APPENDIX A

OWOW Plan Update 2018 Timeline

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ONE WATER ONE WATERSHED PLAN UPDATE 2018 TIMELINE

07/07/16	OWOW Steering Committee
08/25/16	OWOW Pillar Integration Meeting
10/27/16	OWOW Pillar Integration Meeting
01/25/17	OWOW Steering Committee
02/23/17	OWOW Pillar Integration Meeting
03/23/17	OWOW Steering Committee
04/24/17	Disadvantaged Communities and Tribal Communities Pillar Meeting
04/26/17	Integrated Stormwater Management Pillar Meeting
04/26/17	Beneficial Use Assurance Pillar Meeting
04/27/17	OWOW Pillar Integration Meeting
05/01/17	Natural Resources Stewardship Pillar Meeting
05/22/17	Disadvantaged Communities and Tribal Communities Pillar Meeting
05/22/17	Climate Change Response Pillar Meeting
05/25/17	**OWOW Annual Conference**
05/31/17	Integrated Stormwater Management Pillar Meeting
06/20/17	Recycled Water Pillar Meeting
06/21/17	Land Use and Water Planning Pillar Meeting
06/22/17	OWOW Pillar Integration Meeting
06/27/17	Natural Resources Stewardship Pillar Meeting
06/27/17	*North/Central Orange County IRWM Planning Meeting (Subregional Plan)*
06/28/17	Integrated Stormwater Management Pillar Meeting
07/06/17	Water Use Optimization Pillar Meeting

07/13/17	Beneficial Use Assurance Pillar
07/19/17	Land Use and Water Planning Pillar Meeting
07/20/17	Climate Change Response Pillar Meeting
07/25/17	Disadvantaged Communities and Tribal Communities Pillar Meeting
07/27/17	OWOW Steering Committee
07/27/17	Natural Resources Stewardship Pillar Meeting
08/03/17	Water Resources Optimization Pillar Meeting
08/28/17	Data Management and Monitoring Pillar Meeting
08/29/17	Disadvantaged Communities and Tribal Communities Pillar Meeting
08/29/17	*North/Central Orange County IRWM Planning Meeting (Subregional Plan)*
09/12/17	Water Use Efficiency Pillar Meeting
09/14/17	Joint Pillar Special Meeting
09/25/17	Disadvantaged Communities and Tribal Communities Pillar Meeting
09/28/17	OWOW Steering Committee Meeting
10/10/17	Water Use Efficiency Pillar Meeting
10/12/17	Natural Resources Stewardship Pillar Meeting
10/23/17	Disadvantaged Communities and Tribal Communities Pillar Meeting
10/25/17	Land Use and Water Planning Pillar Meeting
10/26/17	Pillar Integration Meeting
11/15/17	Russian River Pilot Outreach and Indicators Work Session
11/16/17	OWOW Steering Committee Meeting
11/27/17	Russian River Pilot Tech Group Meeting
11/29/17	OWOW Tribal Communities Workshop

11/30/17	Natural Resources Stewardship Pillar Meeting
12/13/17	Water Resource Optimization Pillar Meeting
12/13/17	Climate Risk and Response Pillar Meeting
12/13/17	Land Use and Water Planning Pillar Meeting
12/14/17	OWOW Pillar Integration Special Meeting – Sediment Management
12/18/17	Disadvantaged Communities and Tribal Communities Pillar Meeting
12/21/17	Russian River Pilot – Key Issues for the Water Plan Meeting
01/03/18	Water Use Efficiency Pillar Meeting
01/10/18	Climate Risk and Response Pillar Meeting
01/18/18	Natural Resources Stewardship Pillar Meeting
01/22/18	Disadvantaged Communities and Tribal Communities Pillar Meeting
01/24/18	Water Use Efficiency Pillar Meeting
01/25/18	OWOW Steering Committee Meeting
01/31/18	Recycled Water Pillar Meeting
02/02/18	Integrated Stormwater Resources Management Pillar Meeting
02/08/18	Water Resource Optimization Pillar Meeting
02/12/18	Water Use Efficiency Pillar Meeting
02/14/18	Climate Risk and Response Pillar Meeting
02/22/18	OWOW Pillar Integration Meeting
02/26/18	Disadvantaged Communities and Tribal Communities Pillar Meeting
03/07/18	2019 State of the Watershed Conference Planning Call (SAWPA and WEF Staff Only)
03/14/18	Climate Risk and Response Pillar Meeting
03/15/18	Data Management and Monitoring Pillar Meeting

03/21/18	OWOW Tribal Workshop No. 2
03/22/18	OWOW Steering Committee Meeting
03/22/18	Data Management and Monitoring Pillar Meeting
03/26/18	Disadvantaged Communities and Tribal Communities Pillar Meeting
04/04/18	Land Use and Water Planning Pillar Meeting
04/10/18	Data Management and Monitoring Pillar Meeting
04/12/18	SAWPA OWOW Presentation to California Coastal Conservancy South Coast Workgroup
04/19/18	SAWPA OWOW Presentation to the Western Riverside Council of Governments
04/22/18	**Opened: Call for Projects to Be Included in the OWOW Plan**
04/26/18	OWOW Pillar Integration Meeting
05/07/18	OWOW Pillar Chairs Meeting
05/08/18	SAWPA OWOW Presentation to the Pacific Institute California Water Action Collaborative (CWAC) in Irvine
05/24/18	OWOW Steering Committee Meeting
06/21/18	SAWPA OWOW Presentation to the San Bernardino Council of Governments
06/28/18	OWOW Pillar Integration Meeting
06/28/18	OWOW Pillar Chairs Meeting
07/26/18	OWOW Steering Committee Meeting
07/31/18	SAWPA Check-In with DWR in Sacramento
08/06/18	Presentation to WRCOG Executive Committee
08/08/18	Presentation to the Pacific Institute Context Based Water Targets Workgroup
08/23/18	OWOW Pillar Integration Meeting
09/04/18	Special OWOW Pillar Chairs Meeting

09/27/18	OWOW Steering Committee Meeting
10/09/18	OWOW Presentations at California Water Plan Plenary, West Sacramento
10/17/18	Presentation to the Rivers & Lands Conservancy
10/18/18	Pillar Integration Meeting (at Orange County Public Works)
11/15/18	OWOW Steering Committee Meeting
11/19/18	**OWOW Plan Update 2018 Public Review Draft Released**
11/26/18	**Opened: Call for Projects Seeking Prop 1 Round 1 IRWM Grants**
12/14/18	Public Review Period Closes
01/24/19	OWOW Steering Committee Meeting Recommend Adoption of OWOW Plan Update 2018
01/31/19	Close: Call for Projects Seeking Grants
02/19/19	SAWPA Commission Meeting Public Hearing: Adopt OWOW Plan Update 2018

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APPENDIX B

Projects Submitted for the OWOW Plan Update 2018

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APPENDIX B: PROJECTS SUBMITTED TO THE OWOW PLAN UPDATE 2018

On the following pages is the list of projects within the OWOW Plan Update 2018 as of January 31, 2019, including those seeking Proposition 1 IRWM implementation grants. The list, however, is dynamic and can be amended by action of the OWOW Steering Committee and/or the SAWPA Commission, as is described in Chapter 6, Project/Program Review, Evaluation, and Prioritization. To review the up-to-date list, visit www.sawpa.org/owow. The instructions for submitting projects to be adopted into the OWOW Plan Update 2018 can also be found there.

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Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180161	In the Plan	1,2,3, Trichloropropane (1,2,3 - TCP) removal	City of Chino Hills
20180021	In the Plan	19th Street - Caltrans 210 Freeway/Colonies RW Pipeline in 15th St - 2nd Ave to Benson Ave.	Inland Empire Utilities Agency
20180355	In the Plan	Active Recharge in the SAR Tributaries (West)	San Bernardino Valley Municipal Water District
20180190	In the Plan	Alum Addition to Wet Weather Inflows	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180136	In the Plan	Anaheim Bay-Barber Channel Watershed Stormwater Capture Projects	City of Anaheim
20180135	In the Plan	Anaheim Hills Golf Course Constructed Wetland	City of Anaheim
20180075	In the Plan	Anaheim Lake Recontouring	Orange County Water District
20180127	In the Plan	Anaheim Right of Way Projects	City of Anaheim
20180125	In the Plan	Anaheim Shallow Aquifer Pumping for Nonpotable Uses	City of Anaheim
20180134	In the Plan	Anaheim South Recycled Water Project	City of Anaheim
20180156	In the Plan	Anita B. Smith GAC Treatment Addition	Rubidoux Community Services District
20180182	In the Plan	Arlington Desalter Expansion Project	Western Municipal Water District
20180183	In the Plan	Arlington Desalter Expansion Project	Western Municipal Water District
20180302	In the Plan	Artificial Recirculation in Canyon Lake	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180132	In the Plan	Ball Road Sewer and Storm Drain Reconstruction	City of Anaheim
20180155	In the Plan	Basin Enhancement and Optimization Project	Chino Basin Water Conservation District
20180131	In the Plan	Boysen Park Detention Projects	City of Anaheim
20180448	In the Plan	Bunker Hill Conjunctive Use Project	San Bernardino Valley Municipal Water District

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180449	In the Plan	Cactus Basin Recharge Pipeline	San Bernardino Valley Municipal Water District
20180402	In the Plan	Carbon Canyon Channel	San Bernardino County - Flood Control District
20180395	In the Plan	Carbon Canyon Water Recycling Facility Improvements	Inland Empire Utilities Agency
20180126	In the Plan	Central Orange County Water Supply and Water Quality Improvement Project	Irvine Ranch Water District
20180481	In the Plan	Chantilly Storm Drain Diversion to Burris Basin	OC Watersheds
20180098	In the Plan	Chantilly Stormwater Recharge	Orange County Water District
20180369	In the Plan	Chino Basin Conjunctive Use Environmental Water Storage/Exchange Program	Inland Empire Utilities Agency
20180396	In the Plan	Chino Basin Conjunctive Use Environmental Water Storage/Exchange Program	Inland Empire Utilities Agency
20180167	In the Plan	Chino Basin Groundwater Recharge Master Plan Construction Project	Inland Empire Utilities Agency
20180020	In the Plan	Chino Basin Groundwater Supply Wells and Raw Water Pipeline	Inland Empire Utilities Agency
20180022	In the Plan	Chino Basin Improvement and Groundwater Clean-up Project	Inland Empire Utilities Agency
20180174	In the Plan	Chino Basin Production Well(s) and Chino Basin Well Biological Treatment System	Inland Empire Utilities Agency
20180168	In the Plan	Clean Camp Coalition	Rivers and Lands Conservancy
20180371	In the Plan	Climate Change and Operational Flexibility	San Bernardino Valley Water Conservation District
20180172	In the Plan	Coldwater Sub-Basin Watershed Storm Water Capture	Bedford Coldwater Groundwater Sustainability Agency
20180073	In the Plan	Conrock Warner Transfer Pipeline	Orange County Water District
20180084	In the Plan	Cowbird Removal Project	Orange County Water District

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180482	In the Plan	Crescent Basin and Gilbert Basin WIPS Project	OC Watersheds
20180403	In the Plan	Del Rosa Channel	San Bernardino County - Flood Control District
20180097	In the Plan	Desilting Santa Ana River Flows	Orange County Water District
20180300	In the Plan	Dredging at East Bay	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180411	In the Plan	Elder Creek Channel	San Bernardino County - Flood Control District
20180189	In the Plan	EMWD Effluent Treatment	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180446	In the Plan	Enhanced Recharge in Santa Ana River Basins Phase 1B	San Bernardino Valley Municipal Water District
20180177	In the Plan	Enhanced Recycled Water Recharge	City of Ontario - Municipal Utilities Company
20180407	In the Plan	Etiwanda Channel Invert Repair	San Bernardino County - Flood Control District
20180083	In the Plan	Feral Pig Study and Removal Project	Orange County Water District
20180303	In the Plan	FS1-Site Improvement-Santa Ana Meadow Restoration Analysis	US Forest Service
20180399	In the Plan	Grove Basin Outlet Storm Drain - City of Ontario	San Bernardino County - Flood Control District
20180108	In the Plan	GWRS Pipeline Turnout into Burris Basin	Orange County Water District
20180454	In the Plan	Hidden Valley Duck Ponds Mitigation Project	San Bernardino Valley Municipal Water District
20180299	In the Plan	Hypolimnetic Oxygenation System (HOS)	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180017	In the Plan	IEUA-Pomona-MVWD Recycled Water Intertie	Inland Empire Utilities Agency
20180109	In the Plan	Increase Water Supply through Brine Concentration	Orange County Water District

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180336	In the Plan	Indirect Potable Reuse at Canyon Lake	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180377	In the Plan	Integrated Approach for Sustainable Development and Redevelopment on Southern California's Alluvial Floodplains	Santa Ana Watershed Project Authority
20180376	In the Plan	Integrated Data Framework	Inland Empire Utilities Agency
20180082	In the Plan	Invasive Plant Removal Project	Orange County Water District
20180068	In the Plan	Lincoln Basin Rehabilitation	Orange County Water District
20180415	In the Plan	Mabury Park Stormwater Capture Project	City of Santa Ana
20180122	In the Plan	Main Plant Water Well #7 Replacement	City of Fullerton
20180372	In the Plan	Mill Diversion Project	San Bernardino Valley Water Conservation District
20180373	In the Plan	Mill Habitat Planning	San Bernardino Valley Water Conservation District
20180412	In the Plan	Mission Channel	San Bernardino County - Flood Control District
20180130	In the Plan	Modjeska Park Detention Basin	City of Anaheim
20180104	In the Plan	MTBE Contamination Remediation	Orange County Water District
20180483	In the Plan	Murdy Park and Community Center Storage Facility WIPS Project	OC Watersheds
20180188	In the Plan	Mystic Lake Drawdown	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180176	In the Plan	Neighborhood Water Supply Sustainability Collaboration	City of Ontario - Municipal Utilities Company
20180099	In the Plan	New OCWD Recharge Basin	Orange County Water District
20180103	In the Plan	North Basin VOC Contamination Remediation	Orange County Water District
20180138	In the Plan	North/Central Orange County Irrigation Efficiency, Runoff Reduction, and Pollution Prevention Program	Municipal Water District of Orange County

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180129	In the Plan	OCSD Trunkline Repurposing	City of Anaheim
20180095	In the Plan	OCWD Recharge Basins Rehabilitation	Orange County Water District
20180106	In the Plan	OCWD Groundwater Replenishment System Flow EQ Tanks	Orange County Water District
20180086	In the Plan	Off-Stream Stormwater Storage (Aliso Canyon Dam)	Orange County Water District
20180112	In the Plan	Orange County Regional Stormwater Infiltration Project	Orange County Water District
20180101	In the Plan	Orange County Seawater Intrusion Control Program	Orange County Water District
20180455	In the Plan	Pedley Landfill Removal and Native Habitat Restoration Mitigation Project	San Bernardino Valley Municipal Water District
20180375	In the Plan	Pilot Turf Replacement Landscape Coach Project	Jurupa Community Services District
20180367	In the Plan	Plunge Creek Conservation Project Phase II	San Bernardino Valley Water Conservation District
20180152	In the Plan	Prado Basin Feasibility Study Project	Orange County Water District
20180116	In the Plan	Quagga Mussel Research	Orange County Water District
20180394	In the Plan	Quail Valley Sewer Improvements (Subarea 4)	Eastern Municipal Water District
20180245	In the Plan	R21-Site Improvement-Santa Ana Sucker Habitat Protection and Beneficial Use Enhancement	Santa Ana Watershed Project Authority
20180248	In the Plan	R24-Site Improvement-California Native Plant Garden	Rivers and Lands Conservancy
20180111	In the Plan	Ranney Recharge Well	Orange County Water District
20180096	In the Plan	Recharge in Lower Santiago Creek	Orange County Water District
20180015	In the Plan	Regional Plant No. 1 and Regional Plant No. 5 Expansion Construction	Inland Empire Utilities Agency
20180452	In the Plan	Regional Recycled Water Recharge Pipeline	San Bernardino Valley Municipal Water District

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180160	In the Plan	Replace Water Storage Tank (Reservoir No. 2)	City of Chino Hills
20180158	In the Plan	Restore Our Arroyo	Rivers and Lands Conservancy
20180409	In the Plan	Rialto Channel - From Willow Avenue to Etiwanda Avenue	San Bernardino County - Flood Control District
20180408	In the Plan	Rialto Channel at Riverside Avenue	San Bernardino County - Flood Control District
20180128	In the Plan	Richfield Road Storm Drain	City of Anaheim
20180359	In the Plan	Riverside Basin Stormwater Capture and Recharge	City of Riverside - Public Utilities Department
20180171	In the Plan	Riverside Habitat, Parks, and Water Project	City of Riverside - Public Utilities Department
20180175	In the Plan	Riverside North Aquifer Storage and Recovery Project	City of Riverside - Public Utilities Department
20180451	In the Plan	Riverside North Aquifer Storage and Recovery Project	San Bernardino Valley Municipal Water District
20180354	In the Plan	Riverside North Recharge Basin	City of Riverside - Public Utilities Department
20180180	In the Plan	Riverside Service Area Meter Replacement and Retrofit	Western Municipal Water District
20180185	In the Plan	Robidoux Nature Center and Sunnyslope Creek Restoration Project	San Bernardino Valley Municipal Water District
20180014	In the Plan	RW Supply Optimization and Drought Relief Project	Inland Empire Utilities Agency
20180094	In the Plan	San Diego Creek Diversion/Trash Removal Project	City of Newport Beach
20180389	In the Plan	San Timoteo Canyon State Park Habitat Conservation	RLC
20180016	In the Plan	Santa Ana River Conservation and Conjunctive Use Project (SARCCUP): a multi-agency, watershed-wide program	Inland Empire Utilities Agency
20180374	In the Plan	Santa Ana River Spreading on Woolly Star Preserve Area	San Bernardino Valley Water Conservation District

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180410	In the Plan	Santa Ana River Wall Repair	San Bernardino County - Flood Control District
20180327	In the Plan	Santa Ana River Wash Recreation Trails	San Bernardino Valley Water Conservation District
20180364	In the Plan	Security Fencing of Groundwater Recharge and Conservation Areas	San Bernardino Valley Water Conservation District
20180173	In the Plan	Six Basins Production Well(s) and Cucamonga Basin Well	Inland Empire Utilities Agency
20180102	In the Plan	South Basin VOC Contamination Remediation	Orange County Water District
20180113	In the Plan	South OC Water Storage in OCWD	Orange County Water District
20180124	In the Plan	St. College Detention Basin	City of Anaheim
20180485	In the Plan	Sterling Natural Resource Center	East Valley Water District
20180164	In the Plan	Storm Water Management Facilities: Wineville Jurupa and RP-3 Basins	Inland Empire Utilities Agency
20180150	In the Plan	Talbert Seawater Barrier Improvement Project	Orange County Water District
20180146	In the Plan	The Confluence Regional Water Resources Project	Chino Basin Water Conservation District
20180335	In the Plan	Ultrasonic Algae Control	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180110	In the Plan	Urban Runoff Diversion Program to OCSD System	Orange County Water District
20180366	In the Plan	Wash Habitat Conservation Plan	San Bernardino Valley Water Conservation District
20180379	In the Plan	Wastewater Treatment Plant Expansion/Renovation Project	City of Beaumont
20180453	In the Plan	Waterman Turnout Hydroelectric Plant	San Bernardino Valley Municipal Water District
20180337	In the Plan	Watershed BMPs in Urban Drainage Areas	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180404	In the Plan	West Fontana Channel - Phase II	San Bernardino County - Flood Control District
20180059	In the Plan	West Orange County Wellfield	Orange County Water District
20180401	In the Plan	West Street Storm Drain - Segment III B & III C	San Bernardino County - Flood Control District
20180115	In the Plan	Wildlife Exhibit	Orange County Water District
20180405	In the Plan	Wildwood Channel	San Bernardino County - Flood Control District
20180479	In the Plan	William Mason Regional Park & UC Irvine WIPS Project	OC Watersheds
20180181	In the Plan	WMWD Recycled Water Project	Western Municipal Water District

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180461	Seeking Prop 1	2019 Canyon Lake Dredging Project	Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)
20180184	Seeking Prop 1	Accelerated Leak Detection and Meter Testing	Eastern Municipal Water District
20180187	Seeking Prop 1	Advancing Sustainable Landscapes in the Santa Ana River Watershed	Pacific Institute
20180475	Seeking Prop 1	Beaumont Cherry Valley Water District Recycled Water Facility	Beaumont Cherry Valley Water District
20180178	Seeking Prop 1	Best Practices for Commercial, Institutional, and Municipal-Scale California Native Landscapes Guidebook	Chino Basin Water Conservation District
20180478	Seeking Prop 1	Clean Camp Coalition	Inland Empire Waterkeeper
2018470	Seeking Prop 1	Cleanup OC	Orange County Coastkeeper
20180469	Seeking Prop 1	Coastkeeper Smartscape	Orange County Coastkeeper
20180463	Seeking Prop 1	Enhancements to Watershed-Wide Water Budget Decision Support Tool	Santa Ana Watershed Project Authority
20180484	Seeking Prop 1	Evans Lake Tributary Restoration and Camp Evans Recreation	San Bernardino Valley Municipal Water District
20180462	Seeking Prop 1	Every Neighbor Caring for Our River	Inland Empire Waterkeeper
20180105	Seeking Prop 1	Groundwater Replenishment System Final Expansion	Orange County Water District
20180400	Seeking Prop 1	Hawker Crawford Channel	San Bernardino County - Flood Control District
20180154	Seeking Prop 1	Joint IEUA-JCSD Regional Water Recycling Program	Inland Empire Utilities Agency
20180464	Seeking Prop 1	Montclair Basin Improvements Project	Inland Empire Utilities Agency
20180091	Seeking Prop 1	Peters Canyon Water Treatment Plant Reconstruction	East Orange County Water District
20180334	Seeking Prop 1	Physical Harvesting of Algal Biomass in Lake Elsinore – Pilot Program	City of Lake Elsinore
20180100	Seeking Prop 1	Placentia and Raymond Basins Flood Control Improvement and Groundwater Recharge Project	Orange County Water District

Project ID	Submittal Type	Project Name (alphabetical)	Lead Agency Name
20180460	Seeking Prop 1	Raitt & Myrtle Park	City of Santa Ana
20180186	Seeking Prop 1	Replenish Big Bear	Big Bear Area Regional Wastewater Agency
20180151	Seeking Prop 1	River Road Sand Removal Project	Orange County Water District
20180340	Seeking Prop 1	Salinity and Groundwater Enhancement (SAGE)	Yucaipa Valley Water District
20180476	Seeking Prop 1	San Jacinto Valley Watershed Conservation and In-Lieu Recycled Water Program	Eastern Municipal Water DIstrict
20180447	Seeking Prop 1	Santa Ana Mountains Watershed Protection Project	Cleveland National Forest
20180474	Seeking Prop 1	Santa Ana Recycled Water Expansion	City of Santa Ana
20180179	Seeking Prop 1	Santa Ana Watershed Literacy Guide and Interpretation Toolkit	Chino Basin Water Conservation District
20180157	Seeking Prop 1	SAWPA Regional Comprehensive Landscape Rebate Program	Municipal Water District of Orange County
20180465	Seeking Prop 1	Well 30 Wellhead Treatment Project	Monte Vista Water District
20180473	Seeking Prop 1	Well 34 Wellhead Treatment Project	Monte Vista Water District
20180385	Seeking Prop 1	Wilson III Basin Project	City of Yucaipa

APPENDIX C

Governing Laws, Judgments, and Agreements

Listed below are the past and present laws, judgments, and agreements that affect water management and conflicts in the watershed:

- Settlement Agreement between City of San Bernardino and City of Riverside and Riverside Water Company, 1922
- Rialto Basin Judgment, 1961
- SAWPA Joint Exercise of Powers Agreement, 1967
- Chino Basin–City of Pomona Agreement, 1968
- Orange County/Chino Judgment, 1969
- Western/San Bernardino Judgment, 1969
- Western, Chino Basin, County of Riverside, Riverside County Flood Control and Water Conservation District Agreement, 1969
- Porter-Cologne Water Quality Control Act, 1969
- Chino Basin–Western Agreement, 1970
- Federal Water Pollution Control Act (Clean Water Act), 1972
- Endangered Species Act, 1973
- Santa Ana River–Mill Creek Cooperative Water Project Agreement, 1976
- Big Bear Municipal Water District/North Fork Water Co. Judgment, 1977
- Chino Basin Judgment, 1978
- San Bernardino–City of San Bernardino, City of Riverside Agreement, 1981
- San Bernardino–Western Agreement, 1981
- San Bernardino–Western, Orange County, Riverside, and San Bernardino City Agreement, 1985
- Monterey Agreement, 1994
- Big Bear Municipal and Valley District Agreement, 1996
- Chino Basin Peace Agreement, 2000
- Integrated Regional Water Management Planning Act, 2002
- Groundwater Management Planning Act, 2002
- Seven Oaks Accord, 2004
- Beaumont Basin Judgment, 2004
- Settlement Agreement between San Bernardino Valley Municipal Water District, Western Municipal Water District, and San Bernardino Valley Water Conservation District, 2005
- Chino Basin Peace II Agreement, 2008

- Soboba Water Rights Settlement Act, 2008
- Institutional Controls and Settlement Agreement, 2004
- Agreement Relating to the Diversion of Water from the Santa Ana River System among Western Municipal Water District, San Bernardino Valley Municipal Water District, and City of Riverside, 2004
- Cooperative Agreement to Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basin, 2007

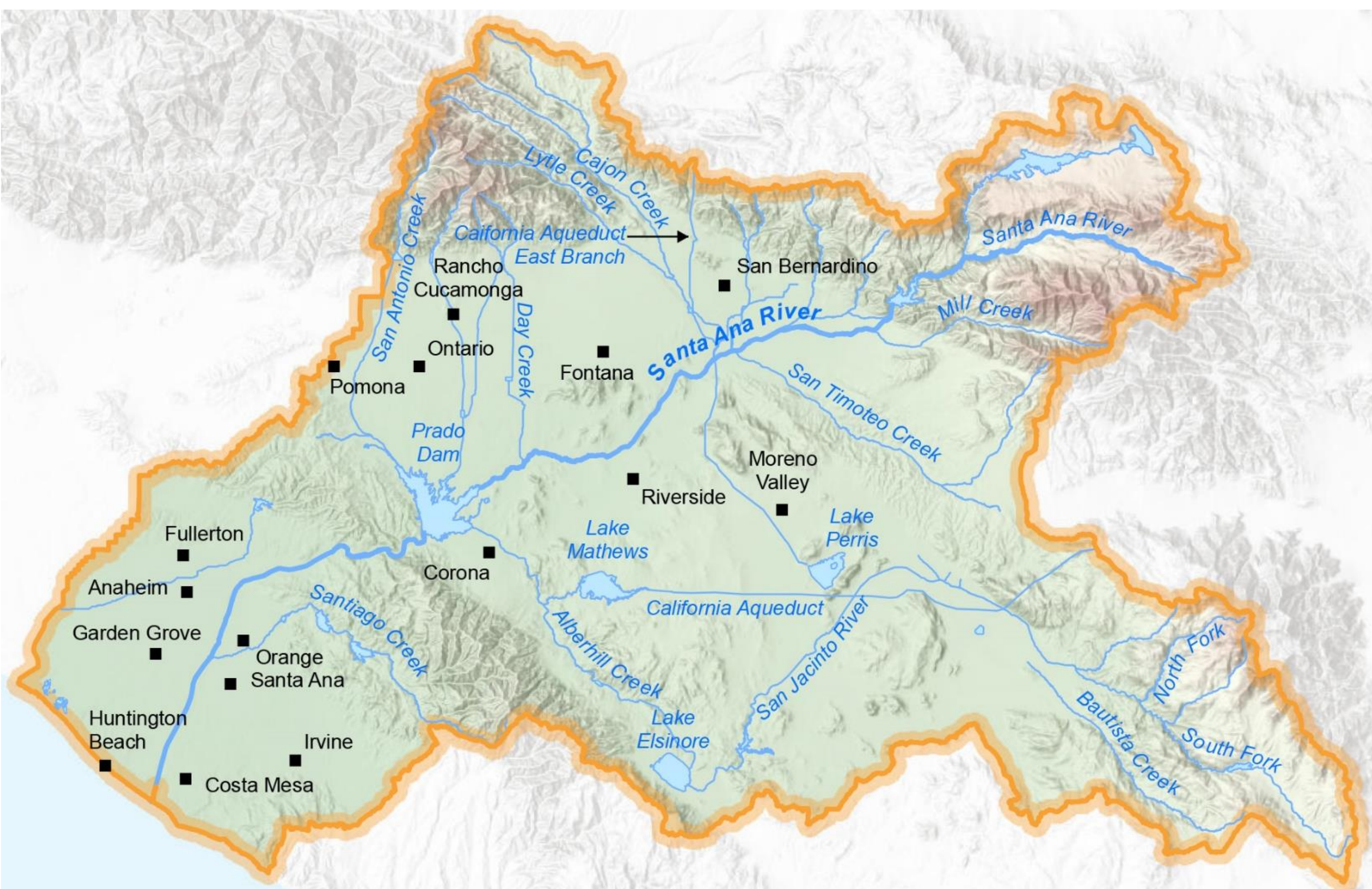
APPENDIX D

ESA Sustainability Assessment

OWOW PLAN UPDATE 2018
WATERSHED SUSTAINABILITY ASSESSMENT

Prepared for
Santa Ana Watershed Project Authority
and California Department of Water
Resources

January 2019



OWOW PLAN UPDATE 2018
WATERSHED SUSTAINABILITY ASSESSMENT

Prepared for
Santa Ana Watershed Project Authority
and California Department of Water
Resources

January 2019

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FOREWORD

The Sustainability Assessment that follows was developed by Environmental Science Associates (led by Betty Andrews and Karen Lancelle) in collaboration with Peter Vorster of The Bay Institute, working with the Santa Ana Watershed Project Authority. It was made possible with the financial support of the California Department of Water Resources as a pilot effort to demonstrate a regional sustainability assessment as encouraged by recent and current versions of the California Water Plan.

The Sustainability Assessment was crafted to provide feedback to decision-makers and stakeholders of the One Water One Watershed (OWOW) Plan regarding how well Plan goals are being achieved. This feedback will inform where additional or modified emphasis and investment is needed to realize the goals of the OWOW Plan. Unlike the California Water Plan Update 2018, which focused on developing a tool for assessing the effectiveness of water management for sustainability (the Sustainability Outlook), the OWOW Plan Update 2018 developed goals focused on improving watershed sustainability.

Because this assessment was conducted while the California Water Plan Update 2018 and OWOW Plan Update 2018 were being developed, it may not fully conform to the final versions of either document.

The Sustainability Assessment was developed with input from stakeholders and decision-makers, though the engagement was limited due to its parallel execution with the drafting of the OWOW Plan Update 2018. The Sustainability Assessment, as designed, supports collaborative dialogue, prioritization, and further analysis – it is not intended to be a comprehensive and exhaustive analysis of watershed condition. More comprehensive work is done routinely elsewhere, driven by specialty activity and carried out by technical experts. This tool draws from such work, but it does not seek to replicate it nor encompass its full complexity. The simple rating system used supports the purpose of the Sustainability Assessment as a quick reference overview of an extraordinarily complex and multi-faceted system of natural and human processes.

In summary, this Sustainability Assessment is the initial iteration of a tool intended to be useful to the OWOW Plan stakeholders in guiding Plan implementation. Future work can further refine its utility to the region and deepen the connections to the California Water Plan Sustainability Outlook tools as they develop.

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Introduction

This document provides a summary of the watershed sustainability assessment developed and conducted for the OWOW Plan Update 2018. A brief introduction to the assessment is provided, including a discussion of its purpose and goals; background on other watershed sustainability assessments that informed its development; discussion on the principles that were applied during its development; an overview of the indicators and metrics selected for the assessment; a brief introduction to its implementation; and a summary of the assessment findings, first in a table form and then as individual pages presenting each metric evaluated.

A more detailed presentation of the implementation of each metric evaluation is contained in **Attachment A**, including a discussion of data sources, approach to scoring and rating, detailed implementation steps, and considerations for future iterations of the assessment.

Purpose and Goals

The primary purpose of the watershed sustainability assessment for the OWOW Plan Update 2018 is to help promote sustainability within the Santa Ana River watershed by supporting decision making and stakeholder action to achieve the goals of the OWOW Plan. By providing feedback on how well the OWOW Plan goals are being achieved, decision making can adapt to provide increased resources and attention where it is needed.

At the watershed scale, the watershed sustainability assessment supports decision making by demonstrating whether or not existing efforts are showing progress towards meeting goals. It will additionally inform future projects and planning efforts by helping to focus attention on meaningful objectives, identifying activities that are needed to shift key indicators. The sustainability assessment can also support the effectiveness of the Plan itself. It provides a measuring stick for each iteration of the OWOW Plan; if it is found that the effects of implementing the OWOW Plan are successful based on the findings of the sustainability assessment, but fail to address key aspects of sustainability still challenging the watershed, modification of the OWOW Plan's goals and objectives should follow.

At the individual scale, by providing a vehicle for a shared understanding of progress toward the shared goals expressed in the OWOW Plan, the watershed sustainability assessment also helps to build a sense of common purpose among watershed stakeholders, which can multiply the collective effect of their individual decisions, including support for watershed-scale actions.

With sufficient ease of implementation, the performance feedback provided by the assessment can be carried out more often than at each plan update, perhaps even annually, to 1) help refine implementation of the Plan on a time scale that will be regularly meaningful to decision-makers, 2) build momentum around demonstrating progress towards the goals, and 3) serve to reinforce the value of the Plan and its implementation to the stakeholders in the watershed.

Background

Over the past two decades in California, multiple statewide and regional efforts have emerged to develop and apply indicator-based assessment frameworks and tools to help manage water resources for sustainability. Sustainability frameworks and visions were included in the California Water Plan (CWP) updates from 2005 through 2018 and in the 2013 iteration of the One Watershed One Water (OWOW) Program. In addition to these public programs, the Sustainable Water Management Profile, an assessment tool prepared for the Water Foundation, was developed in 2012.

As part of the 2013 iteration of the OWOW Program, also called the OWOW 2.0 Plan, a Sustainability Indicators Framework was used to understand the performance of integrated water management in the watershed. The results were published in Appendix A of the OWOW 2.0 Plan as an "Assessment of the Health of Santa Ana River Watershed." The Sustainability Indicators Framework was designed to integrate sustainability indicators and performance measures into a single reporting system.

