Gross Water Use	2,116
	Total Supplies	2,116
	Surplus/Shortfall without WSCP Action	0
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2022	Gross Water Use	2,248
	Total Supplies	2,248
	Surplus/Shortfall without WSCP Action	0
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2023	Gross Water Use	2,395
	Total Supplies	2,395
	Surplus/Shortfall without WSCP Action	0
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2024	Gross Water Use	2,559
	Total Supplies	2,559
	Surplus/Shortfall without WSCP Action	0
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%
2025	Gross Water Use	2,742
	Total Supplies	3,355
	Surplus/Shortfall without WSCP Action	613
	Planned WSCP Actions (Use Reduction and Supply Augmentation)	
	WSCP (Supply Augmentation Benefit)	
	WSCP (Use Reduction Savings Benefit)	
	Revised Surplus/Shortfall	0
	Resulting Percent Use Reduction from WSCP Action	0%

For the purposes of the DRA, it is assumed that non-potable and recycled water supply is equal to the non-potable and recycled water demand. Due to seasonal demand variations, TVWD will have additional surplus recycled water supply in 2021-2024 that will be percolated in off-peak demand months, but it is not practical to estimate the amount of surplus so it is excluded from this analysis to be conservative.

8

2020 URBAN WATER MANAGEMENT PLAN

Water Shortage Contingency Plan Summary

This Water Shortage Contingency Plan (WSCP) is a detailed plan for how TVWD intends to predict and respond to foreseeable and unforeseeable water shortages. This chapter provides an overview of the contents of TVWD's WSCP. The standalone WSCP is included in Appendix F.

IN THIS SECTION

- Overview of the WSCP Components

The California Water Code Section 10632 requires that every urban water supplier that serves more than 3,000 acre-feet per year or has more than 3,000 connections prepare and adopt a standalone Water Shortage Contingency Plan (WSCP) as part of its UWMP. TVWD's WSCP is included as Appendix F and will be separately submitted to DWR. The WSCP is developed separately from TVWD's 2020 UWMP and can be amended, as needed, without amending the UWMP.

The WSCP is a strategic plan that TVWD uses to prepare for and respond to foreseeable and unforeseeable water shortages. A water shortage occurs when water supply available is insufficient to meet the normally expected customer water use at a given point in time. A shortage may occur due to a number of reasons, such as water supply quality changes, climate change, drought, regional power outage, and catastrophic events (e.g., earthquake). Additionally, the State may declare a statewide drought emergency and mandate that water suppliers reduce demands, as occurred in 2014. The WSCP serves as the operating manual that TVWD will use to prevent catastrophic service disruptions through proactive, rather than reactive, mitigation of water shortages.

The WSCP provides a process for an annual water supply and demand assessment and structured steps designed to respond to actual conditions. This level of detailed planning and preparation provides accountability and predictability and will help TVWD maintain reliable supplies and reduce the impacts of any supply shortages and/or interruptions.

The WSCP must be updated based on new requirements every five years and will be adopted as a current update for submission to the California Department of Water Resources.

8.1 Overview of the WSCP Components

The Water Code establishes several prescriptive elements which must be included in a retail water supplier's WSCP. Each element and its location within the WSCP is described below.

Water Supply Reliability Analysis: Summarizes TVWD's water supply analysis and reliability and identifies any key issues that may trigger a shortage condition.

Annual Water Supply and Demand Assessment Procedures: Describes the key data inputs, evaluation criteria, and methodology for assessing the system's reliability for the coming year and the steps to formally declare any water shortage levels and response actions.

Shortage Stages: Establishes water shortage levels to clearly identify and prepare for shortages.

Shortage Response Actions: Describes the response actions that may be implemented or considered for each stage to reduce gaps between supply and demand.

Communication Protocols: Describes communication protocols under each stage to ensure customers, the public, and government agencies are informed of shortage conditions and requirements.

Compliance and Enforcement: Defines compliance and enforcement actions available to administer demand reductions.

Legal Authority: Lists the legal documents that grant TVWD the authority to declare a water shortage and implement and enforce response actions.

Financial Consequences of WSCP Implementation: Describes the anticipated financial impact of implementing water shortage stages and identifies mitigation strategies to offset financial burdens.

Monitoring and Reporting: Summarizes the monitoring and reporting techniques to evaluate the effectiveness of shortage response actions and overall WSCP implementation. Results are used to determine if additional shortage response actions should be activated or if efforts are successful and response actions should be reduced.

WSCP Refinement Procedures: Describes the factors that may trigger updates to the WSCP and outlines how to complete an update.

Special Water Features Distinctions: Identifies exemptions for decorative features aside from pools and spas.

Plan Adoption, Submittal, and Availability: Describes the process for the WSCP adoption, submittal, and availability after each revision.

The WSCP was prepared in conjunction with TVWD's 2020 UWMPand is a standalone document that can be modified as needed. The document is compliant with the CWC Section 10632 and incorporates guidance from DWR UWMP Guidebook (California Department of Water Resources, 2021).

9

2020 URBAN WATER MANAGMENT PLAN

Demand Management Measures

This chapter describes TVWD's implementation of demand management measures (DMMs) intended to promote water-use efficiency.

TVWD recognizes water use efficiency as an integral component of its current and future water reliability strategy for its service area. DMMs refer to policies, programs, rules, regulation and ordinances, and the use of devices, equipment and facilities that, over the long term, have been generally justified and accepted by the industry as providing a "reliable" reduction in water demand. This means providing education, tools, and incentives to help the residents and businesses reduce the amount of water used on their property and help TVWD maintain supply reliability.

IN THIS SECTION

9.1 Existing Demand Management Measures for Retail

9.1.1 Water Waste Prevention Ordinances

TVWD has established a Water Conservation Program and encourages customers to use water wisely at all times. Details on restrictions pertaining to water use, especially during a water shortage emergency, are discussed in the WSCP, provided in Appendix F.

9.1.2 Metering

TVWD has universal metering for water accounts in its service area and maintains water use information for residential, commercial, industrial, and irrigation users. All customer accounts are billed each month based on a monthly service charge and a volumetric commodity charge. TVWD also encourages the installation of dedicated landscape meters, which promotes appropriate management of irrigation water use.

TVWD meters all connections and reads meters monthly when not in drought. More frequent metering may occur when water shortage actions are implemented to evaluate the status of demand and supply and identify potential water waste in a timely manner.

9.1.3 Conservation Pricing

TVWD's water rate structure uses a tiered pricing model. Higher water use is charged at a higher rate, which encourages water conservation. Beginning in 2017, TVWD uses a three-tiered structure. The lowest tier is limited to up to 7 units (each unit is equal to 748 gallons).

9.1.4 Public Education and Outreach

Public Outreach

TVWD promotes public awareness of water use by distributing conservation information through bill inserts, brochures and special events every year. Pamphlets on water conservation are available in the lobby of the office where customers pay their bills. Consumption information for the same month from the previous year and letters on how to conserve water are provided on the customer's bill, allowing customers to monitor their own monthly water use, the effectiveness of household water conservation measures, and techniques used to conserve water. TVWD also maintains a web page (http://www.temescalvwd.com) which includes "Water Saving Tips" and "Kids Corner," frequently asked questions, newsletters, public service announcements, conservation related workshops and current press releases and publications. The "Water Savings Tips" includes a variety of information that encourages water conservation throughout TVWD, such as:

- 9 Ways to Save Water in the Bathroom
- 5 Ways to Save Water in the Kitchen and Laundry
- 10 Ways to Save Water Outside

The "Kids Corner" page includes a link to the "EPA Drinking Water Fun," and Western's "Drippy's Drops". These websites provide lesson plans and step-by-step instruction on an array of information for kids, students and teachers. Information is divided ranging from K-12, allowing children of all age groups to learn about the importance of clean water, water pollution, and how the water cycle operates.

TVWD's website also provides customers information on its rebate programs, as well as extending rebates offered through Wester and Metropolitan's SoCal Water$mart Program.

School Education Programs

In addition to distributing information to schools, various fairs and other public events, TVWD supports numerous school education programs implemented by Western within TVWD's service area. The material and services offered meet the requirements of the California Science Framework Addendum and include class presentations and teacher's workshops, student workbooks, water cycle bracelets, earth balls, water story rocks, assembly-related material, teachers' guides, videos, speakers, and field trips. Western's programs are free-of-charge to public and private schools for grades K-12 and are designed to encourage and assist educators as they teach students about water supply, distribution, reclamation, conservation, and the future of water supplies.

As a customer of Western, TVWD is also able to take advantage of education programs offered through Western's wholesale water supplier, Metropolitan. Metropolitan's Conservation Program (http://www.bewaterwise.com) is Metropolitan's gateway to rebates, incentives and grant programs as well as educational materials, tips and inspiration for water-saving ideas indoors and outside.

Metropolitan's Education Unit provides water education programs, supplemental materials, activities and projects, teacher in-services, field trips, and classroom presentation ranging from Pre-K to K-12 for teachers and students in Southern California. The wide array of curriculum offered can be used either in class or online. Details about the education programs available can be found on Metropolitan's Water Education website (https://www.mwdh2o.com/education).

Metropolitan's education unit continues past high school graduation and expands its resources and opportunities into and beyond the classroom. Metropolitan has various internship opportunities in a broad range of academic areas for undergraduate and graduate students to learn about the water industry and gain valuable work experience. Outside of the classroom, Metropolitan's apprentice program provides instruction and on-the-job training for those interested in serving as a mechanic, electrician, or other trade profession in the water industry.   In addition, a variety of water experts are also made available to speak about water issues facing the Temescal Valley region, address a specific water topic such as the drought, or provide an overview of their water system.

9.1.5 Programs to Assess and Manage Distribution System Real Loss

TVWD meters all connections, including connections to Western and for local non-potable and recycled water supplies. TVWD responds to reported waterline breaks and leaks and repairs them in a timely manner. TVWD completes annual water loss audits, in accordance with the AWWA guidelines.

Unaccounted-for water (water loss or non-revenue water) for TVWD is estimated at 8% of all potable water delivered into the distribution system and is not anticipated to increase substantially in the future.

9.1.6 Water Conservation Program Coordination and Staffing Support

Water conservation is under the direction of the TVWD office manager and is administered by TVWD office staff. This staff coordinates TVWD sponsored programs, and supports programs implemented by Western, TVWD's water wholesaler.

9.2 Reporting Implementation

9.2.1 Water Waste Prevention Implementation

9.2.1.1 Residential Programs

TVWD offers various programs to its residential customers to help them reduce and manage their water use. This is one of the primary means by which TVWD manages demands and supports the directive to customers to use water wisely. Conservation program funding and rebate programs available through TVWD or its suppliers over the past five years, are described here.

TVWD Potable Water Conservation Funding Program

This program's goal is to provide incentives to TVWD customers to reduce potable water consumption used for irrigation purposes, which in turn will preserve potable water resources and aid in reducing water consumption charges. Through this program, homeowners are offered rebates for irrigated area converted to rotary (conservation) type sprinkler nozzles, turf removal, conversion to drip type water system or conservation based irrigation timers.

Rebate Programs from TVWD Suppliers

TVWD offers rebates to its residential customers through Metropolitan's SoCal Water$mart program. Rebates offered through this program include:

- Turf Removal
- High-Efficiency Clothes Washers
- Premium High-Efficiency Toilets
- Rain Barrels & Cisterns
- Rotating Sprinkler Nozzles
- Soil Moisture Sensor Systems
- Weather-Based Irrigation Controllers

Educational and Community Programs

In addition to the rebate program offered above, TVWD offers educational and informational material through Metropolitan. Metropolitan offers classes both online and in person to reduce landscape water use, detailed in Table 9-1.

Table 9-1. Educational Classes Offered by Metropolitan

MINI TUTORIALS ON THE BASICS	IN-DEPTH TUTORIALS FOR HOME GARDENERS	PROFESSIONAL LANDSCAPE MAINTENANCE TUTORIALS
Getting Started	Landscape Design Basics	Irrigation Principles
Plant Selection	Efficient Irrigation Systems	Irrigation System Troubleshooting
Irrigation System Basics	Plant Selections	Controller Programming
Planting and Maintenance	Plant Care	Irrigation Scheduling

Drought Tracker

Metropolitan offers several resources to keep customers updated on the drought and its financial, political, and natural impacts.

- Drought in the News: Newspaper articles and broadcast coverage clips of drought related topics updated throughout the year
- Drought Impacts: Investigating the droughts impacts as it affects:
  - Agriculture/Food
  - Jobs
  - Recreation
  - Fire Safety
  - Local
- Supply Allocation Plan
- Water Supply Conditions
- Board Policy and Statements
- State and Federal Information
- Video Library and Resources

Videos

A video archive that displays everything from household repair tips, past water conservation efforts, and upcoming water conservation events.

Watering Calculator

The calculator tool estimates the correct amount of water to irrigate a landscape or garden weekly during normal supply conditions. Developed by the city of San Diego, it provides customized watering schedules by zip code based on data from the California Irrigation Management Information System (CIMIS) weather station network. The calculator uses average numbers for weather, plants, and soils within zip codes of the urban Southern California area.

Water Saving Tips

Residential water saving advice ranging from indoor use (washing machines, leaky faucets, shower length, toilet efficiency) to outdoor use (irrigation times and intervals, smart sprinkler controllers, sprinkler maintenance).

California's Friendly Gardening Guide

This guide features garden tours and galleries which display information on plant care, maintenance, and growth, as well as garden resources and a 1,500-plant index.

Quick Tips for a California Friendly Garden

With smart choices about sprinklers, plants and maintenance, water bills can drop and landscape health increase.

Conservation Materials

Conservation fact sheets provided by Metropolitan include:

- How to choose a water-efficient clothes washer
- How to choose water-efficient sprinkler nozzles
- Five Things to Know About the Drought
- Quick Tips for a California Friendly Garden
- 50 Favorites for California Friendly Landscapes
- Working Together Through the Drought
- How to Make a Rain Garden
- Metropolitan Today and Tomorrow
- How to choose a smart sprinkler controller
- Tips for being water-wise outside and indoors
- Top 10 California Friendly Plants

9.2.1.2 Commercial, Industrial, and Institutional Programs

TVWD offers a variety of programs to its commercial, industrial, and institutional customers to help manage and reduce their demands. Many of these programs overlap with residential programs or provide the same or similar services.

TVWD Recycled Water Conservation Funding Program

TVWD encourages the use of recycled water for homeowner's or commercial buildings. Recycled water customers are given a rate incentive for using recycled water over potable water. TVWD will provide the following items free of charge:

- Recycled Water signage (post and installation not included)
- Consultation, inspection and cross-connection testing

Rebate Programs

Rebates are available to TVWD's commercial customers through Metropolitan's SoCal Water$mart program. Rebates for commercial customers fall into several categories as shown in Table 9-2.

Table 9-2. Rebate Programs

PLUMBING FIXTURES	LANDSCAPE EQUIPMENT	FOOD EQUIPMENT	HVAC EQUIPMENT	MEDICAL AND DENTAL EQUIPMENT
Premium High-Efficiency Toilets	Irrigation Controllers	Connectionless Food Steamers	Cooling Tower Conductivity Controllers	Dry Vacuum Pumps
Ultra-Low and Zero Water Urinals	Rotating Nozzles for Pop-Up Spray Heads	Air-cooled Ice Machines	Cooling Tower pH Controllers	Laminar Flow Restrictors
Plumbing Flow Control Valves	Large Rotary Nozzles			
	In-Stem Flow Regulators			
	Soil Moisture Sensor Systems			

In addition to equipment and fixture rebates, Metropolitan's Water$mart offers other rebate programs to promote water conservation. Additional information can be found at http://socalwatersmart.com/commercial/.

Turf Removal Program

Similar to the program offered to residential customers, this program offers a rebate for turf removal to commercial and public agencies.

Public Agency Landscape Program

To encourage agencies that have not already installed water-efficient landscape to do so, SoCal Water$mart offers incentives for public agencies to install water-efficient landscape devices at their facilities and on their grounds. Eligible devices include weather-based or central computer, soil moisture sensor systems, large rotary nozzles, and rotating nozzles for pop-up spray heads.

On-Site Retrofit Program

Metropolitan's On-site Retrofit Program provides financial incentives directly to public or private property owners to convert potable water irrigation or industrial water systems to recycled water service. Incentives of up to $195 per acre-foot for five years of estimated water use are available, with a cap at the actual retrofit costs. Items eligible for incentives include project design, permitting, construction costs associated with the retrofit of potable to recycled water systems, connection fees and required recycled water signage. Applications are reviewed and funds distributed on a first come, first served basis.

Landscape Irrigation Survey

Surveys are scheduled on a first come, first-served basis. A certified landscape irrigation auditor will survey and provide written recommendations for qualifying non-residential properties within Metropolitan's 5,200 square-mile service area at no cost. To participate, properties must have a minimum of one acre of irrigated area. Eligible landscapes include commercial and industrial sites, homeowner association common areas, and institutional sites like schools, parks and government facilities.

9.2.1.3 Grant Funding Programs

Metropolitan's Water$mart program even offers opportunities to apply for and receive grant funding for research toward water conserving technologies or products.

Innovative Conservation Program

Metropolitan's Innovative Conservation Program (ICP) provides funding in cooperation with the U.S. Bureau of Reclamation (USBR), Environmental Protection Agency (EPA), Southern Nevada Water Authority (SNWA), the Central Arizona Project (CAP), the Southern California Gas Company (SoCalGas) and Western Resource Advocates for research that will document water savings and reliability of innovative water savings devices. The objective is to evaluate the water saving potential and reliability of innovative water saving devices, technologies, and strategies.

Community Partnering Program

The Primary focus of the Community Partnering Program is sponsorship of water conservation and water-use efficiency programs and activities. Grants for up to $2,000 for water use efficiency education and outreach programs are reviewed and awarded throughout the year.

World Water Forum

This program offers grants to college teams to research and develop cost-effective, water-saving technologies, policies, or communication strategies.

World Water Forum College Program

The Metropolitan Water District of Southern California, the U.S. Bureau of Reclamation, and the Sanitation Districts of Los Angeles County sponsor this competitive grant program to help further awareness of global and local water issues. Grants up to $10,000 per team are available to Southern California college teams to research and develop water-saving technologies, policies, or communication strategies.

9.3 Implementation to Achieve Water Use Targets

TVWD will continue implementing the DMMs discussed in this chapter to continue to achieve water use efficiency. All DMMs work together to reduce water use. TVWD will continue to promote Metropolitan and Western conservation programs throughout its service area and continue public education efforts to ensure consistent water use efficiency throughout its service area.

9.4 Water Use Objectives (Future Requirements)

TVWD will continue to help their customers become water efficient and reduce their gallons per capita per day consumption. TVWD will evaluate additional measures, if needed, once future water use efficiency standards are established.

10

2020 URBAN WATER MANAGEMENT PLAN

Plan Adoption, Submittal, and Implementation

To fulfill the requirements of Water Code Section 10621(c), TVWD sent letters of notification of preparation of the 2020 UWMP to all cities and counties within and near TVWD's service area 60 days prior to the public hearing.

10.1 Inclusion of All 2020 Data

TVWD included all 2020 data in development of this UWMP.

10.2 Notice of Public Hearing

Before the public hearing, TVWD made a public draft UWMP and public draft WSCP available for public inspection on TVWD's website. Pursuant to CWC Section 10642, general notice of the public hearing was provided through publication of the hearing date and time and document posting.

Table 10-1 provides a summary of the notifications that were issued as part of TVWD's development of the UWMP. TVWD notified the public within its service area of the opportunity to provide input regarding the UWMP. Copies of the public outreach materials, including newspaper notices and invitation letters, are included in Appendix C and Appendix D.

IN THIS SECTION

- Notice of Public Hearing
- Public Hearing and Adoption
- Plan Submittal
- Plan Availability
- Amending an Adopted UWMP or WSCP

Table 10-1. DWR 10-1R Notification to Cities and Counties

CITY	60 DAY NOTICE	NOTICE OF PUBLIC HEARING	OTHER
City of Corona	Yes	Yes	
COUNTY	60 DAY NOTICE	NOTICE OF PUBLIC HEARING	OTHER
Riverside County	Yes	Yes	
OTHER	60 DAY NOTICE	NOTICE OF PUBLIC HEARING	OTHER
Elsinore Valley Municipal Water District	Yes	Yes	
Western Municipal Water District	Yes	Yes	

10.3 Public Hearing and Adoption

Prior to adoption of the WSCP and 2020 UWMP, TVWD held a public hearing regarding its WSCP and UWMP on December 21, 2021 where the WSCP and UWMP were publicly reviewed. This hearing provided the cities and counties and other members of the public a chance to review the staff report and attend the hearing to provide comments. The public hearing took place before the adoption, allowing an opportunity for the report to be modified in response to public input. Following the public hearing, the WSCP and UWMP were adopted by TVWD on December 21, 2021.

A copy of the Resolution of Plan Adoption signed by the TVWD Board is included as Appendix G of the UWMP. The UWMP includes all applicable information necessary to meet the requirements of the CWC. The 2020 UWMP and WSCP were submitted to the DWR within 30 days of adoption.

10.4 Plan Submittal

An electronic copy of the Final 2020 UWMP and WSCP were sent to the California State Library and electronic copies to DWR (electronically using the WUEdata reporting tool), and electronic copies to all cities and counties within TVWD's service area within 30 days of adoption.

10.5 Public Availability

To fulfill the requirements of CWC Section 10642 of the UWMP Act, TVWD made the 2020 UWMP and WSCP available online for public review within 30 days of adoption.

10.6 Amending an Adopted UWMP or WSCP

Amendments to TVWD's 2020 UWMP and WSCP will be made on an as needed basis. Should TVWD need to amend the adopted 2020 UWMP or WSCP in the future, TVWD will hold a public hearing for review of the proposed amendments to the document and send a 60-day notification letter to all cities and counties within its service area and notify the public in same manner as set forth in this UWMP. Once the amended document is adopted, a copy of the finalized version will be distributed to the California State Library, DWR (electronically using the WUEdata reporting tool), and all cities and counties within TVWD's service area within 30 days of adoption. The finalized version will also be made available to the public online on TVWD's website.

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2020 URBAN WATER MANAGEMENT PLAN

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A

Appendix A. Reduced Delta Reliance

Quantifying Regional Self-Reliance and Reduced Reliance on Water Supplies from the Delta

1. Background

Under the Sacramento-San Joaquin Delta Reform Act of 2009, state and local public agencies proposing a covered action in the Delta, prior to initiating the implementation of that action, must prepare a written certification of consistency with detailed findings as to whether the covered action is consistent with applicable Delta Plan policies and submit that certification to the Delta Stewardship Council. Anyone may appeal a certification of consistency, and if the Delta Stewardship Council grants the appeal, the covered action may not be implemented until the agency proposing the covered action submits a revised certification of consistency, and either no appeal is filed, or the Delta Stewardship Council denies the subsequent appeal.

An urban water supplier that anticipates participating in or receiving water from a proposed covered action such as a multi-year water transfer, conveyance facility, or new diversion that involves transferring water through, exporting water from, or using water in the Delta should provide information in their 2015 and 2020 Urban Water Management Plans (UWMPs) that can then be used in the covered action process to demonstrate consistency with Delta Plan Policy WR P1, Reduce Reliance on the Delta through Improved Regional Water Self-Reliance (WR P1).

WR P1 details what is needed for a covered action to demonstrate consistency with reduced reliance on the Delta and improved regional self-reliance. WR P1 subsection (a) states that:

> *(a) Water shall not be exported from, transferred through, or used in the Delta if all the following apply:*
>
> > *(1) One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c);*
> >
> > *(2) That failure has significantly caused the need for the export, transfer, or use; and*
> >
> > *(3) The export, transfer, or use would have a significant adverse environmental impact in the Delta.*

WR P1 subsection (c)(1) further defines what adequately contributing to reduced reliance on the Delta in terms of (a)(1) above.

> *(c)(1) Water suppliers that have done all the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:*
>
> > *(A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;*
> >
> > *(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and*
> >
> > *(C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected*

> *outcome for measurable reduction in Delta reliance and improvement in regional self-reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).*

The analysis and documentation provided below include all the elements described in WR P1(c)(1) that need to be included in a water supplier's UWMP to support a certification of consistency for a future covered action.

2. Demonstration of Regional Self-Reliance

The methodology used to determine Temescal Valley Water District (TVWD)'s improved regional self-reliance is consistent with the approach detailed in the Department of Water Resources (DWR)'s UWMP Guidebook Appendix C (Guidebook Appendix C), including the use of narrative justifications for the accounting of supplies and the documentation of specific data sources. Key assumptions underlying Western's demonstration of reduced reliance include:

- All data were obtained from the current 2020 UWMP, previously adopted UWMPs or other planning reports or actual water use data.
- All analyses were conducted at the TVWD service area level, and all data reflect the total contributions of TVWD.
- No projects or programs that are described in the UWMPs as "Projects Under Development" were included in the accounting of supplies.

Baseline, Data and Expected Outcomes

To calculate the expected outcomes for measurable reduction in Delta reliance and improved regional self-reliance, a baseline is needed to compare against. This analysis uses a normal water year representation of 2010 as the baseline, which is consistent with the approach described in the Guidebook Appendix C. Data for the 2010 baseline were taken from TVWD's 2004 Water Master Plan (WMP), as the WMP includes a comprehensive set of supply and demand data for a normal water year.

Consistent with the 2010 baseline data approach, the expected outcomes for reduced Delta reliance and improved regional self-reliance for 2015 was taken from Western Municipal Water District's (Western's) 2008 Integrated Regional Water Management Plan (IRWMP). TVWD purchases all of its potable water from Western on a wholesale basis; therefore, Western included demand projections for TVWD in its 2008 IRWMP.

Demand estimates for 2020 were based on projections developed in TVWD's 2015 UWMP. Data and expected outcomes for 2025-2045 was developed as part of TVWD's 2020 UWMP effort. Documentation of the specific data sources and assumptions are included in the discussions below.

Service Area Demands without Water Use Efficiency

In alignment with the Guidebook Appendix C, this analysis uses normal water year demands, rather than normal water year supplies to calculate expected outcomes in terms of the percentage of water used. Normal water year demands serve as a proxy for the amount of supplies that would be used in a normal water year, which helps alleviate issues associated with how supply capability is presented to fulfill requirements of the UWMP Act versus how supplies might be accounted for to demonstrate consistency with WR P1.

Because WR P1 considers water use efficiency savings a source of water supply, water suppliers can calculate their embedded water use efficiency savings based on changes in forecasted per capita water use since the baseline. As explained in the Guidebook Appendix C, water use efficiency savings must be added back to the normal year demands to represent demands without water use efficiency savings accounted for; otherwise, the effect of water use efficiency savings on regional self-reliance would be overestimated. Table C-1 shows the results of this adjustment for Western. Supporting narratives and documentation for all the data shown in Table C-1 are provided below.

Service Area Demands with Water Use Efficiency

The service area demands shown in Table C-1 represent the total water demands for Western's general service area, including Western Retail and other retail agencies. Demand data shown in Table C-1 were collected from the following sources:

- Baseline (2010): TVWD 2004 WMP, Table 2-6
- 2015: Western's IRWMP 2008 Update, Table 4-1
- 2020: TVWD 2015 UWMP, Table 4-2
- 2025-2045: TVWD 2020 UWMP, Table 4-7

Non-Potable Water Demands

TVWD did not include non-potable water demands in this analysis because early planning documents reflected potable water use only. To remain consistent and truly analyze reduced reliance on the Delta, only potable water estimates were used.

Service Area Population

The population data shown in Table C-1 were collected from the following sources:

- Baseline (2010): estimated using the DWR population tool and 2010 Census block level data for TVWD.
- 2015: TVWD 2015 UWMP, Table 3-2
- 2020-2045: TVWD 2020 UWMP, Table 3-2

Estimated Water Use Efficiency Since Baseline

The "Estimated Water Use Efficiency Since Baseline" was calculated using "Potable Service Area Demands with Water Use Efficiency" divided by "Service Area Population" and then comparing with 2010 Per Capita Water Use.

Service Area Water Demands without Water Use Efficiency

In Table C-2, the "Service Area Demands with Water Use Efficiency" was added to the "Estimated Water Use Efficiency Since Baseline" to obtain the "Service Area Water Demands without Water Use Efficiency Accounted For".

Supplies Contributing to Regional Self-Reliance

For a covered action to demonstrate consistency with the Delta Plan, WR P1 subsection (c)(1)(C) states that water suppliers must report the expected outcomes for measurable improvement in regional self-reliance. Table C-3 shows expected outcomes for supplies contributing to regional self-reliance both in amount and as a percentage. The values shown in Table C-3 represent conservation efforts throughout TVWD's service area, as TVWD has used less water to serve more people since the 2010 baseline.

Water Use Efficiency

The water use efficiency information shown in Table C-3 is taken directly from Table C-1.

3. Reliance on Water Supplies from the Delta Watershed

Metropolitan's service area, as a whole, reduces reliance on the Delta through investments in non-Delta water supplies, local water supplies, and regional and local demand management measures.

Metropolitan's member agencies coordinate reliance on the Delta through their membership in Metropolitan, a regional cooperative providing wholesale water service to its 26 member agencies, which includes Western. Accordingly, regional reliance on the Delta can only be measured regionally—not by individual Metropolitan member agencies and not by the customers of those member agencies.

Metropolitan's member agencies, and those agencies' customers, indirectly reduce reliance on the Delta through their collective efforts as a cooperative. Metropolitan's member agencies do not control the amount of Delta water they receive from Metropolitan. Metropolitan manages a statewide integrated conveyance system consisting of its participation in the State Water Project (SWP), its Colorado River Aqueduct (CRA) including Colorado River water resources, programs and water exchanges, and its regional storage portfolio. Along with the SWP, CRA, storage programs, and Metropolitan's conveyance and distribution facilities, demand management programs increase the future reliability of water resources for the region. In addition, demand management programs provide system-wide benefits by decreasing the demand for imported water, which helps to decrease the burden on the district's infrastructure and reduce system costs, and free up conveyance capacity to the benefit of all member agencies.

Metropolitan's costs are funded almost entirely from its service area, except for grants and other assistance from government programs. Most of Metropolitan's revenues are collected directly from its member agencies. Properties within Metropolitan's service area pay a property tax that currently provides approximately 8 percent of the fiscal year 2021 annual budgeted revenues. The rest of Metropolitan's costs are funded through rates and charges paid by Metropolitan's member agencies for the wholesale services it provides to them. Thus, Metropolitan's member agencies fund nearly all operations Metropolitan undertakes to reduce reliance on the Delta, including Colorado River Programs, storage facilities, Local Resources Programs and Conservation Programs within Metropolitan's service area.

Because of the integrated nature of Metropolitan's systems and operations, and the collective nature of Metropolitan's regional efforts, it is infeasible to quantify each of Metropolitan member agencies' individual reliance on the Delta. It is infeasible to attempt to segregate an entity and a system that were designed to work as an integrated regional cooperative.

In addition to the member agencies funding Metropolitan's regional efforts, they also invest in their own local programs to reduce their reliance on any imported water. Moreover, the customers of those member agencies may also invest in their own local programs to reduce water demand. However, to the extent those efforts result in reduction of demands on Metropolitan, that reduction does not equate to a like reduction of reliance on the Delta. Demands on Metropolitan are not commensurate with demands on the Delta because most of Metropolitan member agencies receive blended resources from Metropolitan as determined by Metropolitan—not the individual member agency—and for most member agencies, the blend varies from month-to-month and year-to-year due to hydrology, operational constraints, use of storage and other factors.

Programs Implemented by Metropolitan to Reduce Delta Reliance

Colorado River Programs

As a regional cooperative of member agencies, Metropolitan invests in programs to ensure the continued reliability and sustainability of Colorado River supplies. Metropolitan was established to obtain an allotment of Colorado River water, and its first mission was to construct and operate the CRA. The CRA consists of five pumping plants, 450 miles of high voltage power lines, one electric substation, four regulating reservoirs, and 242 miles of aqueducts, siphons, canals, conduits and pipelines terminating at Lake Mathews in Riverside County. Metropolitan owns, operates, and manages the CRA. Metropolitan is responsible for operating, maintaining, rehabilitating, and repairing the CRA, and is responsible for obtaining and scheduling energy resources adequate to power pumps at the CRA's five pumping stations.

Colorado River supplies include Metropolitan’s basic Colorado River apportionment, along with supplies that result from existing and committed programs, including supplies from the Imperial Irrigation District (IID)-Metropolitan Conservation Program, the implementation of the Quantification Settlement Agreement (QSA) and related agreements, and the exchange agreement with San Diego County Water Authority (SDCWA). The QSA established the baseline water use for each of the agreement parties and facilitates the transfer of water from agricultural agencies to urban uses. Since the QSA, additional programs have been implemented to increase Metropolitan’s CRA supplies. These include the PVID Land Management, Crop Rotation, and Water Supply Program, as well as the Lower Colorado River Water Supply Project. The 2007 Interim Guidelines provided for the coordinated operation of Lake Powell and Lake Mead, as well as the Intentionally Created Surplus (ICS) program that allows Metropolitan to store water in Lake Mead.

Storage Investments/Facilities

Surface and groundwater storage are critical elements of Southern California’s water resources strategy and help Metropolitan reduce its reliance on the Delta. Because California experiences dramatic swings in weather and hydrology, storage is important to regulate those swings and mitigate possible supply shortages. Surface and groundwater storage provide a means of storing water during normal and wet years for later use during dry years, when imported supplies are limited. The Metropolitan system, for purposes of meeting demands during times of shortage, regulating system flows, and ensuring system reliability in the event of a system outage, provides over 1,000,000 acre-feet of system storage capacity. Diamond Valley Lake provides 810,000 acre feet of that storage capacity, effectively doubling Southern California’s previous surface water storage capacity. Other existing imported water storage available to the region consists of Metropolitan’s raw water reservoirs, a share of the SWP’s raw water reservoirs in and near the service area, and the portion of the groundwater basins used for conjunctive-use storage.

Since the early twentieth century, DWR and Metropolitan have constructed surface water reservoirs to meet emergency, drought/seasonal, and regulatory water needs for Southern California. These reservoirs include Pyramid Lake, Castaic Lake, Elderberry Forebay, Silverwood Lake, Lake Perris, Lake Skinner, Lake Mathews, Live Oak Reservoir, Garvey Reservoir, Palos Verdes Reservoir, Orange County Reservoir, and Metropolitan’s Diamond Valley Lake (DVL). Some reservoirs such as Live Oak Reservoir, Garvey Reservoir, Palos Verdes Reservoir, and Orange County Reservoir, which have a total combined capacity of about 3,500 AF, are used solely for regulating purposes. The total gross storage capacity for the larger remaining reservoirs is 1,757,600 AF. However, not all of the gross storage capacity is available to Metropolitan; dead storage and storage allocated to others reduce the amount of storage that is available to Metropolitan to 1,665,200 AF.

Conjunctive use of the aquifers offers another important source of dry year supplies. Unused storage in Southern California groundwater basins can be used to optimize imported water supplies, and the development of groundwater storage projects allows effective management and regulation of the region’s major imported supplies from the Colorado River and SWP. Over the years, Metropolitan has implemented conjunctive use through various programs in the service area; the following table lists the groundwater conjunctive use programs that have been developed in the region.

Program	Metropolitan Agreement Partners	Program Term	Max Storage AF	Dry-Year Yield AF/Yr
Long Beach Conjunctive Use Storage Project (Central Basin)	Long Beach	June 2002-2027	13,000	4,300
Foothill Area Groundwater Storage Program (Monkhill/ Raymond Basin)	Foothill MWD	February 2003-2028	9,000	3,000
Orange County Groundwater Conjunctive Use Program	MWDOC OCWD	June 2003-2028	66,000+	22,000
Chino Basin Conjunctive Use Programs	IEUA TVMWD Watermaster	June 2003-2028	100,000	33,000
Live Oak Basin Conjunctive Use Project (Six Basins)	TVMWD City of La Verne	October 2002-2027	3,000	1,000
City of Compton Conjunctive Use Project (Central Basin)	Compton	February 2005-2030	2,289	763
Long Beach Conjunctive Use Program Expansion in Lakewood (Central Basin)	Long Beach	July 2005-2030	3,600	1,200
Upper Claremont Basin Groundwater Storage Program (Six Basins)	TVMWD	Sept. 2005- 2030	3,000	1,000
Elsinore Basin Conjunctive Use Storage Program	Western MWD Elsinore Valley MWD	May 2008- 2033	12,000	4,000
TOTAL			**211,889**	**70,263**

Metropolitan Demand Management Programs

Demand management costs are Metropolitan's expenditures for funding local water resource development programs and water conservation programs. These Demand Management Programs incentivize the development of local water supplies and the conservation of water to reduce the need to import water to deliver to Metropolitan's member agencies. These programs are implemented below the delivery points between Metropolitan's and its member agencies' distribution systems and, as such, do not add any water to Metropolitan's supplies. Rather, the effect of these downstream programs is to produce a local supply of water for the local agencies and to reduce demands by member agencies for water imported through Metropolitan's system. The following discussions outline how Metropolitan funds local resources and conservation programs for the benefit of all of its member agencies and the entire Metropolitan service area. Notably, the history of demand management by Metropolitan's member agencies and the local agencies that purchase water from Metropolitan's members has spanned more than four decades. The significant history of the programs is another reason it would be difficult to attempt to assign a portion of such funding to any one individual member agency.

Local Resources Programs

In 1982, Metropolitan began providing financial incentives to its member agencies to develop new local supplies to assist in meeting the region's water needs. Because of Metropolitan's regional distribution system, these programs benefit all member agencies regardless of project location because they help to increase regional water supply reliability, reduce demands for imported water supplies, decrease the burden on Metropolitan's infrastructure, reduce system costs and free up conveyance capacity to the benefit of all the agencies that rely on water from Metropolitan.

For example, the Groundwater Replenishment System (GWRS) operated by the Orange County Water District is the world's largest water purification system for indirect potable reuse. It was funded, in part, by Metropolitan's member agencies through the Local Resources Program. Annually, the GWRS produces approximately 103,000 acre-feet of reliable, locally controlled, drought-proof supply of high-quality water to recharge the Orange County Groundwater Basin and protect it from seawater intrusion. The GWRS is a premier example of a regional project that significantly reduced the need to utilize imported water for groundwater replenishment in Metropolitan's service area, increasing regional and local supply reliability and reducing the region's reliance on imported supplies, including supplies from the State Water Project.

Metropolitan's local resource programs have evolved through the years to better assist Metropolitan's member agencies in increasing local supply production. The following is a description and history of the local supply incentive programs.

Local Projects Program

In 1982, Metropolitan initiated the Local Projects Program (LPP), which provided funding to member agencies to facilitate the development of recycled water projects. Under this approach, Metropolitan contributed a negotiated up-front funding amount to help finance project capital costs. Participating member agencies were obligated to reimburse Metropolitan over time. In 1986, the LPP was revised, changing the up-front funding approach to an incentive-based approach. Metropolitan contributed an amount equal to the avoided State Water Project pumping costs for each acre-foot of recycled water delivered to end-use consumers. This funding incentive was based on the premise that local projects resulted in the reduction of water imported from the Delta and the associated pumping cost. The incentive amount varied from year to year depending on the actual variable power cost paid for State Water Project imports. In 1990, Metropolitan's Board increased the LPP contribution to a fixed rate of $154 per acre-foot, which was calculated based on Metropolitan's avoided capital and operational costs to convey, treat, and distribute water, and included considerations of reliability and service area demands.

Groundwater Recovery Program

The drought of the early 1990s sparked the need to develop additional local water resources, aside from recycled water, to meet regional demand and increase regional water supply reliability. In 1991, Metropolitan conducted the Brackish Groundwater Reclamation Study which determined that large amounts of degraded groundwater in the region were not being utilized. Subsequently, the Groundwater Recovery Program (GRP) was established to assist the recovery of otherwise unusable groundwater degraded by minerals and other contaminants, provide access to the storage assets of the degraded groundwater, and maintain the quality of groundwater resources by reducing the spread of degraded plumes.

Local Resources Program

In 1995, Metropolitan's Board adopted the Local Resources Program (LRP), which combined the LPP and GRP into one program. The Board allowed for existing LPP agreements with a fixed incentive rate to convert to the sliding scale up to $250 per acre-foot, similar to GRP incentive terms. Those agreements that were converted to LRP are known as "LRP Conversions."

Competitive Local Projects Program

In 1998, the Competitive Local Resources Program (Competitive Program) was established. The Competitive Program encouraged the development of recycled water and recovered groundwater through a process that emphasized cost-efficiency to Metropolitan, timing new production according to regional need while minimizing program administration cost. Under the Competitive Program, agencies requested an incentive rate up to $250 per acre-foot of production over 25 years under a Request for Proposals (RFP) for the development of up to 53,000 acre-feet per year of new water recycling and groundwater recovery projects. In 2003, a second RFP was issued for the development of an additional 65,000 acre-feet of new recycled water and recovered groundwater projects through the LRP.

Seawater Desalination Program

Metropolitan established the Seawater Desalination Program (SDP) in 2001 to provide financial incentives to member agencies for the development of seawater desalination projects. In 2014, seawater desalination projects became eligible for funding under the LRP, and the SDP was ended.

2007 Local Resources Program

In 2006, a task force comprised of member agency representatives was formed to identify and recommend program improvements to the LRP. As a result of the task force process, the 2007 LRP was established with a goal of 174,000 acre-feet per year of additional local water resource development. The new program allowed for an open application process and eliminated the previous competitive process. This program offered sliding scale incentives of up to $250 per acre-foot, calculated annually based on a member agency’s actual local resource project costs exceeding Metropolitan’s prevailing water rate.

2014 Local Resources Program

A series of workgroup meetings with member agencies was held to identify the reasons why there was a lack of new LRP applications coming into the program. The main constraint identified by the member agencies was that the $250 per acre-foot was not providing enough of an incentive for developing new projects due to higher construction costs to meet water quality requirements and to develop the infrastructure to reach end-use consumers located further from treatment plants. As a result, in 2014, the Board authorized an increase in the maximum incentive amount, provided alternative payment structures, included onsite retrofit costs and reimbursable services as part of the LRP, and added eligibility for seawater desalination projects. The current LRP incentive payment options are structured as follows:

- Option 1 – Sliding scale incentive up to $340/AF for a 25-year agreement term
- Option 2 – Sliding scale incentive up to $475/AF for a 15-year agreement term
- Option 3 – Fixed incentive up to $305/AF for a 25-year agreement term

On-site Retrofit Programs

In 2014, Metropolitan’s Board also approved the On-site Retrofit Pilot Program which provided financial incentives to public or private entities toward the cost of small-scale improvements to their existing irrigation and industrial systems to allow connection to existing recycled water pipelines. The On-site Retrofit Pilot Program helped reduce recycled water retrofit costs to the end-use consumer which is a key constraint that limited recycled water LRP projects from reaching full production capacity. The program incentive was equal to the actual eligible costs of the on-site retrofit, or $975 per acre-foot of up-front cost, which equates to $195 per acre-foot for an estimated five years of water savings ($195/AF x 5 years) multiplied by the average annual water use in previous three years, whichever is less. The Pilot Program lasted two years and was successful in meeting its goal of accelerating the use of recycled water.

In 2016, Metropolitan’s Board authorized the On-site Retrofit Program (ORP), with an additional budget of $10 million. This program encompassed lessons learned from the Pilot Program and feedback from member agencies to make the program more streamlined and improve its efficiency. As of fiscal year 2019/20, the ORP has successfully converted 440 sites, increasing the use of recycled water by 12,691 acre-feet per year.

Stormwater Pilot Programs

In 2019, Metropolitan's Board authorized both the Stormwater for Direct Use Pilot Program and a Stormwater for Recharge Pilot Program to study the feasibility of reusing stormwater to help meet regional demands in Southern California. These pilot programs are intended to encourage the development, monitoring, and study of new and existing stormwater projects by providing financial incentives for their construction/retrofit and monitoring/reporting costs. These pilot programs will help evaluate the potential benefits delivered by stormwater capture projects and provide a basis for potential future funding approaches. Metropolitan's Board authorized a total of $12.5 million for the stormwater pilot programs ($5 million for the District Use Pilot and $7.5 million for the Recharge Pilot).

Current Status and Results of Metropolitan's Local Resource Programs

Today, nearly one-half of the total recycled water and groundwater recovery production in the region has been developed with an incentive from one or more of Metropolitan's local resource programs. During fiscal year 2020, Metropolitan provided about $13 million for production of 71,000 acre-feet of recycled water for non-potable and indirect potable uses. Metropolitan provided about $4 million to support projects that produced about 50,000 acre-feet of recovered groundwater for municipal use. Since 1982, Metropolitan has invested $680 million to fund 85 recycled water projects and 27 groundwater recovery projects that have produced a cumulative total of about 4 million acre-feet.

Conservation Programs

Metropolitan's regional conservation programs and approaches have a long history. Decades ago, Metropolitan recognized that demand management at the consumer level would be an important part of balancing regional supplies and demands. Water conservation efforts were seen as a way to reduce the need for imported supplies and offset the need to transport or store additional water into or within the Metropolitan service area. The actual conservation of water takes place at the retail consumer level. Regional conservation approaches have proven to be effective at reaching retail consumers throughout Metropolitan's service area and successfully implementing water saving devices, programs and practices. Through the pooling of funding by Metropolitan's member agencies, Metropolitan is able to engage in regional campaigns with wide-reaching impact. Regional investments in demand management programs, of which conservation is a key part along with local supply programs, benefit all member agencies regardless of project location. These programs help to increase regional water supply reliability, reduce demands for imported water supplies, decrease the burden on Metropolitan's infrastructure, reduce system costs, and free up conveyance capacity to the benefit of all member agencies.

Incentive-Based Conservation Programs

Conservation Credits Program

In 1988, Metropolitan's Board approved the Water Conservation Credits Program (Credits Program). The Credits Program is similar in concept to the Local Projects Program (LPP). The purpose of the Credits Program is to encourage local water agencies to implement effective water conservation projects through the use of financial incentives. The Credits Program provides financial assistance for water conservation projects that reduce demands on Metropolitan's imported water supplies and require Metropolitan's assistance to be financially feasible.

Initially, the Credits Program provided 50 percent of a member agency's program cost, up to a maximum of $75 per acre-foot of estimated water savings. The $75 Base Conservation Rate was established based Metropolitan's avoided cost of pumping SWP supplies. The Base Conservation Rate has been revisited by Metropolitan's Board and revised twice since 1988, from $75 to $154 per acre-foot in 1990 and from $154 to $195 per acre-foot in 2005.

In fiscal year 2020 Metropolitan processed more than 30,400 rebate applications totaling $18.9 million.

Member Agency Administered Program

Some member agencies also have unique programs within their service areas that provide local rebates that may differ from Metropolitan's regional program. Metropolitan continues to support these local efforts through a member agency administered funding program that adheres to the same funding guidelines as the Credits Program. The Member Agency Administered Program allows member agencies to receive funding for local conservation efforts that supplement, but do not duplicate, the rebates offered through Metropolitan's regional rebate program.

Water Savings Incentive Program

There are numerous commercial entities and industries within Metropolitan's service area that pursue unique savings opportunities that do not fall within the general rebate programs that Metropolitan provides. In 2012, Metropolitan designed the Water Savings Incentive Program (WSIP) to target these unique commercial and industrial projects. In addition to rebates for devices, under this program, Metropolitan provides financial incentives to businesses and industries that created their own custom water efficiency projects. Qualifying custom projects can receive funding for permanent water efficiency changes that result in reduced potable demand.

Non-Incentive Conservation Programs

In addition to its incentive-based conservation programs, Metropolitan also undertakes additional efforts throughout its service area that help achieve water savings without the use of rebates. Metropolitan's non-incentive conservation efforts include:

- residential and professional water efficient landscape training classes
- water audits for large landscapes
- research, development and studies of new water saving technologies
- advertising and outreach campaigns
- community outreach and education programs
- advocacy for legislation, codes, and standards that lead to increased water savings

Current Status and Results of Metropolitan's Conservation Programs

Since 1990, Metropolitan has invested $824 million in conservation rebates that have resulted in a cumulative savings of 3.27 million acre-feet of water. These investments include $450 million in turf removal and other rebates during the last drought which resulted in 175 million square feet of lawn turf removed. During fiscal year 2020, 1.06 million acre-feet of water is estimated to have been conserved. This annual total includes Metropolitan's Conservation Credits Program; code-based conservation achieved through Metropolitan-sponsored legislation; building plumbing codes and ordinances; reduced consumption resulting from changes in water pricing; and pre-1990 device retrofits.

Infeasibility of Accounting Regional Investments in Reduced Reliance Below the Regional Level

The accounting of regional investments that contribute to reduced reliance on supplies from the Delta watershed is straightforward to calculate and report at the regional aggregate level. However, any similar accounting is infeasible for the individual member agencies or their customers. As described above, the region (through Metropolitan) makes significant investments in projects, programs and other resources that reduce reliance on the Delta. In fact, all of Metropolitan's investments in Colorado River supplies, groundwater and surface storage, local resources development and demand management measures that reduce reliance on the Delta are collectively funded by revenues generated from the member agencies through rates and charges.

Metropolitan's revenues cannot be matched to the demands or supply production history of an individual agency, or consistently across the agencies within the service area. Each project or program funded by the region has a different online date, useful life, incentive rate and structure, and production schedule. It is infeasible to account for all these things over the life of each project or program and provide a nexus to each member agency's contributions to Metropolitan's revenue stream over time. Accounting at the regional level allows for the incorporation of the local supplies and water use efficiency programs done by member agencies and their customers through both the regional programs and through their own specific local programs. As shown above, despite the infeasibility of accounting reduced Delta reliance below the regional level, Metropolitan's member agencies and their customers have together made substantial contributions to the region's reduced reliance.

Because of this infeasibility to separate out the individual member agency's reduced reliance on the Delta, Metropolitan has completed the analysis to demonstrate a regional wide reduction which is shown in Table C-4.

4. Summary of Expected Outcomes for Reduced Reliance on the Delta

As stated in WR P1(c)(1)(C), the policy requires that, commencing in 2015, UWMPs include expected outcomes for measurable reduction in Delta reliance and improved regional self- reliance. WR P1 further states that those outcomes shall be reported in the UWMP as the reduction in the amount of water used, or in the percentage of water used, from the Delta.

The expected outcomes for TVWD's reduced Delta reliance and regional self-reliance were developed using the approach and guidance described in the Guidebook Appendix C issued in March 2021.

Improved Regional Self-Reliance

The data used to demonstrate increased regional self-reliance in this analysis represent TVWD's imported potable water use. The following provides a summary of the near-term (2025) and long-term (2045) expected outcomes for TVWD's regional self-reliance.

- Near-term (2025) – Normal water year regional self-reliance is expected to increase by approximately 7,600 AF from the 2010 baseline (Table C-3).
- Long-term (2045) – Normal water year regional self-reliance is expected to increase by approximately 8,600 AF from the 2010 baseline (Table C-3).

The results show that TVWD is reducing reliance on the Delta and improving regional self-reliance through water efficient practices, in conjunction with Western, Metropolitan, and other member agency efforts. As discussed, additional investments in local supplies, such as recycled water, were not included in this analysis to be conservative due to gaps in comparable data between the 2010 baseline and future years. As a result, the improvement in regional self-reliance is expected to be even greater than demonstrated in this analysis.

Reduced Reliance on Supplies from the Delta Watershed

For reduced reliance on supplies from the Delta Watershed, the data used in this analysis represent the total regional efforts of Metropolitan, its member agencies (e.g., Western), and their customers (including TVWD), and were developed in conjunction with Western and other Metropolitan member agencies as part of the UWMP coordination process (as described in Section 5 of Metropolitan's 2020 UWMP). In accordance with UWMP requirements, Metropolitan's member agencies and their customers (many of them retail agencies) also report demands and supplies for their service areas in their respective UWMPs. The data reported by those agencies are not additive to the regional totals shown in Metropolitan's UWMP, rather their reporting represents subtotals of the regional total and should be considered as such for the purposes of determining reduced reliance on the Delta.

While the demands that Metropolitan's member agencies and their customers report in their UWMP's are a good reflection of the demands in their respective service areas, they do not adequately represent each water suppliers' individual contributions to reduced reliance on the Delta. To calculate and report their reliance on water supplies from the Delta watershed, water suppliers that receive water from the Delta through other regional or wholesale water suppliers would need to determine the amount of Delta water that they receive from the regional or wholesale supplier. Two specific pieces of information are needed to accomplish this, first is the quantity of demands on the regional or wholesale water supplier that accurately reflect a supplier's contributions to reduced reliance on the Delta and second is the quantity of a supplier's demands on the regional or wholesale water supplier that are met by supplies from the Delta watershed.

For water suppliers that make investments in regional projects or programs it may be infeasible to quantify their demands on the regional or wholesale water supplier in a way that accurately reflects their individual contributions to reduced reliance on the Delta. Due to the extensive, long-standing, and successful implementation of regional demand management and local resource incentive programs in Metropolitan's service area, this infeasibility holds true for Metropolitan's members as well as their customers. For Metropolitan's service area, reduced reliance on supplies from the Delta watershed can only be accurately accounted for at the regional level.

The results show that as a region, Metropolitan and its members (including Western) as well as their customers (TVWD) are measurably reducing reliance on the Delta and improving regional self-reliance.

5. UWMP Implementation

In addition to the analysis and documentation described above, WR P1 subsection (c)(1)(B) requires that all programs and projects included in the UWMP that are locally cost-effective and technically feasible, which reduce reliance on the Delta, are identified, evaluated, and implemented consistent with the implementation schedule. WR P1 (c)(1)(B) states that:

> *(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta[.]*

In accordance with Water Code Section 10631(f), water suppliers must already include in their UWMP a detailed description of expected future projects and programs that they may implement to increase the amount of water supply available to them in normal and single-dry water years and for a period of drought lasting five consecutive years. The UWMP description must also identify specific projects, include a description of the increase in water supply that is expected to be available from each project, and include an estimate regarding the implementation timeline for each project or program. Details on TVWD's supply is described in Chapter 6 of its 2020 UWMP.

6. 2015 UWMP Appendix I

The information contained in this appendix is also intended to be a new Appendix I to TVWD's 2015 UWMP consistent with WR P1 subsection (c)(1)(C) (Cal. Code Regs. tit. 23, § 5003). TVWD provided notice of the availability of the draft 2020 UWMP, 2020 WSCP, and the new Appendix I to the 2015 UWMP and held a public hearing to consider adoption of the documents in accordance with CWC Sections 10621(b) and 10642, and Government Code Section 6066, and Chapter 17.5 (starting with Section 7290) of Division 7 of Title 1 of the Government Code. The public review drafts of the 2020 UWMP, 2020 WSCP, and Appendix I to the 2015 UWMP were posted on TVWD's website in advance of the public hearing on November 23, 2021. The notice of availability of the documents was sent to TVWD's customers, as well as cities and counties in TVWD's service area. Copies of the notification letters are included in the 2020 UWMP Appendix C. Thus, this Appendix A to TVWD's 2020 UWMP, which was adopted with TVWD's 2020 UWMP, will also be recognized and treated as Appendix I to TVWD's 2015 UWMP.

TVWD held a public hearing for the draft 2020 UWMP, draft 2020 WSCP, and draft Appendix I to the 2015 UWMP on November 23, 2021, at a regular Board of Directors (Board) meeting, held online due to COVID-19 concerns. TVWD's Board determined that the 2020 UWMP and the 2020 WSCP accurately represent the water resources plan for TVWD's service area. In addition, TVWD's Board determined that this appendix to both the 2015 UWMP and the 2020 UWMP includes all the elements described in Delta Plan Policy WR P1, Reduce Reliance on the Delta through Improved Regional Water Self-Reliance (Cal. Code Regs. tit. 23, § 5003), which need to be included in a water supplier's UWMP to support a certification of consistency for a future covered action. As stated in Resolutions R-21-21, R-21-22, and R-21-20, TVWD's Board adopted the 2020 UWMP, 2020 WSCP, and Appendix I to the 2015 UWMP and authorized their submittal to the State of California. Copies of the resolutions are included in the 2020 UWMP Appendix G.

Table 1. C-1 Optional Calculation of Water Use Efficiency

Service Area Water Use Efficiency Demands (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Service Area Water Demands with Water Use Efficiency Accounted For	6,161	6,501	3,221	5,152	5,825	5,825	5,825	5,825
Non-Potable Water Demands								
Potable Service Area Demands with Water Use Efficiency Accounted For	6,161	6,501	3,221	5,152	5,825	5,825	5,825	5,825

Total Service Area Population	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Service Area Population	12,461	18,437	16,919	25,868	29,242	29,242	29,242	29,242

Water Use Efficiency Since Baseline (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Per Capita Water Use (GPCD)	441	315	170	178	178	178	178	178
Change in Per Capita Water Use from Baseline (GPCD)		(127)	(271)	(264)	(264)	(264)	(264)	(264)
Estimated Water Use Efficiency Since Baseline		2,614	5,144	7,637	8,632	8,632	8,632	8,632

Table 2. C-2 Calculation of Service Area Demands without Water Use Efficiency

Total Service Area Water Demands (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Service Area Water Demands with Water Use Efficiency Accounted For	6,161	6,501	3,221	5,152	5,825	5,825	5,825	5,825
Reported Water Use Efficiency or Estimated Water Use Efficiency Since Baseline	-	1,183	3,831	5,630	6,363	6,363	6,363	6,363
Service Area Water Demands without Water Use Efficiency Accounted For	6,161	7,684	7,052	10,782	12,188	12,188	12,188	12,188

Table 3. C-3 Calculation of Supplies Contributing to Regional Self-Reliance

Water Supplies Contributing to Regional Self-Reliance (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Water Use Efficiency	-	1,183	3,831	5,630	6,363	6,363	6,363	6,363
Water Recycling								
Stormwater Capture and Use								
Advanced Water Technologies								
Conjunctive Use Projects								
Local and Regional Water Supply and Storage Projects								
Other Programs and Projects the Contribute to Regional Self-Reliance								
Water Supplies Contributing to Regional Self-Reliance	-	1,183	3,831	5,630	6,363	6,363	6,363	6,363

Service Area Water Demands without Water Use Efficiency (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Service Area Water Demands without Water Use Efficiency Accounted For	6,161	7,684	7,052	10,782	12,188	12,188	12,188	12,188

Change in Regional Self Reliance (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Water Supplies Contributing to Regional Self-Reliance	-	1,183	3,831	5,630	6,363	6,363	6,363	6,363
Change in Water Supplies Contributing to Regional Self-Reliance		1,183	3,831	5,630	6,363	6,363	6,363	6,363

Percent Change in Regional Self Reliance (As Percent of Demand w/out WUE)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Percent of Water Supplies Contributing to Regional Self-Reliance	0.0%	15.4%	54.3%	52.2%	52.2%	52.2%	52.2%	52.2%
Change in Percent of Water Supplies Contributing to Regional Self-Reliance		15.4%	54.3%	52.2%	52.2%	52.2%	52.2%	52.2%

Table 4. C-4 Calculation of Reliance on Water Supplies from the Delta Watershed

Water Supplies from the Delta Watershed (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
CVP/SWP Contract Supplies	1,472,000	1,029,000	984,000	1,133,000	1,130,000	1,128,000	1,126,000	1,126,000
Delta/Delta Tributary Diversions								
Transfers and Exchanges	20,000	44,000	91,000	58,000	52,000	52,000	52,000	52,000
Other Water Supplies from the Delta Watershed								
Total Water Supplies from the Delta Watershed	1,492,000	1,073,000	1,075,000	1,191,000	1,182,000	1,180,000	1,178,000	1,178,000

Service Area Water Demands without Water Use Efficiency (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Service Area Water Demands without Water Use Efficiency Accounted For	5,493,000	5,499,000	5,219,000	4,925,000	5,032,000	5,156,000	5,261,000	5,374,000

Change in Supplies from the Delta Watershed (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Water Supplies from the Delta Watershed	1,492,000	1,073,000	1,075,000	1,191,000	1,182,000	1,180,000	1,178,000	1,178,000
Change in Water Supplies from the Delta Watershed		(419,000)	(417,000)	(301,000)	(310,000)	(312,000)	(314,000)	(314,000)

Percent Change in Supplies from the Delta Watershed (As a Percent of Demand w/out WUE)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045 (Optional)
Percent of Water Supplies from the Delta Watershed	27.2%	19.5%	20.6%	24.2%	23.5%	22.9%	22.4%	21.9%
Change in Percent of Water Supplies from the Delta Watershed		-7.6%	-6.6%	-3.0%	-3.7%	-4.3%	-4.8%	-5.2%

B

Appendix B. DWR Checklist

2020 Guidebook Location	Water Code Section	Summary as Applies to UWMP	Subject	2020 UWMP Location
Chapter 1	10615	A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities.	Introduction and Overview	Section 1 Introduction and Lay Description
Chapter 1	10630.5	Each plan shall include a simple description of the supplier's plan including water availability, future requirements, a strategy for meeting needs, and other pertinent information. Additionally, a supplier may also choose to include a simple description at the beginning of each chapter.	Summary	1.2 UWMP Organization and Lay Description
Section 2.2	10620(b)	Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier.	Plan Preparation	1.1 The California Water Code
Section 2.6	10620(d)(2)	Coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.	Plan Preparation	2.2 Coordination and Outreach
Section 2.6.2	10642	Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan and contingency plan.	Plan Preparation	2.2 Coordination and Outreach
Section 2.6, Section 6.1	10631(h)	Retail suppliers will include documentation that they have provided their wholesale supplier(s) - if any - with water use projections from that source.	System Supplies	2.2.1 Wholesale and Retail Coordination
Section 2.6	10631(h)	Wholesale suppliers will include documentation that they have provided their urban water suppliers with identification and quantification of the existing and planned sources of water available from the wholesale to the urban supplier during various water year types.	System Supplies	N/A
Section 3.1	10631(a)	Describe the water supplier service area.	System Description	3.1 General Service Area Description
Section 3.3	10631(a)	Describe the climate of the service area of the supplier.	System Description	3.2 Service Area Climate
Section 3.4	10631(a)	Provide population projections for 2025, 2030, 2035, 2040 and optionally 2045.	System Description	3.3.1 Service Area Population
Section 3.4.2	10631(a)	Describe other social, economic, and demographic factors affecting the supplier's water management planning.	System Description	3.3.2 Other Social, Economic, and Demographic Factors
Sections 3.4 and 5.4	10631(a)	Indicate the current population of the service area.	System Description and Baselines and Targets	3.3.1 Service Area Population, Table 3-2
Section 3.5	10631(a)	Describe the land uses within the service area.	System Description	3.4 Land Uses within Service Area
Section 4.2	10631(d)(1)	Quantify past, current, and projected water use, identifying the uses among water use sectors.	System Water Use	4.2 Past, Current, and Projected Water Use by Sector
Section 4.2.4	10631(d)(3)(C)	Retail suppliers shall provide data to show the distribution loss standards were met.	System Water Use	4.2.2 Distribution System Water Losses
Section 4.2.6	10631(d)(4)(A)	In projected water use, include estimates of water savings from adopted codes, plans and other policies or laws.	System Water Use	4.2.3 Projected Water Use
Section 4.2.6	10631(d)(4)(B)	Provide citations of codes, standards, ordinances, or plans used to make water use projections.	System Water Use	4.2.3 Projected Water Use
Section 4.3.2.4	10631(d)(3)(A)	Report the distribution system water loss for each of the 5 years preceding the plan update.	System Water Use	4.2.2 Distribution System Water Losses, Table 4-5
Section 4.4	10631.1(a)	Include projected water use needed for lower income housing projected in the service area of the supplier.	System Water Use	4.3 Water Use for Lower Income Households
Section 4.5	10635(b)	Demands under climate change considerations must be included as part of the drought risk assessment.	System Water Use	7.2.1 Data, Methods, and Basis for Water Shortage Condition
Chapter 5	10608.20(e)	Retail suppliers shall provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data.	Baselines and Targets	Section 5 SBX7-7 Baseline, Targets and 2020 Compliance
Chapter 5	10608.24(a)	Retail suppliers shall meet their water use target by December 31, 2020.	Baselines and Targets	5.3 2020 Compliance Daily Per-Capita Water Use (GPCD), Table 5-2
Section 5.1	10608.36	Wholesale suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their retail water suppliers achieve targeted water use reductions.	Baselines and Targets	N/A

Section 5.2	10608.24(d)(2)	If the retail supplier adjusts its compliance GPCD using weather normalization, economic adjustment, or extraordinary events, it shall provide the basis for, and data supporting the adjustment.	Baselines and Targets	N/A
Section 5.5	10608.22	Retail suppliers' per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use of the 5 year baseline. This does not apply if the suppliers base GPCD is at or below 100.	Baselines and Targets	Section 5 SBX7-7 Baseline, Targets and 2020 Compliance
Section 5.5 and Appendix E	10608.4	Retail suppliers shall report on their compliance in meeting their water use targets. The data shall be reported using a standardized form in the SBX7-7 2020 Compliance Form.	Baselines and Targets	5.3 2020 Compliance Daily Per-Capita Water Use (GPCD), Table 5-2
Sections 6.1 and 6.2	10631(b)(1)	Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought.	System Supplies	Section 6 Water Supply Characterization
Sections 6.1	10631(b)(1)	Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought, *including changes in supply due to climate change.*	System Supplies	Section 6 Water Supply Characterization and Chapter 7 Water Service Reliability Assessment
Section 6.1	10631(b)(2)	When multiple sources of water supply are identified, describe the management of each supply in relationship to other identified supplies.	System Supplies	6.2 Water Supply Characterization
Section 6.1.1	10631(b)(3)	Describe measures taken to acquire and develop planned sources of water.	System Supplies	6.2.8 Future Water Projects
Section 6.2.8	10631(b)	Identify and quantify the existing and planned sources of water available for 2020, 2025, 2030, 2035, 2040 and optionally 2045.	System Supplies	6.2.9 Summary of Existing and Planned Sources of Water
Section 6.2	10631(b)	Indicate whether groundwater is an existing or planned source of water available to the supplier.	System Supplies	6.2.2 Groundwater
Section 6.2.2	10631(b)(4)(A)	Indicate whether a groundwater sustainability plan or groundwater management plan has been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization.	System Supplies	6.2.2 Groundwater
Section 6.2.2	10631(b)(4)(B)	Describe the groundwater basin.	System Supplies	6.2.2 Groundwater
Section 6.2.2	10631(b)(4)(B)	Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the supplier has the legal right to pump.	System Supplies	N/A
Section 6.2.2.1	10631(b)(4)(B)	For unadjudicated basins, indicate whether or not the department has identified the basin as a high or medium priority. Describe efforts by the supplier to coordinate with sustainability or groundwater agencies to achieve sustainable groundwater conditions.	System Supplies	6.2.2 Groundwater
Section 6.2.2.4	10631(b)(4)(C)	Provide a detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years	System Supplies	6.2.2.2 Past Five Years, Table 6-1
Section 6.2.2	10631(b)(4)(D)	Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped.	System Supplies	6.2.9 Summary of Existing and Planned Sources of Water
Section 6.2.7	10631(c)	Describe the opportunities for exchanges or transfers of water on a short-term or long- term basis.	System Supplies	6.2.7 Water Exchanges and Transfers
Section 6.2.5	10633(b)	Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.	System Supplies (Recycled Water)	6.2.5 Wastewater and Recycled Water
Section 6.2.5	10633(c)	Describe the recycled water currently being used in the supplier's service area.	System Supplies (Recycled Water)	6.2.5.4 Potential, Current, and Projected Recycled Water Uses
Section 6.2.5	10633(d)	Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses.	System Supplies (Recycled Water)	6.2.5.4 Potential, Current, and Projected Recycled Water Uses
Section 6.2.5	10633(e)	Describe the projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected.	System Supplies (Recycled Water)	6.2.5.4 Potential, Current, and Projected Recycled Water Uses; Table 6-6
Section 6.2.5	10633(f)	Describe the actions which may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year.	System Supplies (Recycled Water)	6.2.5.5 Actions to Exchange and Optimize Future Recycled Water Use
Section 6.2.5	10633(g)	Provide a plan for optimizing the use of recycled water in the supplier's service area.	System Supplies (Recycled Water)	6.2.5.5 Actions to Exchange and Optimize Future Recycled Water Use; Table 6-7

Section 6.2.6	10631(g)	Describe desalinated water project opportunities for long-term supply.	System Supplies	6.2.6 Desalinated Water Opportunities
Section 6.2.5	10633(a)	Describe the wastewater collection and treatment systems in the supplier's service area with quantified amount of collection and treatment and the disposal methods.	System Supplies (Recycled Water)	6.2.5.2 Wastewater Collection, Treatment, and Disposal
Section 6.2.8, Section 6.3.7	10631(f)	Describe the expected future water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and for a period of drought lasting 5 consecutive water years.	System Supplies	6.2.8 Future Water Projects
Section 6.4 and Appendix O	10631.2(a)	The UWMP must include energy information, as stated in the code, that a supplier can readily obtain.	System Suppliers, Energy Intensity	6.3 Energy Intensity
Section 7.2	10634	Provide information on the quality of existing sources of water available to the supplier and the manner in which water quality affects water management strategies and supply reliability	Water Supply Reliability Assessment	Section 7 Water Service Reliability and Drought Risk Assessment
Section 7.2.4	10620(f)	Describe water management tools and options to maximize resources and minimize the need to import water from other regions.	Water Supply Reliability Assessment	7.1.3 Descriptions of Management Tools and Options
Section 7.3	10635(a)	Service Reliability Assessment: Assess the water supply reliability during normal, dry, and a drought lasting five consecutive water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years.	Water Supply Reliability Assessment	7.1.2 Water Service Reliability
Section 7.3	10635(b)	Provide a drought risk assessment as part of information considered in developing the demand management measures and water supply projects.	Water Supply Reliability Assessment	7.2 Drought Risk Assessment
Section 7.3	10635(b)(1)	Include a description of the data, methodology, and basis for one or more supply shortage conditions that are necessary to conduct a drought risk assessment for a drought period that lasts 5 consecutive years.	Water Supply Reliability Assessment	7.2.1 Data, Methods, and Basis for Water Shortage Condition
Section 7.3	10635(b)(2)	Include a determination of the reliability of each source of supply under a variety of water shortage conditions.	Water Supply Reliability Assessment	7.2.2 DRA Water Source Reliability
Section 7.3	10635(b)(3)	Include a comparison of the total water supply sources available to the water supplier with the total projected water use for the drought period.	Water Supply Reliability Assessment	7.1.2 Water Service Reliability
Section 7.3	10635(b)(4)	Include considerations of the historical drought hydrology, plausible changes on projected supplies and demands under climate change conditions, anticipated regulatory changes, and other locally applicable criteria.	Water Supply Reliability Assessment	7.1.1 Constraints on Water Sources
Chapter 8	10632(a)	Provide a water shortage contingency plan (WSCP) with specified elements below.	Water Shortage Contingency Planning	Appendix F, Water Shortage Contingency Plan
Chapter 8	10632(a)(1)	Provide the analysis of water supply reliability (from Chapter 7 of Guidebook) in the WSCP	Water Shortage Contingency Planning	Appendix F, 1.2 Water Supply Reliability Analysis
Section 8.10	10632(a)(10)	Describe reevaluation and improvement procedures for monitoring and evaluation the water shortage contingency plan to ensure risk tolerance is adequate and appropriate water shortage mitigation strategies are implemented.	Water Shortage Contingency Planning	Appendix F, 1.10 Monitoring and Reporting
Section 8.2	10632(a)(2)(A)	Provide the written decision-making process and other methods that the supplier will use each year to determine its water reliability.	Water Shortage Contingency Planning	Appendix F, 1.3 Annual Water Supply and Demand Assessment
Section 8.2	10632(a)(2)(B)	Provide data and methodology to evaluate the supplier's water reliability for the current year and one dry year pursuant to factors in the code.	Water Shortage Contingency Planning	Appendix F, 1.3 Annual Water Supply and Demand Assessment
Section 8.3	10632(a)(3)(A)	Define six standard water shortage levels of 10, 20, 30, 40, 50 percent shortage and greater than 50 percent shortage. These levels shall be based on supply conditions, including percent reductions in supply, changes in groundwater levels, changes in surface elevation, or other conditions. The shortage levels shall also apply to a catastrophic interruption of supply.	Water Shortage Contingency Planning	Appendix F, 1.4 Water Shortage Levels
Section 8.3	10632(a)(3)(B)	Suppliers with an existing water shortage contingency plan that uses different water shortage levels must cross reference their categories with the six standard categories.	Water Shortage Contingency Planning	Appendix F, 1.4 Water Shortage Levels, Figure 1
Section 8.4	10632(a)(4)(A)	Suppliers with water shortage contingency plans that align with the defined shortage levels must specify locally appropriate supply augmentation actions.	Water Shortage Contingency Planning	Appendix F, 1.5.2 Supply Augmentation
Section 8.4	10632(a)(4)(B)	Specify locally appropriate demand reduction actions to adequately respond to shortages.	Water Shortage Contingency Planning	Appendix F, 1.5.1 Demand Reduction
Section 8.4	10632(a)(4)(C)	Specify locally appropriate operational changes.	Water Shortage Contingency Planning	Appendix F, 1.5.3 Operational Changes

Section 8.4	10632(a)(4)(D)	Specify additional mandatory prohibitions against specific water use practices that are in addition to state-mandated prohibitions are appropriate to local conditions.	Water Shortage Contingency Planning	Appendix F, 1.5.4 Additional Mandatory Restrictions
Section 8.4	10632(a)(4)(E)	Estimate the extent to which the gap between supplies and demand will be reduced by implementation of the action.	Water Shortage Contingency Planning	Appendix F, Table 3
Section 8.4.6	10632.5	The plan shall include a seismic risk assessment and mitigation plan.	Water Shortage Contingency Plan	Appendix F, 1.5.6 Seismic Risk Assessment, Mitigation Plan, and Emergency Response Plan
Section 8.5	10632(a)(5)(A)	Suppliers must describe that they will inform customers, the public and others regarding any current or predicted water shortages.	Water Shortage Contingency Planning	Appendix F, 1.6 Communication Protocols
Section 8.5 and 8.6	10632(a)(5)(B) 10632(a)(5)(C)	Suppliers must describe that they will inform customers, the public and others regarding any shortage response actions triggered or anticipated to be triggered and other relevant communications.	Water Shortage Contingency Planning	Appendix F, 1.6 Communication Protocols
Section 8.6	10632(a)(6)	Retail supplier must describe how it will ensure compliance with and enforce provisions of the WSCP.	Water Shortage Contingency Planning	Appendix F, 1.7 Compliance and Enforcement
Section 8.7	10632(a)(7)(A)	Describe the legal authority that empowers the supplier to enforce shortage response actions.	Water Shortage Contingency Planning	Appendix F, 1.8 Legal Authorities
Section 8.7	10632(a)(7)(B)	Provide a statement that the supplier will declare a water shortage emergency Water Code Chapter 3.	Water Shortage Contingency Planning	Appendix F, 1.3 Annual Water Supply and Demand Assessment
Section 8.7	10632(a)(7)(C)	Provide a statement that the supplier will coordinate with any city or county within which it provides water for the possible proclamation of a local emergency.	Water Shortage Contingency Planning	N/A
Section 8.8	10632(a)(8)(A)	Describe the potential revenue reductions and expense increases associated with activated shortage response actions.	Water Shortage Contingency Planning	Appendix F, 1.9 Financial Consequences of the WSCP
Section 8.8	10632(a)(8)(B)	Provide a description of mitigation actions needed to address revenue reductions and expense increases associated with activated shortage response actions.	Water Shortage Contingency Planning	Appendix F, 1.9 Financial Consequences of the WSCP
Section 8.8	10632(a)(8)(C)	Retail suppliers must describe the cost of compliance with Water Code Chapter 3.3: Excessive Residential Water Use During Drought	Water Shortage Contingency Planning	Appendix F, 1.9 Financial Consequences of the WSCP
Section 8.9	10632(a)(9)	Retail suppliers must describe the monitoring and reporting requirements and procedures that ensure appropriate data is collected, tracked, and analyzed for purposes of monitoring customer compliance.	Water Shortage Contingency Planning	Appendix F, 1.10 Monitoring and Reporting
Section 8.11	10632(b)	Analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas.	Water Shortage Contingency Planning	Appendix F, 1.12 Special Water Feature Distinction
Sections 8.12 and 10.4	10635(c)	Provide supporting documentation that Water Shortage Contingency Plan has been, or will be, provided to any city or county within which it provides water, no later than 30 days after the submission of the plan to DWR.	Plan Adoption, Submittal, and Implementation	Appendix F, 1.13 Plan Adoption, Submittal, and Availability
Section 8.14	10632(c)	Make available the Water Shortage Contingency Plan to customers and any city or county where it provides water within 30 after adopted the plan.	Water Shortage Contingency Planning	Appendix F, 1.13 Plan Adoption, Submittal, and Availability
Sections 9.1 and 9.3	10631(e)(2)	Wholesale suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and supplier assistance program.	Demand Management Measures	N/A
Sections 9.2 and 9.3	10631(e)(1)	Retail suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will address specific measures listed in code.	Demand Management Measures	Section 9 Demand Management Measures
Chapter 10	10608.26(a)	Retail suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets (recommended to discuss compliance).	Plan Adoption, Submittal, and Implementation	10.2 Notice of Public Hearing and 10.3 Public Hearing and Adoption
Section 10.2.1	10621(b)	Notify, at least 60 days prior to the public hearing, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. Reported in Table 10-1.	Plan Adoption, Submittal, and Implementation	10.2 Notice of Public Hearing, Table 10-1
Section 10.4	10621(f)	Each urban water supplier shall update and submit its 2020 plan to the department by July 1, 2021.	Plan Adoption, Submittal, and Implementation	10.4 Plan Submittal

Sections 10.2.2, 10.3, and 10.5	10642	Provide supporting documentation that the urban water supplier made the plan and contingency plan available for public inspection, published notice of the public hearing, and held a public hearing about the plan and contingency plan.	Plan Adoption, Submittal, and Implementation	Section 10 Plan Adoption, Submittal, and Implementation
Section 10.2.2	10642	The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water.	Plan Adoption, Submittal, and Implementation	10.2 Notice of Public Hearing
Section 10.3.2	10642	Provide supporting documentation that the plan and contingency plan has been adopted as prepared or modified.	Plan Adoption, Submittal, and Implementation	10.3 Public Hearing and Adoption, Appendix G
Section 10.4	10644(a)	Provide supporting documentation that the urban water supplier has submitted this UWMP to the California State Library.	Plan Adoption, Submittal, and Implementation	10.4 Plan Submittal
Section 10.4	10644(a)(1)	Provide supporting documentation that the urban water supplier has submitted this UWMP to any city or county within which the supplier provides water no later than 30 days after adoption.	Plan Adoption, Submittal, and Implementation	10.5 Public Availability
Sections 10.4.1 and 10.4.2	10644(a)(2)	The plan, or amendments to the plan, submitted to the department shall be submitted electronically.	Plan Adoption, Submittal, and Implementation	10.4 Plan Submittal
Section 10.5	10645(a)	Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the supplier has or will make the plan available for public review during normal business hours.	Plan Adoption, Submittal, and Implementation	10.5 Public Availability
Section 10.5	10645(b)	Provide supporting documentation that, not later than 30 days after filing a copy of its water shortage contingency plan with the department, the supplier has or will make the plan available for public review during normal business hours.	Plan Adoption, Submittal, and Implementation	10.5 Public Availability
Section 10.6	10621(c)	If supplier is regulated by the Public Utilities Commission, include its plan and contingency plan as part of its general rate case filings.	Plan Adoption, Submittal, and Implementation	N/A
Section 10.7.2	10644(b)	If revised, submit a copy of the water shortage contingency plan to DWR within 30 days of adoption.	Plan Adoption, Submittal, and Implementation	10.6 Amending an Adopted UWMP or WSCP

C

Appendix C. Letters of Notification

TEMESCAL VALLEY WATER DISTRICT
Established in 1965

July 15, 2021

Mr. Ryan Shaw
Director of Water Resources
Western Municipal Water District
14205 Meridian Parkway
Riverside, CA 92518

Subject: Temescal Valley Water District 2020 Urban Water Management Plan Update

Dear Mr. Shaw:

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Water Code section 10621(b) requires an urban water supplier updating its UWMP to notify cities and counties within its service area of the update at least sixty (60) days prior to holding a public hearing. This letter serves as TVWD's notice that it is preparing and updating its 2020 UWMP, to be adopted and submitted to the California Department of Water Resources. TVWD will also be adopting its Water Shortage Contingency Plan (WSCP) as part of the 2020 UWMP.

TVWD is also considering an Addendum to its 2015 UWMP to demonstrate consistency with the Delta Plan Policy to Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (California Code Reg., tit. 23, § 5003). A copy of TVWD's draft 2020 UWMP, WSCP, and 2015 UWMP Addendum will be available for review on TVWD's website (https://www.temescalvwd.com/) in fall of 2021, and TVWD will subsequently hold noticed public hearings on the 2020 UWMP, WSCP, and 2015 UWMP Addendum in advance of their proposed adoption.

TVWD invites you to submit comments and consult with TVWD regarding its 2020 UWMP update, WSCP, and 2015 UWMP Addendum. TVWD anticipates holding a public comment period in fall 2021, with a public hearing planned during that time.

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Sincerely,

Jeff Pape
General Manager

TEMESCAL VALLEY
WATER DISTRICT
Established in 1965

July 15, 2021

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Planning Director
County of Riverside
4080 Lemon Street
Riverside, CA 92502

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Temescal Valley Water District
22646 Temescal Canyon Road | Temescal Valley, CA 92883-4106 | tel: 951.277.1414 | fax: 951.277.1419
www.temescalvwd.com

TEMESCAL VALLEY WATER DISTRICT
Established in 1965

July 15, 2021

Mr. Parag Kalaria
Water Resource Manager
Elsinore Valley Municipal Water District
31315 Chaney Street
Lake Elsinore, CA 92530

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July 15, 2021

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Corona Department of Power and Water
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County of Riverside
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TEMESCAL VALLEY WATER DISTRICT
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Public Hearing Notice
2020 Urban Water Management Plan and Water Shortage Contingency Plan

October 28, 2021

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General Manager

Temescal Valley Water District
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D

Appendix D. Public Hearing Notices

THE PRESS-ENTERPRISE

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Temescal Valley Water District
Public Hearing Notice
2020 Urban Water Management Plan, Water Shortage Contingency Plan, and Addendum to the 2015 Urban Water Management Plan

Notice is hereby given that on **Tuesday, December 21, 2021** at 8:30 a.m. the Board of Directors of Temescal Valley Water District (TVWD Board) will conduct a public hearing at the District Office located at 22646 Temescal Canyon Road, Temescal Valley, CA 92883 to receive public comments and consider adoption of the Draft 2020 Urban Water Management Plan (UWMP), Draft Water Shortage Contingency Plan (WSCP), and Draft Addendum to TVWD's 2015 UWMP. Recommended modifications to the Draft 2020 UWMP, Draft WSCP, and Draft Addendum, if any, will be identified after the TVWD Board has heard the public input. Staff anticipates the TVWD Board will adopt the Draft 2020 UWMP and Draft WSCP with recommended modifications after the public hearing portion of the meeting. The Final UWMP and Final WSCP, including any recommended modifications, will be prepared and submitted to the California Department of Water Resources.

To meet the requirements of California Water Code Division 6, Part 2.6, Section 10632, TVWD is also updating the WSCP. The WSCP documents TVWD's plans to manage and mitigate an actual water shortage condition, should one occur because of drought or other impacts on water supplies. The updated WSCP will be adopted as a separate document but will also be included in the 2020 UWMP.

In compliance with California Water Code Sections 10621 and 10642, this publication serves as notification to all nearby city and county agencies to TVWD, and the general public that the Draft 2020 UWMP, Draft WSCP, and Draft 2015 Addendum will be available for public review starting on **November 9, 2021** and can be downloaded at https://www.temescalvwd.com. Any written questions or comments regarding the Draft 2020 UWMP, Draft WSCP, and Draft 2015 Addendum must be received at the District by the close of business on Friday, December 17, 2021 and should be directed to: Temescal Valley Water District, 22646 Temescal Canyon Road, Temescal Valley, California 92883, Attention: Jeff Pape or at JeffP@temescalvwd.com.