The sustainability assessment frameworks developed since 2010 and the other frameworks applied at the watershed scale over the last 20 years in California were analyzed, along with the draft California Water Plan Update 2018 "Sustainability Outlook[1]," to develop an assessment framework with metrics and indicators for the OWOW Plan Update 2018.

Development

As described in the Background section above, statewide and regional efforts to develop sustainability assessment tools have been ongoing for more than a decade. Assessment development for the OWOW Plan Update 2018 intentionally utilized concepts and indicators identified by these previous and concurrent efforts as a potential source for indicators and metrics aligned with the OWOW Plan's goals and objectives, which were developed through local collaborative watershed planning efforts. The intent of this strategic approach was to develop an assessment that reflected the best thinking related to managing water for sustainability while ensuring that the assessment results would be locally meaningful and time- and cost-effective to repeat on a regular basis.

The development of a sustainability assessment for the OWOW Plan Update 2018 recognized that pursuit of sustainability is a process. It also reflected the understanding that, while the pursuit of sustainability is often considered as overcoming a combination of technical challenges, in most settings it is more appropriately recognized as overcoming a combination of political challenges. Watershed sustainability assessment tools are powerful if used to specifically respond to these political challenges. Technical assessment of a thousand nuanced aspects of water sustainability does not address political challenges; it.is simply a collection of what various specialists already know, and it obscures the holistic picture that is needed to harness political will. These considerations influenced the approach to development of the OWOW Plan Update 2018

1 The proposed Sustainability Outlook includes a still-developing suite of indicators that can be used to assess conditions and trends in water and watershed management.

sustainability assessment as well as the selection of its indicators and metrics. The list of indicators and metrics needed to be relatively short, and the metrics themselves needed to be easy for stakeholders to understand, directly responsive to actions to achieve the goals of the OWOW Plan, and practical to evaluate on a regular basis.

The assessment was developed based on the OWOW Plan Update 2018 goals and objectives (goals listed in **Table SA-1**). The OWOW Plan Update 2018 describes how collaborative watershed planning, water and land management, and project implementation support improved sustainability, resilience, and quality of life throughout the Santa Ana River Watershed through 2040.

TABLE SA-1
OWOW PLAN UPDATE 2018 GOALS

Achieve resilient water resources through innovation and optimization.	Ensure high quality water for all people and the environment.
Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function.	Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed.
Educate and build trust between people and organizations.	Educate and build trust between people and organizations.

Components of the assessment framework include indicators and metrics, valuation or scoring, and presentation of results in the form of a rating.

Indicators and their associated metrics were selected by reviewing indicators previously identified for other projects (and regions) and screening them to reflect the Santa Ana River watershed and adopted criteria related to ease of implementation. OWOW stakeholder feedback was sought at multiple stages during the assessment development process. Sets of potential indicators were shared during local stakeholder meetings to solicit feedback and share progress.

The array of potential indicators was narrowed to a select group for further consideration based on four main criteria: easy to understand; responsive to actions; easy to implement; and meaningful to stakeholders.

The assessment reports on trends (that is, scores are relative to past performance) instead of scoring each indicator with either an absolute value or based on its relationship to a target condition (i.e., wanted or unwanted conditions). A three-bin set of results -- a positive trend, a negative trend, or a neutral condition – were elected for the assessment because these three outcomes are easy to understand, limit the number of scoring thresholds to be assigned, and are adequate to indicate movement toward Plan goals.

Table SA-2 lists the selected indicators and metrics associated with each of the six OWOW Plan Update 2018 goals and provides a short rationale for each.

TABLE SA-2
SELECTED INDICATORS FOR OWOW UPDATE GOALS

Goal	Indicator	Metric	Rationale
Achieve resilient water resources through innovation and optimization	Maximization of locally-managed supplies	Percent of total annual supply sourced or managed locally	Water that is sourced locally or imported and stored locally is more reliable than water that is imported and must be immediately used. Maximizing local supplies and storage in the region will make us more resilient and effective managers of an increasingly variable water supply.
	Efficiency of outdoor water use	Percent of watershed population in agencies using parcel-level data to assess outdoor water use	Implementing innovative technology and data management can increase irrigation efficiency and help make landscapes less irrigation dependent. Landscape irrigation is the single largest use of water in the watershed and improving its efficiency will significantly increase watershed resilience.
Ensure high quality water for all people and the environment.	Maintenance of groundwater salinity at or below target levels	Non-exceedance of groundwater salinity standards	Management of water quality in the groundwater basins of the watershed is essential to preserving their utility. Groundwater basins are the watershed's most important local water storage tool, and salinity levels are a primary consideration for maintaining a high-quality, reliable water supply.
	Safety of water for contact recreation	Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination	Bathers in our streams, lakes, and coastal waters must be protected from undue health hazards from water quality impairment.
Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	Abundance of vegetated riparian corridor	Area of vegetated riparian corridor	Active engagement in conserving and restoring riparian vegetation is necessary to retaining and enhancing the values supported by this resource. Vegetation within the riparian corridors of the watershed provides valuable habitat for a large number of species, including those with special status. It also provides beauty and shade for people recreating alongside streams and lakes.
	Abundance of conserved open space	Area of conserved open space	Deliberate management and protection is necessary to maintain the recreational and ecosystem values of open space.
Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	Equitable access to clean drinking water	Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community	Ensuring that all people in the watershed have clean drinking water is essential to human health and prosperity within the watershed.
	Proportionate implementation of climate change adaptation strategies	Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community	Targeted implementation of climate change adaptation strategies that address the potential for increased dangerous heat, a climate change impact predicted in the watershed, will reduce the extent to which vulnerable people are inequitably impacted.
Educate and build trust between people and organizations.	Collaboration for more effective outcomes	Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation	Collaborative action with shared outcomes must be prioritized by water managers because many of the complex challenges facing the watershed cannot be overcome by a single organization.

TABLE SA-2
SELECTED INDICATORS FOR OWOW UPDATE GOALS

Goal	Indicator	Metric	Rationale
	Adoption of a watershed ethic	Total gallons of potable water used per capita per day	Helping conservation become a way of life in California involves education and civic action. As more water users learn how precious our water and watershed are, many of the challenges will be more easily overcome.
Improve data integration, tracking and reporting to strengthen decision-making	Broaden access to data for decision-making	Percent of watershed population in agencies whose residential customers receive relative performance information about their water use	Everyone who uses water is a decision-maker. Informing people how they are using water relative to past and/or budgeted use, will improve decisions, increase efficiency, and make us more resilient.
	Participation in an open data process	Percent of watershed population in agencies participating in establishment of a regional data sharing system	Our ability to create data is outstripping our ability to make effective use of it. Ensuring that data produced is meaningful, is applied to decision-making, and is shared freely without jeopardy is a critical next step for the management of the watershed's supply and demand.

Implementation

After selecting the metrics, a few additional decisions remained to be made for their implementation. The decisions included:

- determining the extent of change that would count toward the trend evaluation (e.g., what change in area of open space would be sufficient to consider a trend to be positive),
- how to handle assessment of metrics for which a simple trend assessment approach was not appropriate (e.g., groundwater quality in a managed, maximum benefit environment),
- which data sources to use and how (e.g., should comparisons be made to the prior year alone or to a multi-year average), and
- methods to combine results for discrete elements (e.g., groundwater basins) to reflect an overall score.

These choices were influenced by data quality and availability as well as expert judgment and assessment of meaningfulness to assessment consumers. In many cases earlier data was not available to address the trend. If such comparable data was not available, the metric value was assessed qualitatively based upon expert judgement, and contextualized using other data.

Target conditions (wanted or unwanted conditions) were not established for this assessment. To be meaningful in a planning context, target conditions must be developed through a collaborative process by the OWOW Plan 2018 Update stakeholders. While at this time the indicators are not evaluated relative to target conditions, this could be carried out in the future, should those conditions be identified.

Two types of scoring emerged, based on the metric being assessed. A positive or negative trend based on either decrease or increase in the metric value was an appropriate basis for scoring for most metrics (such as total gallons of potable water used per capita per day). In other cases, a good-bad scoring approach was used. The good-bad scoring approach was developed to address metrics for which a binary valuation (either a condition is good or bad) exists and is a more appropriate basis for establishing an assessment rating. For example, increases in groundwater salinity from one year to the next would not necessarily be considered a negative trend if the salinity remains below water quality target levels. Further, maintenance of a consistent salinity level below the water quality target was appropriately considered a positive outcome, despite not reflecting a trend in salinity levels.

Attachment A includes a description of the implementation approach for each indicator and metric, along with information about data used, method of implementation, results, the rating, and recommendations for future implementation.

Outcomes

The OWOW Sustainability Assessment Summary presents the outcomes of this assessment in a tabular form. The rating represents the evaluation of management action effectiveness in the pursuit of sustainability. The Sustainability Assessment Summary provides a succinct visual high-level “status update” of the watershed and feedback on OWOW Plan effectiveness. **Table SA-3** provides a key to the rating system used to summarize findings.

A series of Assessment Summary Sheets follow the Sustainability Assessment Summary table and present each metric, rationale, and findings in a simplified graphical format.

TABLE SA-3
RATING SYSTEM KEY

Rating	Quantitative Assessment Rating	Qualitative Assessment Rating
Positive		
Neutral		
Negative		

OWOW Sustainability Assessment Summary

Goal	Indicator	Metric	Rating*	Scoring
Achieve resilient water resources through innovation and optimization	Maximization of locally-managed supplies'	Percent of total annual supply sourced or managed locally		Trend scoring approach. Potentially fully scorable data set if data can be rectified. Qualitative trend assessment - inadequate data available.
	Efficiency of outdoor water use	Percent of watershed population in agencies using parcel-level data to assess outdoor water use		Trend scoring approach. One partial data set: incomplete assessment of all watershed retailers and how parcel-level data is actually used. Qualitative trend assessment - only one data point.
Ensure high quality water for all people and the environment	Maintenance of groundwater salinity at or below target levels	Non-exceedance of groundwater salinity standards		Good-bad scoring approach. Fully scoring using quantitative data. Compare most recent (2015) to average triennial quantitative data 2003-2012.
	Safety of water for contact recreation	Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination		Good-bad scoring approach. Fully scoring using quantitative data.
Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	Abundance of vegetated riparian corridor	Area of vegetated riparian corridor		Trend scoring approach. Fully scoring based on quantitative data. Compare to average of prior 5 years of data.
	Abundance of conserved open space	Area of conserved open space		Trend scoring approach. Fully scoring based on quantitative data. Compare 2017 to 2016 data.
Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	Equitable access to clean drinking water	Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community		Trend scoring approach. Qualitative trend assessment - only one data point.
	Proportionate implementation of climate change adaptation strategies	Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community		Trend scoring approach. Qualitative trend assessment - only one data point.
Educate and build trust between people and organizations	Collaboration for more effective outcomes	Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation		Good-bad scoring approach. Fully scoring based on quantitative data. Compare 2017 to 2016 data.
	Adoption of a watershed ethic	Total gallons of potable water used per capita per day		Trend scoring approach. Fully scoring based on quantitative data. Compare to average of prior 10 years of data.
Improve data integration, tracking and reporting to strengthen decision-making	Broaden access to data for decision-making	Percent of watershed population in agencies whose residential customers receive relative performance information about their water use		Trend scoring approach. Qualitative trend assessment - only one data point.
	Participation in an open data process	Percent of watershed population in agencies participating in establishment of a regional data sharing system		Trend scoring approach. Qualitative trend assessment - inadequate data available.

* A face with hat indicates that the rating results from a qualitative assessment.

OWOW SUSTAINABILITY ASSESSMENT

Summary Sheets

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GOAL:

Achieve resilient water resources through innovation and optimization

SAWPA

Indicator:
Maximization of locally-managed supplies

Metric:
Percent of total annual supply sourced or managed locally

- Sufficient quantitative data was not available to assess this metric, and qualitative information was not available to determine whether the rating should be positive or negative. The metric was therefore given a qualitative neutral rating.
- Data from individual SAWPA wholesalers and the MWD service area for the last 10+ years show an increasing reliance on locally managed supplies resulting from the long-term trend of increased recycled water and groundwater recovery production in combination with demand reductions, increased efficiencies, and opportunistic recharge of local and imported water.
- A cooperative effort by SAWPA water supply agencies with the State and local agencies to whom the data is reported is needed to produce the quality data necessary to quantitatively assess this metric.

Why Evaluate this Indicator?

Water that is sourced locally or imported and stored locally is more reliable than water that is imported and must be immediately used. Maximizing local supplies and storage in the region will make us more resilient and effective managers of an increasingly variable water supply.

Insufficient Data

GOAL:

Achieve resilient water resources through innovation and optimization

SAWPA

Indicator:

Efficiency of outdoor water use

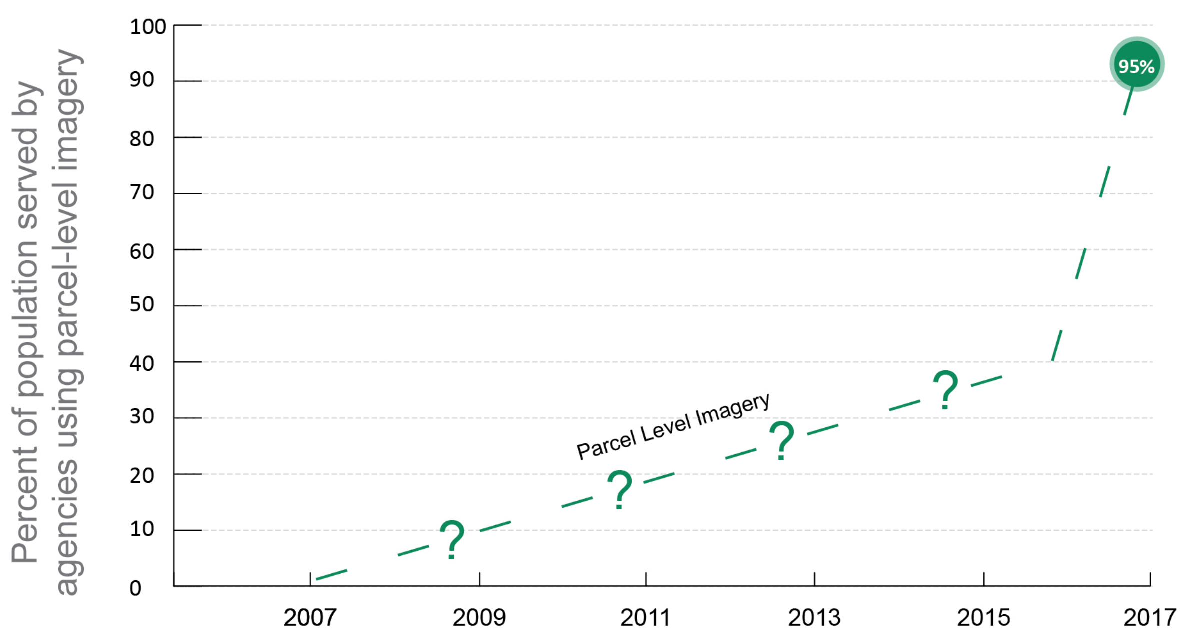
Metric:

Percent of watershed population in agencies using parcel-level data to assess outdoor water use

- By 2017, the water supply and management agencies that together encompass 95% of the watershed's population requested the use of SAWPA-procured 2015 aerial imagery, which can be used for parcel-level assessments of outdoor water use. The retail water suppliers that encompass 74% of the watershed's population also either use or requested the use of the imagery.
- Quantitative information about the use of imagery procured prior to 2015 was not available and thus the trend assessment is qualitative.
- Beginning in 2007, SAWPA has obtained aerial imagery on behalf of the Santa Ana watershed, a noteworthy example of cooperative procurement to reduce costs for individual water suppliers and to assist them to improve the implementation, measurement of, and education about outdoor water use efficiency programs and conservation rate structures.

Why Evaluate this Indicator?

Implementing innovative technology and data management can increase irrigation efficiency and help make landscapes less irrigation dependent. Landscape irrigation is the single largest use of water in the watershed and improving its efficiency will significantly increase watershed resilience.



GOAL:

Ensure high quality water for all people and the environment.

SAWPA

Indicator:

Maintenance of groundwater salinity at or below target levels

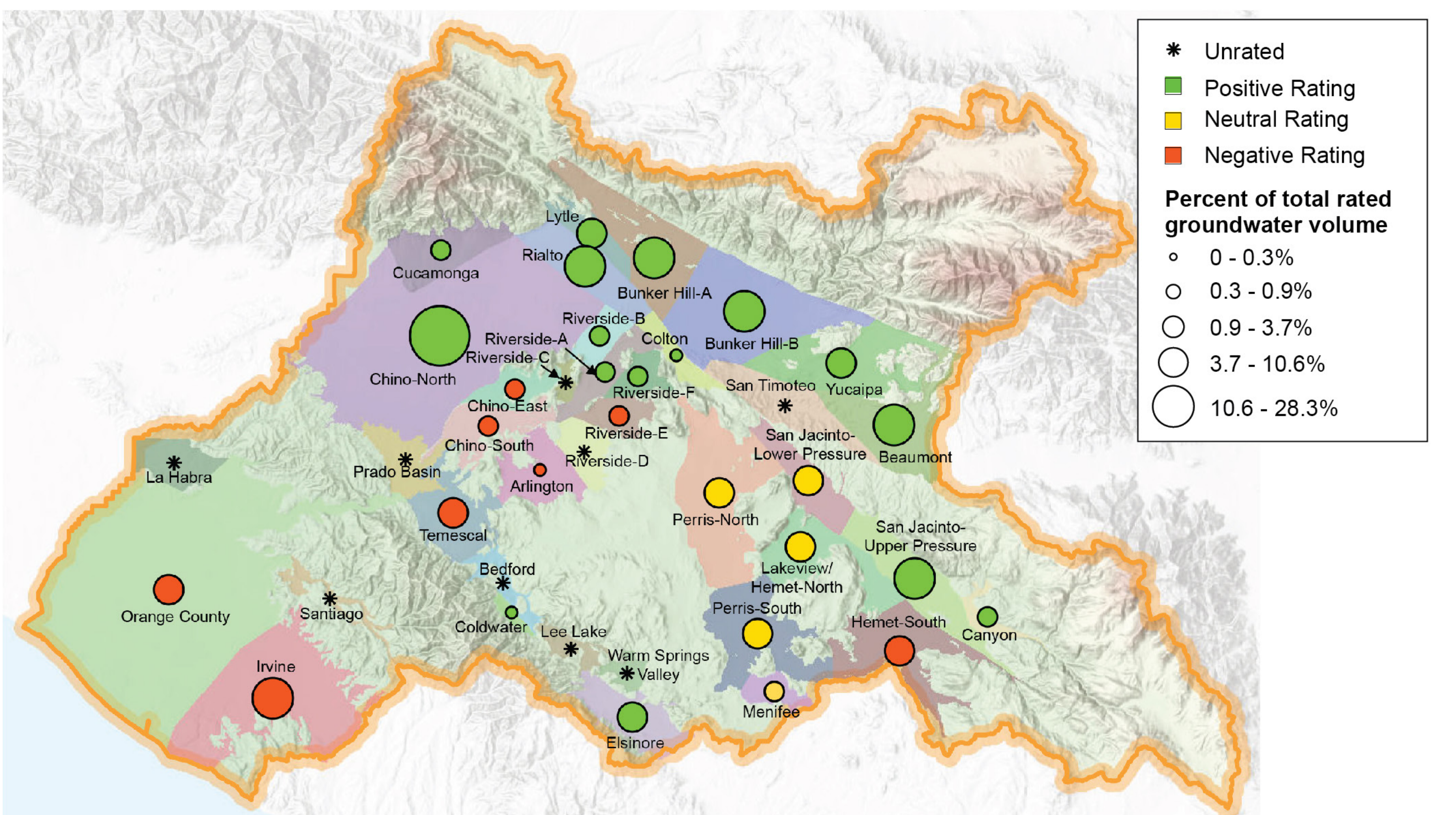
Metric:

Non-exceedance of groundwater salinity standards

- Of the 29 (out of 37 total) managed groundwater zones for which sufficient data exists for evaluation 55%, have salinity levels at the level of the salinity standard or better; when the results are weighted by volume in storage in each zone, the result rises to 71%.
- Overall, 82% of the rated groundwater volume either meets the water quality standard, or fails to meet the standard but has significantly improved compared to recent historic values.
- Salinity within the groundwater basins of the watershed has increased somewhat since 2012, just prior to the conditions described in the last OWOW Plan.

Why Evaluate this Indicator?

Management of water quality in the groundwater basins of the watershed is essential to preserving their utility. Groundwater basins are the watershed's most important local water storage tool, and salinity levels are a primary consideration for maintaining a high-quality, reliable water supply.



GOAL: Ensure high quality water for all people and the environment.

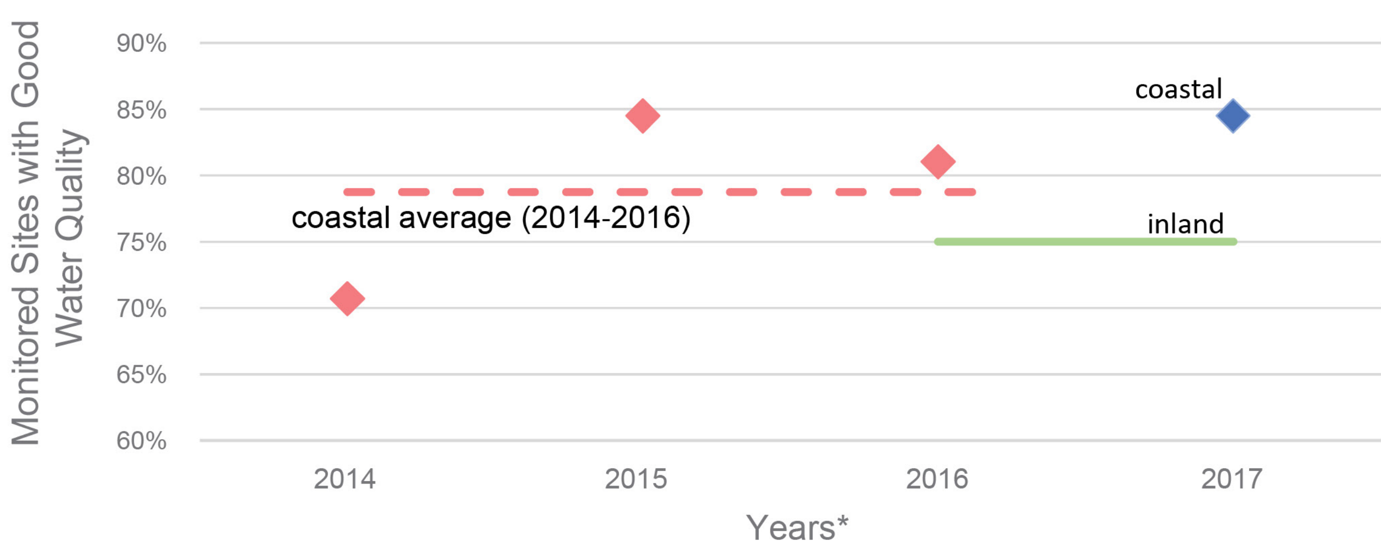
Indicator: Safety of water for contact recreation

Metric: Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination

- In 2017-2018, 84% of coastal sites received a good (A or A+) rating during dry season flows, while an additional 12% were lower quality, but improving, whereas only 63% of inland sites were generally compliant with the water quality objective and an additional 13% (one site) was noncompliant but showed significant improvement. Overall, this was determined to indicate a positive rating.
- The average 2017-2018 coastal dry season water quality grades were better than the average for the preceding three years; average inland water quality compliance was the same compared to the preceding year, the only other year for which data was available, but showed improved water quality.
- Since the last OWOW Plan was issued in 2014, coastal dry season water quality grades have improved overall.

Why Evaluate this Indicator?

Bathers in our streams, lakes, and coastal waters must be protected from undue health hazards from water quality impairment.



*Runoff Year (Apr - Mar); year identified is that which includes the majority of months in the sequence.

GOAL:

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function

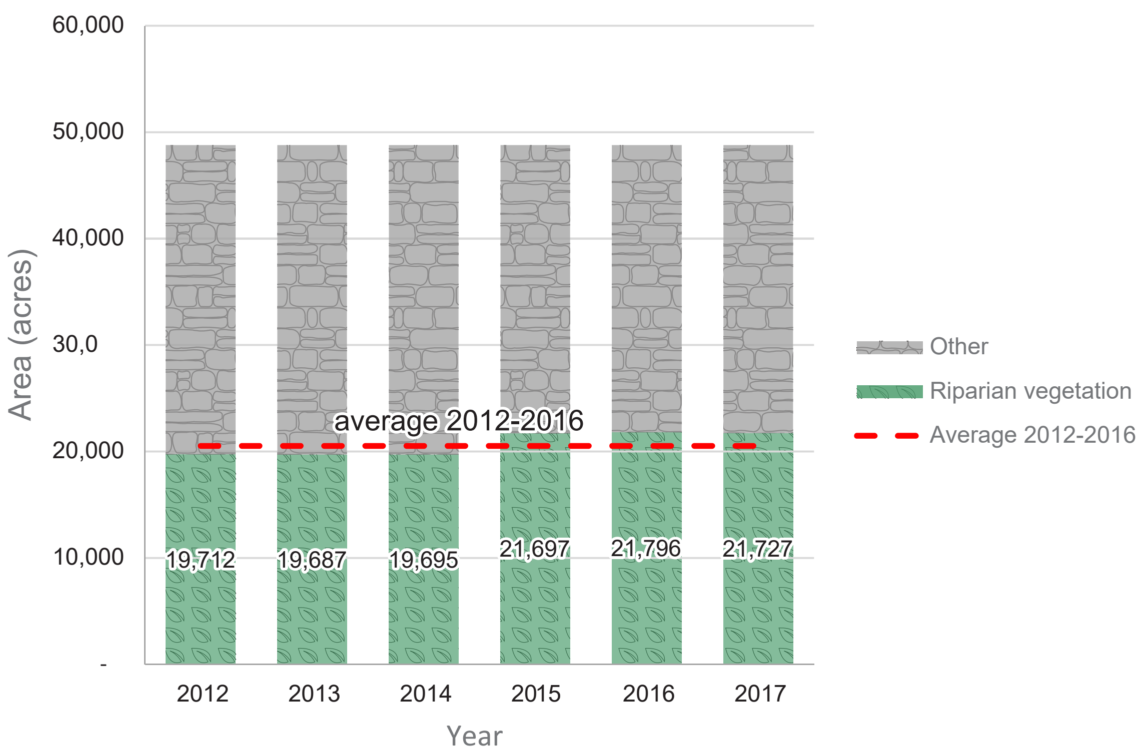
SAWPA

Indicator:	Metric:
Abundance of vegetated riparian corridor	Area of vegetated riparian corridor

- In 2017, there are an estimated 21,727 acres of vegetated riparian corridor in the watershed, which is 1,209 more acres than were estimated for the preceding five-year period, 2012-2016. Due to this significant increase in area of vegetated riparian corridor, the indicator was given a positive rating.
- Riparian vegetation covers just under half of the riparian corridors in the watershed.
- Since 2013, the conditions that formed the basis for the last OWOW Plan, the estimated area of vegetated riparian corridor in the watershed has increased by 2,040 acres.

Why Evaluate this Indicator?

Active engagement in conserving and restoring riparian vegetation is necessary to retaining and enhancing the values supported by this resource. Vegetation within the riparian corridors of the watershed provides valuable habitat for a large number of species, including those with special status. It also provides beauty and shade for people recreating alongside streams and lakes.



GOAL:

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function

SAWPA

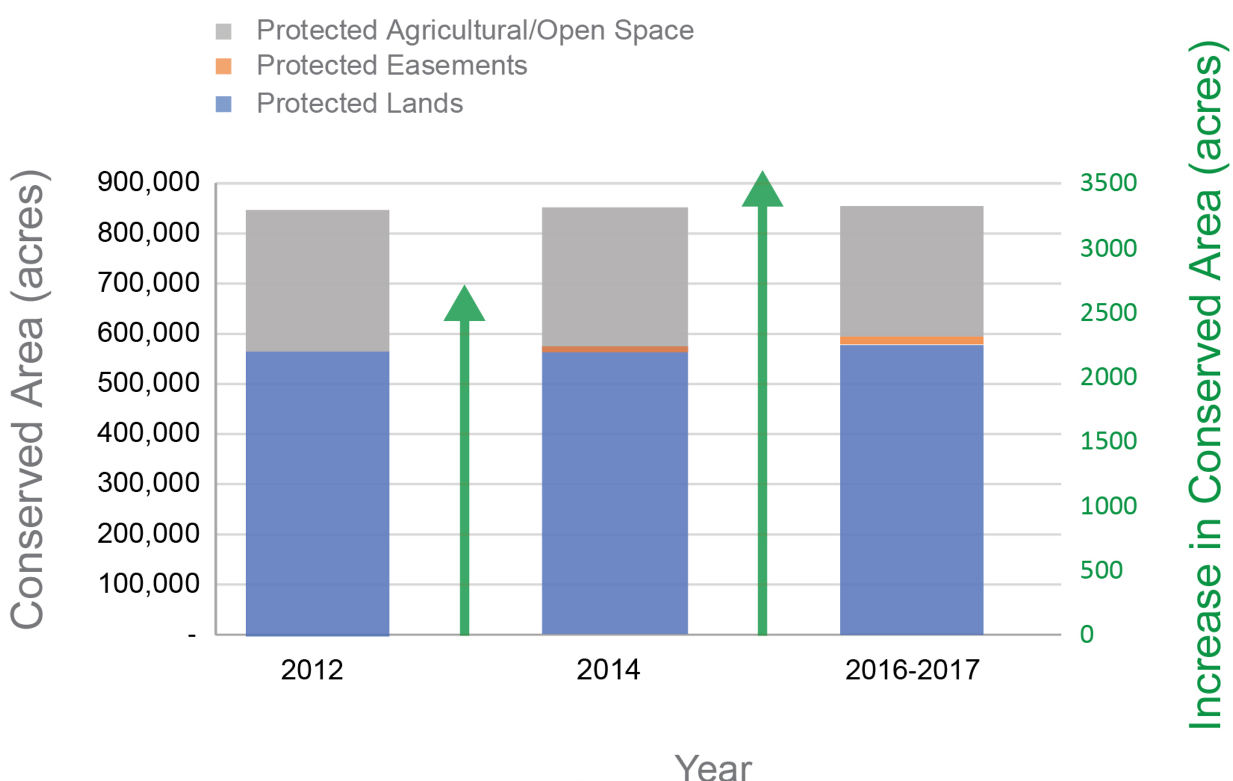
Indicator: Abundance of conserved open space

Metric: Area of conserved open space

- The estimated area of conserved open space in the watershed has increased by 3,633 acres since 2014, the most recent year for which data is available for comparison. Due to this significant increase in area of conserved open space, the indicator was given a positive rating.
- The 855,501 acres of conserved open space estimated for 2016-2017 is just under half of the area within the watershed.
- Since 2012, just before the last OWOW Plan was completed, more than 6,000 acres of conserved open space have been added to the roster of such lands in the watershed.

Why Evaluate this Indicator?

Deliberate management and protection is necessary to maintain the recreational and ecosystem values of open space.



NOTE: Protected easement data not available for 2012.

GOAL:

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed

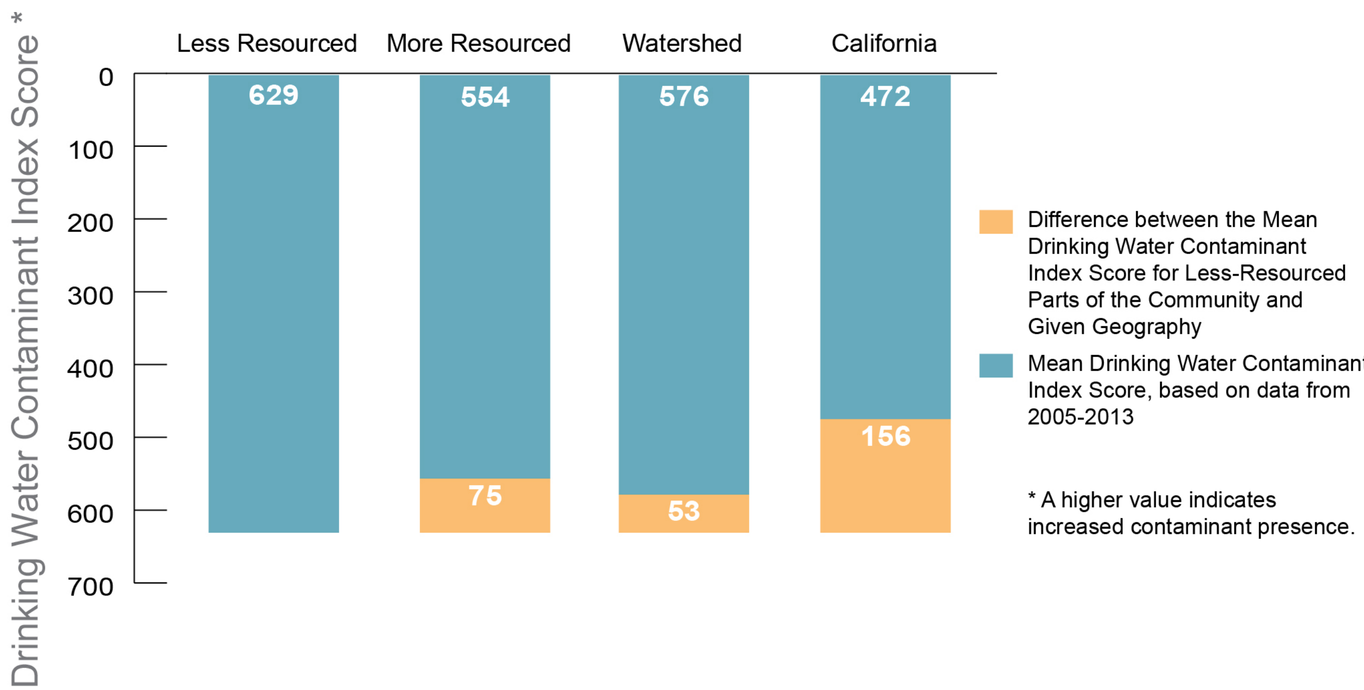
SAWPA

Indicator:	Metric:
Equitable access to clean drinking water	Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community

- Drinking water quality in less-resourced areas is somewhat worse than drinking water quality in more-resourced areas (mean drinking water quality index scores of 629 and 554, respectively), as calculated in 2017 based on 2005-2013 data. The indicator was given a qualitative neutral rating due to lack of previous data.
- No quantitative trend was assessed due to lack of previous data.
- Both the less-resourced and more-resourced parts of the community have lower drinking water quality than the statewide average (California mean drinking water quality index score is 472).