Press-Enterprise: 12/03, 12/10

E

Appendix E. USBR Climate Change Analysis for the Santa Ana River Watershed

RECLAMATION

Managing Water in the West

Technical Memorandum No. 1

Climate Change Analysis for the Santa Ana River Watershed

Santa Ana Watershed Basin Study, California
Lower Colorado Region

Santa Ana River Watershed Location Map

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U.S. Department of the Interior
Bureau of Reclamation

August 2013

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

BUREAU OF RECLAMATION
Water and Environmental Resources Division (86-68200)
Water Resources Planning and Operations Support Group (86-68210)
Technical Services Center, Denver, Colorado

Technical Memorandum No. 86-68210-2013-02

Climate Change Analysis for the Santa Ana River Watershed

Santa Ana Watershed Basin Study, California
Lower Colorado Region

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Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
%	percent
~	Approximately
AB 32	Assembly Bill 32
AMJJ	April - July
AR4	Fourth Assessment Report
BCSD	Bias Correction and Spatial Disaggregation or bias-corrected and spatially downscaled
CDF	Cumulative Distribution Function
CO_2e	Carbon Dioxide Equivalent
CMIP	Coupled Model Intercomparison Project (CMIP1, CMIP2, CMIP3, and CMIP5 are CMIP phases 1, 2, 3, and 5 respectively)
DCP	Downscaled Climate Projections
DEM	Digital Elevation Model
DJFM	December - March
DOE	U.S. Department of Energy
DWR	California Department of Water Resources
EMWD	Eastern Municipal Water District
EVMWD	Elsinore Valley Municipal Water District
FAQs	Frequently Asked Questions
GCM	General Circulation Model, or Global Climate Model

GHG	Greenhouse Gas
IEUA	Inland Empire Utilities Agency
IPCC	Intergovernmental Panel on Climate Change
IRWM	Integrated Regional Water Management
km	kilometer
LESJWA	Lake Elsinore and San Jacinto Watersheds Authority
LLNL	Lawrence Livermore National Laboratory
MAF	million acre-feet
MAFY	million acre feet per year
MGD	million gallons per day
MWDSC	The Metropolitan Water District of Southern California
NCAR	National Center for Atmospheric Research
OCWD	Orange County Water District
OWOW	One Water One Watershed
PCMDI	Program for Climate Model Diagnosis and Intercomparison
PET	Potential Evapotranspiration
QSA	Quantification Settlement Agreement
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
SARP	Santa Ana River Mainstem Project
SARW	Santa Ana River Watershed
SAWPA	Santa Ana Watershed Project Authority
SBVMWD	San Bernardino Valley Municipal Water District

SECURE	Science and Engineering to Comprehensively Understand and Responsibly Enhance
SCAG	Southern California Association of Governments
SLR	Sea Level Rise
SWE	Snow Water Equivalent
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
VIC	Variable Infiltration Capacity hydrologic model
WaterSMART	WaterSMART (Sustain and Manage America's Resources for Tomorrow)
WCRP	World Climate Research Programme
WMWD	Western Municipal Water District
WRMS	Water Resources Management System

Executive Summary

The Santa Ana Watershed Basin Study (Basin Study) is a collaborative effort by the Santa Ana Watershed Project Authority (SAWPA) and the Bureau of Reclamation (Reclamation), authorized under the Sustain and Manage America's Resources for Tomorrow SECURE Water Act (Title IX, Subtitle F of Public Law 111-11). The study began in 2011 and was completed in the spring of 2013. The Basin Study complements SAWPA's Integrated Regional Water Management (IRWM) planning process, also known as the "One Water One Watershed" (OWOW) Plan, and refines the watershed's water projections, and identifies potential adaptation strategies, in light of projected effects of climate change. This climate change analysis for the Santa Ana River Watershed (SARW) is a contributing section to the Basin Study.

This report explains the methods used to develop an analysis of potential implications of the changing climate, and how those implications might affect issues of importance to the Santa Ana River Watershed. Chapter 1 provides an introduction to the project and the study area, along with a summary of relevant previous studies. The development of climate projections and hydrology models used can be found in Chapter 2. Chapter 3 provides projections for water supply and demand in the SARW. An impact analysis was conducted focusing on key areas of importance to the SARW, the results of which can be found in Chapter 4. A tool to evaluate demand management is presented in Chapter 5, along with a case study of potential adaptation strategies. Chapter 6 addresses uncertainties in climate change analysis.

In light of climate change, prolonged drought conditions, growth, and population projections, a strong concern exists to ensure there will be adequate water supplies to meet future water demand. The findings of this Basin Study will be used to update the OWOW Plan, evaluate the implications of climate change, assess increased energy demand, and ensure that future water quality and supply needs are met. Goals of the study include: 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.

Future water supply was analyzed for the Santa Ana River Watershed using the Variable Infiltration Capacity (VIC) hydrologic model (Liang et al., 1994; Liang et al., 1996; Nijssen et al., 1997) to project streamflow using 112 different projections of future climate. Projected climate variables, including daily precipitation, minimum temperature, maximum temperature, and wind speed, came from the Bias Corrected and Spatially Downscaled Coupled Model Intercomparison Project Phase 3 (BCSD-CMIP3) archive. Historical VIC model simulations over the period 1950-1999 were conducted using historical meteorological forcings (factors affecting the climate of the earth that drive or “force” the climate to change) developed by Maurer et al., (2002), and subsequent extensions. The VIC hydrologic model solves the water balance for each of a series of 1/8° by 1/8° (~12km x 12 km) grid cells, which represent the watershed. Daily climate projections span the time period January 1, 1950 to December 31, 2099 and exist for each grid cell. Grid based outputs of daily runoff and baseflow generated by the VIC hydrologic model are routed to select sites throughout the watershed to produce daily streamflow projections. Through coordination with SAWPA and local water agencies, 36 key locations in the basin were determined, so that sub-basins could be delineated. Change factors were developed by calculating decade mean (reference decade – 1990s; three future decades – 2020s, 2050s, and 2070s) total precipitation and temperature, then calculating percent change, and finally calculating the median change for all the 112 projections. Final products include data sets at key locations for precipitation, temperature, evapotranspiration, April 1st Snow Water Equivalent (SWE), and streamflow.

These data sets were used to answer frequently asked questions regarding impacts of climate change on the Santa Ana River Watershed. The questions and key findings can be found below.

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 in order 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 on basin-scale groundwater conditions.

Is Lake Elsinore in danger of drying up?

- Lake Elsinore has less than a 10% chance of drying up (2000-2099).
- 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 (EVMWD) 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 m 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.

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 water in the oceans.
- 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 5-24 inches by 2050 and 16-66 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.

1.0 Introduction

1.1 Purpose, Scope, and Objective of Study

The Santa Ana Watershed Basin Study (Basin Study) is a collaborative effort by the Santa Ana Watershed Project Authority (SAWPA) and the Bureau of Reclamation (Reclamation), authorized under the Sustain and Manage America's Resources for Tomorrow SECURE Water Act (Title IX, Subtitle F of Public Law 111-11). The study began in 2011 and was completed in the spring of 2013. The Basin Study complements SAWPA's Integrated Regional Water Management (IRWM) planning process, also known as their "One Water One Watershed" (OWOW) Plan, and refines the watershed's water projections, and identifies potential adaptation strategies, in light of projected effects of climate change. This climate change analysis for the Santa Ana River Watershed is a contributing section to the Basin Study.

SAWPA is a joint powers authority that represents five major water resource agencies. SAWPA's area includes over 350 water, wastewater and groundwater management, flood control, environmental, and other nongovernmental organizations. These entities work together collaboratively and focus on the region's OWOW Plan.

In light of climate change, prolonged drought conditions, growth, and population projections, a strong concern exists to ensure there will be adequate water supplies to meet future water demand. The findings of this Basin Study will be used to update the OWOW Plan, evaluate the implications of climate change, and ensure that future water quality and supply needs are met. Goals of the study include: 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 affects; facilitating watershed adaptation planning; and expanding outreach to all major water uses and stakeholders.

1.1.1 Location and Description of Study Area

The Santa Ana River Watershed (also referred to as SARW, or 'Watershed') is home to over 6 million people, within an area of 2,650 square miles in southern California. The regional population is projected to grow to almost ten million within the next 50 years (U.S. Census Bureau, 2010). The watershed includes much of Orange County, the northwestern corner of Riverside County, the southwestern corner of the San Bernardino County, and small portions of Las Angeles County. The watershed is bounded on the south by the Santa Margarita watershed, on the east by the Salton Sea and Southern Mojave watersheds, and on the northwest by the Mojave and San Gabriel watersheds. SAWPA has five member agencies: Eastern Municipal Water District (EMWD), Inland Empire

Utilities Agency (IEUA), Orange County Water District (OCWD), San Bernardino Valley Municipal Water District (SBVMWD), and Western Municipal Water District (WMWD). shown below in Figure 1.

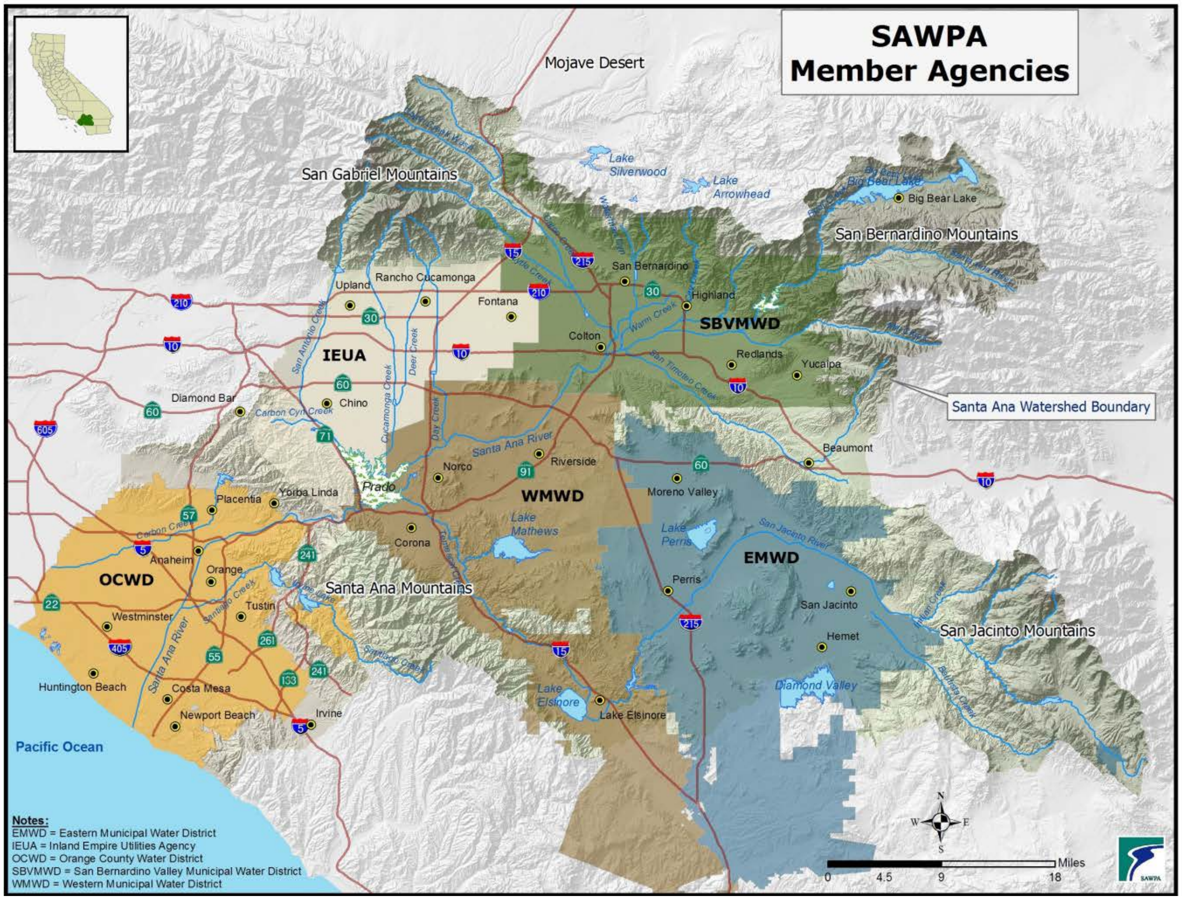


Figure 1: SAWPA member agencies

The climate and geography of the State of California present a unique challenge to the management and delivery of water. While most of the State's precipitation falls on the northern portion of the State, most of California's population resides in the semi-arid, southern portion of the State. Water is diverted, stored, and then transferred from the water-rich north to the more arid central and southern sections of the state through the California State Water Project (SWP), the Central Valley Project, and the Los Angeles Aqueduct. In addition to the projects that transport water from the north to the south, the southern coastal area relies on water imported through The Metropolitan Water District of Southern California's (Metropolitan) Colorado River Aqueduct. The Bureau of Reclamation and seven basin states manage the Colorado River system under the authority of the Secretary of the Interior and for the benefit of the seven basin states. Over-allocation of this resource, along with a U.S Supreme Court Decision (Arizona v. California, 1964) and population and economic growth, led to the recent California "4.4 Plan" and Quantification Settlement Agreement (QSA). The QSA limits California's share of the Colorado River water supply to 4.4 million acre-feet (MAF). As a result of these actions, Metropolitan's supply from the Colorado River was significantly reduced, especially during extended dry periods. In the past, a buffer supply was developed by constructing new facilities, such as dams and/or aqueducts, to provide water supply for future growth. Today, the gap between supply and demand has closed and increasing emphasis is placed on conservation and development of local supplies. Building new facilities is costly and such projects face strict environmental review before they can be approved. This has caused California to seek more creative and sustainable solutions to water resource management.

1.2 Summary of Previous and Current Studies

A large body of research has been conducted over the past ten or more years on climate change and its potential impacts on the western United States. Most of this research has focused on large scale implications (for example, over the western United States), while providing limited regional scale information. The following section summarizes research that is relevant to the Watershed, and shows that although these results are applicable, additional research was required, through this Basin Study, to evaluate smaller scale, site specific, climate change impacts. For additional information on previous and current climate change studies, not directly related to the Watershed, please see Reclamation's Literature Synthesis on Climate Change Implications for Water and Environmental Resources (http://www.usbr.gov/research/docs/climatechangelitsynthesis.pdf).

1.2.1 Historical Trends

California's historical temperature has increased by about 1.7°F over the past 116 years (Moser et al., 2012), while showing declines in spring snowpack and a shift to earlier spring runoff (Knowles et al., 2007; Regonda et al., 2005; Peterson et al., 2008; Stewart et al., 2009). It is difficult to distinguish long-term climate change from natural climate variability, although many studies have tried to distinguish between the two (Bonfils et al., 2007; Cayan et al., 2001; Gershunov et al., 2009). It is likely that the historical temperature trends are due to a combination of anthropogenic climate change and natural climate variability (Reclamation, 2011k).

A study by Gershunov et al., (2012) shows that generally, there is a positive trend (1950-2010) in heat wave activity over the entire California region that is expressed most strongly and clearly in nighttime rather than daytime temperature extremes. This trend in nighttime heat wave activity has intensified markedly since the 1980s and especially since 2000. The two most recent nighttime heat waves were also strongly expressed in extreme daytime temperatures. Circulations associated with great regional heat waves advect hot air into the region. This air can be dry or moist, depending on whether a moisture source is available, causing heat waves to be expressed preferentially during day or night.

A remote moisture source centered within a marine region west of Baja California has been increasing in prominence because of gradual sea surface warming and a related increase in atmospheric humidity. Adding to the very strong synoptic dynamics during the 2006 heat wave were a prolonged stream of moisture from this southwestern source, and despite the heightened humidity, an environment in which afternoon convection was suppressed, keeping cloudiness low and daytime temperatures high.

Vermeera and Rahmstorf (2009) suggest a simple relationship linking global sea-level variations to temperature. This relationship is tested on synthetic data from a global climate model for the past millennium and the next century. When applied to observed data of sea level and temperature for 1880–2000, and taking into account known anthropogenic hydrologic contributions to sea level, the correlation explains 98% of the variance.

Trends in historical precipitation are more sporadic making it difficult to attribute them to climate change (Hoerling et al., 2010). A series of regression analyses, conducted by Dettinger and Cayan (1995), indicate that runoff timing responds equally to the observed decadal-scale trends in winter temperature and interannual temperature variations of the same magnitude, suggesting that the trend in temperature is sufficient to explain the increasingly early runoff. However, this trend is not immediately distinguishable from natural atmospheric variability.

A well-documented shift towards earlier runoff can be attributed, in part, to more precipitation falling as rain instead of snow (Regonda et al., 2005; Pierce et al., 2008; Das et al., 2009; Hidalgo et al., 2009; Lindquist et al., 2009). Knowles et al., (2007) showed a regional trend during the period 1949–2001 toward smaller ratios of winter-total snowfall water equivalent (SWE) to winter-total precipitation, with the most pronounced reductions occurring in the Sierra Nevada and the Pacific Northwest, with more varied changes (but still predominantly reductions) in the Rockies. The trends in this ratio correspond to shifts toward less SWE rather than to changes in overall precipitation, except in the Southern Rockies, where both snowfall and precipitation have increased. The trends toward reduced SWE are a response to warming across the region, with the most significant reductions occurring where winter-average wet-day minimum temperature changes have been less than +3°C over the course of the study period. The observed trends in hydroclimatology over the western United States will likely have significant impacts on water resources planning and management.

There have been preliminary efforts by agencies managing California’s water resources to incorporate climate change research into their planning and management tools, including preliminary modeling studies of potential impacts of climate change to operations of the State Water Project and Central Valley Project, Delta water quality and water levels, flood forecasting and evapotranspiration rates (Anderson et al., 2008).

1.2.2 Climate Projections

The Intergovernmental Panel on Climate Change (IPCC) projections of future climate have been utilized in assessing climate over California. Projections indicate the rate of increase in global mean annual temperature nearly doubles before 2100, and that increases in summer temperatures are greater than winter (IPCC, 2007). There is less confidence in projections of future precipitation than temperature (Reclamation, 2011). However, precipitation projections show less snowfall and more rainfall, less snowpack development and earlier runoff, more intense and heavy rainfall interspersed with longer dry periods (Congressional Budget Office, 2009; Lundquist et al., 2009; Moser et al., 2009; Rauscher et a l2008; Maurer et al.,2007).

1.2.3 Hydrological Projections

The changing climate will likely result in lower stream flow, lower reservoir storage, and decreased water supply deliveries and reliability later in the 21st century throughout California (Vicuna and Dracup, 2007). Drought in the Southwest may no longer be driven by precipitation, but rather by temperature (Hoerling and Eischeid, 2007).

Two hydrologic impacts, in which there is high confidence, are increasing winter streamflow and decreasing late spring and summer flow (Maurer, 2007). There is also high confidence in reduced snowpack at the end of winter, and earlier arrival of the annual peak flow volume, which has important implications for California's water management. The shift to earlier peak streamflow timing, and the decline in end-of-winter snow pack, results in more extreme impacts under higher emissions scenarios in all cases. This indicates that future emissions scenarios play a significant role in the degree of impacts to water resources in California.

The potential effects of climate change on the hydrology and water resources of the Sacramento–San Joaquin River Basin were evaluated by Van Rheenen et al., (2004) using an ensemble of climate projections generated by the U.S. Department of Energy and National Center for Atmospheric Research Parallel Climate Model (DOE/NCAR PCM). From these global simulations, transient monthly temperature and precipitation sequences were statistically downscaled to produce continuous daily hydrologic model forcings, which drove a macro-scale hydrology model (VIC) of the Sacramento–San Joaquin River Basins at a 1/8° spatial resolution, and produced daily streamflow sequences for each climate projection. Each streamflow scenario was used in a water resources system model that simulated current and predicted future performance of the system. Results from the water resources system model indicated that achieving and maintaining status quo system performance in the future would be nearly impossible, given the altered hydrologic projections.

1.2.4 Climate Change Impacts

With respect to management, a number of studies have investigated the implications of climate change on water management in the region, suggesting management of reservoir systems will become more challenging (Vicuna and Dracup, 2007). The impacts are expected to be expensive, but not catastrophic for California (Harou et al., 2010).

Subtle changes in hydrology due to climate change can alter wetlands, resulting in a positive biotic feedback, contributing methane and carbon dioxide to the atmosphere (Burkett and Kusler, 2007). Policy options for minimizing the adverse impacts of climate change on wetland ecosystems include the reduction of current anthropogenic stresses, allowing for inland migration of coastal wetlands as sea-level rises, active management to preserve wetland hydrology, and a wide range of other management and restoration options.

Ficke et al. (2007) summarizes the general effects of climate change on freshwater systems to be increased water temperatures, decreased dissolved oxygen levels, and the increased toxicity of pollutants. Altered hydrologic regimes and increased groundwater temperatures could affect the quality of fish habitat. Eutrophication may be exacerbated and stratification will likely become more pronounced. Model predictions indicate that global climate change will continue even if greenhouse gas emissions decrease or cease. Therefore, proactive management strategies such as removing other stressors from natural systems will be necessary to sustain our freshwater fisheries.

Projected temperature and carbon dioxide increases may extend growing seasons, stimulate weed growth, increase pests, and may impact pollination (Baldocchi and Wong 2006). Stream temperatures in many areas are increasing due to increases in air temperature and reduced summer flows that make streams more sensitive to warmer air temperatures (Haak et al., 2010).

1.3 Identification of Interrelated Activities

1.3.1 Federal – WaterSMART

The WaterSMART Program, established by the Secretary of the Interior under Secretarial Order 3297, addresses an increasing set of water supply challenges, including chronic water supply shortages due to increased population growth, climate variability and change, and heightened competition for finite water supplies. The WaterSMART Program was developed as means of implementing the SECURE Water Act of 2009 (Public Law 111-11). The WaterSMART Program provides the scientific and financial tools and the collaborative environment needed to help balance water supply and demand through the efficient use of current supplies and the development of new supplies. Through WaterSMART, Reclamation is making use of the best available science in the assessments it conducts and the policies it employs. WaterSMART science has and will continue to inform the real-time decisions of water managers who need reliable estimates of current conditions in the hydrologic cycle and projections of supply and demand in watersheds throughout the nation. Many examples of best available science are being developed through the WaterSMART Program. Much of that science can be accessed through the WaterSMART Clearinghouse, an online collaborative site where best practices and cost-effective technologies for water conservation and sustainable water strategies are shared with the public (http://www.doi.gov/watersmart/html/index.php).

1.3.2 State – Proposition 84 and IRWM

California's Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Prop 84) authorizes $5.388 billion in general obligation bonds to fund safe drinking water, water quality and supply, flood control, waterway and natural resource protection, water pollution and contamination control, state and local park improvements, public access to natural resources, and water conservation efforts.

Integrated Regional Water Management (IRWM) is a collaborative effort to manage all aspects of water resources in a region. IRWM crosses jurisdictional, watershed, and political boundaries; involves multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions. The California Department of Water Resources is currently working to ensure that IRWM planning is continued and expanded throughout the State; better align state and federal programs, polices, and regulations to support IRWM; identify stable and sufficient funding for IRWM; and further support regional water management groups.

1.3.3 Local – OWOW

The Santa Ana Watershed Project Authority is a planning and implementation agency that was formed in 1972 with the goal of building facilities to protect the water quality of the Watershed. Their planning efforts have expanded and, in 2006, SAWPA's One Water One Watershed (OWOW) plan was adopted. The OWOW plan is a comprehensive view of the watershed and water issues. The plan encompasses all sub-regions, political jurisdictions, water agencies and non-governmental stakeholders (private sector, environmental groups, and the public at large) in the watershed. All types of water (imported, local surface and groundwater, stormwater, and wastewater effluent) are viewed as components of a single water resource, inextricably linked to land use and habitat, and the plan tries to limit impacts of water use and climate change on natural hydrology.

2.0 Climate Projections and Hydrology Models

2.1 Climate Projections

Projected changes in climate (including both anthropogenic changes and natural variability), and their influence on streamflow and basin water supply, have been studied by several researchers in recent years, as described in Chapter 1. Future projections from global climate models (GCMs) indicate that the climate may exhibit trends and increased variability over the 21st century, beyond what has occurred historically. Downscaled GCM projections are one way to consider plausible future conditions.

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. GCM projections used in this study are spatially downscaled to 12 km grids to make them relevant for regional climate change impacts analysis. This process is illustrated in Figure 2. The downscaled GCM projections used in the Basin Study are based on the Coupled Model Intercomparison Project Phase 3 (CMIP3). These projections were the basis for analysis in the IPCC Fourth Assessment Report (IPCC, 2007).The emission scenarios used in the downscaled GCM projections based on CMIP3 are A2 (high), A1b (medium), and B1 (low), and reflect a range of future GHG emissions. The A2 scenario is representative of high population growth, slow economic development, and slow technological change. It is characterized by a continuously increasing rate of GHG emissions, and features the highest annual emissions rates of any scenario by the end of the 21st Century. The A1B scenario features a global population that peaks mid-century and rapid introduction of new and more efficient technologies balanced across both fossil- and non-fossil intensive energy sources. As a result, GHG emissions in the A1B scenario peak around mid-century. Last, the B1 scenario describes a world with rapid changes in economic structures toward a service and information economy. GHG emission rates in this scenario peak prior to mid-century and are generally the lowest of the scenarios.

Emission scenarios exist that have both higher and lower GHG emissions than those considered in this Basin Study (e.g. A1fi). However, the three scenarios included in the analysis span a wide range of projected GHG, and there are more GCM projections available based on these three emissions scenarios than any others.

This Study used the downscaled CMIP3 climate projections; however, new projections from the CMIP5 were recently published in May 2013. CMIP5 climate projections are based on emission scenarios referred to as representative concentration pathways (RCPs; Taylor, 2011). Even though CMIP5 projections are more current, it has not been determined that they are a more reliable source of climate projections compared to existing CMIP3 climate projections. At this time, CMIP5 projections should be considered an addition to (not a replacement for) the existing CMIP3 projections, unless the climate science community can offer an explanation as to why CMIP5 should be favored over CMIP3.

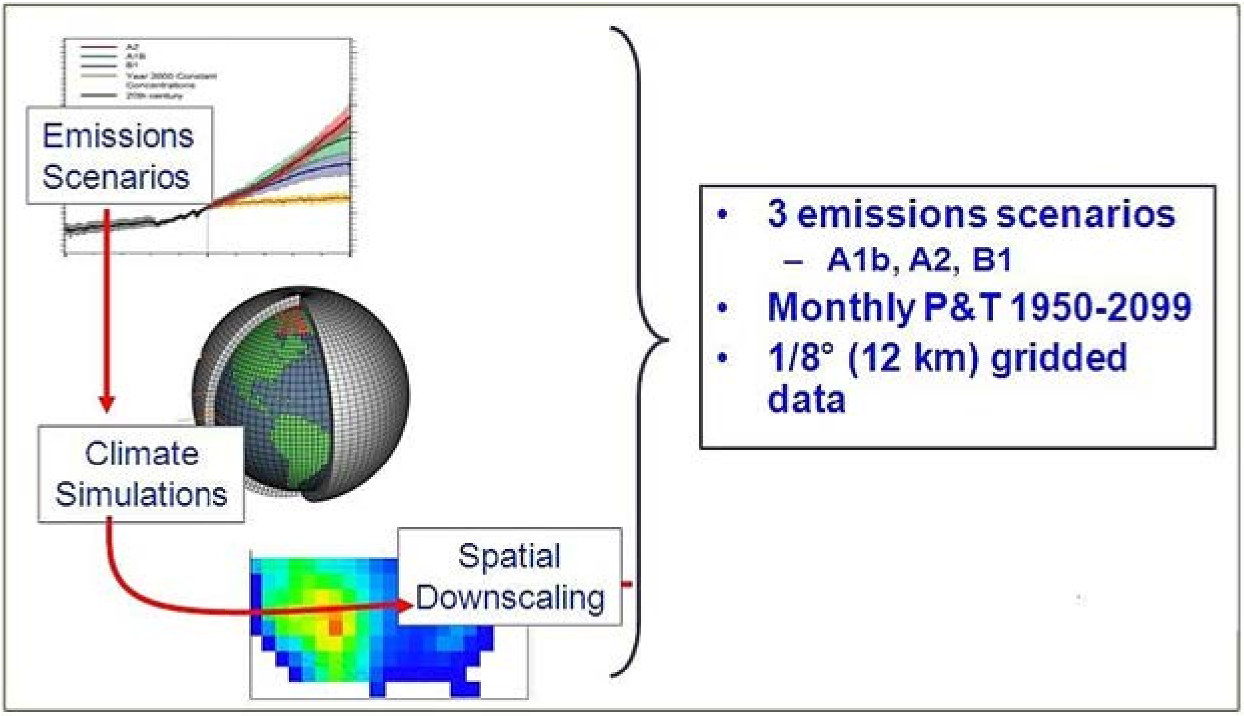


Figure 2: Downscaled GCM key elements figure

2.2 Hydrology Models for the Santa Ana River Watershed

2.2.1 Surface Water

Surface water hydrology projections for the Watershed were developed using the Variable Infiltration Capacity (VIC) model (Liang et al., 1994; Liang et al., 1996; Nijssen et al., 1997) as part of Reclamation's SECURE report on surface water hydrology projections (Reclamation, 2011).

The VIC model is a spatially distributed hydrology model that solves the water balance at each model grid cell. The model initially was designed as a land-surface model to be incorporated in a GCM so that land-surface processes could be more accurately simulated. However, the model now is run almost exclusively as a stand-alone hydrology model (not integrated with a GCM) and has been widely used in climate change impact and hydrologic variability studies. For climate change impact studies, VIC is run in what is termed the water balance mode that is less computationally demanding than an alternative energy balance mode, in which a surface temperature that closes both the water and energy balances is solved for iteratively. A schematic of the VIC hydrology and energy balance model is given in Figure 3.

The VIC model may be implemented at any spatial resolution, adhering to a latitude-longitude grid. For this Basin Study, and for consistency with Reclamation's West-Wide Climate Risk Assessment, the model was implemented over the study area at 1/8° or ~12 km resolution. Physical characteristics of each cell are predefined within the study area to simulate runoff and other water/land/atmosphere interactions at each grid cell. The VIC hydrology model uses daily weather data (precipitation, maximum temperature, minimum temperature and wind) along with land cover, soils, and elevation information at 1/8° grid scale to simulate hydrologic processes.

VIC provides a wide array of hydrologic outputs, typically including runoff, snow-water equivalent and evapotranspiration, which are routinely analyzed to assess climate change impacts on watershed hydrology. Also, note that all these outputs are produced at the native VIC grid cell resolution of 1/8° or ~12 km. Analysis of these hydrologic variables for the watershed is described in Chapter 3.

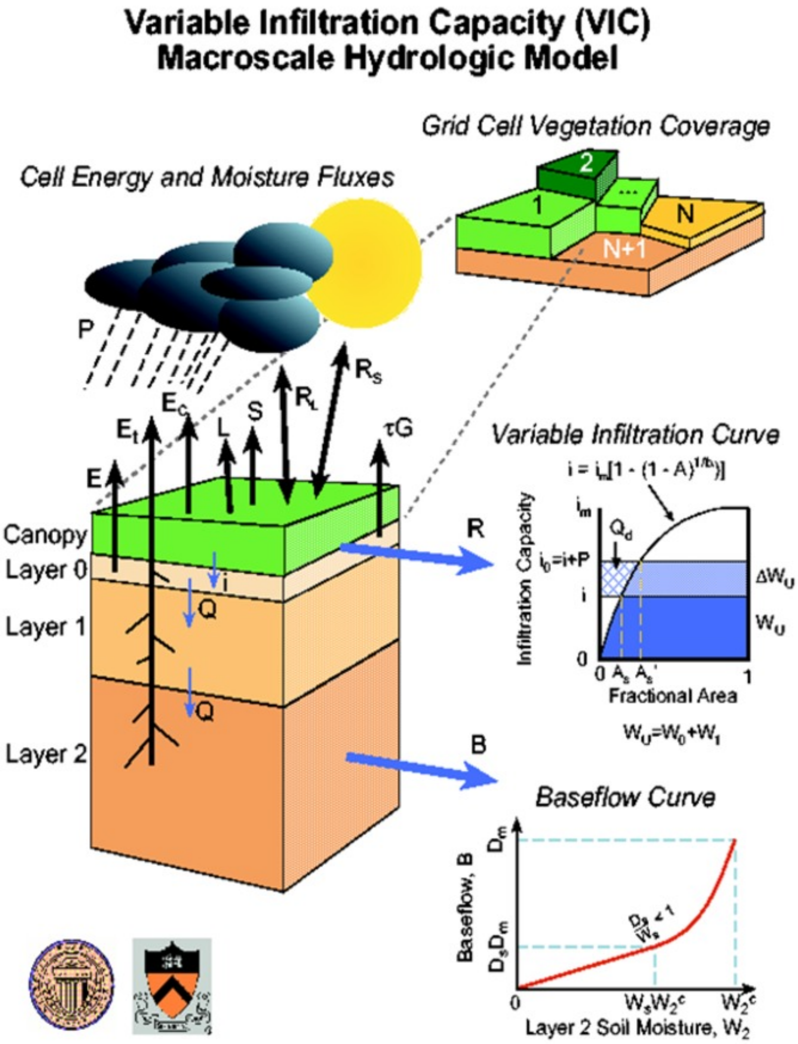


Figure 3: VIC macroscale hydrologic model

However, to analyze streamflow, gridded runoff was routed (Figure 4) to 36 gage locations (Table 1; Figure 5) within the Watershed using the Lohmann et al., (1998) routing model. Additional inputs to the routing model, developed for this Basin Study include, a routing network derived from 15 arc-second (~450 meters) Digital Elevation Model (DEM), flow accumulation, and flow direction data available from the United States Geological Survey (USGS) HydroSHEDS (hydrological data and maps based on Shuttle Elevation Derivatives at Multiple Scales) archive using ArcGIS™. The result of this approach is 112 unique sequences of natural flow under future climate projections. Further details on the development and choice of using the VIC model are available from Reclamation’s West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections (2011) report.

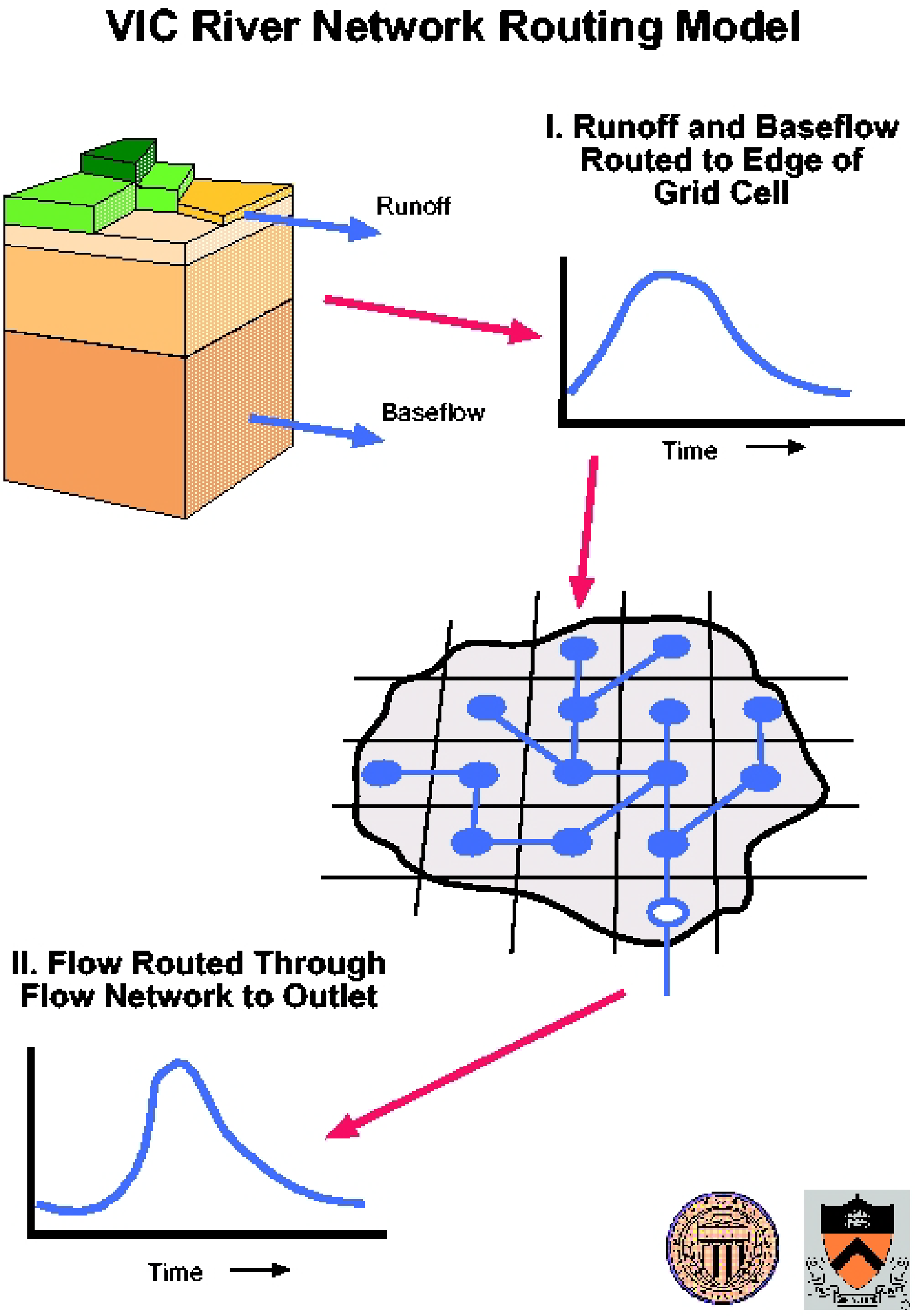


Figure 4: VIC routing model

Table 1: Routing locations in the Santa Ana River Watershed

ID	Latitude (decimal degree)	Longitude (decimal degree)	Site Description
1	33.675020160	-117.835611000	Peters Canyon Wash Tustin Gage
2	33.683909460	-117.745330710	Marshburn Channel Gage
3	33.681686820	-117.809499150	San Diego Creek Myford Rd Gage
4	33.725442191	-117.802408768	El Modina-Irvine Channel Gage
5	33.693809460	-117.823037908	Peters Canyon Wash Irvine Gage
6	33.672798000	-117.835888800	San Diego Creek Lane Rd Gage
7	33.655576290	-117.845611300	San Diego Creek Campus Dr Gage
8	33.885294816	-117.651816486	Santa Ana River Prado Dam Gage
9	33.872738742	-117.670852174	Santa Ana River County Line Gage
10	33.856404490	-117.790611220	Santa Ana River Imperial Highway Gage
11	33.855848910	-117.797555880	Santa Ana River AB SPRD Imperial Highway Gage
12	33.856404440	-117.800889300	Santa Ana River SPRD Imperial Highway Gage
13	33.888903530	-117.845335820	Carbon Creek Olinda Gage
14	33.889459080	-117.845335830	Carbon Creek Yorba Linda Gage
15	33.818812586	-117.873013779	Santa Ana River Ball Rd Gage
16	33.802238450	-117.878390750	Santa Ana River Katella Ave Gage
17	33.822794190	-117.776721310	Santiago Creek Villa Park Gage
18	33.822794190	-117.776721310	Santiago Creek Div Villa Park Gage
19	33.777261477	-117.878057039	Santiago Creek Santa Ana Gage
20	33.752045602	-117.906379262	Santa Ana River Santa Ana Gage
21	33.672033347	-117.943733939	Santa Ana River Adams St Gage
22	33.887792060	-117.926449600	Brea Channel Brea Dam Gage
23	33.873625670	-117.925893710	Brea Channel Fullerton Gage
24	33.895847650	-117.886170600	Fullteron Channel Fullerton Dam Gage
25	33.872875108	-117.902127395	Fullerton Channel Fullerton Gage
26	33.860696271	-117.929366516	Fullerton Channel Richman Ave Gage
27	33.810571570	-118.075342080	Coyote Creek Los Alamitos Gage
28	34.259256110	-117.330684440	Devils Canyon
29	33.968611110	-117.447500000	Santa Ana River AT Metropolitan Water District Crossing NR Arlington
30	34.064688346	-117.303911477	Santa Ana River AT E Street NR San Bernardino
31	33.889166670	-117.561944440	Temescal Creek AB Main Street AT Corona
32	33.982777780	-117.598611110	Cucamonga Creek NR Mira Loma
33	34.003888890	-117.726111110	Chino Creek AT Schaefer Avenue NR Chino
34	34.114206940	-117.096661940	Seven Oaks Dam Outlet
35	34.252500000	-117.525277780	Middle Fork Lytle Creek Gage
36	34.263888890	-117.401388890	Ridge Top Gage NR Devore

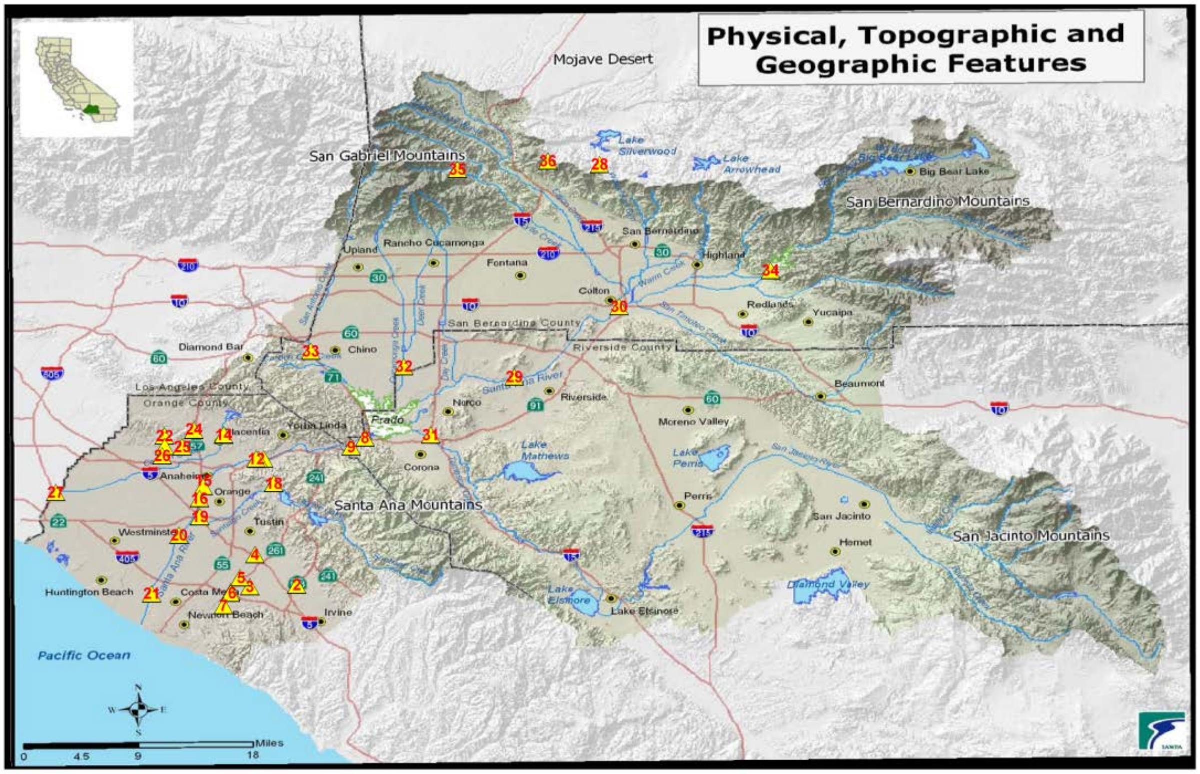


Figure 5: Distribution of routing locations

2.2.2 Groundwater

Changes in climate, population, land use, water management practices, and other natural and anthropogenic factors may affect the quantity and quality of future groundwater resources within the Watershed. Groundwater currently provides approximately 54% of total water supply in the watershed during an average year, and groundwater use is projected to increase over the next 20 years, according to the first OWOW plan (2010). The potential effects of natural and anthropogenic changes on future groundwater resources—including the potential effects of climate change—are therefore a critical component of water resources planning in the Watershed.

Changes in precipitation and temperature directly affect hydrologic processes at the land surface, including groundwater recharge. Changes in precipitation and temperature may also affect groundwater storage and discharge indirectly through changes in water demands. Accurately projecting the potential effects of climate change on groundwater resources within the Watershed, however, is a significant challenge due to the many local factors that govern groundwater recharge and use throughout the watershed. The Watershed encompasses 17 individual groundwater basins and sub-basins; however, only 4 have consistent historical data available, as shown in Figure 6 (California Department of Water Resources [DWR] Bulletin 118). Effects of changes in precipitation and temperature on groundwater resources are likely to vary substantially between groundwater basins due to differences in local hydrologic, geologic, and topographic conditions, as well as differences in local water supplies, water demands, and water management practices between basins.

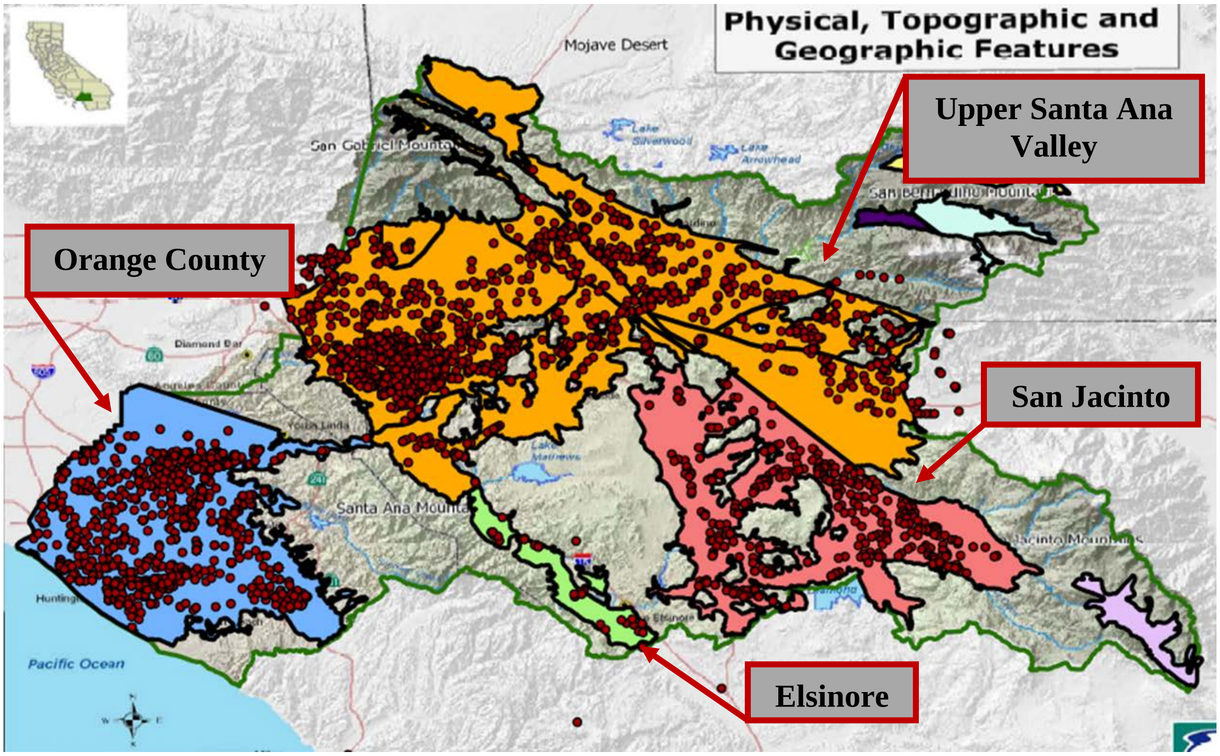


Figure 6: Groundwater basins and monitoring well locations (illustrated by red dots)

The effects of climate change on groundwater resources are commonly evaluated using a spatially distributed numerical model of the groundwater flow system in question, which may consist of a single aquifer or unit, multiple aquifers, or an entire groundwater basin or sub-basin. A numerical model of the groundwater flow system is constructed to represent the relevant physical properties of the system, including its geographic extent and orientation, the porosity and permeability of subsurface materials, and the location and extent of key features affecting groundwater flow such as faults, aquitards, and aquicludes. Historical inflows and outflows from the groundwater system are estimated from available data and formatted as model inputs, including spatially distributed recharge from precipitation, focused recharge from stream and canal seepage losses or deep percolation of irrigation water, groundwater abstraction by pumping, and other inflows and outflows. The model is then calibrated and verified with respect to available observations. A second set of groundwater inflows and outflows is then developed based on projected future climate conditions, and is again formatted as model inputs. Finally, the model is used to simulate groundwater flow and storage under historical and projected climate conditions and the resulting model outputs are compared to evaluate the effects of climate change on groundwater resources.

The use of spatially-distributed numerical models to evaluate climate change impacts on groundwater is both data intensive and computationally intensive, and requires explicit representation of the many local factors that affect groundwater recharge and use. As a result, this approach generally bears a large cost and long timeline. Moreover, the use of spatially-distributed numerical models to evaluate climate change impacts on groundwater resources in the Watershed would require development of separate models for individual groundwater basins and sub-basins. The cost of such an analysis is therefore prohibitive at the watershed scale.

In order to evaluate basin-scale groundwater conditions in the Watershed under future climate, population, land use, and water management scenarios, a basin-scale groundwater screening tool was developed based on a simplified representation of individual groundwater basins. The groundwater screening tool estimates fluctuations in basin-scale groundwater levels in response to natural and anthropogenic drivers, including climate and hydrologic conditions, agricultural land use, municipal water demand, and trans-basin water imports. The tool allows users to quickly estimate basin-scale groundwater conditions under a broad range of future scenarios and provides insight into the primary factors driving basin-scale groundwater fluctuations.

A basin-scale groundwater screening tool was developed to facilitate evaluation of groundwater conditions within the Watershed under future climate, population, land use, and water management scenarios. The tool estimates fluctuations in average groundwater levels over a given groundwater basin, at a monthly time scale, in response to natural and anthropogenic drivers, including climate and hydrologic conditions, agricultural land use, municipal water demand, and trans-basin water imports. The tool allows users to quickly estimate changes in basin-average groundwater levels in response to projected changes in future climate, and provides insight into the primary factors driving basin-scale groundwater fluctuations.

In groundwater basins where groundwater is a primary source of water supply, fluctuations in basin-averaged groundwater level depend on both water availability and water demands. In general, higher than average water availability from precipitation, local streamflow, and imported water contributes to increased recharge and/or decreased groundwater pumping, resulting in rising groundwater levels. By contrast, higher than average water demands for municipal and agricultural uses and higher than average evaporative demand from native and landscaped vegetation contribute to decreased recharge and/or increased groundwater pumping, resulting in declining groundwater levels. In addition to supply and demand, large-scale management objectives in some groundwater basins such as pressurization of hydraulic barriers against sea water intrusion and dewatering for hydraulic control of groundwater discharge may also affect basin-average groundwater levels.

The competing influences of water availability, water demand, and large-scale groundwater management objectives on basin-scale groundwater elevations are illustrated schematically in Figure 7, which forms the conceptual model for the basin-scale groundwater screening tool. This conceptual model considers fluctuations in basin-average groundwater elevations as a function of basin-scale drivers. As a result, use of the groundwater screening tool does not require detailed information regarding local hydrologic, geologic, climatic, and anthropogenic factors that may affect local groundwater fluctuations; however, it should be noted that as a result of this basin-scale approach, the groundwater screening tool is primarily applicable at the scale of individual groundwater basins or sub-basins, where the effects of local-scale conditions are largely averaged out and where subsurface inflows and outflows from surrounding areas are negligible.

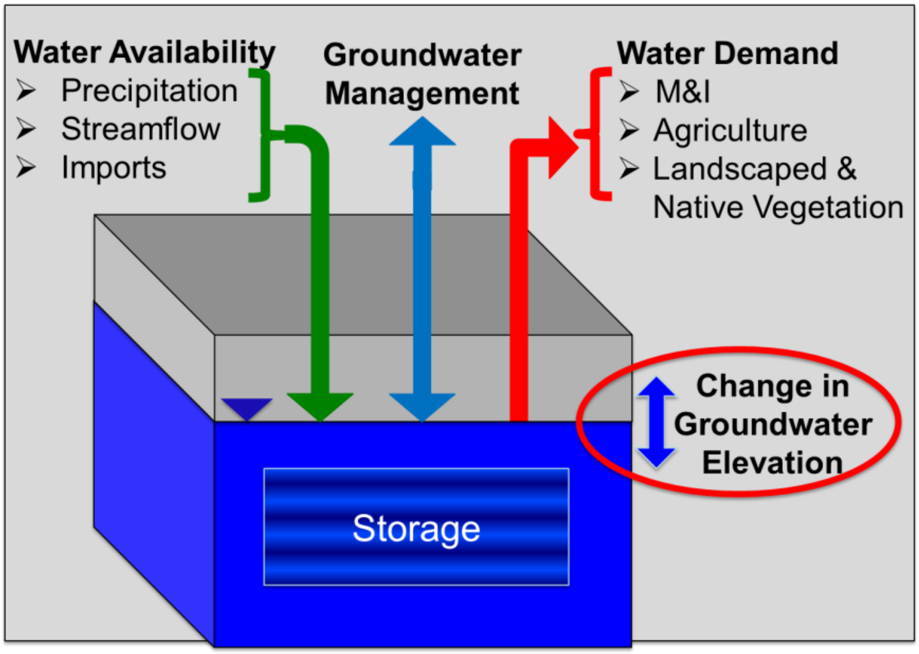


Figure 7: Conceptual model of basin-scale groundwater fluctuations used in developing the groundwater screening tool

In the basin-scale groundwater screening tool, fluctuations in groundwater elevation are estimated as a function of three inputs that characterize water availability (precipitation, local streamflow, and trans-basin imports), three inputs that characterize water demand (municipal and industrial demand, agricultural land use [irrigated acreage], and evaporative demand), and an optional exogenous input that represents groundwater management objectives that affect basin-scale groundwater levels. The functional relationship is implemented in the form of a multi-variate linear regression equation (Equation 1):

$$\frac{\Delta h}{\Delta t} = (C_1 \cdot P_t) + (C_2 \cdot E_t) + (C_3 \cdot Q_t) + (C_4 \cdot M_t) + (C_5 \cdot A_t) + (C_6 \cdot I_t) + (C_7 \cdot X_t) \ldots\ldots \textbf{Eq. 1}$$

Where:

$\frac{\Delta h}{\Delta t}$ is the change in basin-averaged groundwater elevation (t is in months)

P_t is total precipitation over the groundwater basin

Q_t is streamflow at a representative location that reflects surface water availability in the basin

I_t is the volume of trans-basin water imports to the groundwater basin

M_t is municipal and industrial demand within the basin

E_t is evaporative demand from native and landscaped (non-agricultural) vegetation

A_t is agricultural water demand (applied water demand)

X_t is a timeseries of values representing the effect of a specific large-scale water management practice on groundwater levels within the basin

C_i are linear regression coefficients

Variables P_t, Q_t, and I_t represent the available water supplies within the groundwater basin during the given time period, whereas variables M_t, E_t, and A_t represent the primary water demands within the basin during the same period. Variable X_t is optional and can be used to reflect specific large-scale management activities that affect groundwater levels throughout the basin. Coefficients C_i are determined via linear regression (i.e., by fitting Equation 1 to historical observations). After the coefficient values have been determined, the groundwater screening tool uses Equation 1 to estimate future groundwater elevations under various future scenarios. For example, the tool can be used to estimate future groundwater elevations under climate change by modifying inputs P_t, Q_t, and E_t to reflect projected future climate conditions.

In addition to reduced data and computational requirements, implementation of the basin-scale conceptual model via linear regression provides broad flexibility in the development of inputs to the groundwater screening tool. The conceptual model represents the large-scale mass balance of groundwater in a given basin. However, accurate and comprehensive data for many of the inflow and outflow terms in the conceptual model are often unavailable for most groundwater basins.

For example, evaporative demand for native and landscaped vegetation generally is not readily available for most groundwater basins. The regression-based approach used here allows the user to substitute a related variable in place of the missing data. In the case of evaporative demand, the user may substitute temperature data for evaporative demand as temperature is strongly correlated with evaporative demand. As long as fluctuations in the substituted dataset (in this case temperature) are strongly correlated with fluctuations in the primary input variable (in this case evaporative demand), discrepancies in magnitudes of two variables are accounted for by the regression coefficient on this term.

Development of Groundwater Model Inputs

As detailed above, the groundwater screening tool estimates changes in basin-averaged groundwater levels over time as a function of seven natural and anthropogenic factors that govern groundwater recharge and discharge: precipitation, local streamflow, trans-basin water imports, municipal and industrial water demands, agricultural water demand, evaporative demand from native and landscaped vegetation (non-agricultural), and an optional exogenous input that represents groundwater management objectives that affect basin-scale groundwater levels. The regression-based approach used in the groundwater screening tool allows substitution of related datasets where accurate data for one or more model input is not available. This section summarizes the development of inputs to the groundwater screening tool for groundwater basins within the Watershed.

Historical Input Data (1990-2009)

Historical data were used to fit the regression coefficients in Equation 1 and to evaluate model performance over the historical period (1990-2009). For each groundwater basin, historical inputs are required for the six primary input variables to Equation 1. Additional inputs may be provided for the optional exogenous variable if desired. No exogenous inputs were developed for groundwater basins within the Watershed; however, exogenous inputs may be incorporated by water resources planners and decision makers in the watershed based on knowledge of management operations relevant to individual groundwater basins.

Groundwater Elevation (h_t)

The groundwater screening tool requires an input timeseries representative of historical monthly groundwater elevations within the basin for the period 1990-2009. For this study, a database of historical groundwater elevations from more than 4,000 monitoring wells within the Watershed was obtained from SAWPA. Monitoring well locations are shown in Figure 6. Well records were evaluated to determine the period of record, completeness of record, and occurrence of outlier or spurious values. Wells exhibiting records shorter than 10 consecutive years or exhibiting a high frequency of missing values were excluded from this analysis. For each well identified as having a sufficient period of record and sufficient sampling frequency, monthly mean groundwater elevations were calculated from the available instantaneous measurements. For months containing more than one measurement, the monthly average was computed as the unweighted arithmetic average of the available measurements. For months with a single measurement, the single measurement was assumed to reflect average conditions during that month. It should be noted that individual outlier points were excluded from averaging; outliers likely reflect measurement errors, data transcription errors, or measurements taken during or after permeability testing was carried out (i.e., during or after a slug test or pump test). Lastly, monthly averages were linearly interpolated to develop a complete timeseries of monthly mean groundwater elevations over the period of record. Accuracy of monthly timeseries was evaluated by sub-sampling and cross-validation. Interpolated monthly timeseries were shown to accurately reflect raw measurements.

Monthly timeseries of basin-averaged groundwater elevations were then developed for each of the individual groundwater basins and sub-basins (defined by DWR) in the Watershed. Steps were required to avoid two sources of bias in calculating basin-average groundwater elevations: variations in the period of record between wells, and outlier wells that are not representative of large-scale groundwater fluctuations within a basin. These steps are described below.

Very few wells in the database used here exhibit complete monthly timeseries for the full historical period (1990-2009). As a result, simply taking the arithmetic average of well records over each groundwater basin results in a biased estimate of basin-average groundwater elevations. This bias occurs due to differences in the period of record of wells within a given basin: if the basin average for different months is based on a different sub-set of wells, and each well has a different mean groundwater elevation, then the resulting average reflects variations in the sub-set of well used. To minimize biases associated with varying record lengths, averaging was carried out based on monthly deviations rather than monthly groundwater elevations. This was done by computing monthly deviations (anomalies) for each record (i.e. for each well), where monthly deviations are calculated as the difference between the monthly mean value and the long-term average value for that month.

In addition to differences in record length, potential biases may occur in cases where individual well records reflect unique local conditions that are not broadly representative of groundwater fluctuations within the basin. This situation might occur when groundwater pumping throughout a basin is not driven primarily by municipal and industrial demand, but is driven by agricultural demand in one small area of the basin. Groundwater fluctuations in the agricultural portion of the basin are likely to exhibit substantially different behavior than groundwater fluctuations throughout the rest of the basin. In basins where a large number of monitoring wells are available, individual outliers have little effect on the basin-scale average and therefore do not need to be excluded from analysis. Where a small number of samples are available, however, individual outliers can disproportionately impact the basin average, resulting in potentially significant bias.

For this study, a correlation-based clustering procedure was developed to group wells into sub-sets exhibiting similar behavior. In basins and sub-basins where a large number of monitoring records were available, the majority of wells fell into a single cluster. For the purposes of this analysis, the largest cluster was assumed to reflect basin-average conditions, and basin-average groundwater elevations were calculated based on wells in this cluster. In basins and sub-basins where, only a small number of records were available, wells generally fell into a small number of similar size clusters. For the purposes of this analysis, these clusters were assumed to represent conditions in different portions of the basin where groundwater fluctuations were subject to different primary stressors. In these cases, averages were computed for each cluster and were evaluated separately. This report only presents results for basins where the majority of groundwater records fell into a single cluster.

Precipitation (P_t)

The groundwater screening tool requires an input timeseries that is representative of historical monthly precipitation over the groundwater basin for the period 1990-2009. Precipitation input may be basin-averaged monthly precipitation calculated from multiple gage records or from a gridded precipitation dataset. Alternatively, precipitation input may be derived from gage data at a single location or selected locations that represent key areas within the groundwater basin, such as areas of significant recharge or runoff. For this study, basin-average monthly precipitation was calculated for each groundwater basin based on the historical gridded daily precipitation dataset developed by Maurer et al. (2002), the same dataset used to derive the surface water projections. Area-weighted monthly total precipitation was computed for each basin based on groundwater basin polygons developed by DWR.

Evaporative Demand (E_t)

The groundwater screening tool requires an input timeseries that is representative of historical monthly evaporative demand from native and landscaped (non-agricultural) vegetation over the groundwater basin for the period 1990-2009. Because evaporative demand is generally not measured directly, monthly mean temperature or calculated monthly potential evapotranspiration (PET) may be used as surrogates for evaporative demand. For this study, basin-average monthly-mean temperature was calculated for each groundwater basin based on the historical gridded daily temperature dataset developed by Maurer et al. (2002), the same dataset used to derive the surface water hydrology projections. Area-weighted monthly-mean temperature was computed for each basin based on groundwater basin polygons developed by DWR.

Streamflow (Q_t)

The groundwater screening tool requires an input timeseries that is representative of historical monthly streamflow that contributed to water supply in the groundwater basin for the period 1990-2009. This streamflow excludes that which is provided by trans-basin imported water. Locations selected for the streamflow inputs for the four basins can be seen in Figure 8; the latitude and longitude for each point can be found in Table 2. Locations were chosen to be representative of streamflow in the basin. The San Jacinto and Elsinore Basins are able to share a stream flow point because the point is representative of water leaving the San Jacinto Basin and water entering the Elsinore Basin. Streamflow input may be based on a single gage that is representative of natural streamflow conditions within the basin, or may be estimated natural flow in the absence of storage and trans-basin diversions (i.e., naturalized streamflow). For this study, simulated historical natural flow at a representative point was used for each basin, development of which is described in section 2.2.1.

Table 2: Streamflow locations for groundwater basins

Groundwater Basin	Latitude (decimal degree)	Longitude (decimal degree)
Orange County	33.85640444	-117.80088930
Upper Santa Ana Valley	33.88916667	-117.56194444
Elsinore/San Jacinto	33.66411200	-117.29397600

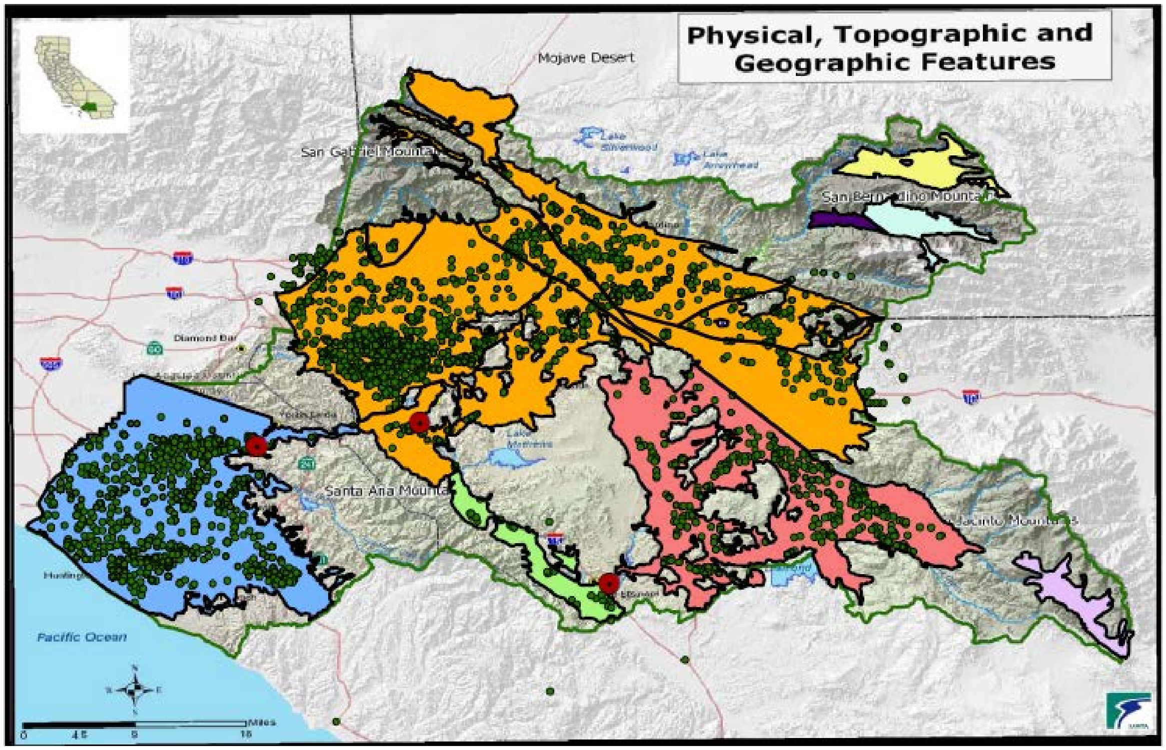


Figure 8: Locations for streamflow inputs (represented by red dots)

Municipal and Industrial Demand (M_t)

The groundwater screening tool requires an input timeseries that is representative of historical monthly municipal and industrial water demand within the groundwater basin for the period 1990-2009. Where municipal and industrial demand data are not directly available, demand may be estimated from available population and per capita water use data, interpolated as needed to obtain monthly data for the period 1990-2009. For this study, population within each groundwater basin was calculated from census tract data for years 1990, 2000, and 2010, and were interpolated to obtain monthly values. Data for annual per capita water use were obtained from urban water management plans for SAWPA member agencies and other water providers within each basin, and were similarly interpolated to obtain monthly values. Municipal and industrial demand was then estimated as the product of population and per capita use.

Agricultural Demand (A_t)

The groundwater screening tool requires an input timeseries that is representative of historical monthly agricultural water demand within the groundwater basin for the period 1990-2009. Accurate and consistent data on agricultural water use is not available for the groundwater basins within the Watershed. For this study, agricultural land area (irrigated acreage) was used as a surrogate for agricultural demand. For each groundwater basin, irrigated acreage was calculated from available land use datasets developed by the Southern California Association of Governments (SCAG). Available values were interpolated to obtain estimates of monthly values over the period 1990-2009. Where cropping patterns and irrigation practices are reasonably constant, agricultural acreage is strongly correlated with agricultural demand.

Trans-basin Imported Water (I_t)

The groundwater screening tool requires an input timeseries that is representative of historical monthly trans-basin water imported into the groundwater basin for the period 1990-2009. For this study, import data were obtained from SAWPA member agencies and associated, to the extent possible, with the corresponding groundwater basin. Initial analysis revealed that trans-basin imports are generally small compared to precipitation and natural streamflow for most groundwater basins in the watershed; as a result, uncertainties associated with the historical trans-basin import data used in this analysis is considered negligible.

Exogenous Variable (X_t)

The simplified approach used by the groundwater screening tool does not represent many of the complex and dynamic processes that may affect groundwater fluctuations within a given basin. For this purpose, the tool allows for an optional exogenous input, which provides the user an opportunity to account for a key driver that is not explicitly represented by the above inputs. Key drivers may include groundwater injection operations for a hydraulic barrier against sea water intrusion, dewatering for hydraulic control of groundwater discharge, or other management objectives that affect groundwater levels. No exogenous variable was used in this study.

Projected (Future) Input Data (2010-2099)

The groundwater screening tool estimates future groundwater elevations over the period 2010-2099 based on input data reflecting projected water supply, water demand, and water management conditions over this period. Future inputs are required for each of the primary input variables to the screening tool. If an exogenous variable is used for the historical period, projected values of the same exogenous variable are required for the future period. As noted above, no exogenous inputs were developed for groundwater basins within the Watershed. It should also be noted that projected groundwater elevations are calculated by the screening tool; groundwater elevation is not an input for the future period.

Precipitation (P_t)

The groundwater screening tool allows users to provide up to 250 projections of future precipitation for a given basin. Consideration of multiple future projections provides insight into the range of future conditions corresponding to uncertainties in projected future climate. For this study, projected basin-average monthly precipitation for the period 2010-2099 was calculated based on an ensemble of 112 bias corrected and spatially disaggregated climate projections (see Section 2.2.1). For each projection, input timeseries were developed by calculating the area-weighted monthly total precipitation for groundwater basin polygons developed by DWR.

Evaporative Demand (E_t)

Similar to precipitation, the groundwater screening tool allows users to provide up to 250 projections of future evaporative demand for a given basin. For consistency with historical inputs, basin-average monthly-mean temperature was used to represent monthly evaporative demand over the future period. Projected basin-average monthly average temperature inputs were calculated for each groundwater basin based on an ensemble of 112 BCSD climate projections (see Section 2.2.1). For each projection, input timeseries were developed by calculating the area-weighted monthly average temperature for groundwater basin polygons developed by DWR.

Streamflow (Q_t)

Similar to precipitation and temperature, the groundwater screening tool allows users to provide up to 250 projections of streamflow for a given basin. For this study, projected natural flow at a representative point for the period 2010-2099 was used for each basin (see Section 2.2.1).

Municipal and Industrial Demand (M_t)

The groundwater screening tool requires a single timeseries input representing projected municipal and industrial demand for the future period. For the purposes of this study, it was assumed that future municipal and industrial demand will remain at current levels. However, the tool allows water resources planners and decision makers to input alternative projections of future municipal and industrial demand based on various scenarios and planning objectives related to individual groundwater basins.

Agricultural Demand (A_t)

The groundwater screening tool requires a single timeseries input representing projected agricultural demand for the future period. For consistency with historical inputs, agricultural land area (irrigated acreage) was used to represent agricultural water demand in the future. For the purposes of this study, it was assumed that future agricultural land area will remain at current levels. However, the tool allows water resources planners and decision makers to input alternative projections of future agricultural demand based on various scenarios and planning objectives related to individual groundwater basins.

Trans-basin Imported Water (I_t)

The groundwater screening tool requires a single timeseries input representing projected trans-basin imported water for the future period. For the purposes of this study, it was assumed that future water imports will remain at the average historical level, calculated as the average over the period 1990-2009. However, the tool allows water resources planners and decision makers to input alternative projections of future water imports based on various scenarios and planning objectives related to individual groundwater basins.

Exogenous Variable (X_t)

As for the historical period, no exogenous variable was used in this study for the future period.

The methods described in this chapter were used to project hydroclimate conditions including surface water and groundwater supplies, which are presented in Chapter 3 along with projected demand.

3.0 Water Supply and Demand Projections

3.1 Water Supply

Future water supply projections were made using the CMIP3 projections and the VIC hydrology model. The CMIP3 archive provides a downscaled 12 kilometer resolution grid on a monthly time-series of precipitation and temperature from 1950-2099 for 112 climate projections.

3.1.1 Hydroclimate Projections

Timeseries Plots

This set includes projection specific annual timeseries plots for six hydroclimate indicator variables covering the period 1950–2099 (water years 1951-2099). The six variables are:

- Annual Total Precipitation
- Annual Mean Temperature
- April 1st Snow Water Equivalent
- Annual Runoff
- December–March Runoff
- April–July Runoff

The three variables—annual total precipitation, annual mean temperature, and April 1st SWE—vary spatially (at 1/8° or ~ 12-km-grid resolution) across the basins. To estimate total annual precipitation for the basin, basin-wide average precipitation (average across the grid cells in the basin) was first calculated for each month of the years 1950–2099. These basin average monthly precipitation values then were summed for each water year 1951-2099 to obtain the annual total precipitation.

To estimate basin mean temperature, average monthly temperature was calculated from all the grid cells in the basin for each month of the water years 1951–2099. These monthly temperatures for any given year next were averaged across the grid cells in the basin to estimate the basin-wide annual mean temperature.

SWE on April 1st of a given year is a widely used measure to assess snowpack and subsequent spring–summer runoff conditions in the snowmelt dominated basins of the western United States. SWE is one possible output from the VIC hydrology model. For each of the simulation water years, April 1st SWE was saved from the simulations for each model grid cell in the basin. Gridded SWE on April 1st was averaged over all the grid cells for the given basin to calculate the basin-wide April 1st SWE for water years, 1950–2099.

Runoff for each of the 36 site locations (Table 1) was calculated for the annual timescale and for two seasonal timescales December–March (DJFM) total runoff depicting winter season runoff conditions and April–July (AMJJ) total runoff depicting spring–summer runoff conditions. For each of the simulation years 1950–2099, monthly runoff was aggregated on a water year basis to calculate water year specific total annual runoff, DJFM runoff, and AMJJ runoff.

The annual time series plots for the six hydrologic indicator variables for all 112 projections were calculated, and the results are presented to reflect ensemble central tendency and ensemble spread. The central tendency is measured using the ensemble median. The 5th and 95th percentiles from the 112 projections provide the lower and upper uncertainty bounds in the envelope of projections through time.

Figure 9 shows the projection ensemble for six hydroclimate indicators for the site Santa Ana River at Adams Street Gage (most downstream location): annual total precipitation (top left), annual mean temperature (top right), April 1st SWE (middle left), annual runoff (middle right), DJFM runoff season (bottom left), and AMJJ runoff season (bottom right). The heavy black line is the annual time series of 50th percentile values (i.e., ensemble-median). The shaded area is the annual time series of 5th to 95th percentiles.

The annual total precipitation over the basin shows a somewhat declining trend over the transient period going out to 2099. The uncertainty envelope does not appear to expand or contract over time. The mean annual temperature over the basin shows a monotonically increasing trend and a diverging uncertainty envelope over time. April 1st SWE also shows a decreasing trend. The annual runoff follows the long-term declining trend pattern similar to precipitation. The winter season DJFM runoff shows a declining trend, so does the AMJJ summer season runoff.

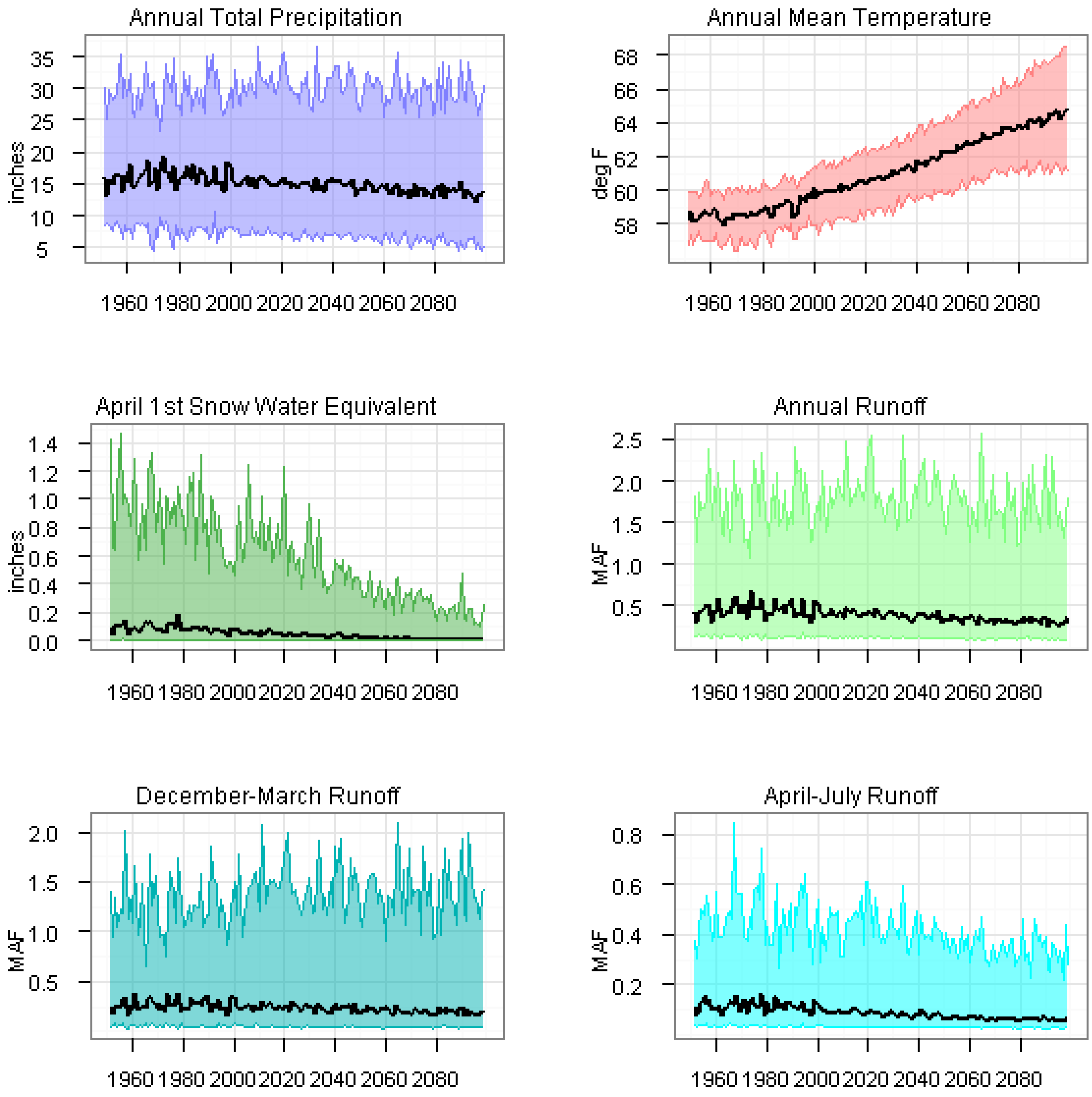


Figure 9: Projection ensemble for six hydroclimate indicators for the site Santa Ana River at Adams Street Gage

Spatial Plots

The next set of plots includes spatial plots of decade-mean precipitation, and temperature. These plots show the spatial distribution for the variables across the contributing basin. The spatial plots were developed on a water year basis for the reference decade of the 1990s (water years 1990–1999).

Spatial distribution of precipitation for the 1990s decade is presented as an ensemble median of the 112 projections. At each grid cell in the basin and for each of the 112 projections, average total precipitation was calculated by averaging total precipitation from the 10 water years, 1990–1999. Next, for each grid cell, the ensemble median of the decade average total precipitation was calculated and used in developing the spatially varying precipitation plot.

Precipitation changes in each of the future decades – 2020s (represented by water years, 2020-2029), 2050s (represented by water years, 2050-2059), and 2070s (represented by water years, 2070-2079) – were calculated as follows. At each grid cell in the basin and for each of the 112 projections, average total precipitation was calculated by averaging total precipitation from the 10 water years in the respective future decades. Then, for a given projection and at a given grid cell, the percentage difference in average total precipitation between a given future decade and the reference 1990s decade was calculated. This percentage difference for a given cell was calculated only if the 1990's average total precipitation for that cell was greater than 0.01 millimeter. This step is necessary to threshold division by a small value, which would result in a numerically large change magnitude. Positive percentage change implies wetter conditions, while negative percentage change implies drier conditions from the 1990s reference decade.

After all projection-specific changes were calculated for a given future decade, the median change from the 112 projections was calculated. The median or 50th percentile change provides a measure of the central tendency of change in decade average total precipitation for a given future decade compared with the reference 1990s decade (Figure 10).

The 2020s decade shows some increase in the upper elevation parts of the watershed from the 1990s reference decade, but for the subsequent two decades – 2050s and 2070s – the precipitation shows consistent decline throughout the watershed.

The calculations for the spatial distribution of mean temperature are similar to the spatial distribution of precipitation calculation for the 1990s reference decade. The difference being, in case of temperature, mean annual temperature is first calculated from the 12 monthly values (in case of precipitation, it is the total precipitation) for each of the 10 water years, and subsequently, averaged to calculate the decade average mean annual temperature. The changes in mean annual temperature for the future decades are presented as magnitude changes and not as percentage change (as computed for precipitation). The median or 50th percentile change from the 112 projections represents the central tendency in decade-mean temperature distribution.

Figure 11 shows the spatial distribution of simulated decadal temperature. These results show that the watershed is expected to get hotter through the successive decades (2020s, 2050s and 2070s) compared with the 1990s reference decade.

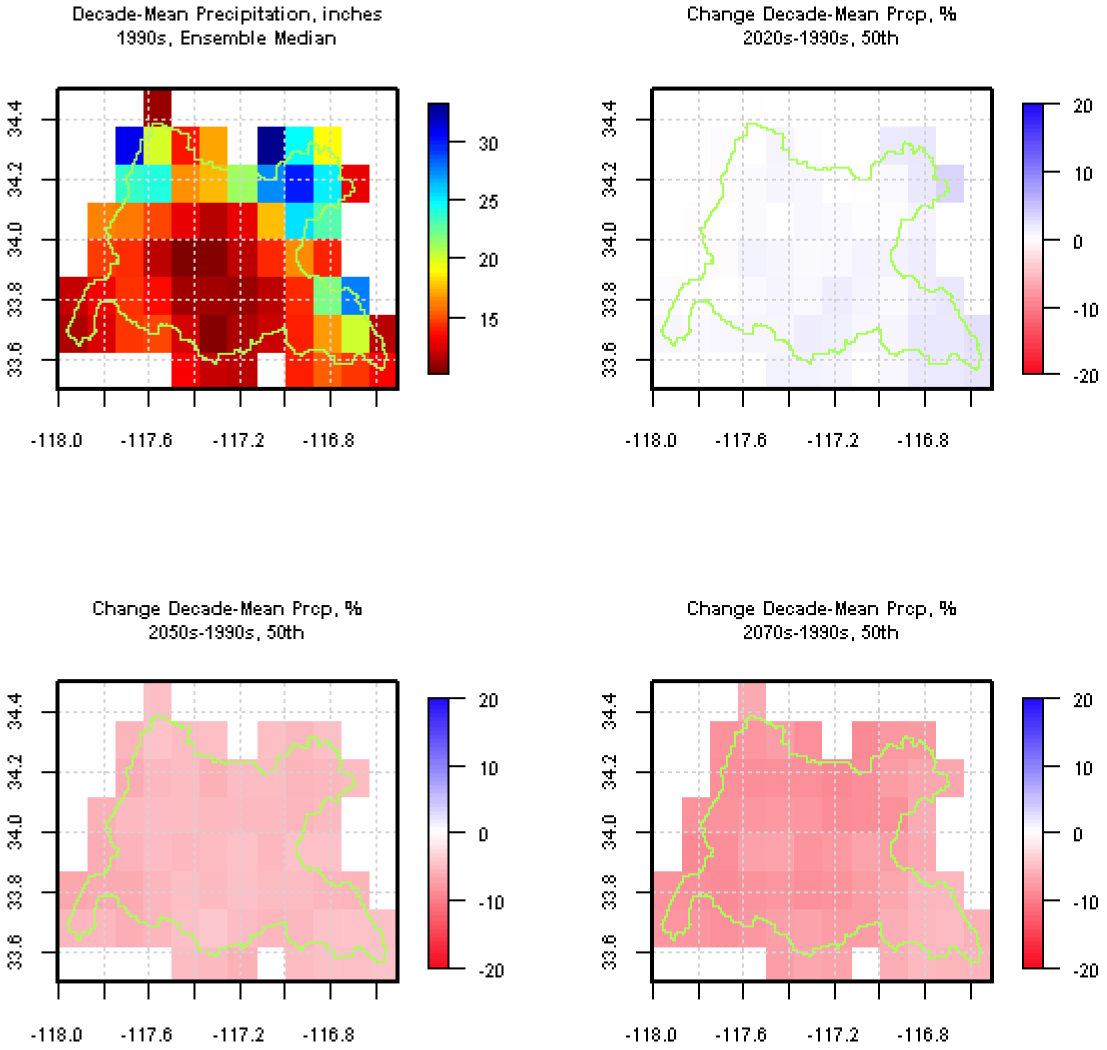


Figure 10: Spatial distribution of simulated decadal precipitation. The vertical axis represent latitude, the horizontal axis represent longitude

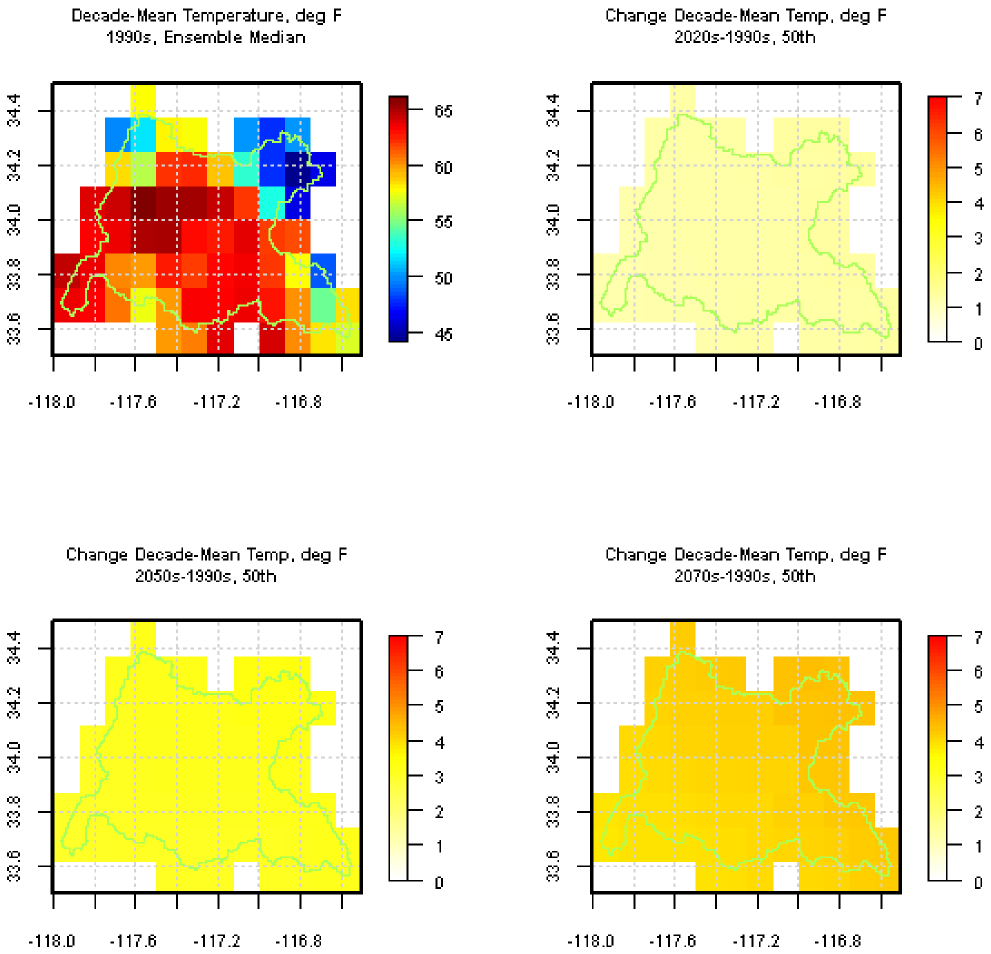


Figure 11: Spatial distribution of simulated decadal temperature. The vertical axis represent latitude, the horizontal axis represent longitude

3.1.2 Impacts on Runoff Annual and Seasonal Cycles

Similar to the calculations of precipitation and temperature changes, annual and seasonal runoff changes were calculated for all 36 sites listed in Table 1. Figure 12 shows mean annual and mean-seasonal runoff change for the site, Santa Ana River at Adams Street Gage (most downstream location). Changes in mean runoff (annual or seasonal) were calculated for the three future decades – 2020s, 2050s and 2070s – from the reference 1990s decade. For the 2050s and 2070s decade, there is a decline in the mean annual and seasonal runoff from the 1990s decade; for the 2020s decade the change in runoff is nominal. Similar change in runoff patterns was observed for all sites across the basin, as can be seen in Table 3.