Why Evaluate this Indicator?

Ensuring that all people in the watershed have clean drinking water is essential to human health and prosperity within the watershed.



GOAL:

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed

SAWPA

Indicator:

Proportionate implementation of climate change adaptation strategies

Metric:

Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community

- The mean tree and shrub density of less-resourced residential parts of the community (9.9%) is slightly less than the tree and shrub density for the watershed as a whole and in more-resourced residential parts of the community (10.1% and 10.2%, respectively). The indicator was given a qualitative neutral rating due to lack of previous data.
- No quantitative trend was assessed due to lack of previous data.
- The mean tree and shrub density of less-resourced and more-resourced parts of the community is less than the Green View Index value for the City of Los Angeles (15.2%).

Why Evaluate this Indicator?

Targeted implementation of climate change adaptation strategies that address the potential for increased dangerous heat, a climate change impact predicted in the watershed, will reduce the extent to which vulnerable people are inequitably impacted.

Less-Resourced Areas

9.9%

62 square miles of tree and shrub area

Watershed Overall

10.1%

237 square miles of tree and shrub area

More-Resourced Areas

10.2%

175 square miles of tree and shrub area

Los Angeles

15.2%

GOAL:

Educate and build trust between people and organizations

SAWPA

Indicator:

Collaboration for more effective outcomes

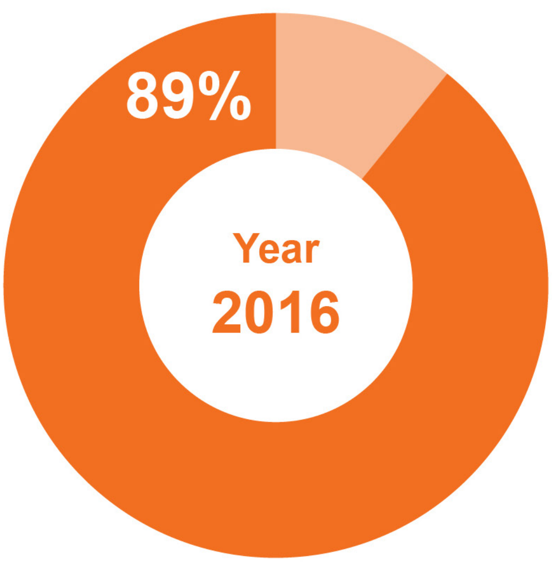
Metric:

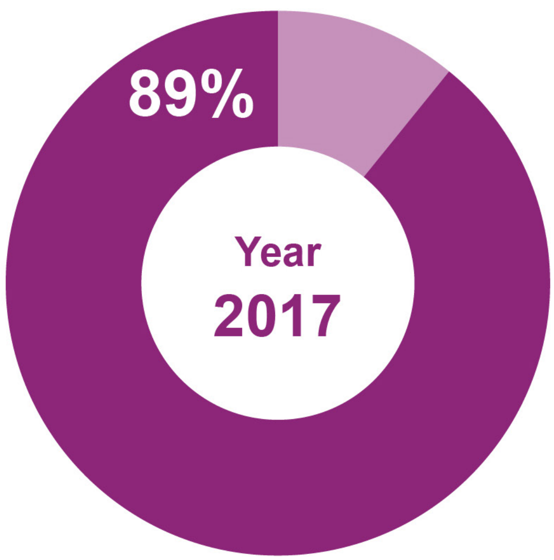
Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation

- In 2017, 89% of regulated entities participated in TMDL implementation in the watershed (based on financial or in-kind contributions), the same percentage of regulated entities participated in 2016. Based on this significant continued participation, a positive rating was given.
- Nearly all of the TMDL implementation plans are being conducted in part through a collaborative entity, such as a SAWPA Task Force or the Newport Bay Watershed Executive Committee.
- Participation has remained at about the same level since 2014 , when the last OWOW Plan was adopted.

Why Evaluate this Indicator?

Collaborative action with shared outcomes must be prioritized by water managers because many of the complex challenges facing the watershed cannot be overcome by a single organization.





GOAL:

Educate and build trust between people and organizations

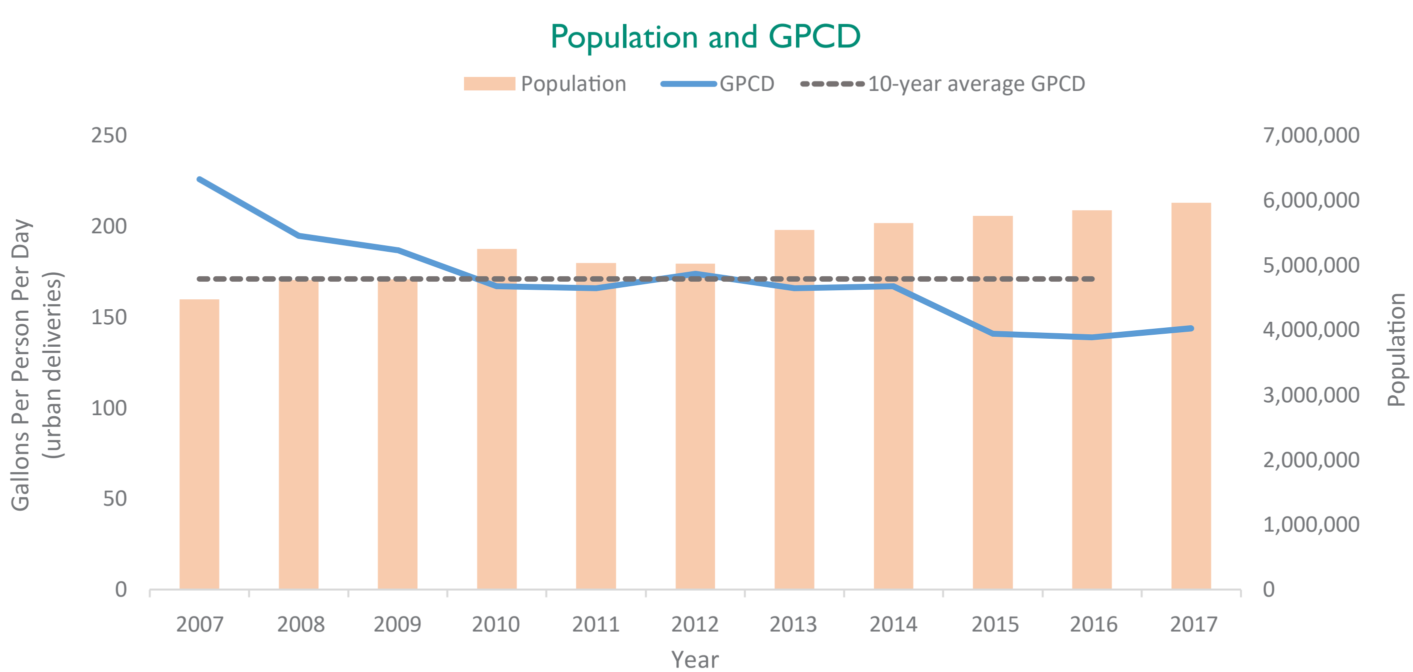
SAWPA

Indicator:	Metric:
Adoption of a watershed ethic	Total gallons of potable water used per capita per day

- Compared with the previous 10-year average, total gallons of water delivered per capita per day in the watershed in 2017 declined by 16%. Based on this more efficient water use, a positive rating was given.
- Between 2016 and 2017, the rate of water use per capita increased by about 3%.
- Since 2013, when the OWOW 2.0 Plan was drafted, the rate of water use per capita has declined by 13%.

Why Evaluate this Indicator?

Helping conservation become a way of life in California involves education and civic action. As more water users learn how precious our water and watershed are, many of the challenges will be more easily overcome. Total GPCD was the metric selected for this indicator because the data is available and its value is moderately responsive to management actions.



GOAL:

Improve data integration, tracking and reporting to strengthen decision-making

SAWPA

Indicator:

Broaden access to data for decision-making

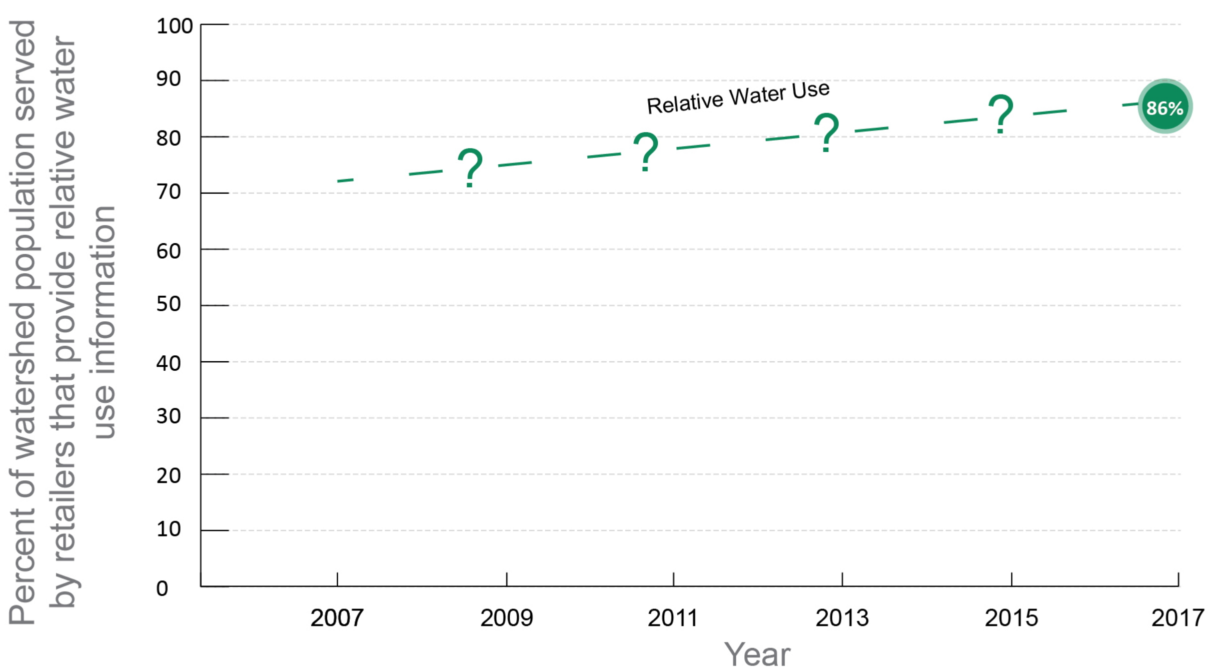
Metric:

Percent of watershed population in agencies whose residential customers receive relative performance information about their water use

- 86% of watershed's population are served by retailers that provide residential customers information on their bill about how their current water use compares to past water use and/or water use budgets or targets.
- Data about the relative water use information provided in previous years was not readily available from the retailers so only a qualitative trend assessment can be made.
- Since 2014 adoption of the OWOW Plan, increased adoption of budget-based rates as well as drought water use restrictions stimulated retailers to provide more relative water use information to residential customers. On this basis, a qualitative positive rating was given.

Why Evaluate this Indicator?

Everyone who uses water is a decision-maker. Informing people how they are using water relative to past and/or budgeted use, will improve decisions, increase efficiency, and make us more resilient.



GOAL:

Improve data integration, tracking and reporting to strengthen decision-making

Indicator:

Participation in an open data process

Metric:

Percent of watershed population in agencies participating in establishment of a regional data sharing system

- Sufficient quantitative data was not available to assess this metric, and qualitative information was not available to determine whether the rating should be positive or negative. The metric was therefore given a qualitative neutral rating. Assessment of this metric can start to occur when water management agencies in the SAWPA region commit to the establishment of a regional trust framework needed for data sharing and management.
- The majority of the watershed population are in wholesale and retail water supply agencies that have taken initial steps to establish regional data sharing by engaging with the implementation of the Open and Transparent Water Data Act (AB 1755) and/or participating in the California Data Collaborative.
- Progress since 2014 adoption of the OWOW Plan includes the 2016 passage of AB 1755 and the development of the recommendations in the Data Management Pillar in the OWOW 2018 update.

Why Evaluate this Indicator?

Our ability to create data is outstripping our ability to make effective use of it. Ensuring that data produced is meaningful, is applied to decision-making, and is shared freely without jeopardy is a critical next step for the management of the watershed's supply and demand.

Insufficient Data

ATTACHMENT A
Assessment Implementation Sheets

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Achieve resilient water resources through innovation and optimization	
INDICATOR	METRIC
Maximization of locally-managed supplies	*Percent of total annual supply sourced or managed locally*

Implementation Approach

This indicator and associated metric attempts to quantitatively assess progress on regional and local water management efforts to become more resilient, given the changing climate and the resulting increased variability in imported water supplies. These efforts include increasing recycled water use to replace and increase potable supplies, increasing recovered groundwater, increasing utilization and recharge of surface water runoff, optimizing local groundwater basin storage and utilization with coordinated operation and wetter year recharge of imported supplies, and demand reduction measures. The metric quantifies the locally-sourced supply for the retailers in the watershed plus the water recharged into groundwater basins, including water imported in wetter years used for groundwater recharge (i.e., imports not immediately used to meet retailer demand as this becomes a locally managed supply for later use), on an annual basis. The summed annual production and recharge is divided by the total annual production and recharge (including imported water to meet retailer demand) to calculate the percentage of total supply met from the locally-managed supply. The primary source for the retail supplier production is the State Water Resources Control Board's Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR). Groundwater recharge data can be obtained from wholesalers, special districts, flood control agencies, and watermasters of adjudicated groundwater basins.

Output

The metric output is the percentage of the watershed's total annual supply, including recharge, that is met by locally-sourced and -managed supply, including recharge as defined above.

Data Sources

The retailer supply data was limited to the 53 retail water suppliers that have over 3,000 water meters or that serve customers over 3,000 acre-feet of potable water (i.e., retailers required to prepare Urban Water Management Plans); these 53 retailers serve nearly 98% of the Santa Ana River watershed's population.[1] The primary data source for the retailer supply prior to 2013 is the Department of Water Resources (DWR) voluntary Public Water System Statistics (PWSS) Survey.[2] Starting in 2013, the PWSS data was extracted from the mandatory data reports filed by drinking water suppliers to the SWRCB Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR). The EAR form requires retailers to report their monthly and

[1] San Antonio Water Company (SAWCO) also files an Urban Water Management Plan. They wholesale water to qualifying retailers in the Inland Empire Utility Agency service area, but this agency was not included in the current retailer supply compilation. IEUA's annual water use report quantifies the sales and transfer of surface and groundwater to the IEUA retailers.

[2] The PWSS survey data is used for the regional water supply and demand balances in the California Water Plan. See https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Public-Water-Systems-Statistics-Surveys.

Achieve resilient water resources through innovation and optimization	
INDICATOR	METRIC
Maximization of locally-managed supplies	*Percent of total annual supply sourced or managed locally*

annual calendar year supply (disaggregated by the groundwater, surface water, untreated, recycled production, purchased water, and sales to other agencies) and metered water deliveries by customer class.

Detailed Implementation Steps

A detailed description of the implementation steps is not provided since the quantitative metric assessment could not be completed with current and historic data due to data deficiencies. Improvements in the systems used to capture data is expected to allow assessment of this metric in the future.

Once metric quantification is possible, trend assessment should compare current data to recent historic data by using the average value for the previous ten years to define recent historic conditions. This approach will help to distinguish variability in water supply due to annual water availability fluctuation from progress in increasing locally-sourced supply.

Implementation Challenges

The calculation of the metric is a percentage of total supply calculation once the data is compiled and accurately disaggregated by the source. Nonetheless, compiling accurate data can be quite challenging. In the 2007 to 2012 period, the PWSS survey did not have data for 6 to 7 of the 53 retailers.[3] The SWRCB EAR does not provide sufficient guidance for the retailers to report their supply sources in a consistent manner. Many of these discrepancies can be seen when comparing the data in the EAR reports with the data reported for a comparable year in their Urban Water Management Plans (UWMPs). Inconsistencies in the data reported to the EAR (described in more detail in the Implementation Challenges section below) stymied the assessment of this metric.

Observations about the EAR dataset made during the conduct of the current assessment include the following:

1. While most retailers report their imported water as purchased water, it appears that some of them report their purchased water as surface water production (reflecting perhaps that the source is from surface runoff to the Delta).[4]

2. Most retailers report groundwater from the desalters, which pump, treat, and sell saline groundwater, as purchased water, and thus it is lumped with the imported water.

3. Some, but not all, retailers report local surface supplies as purchased water while others report it as surface water.

4. At least one retailer that is also a wholesaler reported purchases and sales that appear to result in double-counting when compared to their retailer reports.

3 The missing retailer data in the 2007-2012 period was not for the same set of 6 or 7 retailers in each year.

4 The retailers in Orange County that purchase imported water directly from MWD reported their purchases as surface water. The reporting of each of the 53 retailers, however, was not examined in detail.

Achieve resilient water resources through innovation and optimization	
INDICATOR	METRIC
Maximization of locally-managed supplies	*Percent of total annual supply sourced or managed locally*

5. The EAR also has an "untreated" supply category which can be over 60 thousand acre-feet in some years, but it does not designate the source of that water.

6. The recycled production cannot be not disaggregated to determine whether it is sold to other users, or used for other purposes, such as to offset potable uses (e.g., landscaping), or used for habitat.

In addition, both the EAR and PWSS had quality control issues, with approximately 10 percent of the retailers having records requiring adjustment. In some cases, reported monthly totals and annual totals did not align. Some data values were clear outliers, potentially indicating inaccurate data entry. Units were also sometimes mismatched (for example, gallons entered into a column which should have been reported in acre-feet).

Results

Because the SWRCB Drinking Water annual report form had incomplete information for the retailers' supply reporting, resulting in numerous data inconsistencies, and procuring 2007 to 2017 data from the individual retailers was not feasible, no quantitative results are provided for this metric for either current or recent historic conditions.

Trend Discussion

While a more complete picture of locally-sourced or locally-managed supplies for the Santa Ana River watershed is not available, partial and regional data suggest that this metric may be increasing. Data from individual SAWPA wholesalers and for the larger MWD service area from the last 10 years indicate an increasing use of locally-managed supplies resulting from the investments in increased recycled water and groundwater recovery production in combination with demand reductions in this region.

For the current assessment, where data is lacking to show a trend, a qualitative neutral status is identified as the rating.

Going Forward

A cooperative effort by the watershed's water supply and management agencies, in concert with the State and local agencies to whom the data is reported, is needed to produce the quality data to quantitatively assess this metric. Currently there are opportunities and alignment of interests to rectify the data issues that inhibit the efficient quantification of this metric. DWR relies upon the retailer data reported to the SWRCB EAR for the regional water supply and demand assessments for the California Water Plan. DWR is aware of the data issues with the SWRCB EAR and the time-consuming effort to extract and confirm quality of the data for the California Water Plan and regional efforts, such as the OWOW Plan Update 2018. In addition, DWR is promoting and supporting regional data management efforts to develop indicators of sustainability, such as these OWOW indicators, as part of their implementation of the Open and Transparent Water Data

Achieve resilient water resources through innovation and optimization	
INDICATOR	METRIC
Maximization of locally-managed supplies	*Percent of total annual supply sourced or managed locally*

legislation (AB 1755).[5] DWR efforts align with OWOW plan goals to improve data integration, tracking and reporting as well as the Data Management Pillar's recommendations to establish data management and trust frameworks. Because of these alignments and opportunities, it is recommended that the watershed's water supply and management agencies engage with the State and regional agencies to whom the supply and demand data is reported to help produce quality data for this metric.

Assuming the retailer supply data reported SWRCB EAR can be accurately disaggregated by source, the data should be evaluated for consistency with comparable data reported in Urban Water Management Plans and wholesaler and watermaster annual reports. Individual wholesalers, such as Inland Empire Utility Agency (IEUA), compile annual reports with supply and demand data for their retailers, but it was not feasible in the allotted time for this assessment to determine if the wholesalers generally would be a source of retailer supply data. The groundwater recharge data sources—wholesalers, flood control agencies, special districts, and watermaster reports—were not examined for this effort once it became apparent that the data challenges would prevent metric analysis. Compilation of the groundwater recharge data will require careful evaluation for consistency with other regional reports reporting similar data.

References

Department of Water Resources (DWR), Public Water Systems Statistics Data from 2007 to 2016.

State Water Resources Control Board (SWRCB), Large Water System Drinking Water Program Electronic Annual Report, data for 2017.

5 As part of AB1755, DWR is also supporting efforts to automate some of the quality control review, such as mismatched units, which are not unusual and can be detected and corrected with software developed for those purposes.

Achieve resilient water resources through innovation and optimization	
INDICATOR	METRIC
Efficiency of outdoor water use	*Proportion of watershed population in agencies using parcel-level data to assess outdoor water use*

Implementation Approach

This indicator focuses on outdoor water use from landscape irrigation because it is estimated to be the largest source of demand in the SAWPA watershed. Parcel-level data can be obtained using tax assessor parcel databases and with aerial imagery. For this assessment, the metric evaluated participation in SAWPA's procurement and distribution of parcel-level vegetation data for the Santa Ana River watershed in the 2015-2017 period. The metric is currently limited to a one-time measurement of program participation by the water supply agencies.

Output

The output for this metric is expressed as the percentage of the total watershed population served by agencies that had license agreements with SAWPA to receive the parcel level imagery and vegetation data.

Data Sources

In 2015 SAWPA procured high-resolution aerial imagery of the watershed. That imagery in combination with high-accuracy land survey and parcel data was analyzed to produce accurate measurements of landscape vegetation for the 1.4 million urbanized parcels within the Santa Ana River watershed. This data was made available to retail and wholesale water suppliers and other water management agencies in the watershed. The data was distributed in 2016 and 2017 to the agencies which had a license agreement with SAWPA.

The population of the participating retail agencies was obtained from the population reported to the State Water Resources Control Board (SWRCB) Large Water System Drinking Water Program Electronic Annual Report. Wholesalers and SAWPA member agency population was obtained from the websites of the individual wholesalers and SAWPA.

Detailed Implementation Steps

This initial effort was a straightforward process of obtaining from SAWPA the list of wholesale and retail water suppliers who had license agreements to receive the imagery and landscaped vegetation measurements. The metric calculation involved summing the population of the participating agencies and dividing it by the watershed population. A separate calculation was made for the participating retail suppliers and for the wholesalers and SAWPA member agencies.

Implementation Challenges

This indicator and metric initially intended to survey all 53 qualifying retailers and the wholesalers in the watershed to assess whether they were using or had used any kind of parcel-

Achieve resilient water resources through innovation and optimization	
INDICATOR	METRIC
Efficiency of outdoor water use	*Proportion of watershed population in agencies using parcel-level data to assess outdoor water use*

level data to quantify landscape water use and measures to improve its efficiency. The qualifying retailers are those which had over 3,000 water meters or that served customers over 3,000 acre-feet of potable water (i.e., retailers required to prepare Urban Water Management Plans). That effort was not undertaken in this initial effort because of time constraints.

Results

TABLE A.2-1
PROCUREMENT OF SAWPA AERIAL IMAGERY AND PARCEL-LEVEL VEGETATION DATA

Entity Type	Number of Entities	Percent of watershed population served
Wholesale water suppliers, SAWPA member agencies	6	95%
Retail water suppliers	36	74%

By 2017, all five SAWPA member agencies (four wholesalers and the Orange County Water District) plus the Municipal Water District of Orange County (wholesaler), which together serve 95% of the watershed's population, requested the SAWPA-procured 2015 aerial imagery and data. The imagery and data was also requested by 36 retail water suppliers, which serve 74% of the watershed's population. Although this effort did not systematically survey all the water agencies on the use of the data, information provided by SAWPA indicated that 16 of the participating retailers (nearly half) used the data to assess parcels for rate structure investigations.[1]

Trend Discussion

This effort provided a one-time snapshot of the participation in the SAWPA program to procure and distribute parcel-level data. No quantitative information was obtained on participation in SAWPA's cooperative program to procure aerial imagery in previous years; therefore, only a qualitative trend assessment can be made. Previous OWOW plans identified the need to shift the focus of water efficiency programs from indoor to outdoor water use. SAWPA is a leader in leveraging resources and providing support for regional water use efficiency efforts. In a September 2018 report to the Southern California Water Committee, the California Data Collaborative cited SAWPA's cooperative purchasing program for aerial imagery as an example of overcoming technology barriers through collaboration (p.30)[2]:

> Beginning in 2007, SAWPA has procured aerial imagery on behalf of the Santa Ana watershed, allowing local jurisdictions to utilize the imagery and analysis for water-related research and planning. In order to determine the watershed's imagery needs, SAWPA collects information from jurisdictions to understand the imagery requirements with regard to resolution and use before putting together a series of specifications for vendors. SAWPA is

1 10 of the 16 agencies adopted or are in the process of adopting water budget-based rate structures.

2 California Data Collaborative 2018 California water efficiency: leading the way into the future: A report to the SCWC Water Energy Task Force September 10 2018.

Achieve resilient water resources through innovation and optimization	
INDICATOR	METRIC
Efficiency of outdoor water use	*Proportion of watershed population in agencies using parcel-level data to assess outdoor water use*

able to tell each participating agency the precise costs for a variety of imagery options, allowing them to make an informed decision based on their available budgets. SAWPA is then able to charge a small administrative fee of 2.5% to participating agencies, far lower than the savings enjoyed through the cooperative purchasing process alone.

Going Forward

This effort did not survey the water management agencies to determine how they used the imagery and whether other parcel-level data is used for managing outdoor water use and developing conservation rate structures. A more complete assessment of the watershed's use of parcel-level data, by surveying retailers and wholesalers in the watershed, is recommended.

Although this effort only resulted a one-time snapshot, it provides the potential to identify a trend, given SAWPA's decade-long history of aerial imagery procurement and continued development and expansion of their program. SAWPA is currently developing an online web application and cloud services to provide water retailers access to aerial imagery and landscape measurement data.

References

State Water Resources Control Board (SWRCB), Large Water System Drinking Water Program Electronic Annual Report, data for 2017.

California Data Collaborative, California water efficiency: leading the way into the future: A report to the SCWC Water Energy Task Force September 10 2018.

Ensure high quality water for all people and the environment.	
INDICATOR	METRIC
Maintenance of groundwater salinity at or below target levels	*Non-exceedance of groundwater salinity standards*

Implementation Approach

The salinity of groundwater is evaluated using the water quality modeling analysis conducted for the Triennial Basin Plan review for the Santa Ana Regional Water Quality Control Board (RWQCB). This analysis is used to establish the assimilative capacity for salt, or the ability to accept additional salt inputs without impairing water quality, for 37 different groundwater management zones within the Santa Ana River watershed. This is determined by the difference between estimated ambient water quality in terms of total dissolved solids, or TDS, and a water quality target established for each groundwater management zone. Ambient water quality shown for any given year is based on data for the 20 years prior to and including that year. The water quality target established for each groundwater management zone was set at the greater of the following: the water quality objective (WQO) established by the RWQCB, or 500 mg/l of total dissolved solids. Where established, the "maximum benefit" WQO was used as the WQO. The 500 mg/l criterion was adopted as the recommended maximum criterion for consumer acceptance established by the State. This criterion protects all municipal beneficial uses.

Conditions for each groundwater management zone were considered "good" if water quality objectives were substantially met and "bad" if they were not, for both recent and prior conditions. The evaluation was then made to determine whether the sequencing of prior to recent conditions warranted a positive, neutral, or negative trend result according to **Table A.3-1**.

TABLE A.3-1
GOOD-BAD ASSESSMENT SYSTEM

Prior Conditions	Recent Conditions	Result
GOOD	GOOD	+1
BAD	GOOD	+1
GOOD	BAD	-1
BAD	BAD	0 (if appreciably better)
BAD	BAD	-1 (if similar or worse)

The trend results were then weighted by the volume of groundwater estimated in storage in each groundwater management zone. Weighted results were then totaled to produce an overall score, which was rated using the criteria shown in **Table A.3-2**.

Ensure high quality water for all people and the environment.	
INDICATOR	METRIC
Maintenance of groundwater salinity at or below target levels	*Non-exceedance of groundwater salinity standards*

TABLE A.3-2
RATING SYSTEM

Result	Criterion
Positive	Score ≥ 0.50
Neutral	0.40 < Score < 0.50
Negative	Score ≤ 0.40

Output

The targeted output for each metric is a weighted average "good/bad"-based score for all current groundwater management zones under current conditions.

The "good/bad"-based scoring system is reflective of trends but configured to highlight conditions status relative to regulatory or generally-accepted water quality standards. If those standards are met, conditions are considered to be "good." This approach is considered more appropriate than suggesting that continued improvement beyond those standards was needed, as a simple trend analysis might imply.

Data Sources

The salinity of groundwater was evaluated using the analysis conducted for the Triennial Basin Plan review, specifically the Triennial Recomputation of Ambient Water Quality for the Santa Ana River Watershed for the Period 1996-2015 (DBS&A 2017), available at: https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/SMP/2017/AWQ-Tech-Memo_9-22-2017.pdf. Table 2-2 in this document provided estimated groundwater volumes used for weighting the results, while Table 3-1 in the document provided WQOs, assimilative capacity, and salinity over time, expressed as Total Dissolved Solids, or TDS.

In all cases, the "maximum benefit" water quality objectives were used for the basins that had them.

Detailed Implementation Steps

Analyses prepared to support the Triennial Review of the Basin Plan for salinity were reviewed to obtain the needed salinity data. TDS concentrations in each of the groundwater management zones for the most recent analysis (representing ambient conditions for the 20-year period ending in 2015) were evaluated to determine whether water quality targets were met. If so, a condition assessment of "good" was made for that basin. If not, the condition assessment was "bad."

A prior triennial estimate of ambient conditions was then assessed. Because each triennial assessment represents the ambient conditions of the preceding 20-year period, the 2015 analysis represents the period from 1996-2015. The triennial estimate ending halfway through the 20-year period of this most recent assessment (2006) was therefore selected for historical comparison, so that the two periods being compared have only 10 years of overlap. The TDS concentrations from the 2006 triennial assessment, covering the years 1987-2006, were compared to the water quality

Ensure high quality water for all people and the environment.	
INDICATOR	METRIC
Maintenance of groundwater salinity at or below target levels	*Non-exceedance of groundwater salinity standards*

targets; if that standard was met in a given zone, then recent historic conditions were assessed as "good." If not, they were assessed as "bad."

The most recent assessment results were then compared to those representing recent historic conditions to generate results per Table A.3-1. For the purposes of applying Table A.3-1, a score had to improve by more than 10 milligrams/liter to be considered "appreciably better." Those results were then weighted by groundwater volume and summed to provide the overall score for the metric. Weights for the results were established using groundwater volumes from Table 2-2 of the DBS&A report (2017).[1] The score was then evaluated using the criteria in Table A.3-2.

Implementation Challenges

The primary challenge associated with evaluating this metric is that data are only generated every three years, and then only for a period ending two years prior to the year in which values are published. Thus, annual updates may not be possible, and assessments may always rely on data from conditions two or more years prior to the current year.

An additional challenge is that some water quality estimates are missing. Because the basins that lacked enough data were assumed to be less important sources of water supply, basins missing an estimate of water quality under historic or current conditions were omitted from the analysis. Only 29 out of 37 groundwater management zones had enough data to produce findings.

Results

TABLE A.3-3
FINDINGS

Time Frame	Good Conditions	Bad Conditions
Current (1996-2015)	16 zones	13 zones
Recent Historic (1987-2006)	19 zones	10 zones

Using the findings above in **Table A.3-3** and the rubric established in Table A.3-1, results were generated for each groundwater management zone and modified by applying weights based on the groundwater volume in storage within each management zone. When these results were summed, a score of 0.53 was produced. This score yields a positive rating, based on the Rating System defined in Table A.3-2.

Trend Discussion

Because more than half (53 percent) of the groundwater volume in the groundwater management zones of the Santa Ana River watershed exists in four of the groundwater management zones, the

1 An exception was made for the Orange County groundwater management zone, which was weighted using its active management volume of 500,000 acre-feet (OCWD, 2015) instead of the modeled aquifer volume of 23,600,000 acre-feet.

Ensure high quality water for all people and the environment.	
INDICATOR	METRIC
Maintenance of groundwater salinity at or below target levels	*Non-exceedance of groundwater salinity standards*

score for this metric will be primarily driven by what happens in these four groundwater management zones: Beaumont, Bunker Hill-B, Chino-North, and Irvine. In the current analysis, all but Irvine were found to warrant a positive rating, helping to keep the overall rating in the positive zone. The decline in the number of groundwater management zones in good condition from recent historic to current conditions, a drop from 19 to 16, may be due in significant part to the reduction in both natural recharge and use of imported water for groundwater recharge during the 2011-2016 drought.

Historical ambient water quality conditions in the groundwater management zones (based on 1954-1973 data) were typically better than current conditions.

Going Forward

The use of a 500,000 acre-foot management volume for the Orange County Groundwater Management zone should be revisited for appropriateness.

It may be possible to obtain information prior to the publication of the supporting analysis for the triennial review sufficient to perform analysis of this metric more often than once every three years—provided it is determined prudent to perform an assessment based on pre-publication data. The Triennial Review analysis of the 1999-2018 period may begin in late 2017 or early 2018 and may begin with the review of recent monitoring results that may be sufficient to allow 2016, 2017, or 2018 data to be assessed on an interim basis relative to historic assessment results, prior to the completion of modeling analysis. This opportunity can be evaluated.

The hypothesis that a 10-year period of non-overlap between 20-year periods of estimated ambient water quality is appropriate to use for a water quality trend analysis can also be revisited.

References

Daniel B. Stephens & Associates, Inc. [DBS&A]. 2017. Technical memorandum: Recomputation of ambient water quality in the Santa Ana River Watershed for the Period 1996 to 2015. Prepared for the Santa Ana Watershed Project Authority Basin Monitoring Program Task Force under contract.

Orange County Water District [OCWD]. 2015. Groundwater Management Plan 2015 Update, June 17.

Ensure high quality water for all people and the environment	
INDICATOR	METRIC
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

Implementation Approach

The safety of water for contact recreation was evaluated using routinely-collected monitoring datasets collected for inland and coastal water quality at sites used for recreation involving water contact. Conditions at each site were considered "good" if water quality objectives were substantially met and "bad" if they were not, for both recent and prior conditions. The evaluation was then made to determine whether the sequencing of prior to recent conditions warranted a positive, neutral, or negative trend finding according to **Table A.4-1**.

TABLE A.4-1
GOOD-BAD ASSESSMENT SYSTEM

Prior Conditions	Recent Conditions	Result
GOOD	GOOD	+1
BAD	GOOD	+1
GOOD	BAD	-1
BAD	BAD	0 (if appreciably better)
BAD	BAD	-1 (if similar or worse)

The "good/bad"-based scoring system is reflective of trends but configured to highlight conditions status relative to regulatory or generally-accepted water quality standards. If those standards are met, conditions are considered to be "good." This approach is considered more appropriate than suggesting that continued improvement beyond those standards was needed, as a simple trend analysis might imply. The good-bad assessment results were then averaged to produce an overall score (Score = Average of the findings), which was rated using the criteria in **Table A.4-2**.

TABLE A.4-2
RATING SYSTEM

Rating	Criterion
Positive	Score ≥ 0.80
Neutral	0.60 < Score < 0.80
Negative	Score ≤ 0.60

Separate scores are produced for inland and coastal water quality, separate ratings established, and then combined, using equal weighting for each. To combine the ratings for coastal and inland areas, the following system is applied:

Ensure high quality water for all people and the environment	
INDICATOR	METRIC
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

- Positive trend: One score shows a positive trend and the other score shows a positive or neutral trend.
- Neutral trend: Either both scores show a neutral trend or one is positive and one is negative.
- Negative trend: One score shows a negative trend and the other score shows either a negative or neutral trend.

Output

The targeted output for each metric is an average "good/bad"-based score for all current sites under current conditions.

Data Sources

Inland water quality monitoring data and compliance analysis was obtained from the Santa Ana River Watershed Bacteria Monitoring Program Annual Report (accessible from https://www.waterboards.ca.gov/santaana/water_issues/programs/planning/Bacteria_Monitoring_Program.html). Coastal water quality information is based on data and analysis used to generate the *Beach Report Card* (the 2017-2018 report is accessible at https://healthebay.org/wp-content/uploads/2018/07/BRC_2017-2018_07-12-18.pdf) and was obtained directly from Heal the Bay.

Inland water quality

The inland water quality monitoring data used for this metric was that associated with high-frequency use primary contact recreation sites, which are designated as Priority 1 sites and REC1 Tier A waters in the Santa Ana River Basin Plan.

> Eight monitoring sites, identified as REC1 Tier A waters, are included for Priority 1 monitoring. This includes four lakes: Big Bear Lake, Lake Perris, Canyon Lake, and Lake Elsinore; and four flowing water sites: SAR Reach 3 (two sites), Lytle Creek, and Mill Creek Reach 2. Five sites are located in Riverside County and two sites are located in San Bernardino County.
>
> …
>
> Dry weather sample collection occurs during both warm, dry (April 1 – October 31) and cool, wet (November 1 – March 31) season periods…. Priority 1… sites were monitored weekly for twenty consecutive weeks during the warm, dry season and for five consecutive weeks during the cool, wet season.
>
> …
>
> The compliance analysis compares the E. coli geomeans to the Santa Ana Basin Plan geomean WQO of 126 MPN/100 mL.
>
> (SAWPA, 2018)

Ensure high quality water for all people and the environment	
INDICATOR	METRIC
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

Notes:

1. SAR stands for Santa Ana River.
2. A geomean or geometric mean is the *n*th root of the product of *n* numbers.
3. WQO stands for Water Quality Objective.
4. MPN stands for Most Probable Number, or the count of organisms present. The acronym "mL" stands for milliliters, or a one thousandth of a liter.

Because there are so few sites, they are identified in **Table A.4-3** below.

TABLE A.4-3
INLAND WATER QUALITY SITES

Site ID	Name
P1-1	Canyon Lake at Holiday Harbor
P1-2	Lake Elsinore
P1-3	Lake Perris
P1-4	Big Bear Lake at Swim Beach
P1-5	Mill Creek Reach 2
P1-6	Lytle Creek (Middle Fork)
WW-S1	Santa Ana River Reach 3 at MWD Crossing
WW-S4	Santa Ana River Reach 3 at Pedley Avenue

More details on the methodology and basis for the site selection are available in the Annual Report.

Coastal water quality

Coastal water quality scores were based on more than 50 monitoring sites along the coast of the watershed compiled in the Beach Report Card. The Beach Report Card uses data compiled from "routine beach water quality sampling conducted by county health agencies, sanitation departments, and dischargers. Water samples are analyzed for three fecal indicator bacteria (FIB) that indicate pollution from numerous sources, including human and animal waste. These FIB are total coliform, fecal coliform (Escherichia coli), and Enterococcus spp." These data are analyzed for three different time periods over the April-March period:

- Summer dry season (April-October)
- Winter dry season (November – March)
- Year-round wet conditions (April – March)

Based on the monitoring data, a score of A+, A, B, C, D, or F is given to each site for each of the three seasons identified above. The assessment used only the dry season scores, as these are more indicative of conditions that affect most beachgoers.

Ensure high quality water for all people and the environment	
INDICATOR	METRIC
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

More details on the methodology and basis for the site selection are available in the annual Report Card.

The assessment approach used for both beach and inland sites relies on determining, for each site, whether improvements or degradation have occurred based on a comparison of current (as recent as available) versus prior period conditions. As a roll-up score, the average finding (for all positive, neutral, and negative findings) is used to generate a score. The beach and inland water quality findings are each assessed independently.

Detailed Implementation Steps

Inland water quality

The most recent Santa Ana River Watershed Bacteria Monitoring Program Annual Report was reviewed for its dry weather *E. coli* Priority 1 site results. "Good" scores were assigned to all sites with readings over the course of the year that produce a geomean exceedance frequency of 0% **-** 10%. A finding of "bad" was assigned to all other sites.

The most recent results were compared to those of the prior year to generate findings according to **Table A.4-1** and then those findings were averaged to produce a score. The score was then evaluated using the criteria in **Table A.4-2**. For the purposes of applying Table A.4-1, a score must improve by more than 10% to be considered "appreciably better."

Because dry weather flows are not expected to vary significantly due to year-to-year hydrologic variability, and because the current sites have only been evaluated and reported on in a consistent fashion for two years, prior year findings were used as a point of comparison instead of comparing to a multi-year average of prior year findings.

Coastal water quality

The most recent Beach Report Card evaluation was obtained for the relevant sites. Values are assigned as shown in **Table** A.4-**4**.

TABLE A.4-4
BEACH GRADES AND VALUATION

Grade	Numeric Range	Value
A, A+	100%-90%	4
B	89%-80%	3
C	79%-70%	2
D	69%-60%	1
F	<60%	0
–	–	0

Ensure high quality water for all people and the environment	
INDICATOR	METRIC
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

A grade of A or A+ receives an assessment of "good"; all other grades receive an assessment of "bad." The current assessment was then compared to the average value of dry season grades for the prior 3 years. For this multi-year average of two grades per year, any value of 7 or above was considered "good."

The most recent results were compared to those of the prior year to generate findings according to Table A.4-1 and then those findings were averaged to produce a score. The score was then evaluated using the criteria in Table A.4-2. For the purposes of applying Table A.4-1, a score had to improve by more than one point in value, equivalent to one letter grade, to be considered "appreciably better."

Implementation Challenges

1. For both inland and coastal water quality, data bridges the calendar year—each report runs from April through March—which is not fully consistent with the time periods assessed for other metrics.

2. For both data sets, changes in location and the approach to assessing data can be expected to occur from time to time. This was addressed by using only reasonably consistent datasets for comparison and was not seen to be a significant impediment in the current assessment.

3. A limited data set was available for each metric, as both sites and methodologies have evolved over time. For inland water quality, data was available for only the two most recent years. This was determined to be adequate, as dry season water quality is hypothesized to not be significantly affected by hydrologic variability. For coastal water quality, data was available for both summer and winter dry periods for only four years, allowing only a 3-year average as a point of comparison for trend analysis between current and recent historic conditions.

4. The coastal data set is missing some grades. These were assessed as having zero value, consistent with an "F" grade.

Results

TABLE A.4-5
ASSESSMENT RESULTS AND RATING

Metric	Score	Rating
Inland	0.63	Neutral
Coastal	0.81	Positive
Combined		**Positive**

Trend Discussion

Inland water quality

Six out of eight inland water quality sites showed "good" results for both the 2017-2018 and 2016-2017 assessment years, with both the Santa Ana River sites producing results that were

Ensure high quality water for all people and the environment	
INDICATOR	METRIC
Safety of water for contact recreation	*Percentage of monitored sites where recreational use is likely and identified as low risk due to bacterial contamination*

classified as "bad." However, one of the two sites exhibited significantly reduced (improved) exceedance values, dropping from 82% to 53%.

While a longer-term comparable dataset is not readily available, experts note that while measured bacteria concentrations have been increasing, the total load has not been, even as population has continued to grow. A significant driver in those concentration increases has been the increase in stormwater and recycled water diversions for groundwater recharge (Tim Moore, personal communication).

Coastal water quality

A total of 49 out of 58 or 85%of coastal water quality sites were identified as having "good" water quality in 2017-2018, compared to 41-49 or 71 – 85% of sites in the preceding three years (2014-2017). Only two sites identified as having "bad" water quality in 2017-2018 had failed to improve appreciably, compared to average conditions over the prior three years.

Going Forward

Inland water quality results should be scrutinized in future years to assess whether the hypothesis that dry season water quality is not significantly affected by hydrologic variability is supported.

Coastal water quality trend findings should be based on a longer multi-year average than three years, as they are hypothesized to be significantly affected by hydrologic variability. The multi-year basis for comparison should be extended to 5 years or more, as data becomes available.

References

Heal the Bay, 2018. 2017-2018 Beach Report Card.

SAWPA (Santa Ana Watershed Project Authority), 2017. Santa Ana River Watershed Bacteria Monitoring Program Annual Report: 2016-2017 FINAL REPORT.

SAWPA (Santa Ana Watershed Project Authority), 2018. Santa Ana River Watershed Bacteria Monitoring Program Annual Report: 2017-2018 FINAL REPORT.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	METRIC
Abundance of vegetated riparian corridor	*Area of vegetated riparian corridor*

Implementation Approach

The abundance of vegetated riparian corridor was evaluated using an analysis approach developed by the US Forest Service in conjunction with the School of Forest Resources & Environmental Science at Michigan Technological University. Software developed to implement this process uses readily-available streams, topography, and hydrologic data to identify an estimated riparian corridor area for a given stream network, and then uses an annually-generated national land cover dataset to calculate the areas of different land cover types within the riparian corridor. Within the defined riparian corridor, lands with forest, shrubland, wetlands, and open water are defined as vegetated riparian area. Areas with land cover defined as crops, developed, or barren are excluded. This process is executed within the SAWPA boundary to determine the vegetated riparian area within the Santa Ana River watershed.

Trends for vegetated riparian area are evaluated by comparing the most recent results for vegetated riparian area to the average for the five previous years. This multi-year averaging approach was taken to reduce the influence of hydrologic variability on baseline land cover conditions. The trend is used to identify the rating. Thresholds used to identify the trend are shown in **Table A.5-1** below.

TABLE A.5-1

TREND RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 1,000 acres
Neutral	-1000 acres < Result < 1,000 acres
Negative	Result ≤ -1,000 acres

Output

The output of the analysis process is the area of vegetated riparian corridor.

Data Sources

The analysis process uses stream gage data to estimate 50-year flood levels for a range of stream sizes, or orders, based on a stream's relationship to its headwaters and incoming tributaries. Additionally, it uses multiple nationally-generated datasets, as shown in **Table A.5-2**. The land cover dataset is generated annually to provide estimates of crop acreages of major commodities using satellite imagery at a 30-meter resolution.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	METRIC
Abundance of vegetated riparian corridor	*Area of vegetated riparian corridor*

TABLE A.5-2
DATA SOURCES

Data Type	Source Name	URL
Stream gage data	USGS stream gaging network	*https://maps.waterdata.usgs.gov/mapper/index.html*
Stream network	USGS National Hydrography Dataset	*http://nhd.usgs.gov*
Topographic data	The National Map	*http://nhd.usgs.gov/*
Land cover data	CropScape	*https://nassgeodata.gmu.edu/CropScape/*

Detailed Implementation Steps

Directions for data preparation are available at: https://docs.wixstatic.com/ugd/d5da6c_dd8e6178b3114dac9e2a5e3c1f99abe4.pdf.[1] A toolbox for implementation is available at www.riparian.solutions.

Implementation notes:

- Use no spaces or special characters in watershed feature class names; make sure field types (double, long integer) are correct.
- Make sure all input data share the same projected coordinate system using meter linear units. When reprojecting rasters, it is important to maintain the same pixel/cell size for projected rasters.
- Create separate file geodatabases to store vector data and raster data (e.g., project_vector.gdb and project_raster.gdb). If everything is stored in a single geodatabase file, Arcmap may delete all rasters during script processing to free up resources.
- The toolbox includes a utility to check the input files to ensure projections and field names/types are correct for processing.
- Determine 50-year flood heights for stream order/levels within study area using this guide - https://docs.wixstatic.com/ugd/d5da6c_5e1ba4a770804211834b1e6a513ed960.pdf.

For the current analysis, data from 17 gages were used and the 50-year flood estimates from the worksheets for each stream order were averaged to generate the model 50-year curve. Three estimates were excluded as outliers that seemed to be drastically affecting the model fit. The more plausible polynomial (2nd order) model fit was used to generate the “FloodData” required—that is, a modeled 50-yr flood height for each stream order in the data set. The “FloodData” and related riparian buffers generated for the current analysis need not be regenerated until at least 10

[1] For this analysis, the standard approach was applied without accounting for soil types, which were not expected to be helpful for defining riparian corridors in this region.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	METRIC
Abundance of vegetated riparian corridor	*Area of vegetated riparian corridor*

years of additional gage data are available, additional gages with at least 10 or more years of data become available, or additional stream vectors are added.

The watershed area, at about 2.6 million acres, includes more than 100 subwatersheds at the "HUC-12" level. The tool loops through each subwatershed in turn, first generating a buffer around the stream vectors, creating a buffer feature class within a new geodatabase for each subwatershed. A script was used to combine all the subwatershed geodatabases into a single file. This produced the riparian corridor extents dataset. The land cover datasets from CropScape were then overlain to extract the land cover areas within the riparian corridors. Within the defined riparian corridor, lands with forest, shrubland, wetlands, and open water were defined as vegetated riparian area. Areas with land cover defined as crops, developed, or barren were excluded. Total vegetated riparian areas within the riparian corridor extents were calculated.

TABLE A.5-3
LAND COVER DATASETS USED

Time Frame	CropScape
Current	2017
Recent Historic	2012-2016

Implementation Challenges

Riparian corridors are approximately defined, though in a way that provides consistency in approach. Similarly, the land cover data is being generated for a different purpose than tracking the abundance of riparian vegetation and no doubt imperfectly characterizes these land cover conditions, but at least is generated in a relatively consistent fashion. From time to time, changes in methodology or satellite imagery characteristics used to generate the land cover dataset may trigger changes in results from one year to the next that are not driven by changes on the ground.

Results

TABLE A.5-4
ANALYSIS RESULTS (ACRES)

Time Frame	Riparian Vegetation	Other
Current (2017)	21,727	27,060
Recent Historic (2012-2016)	20,518	28,268

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	METRIC
Abundance of vegetated riparian corridor	*Area of vegetated riparian corridor*

Trend Analysis

The data shown in **Table A.5-4** above was analyzed to determine the change in acres from the calculated recent historic average to current conditions. The result is presented in **Table A.5-5** below.

TABLE A.5-5
TREND ANALYSIS RESULTS

Time Frame	Change (acres)
Recent Historic (2012-2016) to Current (2017)	1,209

Because the average annual change from recent historic to current conditions exceeds 1,000 acres, the trend analysis and therefore the rating for this metric is positive.

Going Forward

No recommendations.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	METRIC
Abundance of conserved open space	*Area of conserved open space*

Implementation Approach

Multiple data sources are used to identify the area of conserved open space. Conserved open space is defined as including lands owned in fee title for open space purposes, conservation easements, and agricultural lands that are restricted from development under the Williamson Act. Conservation easements are deed-based restrictions on private land that limit its uses to those compatible with maintaining it as open space. Williamson Act restrictions provide landowners with a tax break when they enroll their agricultural or open space lands in the program, which requires that the lands be kept in agriculture or open space for a rolling 10-year period.

GIS datasets representing these land areas are developed by others and are readily available. These datasets are intersected with the SAWPA boundary to identify the total area of land within these categories within the watershed. Comparison of the most recent data to recent historical data is used to identify the trend for this metric, and the trend is used to identify the rating. Thresholds used to identify the trend are shown in **Table A.6-1** below.

TABLE A.6-1
RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 1,000 acres
Neutral	-1,000 acres < Result < 1,000 acres
Negative	Result ≤ -1,000 acres

Output

This analysis generates an estimate of the area of conserved open space within the Santa Ana River watershed, including lands owned in fee title for open space purposes, conservation easements and agricultural lands restricted from development.

Data Sources

Lands identified in the California Protected Areas Database (CPAD), California Conservation Easement Database (CCED), and Williamson Act lands are used to represent the total area of conserved open space. Both CPAD and CCED are maintained by the California-based nonprofit organization GreenInfo Network. Williamson Act lands are tracked by county tax assessors' offices.

Lands identified in CPAD are compiled from data provided by approximately 1,100 public agencies or nonprofit organizations. It is known to be incomplete and is subject to continual updating. Until recently, data entry did not include the time of acquisition of the land. The most

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	METRIC
Abundance of conserved open space	*Area of conserved open space*

recent dataset available is from August 2017. Prior datasets have been released one to two times per year, dating back to the first release in May, 2008.

Lands identified in CCED were compiled from multiple sources (approximately 215 public agencies or nonprofit organizations). It is known to be incomplete and is subject to continual updating. Until recently, data entry did not include the time of acquisition of the easements. The first version of the dataset was released in April 2014. It was used to represent recent historic conditions. The second and most recent dataset was released in December 2016.

Because Williamson Act datasets are associated with tax assessment, these datasets are expected to be both current and complete.

Detailed Implementation Steps

Recent and historic CPAD and CCED datasets were downloaded from http://www.calands.org/data.

Williamson Act datasets were obtained from the three primary counties in the Santa Ana River Watershed: Orange, Riverside, and San Bernardino. (Data for Los Angeles County, which contains a very small part of the watershed, was not included.) No data was available for 2016 Orange County Williamson Act lands; these were counted as zero.

TABLE A.6-2
RELEASE DATASETS USED

Time Frame	CPAD	CCED	Williamson Act
Current	August 2017	December 2016	2016
Recent Historic*	March 2014	April 2014	2014
Older Historic	July 2012	Not Available	2012

* The analysis used 2014 to represent recent historic conditions, as that was the most recent prior data for the CCED dataset.

Datasets were overlain with the SAWPA boundary and any overlapping areas of the datasets within that were clipped to avoid double-counting. Total acreages were identified for “current” and “recent historic” time periods. A difference in the total land area classified as conserved open space in current conditions compared to recent historic conditions was identified as the score. The result was evaluated according to the criteria shown in Table A.6-1 to determine the rating.

Implementation Challenges

1. Data incompleteness – Both the CPAD and CCED datasets are known to be incomplete. The addition of missing data causes the apparent area of conserved open space to grow when no changes in land protection have occurred. Efforts are underway to address this issue by adding acquisition dates to the dataset, but enhancing the dataset will take time and relies in significant part on voluntary actions. It would be possible in the future for actors within the Santa Ana River watershed boundary to make a concerted investment in improving both

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	METRIC
Abundance of conserved open space	*Area of conserved open space*

CPAD and CCED within the watershed to improve the quality of the data used to evaluate this metric.

2. Irregular release dates – Both CPAD and CCED are released periodically but irregularly. As a result, "current" conditions may not be very current, and datasets added together mix different snapshots in time.

Results

TABLE A.6-3
ANALYSIS RESULTS

Time Frame	CPAD (square miles)	CCED (square miles)	Williamson Act (square miles)	Total (square miles)	Total (acres)
Current (2016-2017)	905	24	407	1,337	855,501
Recent Historic (2014)	880	18	433	1,331	851,868
Older Historic (2012)	887	NA	440	1,327	849,010

Trend Analysis

The data shown in **Table A.6-3** above was analyzed to determine the average annual change in acres. Because the most current dataset covers a 2-year span, an assumption of 2.5 years for the time period from recent historic to current conditions was made. The results are presented in **Table A.6-4** below.

TABLE A.6-4
TREND ANALYSIS RESULTS

Time Frame	Years Assumed for Averaging	Average Annual Change (acres)
Recent Historic (2014) to Current (2016-2017)	2.5	1,453
Older Historic (2012) to Recent Historic (2014)	2	1,429

Because the average annual change from recent historic to current conditions exceeds 1,000 acres, the trend analysis and therefore the rating for this metric is positive.

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function	
INDICATOR	METRIC
Abundance of conserved open space	*Area of conserved open space*

Going Forward

As noted above under implementation challenges, there is an opportunity for players within the Santa Ana River watershed to improve the quality of the data on which this metric relies. The CPAD and CCED datasets both accept input to improve datasets. In particular, adding information on when acquisitions were made would greatly improve the utility of this dataset for assessment purposes.

References

GreenInfo Network, California Protected Areas Database (CPAD) and California Conservation Easement Database (CCED). http://www.calands.org/data.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

Implementation Approach

To assess this indicator and metric, one existing dataset compiled by the state Office of Environmental Health and Hazard Assessment (OEHHA) was overlaid with a dataset compiled by the state Department of Water Resources (DWR) in a geographic information system (GIS). Both datasets were available by census tract. The purpose was to understand the extent to which drinking water contamination is an environmental justice issue in the watershed and whether that issue is increasing or decreasing over time.

The rating system used for this indicator and metric is reflective of trends but configured to primarily highlight the change in water quality in less-resourced parts of the community. An improvement in water quality in the less-resourced parts of the community (LR), along with no decline in water quality in more-resourced parts of the community (MR), was considered a positive trend. Other combinations of the change in index value for less-resourced and more-resourced parts of the community were considered either neutral or negative trends. Unless drinking water quality in less-resourced parts of the community improves, the rating cannot be a positive trend. In summary,

- Positive trend: LR result shows an improving trend and MR result shows an improving trend or neutral trend.
- Neutral trend: LR and MR results both show a neutral trend.
- Negative trend: At least one result shows a worsening trend.

The rating system shown in **Table A.7-1** identifies the rating given to changes in the LR or MR result. For example, in order to show an improving trend, the LR result would need to improve by over 10% between current and historic conditions. Anything less than 10% change in the LR result would show a neutral trend for the LR.

TABLE A.7-1
TREND RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 10% decrease
Neutral	-10% < Result < 10%
Negative	Result ≥ 10% increase

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

Output

The output for this metric consists of a combination of the trend in mean drinking water quality index scores of the less-resourced parts of the community and the more-resourced parts of the community.

Data Sources

California Water Code Section 79505.5(a) defines a "disadvantaged community" as a community with annual median household income that is less than 80 percent of the statewide annual median household income. The Department of Water Resources (DWR) uses data from the U.S. Census Bureau American Community Survey to characterize areas (census tracts) throughout California where people would be considered as members of "disadvantaged communities" in accordance with the Water Code definition. Areas where people who would be considered members of disadvantaged communities as identified in the DWR data were considered less-resourced parts of the watershed community for purposes of this analysis. All other census tracts within the watershed were considered more-resourced parts of the community.

Data from CalEnviroScreen version 3.0, based on 2005-2013 data and completed in 2017, was used in this assessment.[1] The temporal range of data used represented three compliance periods, and was selected due to the fact that some water supply systems only test once during a cycle. The next version of CalEnviroScreen is planned for release in 2019; with that version the indicator will be based on data from 2008 through the current compliance period. The indicator score is calculated using average contaminant concentrations over the three compliance periods.

The drinking water contaminant index combines information about 13 contaminants and 2 types of water quality violations that are sometimes found when drinking water samples are tested.[2] The index values across California range from less than 165 to over 812. A higher value indicates increased contaminant presence. The following five steps were used in CalEnviroScreen to calculate the index.

1. Establish drinking water system boundaries.
2. Associate water contaminant data with each drinking water system, and calculate average contaminant concentrations.
3. Reallocate each drinking water systems' average water contaminant concentrations to census tracts.

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1 CalEnviroScreen 3.0 geodatabase can be downloaded from https://oehha.ca.gov/calenviroscreen/maps-data/download-data.

2 The contaminants are arsenic, cadmium, hexavalent chromium, dibromochloropropane (DBCP), lead, nitrate (NO3), perchlorate, radium 226 and 228, total trihalomethanes (THM), tetrachloroethylene (PCE), trichloroethylene (TCE), 1,2,3-trichloropropane, and uranium. The two violation types evaluated were maximum contaminant level (MCL) violations and total coliform rule violations.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

4. Rank census tracts to obtain percentile score for each contaminant and tract.
5. Calculate census tract contaminant index, which is the sum of the percentiles for all contaminants.

Contaminant data from the following sources were used to calculate the index:

- CDPH drinking water systems geographic reporting tool
- CDPH Public water system location data in the PICME database
- US EPA Safe Drinking Water Information System
- CDPH Water Quality Monitoring Database
- SWRCB GAMA Domestic Well Project
- SWRCB and USGS GAMA Priority Basin Project

Detailed Implementation Steps

The most recent drinking water contaminant and disadvantaged community data was downloaded from the CalEnviroScreen website. Using GIS, census tracts within the SAWPA boundary were identified and evaluated. All areas within disadvantaged communities were identified as less-resourced, and areas outside of disadvantaged communities were identified as more-resourced. The average index value was identified for both less- and more-resourced areas.

Data for recent historic conditions was not evaluated during the current assessment, as comparable data did not exist.

Implementation Challenges

CalEnviroScreen 3.0 used the same compliance data as CalEnviroScreen 2.0 (data collected over the three compliance periods during 2005-2013), and CalEnviroScreen 1.0 used a different metric to evaluate water quality (the indicator was “impaired water bodies,” and the metric was summed number of pollutants across all water bodies designated as impaired within each zip code). In CalEnviroScreen 1.0, a score was assigned to each zip code instead of each census tract, each zip code was scored based on the sum of the number of individual pollutants found within and/or bordering it, and the score was based on surface water quality, not necessarily on drinking water. For this reason, a trend analysis for this indicator was not completed with this implementation of the assessment.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

Results

TABLE A.7-2
WATER CONTAMINANT INDEX RESULTS

Estimated Population	Mean Water Contaminant Index Score	Total Tracts	Total Area (square miles)	Percent (Number) of Tracts Above the Mean Watershed Index Score
Less-Resourced Parts of the Community				
1,716,533	628.53	335	717.4	56.6 (188)
More-Resourced Parts of the Community				
4,341,250	554.13	799	2,122.4	42.0 (335)
Watershed				
6,057,783	575.97	1,131	2,839.9	N/A

SOURCE: CalEnviroScreen Version 3.0

Recent historic data was not available, since the CalEnviroScreen 3.0-type analysis was only completed for one period. For this reason, the assessment is qualitative, and the rating is neutral.

Trend Analysis

The mean contaminant index score for less-resourced parts of the community is higher than the mean score for more-resourced parts of the community, indicating a higher degree of contamination, and the difference in scores is statistically significant, as discussed below. In addition, more-resourced parts of the community include fewer tracts above the mean watershed index score than are present in less-resourced parts of the community. The mean index score for more-resourced parts of the community is below the mean index score for the entire watershed.

Statistical analysis conducted with an independent two-sample t-test on equal samples of less-resourced tracts (n= 332) and more-resourced tracts (n= 332) documents a statistically significant difference in water quality values between the two groups: $t(661) = 3.49$, $p = 0.001$. Less-resourced tracts exhibited higher values (mean = 628.5; median = 686.7) than more-resourced tracts (mean = 563.1; median = 515.8), although the effect size is moderately small (Cohen's $d = 0.27$) (Gail and Sullivan, 2012).

Going Forward

While a trend was not evaluated with this implementation of the assessment, as noted previously, OEHHA plans to release CalEnviroScreen 4.0 in 2019, which would be updated to use compliance data from the 2008-current period.

Mean values were used in this assessment to determine statistical significance; however, the use of median values may be more appropriate and should be evaluated for use in future assessments.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Equitable access to clean drinking water	*Relative value of the drinking water contaminant index from CalEnviroScreen between less resourced parts of the community and more resourced parts of the community*

References

Gail M. Sullivan, Richard Feinn, (2012) Using Effect Size—or Why the P Value Is Not Enough. Journal of Graduate Medical Education: September 2012, Vol. 4, No. 3, pp. 279-282.

California OEHHA, CalEnviroScreen 3.0 geodatabase can be downloaded from https://oehha.ca.gov/calenviroscreen/maps-data/download-data.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Proportionate implementation of climate change adaptation strategies	*Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community*

Implementation Approach

The relative value of tree and shrub density between different parts of the community was evaluated using tree and shrub density data available at the parcel level from Santa Ana Watershed Project Authority (SAWPA) and Department of Water Resources (DWR) data available by census tract. These data were overlaid in a geographic information system (GIS). To the extent that residential parcels in less-resourced parts of the community have lower tree and shrub density, this indicator measures the equitable implementation of vegetation planting as a climate change adaptation strategy.

The rating system used for this indicator and metric is reflective of trends but configured to primarily highlight the change in water quality in less-resourced parts of the community. An improvement in water quality in the less-resourced parts of the community (LR), along with no decline in water quality in more-resourced parts of the community (MR), was considered a positive trend. Other combinations of the change in index value for less-resourced and more-resourced parts of the community were considered either neutral or negative trends. Unless drinking water quality in less-resourced parts of the community improves, the rating cannot be a positive trend. In summary,

- Positive trend: LR result shows an improving trend and MR result shows an improving trend or neutral trend.
- Neutral trend: LR and MR results both show a neutral trend.
- Negative trend: At least one result shows a worsening trend.

The rating system shown in **Table A.8-1** identifies the rating given to changes in the LR or MR result. For example, in order to show an improving trend, the LR result would need to improve by over 10% between current and historic conditions. Anything less than 10% change in the LR result would show a neutral trend for the LR.

TABLE A.8-1
TREND RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 10% decrease
Neutral	-10% < Result < 10%
Negative	Result ≥ 10% increase

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Proportionate implementation of climate change adaptation strategies	*Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community*

Output

The targeted output for this metric consists of a combination of the trend in median tree and shrub density in the less-resourced parts of the community and the more-resourced parts of the community.

Data Sources

SAWPA generated the tree and shrub data used for this indicator based on aerial imagery collected in 2015. The tree and shrub data covers areas cumulatively containing approximately 99% of the watershed population. The tree and shrub data for residential parcels was overlaid with the less-resourced tracts and more-resourced tracts in the watershed (identified using the DWR data) to see if the changes in density are occurring more frequently in either tract type.

California Water Code Section 79505.5(a) defines a "disadvantaged community" as a community with annual median household income that is less than 80 percent of the statewide annual median household income. The Department of Water Resources (DWR) uses data from the U.S. Census Bureau American Community Survey to characterize areas (census tracts) throughout California where people would be considered as members of "disadvantaged communities" in accordance with the Water Code definition. Areas where people who would be considered members of disadvantaged communities as identified in the DWR data were considered less-resourced parts of the watershed community for purposes of this analysis. All other census tracts within the watershed were considered more-resourced parts of the community.

Detailed Implementation Steps

Tree and shrub data was collected for residential parcels within the SAWPA boundary, and the DWR disadvantaged communities dataset was downloaded from the DWR Disadvantaged Communities Mapping Tool. The tree and shrub data were overlaid with DWR disadvantaged communities data in GIS, and tree and shrub density was calculated by dividing the tree and shrub area by the total area of less-resourced parts of the community (the total area of disadvantaged communities mapped in the watershed).

> Tree and shrub density (as a percentage) = total tree and shrub area in disadvantaged communities, square miles / total disadvantaged communities area, square miles

The same calculation was completed for more-resourced parts of the community (all areas in the watershed that are not mapped as part of the DWR disadvantaged communities), and the relative values of tree and shrub density for the less-resourced and more-resourced areas was calculated. The statistical significance of this difference was evaluated; if the difference was not statistically significant, the metric value is zero and the rating is neutral.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Proportionate implementation of climate change adaptation strategies	*Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community*

Data for recent historic conditions was not evaluated during the current assessment, as comparable data did not exist.

Implementation Challenges

The tree and shrub data used for this analysis was generated by imagery analysis of aerial photos from 2015. This is the most recent data available. Analysis of earlier or more recent aerial imagery has not occurred. However, given the utility of the data, SAWPA anticipates collection and genesis of this type of data will continue in the future. In the future, SAWPA would then be able to assess the trend within the Santa Ana region.

Results

TABLE A.8-2
TREE AND SHRUB DENSITY RESULTS

	Less-Resourced Areas	More-Resourced Areas
Number of parcels, residential	347,238	1,070,308
Number of census tracts, residential	319	749
Total Area, residential (square miles)	627	1,718
Total Tree and Shrub Area, residential (square miles)	62	175
Tree and Shrub Density (percent)	9.89	10.19
SOURCE: SAWPA		

Table A.8-2 presents the results of this analysis for the 2015 data. As shown in Table A.8-2, tree and shrub density is slightly higher (0.3 percent) in more-resourced tracts than it is in less-resourced tracts. This difference, while small, is statistically significant.

Descriptive statistics derived from equal samples of less-resourced tracts (n= 319) and more-resourced tracts (n= 319) indicate that more-resourced tracts have slightly more tree and shrub coverage (mean = 12.9%; median = 11.5%) than less-resourced tracts (mean = 11.2%; median = 10.3%). The means described here differ slightly from the means reported in Table A.8-2 due to the sample size used for the statistical analysis. Although statistical analysis conducted with an independent two-sample t-test assuming unequal variance (more-resourced = 0.009; less-resourced = .003) indicates that the difference in coverage is statistically significant (t(501) = 2.71, p = 0.007), the effect size calculated using Cohen's *d* (0.22) indicates the magnitude of difference between the two groups is small.[1]

[1] Gail M. Sullivan, Richard Feinn, (2012) Using Effect Size—or Why the P Value Is Not Enough. Journal of Graduate Medical Education: September 2012, Vol. 4, No. 3, pp. 279-282.