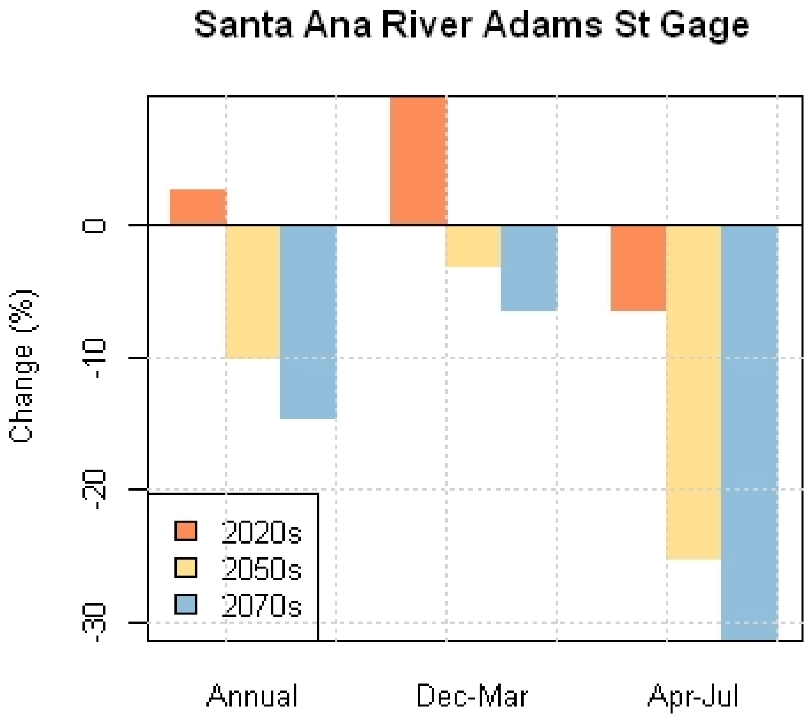


Figure 12: Simulated mean annual and mean-seasonal runoff change

Table 3: Percent change from 1990s for annual, DJFM, and AMJJ runoff

ID	Site Description	2020s			2050s			2070s		
		Annual Flow	DJFM	AMJJ	Annual Flow	DJFM	AMJJ	Annual Flow	DJFM	AMJJ
1	Peters Canyon Wash Tustin Gage	2.58	5.95	-6.08	-8.92	-1.19	-15.75	-11.82	-8.96	-19.06
2	Marshburn Channel Gage	5.10	6.76	-8.79	-6.41	-2.60	-21.70	-10.73	-8.12	-23.97
3	San Diego Creek Myford Rd Gage	4.40	6.98	-7.87	-8.36	-3.28	-18.67	-11.44	-7.34	-21.36
4	El Modina-Irvine Channel Gage	2.89	4.01	-3.50	-6.36	-3.54	-14.84	-9.05	-8.46	-15.37
5	Peters Canyon Wash Irvine Gage	2.59	5.98	-6.15	-8.86	-1.20	-15.77	-11.84	-8.98	-19.10
6	San Diego Creek Lane Rd Gage	2.58	5.93	-6.03	-8.95	-1.19	-15.73	-11.81	-8.95	-19.03
7	San Diego Creek Campus Dr Gage	4.37	6.48	-4.81	-7.74	-3.22	-13.80	-10.30	-8.42	-15.05
8	Santa Ana River Prado Dam Gage	2.71	9.76	-6.65	-10.69	-1.90	-26.04	-14.97	-7.19	-32.29
9	Santa Ana River County Line Gage	2.72	9.84	-6.66	-10.67	-2.20	-25.96	-14.95	-7.08	-32.24
10	Santa Ana River Imperial Highway Gage	2.69	9.87	-6.54	-10.57	-2.52	-25.88	-14.91	-6.92	-32.13
11	Santa Ana River AB SPRD Imperial Highway Gage	2.68	9.86	-6.54	-10.56	-2.53	-25.88	-14.91	-6.92	-32.13
12	Santa Ana River SPRD Imperial Highway Gage	2.68	9.86	-6.54	-10.56	-2.53	-25.88	-14.90	-6.92	-32.12
13	Carbon Creek Olinda Gage	3.06	6.96	-4.49	-3.09	-3.69	-17.86	-8.07	-6.58	-20.91
14	Carbon Creek Yorba Linda Gage	3.06	6.96	-4.49	-3.09	-3.69	-17.86	-8.07	-6.58	-20.91
15	Santa Ana River Ball Rd Gage	2.67	9.84	-6.53	-10.52	-2.60	-25.82	-14.88	-6.92	-32.07
16	Santa Ana River Katella Ave Gage	2.65	9.89	-6.55	-10.49	-2.83	-25.71	-14.85	-6.88	-32.01
17	Santiago Creek Villa Park Gage	2.90	8.35	-4.59	-5.09	-0.25	-18.15	-10.07	-7.81	-23.45
18	Santiago Creek Div Villa Park Gage	2.90	8.35	-4.59	-5.09	-0.25	-18.15	-10.07	-7.81	-23.45
19	Santiago Creek Santa Ana Gage	4.15	7.43	-5.11	-5.40	-1.30	-17.99	-10.42	-7.02	-20.97
20	Santa Ana River Santa Ana Gage	2.63	9.85	-6.39	-10.09	-3.01	-25.48	-14.69	-6.41	-31.70
21	Santa Ana River Adams St Gage	2.60	9.82	-6.35	-10.08	-3.01	-25.24	-14.61	-6.38	-31.39
22	Brea Channel Brea Dam Gage	1.99	5.34	-5.77	-3.37	-1.79	-19.51	-8.88	-7.33	-19.75
23	Brea Channel Fullerton Gage	1.73	4.97	-6.04	-3.54	-1.35	-19.91	-8.84	-7.45	-19.87
24	Fullteron Channel Fullerton Dam Gage	0.94	3.76	-5.87	-4.13	-1.47	-18.91	-8.98	-8.82	-18.91
25	Fullerton Channel Fullerton Gage	0.14	3.60	-5.68	-4.54	-3.08	-18.43	-9.14	-9.08	-16.44
26	Fullerton Channel Richman Ave Gage	2.15	4.95	-5.48	-4.55	-2.02	-17.80	-8.58	-7.34	-18.39
27	Coyote Creek Los Alamitos Gage	0.31	4.85	-4.60	-3.59	-3.16	-17.37	-9.54	-7.87	-16.51
28	Devils Canyon	2.94	5.12	-3.29	-13.23	-6.71	-22.69	-13.38	-10.72	-26.62
29	Santa Ana River AT MWD Crossing NR Arlington	2.73	10.54	-9.68	-11.36	-2.04	-30.55	-17.35	-7.84	-37.75
30	Santa Ana River AT E Street NR San Bernardino	3.03	10.66	-11.25	-10.86	-2.34	-31.89	-16.98	-7.35	-39.70
31	Temescal Creek AB Main Street AT Corona	5.50	9.02	-6.01	-7.65	-1.64	-18.68	-12.06	-5.03	-28.47
32	Cucamonga Creek NR Mira Loma	2.20	7.43	-3.35	-13.45	-8.76	-27.40	-17.51	-13.81	-33.20
33	Chino Creek AT Schaefer Avenue NR Chino	2.30	4.54	-3.62	-7.11	-2.05	-19.63	-11.19	-8.46	-19.83
34	Seven Oaks Dam Outlet	1.11	12.83	-19.49	-13.17	-4.07	-40.17	-19.29	-4.76	-48.65
35	Middle Fork Lytle Creek Gage	2.94	6.88	-9.22	-15.28	-8.14	-36.30	-21.35	-16.24	-40.80
36	Ridge Top Gage NR Devore	3.08	6.48	-6.72	-7.15	-1.54	-18.56	-6.26	-5.05	-21.65

3.1.3 Groundwater Impacts

The groundwater screening tool was applied to four groundwater basins (Orange County, Upper Santa Ana Valley, San Jacinto, and Elsinore) within the Watershed where sufficient data were available, including observed groundwater elevations, municipal and industrial demands, agricultural acreage, and trans-basin imported water.

Figure 13 illustrates observed and simulated monthly changes in groundwater elevation for the Orange County Coastal Plain groundwater basin for the period 1990-2009, as well as observed and simulated monthly basin-averaged groundwater elevations. Figure 13a shows that the groundwater screening tool realistically simulates the timing of month-to-month changes in groundwater elevation, but does not capture the peak magnitudes of drawdown and rise. Similarly, Figure 13c shows that the tool accurately simulates seasonal fluctuations in groundwater elevation as well as trends in groundwater elevation over the past two decades, but does not capture interannual variations in groundwater elevation, including the groundwater decline of the early 1990s and subsequent rebound during the late 1990s and early 2000s. Interannual fluctuations may be driven by local-scale non-linear processes that are not represented in the basin-scale screening tool, or by management objectives that are not included in this analysis. The correlation between simulated and observed changes in groundwater elevation is 0.618 (R^2 = 0.382), and correlation between simulated and observed groundwater elevation is 0.884 (R^2 = 0.782).

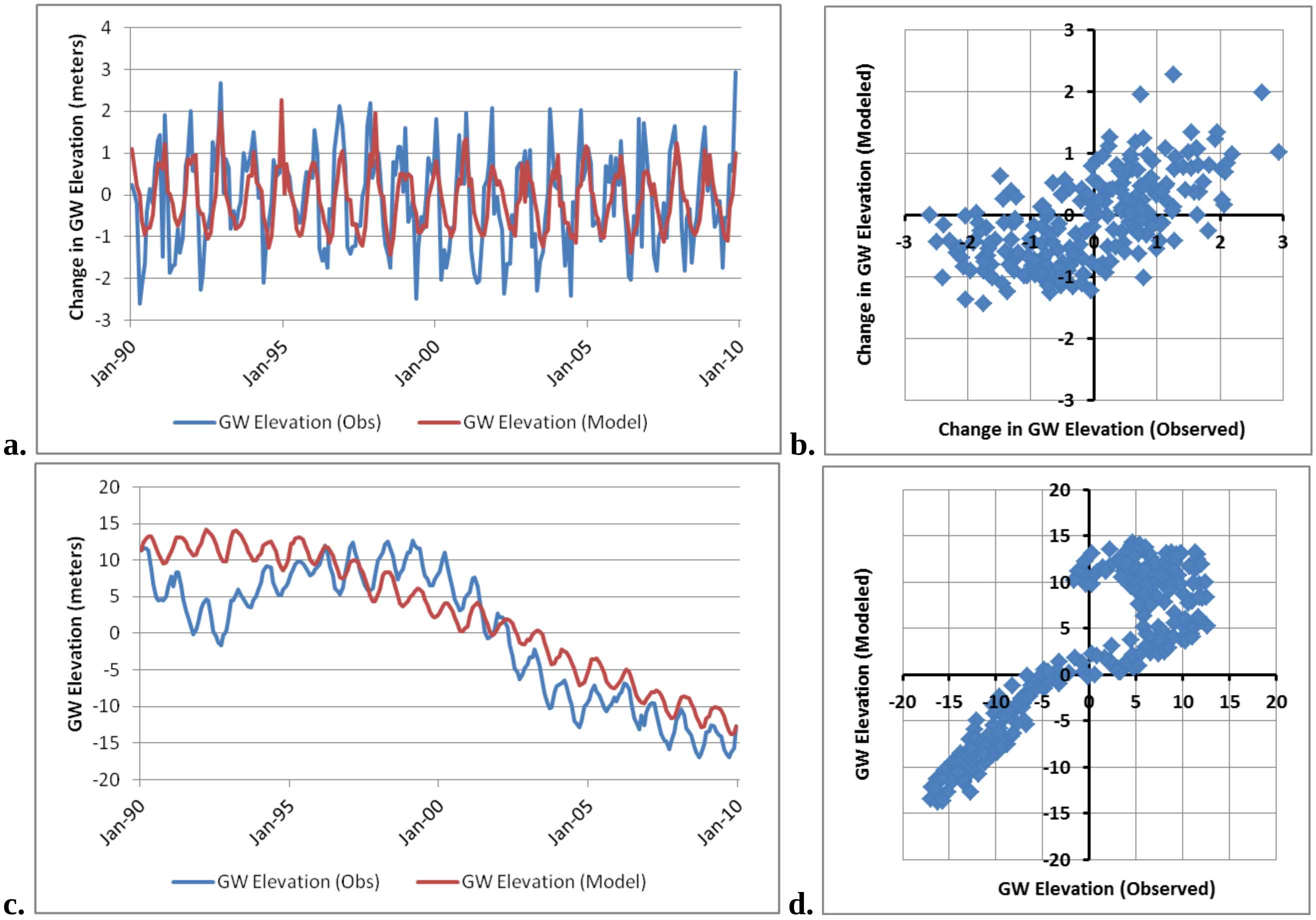


Figure 13: (a) Timeseries of observed and simulated fluctuations in monthly groundwater elevation for the period 1990-2009; (b) scatter plot of simulated monthly change in groundwater elevation as a function of observed change groundwater elevation; (c) Timeseries of observed and simulated monthly groundwater elevation for the period 1990-2009 (zero represents mean sea level); (d) scatter plot of simulated monthly groundwater elevation as a function of observed groundwater elevation (all plots are for Orange County groundwater basin)

Future groundwater availability in the Watershed will depend on future recharge from precipitation, stream seepage, and managed infiltration facilities, as well as future groundwater withdrawals to for municipal, industrial, and agricultural uses. Projected increases in temperature and decreases in precipitation will result in increased water demands and decreased groundwater recharge, respectively. Management actions will be required to protect groundwater resources under projected future climate conditions. Figure 14 illustrates the observed range of basin-averaged groundwater levels in the Orange County groundwater basin for 1990-2009, along with simulated groundwater levels under projected climate conditions. In the absence of groundwater management actions, groundwater levels are projected to decline significantly over the 21st century. It should be noted that projected declines are not constrained by the physical limits of the aquifer; for example, projected declines may exceed the actual amount of usable groundwater in the basin.

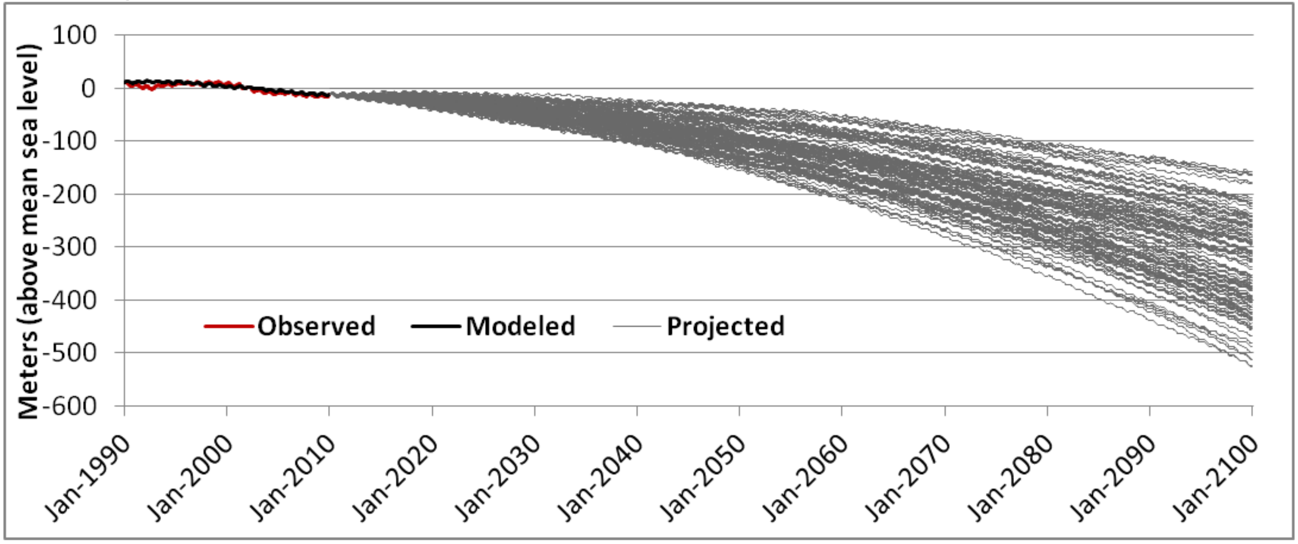


Figure 14: Projected groundwater elevations for Orange County for a no action scenario

The groundwater screening tool, developed by Reclamation for this Basin Study, can be used to evaluate potential deficiencies in future supplies and to develop sustainable management alternatives. 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, gradual reduction of approx. 15% by 2020 (i.e., reduce per capita use from ~175 gallons per day in 2010 to ~150 gallons per day by 2020).
- Increase imports from the Colorado River Aqueduct and State Water Project gradually from ~30,000 acre-ft per year to ~105,000 acre-ft per

year (this may not be feasible due to cost, greenhouse gas emissions, or availability).
- Increase local water supplies by ~75,000 acre-ft per year through recycled water treatment capacity, development of seawater desalination capacity, and increase storm water capture efficiency.

Figures 15, 16, and 17 show the projected groundwater elevations for a no action scenario for the Upper Santa Ana Valley, San Jacinto, and Elsinore respectively. The groundwater screening tool can be used to develop and compare additional management alternatives in order to meet the projected growing demands that are discussed in the next section.

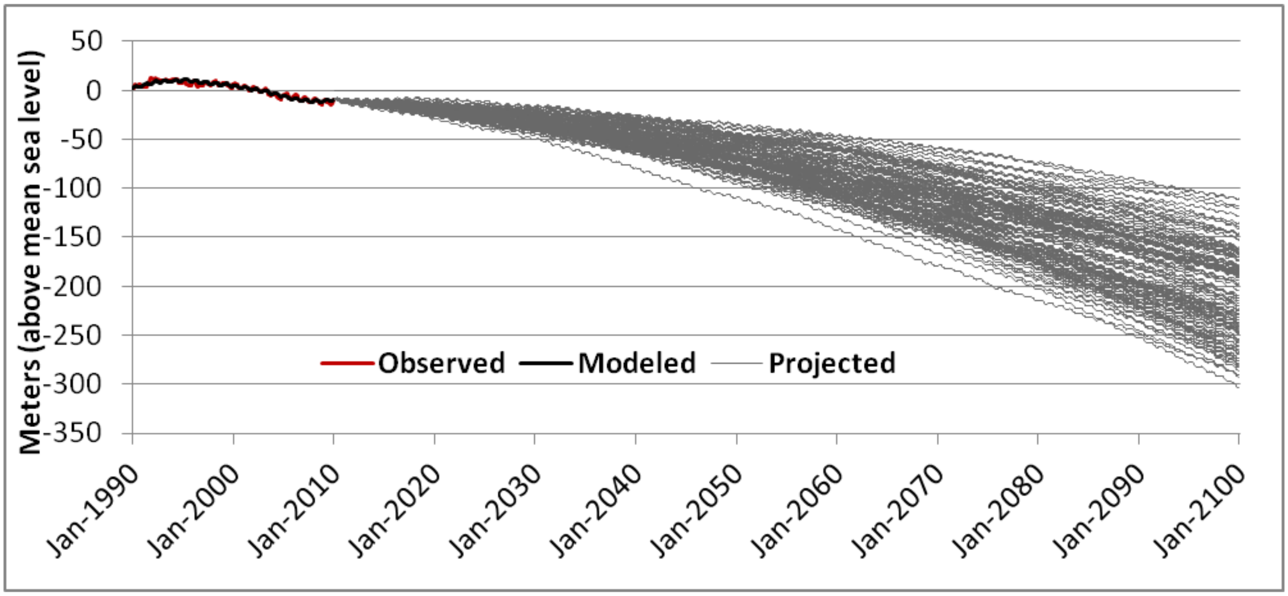


Figure 15: Projected groundwater elevations for Upper Santa Ana Valley for a no action scenario

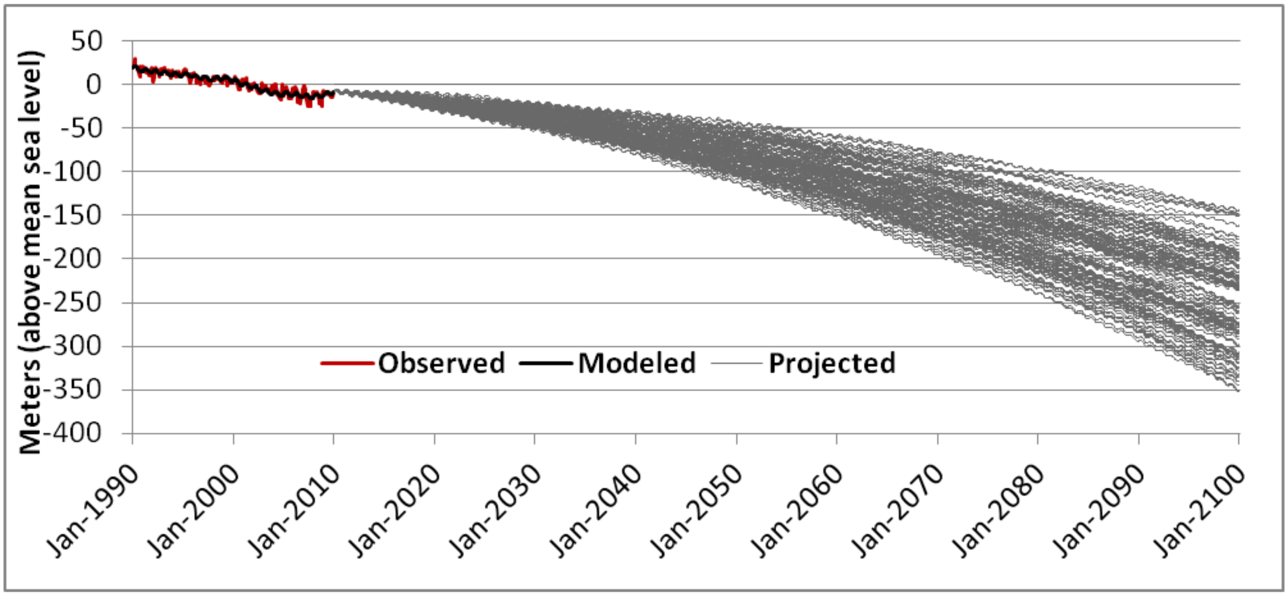


Figure 16: Projected groundwater elevations for San Jacinto for a no action scenario

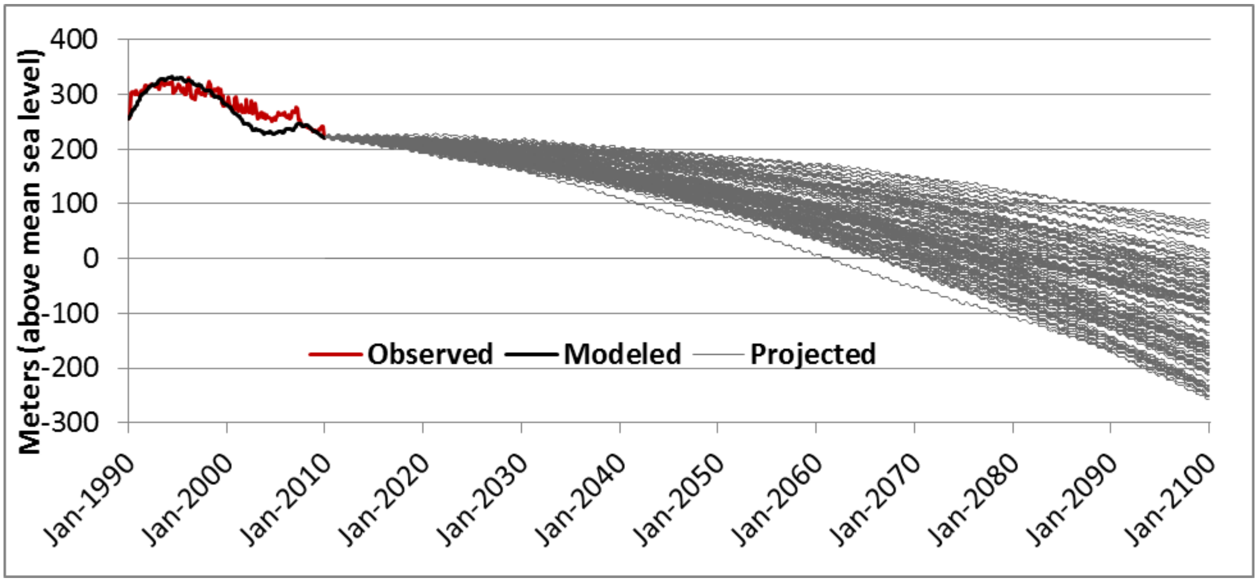


Figure 17: Projected groundwater elevations for Elsinore for a no action scenario

Note: The Elsinore groundwater basin projections, shown in Figure 17, are not as representative of what is actually happening in the basin as the other three basins. This is because the basin average groundwater timeseries is based on four wells, three of which are missing a fair amount of data, resulting in a poor model fit. More representative results could be obtained if a more complete input dataset were developed.

3.2 Water Demands

Many factors affect future water demands such as population growth, hydrologic conditions, public education, and economic conditions, among others. In 1990, 4.2 million people lived in the Watershed. In the 1990s, the population grew by 17.6%, and continued to grow to the present population of approximately 6.1 million, as shown in Figure 18. By 2050, the population is projected to reach 9.9 million (Santa Ana Integrated Watershed Plan, 2002).

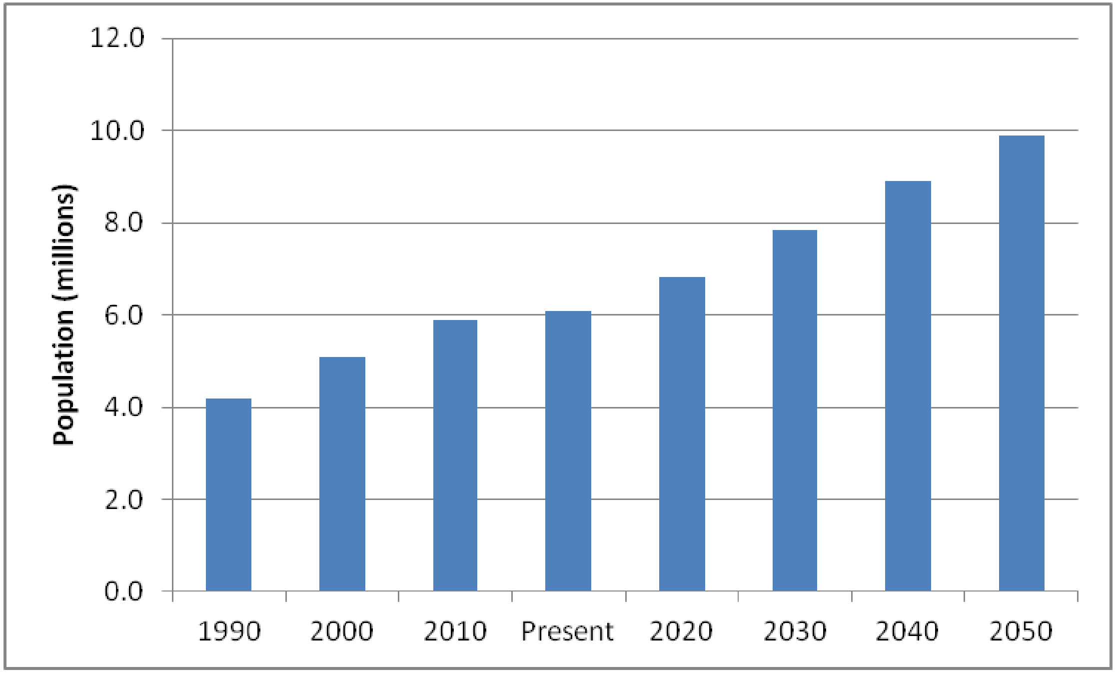


Figure 18: Population for the Santa Ana River Watershed

3.2.1 Water Demand Projections

Projected water demands out to 2050 were obtained from the various water resource plans for each of the individual member agencies. The projections, shown in Figure 19, include direct water demand for residential, municipal, commercial, and agricultural uses, but do not include recharge. Conservation is not taken into account in the projected demand. Aggressive conservation can drastically reduce the projected water demand, an example of which is shown in Chapter 5.

For the purpose of this study, the demand was calculated for the watershed, as a whole, every ten years from 1990-2050 (see Chapter 5 for a description of the tool used). The population projections from Figure 18 were used to determine the demand, and conservation was not taken into account. The results, found in Figure 20, are very similar (1% difference in 2050) to the demand projections calculated by the member agencies in Figure 16.

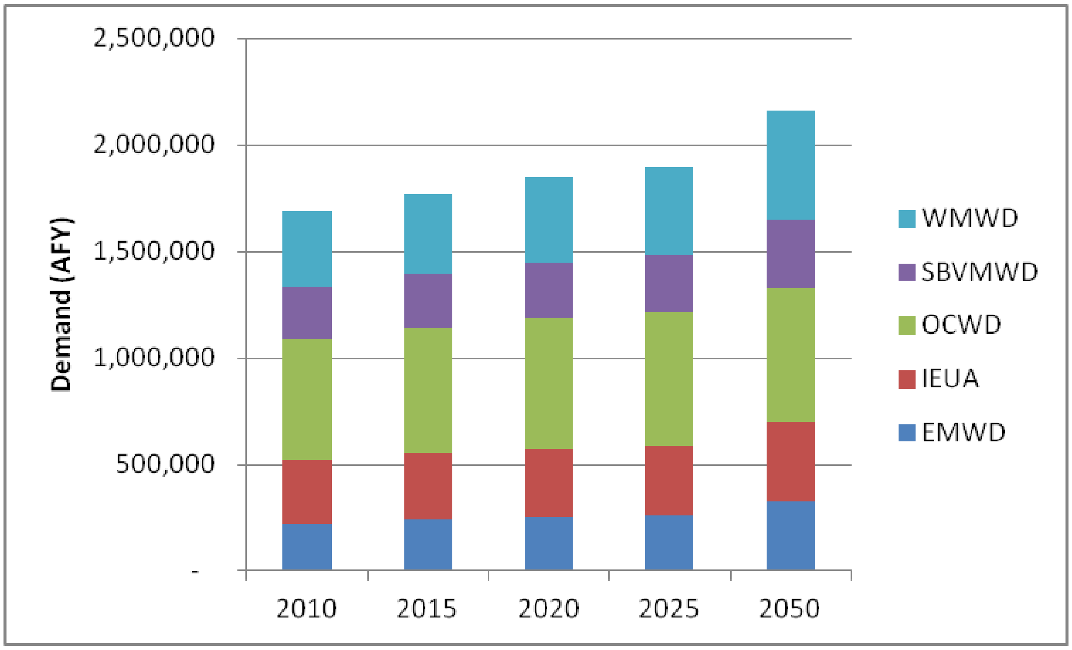


Figure 19: Water demand by member agency (Western Municipal Water District (WMWD); San Bernardino Valley Municipal Water District (SBVMWD); Orange County Water District (OCWD); Inland Empire Utilities Agency (IEUA); Eastern Municipal Water District (EMWD))

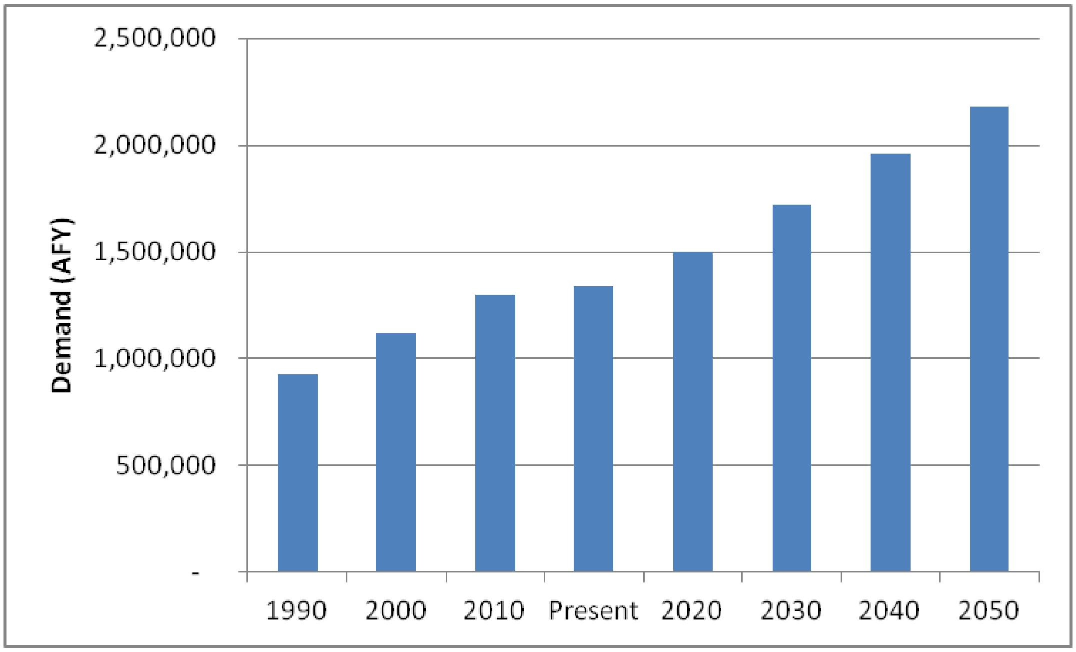


Figure 20: Santa Ana Watershed water demand calculated for this study

3.3 Supply and Demand Summary

Table 4 shows a summary of the project effects of climate change on a variety of hydroclimate metrics for three future periods (above the most downstream location, Adams St. Bridge). Table 5 shows a summary of projected water demands out to 2050.

Table 4: 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 (°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 5: 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 they predict 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.

4.0 Decision Support and Impact Assessment

The analyses presented in this chapter were performed using the climate and hydrological projections and models described in Chapter 3.

4.1 Impacts on Recreation in Lake Elsinore

4.1.1 Background

Lake Elsinore, shown in Figure 21, is southern California's largest natural lake and is situated at the bottom of the San Jacinto Watershed. Because Lake Elsinore is a terminal lake, historically fed only by rain and natural runoff, it has been impacted by low lake levels. As the climate continues to change it is likely that these impacts will become more severe. Lake Elsinore is used for recreation and is currently not considered a water supply source.

In 2005, Elsinore Valley Municipal Water District (EVMWD) began a two-year pilot project to introduce recycled water into Lake Elsinore to stabilize lake levels. Soon thereafter, a discharge permit was granted to EVMWD by the Santa Ana Regional Water Quality Control Board to allow recycled water to be delivered to the lake. In 2008, a 36-inch-diameter pipeline was constructed to deliver recycled water from EVMWD's Regional Wastewater Treatment Plant, funded by the State of California Proposition 40 Water Bond and the Lake Elsinore and San Jacinto Watersheds Authority. The project delivers approximately 5 million gallons per day (MGD) of recycled water to Lake Elsinore, and includes repair and retrofit of three local, shallow groundwater wells that deliver approximately 1 MGD. As part of the Basin Study, an analysis was done to determine if these measures would be enough to meet the minimum goal volume of 41,704 acre-ft (elevation 1,240 ft), avoid low lake levels (below 24,659 acre-ft, elevation 1,234 ft), and prevent the lake from drying up altogether (as occurred in the 1930s) under a changing climate.

Figure 21: Lake Elsinore and VIC model grid cell used to determine data for Lake Elsinore analysis

4.1.2 Methodology

Monthly streamflow and open water evaporation values from 1950-2099 were determined by using BCSD-CMIP3 climate projections and the VIC macro-scale hydrology model. Gridded daily meteorological forcings from Maurer et al., (2002) were used to simulate historical conditions from 1950-1999. The model accounted for the upstream contributing basin, the San Jacinto River subwatershed, feeding the inlet of Lake Elsinore, excluding the effect of any upstream regulation.

A mass balance analysis of Lake Elsinore was conducted, resulting in a natural volume, unregulated by upstream reservoirs. Change values were determined for each future period using modeled observed average annual volume applied to historic annual average volume. The operations of Canyon Lake, a reservoir upstream from Lake Elsinore, were not taken into account in this analysis.

4.1.3 Results

Figure 22 shows the distribution of projected average annual volume for two future periods, 2000-2049 and 2050-2099, based on 112 different climate change projections. The two future periods were also analyzed with the addition of the EVMWD project. For the 2000-2049 period there is greater than a 50% chance that the average annual lake level will meet the minimum goal; adding in the EVMWD project brings that likelihood up to above 75%. For the 2050-2099 period there is less than a 5% chance that the minimum goal will be met; adding the EVMWD project brings that likelihood to almost 50%. Both periods are likely to stay above low lake level, with the 2050-2099 period having less than a 10% chance of drying up completely.

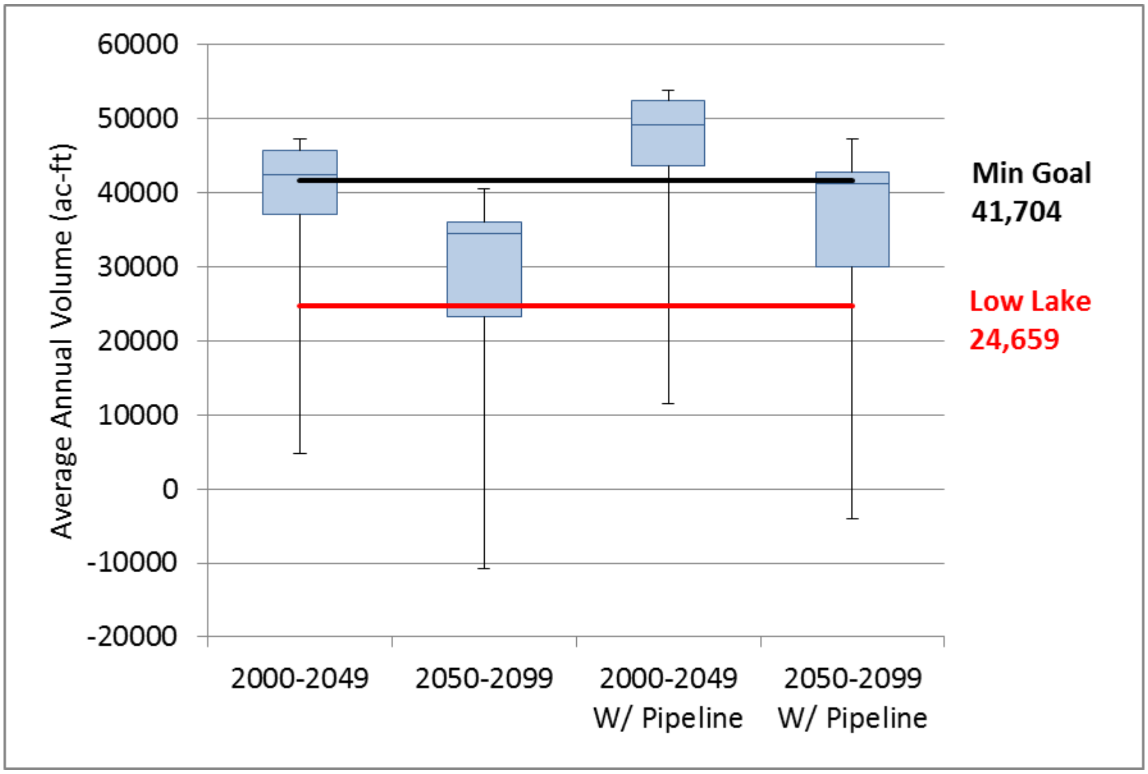


Figure 22: Projected average annual volumes for Lake Elsinore for two future periods, with and without EVMWD project

4.2 Alpine Climate Impacts

4.2.1 Background

An alpine climate is defined as the average weather for the region above the tree line. Climate change impacts could harm alpine recreation such as skiing. The Big Bear Mountain Resorts (Big Bear) are located in the San Bernardino Mountains within the SARW. They consist of two ski areas, Bear Mountain and Snow Summit, and provide nearly 750 skiable acres. They range in elevation from roughly 2,180 m to more than 2,600 m. Although Big Bear has the ability to cover 100% of its terrain with manmade snow using water from Big Bear Lake, there are still concerns about rising temperatures and decreased natural snowfall.