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed	
INDICATOR	METRIC
Proportionate implementation of climate change adaptation strategies	*Relative value of tree and shrub density between less resourced parts of the community and more resourced parts of the community*

Trend Analysis

As noted above, there are no earlier analogous tree and shrub data available. The trend in tree and shrub density overall, as well as trends within less-resourced or more-resourced areas of the watersheds, therefore cannot be assessed at this time. As a result, the trend is shown as a qualitative neutral rating.

A similar type of index has been calculated for the City of Los Angeles based on data collected around the same time[2] and provides an interesting point of comparison. The Green View Index differs from the SAWPA tree and shrub density data in that it uses Google Street View panoramas instead of satellite imagery, and rates the percentage of canopy coverage in an area on a scale from 1 to 100 based on these street-level perspectives. The SAWPA tree and shrub density data only included residential areas, as described above, and so may exclude some areas that the Green View Index would include (such as commercial streets) while also including some areas the Green View Index would exclude (such as vegetated areas located closer to the center of city blocks). For purposes of comparison, the City of Los Angeles was considered the most similar geography to which the Green View Index has been applied. As of 2015, the Green View Index for the City of Los Angeles was 15.2%.

Going Forward

As more data relevant to climate change adaptation becomes available, another metric may better reflect the proportionality of conditions or implementation of climate change adaptation strategies in the region across less- and more-resourced parts of the community.

While mean values were used in this assessment to determine statistical significance, the use of median values may be more appropriate in the future.

[2] The Green View Index was developed by the Massachusetts Institute of Technology Senseable City Lab. The Green View Index is calculated using Google Street View panoramas. http://senseable.mit.edu/treepedia/cities/los%20angeles.

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	***Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.***

Implementation Approach

Collaboration for more effective outcomes was assessed by reviewing the list of entities regulated in adopted total daily maximum load (TMDL) orders in the Santa Ana Region and identifying how many are participating in collaborative efforts to comply with the TMDL requirements. Participation is indicated by financial or in-kind contributions. Conditions for collaboration were considered "good" if the number of participants was substantially the same as the number of regulated entities and "bad" if the number was not, for both recent and prior conditions. An evaluation was then made to determine whether the sequencing of prior to recent conditions warranted a positive, neutral, or negative trend finding according to **Table A.9-1**.

The "good" – "bad"-based scoring system is reflective of trends but configured to highlight conditions status relative to full participation rather than expecting continued improvement beyond full participation. Participation by equal to or greater than 80% of the regulated entities was considered "good."

TABLE A.9-1
GOOD-BAD ASSESSMENT SYSTEM

Prior Conditions	Recent Conditions	Result
GOOD	GOOD	Positive
BAD	GOOD	Positive
GOOD	BAD	Negative
BAD	BAD	Neutral (if appreciably better)
BAD	BAD	Negative (if similar or worse)

Desired Output

The targeted output was the percentage of entities regulated by adopted TMDLs who have made financial or in-kind contributions to TMDL implementation in the past year.

Data Sources

The Santa Ana Region's website summarizing TMDLs for the region, along with the region's Water Quality Control Plan, were reviewed to identify TMDLs in the implementation phase. Financial or in-kind contributions determined by reviewing:

- SAWPA Task Force contribution records
- Newport Bay Watershed Executive Committee reports

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

Detailed Implementation Steps

The Santa Ana Region Basin Plan was reviewed to identify the TMDLs in an implementation phase in the region. The total number of entities regulated by the TMDLs was determined by reviewing the list of permittees identified in each relevant order from the RWQCB. Recent records of contributions to TMDL implementation efforts were collected from SAWPA and the Newport Bay Watershed Executive Committee reports. A list of entities that have contributed to these efforts in the past year was compiled from these sources. The list of entities that have contributed to implementation of each TMDL (entities are counted once for each TMDL – that is, if the same entity is named in two TMDLs, it is counted twice) was compared with the list of entities named in the relevant order from the RWQCB, and a percentage of entities participating was calculated based on the comparison. The percentage of entities participating was converted into a good or bad score, and the trend was determined based on the comparisons shown in **Table A.9-1**.

Implementation Challenges

In some cases, the adopted orders included entities that no longer exist, or that have already completed their implementation activities (and so no longer participate despite the ongoing TMDL implementation plan).

In some cases, the data does not change annually. The cost-sharing agreement for the Newport Bay Sediment TMDL was last updated in 2014. The same agencies have been splitting the cost of implementing projects to address sediment and related water quality issues since 2014. The cost-sharing agreement for all other TMDLs for Newport Bay and San Diego Creek had been entered into in 2015 and was undergoing revision as of summer 2018.

Results

Positive trend

89% participation (62 out of 70 entities) in 2017

89% participation (62 out of 70 entities) in 2016

Trend Discussion

In the Santa Ana region, 70 participants are named in adopted TMDLs in the implementation phase, summarized in **Table A.9-2**. This number does not include entities named in the recently adopted selenium TMDL for San Diego creek or entities named as part of the completed Agricultural Nutrient Management Program in Newport Bay. Of these entities named in the orders, 62 participated (as measured by financial contributions to implementation projects) in TMDL implementation-related efforts in 2017. The same number participated in 2016. This amounts to a participation rate of 89 percent for both years; therefore, in both years collaboration was in “good” condition.

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

Nearly all of the TMDL implementation plans are being implemented in part through a collaborative entity, such as a SAWPA Task Force, the Newport Bay Watershed Executive Committee, and the Orange County Stormwater Program.

Going Forward

In the future, SAWPA may want to track the percent of TMDL activities implemented in partnership annually, which could provide similar, more complete information about collaboration relevant to water management in the watershed. SAWPA could conduct an annual survey of TMDL permittees to identify projects undertaken as part of TMDL implementation plans during the year. SAWPA could then more clearly identify which of the TMDL projects were completed by two or more entities (instead of one entity), reflecting collaboration in the watershed.

References

Newport Bay Watershed Executive Committee, *Central Orange County Watershed Management Area Executive Action Plan 2017-22*, September 20, 2017.

Santa Ana Watershed Project Authority, Task Force Contribution Data.

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

TABLE A.9-2
303(D) LIST WATER BODIES IN THE REGION WITH TMDL IMPLEMENTATION PLANS AND PARTICIPATING AGENCIES/DISCHARGERS

Water Body	Pollutants	303(d) Listing Status	Collaborative Entity	Entities Included in TMDL (total number) [a]	TMDL Entities Contributing Financially or In-Kind (total number), 2017 or last year information is available [a]
Big Bear Lake	Noxious aquatic plants, nutrients	5B, being addressed by USEPA approved TMDL	Nutrient TMDL working group	**US Forest Service**, **Caltrans**, San Bernardino County, San Bernardino County Flood Control District, City of Big Bear Lake, Big Bear Mountain Resorts (6)	San Bernardino County, San Bernardino County Flood Control District, City of Big Bear Lake and Mammoth Mountain *formerly the Ski Resorts* (4)
Canyon Lake	Nutrients (nonpoint source)	4a, addressed by USEPA approved TMDL *Resolution R8-2004-0037*	SAWPA Task Force	**US Forest Service**, March Air Reserve Base, March Joint Powers Authority, Caltrans, California Department of Fish and Game, County of Riverside, cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside, and Beaumont, Eastern Municipal Water District, Elsinore Valley Municipal Water District, **concentrated animal feeding operators** and other agricultural operators within San Jacinto watershed (19)	March Air Reserve Base, March Joint Powers Authority, Caltrans, California Department of Fish and Game, County of Riverside, cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside, Beaumont, **Menifee**, and **Wildomar**, Eastern Municipal Water District, Elsinore Valley Municipal Water District, San Jacinto Agricultural Operators (19)
Chino Creek Reach 1A	Indicator bacteria	5B, being addressed by USEPA approved TMDL *Resolution R8-2005-0001*	SAWPA Task Force (Middle Santa Ana River [MSAR] Task Force)	**US Forest Service**, the County of San Bernardino, the County of Riverside, the cities of Ontario, Chino, Chino Hills, Montclair, Rancho Cucamonga, Upland, Rialto, Fontana, Norco, Riverside, Corona, Pomona and Claremont, and agricultural operators in the watershed (17)	San Bernardino County Flood Control, the County of Riverside, the cities of Ontario, Chino, Chino Hills, Montclair, Rancho Cucamonga, Upland, Rialto, Fontana, Norco, Riverside, Corona, Pomona, Claremont, **Eastvale, Jurupa Valley**, and agricultural operators in the watershed *represented by the Chino Basin Watermaster Agricultural Pool* (18)
Chino Creek Reach 1B	Indicator bacteria	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	
Chino Creek Reach 2	Indicator bacteria	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	
Lake Elsinore	Nutrients, Organic enrichment/low dissolved oxygen	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (combined with Canyon Lake)	Combined with Canyon Lake	
Mill Creek (Prado Area)	Indicator bacteria	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	***Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.***

Water Body	Pollutants	303(d) Listing Status	Collaborative Entity	Entities Included in TMDL (total number) [a]	TMDL Entities Contributing Financially or In-Kind (total number), 2017 or last year information is available [a]
Newport Bay [b]	Fecal coliform	5B, being addressed by USEPA approved TMDL *Resolution 99-10*	Newport Bay Watershed Executive Committee	County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest and Newport Beach and **agricultural operators in the Newport Bay watershed** (9)	County of Orange, **Orange County Flood Control District,** the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, Newport Beach, **Laguna Hills,** and **Laguna Woods, Irvine Ranch Water District,** and the **Irvine Company** (13)
	Nutrients	5B, being addressed by USEPA approved TMDL *Resolution 98-100*	Urban Stormwater Permittees - Environmental Monitoring Division of OC Public Works/Environmental Resources implements monitoring programs (Orange County Stormwater Program)	County of Orange, the Orange County Flood Control District, and the 34 cities of Orange County *referred to as the Co-Permittees of the Areawide Urban Stormwater Permit (3)*	County of Orange, the Orange County Flood Control District, and the 34 cities of Orange County (3)
			Agricultural Nutrient Management Program completed 2000-2003	Orange County Farm Bureau, UC Cooperative Extension, and agricultural operators (agricultural nutrient management program) (3)	*Agricultural Nutrient Management Program completed 2000-2003*
	Sediment	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	County of Orange, the Cities of Irvine, Tustin, Lake Forest, **Costa Mesa, Santa Ana**, and Newport Beach (7)	County of Orange, **Orange County Flood Control District**, the Cities of Irvine, Tustin, Lake Forest, Newport Beach, **the Irvine Company** (7)
Newport Bay, upper	Diazinon and Chlorpyrifos	5B, being addressed by USEPA approved TMDL *Resolution R8-2003-0039*	Newport Bay Watershed Executive Committee	County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, and Newport Beach, and **agricultural operators in the Newport Bay watershed** (9)	County of Orange, **Orange County Flood Control District,** the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, Newport Beach, **Laguna Hills,** and **Laguna Woods, Irvine Ranch Water District,** and the **Irvine Company** (13)
Prado Park Lake	Indicator bacteria	5B, being addressed by USEPA approved TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	
San Diego Creek Reach 1	Nutrients	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Nutrients TMDL, listed previously	
	Pesticides	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Diazinon and Chlorpyrifos TMDL, listed previously	
	Siltation/Sediment	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Sediment TMDL, listed previously	

Educate and build trust between people and organizations	
INDICATOR	**METRIC**
Collaboration for more effective outcomes	*Percent of entities regulated by a total maximum daily load (TMDL) that have made financial or in-kind contributions to TMDL implementation.*

Water Body	Pollutants	303(d) Listing Status	Collaborative Entity	Entities Included in TMDL (total number) [a]	TMDL Entities Contributing Financially or In-Kind (total number), 2017 or last year information is available [a]
	Selenium	5B, being addressed by USEPA approved TMDL	No	MS4 permittees, other NPDES permittees (groundwater cleanup/dewatering permittees), IRWD (operator of IRWD constructed treatment wetlands), UC Irvine (operator of UCI San Joaquin Marsh Reserve wetlands) (4)	Order adopted in 2017
San Diego Creek Reach 2	Nutrients	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Nutrients TMDL, listed previously	
	Sediment/siltation	5B, being addressed by USEPA approved TMDL	Newport Bay Watershed Executive Committee	Same as Newport Bay Addressed as part of Newport Bay Sediment TMDL, listed previously	
Santa Ana River Reach 3	Indicator bacteria	4a, addressed by USEPA TMDL	SAWPA Task Force (MSAR Task Force)	Same as Chino Creek Reach 1A	

NOTES:

a Bolded text in these columns identifies entities that are not listed in both columns.
b Newport Bay Watershed Executive Committee cost sharing agreements for TMDLs were entered into in 2014 (for Sediment TMDL) and 2015 (for all other TMDLs).

SOURCE: Newport Bay Watershed Executive Committee, *Central Orange County Watershed Management Area Executive Action Plan 2017-22*, September 20, 2017; Santa Ana Watershed Project Authority Task Force Contribution Data.

Educate and build trust between people and organizations	
INDICATOR	METRIC
Adoption of a watershed ethic	*Total gallons of potable water used per capita per day*

Implementation Approach

This indicator and metric were assessed using water use and population data from the SWRCB Large Water System Drinking Water Program Electronic Annual Report and from the Department of Water Resources (DWR) Public Water Systems Statistics (PWSS) survey.

Annual water use generally fluctuates in response to water year type (wet or dry). In order to separate changes in water use due to adoption of a watershed ethic from responses to annual water availability, for trend analysis and scoring purposes the value of this metric is compared with the average value calculated over the last ten years. The percent difference between the two values is the result used for rating according to the criteria shown in **Table A.10-1** below.

TABLE A.10-1
TREND RATING SYSTEM

Rating	Criterion
Positive	Result ≥ 10% decline
Neutral	-10% < Result < 10%
Negative	Result ≥ 10% increase

Output

The output for this metric is the average gallons per capita per day (GPCD) for the watershed for the most recent year compared to the average GPCD of the previous 10 years of data.

Data Sources

Prior to 2013, DWR collected the water agency data used in this indicator (via the voluntary PWSS survey). Starting in 2013, the PWSS data was derived from the mandatory reports by water suppliers to the SWRCB Large Water System Drinking Water Program Electronic Annual Report, which was expanded to include the water use data previously submitted to the PWSS. The assessed water suppliers were limited to those which had over 3,000 water meters or that served customers over 3,000 acre-feet of potable water (i.e., retailers required to prepare Urban Water Management Plans). As of 2013, these 53 suppliers serve approximately 98 percent of the watershed's population. Between 2007-2012, at least 46 out of the 53 retailers reported their water use and population to DWR's PWSS. While the retailers that did not report during the 2007-2012 period changed annually, the populations excluded were generally split between inland and coastal areas such that the GPCD reported between 2007-2012 is not skewed by local climate conditions. Because the GPCD is calculated based upon the water use and population of the reporting agencies and there was not a geographic skew in the 2007-2012 data, it was determined that comparing the GPCD for the most recent year with the average calculated over the 2007-2016 was appropriate.

Educate and build trust between people and organizations	
INDICATOR	METRIC
Adoption of a watershed ethic	*Total gallons of potable water used per capita per day*

While total production data is available in the PWSS data, inconsistencies and potential double-counting were noted in the data. For this reason, the average GPCD was calculated using total urban delivered water instead of total water production data. The result of the trend calculation is similar using total production data.

Detailed Implementation Steps

The total GPCD for most users in the watershed was calculated based on the reported total annual potable water delivered for urban uses (residential, commercial, industrial, urban land irrigation, and other urban uses) reported in the PWSS data for each retailer, along with the total population served by each retailer.

Total annual GPCD = (urban water deliveries)*(conversion factor to convert from acre-feet to gallons) / (Population*365 [or 366 for leap year])

The 2007-2016 average GPCD was calculated by calculating the average population between 2007-2016 and the average of total delivered urban water (as defined above) during 2007-2016, then substituting those average values into the total annual GPCD equation.

Some quality control processing of the data was required to ensure data were consistent and comparable. Data quality control steps included confirming the units (acre feet versus million gallons, for example), confirming the annual value by cross-checking against a sum of monthly values, and identifying outlier data by comparing against previous years' data.

Implementation Challenges

While multiple years of data were available for this indicator, the data quality varied. Approximately 10 percent of the records used to calculate the GPCD had a quality control issue requiring adjustment. In some cases, monthly data was unavailable for select retailers. Reported monthly totals and annual totals did not align. Some data values were clear outliers, potentially indicating inaccurate data entry. Units were also sometimes mismatched (for example, gallons entered into a column which should have been reported in acre-feet).

Results

GPCD (urban water deliveries) in 2017 compared with the ten-year average (2007-2016):

Positive trend (decline of 16%, from 171 to 144)

Trend Analysis

The last available total GPCD data records water use during 2017. In 2017, on average, 144 gallons of water was delivered to urban uses per capita in the watershed each day. This rate of usage is less than the ten-year average (2007-2016) of 171 gallons per capita per day, and represents a decline of approximately 16 percent relative to the ten-year average.

Educate and build trust between people and organizations	
INDICATOR	METRIC
Adoption of a watershed ethic	*Total gallons of potable water used per capita per day*

As shown in Table **A.10-2**, this is the high end of the range of year over year percent change for the period 2007-2016, and is similar in magnitude of decline to the decrease in use between 2014-2015, when mandatory restrictions on water use were enacted statewide. For these reasons, this is considered a significant decline in water use (or increase in water conservation). Between 2016 and 2017, total urban delivery GPCD increased by approximately four gallons per day (or about three percent), within range of interannual variability.

TABLE A.10-2
GALLONS PER CAPITA PER DAY

Year	Retailers	Population	Year over year change (percent)	Gallons per Capita per Day (GPCD) a
Annual				
2007	46	4,476,497	n/a	226
2008	47	4,776,264	-13	195
2009	47	4,785,041	-4	187
2010	49	5,253,274	-10	167
2011	47	5,036,077	-1	166
2012	47	5,028,565	5	174
2013	53	5,544,576	-5	166
2014	53	5,657,352	0	167
2015	53	5,765,113	-16	141
2016	53	5,846,144	-1	139
2017	53	5,967,921	3	144
Averages				
Average of the Previous Ten Years of Data (2007-2016)a	50	5,216,132	-	171

NOTES:
[a] Prior to 2013, urban delivered water information was not required for all water retailers; for this reason, the urban delivered water volumes from 2007 to 2012 do not include data from all of the retailers that began reporting in 2013.

SOURCE: Department of Water Resources, Public Water Systems Statistics data from 2007 to 2016; State Water Resources Control Board (SWRCB), Large Water System Drinking Water Program Electronic Annual Report, data for 2017.

Going Forward

Future implementation of this metric could compare the annual value to a ten-year moving average value. As consistent data is collected, the period of the moving average could extend (for example, up to fifteen years instead of ten).

Given that the PWSS data is collected from the SWRCB Large Water System Drinking Water Program Electronic Annual Report, future implementation of this indicator would likely collect data directly from the SWRCB system instead of using the PWSS dataset. Quality control testing

Educate and build trust between people and organizations	
INDICATOR	METRIC
Adoption of a watershed ethic	*Total gallons of potable water used per capita per day*

of the reported data (in either the SWRCB system or the PWSS system) would allow for improved accuracy of this indicator in the future.

A validation step not taken with this implementation but potentially valuable in future implementations would be to compare the values from this data to the values reported in the Urban Water Management Plans of relevant agencies.

References

Department of Water Resources (DWR), Public Water Systems Statistics data from 2007 to 2016.

State Water Resources Control Board (SWRCB), Large Water System Drinking Water Program Electronic Annual Report, data for 2017.

Improve data integration, tracking and reporting to strengthen decision-making	
INDICATOR	METRIC
Broaden access to data for decision-making	*Percent of watershed population in agencies whose residential customers receive relative performance information about their water use*

Implementation Approach

This indicator recognizes that since everyone who uses water is a decision-maker, it is important to have broad and easy access to data for decision-making. Residential customer bills provide prior month water use consumption for billing purposes, but they also provide the opportunity to transmit information on how the billed usage compares to past usage, conservation or efficiency targets, or water budget amounts. The underlying assumption for this indicator is that informing water consumers how they are using water relative to past or targeted/budgeted use will improve decisions and increase efficiency. The metric for the current assessment is a simple yes/no survey of the watershed's retail water supply agencies to determine if their residential customers' bills provide relative performance information (i.e., quantitative contextual water use information the customer can compare to their current measured water use).

Output

The metric is expressed as the percentage of the total watershed population served by retail supply agencies that provide customers relative performance information about their water use on their bills.

Data Sources

The assessment is limited to the 53 retail water suppliers that have over 3,000 water meters or that serve customers over 3,000 acre-feet of potable water (i.e., retailers required to prepare Urban Water Management Plans). The population of the surveyed agencies was obtained from the population reported to the State Water Resources Control Board (SWRCB) Large Water System Drinking Water Program Electronic Annual Report. These 53 retailers serve nearly 98% of the Santa Ana River watershed's population.

The assessment was based upon information about residential customer billing found on agency web-sites, retrieved by contacting the retail agency directly by phone or email, and through information provided by their wholesale supplier.

Detailed Implementation Steps

The retailers were assessed to determine if relative water use information is provided to the customers on a bill (either hard copy or made available in a customer on-line account), or in an app, and which informs the customer about how their current measured water use compares to any of the following:

Improve data integration, tracking and reporting to strengthen decision-making	
INDICATOR	METRIC
Broaden access to data for decision-making	*Percent of watershed population in agencies whose residential customers receive relative performance information about their water use*

a) previous water use, such as the same month in the previous year, or the previous month's usage – ideally at least 3 or months, or

b) a water use target or usage/budget tier used for billing, or

c) their neighborhood use or use by similar customers.

The following steps were taken to procure the information, which was recorded on a spreadsheet as a yes/no answer based upon the above criteria.

1. Examine the retailer web-site for information about residential customer bills. A search of "how to read your bill" often displayed a copy of a generic bill.

2. If the generic bill was not available, some retailer sites described the water use information available to a customer an on-line account would provide.

This method procured the yes/no information from 38 out of the 53 retailers.

Eleven out of the 15 retailers that did not provide enough information on their web-site to make a yes/no determination were contacted by senior staff of their respective wholesale supply agency. Lisa Morgan-Perales of Inland Empire Utilities Agency (IEUA), senior water resource analyst, reached out to four IEUA retailers. All the IEUA retailers responded by phone or email after a little prodding by Lisa; agency staff who were reached by phone provided useful context information such as how their billing systems were about to be updated or that conservation targets were added to the bill during the drought. Joe Berg, Director of Water Use Efficiency Coordinator at Municipal Water District of Orange County (MWDOC), contacted seven MWDOC retailers; four of them eventually responded by email after follow-up was conducted.

The four remaining retailers were contacted by phone and email by a SAWPA intern. Two out of the four responded.

Implementation Challenges

It was expected that most retailers would provide some kind relative performance information on their residential bills. Initially the survey intended to also evaluate the different methods retailers used to provide relative water use and real-time water use information to customers, including traditional billing apps, such as Water Smart or DropCountr, or real-time usage based upon AMI/AMR systems. It was quickly determined that gathering such data would be too time-consuming without developing a formal survey with the input of SAWPA wholesalers and retailers. The time and effort to procure responses from the retailers that did not provide the needed information on their website was more than initially expected, and it was still not successful in yielding responses from five of the retailers. Although a few of the retailer websites

Improve data integration, tracking and reporting to strengthen decision-making	
INDICATOR	METRIC
Broaden access to data for decision-making	*Percent of watershed population in agencies whose residential customers receive relative performance information about their water use*

required considerable amount of searching to determine the yes or no answer, it was fortunate that the determination could be made from the websites of 70% of the retailers.

Results

The assessment found that 84% of watershed's population[1] are served by retailers that provide residential customers information on their bill about how their current water use compares to past water use and/or water use budgets or targets. The percentage is likely higher than 84%, since about 8% of the watershed population are in retail agencies that did not respond to the assessment/survey.

Trend Analysis

This is the first time the retail agencies were assessed on this topic, therefore there is no previous information available to quantitatively assess a trend for this metric. In the past decade, evidence from a few retailers suggests the adoption of conservation-focused rate structures, including water budget-based rates, mandatory water use restrictions during the drought, and retail agency efforts to promote water efficiency and meet legislative mandates to reduce per-capita use likely stimulated retailers to provide more relative water use information to residential customers, although many retailers already provided basic information about past water use on their residential customer bills.

Going Forward

The next assessment of retailers about the relative water use information provided to customers should be conducted as a survey. Consideration should be given to including multi-family residential and non-residential customer classes, as well as surveying the different methods retailers use to provide that information to the different customer classes. It would likely require a simple but well-publicized survey instrument as well identification of the right staff person at the retail supplier to whom the survey should be sent. The watershed wholesalers should also be involved in promoting the survey. The survey questions could also be designed for possible inclusion on the State Water Resources Control Board's Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR), which currently includes questions about retailer rate structures and affordability.

[1] About 2% of the population are served by retailers too small to assess.

Improve data integration, tracking and reporting to strengthen decision-making	
INDICATOR	METRIC
Participation in an open data process	*Percent of watershed population in agencies participating in establishment of a regional data sharing system*

Implementation Approach

The Data Management Pillar recognized that the first step in the process of creating a "federated" regional data sharing system in the SAWPA region is the establishment of a regional trust framework designed to establish trust between agencies as well as trust in the functionality of data management systems. Because a commitment to establish the trust framework has not yet been made, this metric cannot be quantitatively assessed. Once the commitment is made, the metric will be assessed by calculating the percentage of the total watershed population in the service areas of water supply and water management agencies participating in the trust framework.[1] After the first step of the commitment to the trust framework, the second step, establishing the regional data framework and data sharing system will be assessed. The assessment of this second step will be based upon calculating the percentage of the total watershed population by retail water suppliers that are participating in the establishment regional data sharing system. The retailer engagement is essential for federated regional data sharing since their supply and demand data are core data in the assessment of water management in region. The two steps of this metric can be combined into one score by averaging the percentage values of the two steps.

Output

The metric's first step is expressed as the percentage of the total watershed population served by the agencies that have committed to participating in the trust framework. The metric's second step is the percentage of the total watershed population served by retail water suppliers participating in the establishment of a regional data sharing system. The calculated percentages from the two steps are averaged to result in one score.

Data Sources

Information on commitment to a trust framework may ultimately be available from a formal source, but in the meantime will require communication with leaders of trust framework organizations. Similarly, identification of retail water suppliers participating in the establishment of a regional data sharing system will require communication with leaders of any emerging regional data sharing organizations.

The population of the participating retail agencies can be obtained from the population reported to the State Water Resources Control Board (SWRCB) Large Water System Drinking Water

1 The water management agencies could wastewater, flood control, and groundwater management agencies.

Improve data integration, tracking and reporting to strengthen decision-making	
INDICATOR	METRIC
Participation in an open data process	*Percent of watershed population in agencies participating in establishment of a regional data sharing system*

Program Electronic Annual Report. The participating retail agencies is not limited to the retailers that have over 3,000 water meters or that serve customers over 3,000 acre-feet of potable water (ones that file Urban Water Management Plans). The population of wholesale supply agencies and other water management agencies can be obtained from the websites of the individual agencies and SAWPA.

Detailed Implementation Steps

A detailed description of the implementation steps cannot be provided since the quantification of the metric could not be completed at this time.

Implementation Challenges

It could be a challenge to engage the small, less-resourced retail water agencies, including cities, to engage in establishing a trust framework, data management framework and a data sharing system. The better-resourced state, regional and local management agencies and regulators to whom retail suppliers are required to report need to effectively make the case that the effort will eventually create time and labor efficiencies if it reduces duplicative reporting and increases the quality of collected and reported data.

Results

The metric cannot be quantitatively assessed at this time.

Trend Analysis

Even though a trend for this metric cannot be established due to an absence of progress for this metric, it is notable that the majority of the watershed population are in wholesale and retail water supply agencies that have taken initial steps towards establishing regional data sharing systems by engaging with the implementation of the Open and Transparent Water Data Act (AB 1755) and/or participating in the California Data Collaborative.

For the current assessment, where data is lacking to show a trend, a qualitative neutral status is identified as the rating.

Going Forward

The region should look for opportunities to help stimulate the establishment of a trust framework and a federated data sharing system for the watershed. One opportunity is encouraging the watershed's water supply retailers to engage with DWR's Public Water System Statistics survey and the State Water Resources Control Board's Large Water System Drinking Water Program Electronic Annual Report (SWRCB EAR) about the water supply and demand data those reports require, to ensure that it is more usable for both State and regional planning efforts. Another opportunity may be developing a constituency for an AB 1755 use case in the watershed to 1) assist SAWPA's effort to track the progress of the OWOW Plan towards its goals with indicators and metrics, and 2) implement a California Water Plan Sustainability Outlook for the watershed, for which DWR has been supportive.

APPENDIX E

Water Supply Reliability Scenarios

WATER SUPPLY RELIABILITY SCENARIO EVALUATION

Members of the Water Resource Optimization Pillar led an effort to evaluation water supply reliability for the watershed using the scenarios given in the Urban Water Management Planning Act (Table 1) and some additional scenarios developed by the Water Resources Optimization Pillar (Table 2). The scenarios analyzed represent a snapshot in time. As new challenges and constraints to water supply reliability are identified, they will require evaluation.

Table 1. Water Supply Reliability Scenarios Provided in the Urban Water Management Planning Act

Scenario	Description
Average conditions[1]	Water supply reliability vulnerabilities, given average supplies to the region
Single-year drought[1]	Water supply reliability vulnerabilities, given a single year of drought
Multi-year drought[1]	Water supply reliability vulnerabilities, given a multi-year drought
50% reduction in imported water supplies[1]	Because the single-year drought scenario is more severe than this scenario, it was not evaluated.
Natural disaster[2]	Water supply reliability vulnerabilities if a catastrophic interruption occurs due to an earthquake or other disaster

1 Scenario presented in the Catastrophic Interruption section of the Urban Water Management Planning Act.
2 Natural disasters are included in the Catastrophic Interruption scenario noted in Table 2 and the discussion that follows the table.

Table 2. Additional Water Supply Reliability Scenarios Evaluated as Part of the OWOW Process

Scenario	Description
Catastrophic interruption:	
Earthquake	Effects of an earthquake on water supply reliability
Delta levee failure	Effects of a Delta levee failure, possibly due to earthquake, on quality and reliability of water supply
Power failure	Effects of power failure on water delivery
Wildfire	Effects of wildfire on water supply reliability
Terrorism	Effects of terrorism on water supply reliability
State Water Project deficit	Effects of SWP deficit on water supply in watershed
Climate change	Effects of climate change on water supply reliability
Quagga and/or zebra mussels	Water supply reliability vulnerabilities if the quagga mussel and/or the zebra mussel were to infiltrate the SWP
Sediment transport	Effects of sediment transport at Seven Oaks Dam and/or Prado Dam on water supply reliability
Channel armoring and sediment transport	Effects of channel armoring and sediment transport in the Santa Ana River on water supply reliability
Water quality degradation	Effects of water quality degradation on water supply reliability

SWP = State Water Project.

EVALUATION OF WATER SUPPLY RELIABILITY SCENARIOS

The evaluation of water supply reliability scenarios consisted of analyzing anticipated water supplies for each of these scenarios to determine whether they are adequate to meet the anticipated demand. If anticipated demand is less than anticipated supplies, the system is deemed reliable. If the anticipated demand is greater than anticipated supplies, water management strategies are developed to offset these deficits. These strategies are presented in Section 5.1, Water Resources Optimization, of the One Water One Watershed (OWOW) Plan Update 2018. Figure 1 provides an overview of the evaluation process.

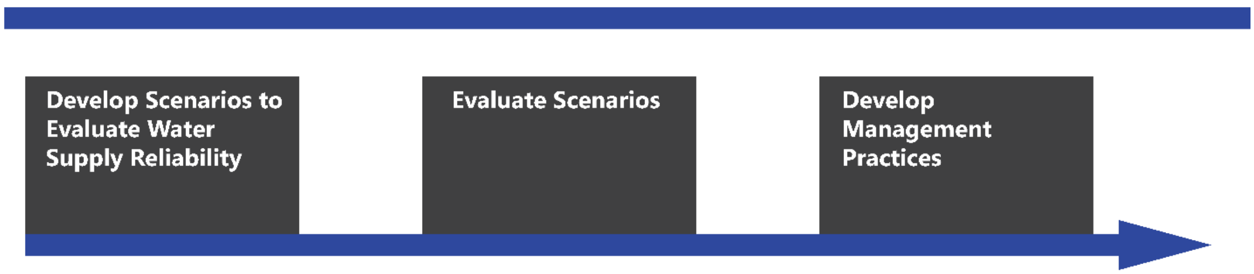


Figure 1. Overview of the Water Supply Reliability Evaluation Process

The information that was used to evaluate water supply reliability in this OWOW Plan Update 2018 comes from Urban Water Management Plans (UWMPs). The Urban Water Management Planning Act requires urban water providers to assess the reliability of their water sources over a 20-year planning horizon considering normal, dry, and multiple dry years and other scenarios and present the results in a UWMP.

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

In November 2009, SB X7-7 (Steinberg) was enacted, requiring California's urban water suppliers to reduce per capita use 10% by 2015 and 20% by 2020. This legislation has resulted in a significant reduction in demand since the previous OWOW 2.0 Plan. It is important to recognize that both the reduced demand and the anticipated supplies assume a significant investment in public works projects.

RELIABILITY MARGIN

There are many hydrologic uncertainties including future weather patterns, the effects of climate change, and possible legal restrictions that could be placed on water supplies. To help prepare for uncertainty, a reliability margin of 10% above calculated demand was used in the OWOW Plan Update 2018. The reliability margin was established at 10% to be consistent with other water budgets in the watershed.