Member agencies of SAWPA extend to the San Bernardino Mountain, the San Gabriel Mountains, the San Jacinto Mountains and the Santa Ana Mountains. As such, potential climate change impacts to alpine ecosystems and recreational activities are an area of concern. In general, alpine ecosystems are characterized by cold temperatures and harsh growing conditions. One species of particular importance is the Jeffrey Pine. Jeffrey Pines are a coniferous species common to the area and extend through the Sierra Nevadas up to Oregon. They are a high altitude pine species that have the ability to grow in a diverse range of climates.

They can do well in harsh settings and infertile sites because they require a shorter growing season than some other species (Moore, 2006).

4.2.2 Methodology

Impacts to skiing near Big Bear Lake were analyzed by considering projected changes for April 1st SWE. April 1st SWE values from 1950 to 2099 were generated for 112 CMIP3 climate projections using the VIC model forced with downscaled (BCSD) climate variables. Each climate projection consists of 1/8° x 1/8° degree (~12 km x 12km) grid cell daily forcings. For this analysis, the locations of the Bear Mountain and Snow Summit ski areas were mapped to the single grid cell that contained them. Results shown in Section 4.2.3 summarize the median change (taken from the 112 projections) in April 1st SWE compared to the 1990s.

For comparison, results were also summarized from a study of climate change impacts in California by Hayhoe et al. (2004). They used climate forcing data generated with two GCMs of low (Parallel Climate Model, PCM) and medium (Hadley Center Climate Model version 3, HadCM3) sensitivity, forced using two emissions scenarios, one lower (B1) and one higher (A1fi). SWE results were generated using the VIC model forced with the BCSD temperature and precipitation. Results are provided in Section 4.2.3 on a statewide basis grouped by elevation.

Quantitative analysis of ecosystem impacts was not conducted as part of this work. Rather a literature review of existing climate change impact studies was conducted and the relevant findings are provided here.

4.2.3 Results

Recreation at Big Bear

It is likely that future snowpack at Big Bear will be significantly less than what is currently normal and accumulated snowpack will remain on the ground for a shorter season. Figures 23 and 24 illustrate future changes in April 1st SWE. Projected declines are between 30% and 40% by the 2020s, and are generally projected to be greater than 70% by the 2070s. These changes are largely a result of increased winter temperatures and potential declines in winter precipitation. Warmer temperatures will result in a delayed onset of the ski season, as well as earlier spring melting. Future precipitation is much more uncertain but many projections show decreased winter precipitation. Lower altitudes will likely be the most sensitive to increased temperature because small temperature changes can result in precipitation falling as rain rather than snow. Hayhoe et al. (2004) note that reductions in SWE are most pronounced below 3,000 m where roughly 80% of California’s snowpack storage currently occurs. The Bear Mountain and Snow Summit ski areas both fall between roughly 2,100 and 2,600 m, making them vulnerable to increased temperatures.

While there is general consensus for a projected decrease in snowpack, it is also important to note that there is significant variability between climate projections. For example, the low sensitivity, low emissions scenario in Figure 24 projects only a 20% decrease in snowpack by 2070, while the other scenarios as well as the median, shown in Figure 23, project a greater than 70% decrease. Also, the grid resolution for both methodologies is 1/8° which is much larger than either ski area. As such, results include surrounding areas that are at lower elevations and beyond ski area itself. However, the overall findings in Figures 23 and 24 are consistent.

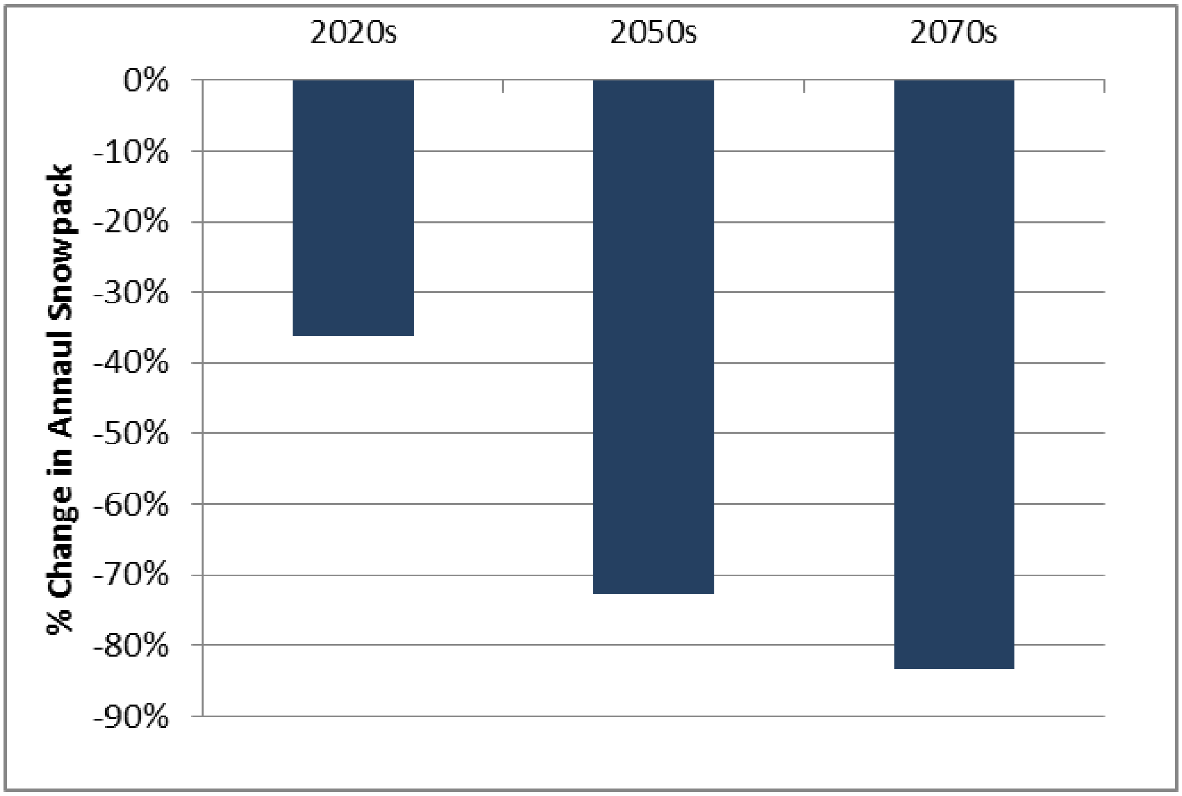


Figure 23: Median percent change (from 112 climate projections) in April 1st SWE for the grid cells containing the Bear Mountain and Snow Summit ski areas

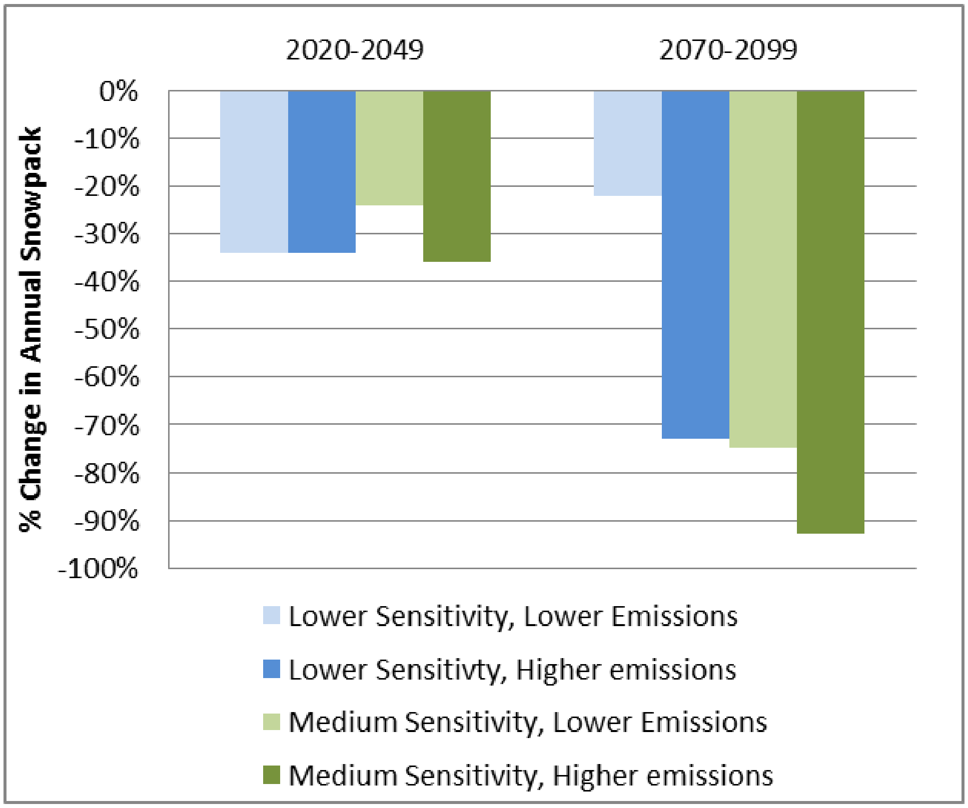


Figure 24: Percent change in April 1st SWE from Hayhoe et al. (2004) for areas of 2,000 to 3,000 m elevation

Jeffrey Pine Ecosystem

Predicting climate change impacts on ecosystems is very difficult because of the interconnections and dependencies among the large numbers of species present in any system. This is further complicated by uncertainty about future climate. For example, there is significant uncertainty about the role of increased carbon dioxide levels on forest productivity. In general, predictions about forest productivity are uncertain and will rely mainly on future precipitation. While there is variability among climate change scenarios, especially with respect to precipitation, all projections include increased temperature and increased levels of atmospheric carbon dioxide.

Based on projected climate, it is expected that warmer temperatures will cause trees to move northward and to higher elevations. Lenihan et al. (2008) project changes in total forest cover for the state of California will range from a 25% decrease to a 23% increase by 2100. Species with the smallest geographical and climate ranges are expected to be the most vulnerable to change because they will have limited ability to migrate. Alpine ecosystems are particularly vulnerable to increased temperatures because their habitat is already limited with little opportunities to shift to higher elevations. Lenihan et al. (2008) project that Alpine and subalpine forests will decrease in area by 50-70% by 2100, as shown in Figure 25.

Consistent with other tree species, it is likely that the Jeffery Pines (found at elevations of 2000-3100 m) will migrate to higher elevation and some lower elevation forest area will be lost. Several studies predict that warming temperatures will result in the displacement of evergreen conifer forests by mixed evergreen forests across California (Hayhoe et al., 2004; California, 2010). This trend is also shown by the decrease in conifer forests in Figure 25.

Figures 26 and 27 show projected change in viable Jeffery Pine habitat in southern California for three emissions scenarios looking out to 2030 and 2090, respectively (Crookston, 2009). The plots, generated using the Moscow Forestry Sciences Laboratory website http://forest.moscowfsl.wsu.edu/climate/species/speciesDist/Jeffrey-pine/, show significant decrease in viable Jeffery Pine habitat for many scenarios, and some of the most severe (e.g. A2 emission scenario) show no Jeffrey Pine habitat within the Watershed by 2090.

In addition to changes in forest area, warmer temperatures may also impact forest health. For example, extended droughts and earlier snowmelt could cause fire seasons to start earlier and last longer (California, 2010). Also, temperature increases may change the frequency and magnitude of infestations by pests, such as the pine beetle.

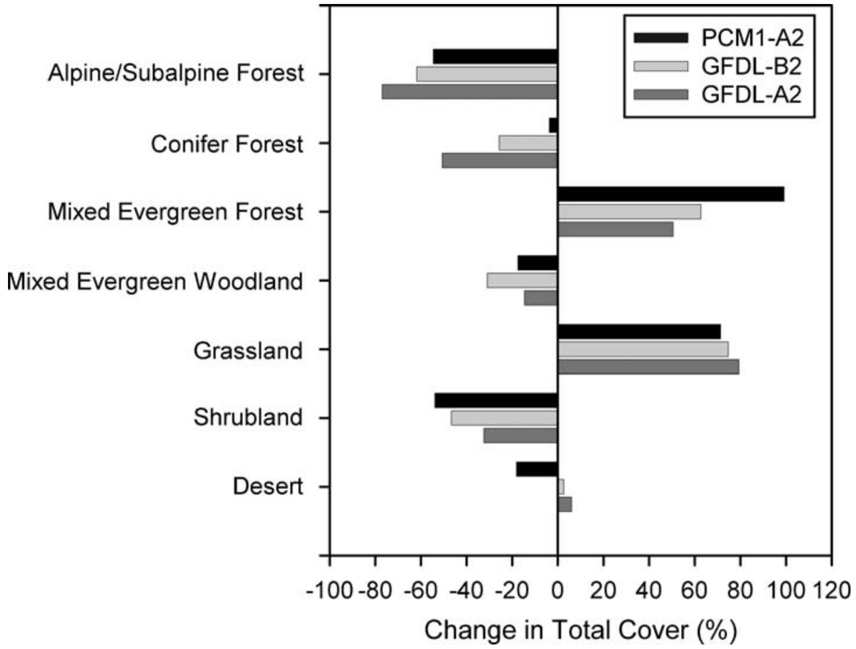


Figure 25: Fig. 4 from Lenihan et al., (2008). Percent change in total land cover for vegetation classes by 2100 for three climate change scenarios predicted using the MC1 Dynamic Vegetation Model

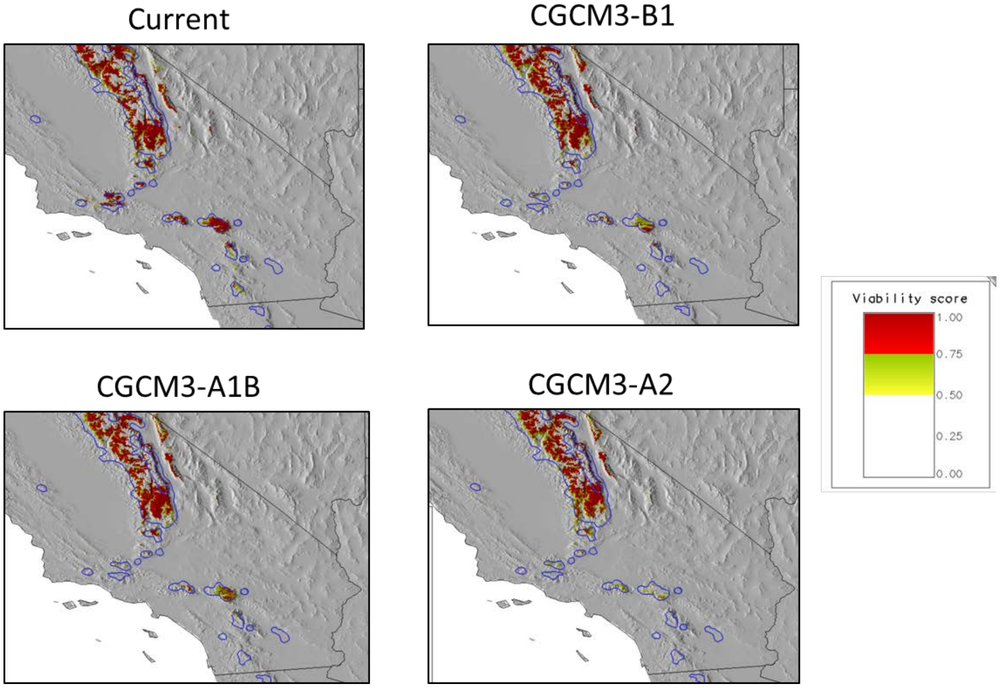


Figure 26: Viability scores for Jeffery Pine currently and for three future projections for 2030

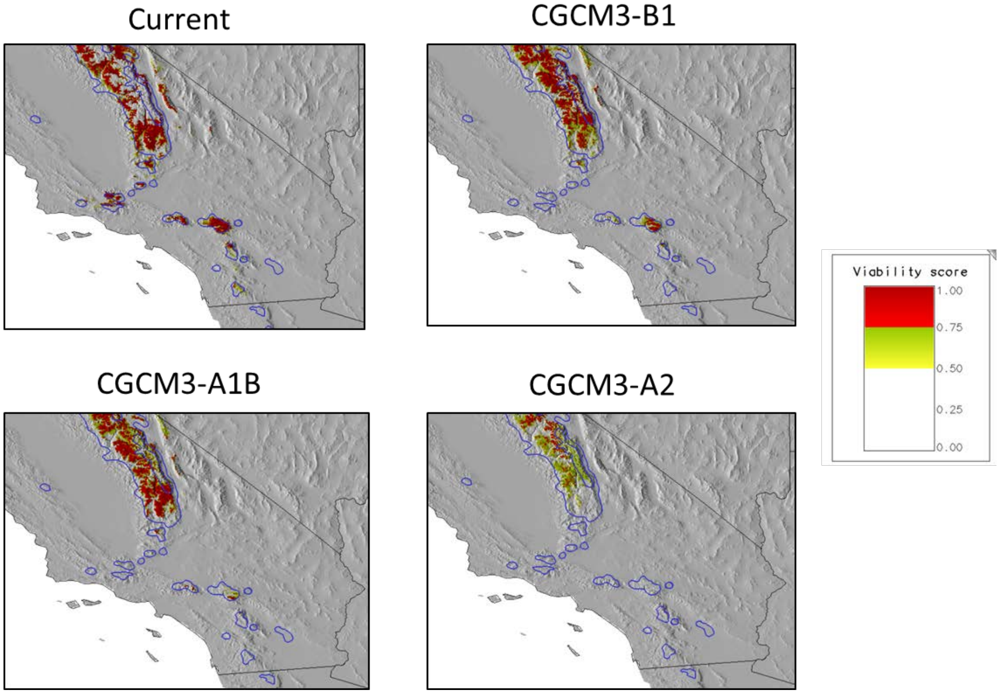


Figure 27: Viability scores for Jeffery Pine currently and for three future projections for 2090

Source: http://forest.moscowfsl.wsu.edu/climate/species/speciesDist/Jeffrey-pine/

4.3 Extreme Temperature Impacts

4.3.1 Background

There is no standard definition of an extreme heat event, commonly known as a "heat wave." It is most commonly defined as a period with more than three consecutive days of maximum temperatures at or above 90°F. However, temperature is only one component of heat, which also depends on humidity, wind speed and radiant load. Climate change is resulting in more frequent and severe heat waves (Dia, 2011). The increased heat could lead to additional air pollution in urban areas, bringing increased health risks.

In 2007, the IPCC concluded that "hot extremes" and "heat waves" are very likely (>90% probability of occurrence) to increase as our climate continues to change. This predicted temperature increase is particularly pronounced for night temperatures, resulting in reduced night-time relief from the heat. These changing weather conditions are a growing concern for individuals and communities in the Watershed.

4.3.2 Methodology

Daily maximum temperature values came from the BCSD-CMIP3 archive for 112 climate projections. Each projection has 1/8° x 1/8° (~12 km x 12 km) grid cell daily forcings that start on January 1, 1950 and run through December 31, 2099. For this analysis, the location of each city was matched to the single VIC grid cell that contains it. The data was analyzed and days with maximum temperatures over 95°F were considered to contribute to the results, found in Section 4.3.3, which summarize temperature trends for all 112 projections from 1950 to 2099 for the selected grid cell.

4.3.3 Results

Figure 28 shows the distribution of the annual number of days above 95°F from 1950-2099 for each of the cities (Anaheim, Riverside, and Big Bear City) for all 112 climate projections. As shown here, there is a clear, increasing trend in the number of days above 95°F for all three locations, with Riverside in the lead, followed by Anaheim. Big Bear City has the least number of days with a median of zero for all years prior to about 2030. The shaded area in Figure 28 shows the range of the 112 climate projections and demonstrates a large spread in projected results. Table 6 summarizes the median number of days above 95°F for each location for the historical time period (1951-1999) and three 30-year future time periods centered around 2020, 2050 and 2070. As shown in Table 6, the number of days increases for all stations advancing into the future. Changes are quite significant; for example, the median value for Anaheim quadrupled from 4 to 16 days between the historical time period and 2070. Similarly, the median value for Riverside nearly doubled between the historical time period and 2070 going from 43 to 82 days.

A study of warming trends in and around the city of Los Angeles also had similar findings (Hall et al., 2012). For this study they statistically and dynamically downscaled GCMs outputs for two emission scenarios ("Business as usual" RCP8.5 and "mitigation" RCP2.6) and compared results between a baseline period of 1981-2000 and future a future period from 2041-2060. Overall, they reported two to three times as many extreme days (i.e. greater than 95 °F) in coastal areas and within the Los Angeles Basin. Inland areas were noted to have three to five times the number of extremely hot days. Although the trends are the same, there are some differences between this report and the results presented in Table 6.

For example, in the Los Angeles study, they report that Riverside had a historical average of 9.6 day extreme heat days per year, while Table 6 reports 43 days. This difference is likely a result of differences in historical time periods (1981-2000 vs. 1950-1999), as well as differences in downscaling methodology. For example, the methodology used for this analysis did not include any bias correcting to match downscaled results to observed temperature gages. Similarly the future estimates provided in the Los Angeles report for Riverside range from 17 to 59 which is less than the 72 days reported in Table 6. Results for Big Bear are very similar between the reports because temperatures are much lower in Big Bear so the number of extreme days remains close to zero in all cases. However, in the Los Angeles report, they also repeated the extreme day analysis with locally derived temperature thresholds. For Big Bear, the local temperature threshold was set to 76.8 °F. Given this lower threshold, it was found that the number of extreme days increased from 7.3 days historically up to a range of 9 to 78 days by 2050. Anaheim was not covered in the Los Angeles report and so cannot be directly compared.

Table 6: Median annual number of days above 95°F for one historical (1951-1999), and three future (2005-2034, 2035-2064, 2055-2084) time periods

	Historical	2020	2050	2070
Anaheim	4	7	12	16
Riverside	43	58	72	82
Big Bear City	0	0	2	4

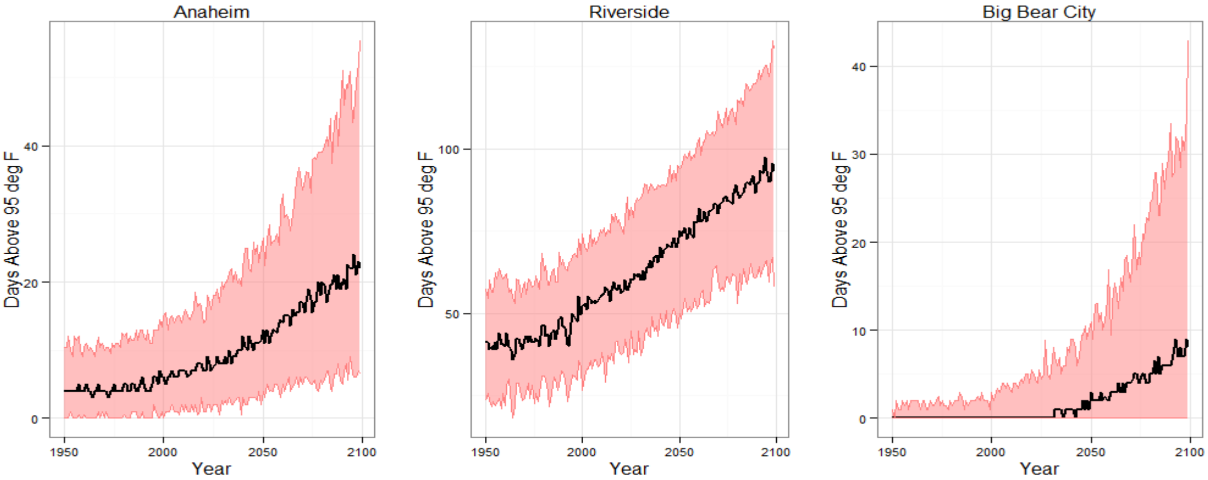


Figure 28: Projected annual number of days above 95°F. Solid black line is the median and the red shading denotes the 5th and 95th percentile bounds

4.4 Flood Impacts

4.4.1 Background

The Santa Ana River has a long history of flooding. In 1862, more than 30 days of rain resulted in flooding across California and destroyed the state capital (Hiltner, 2010). During this flood, it is estimated that the Santa Ana River flowed at roughly 320,000 cfs, about half the flow of the Mississippi River (Hiltner, 2010). Subsequently in 1916, flooding occurred along the Santa Ana River and Santiago Creek, washing out bridges and causing other damages (City of Santa Ana, 2006). In 1938 a flash flood inundated 68,400 acres, resulting in 19 fatalities and leaving 2,000 homeless (City of Santa Ana, 2006). This event led the U.S. Army Corps of Engineers to declare the Santa Ana River the biggest flood hazard west of the Mississippi (Hiltner, 2010). It also helped motivate the construction of Prado Dam and paved the way for a post-World War II construction boom that developed large agricultural areas (City of Santa Ana, 2006). Subsequently, another flood in 1969 caused extensive damage along tributaries. Most recently in 2005, an extended wet period put stress on Prado Dam. No flooding occurred, but the dam began to crack and downstream residents were temporarily evacuated.

As a result of historical floods, there have been a number of efforts to improve flood safety in the basin. In 1964, the Santa Ana River Mainstem Project (SARP) was initiated with a goal of providing flood protection to communities along 75 miles of the Santa Ana River in Orange, Riverside and San Bernardino counties. Today it provides increased flood protection to about 3.35 million people through improvement projects such as channel lining and dam construction (SARP, 2013). Although the flood control system has greatly improved safety, it's important to note that increased development in the area has also increased impervious area and decreased the effectiveness of existing infrastructure.

Generally, the goal of flood frequency analysis is to determine the probability of occurrence for a range of flood values. Often this is expressed in terms of return periods (equal to the inverse of the threshold exceedance probability). If the probability of a given flood magnitude occurring in a given year is 1%, then the return interval is equal to 100-years (assuming every year is an independent sample from all years and that events are equally likely). There are two main approaches to flood frequency analysis. The extreme value approach uses historical flood data to generate a probability distribution that can be used to predict the flood magnitude for any number of return intervals. Alternatively, flood process can be modeled directly using physically-based hydrodynamic models driven by meteorological forcings. For this analysis we combine both approaches; first we simulate floods using a physically based hydrologic model, then we fit an extreme value distribution to the results.

Extreme value functions are designed to capture the distribution of extremes drawn from other distributions. Pearson Type III and Generalized Extreme Value (GEV) are two of the most commonly used distributions. The Gumbel and Weibul distributions are special cases of the GEV distribution that are commonly applied in hydrology. For this work we use the Log Pearson Type III distribution following the standard United States Government methodology presented in Bulletin 17B, “Guidelines for Determining Flood Flow Frequency” (Bulletin 17B, 1982).

Once an extreme value function has been chosen, the next task is to fit it to the observed data. There are three main approaches: plotting positions, method of moments, and maximum likelihood. Plotting positions is the simplest approach; it’s based on visualizing the observed data and fitting a distribution visually or by minimizing errors (e.g. using least squares fitting). Although this method is very straightforward, it is not very commonly used because it is problematic when dealing with limited data. Also, when using least squares to fit, the errors are minimized between sample values and distribution values, but the error that should in fact be considered is frequency not value (FEMA, 2007).

To improve upon this, the method of moments fits distributions using the various moments of the observed data (e.g. mean, variance, skew, kurtosis) rather than the values themselves. For example, one can simply compute sample moments and distribution moments and solve for distribution parameters. This approach can also be difficult, because simple moments may not exist for a given distribution and higher order moments may be limited by sample size (FEMA, 2007). Probability-weighted moments and linear moments (L-Moments) can address these issues (Hosking and Wallis, 1997). Finally, the maximum likelihood approach calculates the likelihood of a sample given the assumed distribution. Parameters are determined by trying to maximize the likelihood or often (log likelihood) for a chosen distribution. Once again following the standard methodology recommended in Bulletin 17B, we will fit distributions using the methods of moments for this analysis.

Before applying flood frequency analysis, it is important to understand key underlying assumptions. All extreme value distributions assume that annual max floods are independent samples from a population. Also the distribution approach assumes point data. If data is available from multiple sites, regional frequency analysis can be used to improve parameter estimation. Finally, most extreme value approaches, including the methodology used here, assume that the distribution that is fit to the observed data remains stationary throughout time. This assumption can be problematic in the face of changing climate in which we might expect increased frequency of extreme events. To address this issue, a number of studies have explored the use of non-stationary extreme value distributions in which distribution parameters are allowed to vary as a function of covariates such as time, precipitation or temperature (Katz and Naveau, 2002; Graffis and Stedinger, 2007). For this study, we fit the traditional stationary models. However, we do account for climate change through the physical modeling step by applying non-stationary climate forcings to simulate future floods.

4.4.2 Methodology

As previously noted, for this analysis we used a combined physical and statistical modeling approach. First, floods are modeled using the VIC physical model forced with climate data from 112 climate simulations. Next, Log Pearson distributions are fit to the annual maximum flood values for each simulation for a range of historical and future time periods. We consider three locations along the Santa Ana: Prado Dam, Seven Oaks Dam, and the Adams Street gage near the river outlet. Three 30-year periods are considered centered around: 2020, 2050 and 2070. The historical period spans 50 years from 1950 to 1999.

Annual maximum one-day flood values are calculated from the VIC outputs for each of the 112 150-year simulations. Flood frequencies are estimated following the standard United States Government method outlined in Bulletin 17-B. For each analysis time period (one historical and three 30-year futures) and climate scenario, a Log Pearson III distribution is fit to the annual maximum values using the L-moments approach. Note that each time period is treated separately. For example, each future period will have 30 values with which to fit the distribution. Using the parameters for the Log-Pearson III distributions, the 200-year return period flow values are estimated for every climate simulation and analysis period. The 200-year storm was used in order to fill the requirements set forth in the California Department of Water Resources' Climate Change Handbook for Regional Water Planning (Appendix B). The distribution is also used to calculate the return period for the median historical 200-year flood for each climate simulation and future time period.

4.4.3 Results

Figures 29 through 31 show results for the three analysis locations: Prado Dam, Seven Oaks Dam, and the Adams Street gage. The boxplots on the left show the distribution of 200-year flood flows estimated using the distributions fit to the 112 scenarios for each time period. The boxplots on the right show the simulated return period of the historical median 200-year flood flow. Tables 7 and 8 summarize the data presented in the boxplots. Table 7 provides the median and interquartile range of 200-year flood flow values. Table 8 provides similar information for the future return periods of the historical median flood flows.

For all stations, there is a clear trend of increasing median 200-year flood flow for each subsequent future analysis period. However, there is also large variability in the future flood projections. Still, in all cases, the bottom of the historical interquartile range (designated by the shaded box) falls below the projected future interquartile range. As would be expected, this results in a decreased return interval for the median historical 200-year flood (as shown in the figures on the right). On average, projections indicate that what was historically the 200-year flood may be closer to a 70-year flood.

Comparing results from station to station, the trends are very similar, increasing flood volumes and decreasing return intervals. This trend is most pronounced for the Seven Oaks Dam site where there is a clear increasing trend in 200-year flood volumes and dramatic decrease in return periods. Seven Oaks Dam also shows a clear decrease in the upper interquartile range for return periods in later future periods.

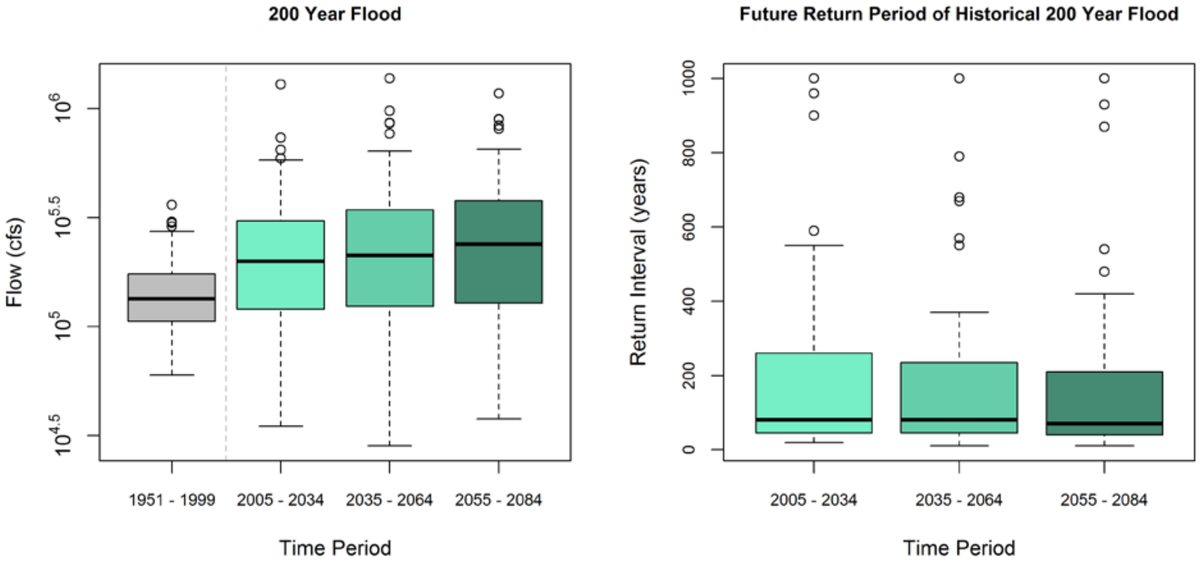


Figure 29: Station 8 Prado Dam - boxplots of 200-year flood volumes and future return periods for the median historical 200-year flood

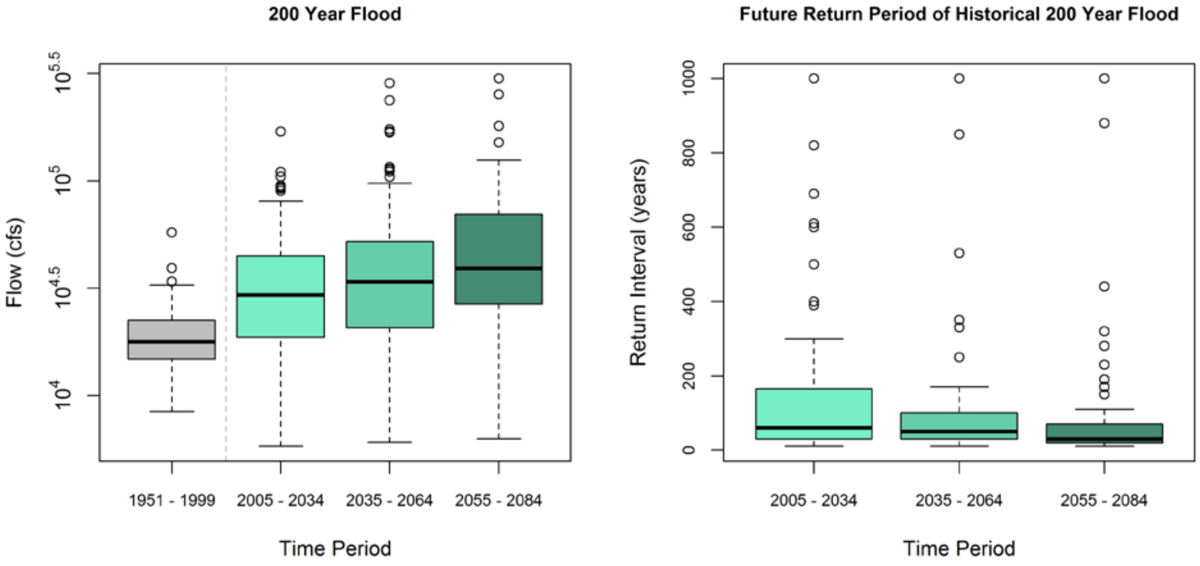


Figure 30: Station 34 Seven Oaks Dam - boxplots of 200-year flood volumes and future return periods for the median historical 200-year flood

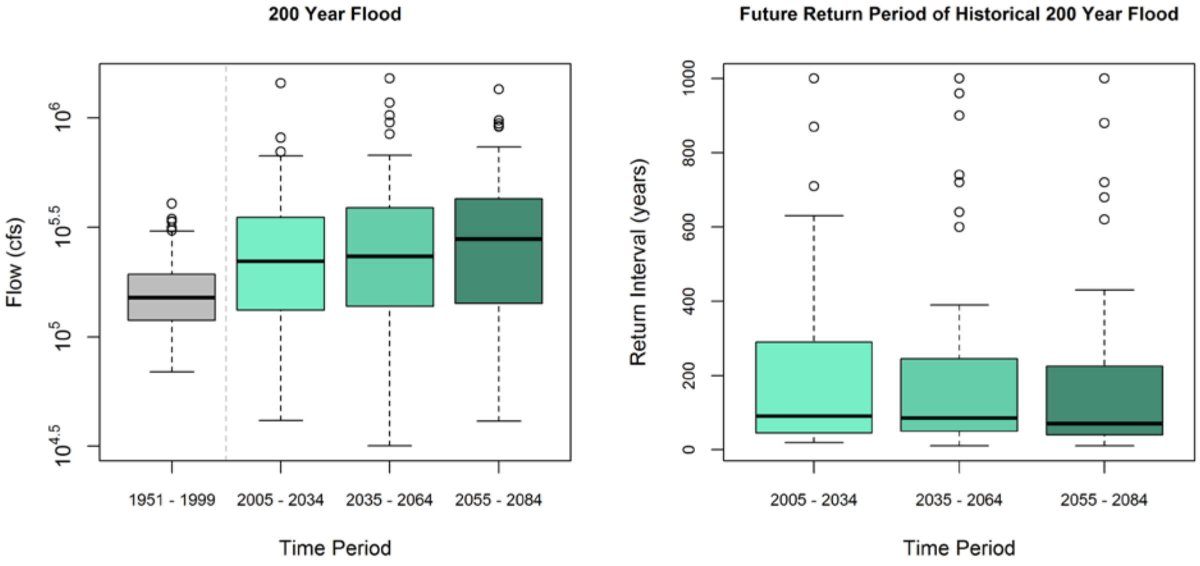


Figure 31: Station 21 Adams Street Gage - boxplots of 200-year flood volumes and future return periods for the median historical 200-year flood

Table 7: Summary of 200-year flood flows (cfs)

Station	Time Period	Percentile		
		25%	50%	75%
Prado Dam	Historical	106,289	134,170	174,018
	2020	120,616	199,623	302,401
	2050	124,369	212,392	335,621
	2070	129,706	239,359	377,660
Seven Oaks Dam	Historical	14,805	17,786	22,428
	2020	18,821	29,394	44,474
	2050	20,730	33,813	52,073
	2070	26,765	39,099	69,724
Adams Street Gage	Historical	119,084	151,084	192,357
	2020	132,923	221,375	347,943
	2050	137,749	232,974	385,438
	2070	142,980	279,004	424,881

Table 8: Summary of return periods, in years, for the median 200-year historical flood

Station	Time Period	Percentile		
		25%	50%	75%
Prado Dam	2020	48	80	260
	2050	48	80	233
	2070	40	70	205
Seven Oaks Dam	2020	30	60	163
	2050	30	50	100
	2070	20	30	70
Adam Street Gage	2020	48	90	285
	2050	50	85	243
	2070	40	70	223

Results from this analysis indicate increased risk of flooding in the future. This is demonstrated by increased 200-year flood magnitudes as well as decreased recurrence intervals for what was historically considered a 200-year flood. While these results show clear trends, it is also important to note that there is large variability between climate simulations. For the purposes of this analysis, it is assumed that all future scenarios are equally likely. Variability in the results reflects large underlying uncertainties with GCM outputs and downscaling methodologies. Additionally, the quality of results is necessarily limited by the ability of the VIC model to accurately generate flood flows from forcing data. While these constraints are acknowledged, it should be noted that this analysis follows standard methodologies and utilizes the best available input data.

4.5 Sea Level Rise Impacts

4.5.1 Background

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 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 (Cayan et al., 2009), 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, power plants, 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.

4.5.2 Methodology

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 injection barriers, shown in Figure 32.

Projected sea level rise scenarios were developed by the California Climate Change Center (Cayan et al., 2009). For this analysis, the moderate projected sea level rise along the California coast was used. The projected time horizon or year is not critical for the model runs (described below), but rather just the sea level rise amount. Therefore, to bracket the entire range of projected moderate case sea level rise values, OCWD chose to model a low end of 0.5 feet and an upper end of 3 feet. Separate model runs were conducted for these two sea level rise cases, both for the Talbert Barrier area using the basin model and for the Alamitos Barrier area using the Alamitos Barrier flow model.

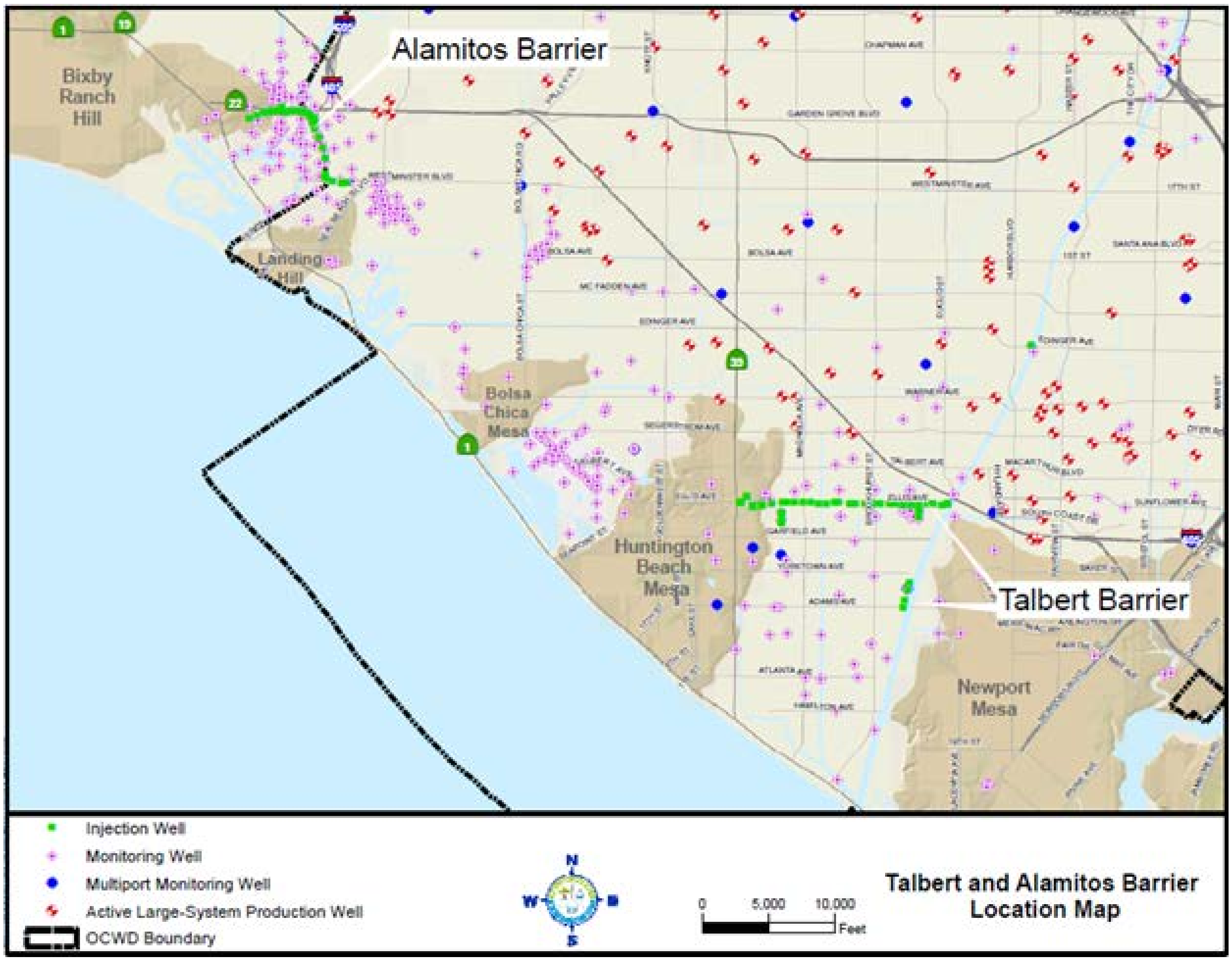


Figure 32: Locations selected for OCWD analysis

The model encompasses the entire basin and extends approximately three miles west into the Central Basin of Los Angeles County. The model grid cells are 500 by 500 feet and have vertical dimensions ranging from approximately 50 to 1,800 feet, depending on the thickness of each model layer at that grid cell location. The model accounts for time varying specified head boundaries, pumping rates, and recharge rates.

Model input data were obtained from well logs, aquifer pump tests, groundwater elevation measurements, hand-drawn contour maps, geologic cross sections, water budget spreadsheets, and other data stored in the OCWD Water Resources Management System (WRMS) database. The basin model was calibrated to transient conditions to achieve an acceptable match between simulated and actual observed conditions using monthly flow and water level data for the period 1990-1999.

4.5.3 Results

Increasing temperatures will melt ice sheets and glaciers and cause thermal expansion of ocean water, both of which will increase the volume of water in the oceans and thus contribute to global mean SLR. Regional SLR may be higher or lower than global mean SLR due to regional changes in atmospheric and ocean circulation patterns. Figure 33 shows the range of projected global mean SLR by 2100. Regional mean sea level along the Southern California coast is projected to rise by 40-300 mm (1.5-12 in) by 2030, 125-610mm (5-24 in) by 2050, and 405-1675 mm (16-66 in) by 2100.

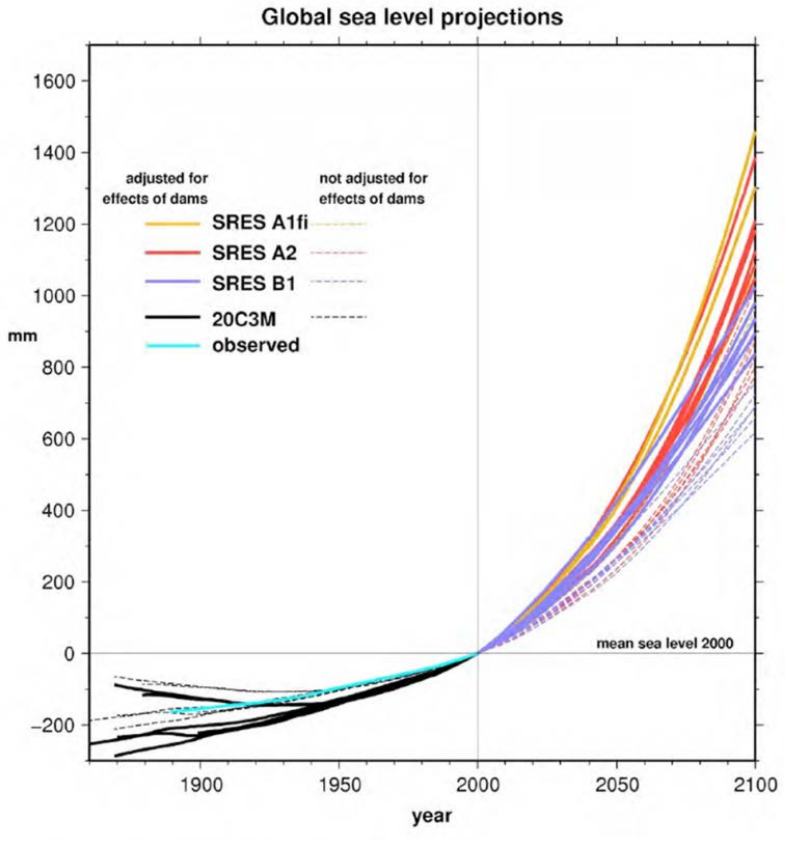
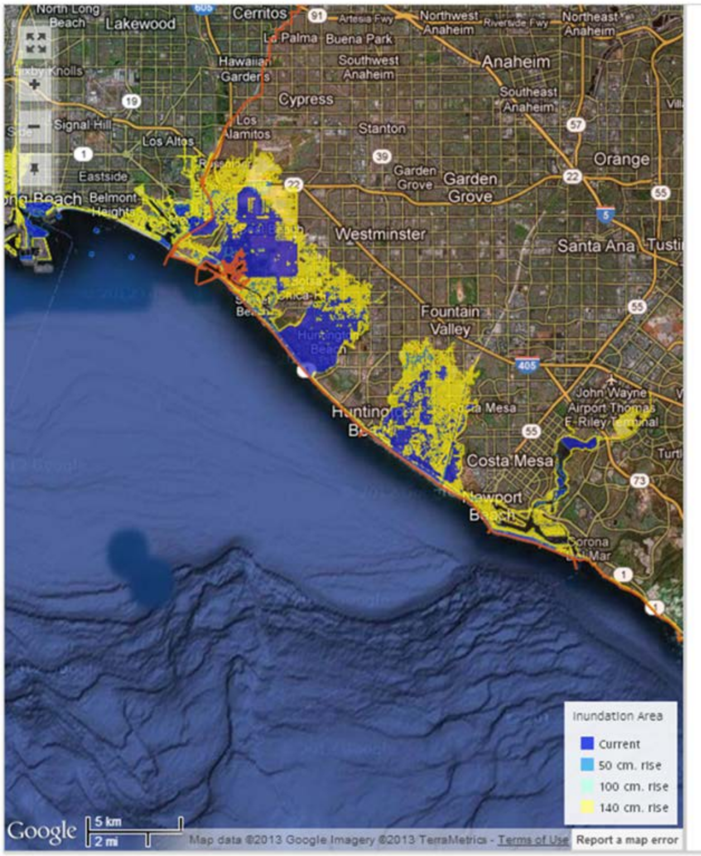


Figure 33: Projections of global mean sea level rise

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. Figure 34 shows the areas of Orange County that are currently vulnerable to inundation due to a 100-year flood event (blue) and areas that will be vulnerable to inundation with a 1400 mm (55 in) rise in mean sea level (source: http://cal-adapt.org/sealevel/).

Detailed analysis carried out by Orange County Water District found that the Talbert Barrier would be effective at preventing seawater intrusions through the Tablert 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 barriers at preventing seawater intrusion under rising sea levels.



Source: http://cal-adapt.org/sealevel

Figure 34: Area at risk of inundation from 100-year flood event under current conditions (blue) and under 1400 mm sea level rise (yellow)

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.

4.6 Decision Support and Impact Assessment Summary

A set of frequently asked questions (FAQs) were answered using the previous analyses. Those questions and the key findings are summarized below.

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 in order 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 on basin-scale groundwater conditions.

Is Lake Elsinore in danger of drying up?

- Lake Elsinore has less than a 10% chance of drying up (2000-2099).
- 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 (EVMWD) project does aid in stabilizing lake levels; however, for the period 2050-2099 additional measures will likely be required to 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 m 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.

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 water in the oceans.
- 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.

In order to adapt to the impacts of climate change described in this chapter, water managers need tools that enable them to make informed decisions. Reclamation has developed a tool, the Greenhouse Gas (GHG) Emissions Calculator, which can be used to inform adaptive strategies. This tool was used to conduct a demand management case study for Orange County. The tool and case study are presented in Chapter 5.

5.0 Demand Management to Inform Adaptive Strategies

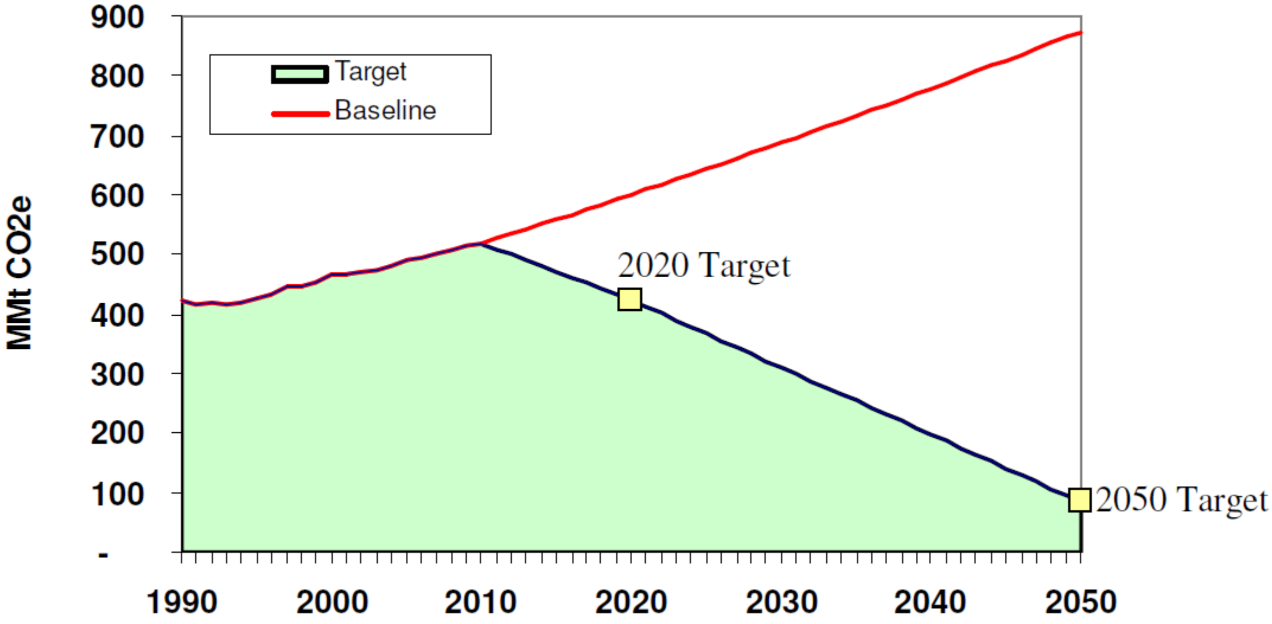
5.1 Background

Water resource managers are currently being challenged to develop sustainable methods for adaptation and mitigation to climate change. Demands for treatment and transportation of water are increasing globally due to developments in industrial, agricultural and domestic water use, and water quality regulation (King and Webber, 2008). Large increases in energy use in the water sector are being driven by rising demand for food and bio-fuels, and their international trade, driving up irrigated cropland and cropping intensity (DOE, 2006). This estimate excludes the effects of climate change, which in many cases will put further pressure on water resources (IPCC, 2008). With increased irrigation, further development of ground water is highly likely. Declining ground water will compound energy use, as deeper wells require more carbon-intensive electric-driven pumps.

Growing populations are creating a higher water demand. In areas where water is already scarce, accelerated research will be required in order to develop sustainable mitigation and adaptation scenarios to climate change, while still meeting the demand. Consideration of alternative water supply systems, treatment technologies, or water allocation may have a tendency to overlook the carbon cost. This is particularly the case in the absence of regulatory pressure. The passing of California’s Assembly Bill 32: The Global Warming Solutions Act (AB 32) is the first in a series of legislation forcing this issue to be addressed.

Climate change threatens California’s natural environment, economic prosperity, public health, and quality of life (California Energy Commission, 2005; AB 32, 2006). Recognizing the need for action, California has put in place ambitious emission reduction goals in the form of AB 32. By requiring in law a reduction in GHG emissions, California has set the stage to transition to a sustainable, clean energy future, and put climate change mitigation on the national agenda, spurring action by many other states. AB 32 directly links anthropogenic 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 ever major sector in the state.

AB 32 requires that every major sector in California reduce its GHG emissions to the 1990 levels by 2020, and to 80% below the 1990 levels by 2050, shown in Figure 35. These targets were developed from the levels of reduction climate scientists agree is required to stabilize our climate (IPCC, 2008). The red line in Figure 35 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.



Source: http://ethree.com/documents/GHG6.10/CA_2050_GHG_Goals.pdf

Figure 35: AB 32 GHG Emission Reduction Targets

5.2 Methods

The methods used account for embodied energy and the subsequent GHG emissions of water consumption in a study area. Figure 36 illustrates the different energy consuming processes involved in the delivery and treatment of water. End-use of water is not considered in this analysis; for example, energy used for heating water in the home. The energy intensity of each of these processes, and the volume of water passing through each, will need to be known in order to accurately inventory emissions associated with water consumption. The degree to which each of the processes used to deliver water is identified, and the energy intensity of each of those processes is known, will define the accuracy of the methods for determining the GHG emissions from water consumption. Water conveyance can be the most impactful element in California. Communities in the south draw significant amounts of water from vast distances over elevated terrain.

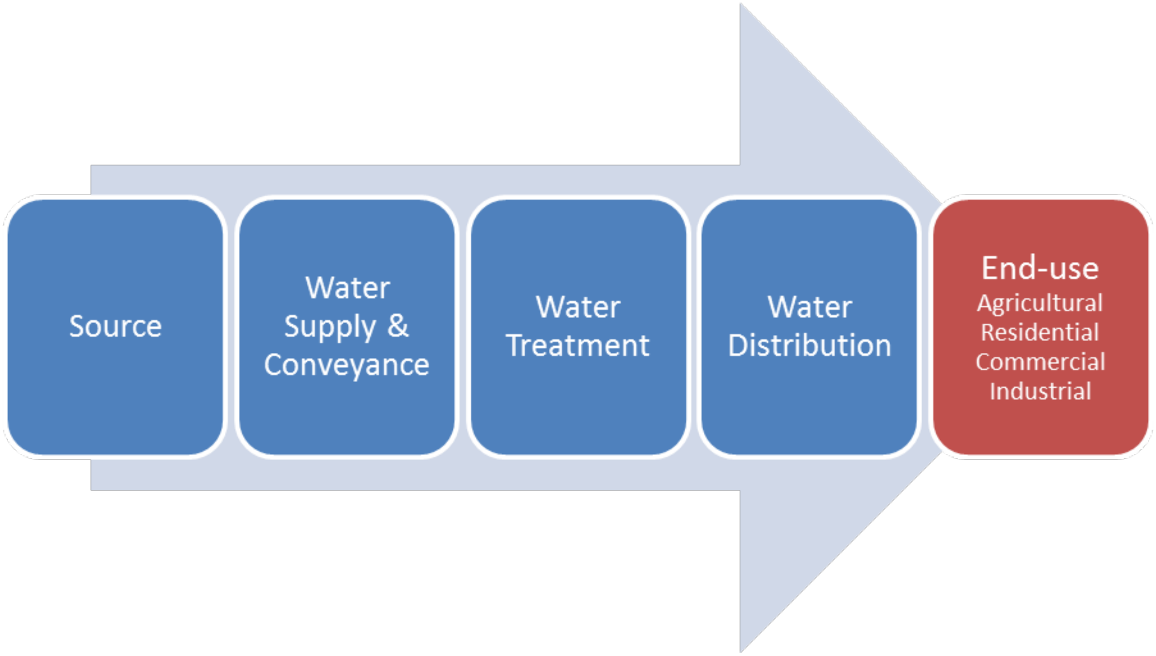


Figure 36: Energy Consuming Process in the Delivery and Treatment of Water (red not included in analysis)

Study area specific energy consumed per unit of water for each process of the water system is utilized. If site specific information is not available, southern California defaults are used. Default utility specific emission factors were obtained from the California Climate Action Registry Power/Utility Protocol reports. Annual average electricity emission factors came from the California Air Resources Board Greenhouse Gas Inventory (2007), and eGRID (2009).

Equation 2 depicts how total annual CO_2e emissions are calculated:

Annual CO_2e emissions = Extraction + Conveyance + Treatment + Distribution…….**Eq. 2**

Where:

Extraction =

$$\Sigma\,(\text{Source Percentage} * \text{Population} * \text{per capita Use} * \text{Process Energy Intensity}_{\text{GW Extraction}}) * \text{Energy Emissions Factor} * \text{Unit Conversions}$$

$$\text{Conveyance} = \Sigma\left(\text{Source Percentage} * \text{Population} * \text{per capita Use} * \text{Process Energy Intensity}_{\text{Conveyance}}\right) * \text{Energy Emissions Factor} * \text{Unit Conversions}$$

$$\text{Treatment} = \Sigma\left(\text{Source Percentage} * \text{Population} * \text{per capita Use} * \text{Process Energy Intensity}_{\text{Treatment}}\right) * \text{Energy Emissions Factor} * \text{Unit Conversions}$$

$$\text{Distribution} = \Sigma\left(\text{Source Percentage} * \text{Population} * \text{per capita Use} * \text{Process Energy Intensity}_{\text{Distribution}}\right) * \text{Energy Emissions Factor} * \text{Unit Conversions}$$

A GHG Emissions Calculator was developed by Reclamation to allow users to implement this method in order to easily and quickly evaluate how their water management decisions affect their water demand, energy use, and GHG emissions. A full technical report on the GHG Emissions Calculator will be published by fall 2013.

5.3 Application

In February 2008, California Governor Schwarzenegger directed state agencies to develop a plan to reduce statewide per capita urban water use by 20% by the year 2020. The GHG Emissions Calculator was used to evaluate whether this conservation measure alone would be enough to meet AB 32 targets (shown in Figure 35) in Orange County. The results show that a 20% reduction by the year 2020 allows Orange County to meet the 2020 target (back to 1990 levels), but do not meet the 2050 target of 80% below 1990 levels, as shown in Figure 37.

A 20% reduction in per capita water use every 10 years from 2020 to 2050 was evaluated in the GHG Emissions Calculator. These additional conservation measures only reach 50% below the 1990 GHG emission levels, as shown in Figure 38. In order to reach the AB 32 2050 target of 80% below the 1990 levels of GHG emissions through conservation alone, a per capita water use reduction of an additional 10% each decade would need to be achieved, results of which are shown in Figure 39. This level of conservation, shown in Table 9, may not be feasible for the area. In Figure 40, the three conservation scenarios described above are compared to the no action scenario, a task easily accomplished by the GHG Emissions Calculator. The GHG Emissions Calculator can also be used to evaluate additional measures to reduce GHG emissions including changes to water supply portfolio, graywater reuse, and rainwater harvesting among many others. It is likely that a combination of measures will be required to meet the GHG emission reduction targets laid out in AB 32.

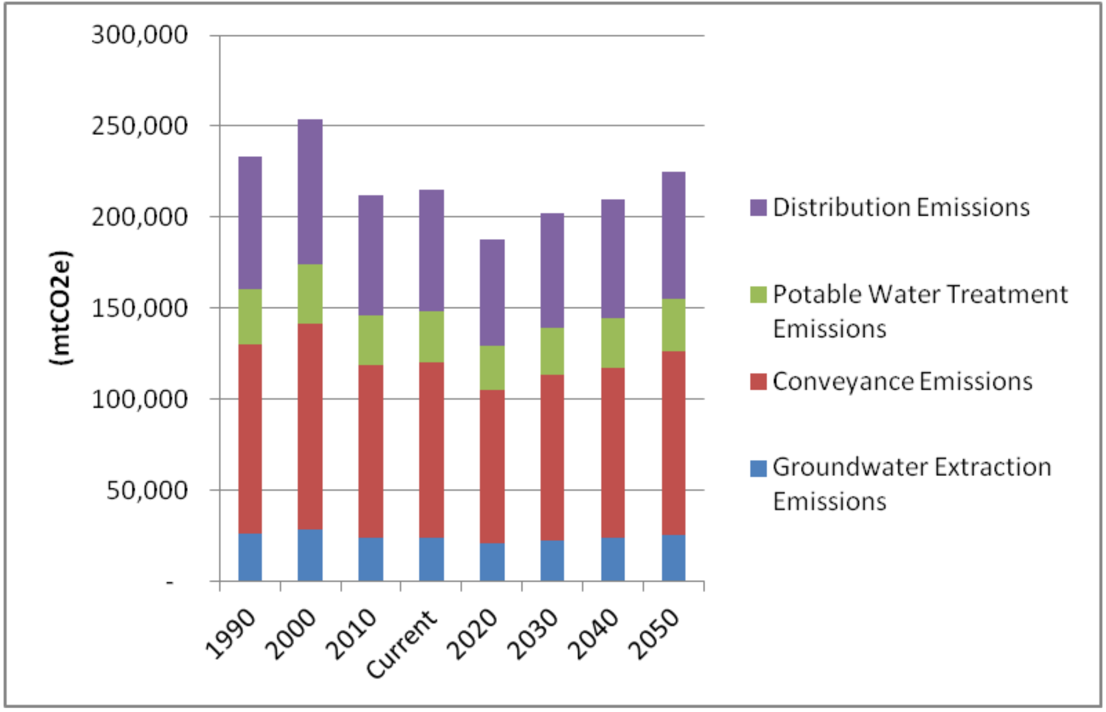


Figure 36: Conservation for Orange County to meet a 20% reduction in GHG emissions by 2020 (also referred to as 20x2020)

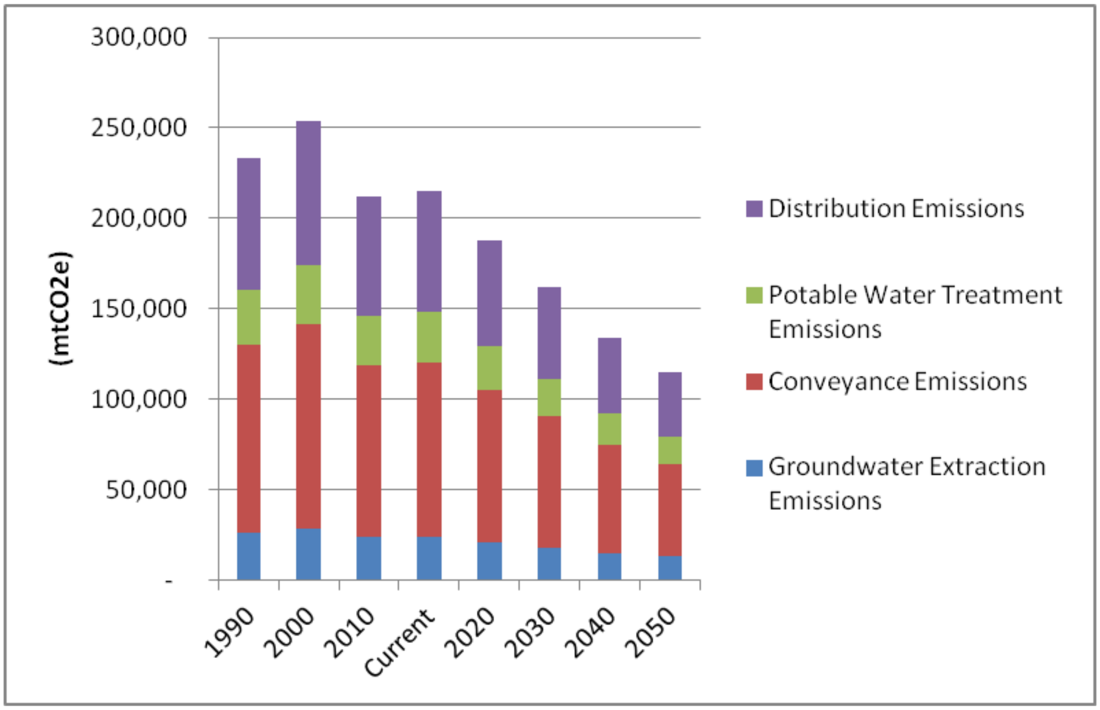


Figure 37: GHG emissions resulting from a 20% reduction in per capita water use every 10 years from 2020 to 2030 for Orange County

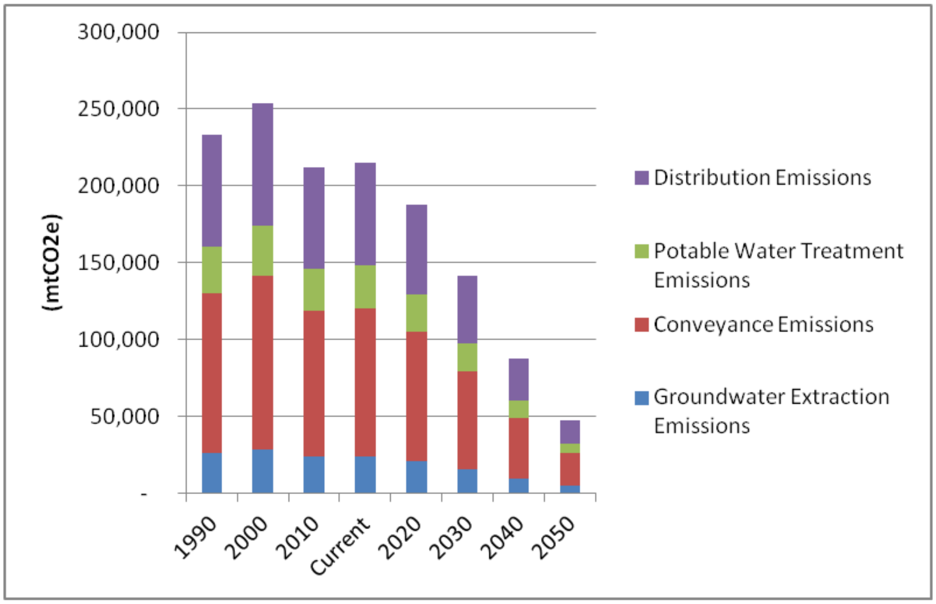


Figure 38: GHG emissions resulting from reductions in per capita water use shown in Table 9 for Orange County

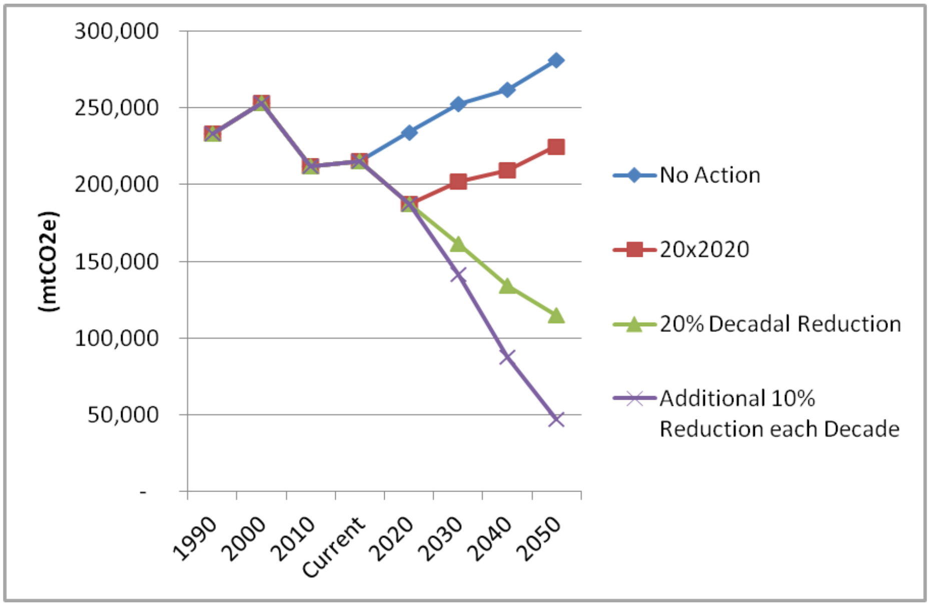


Figure 39: Comparison of GHG emissions resulting from conservation scenarios

Table 9: Conservation measures required to meet AB 32 2050 target

Historical and Projected Per Capita Water Use							
	1990	2000	2010	2020	2030	2040	2050
Per Capita Water Use (gpd)	240	221	175	140	98	59	29
Decadal Conservation Rate		-8%	-21%	-20%	-30%	-40%	-50%

6.0 Uncertainties

This 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 study results, 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 Basin Study FAQs.

6.1 Climate Projection Information

6.1.1 Global Climate Forcing

Although surface water hydrologic projections often consider future climate projections representing a range of future greenhouse emission paths, the uncertainties associated with these pathways are often not explored. Such uncertainties include those introduced by assumptions about technological and economic developments, globally and regionally; how those assumptions translate into global energy use involving GHG emissions; and biogeochemical analysis to determine the fate of GHG emissions in the oceans, land, and atmosphere. Also, not all the uncertainties associated with climate forgings are associated with GHG assumptions. Considerable uncertainty remains associated with natural forcings, with the cooling influence of aerosols being regarded as the most uncertain on a global scale (e.g., figure SPM-2 in IPCC 2007).

6.1.2 Global Climate Simulations

While the activity presented in this report considers climate projections produced by state-of-the-art coupled ocean-atmosphere climate models, there are still uncertainties about the scientific understanding of physical processes that affect climate. For example, how to represent such processes in GCMs (e.g., atmospheric circulation, clouds, ocean circulation, deep ocean heat update, ice sheet dynamics, sea level, land cover effects from water cycle, vegetative, and other biological changes); and how to do so in a mathematically efficiently manner, given computational limitations. Still, these models have shown an ability to simulate the influence of increasing GHG emissions on global climate (IPCC 2007).

6.1.3 Climate Projection Bias Correction

Surface water hydrologic projections inherit GCM biases toward being too wet, too dry, too warm, or too cool. Such systematic biases in GCMs should be identified and accounted for through bias-correction of climate projections, prior to use in impacts studies. Bias correction of climate projections data affects results on incremental runoff and water supply response.

6.1.4 Climate Projection Spatial Downscaling

The Basin Study uses projections that have been spatially disaggregated on a monthly time step (following GCM bias correction on a monthly time step). Although this technique has been used to support numerous water resources impacts studies (e.g., Van Rheenan et al., 2004; Maurer, 2007; Anderson et al., 2008; Reclamation, 2008; Reclamation, 2010; Elsner et al., 2010), uncertainties remain about the limitations of empirical downscaling methodologies. One potential limitation relates to how empirical methodologies require historical reference information use on spatial climatic patterns at the downscaled spatial resolution. These finer-grid patterns are implicitly related to historical large-scale atmospheric circulation patterns, which presumably would change somewhat with global climate change. Application of the historical finer-grid spatial patterns to guide downscaling of future climate projections implies an assumption that the historical relationship between finer-grid surface climate patterns and large-scale atmospheric circulation is still valid under the future climate. In other words, the relationship is assumed to have statistical stationarity, meaning the joint probability distribution does not change when shifted in time or space. In actuality, it is possible that such stationarity will not hold at various space and time scales, over various locations, and for various climate variables. However, the significance of potential non-stationarity in empirical downscaling methods, and the need to utilize alternative downscaling methodologies remains not well understood.

6.2 Assessing Hydrologic Impacts

6.2.1 Generating Weather Sequences Consistent with Climate Projections

The temporal disaggregation method developed first by Wood et al., (2002), was used in this Basin Study to translate monthly BCSD climate projections into daily VIC weather forcings. However, other techniques might have been considered. Choice of weather generation technique depends on aspects of climate change that are being targeted in a given study. Preference among available techniques remains to be established. Various characteristics, such as that the resampling approach, does not allow daily temperature ranges to vary from those selected with the sample, make the disaggregation approach unsuitable for studies focusing on potential changes in the diurnal range of temperature. In contrast, it may be sufficient for monthly time step hydrological assessments if the disaggregation is performed with thoughtful sampling constraints.

6.2.2 Natural Runoff Response

This Basin Study analyzes natural runoff response to changes in precipitation, temperature, and change in natural vegetation PET while holding other watershed features constant. Other watershed features might be expected to change as climate changes and affects runoff (e.g., vegetation affecting evapotranspiration and infiltration, etc.). On the matter of land cover response to climate change, the runoff models' calibrations would have to change if land cover changed, because the models were calibrated to represent the historical relationship between weather and runoff as mediated by historical land cover. Adjustment to watershed land cover and model parameterizations are difficult to consider due to lack of available information to guide such an adjustment. Eco-hydrological frameworks, perhaps involving dynamic vegetation response, may be suitable to represent such land surface changes for studies in which such sensitivities are important.

6.2.3 Hydrologic Modeling

The hydrology model used in the Basin Study excludes ground water interaction with surface water systems. The fate of precipitation is modeled as loss only to runoff and evapotranspiration; and loss of precipitation to deep percolation and return flows to stream channel networks are not considered in the VIC hydrology model. The groundwater impacts in the basin are simulated using a simplified tool.

6.2.4 Bias and Calibration

Where the VIC applications have been calibrated, they can reproduce historical natural streamflow with little bias. Where the VIC applications have not been calibrated, they can exhibit significant bias. The location-specific implications of calibration, or lack thereof, on the conclusions of the study have not been quantified.

6.2.5 Time Resolution of the Applications

Simulations were conducted at daily time steps, while the applications were calibrated to reproduce monthly and annual runoff characteristics at a subset of locations in the basin. For this reason, users should cautiously interpret the daily hydrologic information coming from these simulations. The daily runoff information is physically consistent with assumed weather forcings and hydrologic model structure; however, there could be significant simulation biases at the submonthly level.

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Appendix F. Water Shortage Contingency Plan

Water Shortage Contingency Plan

The Water Shortage Contingency Plan (WSCP) is a strategic plan that Temescal Valley Water District (TVWD) uses to prepare for and respond to foreseeable and unforeseeable water shortages. A water shortage occurs when water supply available is insufficient to meet the normally expected customer water use at a given point in time. A shortage may occur due to a number of reasons, such as water supply quality changes, climate change, drought, regional power outage, and catastrophic events (e.g., earthquake).

Additionally, the State may declare a statewide drought emergency and mandate that water suppliers reduce demands, as occurred in 2014. The WSCP serves as the operating manual that TVWD will use to prevent catastrophic service disruptions through proactive, rather than reactive, mitigation of water shortages. The WSCP provides a process for an annual water supply and demand assessment and structured steps designed to respond to actual conditions. This level of detailed planning and preparation provides accountability and predictability and will help TVWD maintain reliable supplies and reduce the impacts of any supply shortages and/or interruptions.

This WSCP was prepared in conjunction with TVWD's 2020 Urban Water Management Plan (UWMP) and is a standalone document that can be modified as needed. This document is compliant with the California Water Code (CWC) Section 10632 and incorporates guidance from the State of California Department of Water Resources (DWR) UWMP Guidebook 2020 (California Department of Water Resources, 2021). This WSCP is required to be updated based on new requirements every five years and will be adopted as a current update for submission to the California Department of Water Resources.

1.1 Overview of the WSCP

TVWD serves water to retail customers, and this WSCP addresses TVWD's response to shortages in both its potable and non-potable systems.

The WSCP describes the following:

Water Supply Reliability Analysis

Summarizes TVWD's water supply analysis and reliability and identifies any key issues that may trigger a shortage condition.

Annual Water Supply and Demand Assessment Procedures

Describes the key data inputs, evaluation criteria, and methodology for assessing the system's reliability for the coming year and the steps to formally declare any water shortage levels and response actions.

Shortage Stages

Establishes water shortage levels to clearly identify and prepare for shortages.

Shortage Response Actions

Describes the response actions that may be implemented or considered for each stage to reduce gaps between supply and demand.

Communication Protocols

Describes communication protocols under each stage to ensure customers, the public, and government agencies are informed of shortage conditions and requirements.

Compliance and Enforcement

Defines compliance and enforcement actions available to administer demand reductions.

Legal Authority

Lists the legal documents that grant TVWD the authority to declare a water shortage and implement and enforce response actions.

Financial Consequences of WSCP Implementation

Describes the anticipated financial impact of implementing water shortage stages and identifies mitigation strategies to offset financial burdens.

Monitoring and Reporting

Summarizes the monitoring and reporting techniques to evaluate the effectiveness of shortage response actions and overall WSCP implementation. Results are used to determine if additional shortage response actions should be activated or if efforts are successful and response actions should be reduced.

WSCP Refinement Procedures

Describes the factors that may trigger updates to the WSCP and outlines how to complete an update.

Special Water Features Distinctions

Identifies exemptions for decorative features aside from pools and spas.

Plan Adoption, Submittal, and Availability

Describes the process for the WSCP adoption, submittal, and availability after each revision.

1.2 Water Supply Reliability Analysis

TVWD imports water from the Metropolitan Water District of Southern California (Metropolitan) through Western Municipal Water District (Western) to meet 100% of its potable demands; therefore, TVWD's imported water supply reliability mimics that of Western and Metropolitan's 2020 UWMP analysis. Metropolitan described several challenges in providing adequate, reliable, and high-quality supplemental water supplies along with potential management measures in the Metropolitan 2020 UWMP, as described in TVWD's UWMP. Furthermore, both Western and Metropolitan anticipate meeting customer demands over the planning period. While investments in storage and flexible operations have prepared Metropolitan to capitalize on available supplies in wet years and manage through drought years, drought challenges remain. The Colorado River Basin has historically experienced large swings in annual hydrologic conditions and has exhibited a drying trend over the last 21 years. Changes in this period have been mitigated by actions taken by Metropolitan in cooperation with the Bureau of Reclamation and the other Basin States to maintain system storage, avoiding a shortage declaration. At the close of 2020, however, system storage was at or near its lowest since 2000, so there is less water available to buffer future dry conditions. The Sacramento-San Joaquin Delta (Bay-Delta) has suffered reduced flows and rising temperatures and SWP supplies have been significantly reduced at times, with a record low allocation of 5 percent in 2014 and again in 2021. It is anticipated that 2022 may be another dry year. Metropolitan plans to utilize stored water and Colorado River supplies to meet customer demands for the remainder of 2021 and the beginning of 2022. As part of proactive management, Metropolitan continues to plan for dry years and explore efforts to access emergency supplies. Possible solutions include accessing DWR's emergency supplies in southern SWP reservoirs and replenish these reservoirs once allocations are available again, temporarily treat and use stored groundwater along the California Aqueduct, and continued water conservation efforts (Adel Hagekhalil, Metropolitan Water District of Southern California, 2021).

Based on the results of Metropolitan's and Western's reliability analysis, it is expected that sufficient supply is available to meet demands. As a result, TVWD anticipates no reliability concerns within its potable system over the planning period.

TVWD also does not expect any reliability concerns within its non-potable and recycled water systems. Recycled water is considered a drought-proof supply, as it is generated from indoor water uses. Local groundwater from the Bedford-Coldwater is considered reliable because TVWD's extractions are relatively small. As TVWD approaches buildout, it is anticipated that additional recycled water will be generated and reused, and non-potable groundwater use may be reduced.

1.3 Annual Water Supply and Demand Assessment

The Annual Water Supply and Demand Assessment (Annual Assessment) is an evaluation of the near-term outlook for supplies and demands to determine whether the potential for a supply shortage exists and whether there is a need to trigger a WSCP shortage stage and response actions in the current calendar year to maintain reliability. Starting in 2022, the Annual Assessment will be due by July 1st of every year, as indicated by CWC Section 10632.1.

To complete TVWD's Annual Assessment, TVWD will coordinate with Western. The steps TVWD's General Manager will take to perform the Annual Assessment are outlined in Table 1.

Table 1. Annual Assessment Timeline

TIMING	ASSESSMENT ACTIVITIES	PROCEDURE, KEY DATA INPUTS, EVALUATION CRITERIA AND OTHER CONSIDERATIONS	STAFF RESPONSIBLE
MARCH	Estimate unconstrained demands for the coming year	TVWD will estimate expected potable and non-potable demands for the coming year based on demands from the current year plus expected increases due to development. TVWD will provide the potable demand estimate to Western once complete. TVWD will further analyze the total non-potable demand and break down by location (demand overlays either the Bedford or Coldwater subbasins).	General Manager
MARCH	Estimate available supplies for the year, considering the following year will be dry.	TVWD is fully reliant on Western to meet potable demands. TVWD will coordinate with Western for potable supply. TVWD anticipates that sufficient imported supplies will be available, even in dry years, based on both Western and Metropolitan's UWMPs. If Metropolitan has declared a reduction to allocation, as outlined in their Water Shortage Allocation Plan (WSAP) (typically done in spring of a given year, if needed), water use above the WSAP stage will be charged a penalty rate. TVWD will estimate the expected recycled water supply for the coming year and the amount of recycled water that can be used to meet non-potable demands. Any excess recycled water will be percolated. TVWD will estimate groundwater supply needed to meet non-potable demands that are not met by recycled water.	General Manager
MARCH	Consider potential infrastructure constraints that may impact supply delivery	Identify any known Metropolitan, Western or TVWD infrastructure issues that may pertain to near-term water supply reliability, including repairs, construction, and environmental mitigation measures that may temporarily constrain capabilities, as well as any new projects that may add to system capacity. Identify any facilities out of service due to water quality problems, equipment failure, etc. that may impact normal water deliveries.	General Manager
APRIL	Conduct Annual Assessment	Compare supplies and demands and analyze any infrastructure constraints that may impact supply delivery. If the potential for a shortage exists or if Metropolitan/Western have enacted a WSAP stage, determine if a shortage response stage is required and recommend which response actions to reduce/eliminate the shortage.	General Manager
MAY	Inform the Board of Directors	If a shortage stage and response actions are recommended, provide an update to the Board of Directors with the findings of the Annual Assessment and planned actions.	General Manager

ON-GOING	Implement WSCP actions, if needed	Staff will implement shortage response actions if needed.	General Manager
PRIOR TO JULY 1	Submit Annual Assessment	Send Final Annual Assessment to DWR.	General Manager

1.4 Water Shortage Levels

TVWD utilizes five shortage stages to identify and respond to water shortage emergencies. TVWD, at a minimum, encourages baseline conservation efforts year-round, regardless of a shortage emergency. Details on TVWD's shortage stages are provided in Table 2.