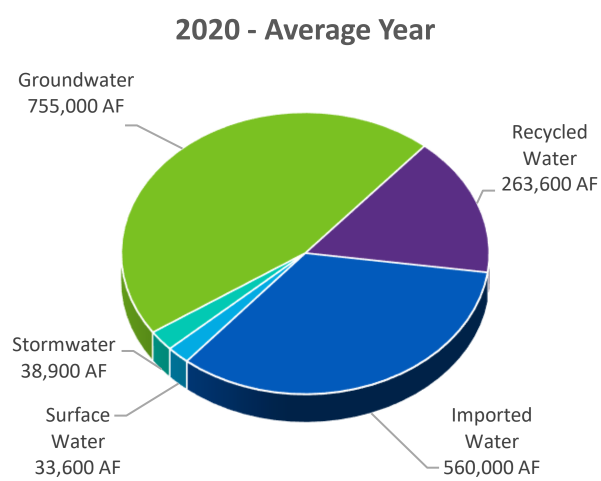
AVERAGE CONDITIONS (BASELINE)

Evaluating average water supplies provides a baseline for comparison purposes. Table 3 summarizes projected water supply sources for 2020 and 2040 under normal conditions from data presented in the 2015 UWMPs.

Table 3. Summary of Average Projected Water Supplies and Demand for Santa Ana River Watershed – Average Water Year (Acre-Feet)

Category	2020	2025	2030	2035	2040
Surface water	60,300	60,300	60,300	60,300	60,300
Stormwater	84,900	90,400	90,400	90,400	90,400
Groundwater	696,300	703,700	708,900	711,400	711,300
Recycled water	263,600	315,800	327,000	345,500	354,500
Imported water	583,300	608,400	627,300	651,800	663,000
Supply total	**1,688,400**	**1,778,600**	**1,813,900**	**1,859,400**	**1,879,500**
Demand total	**1,404,500**	**1,497,500**	**1,558,500**	**1,611,500**	**1,669,500**
Surplus/deficit	***283,900***	***281,100***	***255,400***	***247,900***	***210,000***

Local precipitation (groundwater, surface water, and stormwater) is estimated to meet about 50% of the demand. Other sources of supply and/or conservation measures are needed to meet the remaining 50% of demand.

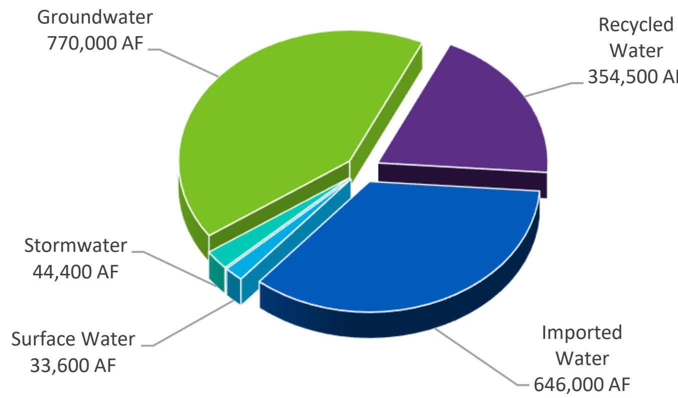


Given average hydrologic conditions, calculations show that the watershed will be able to meet its needs through 2040 including the reliability margin. However, although the watershed as a whole will be able to meet demands, San Gorgonio Pass Water Agency is projecting a 16,500 AF deficit. The watershed will need to coordinate water supply and conservation projects to overcome this deficit. The overall projections based on the 2015 UWMP data are positive and are generally based on the following assumptions (SGPWA 2017):

1. Future local precipitation patterns will be the same as past precipitation patterns (possible effects of climate change addressed later in the chapter).
2. The predicted reliability of the State Water Project (SWP) as taken from the most recent update of the California Department of Water Resources (DWR) SWP Delivery Reliability Report is accurate.

3. The watershed will store wet-year SWP supplies for use during dry years.
4. The demand estimates are accurate.
5. The watershed will invest over $4 billion in water conservation and infrastructure projects.
6. Significant investments will be made to improve the reliability of imported water supplies, including the California WaterFix.

2040 - Average Year

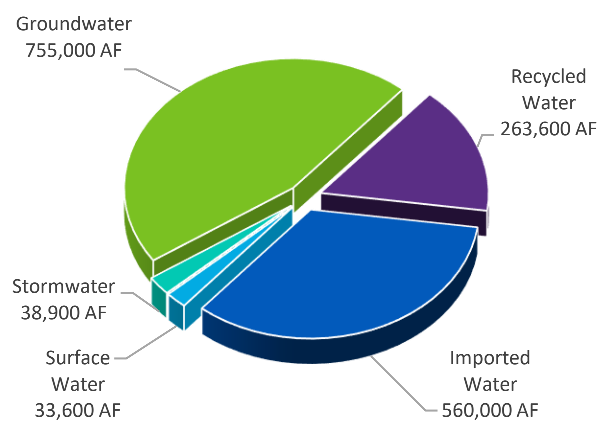


Given the uncertainty of these assumptions, the watershed should continue to strive toward efficiency and toward projects that provide redundancy in case hydrologic projections are incorrect.

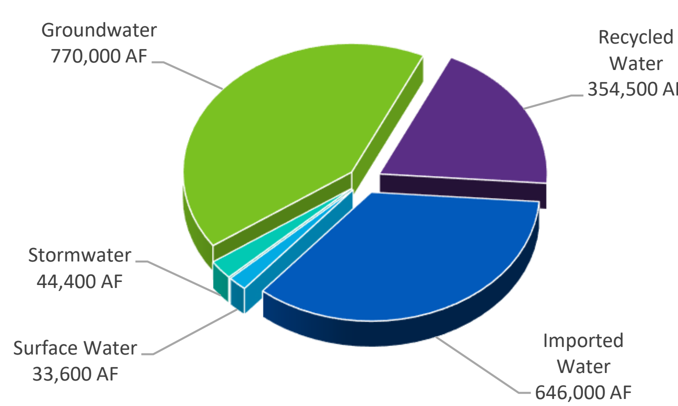
SINGLE-YEAR DROUGHT

Nearly all of the water agencies defined the single-year drought as the year that they historically received the lowest amount of imported water. The watershed will be able to meet its demands in a single-year drought, including the reliability margin. The watershed will be able to make it through a single-year drought by relying on the various imported water storage programs, which store water when it is available during wet periods for use during drought periods, and on recycled water, which is not impacted by drought. Although the watershed as a whole has enough supply to meet demand during a single-year drought, San Gorgonio Pass Water Agency (SGPWA) projects a shortage of 27,000 AF in a single year of drought. Much of this deficit would be met by taking groundwater out of storage in the SGPWA service area.

2020 - Single Year Drought

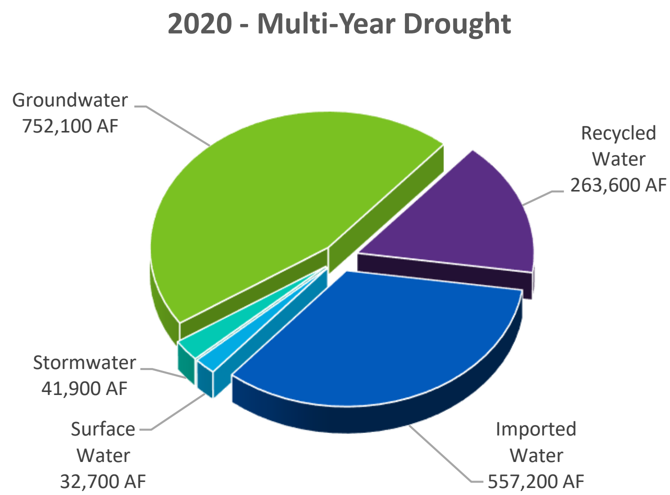


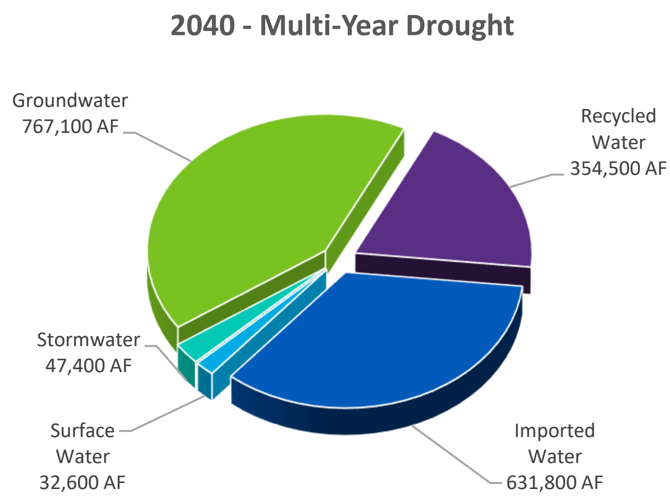
2040 - Single Year Drought



MULTI-YEAR DROUGHT

This scenario evaluates the water supply reliability for the watershed assuming a multi-year (3-year) drought. For their UWMP development, nearly all of the water agencies chose a 3-year period that had the lowest historic delivery of imported water. Although a 3-year drought lasts longer than a single-year drought, the average SWP entitlement available during multi-year drought is slightly higher than the SWP entitlement available during a single-year drought. The watershed will be able to meet its needs during a multi-year drought, due mostly to storage programs that stock water in wet years. However, despite the overall ability to meet demand, SGPWA is expecting a deficit of about 23,000 AF during a multi-year drought. Much of this would be met by withdrawing groundwater from storage in the SGPWA service area (USARW IRWM Region 2015).





EFFECTS OF A CATASTROPHIC INTERRUPTION IN WATER SUPPLIES

The water system that serves both local and imported water to the watershed consists of a variety of facilities, including pipes, canals, wells, and levees, all of which are susceptible to damage or failure from a catastrophic event. The catastrophic events that were evaluated as part of the OWOW process are earthquake, Sacramento–San Joaquin Bay Delta (Delta) levee failure, power failure, wildfire, and terrorism. While catastrophic events may not be avoided entirely, measures can be developed and set in place to minimize the interruption to water service following a catastrophic event. These measures include assessing the vulnerability of systems, quantifying available resources and existing statewide support programs/opportunities, determining optimal use of resources, increasing the flexibility of distribution systems, increasing regional coordination, and establishing repair priorities.

Effects of an Earthquake on Water Supplies

The watershed is located within a seismically active region of Southern California. As shown on Figure 2, six active major earthquake faults and a number of smaller faults extend through the watershed. A seismic event along one of the major active faults in the watershed could result in an earthquake in the range of magnitude 6.0 to 8.0 on the Richter scale.

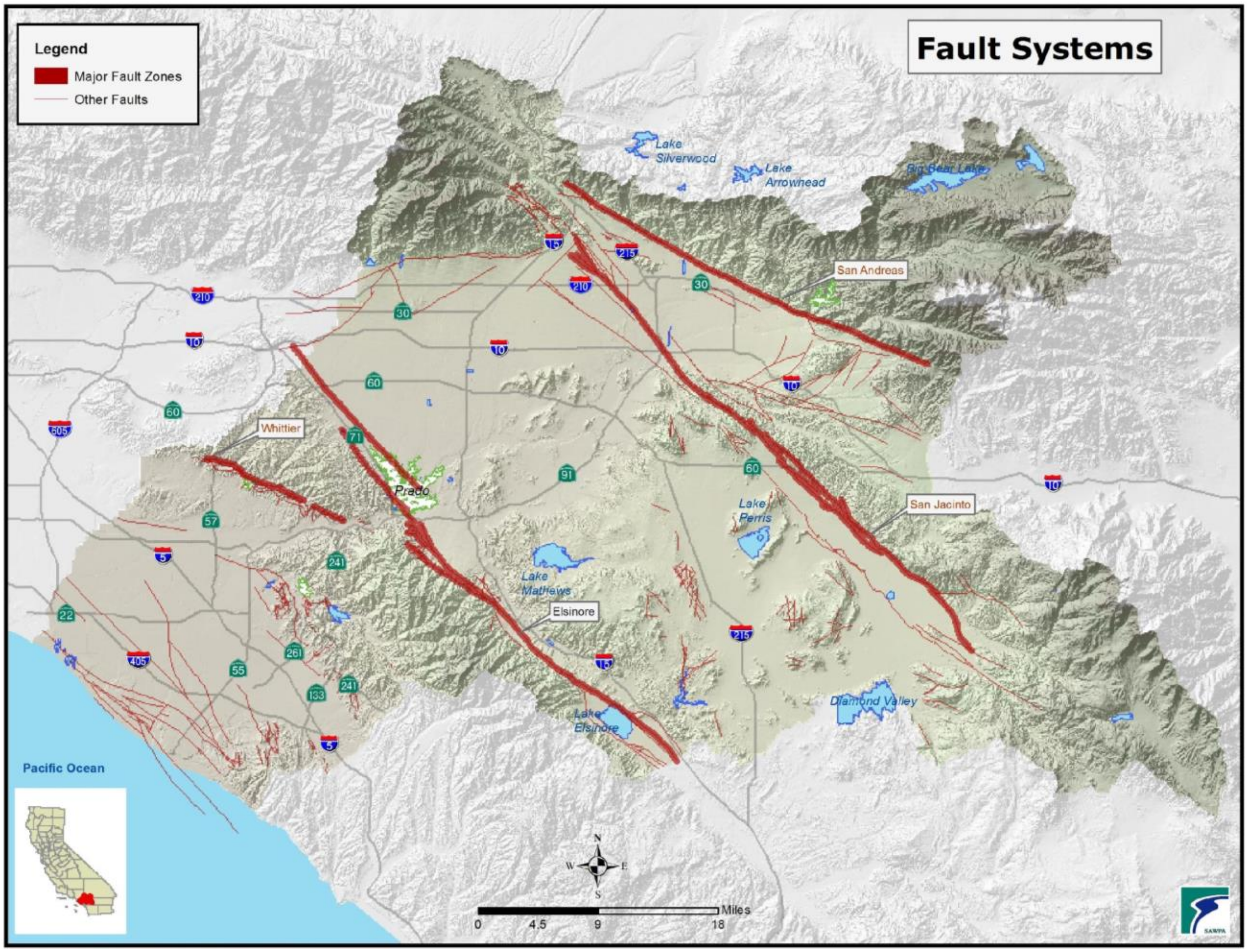


Figure 2. Fault Systems in the Santa Ana River Watershed

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

The Municipal Water District of Orange County (MWDOC) conducted an evaluation of system needs for each water provider in Orange County based on technical work by seismic experts (MWDOC 2016). The evaluation used the most recent information regarding ground motion from known earthquake faults, groundwater wells, and imported water facilities to determine what backup water supplies and power facilities would be needed. The results of this evaluation indicated that no backup water supplies were needed in the portion of Orange County within the watershed, because there is sufficient flexibility built into the system. For instance, MWDOC can get imported water to water providers when groundwater wells are down or use groundwater wells when imported water facilities are down—note that different faults created different seismic scenarios, and no scenario had resulted in an outage of both wells and key imported water facilities. However, it was recommended that additional backup power be provided at key facilities in the event of a major seismic event that could cause both groundwater wells and imported supplies to be disrupted.

Effects of a Delta Levee Failure on Water Supplies

The Sacramento–San Joaquin Bay Delta (Delta) is a region where two of California's largest rivers, the Sacramento River and the San Joaquin River, meet. It is the hub of the state's water supply system. The structural integrity of the Delta levee system is vital to maintaining water supplies to Southern California. However, the Delta levee system is aging, and a considerable amount of the land along the Delta levee system has subsided below sea level. The earthen levees are subject to risk from earthquakes, flooding, and saltwater intrusion. Catastrophic damage sustained by the levees would result in interruptions to SWP supplies to the watershed due mostly to saltwater intrusion. The New Orleans levee failures caused by Hurricane Katrina raised awareness of the severe consequences and export outages that would occur with catastrophic multi-island levee failures resulting from a severe earthquake in the Sacramento–San Joaquin Bay Delta region.

A severe earthquake in the Delta region would result in multiple levee breaches and slumping, causing multi-island failures. There would be extensive levee slumping and overtopping resulting from liquefaction of levee foundations, severely hampering levee restoration efforts. This failure scenario would allow excessive salinity to enter the central and south Delta, increasing salinity at the export pumps significantly beyond levels that are acceptable for municipal and agricultural uses. Restoring water quality at the pumps would be difficult because of how water flows through the Delta, pushing out the saline water could take decades, and there is no infrastructural solution.

For example, a June 2005 report prepared by Jack Benjamin and Associates for the California Bay–Delta Authority and DWR indicates that a 6.7 magnitude earthquake in the western Delta would generate an approximately 20-island failure scenario and a 28-month water supply disruption in the Delta before levees could be restored to their current state. There is a 66% probability that a 6.5 magnitude earthquake will occur in the Delta region by 2032 or within the next 20 years (CBDA and DWR 2005). Further, one or more dry years immediately before or within the disruption period would substantially increase economic impacts and may lengthen the disruption period due to less availability of freshwater in the Delta.

Assuming a 28-month repair period, the effects of this catastrophic interruption would be similar to a multi-year drought. Thus, the strategies that are implemented to offset the effects of a multi-year drought also would be helpful to offset this event. Should the levee failure(s) occur after a drought period when stored water supplies are severely depleted, other emergency strategies would need to be implemented, such as extreme conservation and mandatory rationing.

The 2014 DWR Delta Flood Emergency Management Plan studies suggest that, depending on hydrologic conditions, after a catastrophic multi-island levee failure it would take several years to reduce salinity concentrations to the level necessary for municipal water quality needs at the export pumps. Analyses indicate that reservoir releases alone could not restore adequate water quality at the export pumps for municipal use.

The Metropolitan Board developed a comprehensive emergency preparedness and response strategy to safeguard water exports from the Delta by restoring an emergency freshwater pathway through the Delta, generally along Middle River, to water export facilities in the south Delta in approximately 6 months. This strategy includes levee improvements on pathway levees to reduce levee slumping and breaches and pre-placement of emergency material stockpiles for closure of breaches. Both pathway levee improvements and preparedness stockpiles have been initiated and will continue to completion in the next several years.

Effects of a Power Failure on Water Supplies

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

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

Effects of Wildfire on Water Supplies

Wildfire can damage water delivery facilities, or the power infrastructure used by water facilities. From 2003 to 2016, more than 470,000 acres have burned in the watershed. In addition, the loss of vegetation resulting from a wildfire can change runoff patterns, increase sediment, and reduce water storage. There also are potential water quality concerns associated with ash falling into surface reservoirs, which could overwhelm filtration plants as turbidities increase by orders of magnitude.

Effects of Terrorism on Water Supplies

There is always a possibility that water infrastructure could be targeted by terrorists. Water agencies have responded to this potential threat by reducing public access to information about infrastructure and to water infrastructure itself, which has entailed increasing security measures at their facilities.

RELIABILITY OF STATE WATER PROJECT SUPPLY

The 2015 DWR SWP Delivery Capability Report (DCR) provides estimates of SWP water supply availability under both current and future conditions. The 2015 DCR uses the following assumptions to model current conditions: existing facilities, hydrologic inflows to the model based on 82 years of historical inflows (1922 through 2003), current regulatory and operational constraints, and contractor demands at maximum Table A amounts (the maximum amount of SWP water a contractor may request annually; see DWR 2018).

Most of the UWMPs use the Early Long Term scenario in the 2015 DCR to estimate future SWP supply availability because it is based on existing facilities and regulatory constraints, with hydrology adjusted for the expected effects of climate change.

The estimated long-term average availability for San Bernardino Valley Municipal Water District (SBVMWD) from the 2015 DCR is shown in Table 4.

Table 4. Wholesale Water Supplies Available (Long-Term Average)

Wholesaler (Supply Source)	2020	2025	2030	2035	2040
State Water Project					
Percentage of total amount available	61%	61%	61%	61%	61%

Source: DWR 2015.

Table 5 summarizes estimated SWP supply availability in a single dry year (based on a repeat of the worst-case historic hydrologic conditions of 2014) and over a multiple-dry-year period (based on a repeat of the worst-case historic 4-year drought of 1931 to 1934). The table also shows estimated delivery in a wet year, based on a repeat of the hydrologic conditions of 1983.

Table 5. Estimated Wholesale Supply Reliability

Wholesale	Single Wet Year (1983)	Single Dry Year (2014)	Multiple Dry Year (1931–1934)
State Water Project			
Percentage of total amount available	98%	5%	33%

Source: DWR 2015.

The "optimize imported water" strategy (see Section 5.1.2, Recommended Management Strategies, of the OWOW Plan Update 2018) would entail storing SWP water that is available in wet years so that it can be used in dry years.

EFFECTS OF CLIMATE CHANGE ON WATER SUPPLIES

Climate change could have an impact on water supply reliability. In a recent report, the U.S. Department of the Interior Bureau of Reclamation (Reclamation) provides potential impacts, including reduction in snowpack, changes in the timing and amount of runoff, changes in the frequency and magnitude of extreme storm events, increased watershed vegetation demands due to higher evapotranspiration rates, changes in future agriculture and urban water demands, changes in sea level rise, and increased potential for saltwater intrusion to the Delta and groundwater basins near the coast.

EFFECTS OF QUAGGA AND/OR ZEBRA MUSSELS ON WATER SUPPLIES

Quagga mussels (*Dreissena bugensis*) were discovered in Lake Mead in January 2007 and rapidly spread throughout the lower Colorado River and Metropolitan's Colorado River Aqueduct system. Quagga mussels are indigenous to the Ukraine and are related to the better-known zebra mussels (*Dreissena polymorpha*). Similar to the zebra mussel, which was most likely introduced to the Great Lakes in the late 1980s via ship ballast water, the quagga mussel was introduced to Lake Mead most probably through the translocation of boats. Although the introduction of these two species into drinking water supplies does not typically result in violation of drinking water standards, invasive mussel infestations can adversely impact aquatic environments. Two areas of relevance for aquatic environments used as sources of drinking water are (1) the potential for clogging of intakes and raw water conveyance systems by large numbers of mussels attaching to surfaces and (2) a long-term potential for making lakes more susceptible to damaging algae blooms. Control of mussel infestations can cost water conveyance systems millions of dollars annually. Quagga mussels have infested water conveyance systems linked to the lower Colorado River. There is concern that quagga mussels could become more widespread and infest the SWP system and other watersheds, transferred by boats and other watercraft. Preventive measures implemented include boat inspections prior to boats entering un-infested water bodies and decontamination (clean, drain, and dry) of vessels departing infested water bodies. Metropolitan, DWR, and the California Department of Fish and Wildlife implement programs to monitor for the presence of quagga mussels in imported water supplies, and if needed, develop response plans to reduce the risk of spread of quagga mussels.

EFFECTS OF SANTA ANA RIVER CHANNEL ARMORING AND SEDIMENT TRANSPORT

The Santa Ana River is a productive natural recharge facility that helps replenish the watershed's groundwater basins. The transport and deposition of sediment along the Santa Ana River is critical to maintaining existing groundwater recharge capacity. A sandy river bottom with naturally deposited sand and gravel allows surface water to percolate easily into the groundwater basin and maximizes recharge rates. If the natural sediment transport process of the river is interrupted and the sediment grain size distribution of the river bottom changes, the recharge capacity of the river bottom can be reduced.

The transport and deposition of sand within the Santa Ana River is interrupted when it is trapped by flood risk management facilities such as Seven Oaks Dam and Prado Dam. Seven Oaks Dam traps sediment at the base of the San Bernardino Mountains while Prado Dam traps sediment just upstream of Orange County. This sand entrapment causes negative impacts on the recharge capacity of the riverbed downstream of both dams. Flood risk management structures such as debris basins on tributaries to the Santa Ana River also affect sediment transport in the watershed.

In addition, as the sand moves downstream without being replaced by upstream deposits, the substrate gradually transitions from soft to coarse, which includes a larger amount of heavier material such as gravel and cobbles. The gravel and cobbles eventually interlock with fine sediments and form a hard, armored layer. This process, referred to as "channel armoring," can reduce the recharge rate of the river and tributaries. A Groundwater Recharge Study prepared by OCWD estimates that the armoring of the Santa Ana River has resulted in a loss of percolation of about 1% per year (OCWD 2013). With a long-term degradation of recharge rates, longer stretches of the river would be needed to recharge the same amount of water that is recharged today, or some other kind of mitigation would be required. Changes in sediment characteristics of the river bottom can also affect natural resources, such as fish like the Santa Ana sucker (*Catostomus santaanae*).

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

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

EFFECTS OF WATER QUALITY DEGRADATION ON WATER SUPPLIES

Water supply reliability in the watershed can be improved by reinstating local water resources that have been avoided due to water quality issues, such as high concentrations of salt. In the past, rather than extracting and treating this poorer quality water, many groundwater producers chose to replace it with other sources of water that did not require treatment. This same approach also has been used in groundwater basins that were polluted by volatile organic compounds (VOCs) and other contaminants. If, instead, these local resources were to be treated and used, they effectively would become new sources of water within the watershed, which would increase water supply reliability.

SUMMARY OF WATER SUPPLY RELIABILITY EVALUATION RESULTS

The water supply reliability scenarios that were evaluated as part of this analysis can be divided into two general categories: short-term impacts and long-term impacts. Table 6 summarizes the two general categories. Those in the short-term category are difficult to quantify. Those in the long-term category are more easily quantified, with the exception of climate change, sediment transport, and channel armoring, which are still under investigation. However, all of the recommended water management strategies to help the watershed overcome the long-term impacts will also help the watershed endure the short-term impacts.

Table 6. Summary of Water Supply Reliability Scenarios

Short-Term Impacts	Long-Term Impacts
Changed average hydrologic conditions due to: Earthquake Delta levee failure Power failure Wildfire Terrorism State Water Project deficit Quagga and/or zebra mussels	Average hydrologic conditions Single-year drought hydrologic conditions Multi-year drought hydrologic conditions Climate change Sediment transport Channel armoring Water quality degradation

Due to the uncertainty tied to seismic events, power outages, wildfires, and terrorist attacks, it is not possible to determine the exact impacts on water supply. However, the watershed can implement strategies that will better prepare the watershed for such events. From a water management perspective, the strategies that increase reliability without climate change will also increase reliability with climate change. As a result, there are no specific strategies targeting climate change. To plan for this and other unknowns, the watershed has implemented a reliability margin of 10%.

Water supply reliability in the watershed will be challenged by multi-year droughts, droughts on the Colorado River, limited local water resources, the vulnerability of the Delta, and the threat of climate change. In addition, vulnerabilities in regional and statewide infrastructure could increase due to catastrophic interruptions. Designing a diverse and flexible water supply portfolio will help to ensure water reliability and a sustainable and vibrant economy for the watershed.

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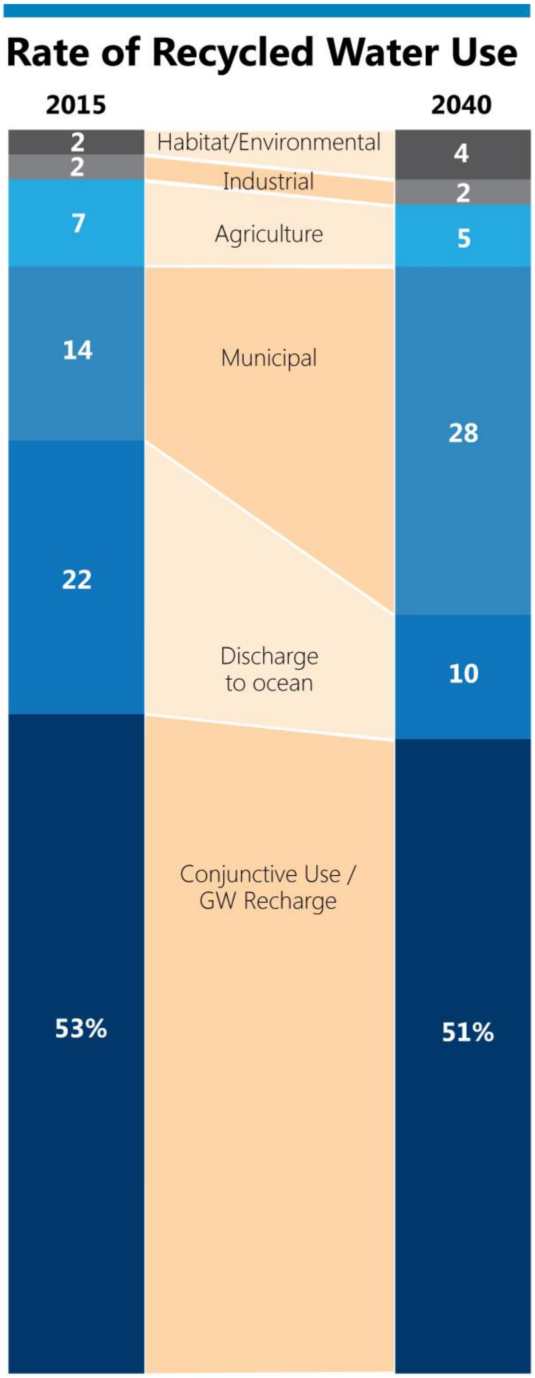
APPENDIX F

Analysis of Water Recycling, Today and Tomorrow

CURRENT CONDITIONS IN THE WATERSHED



Note: 2015 data reflects 2018 update.
2040 data update in progress

Figure 1. Comparison of Average Projected Recycled Water Use for 2020 and 2040

Recycled water has long been used in the watershed to supplement local and imported potable supplies. Currently, more than 285,000 acre-feet per year (AFY) of recycled water is being used to meet groundwater recharge (53%), municipal (14%), agricultural irrigation (7%), industrial (2%), and habitat and environmental (2%) water needs within the watershed (see Figure 1). The 285,000 AFY includes approximately 65,000 AFY of tertiary-treated wastewater that flows down the Santa Ana River from the upper watershed to Orange County, where it is recharged by OCWD in surface recharge basins in Anaheim and Orange. OCWD generally captures all the river flows, except during periods of high storm flow. As seen in Figure 1, only 22% of recycled water in the watershed, or 100,000 acre-feet (AF), is currently being discharged to the ocean.

The 65,000 AFY is considerably more than the 42,000 AF at Prado Dam required by the 1969 Orange County Judgment. As demands continue to increase and other supplies become less reliable, the upper watershed has plans to increase recycling. Over time, OCWD would have to compensate for any reduction in treated wastewater flow in the Santa Ana River by recycling more of the wastewater that flows into the ocean, importing more water, desalting ocean water, or finding some other new source of supply. Tables 5a.8 through 5a.11 of Appendix C show the proposed increase in recycled water use in the upper watershed from 2020 through 2040.

Figure 2 shows the recycled water systems in the watershed, including existing and proposed recycled water pipelines, wastewater treatment plants and storage tanks, existing storage ponds, and the Inland Empire Brine Line.

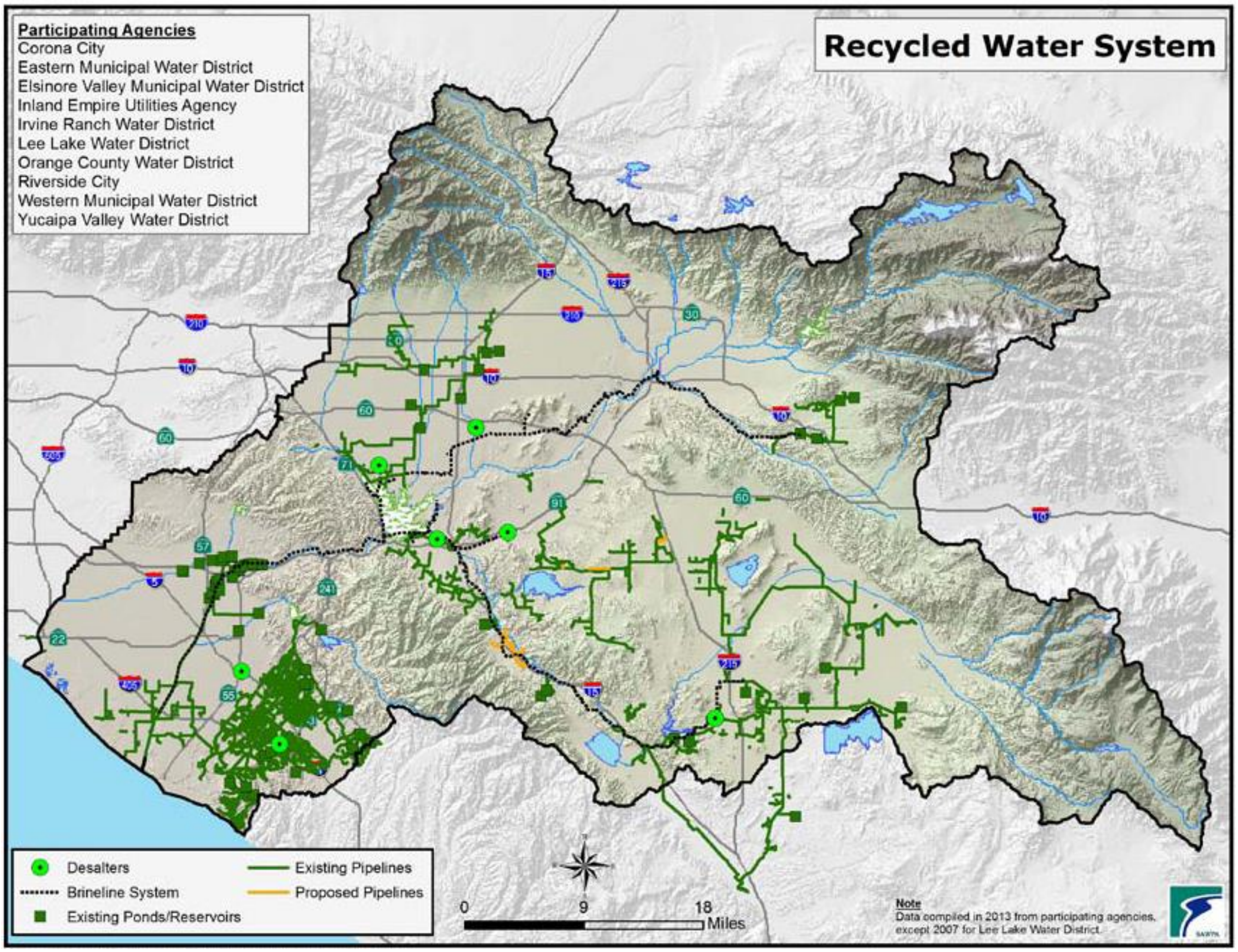


Figure 2. Major Recycled Water Infrastructure in the Santa Ana River Watershed

PROPOSED RECYCLED USE

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

Current projections for 2040 indicate that 438,000 AFY of water treatment plant flows will be recycled in the watershed and 50,000 AFY will be discharged into the ocean (see Figure 1). Current management strategies include the planned and conceptual recycled water projects described in the following paragraphs.

EMWD completed a major planning effort with the completion of its Recycled Water Strategic Plan and Recycled Water Facilities Master Plan in 2016. These studies identified preferred strategic alternatives and the associated facilities required for implementation through 2045. A primary goal is to maintain the EMWD's 100% beneficial reuse of recycled water. EMWD plans to make significant investment in the development of an Indirect Potable Reuse project, which would use advanced treated recycled water for recharge in the Hemet/San Jacinto Groundwater Management Area. Phase 1 of EMWD's Indirect Potable Reuse project is expected to recharge 5,000 AF annually, expanding to 21,300 AF annually with the completion of Phase 3 by 2045. Other elements include the optimization of EMWD's ability to store excess recycled water during winter months, when demand is low, for use during summer months, when demand is high. EMWD recently increased its recycled water storage capacity with the completion of North Trumble Pond and the completion of several shallow recovery wells to capture incidental losses from its unlined Winchester Ponds storage facilities.

City of Riverside. The State Board approved the City of Riverside's wastewater change petition on May 20, 2008. The primary condition of the 2008 wastewater petition order (order) requires that the City of Riverside discharge not less than 25,000 AFY of treated wastewater from its Regional Water Quality Control Plant to the Santa Ana River. The order also modified the purpose of recycled water use to include municipal, industrial, and agricultural purposes and expanded the place of use to include areas within the City limits, the City's water service area boundary, and the boundary of the Jurupa Area Plan to reflect diversion of treated wastewater to recycled water use sites. To be able to meet these future projected needs without increasing the City of Riverside's reliance on imported SWP purchases, it will be critical for the City of Riverside to significantly expand its use of the recycled water recently made available. In May 2013, the Regional Board adopted Order No. R8-2013-0028 granting the City of Riverside Public Utilities a waste discharge requirement and master reclamation permit for distributing recycled water.

IEUA and its member agencies have developed a successful regional recycled water program for both direct irrigation uses and groundwater recharge. In 2000, the region identified recycled water use as a critical component in drought proofing and maintaining its economic growth. With increasing imported water rates and declining long-term imported supply reliability, the region committed to proactively developing local water supplies. This set the path for the development of a regional recycled water distribution system. In 2016–2017, IEUA's service area used 33,411 AF of recycled water.

As the recycled water program continues to advance, the service area reevaluates capital improvement needs. In 2015, IEUA completed the Recycled Water Program Strategy. This document updated the 2005 Recycled Water Implementation Plan and the 2007 Recycled Water Three Year Business Plan. The primary objective of the Recycled Water Program Strategy was to identify improvements needed to maximize the use of recycled water to achieve delivery of 50,000 AFY by 2025. The capital program emphasized on increasing system storage and maximizing deliveries to groundwater recharge basins.

Temescal Valley Water District has completed a recycled water master plan that will allow for the connection of the local parks and schools in the near future. They also have partnered with the City of Corona in its 2008 Groundwater Management Plan for the basins underlying Temescal Valley Water District's boundaries. Temescal Valley Water District currently is investigating potential groundwater recharge options.

OCWD and OCSD jointly developed the Groundwater Replenishment System (GWRS). In 2011, the GWRS produced 72,000 AF of recycled water. OCWD constructed the initial expansion of the GWRS. This project increased the amount of water produced by 31,000 AFY. When construction was completed in 2014, the total amount of water produced by the GWRS was 103,000 AFY. OCWD has committed to a final expansion of the GWRS that is projected to begin construction in 2019 and be completed by 2023. Implementation of this additional expansion of the GWRS would increase treatment capacity and further reduce the amount of effluent discharged into the ocean. This expansion of the GWRS constitutes a new regional water source that would increase the net overall supply of water to the watershed.

SBVMWD completed its Regional Recycled Water Concept Study (RRWC Study) in 2016. The goal of the RRWC Study was to work with partner agencies to identify and evaluate potential recycled water projects. Agencies participating in the RRWC Study in conjunction with SBVMWD included the City of Colton, City of Redlands, City of Rialto, City of Riverside Public Utilities, City of San Bernardino Municipal Water Department, EVWD, San Bernardino County Special Districts Department, West Valley Water District, Western Municipal Water District (WMWD), and Yucaipa Valley Water District (YVWD). Projects were evaluated, ranked, and prioritized using a Triple Bottom Line approach based on economic, social, and environmental criteria. The RRWC Study sought to identify 40,000 AF of new recycled water supply by 2040, with a near-term yield of 11,000–13,000 AF.

SBVMWD and its partner agencies identified 11 conceptual recycled water projects for the RRWC Study. The results of the Triple Bottom Line analysis indicated that the implementation of the five highest-ranked projects would yield a total of approximately 13,670 AF, meeting the near-term target. These projects span multiple agencies and include habitat mitigation activities, non-potable reuse, and groundwater recharge.

WMWD continues to expand its recycled water system, adding new customers while supplying recycled water from the Western Water Recycling Facility. The plant is capable of producing up to 3 million gallons per day (mgd) of tertiary-treated recycled water with the potential to expand to 5 mgd.

WMWD's recycled water customer base continues to expand in both commercial and residential areas. WMWD has successfully retrofitted all landscape irrigation in a 600-acre commercial area to recycled water and is in the process of adding recycled-water landscape irrigation in an additional 450 acres of new commercial area with co-located parks and open space. New residential development will add over 76 acres of new landscape areas irrigated with recycled water. Additionally, an expansion of the Riverside National Cemetery on Van Buren Boulevard in Riverside will expand the area irrigated by recycled water by an additional 350 acres. The Phase 5 Gravesite Expansion and Cemetery Improvements Project filed for construction approval in March 2018.

WMWD successfully implemented a program to use recycled water for construction purposes during the height of the drought. This program saved an estimated 3% of WMWD's potable water demand in 2015 and continues to protect WMWD's potable water supply.

Finally, WMWD will soon be recharging a local groundwater basin using stormwater, with the intent to transition to recycled water in the new future. As total summer irrigation demands likely will exceed recycled water supply, recharge will probably be limited to the winter months. Close coordination with the Regional Board and the State Board's Division of Drinking Water will be required.

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

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

BARRIERS AND CONSTRAINTS

Challenges related to recycling projects include regulatory requirements, Inland Empire Brine Line capacity constraints, storage/seasonal constraints, financial constraints, water quality management, and public perception. These constraints are discussed below.

REGULATORY REQUIREMENTS

The State Board supports and encourages the sustainable use of recycled water to promote conservation of water resources. The Policy for Water Quality Control for Recycled Water (Recycled Water Policy) is an important element of the overall effort to encourage the safe use of recycled water in a manner that is protective of public health and the environment.

The Recycled Water Policy provides goals for recycled water use in California, guidance for use of recycled water that considers protection of water quality, criteria for streamlined permitting of recycled water projects, and requirements for monitoring recycled water for constituents of emerging concern. Additional information on the Recycled Water Policy is available at https://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/.

STORAGE/SEASONAL CONSTRAINTS

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

FINANCIAL CONSTRAINTS

The cost of infrastructure to produce, store, and distribute recycled water is high. Given that demand for recycled water is scattered throughout communities, recycled water distribution pipelines are built only where the demand justifies the expense and where customers agree to use recycled water. This is especially true where sites need to be retrofitted to use recycled water, as opposed to newly constructed sites where rules may dictate its use.

Costs associated with recycled water use include retrofitting of existing systems, required inspections and cross-connection shutdown testing, employee training, and site maintenance. Administrative requirements include extensive permitting, recordkeeping, and reporting requirements. Each use area also must have a site supervisor who is familiar with the use area system and recycled water use restrictions. Many agencies are unable to charge enough to cover the true cost to produce this high-quality water, due to the stigma attached to recycled water.

WATER QUALITY MANAGEMENT

Higher TDS source water, such as Colorado River water (up to an average of 650 milligrams per liter (mg/L) TDS), adds cost because TDS removal, or demineralization, requires energy-intensive reverse osmosis. Residential use of water typically adds 200 to 300 mg/L of TDS to the wastewater stream, and self-regenerating water softeners can add another 60 to 100 mg/L. High TDS in recycled water is problematic for industrial customers and makes water virtually unusable for many agricultural customers. Nutrients such as nitrate also present similar issues.

PUBLIC PERCEPTION

Public perception of recycled water is changing. One successful example of this is OCWD's GWRS project, which used widespread public outreach activities involving the scientific, political, and other communities to inform the public and address potential public perception issues.

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APPENDIX G

Subregional Plans

SUBREGIONAL PLANS

Water and land managers throughout the watershed make plans to drive investments and future operations. Some plans, like Urban Water Management Plans, are mandated by the state, while some are completed voluntarily. Others are collaborative planning efforts, integrated plans either in name or in principle. The Santa Ana River Watershed benefits from the work these plans set in motion, and the long-term sustainability of water management in the watershed in many ways will come primarily from those planning efforts.

The OWOW Plan Update 2018 thinks at the scale of the entire watershed, which is made up of all the smaller areas that the other plans consider. Only the Basin Plan of the Santa Ana Regional Board considers the same geographic extent as the OWOW Program. The OWOW Plan Update 2018, however, is unlike the subregional plans and the Basin Plan in that it considers a broad set of interrelated issues, all critical to the sustainability of the watershed. In this effort to broadly define what is important to managing the watershed sustainably, the OWOW Plan Update 2018 relies on all the subregional plans that grapple with some aspect that the OWOW Program knows is important.

A list of subregional plans and plans that impact an area larger than the watershed that are related to the goals and objectives selected by the stakeholders of the OWOW Plan Update 2018 process is included below. This list is in no way exhaustive; because of the extent of the watershed is so great both in size and in population, including every plan is impossible. The OWOW Program page at www.sawpa.org will maintain a living list of related plans that are completed in the watershed.

Referencing other plans is an important acknowledgment that the OWOW Plan Update 2018 is an (upside-down) umbrella, supporting these other planning efforts by reflecting their interrelationships and encouraging actions that will achieve multiple objectives scattered across the subregional plans. For example, a general plan may consider the restoration of a creek as a recreational asset, while a stormwater resource management plan may consider that same creek as an infiltration opportunity. The OWOW Plan Update 2018 encourages the entities pursuing those two efforts to collaborate and ensure that the project achieves both goals. In this way the OWOW Plan Update 2018 suggests that, if the subregional plans are carried out, particularly in an integrated way built on partnerships, the overall goals in the watershed can be achieved.

Other plans whose “owners” approached the OWOW Steering Committee to take official action to include a subregional plan in the OWOW Plan Update 2018 are designated in the table below. Some of these requests are driven by state policy (the stormwater resource management plans), and some are driven by the decision to align with and share support between the included plan and the OWOW Plan Update 2018.

Plan Name (alphabetical)	Organization	Link	Included by OWOW Steering Committee?
2015 San Bernardino Valley Regional Urban Water Management Plan	San Bernardino Valley Municipal Water District led collaborative effort	http://www.sbvmwd.com/home/showdocument?id=4196	
2016 Chino Basin Storm Water Resources Plan: Functional Equivalency Document	Chino Basin Watermaster	https://www.ieua.org/stormwater-resources-plan/	Yes
Alluvial Fan Task Force Findings and Recommendations Report	California Department of Water Resources	https://aftf.csusb.edu/	
California Ocean Plan	State Water Resources Control Board	https://www.waterboards.ca.gov/water_issues/programs/ocean/	
California Water Plan Update 2018	California Department of Water Resources	https://water.ca.gov/Programs/California-Water-Plan	
Cleveland National Forest Land Management Plan	United States Department of Agriculture Forest Service	https://www.fs.usda.gov/main/cleveland/landmanagement/planning	
Hemet / San Jacinto Groundwater Management Area Water Management Plan	Eastern Municipal Water District led collaborative effort	https://www.dropbox.com/sh/ok0kxmphpt4ymtv/AAA27jxXikBfgOqSAynredWka/Reports?dl=0&preview=Water+Management+Plan.pdf&subfolder_nav_tracking=1	
Integrated Water Resources Plan	Inland Empire Utilities Agency	https://www.ieua.org/download/draft-irp-3-23-16/	
Integrated Water Resources Plan	Metropolitan Water District of Southern California	http://www.mwdh2o.com/AboutYourWater/Planning/Planning-Documents	
Land Management Plan for San Bernardino National Forest	United States Department of Agriculture Forest Service	https://www.fs.usda.gov/main/sbnf/landmanagement/planning	
Long-Term Facilities Plan	Orange County Water District	https://www.ocwd.com/what-we-do/sound-planning/long-term-facilities-plan/	
Natural Community Conservation Plan / Habitat Conservation Plan for the Central and Coastal Subregion of Orange County	Natural Communities Coalition	https://occonservation.org/about-ncc/	
Newport Bay Watershed Idea Book	Newport Bay Conservancy	http://newportbay.org/watershed/watershed-coordinator/	Yes

Plan Name (alphabetical)	Organization	Link	Included by OWOW Steering Committee?
North and Central Orange County Watershed Management Area Integrated Regional Water Management Plan	Orange County Public Works	http://www.ocwatersheds.com/programs/ourws/wmaareas	
Orange County Stormwater Resource Plan	Orange County Public Works	http://www.ocwatersheds.com/programs/ourws/oc_stormwater_resource_plan	Yes
Orange County Tails Master Plan	Parks and Recreation Division of Orange County	https://www.orangecountyfl.net/Portals/0/Library/Culture-Recreation/docs/Orange%20County%20Trails%20Master%20Plan.pdf	
Riverside Arroyo Watershed Policy Study Recommendations	County of Riverside City of Riverside	https://riversideca.gov/planning/pdf/ArroyoReportFromCommittee.pdf	
San Bernardino County Stormwater Resource Plan	San Bernardino County Flood Control District	http://cms.sbcounty.gov/dpw/FloodControl/SantaAnaRiverWatershedStormwaterResourcePlan.aspx	Yes
Santa Ana River Parkway and Open Space Plan	California Coastal Conservancy	http://scc.ca.gov/files/2018/06/SARPOSP_Plan_FINAL.pdf	Yes
Upper Santa Ana River Integrated Regional Water Management Plan	San Bernardino Valley Municipal Water District	https://www.sbvwcd.org/our-projects/upper-santa-ana-integrated-regional-water-management-plan.html	
Water Control Plan for the Santa Ana River Basin	Santa Ana Regional Water Quality Control Board	https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/	
Western Riverside County Multiple Species Habitat Conservation Plan	Regional Conservation Authority of Western Riverside County	http://www.wrc-rca.org/about-rca/multiple-species-habitat-conservation-plan/	

APPENDIX H

Bureau of Reclamation Climate Change Analyses for the Santa Ana River Watershed

WHAT WILL CLIMATE IMPACTS BE ON THE SKI INDUSTRY IN BIG BEAR?

Impacts to skiing near Big Bear Lake were explored using 97 CMIP5 hydrology projections (Reclamation 2016). This is an update from previous publication (Reclamation 2013) which was based on CMIP3 hydrology projections. Analysis uses the same methodology as that used in Reclamation 2013. In the following discussion, CMIP3 results will refer to those presented in Reclamation 2013.

METHODOLOGY

Impacts to skiing near Big Bear Lake were analyzed by considering projected changes for April 1 snow water equivalent (SWE). April 1 SWE values from 1950 to 2099 were generated for 97 CMIP5 climate projections using the VIC model forced with downscaled (BCSD) climate variables. Each climate projection consists of 1/8° × 1/8° degree (~12 km × 12 km) 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 summarize the median change (taken from the 97 projections) in April 1 SWE compared to the 1990s.

RESULTS

Future changes in April 1 SWE are projected to include declines of 32%, 67%, and 82% for the 2020s, 2050s, and 2070s. The results are consistent with CMIP3 results, with the CMIP5 projected declines being a little less for the 2020s and 2050s, and a little more for the 2070s. Reclamation (2013) compared results to Hayhoe et al. (2004) for areas 2,000 to 3,000 meters in elevation and found predicted percent change in annual snowpack to be similar. 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. While there is consensus for a projected decrease in snowpack, it is also important to note that there is significant variability between climate projections. 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.

KEY FINDINGS (SAME AS CMIP3 RESULTS)

Will skiing at Big Bear Mountain Resorts be sustained?

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

WHAT ARE THE PROJECTED CLIMATE CHANGE IMPACTS ON CHAPARRAL AND FOREST ECOSYSTEMS?

Several recent studies indicate that current levels of greenhouse gas emissions are stressing Southern California's native vegetation, including the Santa Ana watershed. A University of California, Davis, study suggests that current rates of emissions could place at risk more than 68% of native vegetation in the lands surrounding Los Angeles and San Diego, including large tracts of chaparral and other forest plants (Thorne et al. 2017). In fact, Thorne et al. (2016) suggests that if trends continue, much of the area currently suitable will no longer support the chaparral ecosystem by the end of the century (Figure 1).

This assessment seem to be in keeping with a study by the U.S. Geological Survey that found high or very high vulnerability to climate change in plant communities (McGinnis et al. 2009). Additionally, Lenihan et al. (2003) found a correlation between increasing temperatures in California and a shift from needle-leaved vegetation to broad-leaved species.

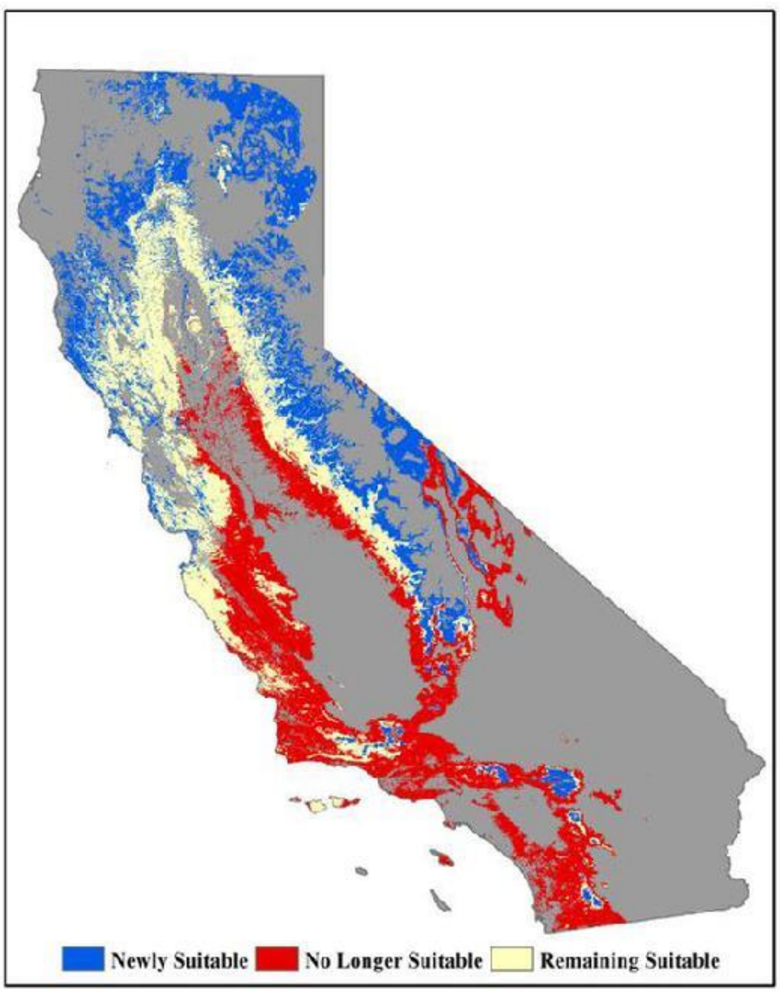


Figure 1. Chaparral Suitability in the 2070–2099 Time Frame under Hot and Dry Climate Conditions

WHAT ARE CURRENT AND EXPECTED CLIMATE CHANGE IMPACTS ON FOREST AND URBAN TREES IN THIS WATERSHED?

Increasing temperatures and their effects on soil moisture, evapotranspirational demand, chronic water stress, and carbon starvation (via reduced gas exchange) are a key factor in conifer species die-off in western North America (Breshears et al. 2005; Weiss et al. 2009; Adams et al. 2009; McDowell et al. 2010). Additionally, correlation between increasing temperatures and a shift from needle-leaved vegetation to broad-leaved species has been found (Lenihan et al. 2003). Increased temperatures are also a key factor in the spread and abundance of the forest insect pests that also have been implicated in conifer mortality (Logan et al. 2003; Williams et al. 2008). For example, Ryan et al. (2008) report that several large insect outbreaks recently have occurred or are occurring in the United States, and increased temperature and drought likely influenced these outbreaks. Climate change has affected forest insect species range and abundance through changes in insect survival rates, increases in life cycle development rates, facilitation of range expansion, and effect on host plant capacity to resist attack. Temperature driven moisture stress on trees and the enhanced life cycles and ranges of insect pests kill large swaths of forest. Bentz et al. (2010) report that "models suggest a movement of temperature suitability to higher latitudes and elevations and identify regions with a high potential for bark beetle outbreaks and associated tree mortality in the coming century." While no literature has been found that specifically identifies impacts on urban trees, it is likely that the same influences that effect forest regions with also effect urban areas.

WHAT ARE THE EXPECTED CHANGES IN EXTREME TEMPERATURES?

Extreme temperature impacts were explored using 97 CMIP5 hydrology projections. This is an update from previous publication, Reclamation (2013) which was based on CMIP3 hydrology projections. Analysis uses the same methodology as that used in Reclamation, 2013, though the graphics presenting results differ. In the following discussion, CMIP3 results will refer to those presented in Reclamation 2013.

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 (Dai 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.

METHODOLOGY

Daily maximum temperature values from the BCSD-CMIP5 archive for 97 climate projections were used in this analysis. Each projection has 1/8° × 1/8° (~12 km × 12 km) grid cell daily forcings (temperature and precipitation) that start on January 1, 1950 and run through December 31, 2099.

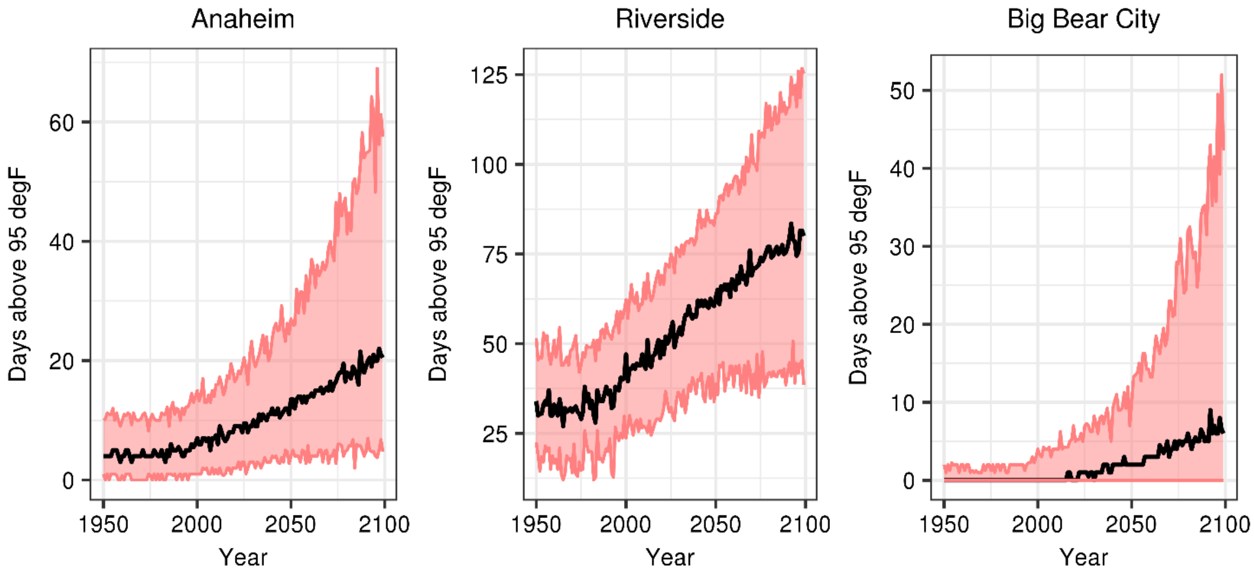
Reclamation 2013 presented results for three cities (Anaheim, Riverside, and Big Bear City) and this is updated for comparison using CMIP5 temperature projections. The location of each city was matched to the single VIC grid cell that contains it. A spatial plot is also provided to show the distribution of the number of days with maximum temperature over 95°F across the watershed.

RESULTS

Figure 2 shows the distribution of the annual number of days above 95°F from 1950 to 2099 for each of the cities (Anaheim, Riverside, and Big Bear City) for all 97 climate projections. There is an increasing trend in the number of days above 95°F for all three locations, which is consistent with CMIP3 results. The shaded area in Figure 2 shows the range of the 97 climate projections and demonstrates a large spread in projected results. Table 1 summarizes the median number of days above 95°F for each location for the historical period (1951–1999) and three 30-year future periods centered around 2020, 2050 and 2070. As shown in Table 1, the number of days increases for all locations into the future and this is consistent with CMIP3 results. See Reclamation 2013 for a discussion comparing CMIP3 results to other studies.

Table 1. Median Annual Number of Days above 95°F for One Historical (1951–1999) and Three CMIP5 Future (2005–2034, 2035–2064, 2055–2084) Time Periods

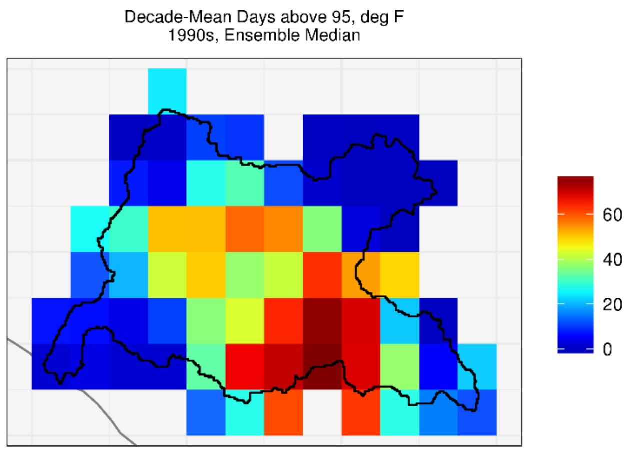
Location	Historical	2020	2050	2060
Anaheim	4	8	12	15
Riverside	33	50	62	71
Big Bear City	0	0	2	4

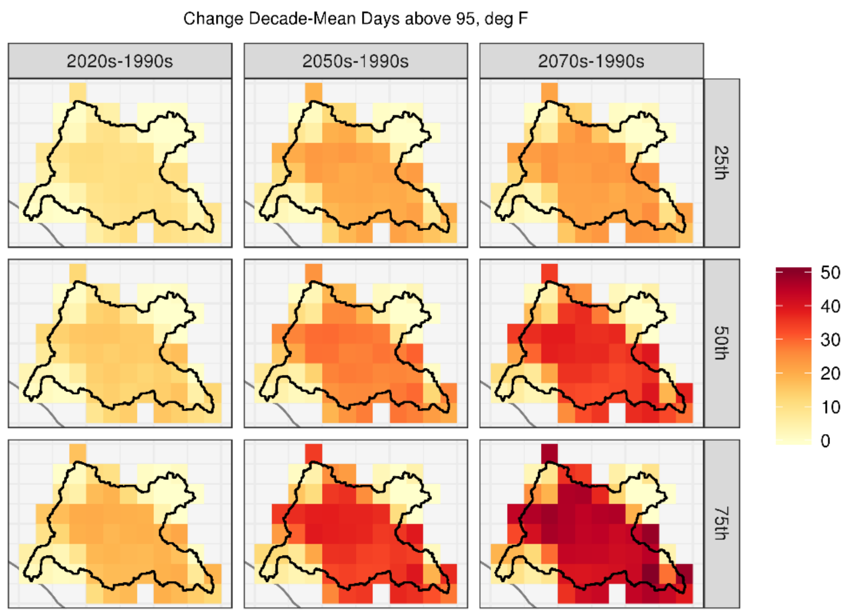


Note: Solid black line is the median and the red shading denotes the 5th and 95th percentile bounds.

Figure 2: Projected Annual Number of Days above 95°F for CMIP5 Projected Climate

Figure 3 shows the distribution of the number of days with maximum temperature over 95°F across the watershed. The watershed is predicted to have more days with a maximum temperature over 95°F through the successive decades (2020s, 2050s, and 2070s) compared with the 1990s reference decade. This is true across the watershed with the lower elevations experiencing larger increases of days (30–40 days) over 95°F. The highest elevations and the area of the watershed near the coast experience smaller increases in the number of days with maximum temperature over 95°F.





Note: The uncertainty in the distribution of the change in decade-mean temperature for the 2020s, 2050s, and 2070s is presented using the 25th and 75th percentile, and the median (50th percentile) represents the central tendency of change in decade-mean temperature distribution.

Figure 3. Spatial Distribution of the Number of Days with Maximum Temperature over 95°F

Warmer average temperatures will lead to hotter days and more frequent and longer heat waves (USGCRP 2016). These changes will lead to an increase in heat-related deaths in the United States. Adaptive responses, such as wider use of air conditioning, are expected to reduce the projected increases in death from extreme heat (USGCRP 2016). Exposure to extreme heat can lead to heat stroke and dehydration, as well as cardiovascular, respiratory, and cerebrovascular disease (USGCRP 2009; CCSP 2008). Certain types of populations are more vulnerable than others: for example, outdoor workers, student athletes, and homeless people tend to be more exposed to extreme heat because they spend more time outdoors. Older adults and low-income households may lack access to air conditioning which also increases exposure to extreme heat. Also, pregnant women, young children, older adults, and people with certain medical conditions are less able to regulate their body temperature and can therefore be more vulnerable to extreme heat (USGCRP 2016). Heat waves are also often accompanied by periods of stagnant air, leading to increases in air pollution and associated health effects (USGCRP 2016).

KEY FINDINGS

How many more extreme heat days will be experienced in the different regions of the watershed, and what are the public health implications?

- All the CMIP5 climate projections demonstrate clear increasing temperature trends and are consistent with CMIP3 results.
- Increasing temperatures will result in a greater number of days above 95°F in the future across the watershed, with the largest increases at the lowest elevations.
- By 2070 it is projected that the median (50th percentile) number of days above 95°F for the lower elevations in the central part of the watershed will see increases of 30–40 days.
- By 2070 it is projected that the number of days above 95°F will quadruple in Anaheim and nearly double in Riverside. The number of days above 95°F at Big Bear City is projected to increase from 0 days historically to 4 days in 2070.
- Exposure to an increasing number of extreme heat days can lead to an increase in heat-related deaths as well as other diseases, with some groups being more vulnerable (the homeless, young children, pregnant women, older adults, and people with certain medical conditions)

HOW WILL GROUNDWATER AND WATER SUPPLIES BE IMPACTED BY PROJECTED CLIMATE CHANGE?

GROUNDWATER IMPACTS

Future water supply projections were made using CMIP5 hydrology projections and the VIC hydrology model. This is an update from previous work (Reclamation 2013) which was based on CMIP3 hydrology projections. Analysis uses the same methodology as that used in the 2013 work and results are presented in the same format. In the following discussion, CMIP3 results will refer to those presented in Reclamation 2013.

The CMIP5 hydrology archive provides a downscaled 1/8° (~12 km) resolution grid of a monthly time-series of precipitation and temperature from 1950-2099 for 97 climate projections, whereas the CMIP3 results are based on 112 climate projections.

Reclamation, 2013 discusses the development of a groundwater screening tool and its use and limitations. 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. 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 groundwater screening tool using CMIP5 hydrology projections 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.

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 for municipal, industrial, and agricultural uses. Figure 4 illustrates the observed range of basin-averaged groundwater levels in the Orange County groundwater basin for 1990–2009, along with simulated groundwater levels under CMIP5 projected climate conditions. In the absence of groundwater management actions, groundwater levels are projected to decline significantly over the 21st century. This general decline is consistent with that seen in the CMIP3 results. The CMIP5 results show a larger range of variability in long-term projected groundwater levels than the CMIP3 results (Reclamation 2013, Figure 15). Some CMIP5 projections show declines in long-term projected groundwater levels that are larger and smaller than those seen in the CMIP3 results.

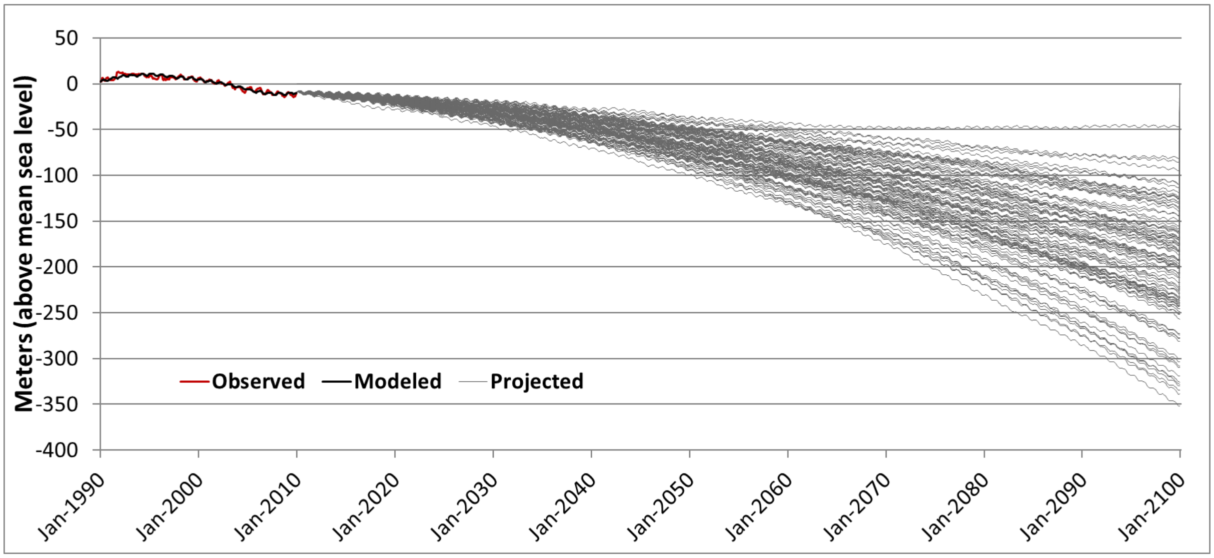


Figure 4. Projected Groundwater Elevations for Orange County for a No Action Scenario

The groundwater screening tool, described in Reclamation 2013, can be used to evaluate potential deficiencies in future supplies and to develop sustainable management alternatives. Potential actions to avoid projected water level declines in Orange County are discussed in Reclamation 2013.