Table 2. DWR 8-1 Water Shortage Contingency Plan Levels

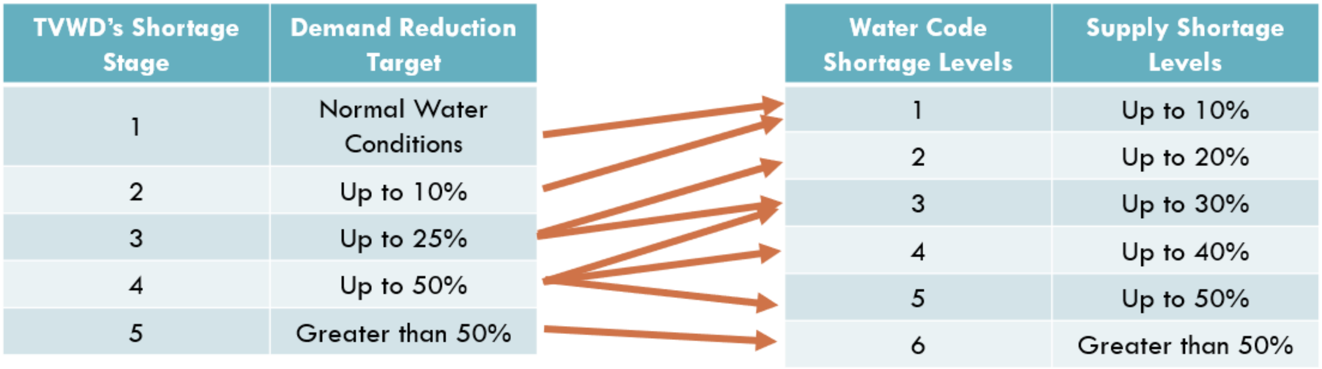
SHORTAGE LEVEL	PERCENT SHORTAGE RANGE1 (NUMERICAL VALUE AS A PERCENT)	SHORTAGE RESPONSE ACTIONS
1	Normal Conditions	
2	Up to 10%	Required savings may be met through a combination of quantifiable and unquantifiable actions. TVWD will only implement measures to the extent necessary to mitigate a water shortage, although estimates may indicate a greater savings is obtainable. It is anticipated that some of the required savings will be met through quantifiable shortage response actions and the remaining savings will be met through other actions, including communication and outreach efforts. For a list of all TVWD specific shortage response actions and their potential savings, please refer to DWR Table 8-2.
3	Up to 25%	Required savings may be met through a combination of quantifiable and unquantifiable actions. TVWD will only implement measures to the extent necessary to mitigate a water shortage, although estimates may indicate a greater savings is obtainable. It is anticipated that some of the required savings will be met through quantifiable shortage response actions and the remaining savings will be met through other actions, including communication and outreach efforts. For a list of all TVWD specific shortage response actions and their potential savings, please refer to DWR Table 8-2.
4	Up to 50%	Required savings may be met through a combination of quantifiable and unquantifiable actions. TVWD will only implement measures to the extent necessary to mitigate a water shortage, although estimates may indicate a greater savings is obtainable. It is anticipated that some of the required savings will be met through quantifiable shortage response actions and the remaining savings will be met through other actions, including communication and outreach efforts. For a list of all TVWD specific shortage response actions and their potential savings, please refer to DWR Table 8-2.
5	Greater than 50%	Required savings may be met through a combination of quantifiable and unquantifiable actions. TVWD will only implement measures to the extent necessary to mitigate a water shortage, although estimates may indicate a greater savings is obtainable. It is anticipated that some of the required savings will be met through quantifiable shortage response actions and the remaining savings will be met

through other actions, including communication and outreach efforts. For a list of all TVWD specific shortage response actions and their potential savings, please refer to DWR Table 8-2.

TVWD is using a 5-stage approach with a cross reference to DWR's 6 standard stages.

The Water Code outlines six standard water shortage levels that correspond to a gap in supply compared to normal year availability. The six standard water shortage levels correspond to progressively increasing estimated shortage conditions (up to 10-, 20-, 30-, 40-, 50-percent and greater than 50-percent shortage compared to the normal reliability condition) and align with the response actions that a water supplier would implement to meet the severity of the impending shortages.

The Water Code allows suppliers with an existing water shortage contingency plan that uses different water shortage levels to comply with the six standard levels by developing and including a cross-reference relating its existing shortage categories to the six standard water shortage levels. TVWD is maintaining its current 4 stages and adding a fifth stage to address the greater than 50% shortage requirement. A cross reference to the six standard stages is provided in Figure 1.



TVWD's Shortage Stage	Demand Reduction Target
1	Normal Water Conditions
2	Up to 10%
3	Up to 25%
4	Up to 50%
5	Greater than 50%

Water Code Shortage Levels	Supply Shortage Levels
1	Up to 10%
2	Up to 20%
3	Up to 30%
4	Up to 40%
5	Up to 50%
6	Greater than 50%

Figure 1. TVWD's Shortage Stages and their Relationship to the Six Standard Shortage Stages

1.5 Shortage Response Actions

TVWD expects to mitigate supply shortages through a variety of response actions focused on reducing demand and conservation efforts, as well as increased communication and outreach efforts.

1.5.1 Demand Reduction

TVWD has identified a variety of demand reduction actions to offset supply shortages. These actions include, but are not limited to, customer outreach, conservation, reduced irrigation use, and other restrictions. Possible actions TVWD may implement during a water shortage emergency are listed in Table 3.

Table 3. DWR 8-3 Demand Reduction Actions

SHORTAGE LEVEL	DEMAND REDUCTION ACTIONS	HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?	ADDITIONAL EXPLANATION OR REFERENCE	PENALTY, CHARGE, OR OTHER ENFORCEMENT
1 and Up	Landscape - Restrict or prohibit runoff from landscape irrigation	0-5%	Customers prohibited from allowing water to leave property by draining onto adjacent properties or roadways.	No
1 and Up	Expand Public Information Campaign	0-5%	Customers asked to practice water conservation and use water wisely.	No
2 and Up	Landscape - Limit landscape irrigation to specific times	0-10%	Parks, golf courses, recreation fields, and school grounds irrigated between 11 p.m. and 5 a.m. Lawn watering and landscape irrigated between 10 p.m. and 5 a.m.	Yes
2 and Up	Other - Prohibit use of potable water for washing hard surfaces	0-10%	No washing down of driveways, parking lots, or other paved surfaces.	Yes
2 and Up	Other	0-10%	No hoses permitted when washing private car(s), RV, boat(s), trailer(s), or truck(s) - by bucket only.	Yes
2 and Up	CII - Restaurants may only serve water upon request	0-5%		Yes
2 and Up	Other water feature or swimming pool restriction	0-10%	No refilling of pools.	Yes
2 and Up	Other - Prohibit use of potable water for construction and dust control	0-10%	Construction meters used for irrigation shall not be used; no new temporary or construction meters; no potable construction water for earthwork or road construction.	Yes
2 and Up	Other water feature or swimming pool restriction	0-5%	No potable water will be used for artificial lakes, ponds, or streams.	Yes
2 and Up	Landscape - Limit landscape irrigation to specific times	0-10%	Agricultural customers limited to water use between midnight and noon.	Yes
2 and Up	CII - Other CII restriction or prohibition	0-10%	Commercial nurseries limited to water use between 11 p.m. and 5 a.m.	Yes
3 and Up	Landscape - Limit landscape irrigation to specific days	11-25%	Parks and recreation fields shall only be watered on even numbered days between 11 p.m. and 5 a.m. All school grounds shall be watered only on odd numbered days between 11 p.m. and 5 a.m.	Yes
3 and Up	Landscape - Limit landscape irrigation to specific times	11-25%	Golf courses shall irrigate greens only between 11 p.m. and 5 a.m.	Yes

SHORTAGE LEVEL	DEMAND REDUCTION ACTIONS	HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?	ADDITIONAL EXPLANATION OR REFERENCE	PENALTY, CHARGE, OR OTHER ENFORCEMENT
3 and Up	Landscape - Limit landscape irrigation to specific days	11-25%	Customers whose house number ends with an even number shall water only on even numbered days; customers whose house number ends with an odd number shall water only on odd numbered days; no watering or irrigation shall be done between 10 a.m. and 5 p.m. on any day.	Yes
3 and Up	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	11-25%	Car and truck washing shall only be done at commercial washes.	Yes
4 and Up	Landscape - Prohibit all landscape irrigation	26-50%	No lawn watering or landscape irrigation shall be done.	Yes
4 and Up	Landscape - Prohibit certain types of landscape irrigation	26-50%	No watering of parks, recreation fields, school grounds, or golf courses unless watered with recycled water.	Yes
4 and Up	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	26-50%	Car, RV, boat, trailer, or truck washing shall only be done at commercial establishments using recycled water.	Yes
4 and Up	Other - Prohibit use of potable water for construction and dust control	26-50%	All construction meters shall be turned off and locked.	Yes
4 and Up	CII - Other CII restriction or prohibition	26-50%	Agricultural customers and commercial nurseries shall stop all irrigation and watering.	Yes
4 and Up	Other	26-50%	TVWD will comply with Metropolitan's Incremental Interruption and Conservation Plan (IICP). Metropolitan will establish periodically under the IICP, targeted water conservation goals for member agencies.	Yes

1.5.2 Supply Augmentation

TVWD may be able to augment supply through additional purchases of imported water. Currently TVWD imports potable water only through Western. Western, as outlined in their 2020 UWMP, estimates additional imported water supply is available, if needed, in alignment with Metropolitan's 2020 UWMP.

In the event that TVWD requires additional non-potable supply, TVWD may be able to negotiate with Western or the neighboring Elsinore Valley Municipal Water District (EVMWD) for raw water purchases. A summary of supply augmentation actions are provided in Table 4.

Table 4. DWR 8-3 Supply Augmentation & Other Actions

SHORTAGE LEVEL	SUPPLY AUGMENTATION METHODS AND OTHER ACTIONS BY WATER SUPPLIER	HOW MUCH IS THIS GOING TO REDUCE THE SHORTAGE GAP?	ADDITIONAL EXPLANATION OR REFERENCE
All Stages	Other purchases	0-100%	Purchase additional water from Western

1.5.3 Operational Changes

TVWD already operates its system as efficiently as possible. Due to having only one potable water source, TVWD is unable to change operations during a water shortage.

1.5.4 Additional Mandatory Restrictions

TVWD does not anticipate imposing additional mandatory restrictions. It is anticipated that TVWD customers will implement demand reduction measures during a water shortage, when necessary.

1.5.5 Shortage Response Action Effectiveness

TVWD has estimated the effectiveness of each demand reduction measure, as outlined in Table 3. It is expected that response actions effectiveness is also a result of successful communication and outreach efforts.

1.5.6 Seismic Risk Assessment, Mitigation Plan, and Emergency Response Plan

TVWD has developed a Risk and Resilience Assessment (RRA) and is in the process of completing its Emergency Response Plan (ERP) in accordance with America's Water Infrastructure Act (AWIA) of 2018. The purpose of the RRA and ERP is to meet the AWIA compliance requirements and plan for long-term resilience of TVWD's infrastructure.

The RRA assesses TVWD's water system to identify critical assets that may be vulnerable to malevolent threats and natural hazards such as a seismic event, as well as identified measures that can be taken to reduce risk and enhance resilience from service disruption for the benefit of customers. The RRA identifies and characterizes both infrastructure-specific and systemwide vulnerabilities and threats, in addition to the consequences of disruption. The RRA also recognizes various options in addressing and mitigating risk due to intentional or accidental threats as well as natural hazards.

The ERP will include prevention and detection measures for a wide range of emergency situations. In the case of a seismic event, the ERP will include specific responses to mitigate damage and provide safety for staff during the event as well as documents detailing responses and action items to complete after the event. The ERP will also define roles and responsibilities of TVWD staff and coordination with neighboring utilities and governing agencies, provides emergency procurement procedures and contact information, defines a path to restore water in the case of a service interruption, and protects public health.

The RRA and ERP contain confidential information related to infrastructure risk and response measures, and therefore are used as internal documents only.

1.6 Communication Protocols

In times of drought and water shortage emergencies, TVWD provides its customers with drought newsletters, expands drought and water conservation information available on its website, and targets customers for rebate participation.

1.7 Compliance and Enforcement

During emergency situations, TVWD may be required to activate this WSCP and notify customers to decrease their nonessential water use. The WSCP provides customers with details on each water shortage stage and actions customers can take to reduce water use and remain in compliance. However, should individual customers not be in compliance, then penalties or incentives may be implemented as allowed by TVWD.

It is unlawful for any water customer to fail to comply with any of the provisions of this WSCP and may be subject to a misdemeanor. The penalties for failure to comply are shown below:

- 1st Violation – Written citation
- 2nd Violation – Water shut off and customer will be required to pay all applicable turn-on fees prior to resumption of service
- 3rd Violation – Penalty to be determined by the Board of Directors

Any such restricted or terminated service may be restored upon application of the customer in person at TVWD offices and only upon a showing by the customer that the customer is ready, willing and able to comply with the provision of this chapter’s rules regarding the conservation of water. Prior to any restoration of the service, the customer shall pay all TVWD charges for any restriction or termination of service and its restoration.

1.8 Legal Authorities

TVWD’s adopted rules and regulations established the Water Conservation Program, provided as Attachment 1, which provides the General Manager the authority to determine and declare a water shortage emergency. The General Manager will use information available that pertains to imported water, such as Western’s and Metropolitan’s water supply and ability to deliver potable water to TVWD.

1.9 Financial Consequences of the WSCP

There is potential for a decrease in revenues as a result of implementation of the Water Shortage Contingency Plan, due to decreased water use. At the same time, enforcement of response actions may increase costs to TVWD. TVWD’s 2016 Water, Recycled Water, and Wastewater Cost of Service Study re-evaluated TVWD’s tiered rate structure, and recommended rate changes. In 2017, TVWD adopted a new rate structure that was priced to provide sufficient revenue to build funds that could be used to cover drought-related expenses but does not include a drought surcharge. The revised recycled water rates include a provision for an increase in commodity charges in the event that non-potable/recycled water demands outpace supply and supplemental potable water is required.

TVWD’s rate structure is tiered, with customers charged a fix fee plus a variable commodity fee. The fixed fee is based on meter size, while the variable commodity fee changes depending on volume of water used for potable water and pumping costs by pressure zone. The fixed fee also includes a pass-through charge that helps cover costs for water provided by Western. This pass-through charge is adjusted when Western’s rates and fees change. Any changes to costs of Western water used to meet potable demands would increase TVWD’s costs but would be accommodated though the pass-through charge.

TVWD has identified four strategies that may be used to avoid financial problems during drought, which include:

- **Use accumulated reserves.** A water purveyor needs a reserve for cash flow and system emergencies. In a severe drought or water emergency, TVWD may utilize emergency reserves.
- **Temporary increase of water rates if required to generate revenue.** This should be done during the winter when the impact on water use is lessened. Summer rate increases, when water usage is naturally greater, only exaggerate the impact of the increase, and should be avoided. All rate increases would be subject to Proposition 218 requirements.
- **Rate structure adjustment.** Have a greater portion of revenue come from the fixed component, making it less vulnerable to changes in water sales.
- **Defer programs and costs – operating and capital.** It is assumed that any kind of emergency may cause TVWD to decrease or suspend certain programs to minimize operating and/or capital costs.

In general, TVWD does not anticipate financial shortfalls during short-term water shortages. There is a risk of negative financial impacts during prolonged periods of drought, however during the last drought, TVWD was able to accommodate changes in revenue and expenditures using a combination of reducing costs and drawing on reserves. Since then, TVWD has adjusted its rate structure to maintain financial health and allow for continued provision of service to customers.

1.10 Monitoring and Reporting

TVWD meters all connections, through which it tracks water use. It also tracks water production through use of the real-time supervisory control and data acquisition (SCADA) system. Additionally, month-end water meter readings are collected and compiled into Monthly and Fiscal Year-to-Date Water System Reports. If a water shortage stage is declared, water production and use data will be monitored and compared from week to week and used to measure the effectiveness of any water shortage actions that may be implemented.

Historically, during a water supply shortage, operations personnel have conducted production facility inspections twice a day with increased monitoring of the SCADA system screens. Reservoir storage trend screens are the key indicators of overall system demand. In addition, field staff has monitored the TVWD service area for signs of system or individual service leaks or excessive landscape watering.

TVWD will also follow implementation of stages of water shortage declared by Western and continue to monitor water demand levels. During more severe shortages, Metropolitan may call for extraordinary conservation efforts and/or reduce allocations. During such periods, TVWD will coordinate emergency activities with Western staff and Metropolitan’s Drought Program Officer and monitor the effectiveness of ongoing conservation programs. Monthly or more frequent reporting on estimated conservation water savings will be provided and reviewed. Water consumption reports, water facility condition, and watershed hydrology information will all be considered for further appropriate action in response to the water shortage.

1.11 WSCP Refinement Procedures

The WSCP is best prepared and implemented as an adaptive management plan. TVWD will use results obtained from its monitoring and reporting program to evaluate any need for revisions. Potential changes to the WSCP that may require an update include, but are not limited to, any changes to trigger conditions, changes to the shortage stage structure, and/or the addition of significant new customer reduction actions.

Any prospective changes to the WSCP would need to be presented at a public hearing and adopted by the Board. Notices for the public hearing date would be published in the local newspaper in compliance with California Water Code requirements.

1.12 Special Water Feature Distinction

TVWD evaluates special water features separately from pools and spas. TVWD expects to restrict water use to special decorative features starting in Stage 2 shortages. Special decorative features apply to items that use of water for aesthetic purposes. Aesthetic purposes pertain to artificial lakes, ponds, or streams.

1.13 Plan Adoption, Submittal, and Availability

A draft WSCP was presented to TVWD’s Board at the public hearing held on December 21, 2021. On July 15, 2021, TVWD sent out 60-day notification letters to local cities, the County of Riverside, and other regional agencies that it was updating their WSCP alongside their UWMP and had planned a public hearing to receive any comments prior to adoption. As the public hearing approached, TVWD published notices in the local newspaper two weeks in advance. Copies of the 60-day notices and public hearing newspaper notice are provided in Appendix C and Appendix D of the UWMP.

The WSCP was formally adopted as part of the 2020 UWMP on December 21, 2021, by TVWD’s Board by Resolution R-21-22, included in Appendix F of the UWMP. The WSCP was made available to all staff, customers, and any affected cities, counties, or other members of the public within 30 days of the adoption date.

The WSCP was submitted to DWR at the same time as the 2020 Urban Water Management Plan.

Attachment 1

Section 39: Water Conservation Program

SECTION 39 DISTRICT WATER CONSERVATION PROGRAM

39.01 ESTABLISHMENT OF THE CONSERVATION PROGRAM

There is hereby established the District Water Conservation Program which shall be administered as provided in this Section 39. This program is adopted pursuant to Sections 375 through 377 of the California Water Code. Any violation of the provisions in this Section 39 is a misdemeanor (California Water Code Section 377).

39.02 NONAPPLICABILITY OF THIS PROGRAM TO CERTAIN ACTIVITIES

A. No provisions of this ordinance shall apply to fire hydrants, fire mains, sprinkler lines, or other equipment used solely for fire protection purposes.

B. No provisions of this ordinance shall apply to any hospital, health care or convalescent facility or any other type of facility where the health and welfare would be affected by restricted water use. This shall also apply to veterinary hospitals and facilities. However, this ordinance does apply to the outdoor grounds, yard and parking areas of these facilities.

39.03 DETERMINATION AND DECLARATION BY GENERAL MANAGER OF WATER SUPPLY CONDITIONS

A. The General Manager of the District, based upon Potable Water Availability as limited by TVWD's Wholesale Suppliers (Metropolitan Water District or Western Municipal Water District), State Water Resource Control Board and all other available data, shall determine and declare whether the District's Potable water supply and/or distribution system is in one of the following four conditions, notify all members of the Board of Directors and post a notice thereof in the lobby of the District's offices:

STAGE I - NORMAL CONSERVATION CONDITIONS: The District is able to meet all the water demands of its customers in the immediate future.

STAGE II - WATER ALERT: There is a probability that the District will not be able to meet all of the water demands of its customers for Human Consumption, Sanitation or Fire Protection or is restricted by the State, MWD or other Governing Authorities. Stage II conservation goal is 25%

STAGE III - WATER WARNING: The District is not able to meet all of the water demands of its customer due to Allocations or Supply Restrictions. Stage III conservation goal is 50%

STAGE IV - WATER EMERGENCY: A major failure of any storage supply or distribution facility.

B. As soon as a particular condition is declared to exist, the water conservation measures provided for herein for that condition shall apply to all District water services until a different condition is declared.

39.04 WATER CONSERVATION MEASURES

A. **STAGE I - NORMAL CONSERVATION CONDITIONS**. When the General Manager has declared that the District's water supply is in a NORMAL condition, customers are asked to use water wisely and to practice water conservation measures to prevent the waste and unreasonable use of water and to promote water conservation, except where necessary to address an immediate health and safety need or to comply with a term or condition in a permit issued by a state or federal agency: Customers are asked to achieve a voluntary 10% conservation from the 2014 base year's use.

1. All landscape or agricultural irrigation shall utilize automated irrigation time clocks or a hand-held hose only when equipped with shut-off nozzle or bucket;
2. The application of potable, non-potable or recycled water to outdoor landscapes in a manner that causes runoff, such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots or structures is prohibited. Runoff is defined in this section as visible water running in a curb, gutter or swale;
3. The use of a hose to dispense potable water to wash a motor vehicle must be fitted with a shut-off nozzle or device attached to it that causes it to cease dispensing water immediately when not in use;
4. The use of potable water to wash parking lots, driveways or sidewalks is prohibited;
5. The application of potable water to outdoor landscaping during or within 48 hours after measurable rainfall is prohibited;
6. The irrigation with potable water of landscapes outside of newly constructed homes and buildings in a manner inconsistent with current District regulations or other County of Riverside requirements is prohibited;
7. All Residential and non-Residential irrigation such as Parks, HOA maintained areas, recreation fields and school grounds shall be scheduled between the hours of 9 PM and 6 AM.

B. **STAGE II - WATER ALERT**. When the General Manager has declared that the District's water supply is in a WATER ALERT condition, customers are asked to achieve a mandatory 25% conservation from the 2014 base year's use. The following rules and regulations shall be in effect:

1. All provisions of Stage I shall apply or as modified by the current Stage;
2. The following residential irrigation schedule is in effect. Irrigation is limited to 10 minutes per station per day between the hours of 9 PM and 6 AM. *This provision does not apply to landscape irrigation systems using water efficient devices including drip/micro-irrigation systems or the use of hand-held hose equipped with a shut-off nozzle or bucket to water landscaped areas.*
   - Odd numbered houses may irrigate on Sunday, Tuesday, and Thursday.
   - Even numbered houses may irrigate on Monday, Wednesday, and Saturday;
3. Non-residential irrigation such as Parks, HOA irrigation meters, recreation fields, and school grounds irrigation are limited to 10 minutes per station per day between the hours of 9 PM and 6 AM and may water on Monday, Wednesday,

and Friday. *With permission by TVWD this provision does not apply to landscape irrigation systems using water efficient devices, including but not limited to: weather-based controllers and drip/micro-irrigation systems upon the commitment to cut use by 25%;*

4. Agricultural use of potable water shall be via micro sprinklers, stream rotors only between midnight and 9 am of the following day on Mondays, Wednesdays and Fridays;
5. Discontinue landscape irrigation during measurable rainfall for a period of 48 hours;
6. There shall be no washing down of driveways, parking lots, or other paved surfaces;
7. Private car, RV, boat, trailer or truck washing shall be done using a bucket and hoses with shutoff nozzle;
8. Restaurants will be asked not to serve water to customers unless specifically requested and then only in disposable cups;
9. Swimming pools shall utilize recirculating system for filtration;
10. District will not issue new potable construction meters;
11. No potable water will be used for artificial lakes, ponds or streams until the WATER ALERT has been declared over;
12. District will not issue new temporary meters;
13. Potable construction water shall not be used for earthwork, general construction purposes or irrigation. Testing of Potable lines accepted;
14. No potable water irrigation of turf on public street medians;
15. No new non-residential irrigation with potable water will be allowed;

C. **STAGE III - WATER WARNING.** When the General Manager has declared that the District's water supply is in a WATER WARNING condition, customers are asked to achieve a mandatory 50% conservation from the 2014 base year's use. The following rules and regulations shall be in effect:

1. All provisions of Stage I shall apply or as modified by the current Stage;
2. All landscape or agricultural irrigation shall utilize automated irrigation time clocks or a hand-held hose only when equipped with shut-off nozzle or bucket;
3. The following residential irrigation schedule is in effect. Irrigation is limited to 5 minutes per station per day between the hours of 9 PM and 6 AM. *This provision does not apply to landscape irrigation systems using water efficient devices including drip/micro-irrigation systems or the use of hand-held hose equipped with a shut-off nozzle or bucket to water landscaped areas;*
    a. Odd numbered houses may irrigate two (2) days a week on Monday and Thursday;
    b. Even numbered houses may irrigate two (2) days a week on Tuesday, and Friday;
4. Non-residential irrigation such as Parks, HOA irrigation meters, recreation fields, and school ground irrigation is limited to 5 minutes per station per day between the hours of 9 PM and 6 AM and may only water on Monday and Friday. *With permission by TVWD this provision does not apply to landscape irrigation*

systems using water efficient devices, including but not limited to: weather-based controllers and drip/micro-irrigation systems upon the commitment to cut water used by 50%;

5. Agricultural use of potable water is prohibited;
6. Discontinue landscape irrigation during measurable rainfall for a period of 4 days;
7. There shall be no washing down of driveways, parking lots, or other paved surfaces;
8. Private car, RV, boat, trailer or truck washing shall be done using a bucket only;
9. Restaurants will be asked not to serve water to customers unless specifically requested and then bottled water only;
10. Swimming pools shall be equipped with full covers and utilize recirculating system for filtration. No dumping and refilling of pools shall be allowed until the Stage III has been lifted;
11. District will not issue new potable construction meters;
12. No potable water will be used for artificial lakes, ponds or streams until the Stage III has been declared over;
13. District will not issue new temporary meters and all temporary meters will be shut off;
14. Potable construction water shall not be used for earthwork, general construction purposes or irrigation. Testing of Potable lines accepted;
15. No potable water irrigation of turf on public street medians;
16. Irrigation with potable water outside of newly constructed homes and buildings that is not delivered by drip/micro irrigation systems is prohibited;

D. **STAGE IV - WATER EMERGENCY**. When the General Manager has determined that the District's water supply is in a WATER EMERGENCY condition, potable water shall only be for indoor use such as sanitation, hygiene and human consumption. The following rules and regulations shall be in effect:

1. No lawn watering or landscape irrigation shall be done with potable water;
2. No watering of parks, recreation fields, school grounds, or golf courses unless watered with reclaimed or non-potable water;
3. No washing down of driveways, parking lots, or other paved surfaces shall be done;
4. Washing of private car, RV, boat, trailer or truck shall be done only at commercial establishments using recycled or reclaimed water;
5. Restaurants shall not serve water to customers unless specifically requested and then only bottled water in disposal cups;
6. Filling of swimming pools shall be prohibited;
7. District will not issue new meters;
8. All construction meters shall be turned off and locked;
9. Agricultural customers and commercial nurseries shall stop all irrigation and watering;
10. Watering livestock shall be permitted at any time;

G

Appendix G. Adoption Resolutions

RESOLUTION No. R-21-21

RESOLUTION OF THE TEMESCAL VALLEY WATER DISTRICT ADOPTING THE 2020 URBAN WATER MANAGEMENT PLAN

WHEREAS, The California Urban Water Management Planning Act, Water Code Section 10610 et seq. (the Act), mandates that every urban supplier of water providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre feet of water annually, prepare an Urban Water Management Plan (Plan); and

WHEREAS, the Act generally requires that said Plan be updated and adopted at least once every five years, in years ending in six and one; and

WHEREAS, pursuant to recent amendments to the Act, urban water suppliers are required to update and electronically submit their 2020 Plans to the California Department of Water Resources; and

WHEREAS, pursuant to the Water Conservation Act of 2009, also referred to as SB X7-7 (Water Code section 10608 et seq.), an "urban retail water supplier" is defined as a water supplier that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre feet of potable water annually at retail for municipal purposes, and an "urban wholesale water supplier" is defined as a water supplier that provides more than 3,000 acre feet of water annually at wholesale for potable municipal purposes; and

WHEREAS, the Temescal Valley Water (DISTRICT) meets the definition of an urban retail water supplier for purposes of the Act and SB X7-7; and

WHEREAS, the DISTRICT has prepared a 2020 Plan in accordance with the Act and SB X7-7, and in accordance with applicable legal requirements, has undertaken certain coordination, notice, public involvement, public comment, and other procedures in relation to its 2020 Plan; and

WHEREAS, in accordance with the Act and SB X7-7, the DISTRICT has prepared its 2020 Plan with its own staff, with the assistance of consulting professionals, and in cooperation with other governmental agencies, and has utilized and relied upon industry standards and the expertise of industry professionals in preparing its 2020 Plan, and has also utilized the California Department of General Guidebook for Urban Water Suppliers to Prepare 2020 Urban Water Management Plans (March 2021), including its related appendices, in preparing its 2020 Plan; and

WHEREAS, in accordance with applicable law, including Water Code sections 10608.26 and 10642, and Government Code section 6066, a Notice of a Public Hearing regarding the DISTRICT's 2020 Plan was published within the jurisdiction of the DISTRICT on December 3, 2021, and December 10, 2021; and

WHEREAS, in accordance with applicable law, including but not limited to Water Code sections 10608.26 and 10642, a public hearing was held on December 21, 2021 at 8:30 a.m., or soon thereafter, at the District's Board Room,22646 Temescal Canyon Road, Temescal Valley, California 92883, in order to provide members of the public and other interested entities with the opportunity to be heard in connection with proposed adoption of the 2020 Plan and issues related thereto; and

WHEREAS, pursuant to said public hearing on the DISTRICT's 2020 Plan, the DISTRICT, among other things, encouraged the active involvement of diverse social, cultural, and economic members of the community within the DISTRICT's service area with regard to the preparation of the Plan, encouraged community input regarding the DISTRICT's 2020 Urban Water Management Plan; and

WHEREAS, the DISTRICT has reviewed and considered the purposes and requirements of the Act and SB X7-7, the contents of the 2020 Plan, and the documentation contained in the administrative record in support of the 2020 Plan, and has determined that the factual analyses and conclusions set forth in the 2020 Plan are legally sufficient; and

WHEREAS, the DISTRICT desires to adopt the 2020 Plan in order to comply with the Act and SB X7-7.

NOW THEREFORE BE IT RESOLVED, the DISTRICT hereby resolve as follows:

1. The 2020 Urban Water Management Plan is hereby adopted as amended by changes incorporated by the DISTRICT as a result of input received (if any) at the public hearing and ordered filed with the Secretary of the DISTRICT;

2. The General Manager is hereby authorized and directed to include a copy of this Resolution in the DISTRICT's 2020 Plan;

3. The General Manager is hereby authorized and directed, in accordance with Water Code sections 10621(d) and 10644(a)(1)-(2), to electronically submit a copy of the 2020 Plan to the California Department of Water Resources;

4. The General Manager is hereby authorized and directed, in accordance with Water Code section 10644(a), to submit a copy of the 2020 Plan to the California State

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Library, no later than thirty (30) days after this adoption date;

5. The General Manager is hereby authorized and directed, in accordance with Water Code section 10645, to make the 2020 Plan available for public review at the DISTRICT's offices during normal business hours and on the DISTRICT's website no later than thirty (30) days after filing a copy of the Plan with the California Department of Water Resources;

6. The General Manager is hereby authorized and directed, in accordance with Water Code Section 10635(b), to provide that portion of the 2020 Plan prepared pursuant to Water Code Section 10635(a) to any city or county within which the DISTRICT provides water supplies no later than sixty (60) days after submitting a copy of the Plan with the California Department of Water Resources;

7. The General Manager is hereby authorized and directed to implement the 2020 Plan in accordance with the Act and SB X7-7 and to provide recommendations to the DISTRICT regarding the necessary budgets, procedures, rules, regulations, or further actions to carry out the effective and equitable implementation of the 2020 Plan.

ADOPTED, this 21st day of December, 2021.

C W Colladay

CHARLES W. COLLADAY
President

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of Resolution No. R-21-21 adopted by the Board of Directors of the TEMESCAL VALLEY WATER DISTRICT at its regular meeting held on December 21st, 2021.

PAUL RODRIGUEZ
Secretary

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RESOLUTION NO. R-21-22

RESOLUTION OF THE TEMESCAL VALLEY WATER DISTRICT ADOPTING THE WATER SHORTAGE CONTINGENCY PLAN

WHEREAS, The California Urban Water Management Planning Act, Water Code Section 10610 et seq. (the Act), mandates that every urban supplier of water providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre feet of water annually, prepare and adopt, in accordance with prescribed requirements, a water shortage contingency plan (WSCP); and

WHEREAS, the Act specifies the requirements and procedures for adopting such Water Shortage Contingency Plans; and

WHEREAS, pursuant to recent amendments to the Act, urban water suppliers are required to adopt and electronically submit their WSCPs to the California Department of Water Resources; and

WHEREAS, pursuant to the Water Conservation Act of 2009, also referred to as SB X7-7 (Water Code section 10608 et seq.), an "urban retail water supplier" is defined as a water supplier that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre feet of potable water annually at retail for municipal purposes, and an "urban wholesale water supplier" is defined as a water supplier that provides more than 3,000 acre feet of water annually at wholesale for potable municipal purposes; and

WHEREAS, the TEMESCAL VALLEY WATER DISTRICT (DISTRICT) meets the definition of an urban retail water supplier for purposes of the Act and SB X7-7; and

WHEREAS, the DISTRICT has prepared a WSCP in accordance with the Act and SB X7-7, and in accordance with applicable legal requirements, has undertaken certain coordination, notice, public involvement, public comment, and other procedures in relation to its WSCP; and

WHEREAS, in accordance with the Act and SB X7-7, the DISTRICT has prepared its WSCP with its own staff, with the assistance of consulting professionals, and in cooperation with other governmental agencies, and has utilized and relied upon industry standards and the expertise of industry professionals in preparing its WSCP, and has also utilized the California Department of Water Resources Guidebook for Urban Water Suppliers to Prepare 2020 Urban Water Management Plans (March 2021), including its related appendices, in preparing its WSCP; and

WHEREAS, in accordance with applicable law, including Water Code sections 10608.26 and 10642, and Government Code section 6066, a Notice of a Public Hearing regarding the DISTRICT's WSCP was published within the jurisdiction of the DISTRICT on December 3, 2021, and December 10, 2021; and

WHEREAS, in accordance with applicable law, including but not limited to Water Code sections 10608.26 and 10642, a public hearing was held on December 21, 2021 at 8:30 a.m., or soon thereafter, in the DISTRICT Board room at 22646 Temescal Canyon Road, Corona, California 92883, in order to provide members of the public and other interested entities with the opportunity to be heard in connection with proposed adoption of the WSCP and issues related thereto; and

WHEREAS, pursuant to said public hearing on the DISTRICT's WSCP, the DISTRICT, among other things, encouraged the active involvement of diverse social, cultural, and economic members of the community within the DISTRICT's service area with regard to the preparation of the Plan, encouraged community input regarding the DISTRICT's Water Shortage Contingency Plan; and

WHEREAS, the DISTRICT has reviewed and considered the purposes and requirements of the Act and SB X7-7, the contents of the WSCP, and the documentation contained in the administrative record in support of the WSCP, and has determined that the factual analyses and conclusions set forth in the WSCP are legally sufficient; and

WHEREAS, the DISTRICT desires to adopt the WSCP in order to comply with the Act and SB X7-7.

NOW THEREFORE BE IT RESOLVED, the DISTRICT hereby resolve as follows:

1. The Water Shortage Contingency Plan is hereby adopted as amended by changes incorporated by the DISTRICT as a result of input received (if any) at the public hearing and ordered filed with the Secretary of the DISTRICT;

2. The General Manager is hereby authorized and directed to include a copy of this Resolution in the DISTRICT's WSCP and/or in the DISTRICT's 2020 Urban Water Management Plan;

3. The General Manager is hereby authorized and directed, in accordance with Water Code sections 10621(d) and 10644(a)(1)-(2), to electronically submit a copy of the WSCP to the California Department of Water Resources;

4. The Water Resources Manager is hereby authorized and directed, in accordance with Water Code section 10644(a), to submit a copy of the WSCP to the California State Library, and any city or county within which the

DISTRICT provides water supplies no later than thirty (30) days after this adoption date;

5. The General Manager is hereby authorized and directed, in accordance with Water Code section 10645, to make the WSCP available for public review at the DISTRICT's offices during normal business hours and on the DISTRICT's website no later than thirty (30) days after filing a copy of the WSCP with the California Department of Water Resources;

6. The General Manager is hereby authorized and directed, in accordance with Water Code Section 10635(b), to provide that portion of the WSCP prepared pursuant to Water Code Section 10635(a) to any DISTRICT or county within which the DISTRICT provides water supplies no later than sixty (60) days after submitting a copy of the WSCP with the California Department of Water Resources;

7. The General Manager is hereby authorized and directed to implement the WSCP in accordance with the Act and SB X7-7 and to provide recommendations to the DISTRICT Board regarding the necessary budgets, procedures, rules, regulations or further actions to carry out the effective and equitable implementation of the WSCP.

ADOPTED, this 21st day of December, 2021.

CW Colladay

CHARLES W. COLLADAY
President

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of Resolution No. R-21-22 adopted by the Board of Directors of the TEMESCAL VALLEY WATER DISTRICT at its regular meeting held on December 21st, 2021.

PAUL RODRIGUEZ
Secretary

RESOLUTION NO. R-21-20

RESOLUTION OF THE TEMESCAL VALLEY WATER DISTRICT ADOPTING AN ADDENDUM TO THE 2015 URBAN WATER MANAGEMENT PLAN

WHEREAS, The California Urban Water Management Planning Act, Water Code Section 10610 et seq. (the Act), mandates that every urban supplier of water providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre feet of water annually, prepare an Urban Water Management Plan (Plan); and

WHEREAS, the Act generally requires that said Plan be updated and adopted at least once every five years, in years ending in six and one; and

WHEREAS, pursuant to recent amendments to the Act, urban water suppliers are encouraged by the California Department of Resources (DWR) and the Delta Stewardship Council (DSC) to consider adopting Appendix A to the 2020 UWMP, the (Addendum) to their 2015 Plan to demonstrate consistency with the Delta Plan Policy WR P1 to Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance, Cal. Code Regs. tit. 23, § 5003; and

WHEREAS, the TEMESCAL VALLEY WATER DISTRICT (DISTRICT) meets the definition of an urban retail water supplier for purposes of the Act; and

WHEREAS, the DISTRICT has prepared an Addendum to the DISTRICT's 2015 Plan in accordance with Delta Plan Policy WR P1, and in accordance with applicable legal requirements, has undertaken certain coordination, notice, public involvement, public comment, and other procedures in relation to its Addendum; and

WHEREAS, in accordance with the Act and Delta Plan Policy WR P1, the DISTRICT has prepared its Addendum to the 2015 Plan with its own staff, with the assistance of consulting professionals, and in cooperation with other governmental agencies, and has utilized and relied upon industry standards and the expertise of industry professionals in preparing its Addendum to its 2015 Plan, and has also utilized the California Department of Water Resources Guidebook for Urban Water Suppliers to Prepare 2020 Urban Water Management Plans (March 2021), including its related appendices, in preparing its Addendum to the 2015 Plan; and

WHEREAS, in accordance with applicable law, including Water Code section 10642, and Government Code section 6066, a Notice of a Public Hearing regarding DISTRICT's Addendum to the 2015 Plan was published within the jurisdiction of the DISTRICT on November 5, 2021, and November 12, 2021; and

WHEREAS, in accordance with applicable law, including but not limited to Water Code section 10642, a public hearing was held on December 21, 2021 at 8:30 a.m., or soon thereafter, in the DISTRICT Board room at 22646 Temescal Canyon Road, Temescal Valley, California 92883, in order to provide members of the public and other interested entities with the opportunity to be heard in connection with proposed adoption of the Addendum to the 2015 Plan and issues related thereto; and

WHEREAS, pursuant to said public hearing on the DISTRICT's Addendum to the 2015 Plan, the DISTRICT, among other things, encouraged the active involvement of diverse social, cultural, and economic members of the community within the DISTRICT's service area with regard to the preparation of the Plan, encouraged community input regarding the DISTRICT's Addendum to the 2015 Urban Water Management Plan; and

WHEREAS, the DISTRICT has reviewed and considered the purposes and requirements of the Act and Delta Plan Policy WR P1, the contents of the Addendum to the 2015 Plan, and the documentation contained in the administrative record in support of the Addendum, and has determined that the factual analyses and conclusions set forth in the Addendum are legally sufficient; and

WHEREAS, the DISTRICT desires to adopt the Addendum to the 2015 Plan in order to comply with the Act and Delta Plan Policy WR P1.

NOW THEREFORE BE IT RESOLVED, the DISTRICT hereby resolve as follows:

1. The Addendum to the DISTRICT's 2015 Urban Water Management Plan to demonstrate consistency with the Delta Plan Policy to Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (Appendix A to the 2020 UWMP)is hereby adopted as amended by changes incorporated by the DISTRICT as a result of input received (if any) at the public hearing and ordered filed with the Secretary of the DISTRICT Council;

2. The General Manager is hereby authorized and directed to include a copy of this Resolution in the DISTRICT's 2015 Plan amendment;

3. The General Manager is hereby authorized and directed, in accordance with Water Code sections 10621(d) and 10644(a)(1)-(2), to electronically submit a copy of the 2015 Plan with the Addendum to the California Department of Water Resources;

4. The General Manager is hereby authorized and directed, in accordance with Water Code section 10644(a), to submit a copy of the 2015 Plan with the Addendum to the California State Library no later than thirty (30) days after this adoption date;

5. The General Manager is hereby authorized and directed, in accordance with Water Code section 10645, to make the 2015 Plan with the Addendum available for public review at the DISTRICT's offices during normal business hours and on the DISTRICT's website no later than thirty (30) days after filing a copy of the Plan with the California Department of Water Resources;

ADOPTED, this 21st day of December, 2021.

CW Colladay

CHARLES W. COLLADAY
President

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of Resolution No. R-21-20 adopted by the Board of Directors of the TEMESCAL VALLEY WATER DISTRICT at its regular meeting held on December 21st, 2021.

PAUL RODRIGUEZ
Secretary