Figures 5, 6, and 7 show the projected groundwater elevations under CMIP5 projected climate for a no action scenario for the Upper Santa Ana Valley, San Jacinto, and Elsinore basins respectively. The results are like those for Orange County, showing long-term groundwater level declines and a larger range of variability in projected CMIP5 groundwater levels than those seen in CMIP3 results.

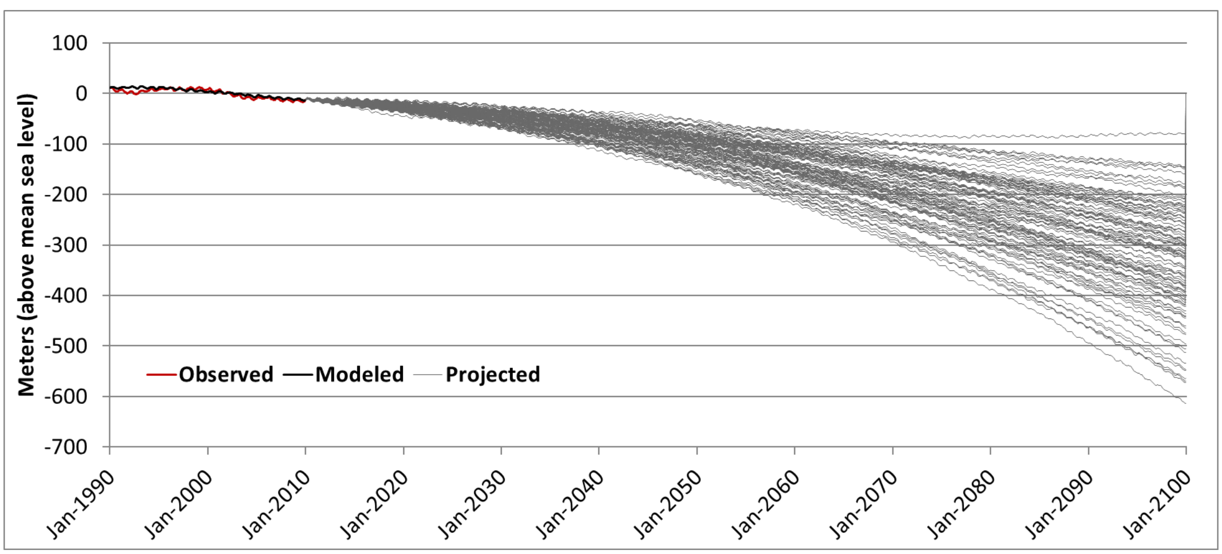


Figure 5. Projected Groundwater Elevations for Upper Santa Ana Valley for a No Action Scenario

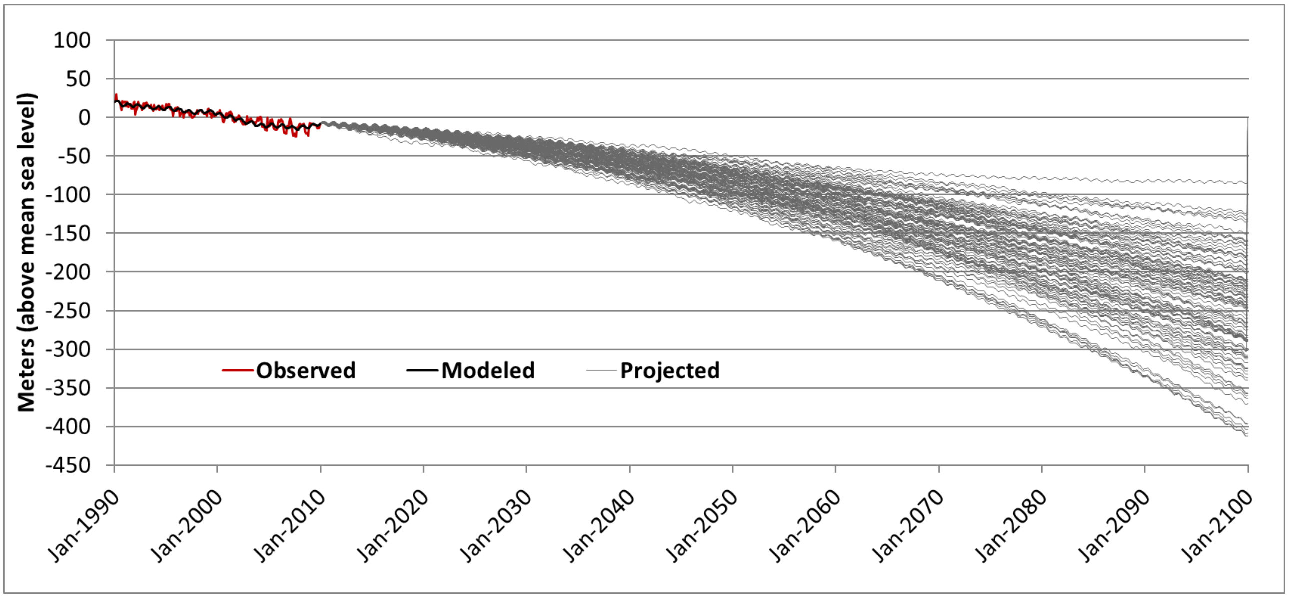
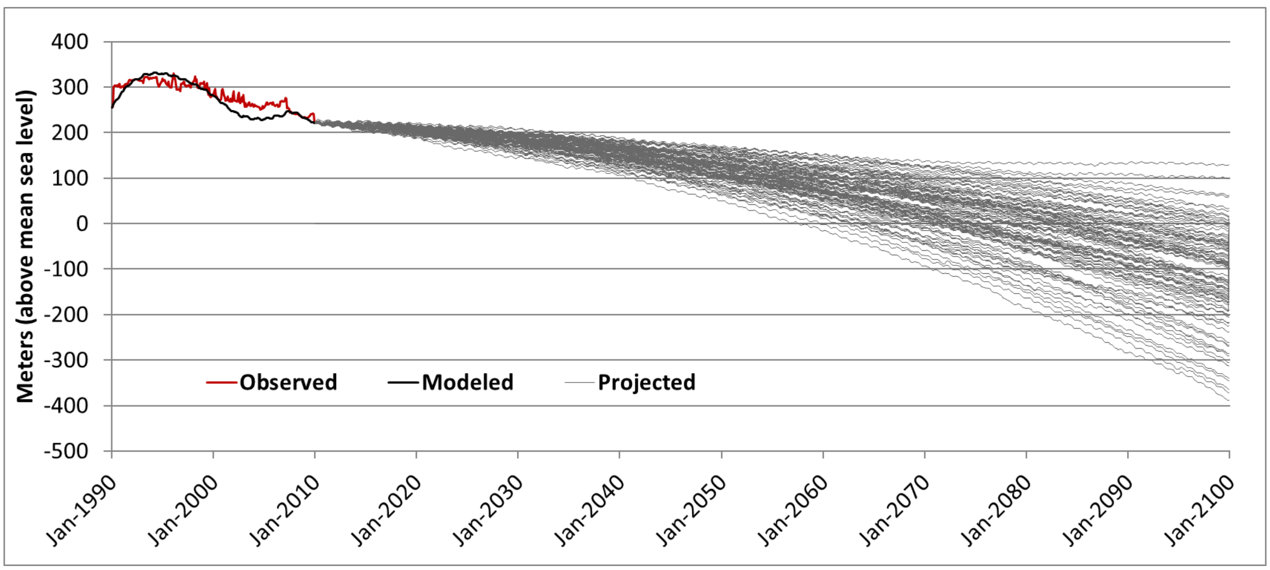


Figure 6. Projected Groundwater Elevations for San Jacinto for a No Action Scenario



Note: The Elsinore groundwater basin projections, shown in this figure, are not as representative of what is happening in the basin as the other three basins. This is because the basin average groundwater time series 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.

Figure 7. Projected Groundwater Elevations for Elsinore for a No Action Scenario

KEY FINDINGS

Will groundwater availability be reduced?

- Groundwater levels under CMIP5 climate projections are projected to decline in the future. CMIP5 results show a larger range of variability in declining groundwater levels than CMIP3 results.
- Projected changes in precipitation and increases in temperature will decrease natural recharge throughout the watershed. The median value in CMIP5 precipitation projections

are slightly wetter than CMIP3 results, but the net impact is still the same—projected declining groundwater levels in the future.

- 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 (Reclamation 2013).
- Management actions such as reducing municipal and industrial water demands or increasing trans-basin water imports and recharge will be required to maintain current groundwater levels (Reclamation 2013).

WATER SUPPLY

Future water supply projections were made using CMIP5 hydrology projections and the VIC hydrology model. This is an update from Reclamation 2013, which was based on CMIP3 hydrology projections. Analysis uses the same methodology as that used in Reclamation, 2013, though the graphics presenting results may differ somewhat. In the following discussion, CMIP3 results will refer to those presented in Reclamation 2013.

The CMIP5 hydrology archive provides a downscaled 1/8° (~12-km) resolution grid on a monthly time-series of precipitation and temperature from 1950-2099 for 97 climate projections, whereas the CMIP3 results are based on 112 climate projections.

HYDROCLIMATE PROJECTIONS

Timeseries Plots

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

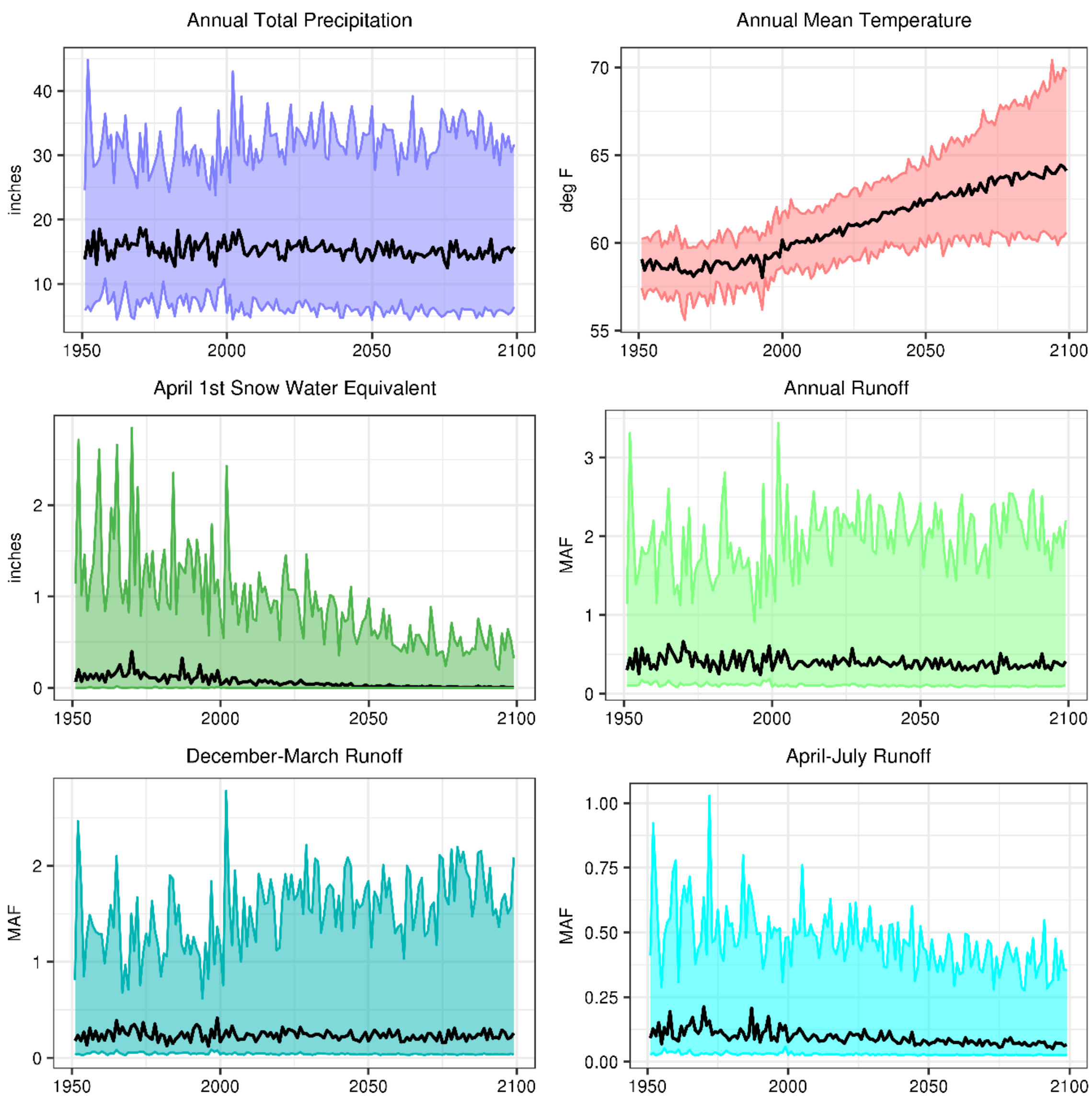
- Annual Total Precipitation
- Annual Mean Temperature
- April 1st Snow Water Equivalent
- Annual Runoff
- December–March Runoff
- April–July Runoff

See Reclamation, 2013 for a detailed description of the development of these variables and similar plots for CMIP3 hydrology projections.

Figure 8 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 range of 5th to 95th percentiles.

In general, all variables show slightly more variability in the uncertainty envelope than the CMIP3 results, with somewhat larger upper bounds. The annual total precipitation over the basin shows a very little change over the transient period going out to 2099, whereas the CMIP3 results show a somewhat declining trend.

The mean annual temperature over the basin follows a monotonically increasing trend and a diverging uncertainty envelope over time, similar to CMIP3 results. April 1st SWE shows a decreasing trend. The annual runoff and the winter season DJFM runoff remains about the same into the future, similar to precipitation, but differing from the CMIP3 results which follow a long-term declining trend pattern. The AMJJ summer season runoff follows a slight declining trend, like that seen in CMIP3 results.



Notes: The heavy black line is the annual time series median value (i.e., median). The shaded area is the annual time series range of 5th to 95th percentiles.

Figure 8. 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).

See Reclamation, 2013 for a detailed description of the development of these variables and similar plots for CMIP3 hydrology projections.

Spatial distribution of precipitation for the 1990s decade is presented as an ensemble median of the 97 projections. At each grid cell in the basin and for each of the 97 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.

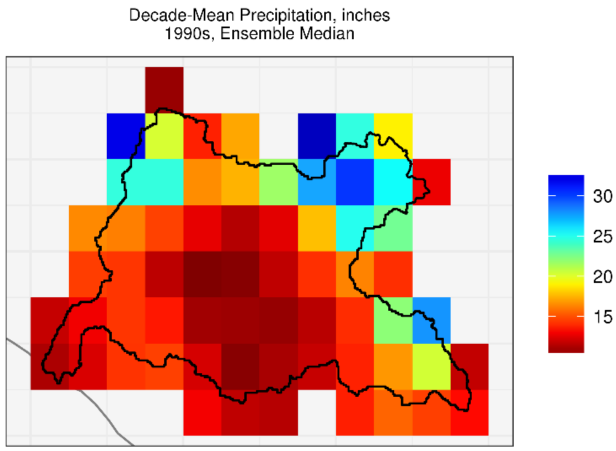
Precipitation changes in each of the future decades—2020s (represented by water years 2020–2029), 2050s (represented by water years 2050–2059), and 2070s (represented by water years 2070–2079)—were calculated as follows. At each grid cell in the basin and for each of the 97 projections, average total 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 difference in average total precipitation between a given future decade and the reference 1990s decade was calculated. A positive magnitude change implies wetter conditions, while negative change implies drier conditions from the 1990s reference decade.

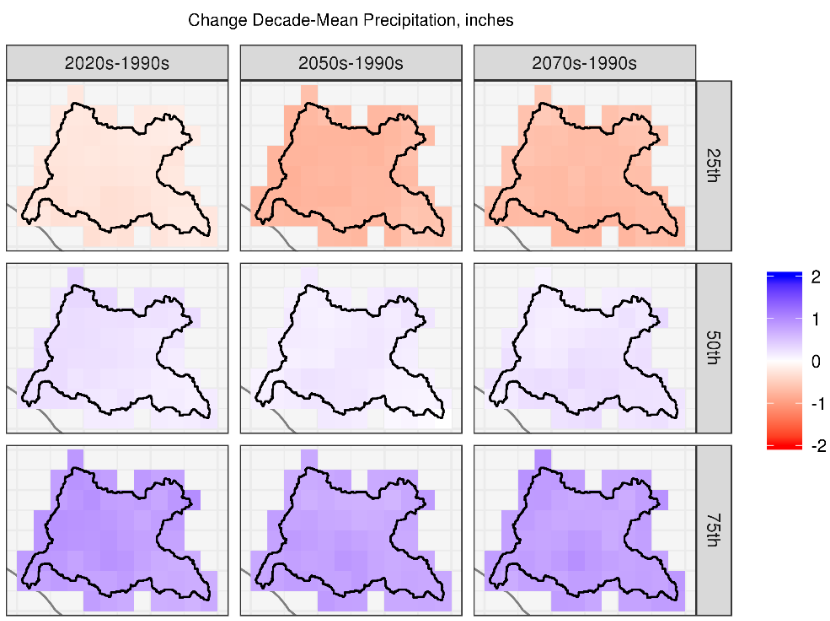
After all projection-specific changes were calculated for a given future decade, the median change from the 97 CMIP5 projections was calculated. The uncertainty in the distribution of the change in decade-mean precipitation for the future decades is presented using the 25th and 75th percentile. The median 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 9).

All future decades show a very slight increase (less than 0.5 inches) in median precipitation across the watershed from the 1990s reference decade. This is in contrast from CMIP3 results, as they showed a very slight increase in the 2020s decade, then a consistent decline in the 2050s and 2070s 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 then averaged to calculate the decade average mean annual temperature.

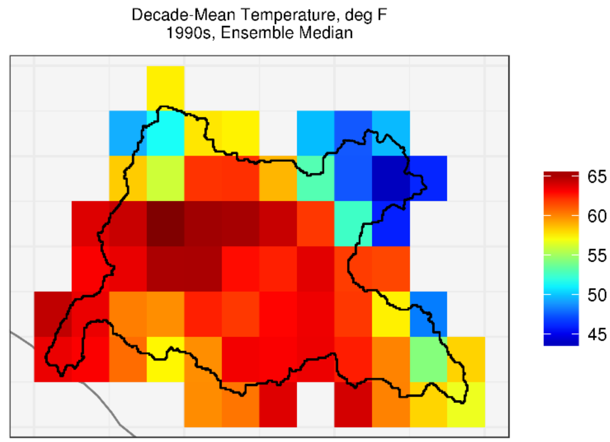
Figure 10 shows the spatial distribution of simulated decadal temperature. These results show that the watershed is expected to get hotter through the successive decades (2020s, 2050s, and 2070s) compared with the 1990s reference decade. This is consistent with the CMIP3 results.

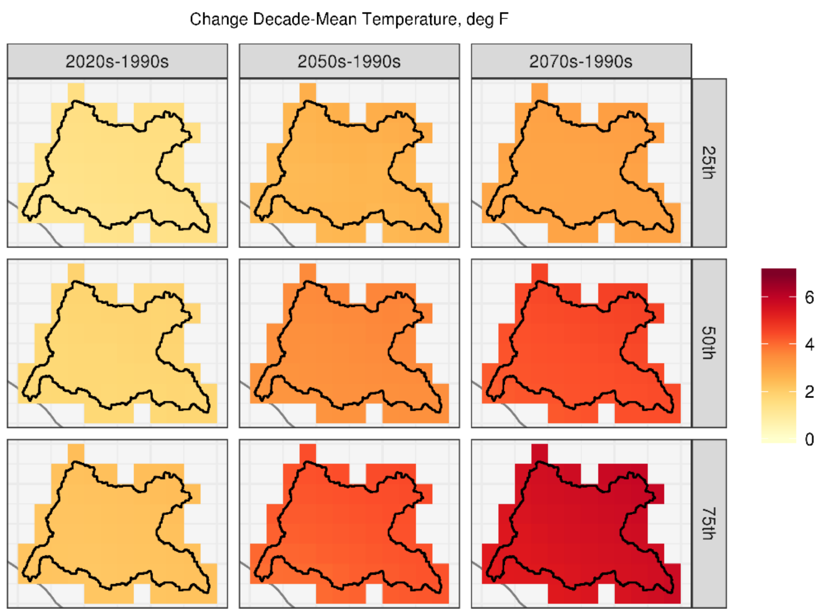




Note: The uncertainty in the distribution of the change in decade-mean precipitation for the future decades is presented using the 25th and 75th percentile, and the median (50th percentile) represents the central tendency of change in decade-mean precipitation distribution.

Figure 9. Spatial Distribution of Simulated Decadal Precipitation





Note: The uncertainty in the distribution of the change in decade-mean temperature for the 2020s, 2050s, and 2070s is presented using the 25th and 75th percentile, and the median (50th percentile) represents the central tendency of change in decade-mean temperature distribution.

Figure 10. Spatial Distribution of Simulated Decadal Temperature

IMPACTS ON RUNOFF ANNUAL AND SEASONAL CYCLES

Annual and seasonal runoff changes were calculated for all 36 sites listed in Table 2. Figure 11 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.

There is an increase in the mean annual and the winter (Dec–Mar) runoff for all future decades. The spring (Apr–Jul) runoff declines for the 2050s and 2070s. Similar change in runoff patterns was observed for all sites across the basin, as can be seen in Table 2. These results are consistent with those found for other watersheds in California using the CMIP5 hydrology projections (Reclamation 2016). The CMIP3 results generally showed declining mean annual and seasonal runoff in future decades.

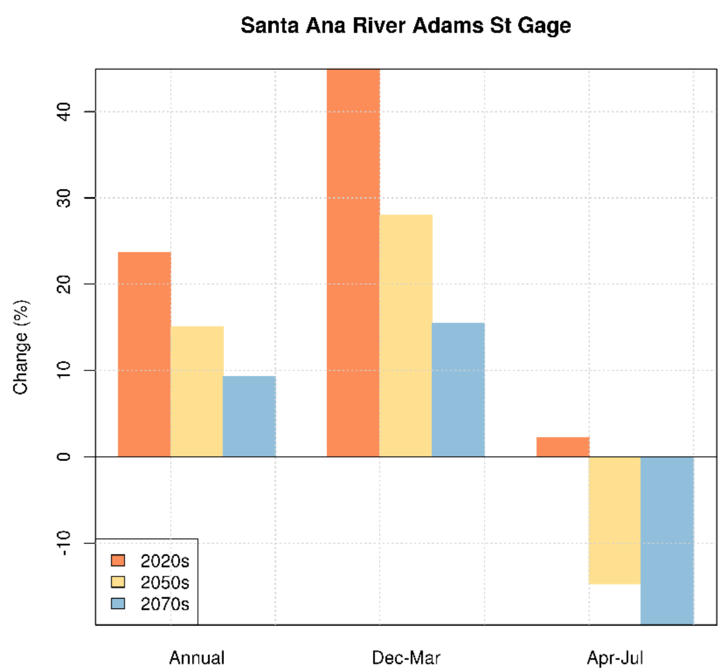


Figure 11. Simulated Mean Annual and Mean Seasonal Runoff Change

Table 2: Percent Change from 1990s for Annual, DJFM, and AMJJ Runoff

		2020s			2050s			2070s		
ID	Site Description	Annual Flow	DJFM	AMJJ	Annual Flow	DJFM	AMJJ	Annual Flow	DJFM	AMJJ
1	Peters Canyon Wash Tustin Gage	27.04	33.22	8.01	15.04	23.63	-0.17	12.43	12.44	-7.40
2	Marshburn Channel Gage	37.44	38.66	11.38	20.51	27.14	6.31	20.04	16.42	-9.01
3	San Diego Creek Myford Rd Gage	28.82	33.22	10.40	15.52	26.08	4.91	12.67	13.86	-8.55
4	El Modina-Irvine Channel Gage	17.93	29.70	3.57	11.91	20.38	-7.01	12.09	13.24	-1.63
5	Peters Canyon Wash Irvine Gage	27.13	33.24	7.99	15.14	23.70	-0.29	12.39	12.42	-7.53
6	San Diego Creek Lane Rd Gage	26.96	33.22	8.03	14.96	23.58	-0.08	12.46	12.45	-7.29
7	San Diego Creek Campus Dr Gage	20.87	32.41	5.23	12.29	18.89	-2.04	9.34	13.59	-4.65
8	Santa Ana River Prado Dam Gage	22.93	44.57	1.94	14.59	29.26	-15.84	8.90	14.83	-20.37
9	Santa Ana River County Line Gage	23.03	44.76	1.93	14.62	29.25	-15.65	8.90	14.96	-20.41
10	Santa Ana River Imperial Highway Gage	23.20	44.85	1.97	14.68	29.01	-15.66	8.96	15.03	-20.47
11	Santa Ana River AB SPRD Imperial Highway Gage	23.20	44.85	1.97	14.68	29.00	-15.65	8.96	15.03	-20.47
12	Santa Ana River SPRD Imperial Highway Gage	23.20	44.85	1.97	14.68	28.99	-15.65	8.96	15.03	-20.48
13	Carbon Creek Olinda Gage	23.80	30.79	9.75	15.66	28.78	-5.61	13.65	19.97	-5.50
14	Carbon Creek Yorba Linda Gage	23.80	30.79	9.75	15.66	28.78	-5.61	13.65	19.97	-5.50
15	Santa Ana River Ball Rd Gage	23.22	44.84	1.99	14.72	28.90	-15.62	9.01	15.02	-20.49
16	Santa Ana River Katella Ave Gage	23.23	44.93	2.00	14.76	28.85	-15.41	9.06	15.11	-20.53
17	Santiago Creek Villa Park Gage	29.10	38.81	10.69	14.74	29.51	-4.15	10.43	14.49	-3.51
18	Santiago Creek Div Villa Park Gage	29.10	38.81	10.69	14.74	29.51	-4.15	10.43	14.49	-3.51
19	Santiago Creek Santa Ana Gage	27.82	35.80	9.92	14.35	27.03	-4.77	11.26	15.30	-4.36
20	Santa Ana River Santa Ana Gage	23.58	44.94	2.21	14.89	28.56	-15.29	9.09	15.27	-20.06
21	Santa Ana River Adams St Gage	23.63	44.95	2.23	15.04	27.96	-14.72	9.27	15.48	-19.50
22	Brea Channel Brea Dam Gage	23.89	29.75	7.80	13.87	26.08	-3.15	12.62	18.17	-4.12
23	Brea Channel Fullerton Gage	23.38	29.70	7.23	13.92	25.26	-4.21	13.13	18.04	-4.10
24	Fullteron Channel Fullerton Dam Gage	22.06	32.06	6.72	12.16	23.73	-4.44	15.31	19.66	-2.93
25	Fullerton Channel Fullerton Gage	21.43	32.06	4.93	11.17	21.60	-3.58	16.09	21.13	-2.34
26	Fullerton Channel Richman Ave Gage	21.56	28.23	6.90	14.28	25.53	-5.06	13.64	17.99	-4.94
27	Coyote Creek Los Alamitos Gage	20.73	29.89	5.20	11.42	21.61	-3.03	12.90	17.97	-1.53
28	Devils Canyon	32.99	47.48	0.14	18.28	31.95	-10.15	7.44	14.82	-22.01
29	Santa Ana River AT MWD Crossing NR Arlington	21.66	41.47	-2.29	14.19	31.30	-25.97	7.62	20.48	-30.37
30	Santa Ana River AT E Street NR San Bernardino	21.13	39.73	-4.41	14.04	31.92	-26.37	8.07	21.67	-31.71
31	Temescal Creek AB Main Street AT Corona	20.26	36.72	2.70	13.86	27.48	-2.06	6.80	11.52	-13.08
32	Cucamonga Creek NR Mira Loma	27.75	43.86	4.17	13.85	22.49	-11.88	8.08	11.60	-12.43
33	Chino Creek AT Schaefer Avenue NR Chino	19.76	32.89	4.35	12.83	18.54	-8.55	9.52	12.33	-5.79
34	Seven Oaks Dam Outlet	15.96	35.45	-11.45	13.28	33.34	-37.39	7.29	43.73	-42.49
35	Middle Fork Lytle Creek Gage	25.66	34.45	-2.95	10.31	21.76	-27.64	6.22	11.55	-24.41
36	Ridge Top Gage NR Devore	31.98	40.84	11.70	20.99	29.76	3.71	11.15	20.57	-14.33

DJFM = December, January, February, March; AMJJ = April, May, June, July.

KEY FINDINGS

Will surface water supply decrease?

- Temperature will increase, which is likely to cause increased water demand and reservoir evaporation.
- April 1st SWE will decrease.
- Precipitation shows long term slightly increasing trends.
- Seasonal runoff will generally increase in the winter and decrease in the spring.
- Annual surface water may increase over future periods, in contrast to CMIP3 results.

HOW WILL INLAND WATER BODIES BE IMPACTED BY CHANGED PRECIPITATION PATTERNS?

Impacts to natural stream inflow to Big Bear Lake, Canyon Lake, and Lake Elsinore were analyzed using 97 CMIP5 hydrology projections (Reclamation 2016). An earlier analysis for Lake Elsinore (Reclamation 2013) only was based on CMIP3 hydrology projections. In the following discussion, CMIP3 results will refer to those presented in Reclamation (2013).

METHODOLOGY

Monthly streamflow was determined by using BCSD-CMIP5 climate projections and the VIC macro-scale hydrology model. The model accounted for the upstream contributing areas, excluding the effect of any upstream regulation or other sources of water provide to the Lakes. CMIP3 results for Lake Elsinore included a mass balance approach that considered recycled water being delivered to the lake as well as evaporation effects. The CMIP5 climate projections predict rising temperatures which will translate to increased evaporation rates. The results presented here are based strictly on natural runoff.

Annual and seasonal inflow changes were calculated for the three sites listed in Table 3. Figures 12 and 13 show mean annual and mean-seasonal inflow change for Big Bear Lake and Lake Elsinore. The results for Canyon Lake (not shown) and Lake Elsinore are almost identical. Changes in mean inflow (annual or seasonal) were calculated for the three future decades—2020s, 2050s, and 2070s—from the reference 1990s decade.

RESULTS

There is an increase in the mean annual and the winter (December–March) natural inflow for all future decades. The spring (April–July) inflow declines for the 2050s and 2070s. Similar change in natural stream inflow patterns was observed for all three lakes, as can be seen in Table 3. These results are consistent with runoff results in the water supply section and those found for other watersheds in California using the CMIP5 hydrology projections (Reclamation 2016). The CMIP3 results generally showed declining mean annual and seasonal runoff in future decades at most sites.

Table 3. Percent Change from 1990s for Annual, DJFM, and AMJJ Runoff

Site Description	2020s			2050s			2070s		
	Annual Inflow	DJFM	AMJJ	Annual Inflow	DJFM	AMJJ	Annual Inflow	DJFM	AMJJ
Big Bear Lake	15.39	44.44	−13.05	13.89	41.78	−39.22	6.53	51.82	−43.08
Canyon Lake	19.40	42.28	1.74	12.53	25.83	−5.08	7.07	12.73	−12.23
Lake Elsinore	19.45	41.88	1.56	12.62	26.03	−5.02	7.06	12.72	−12.26

DJFM = December, January, February, March; AMJJ = April, May June, July.

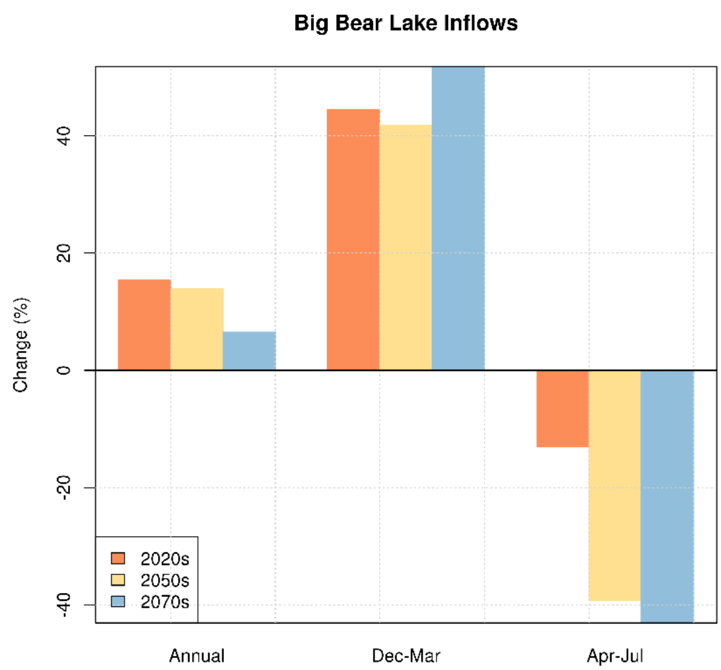


Figure 12. Simulated Mean Annual and Mean-Seasonal Inflow Change for Big Bear Lake

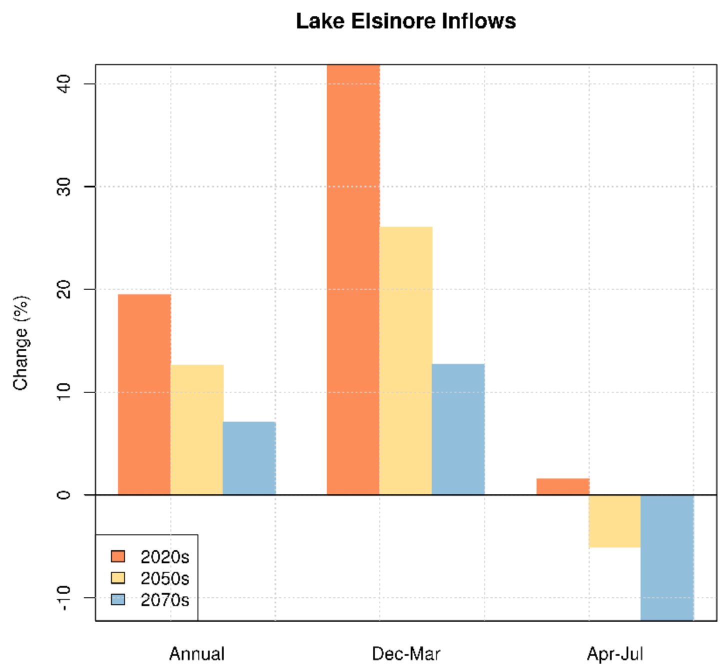


Figure 13. Simulated Mean Annual and Mean-Seasonal Inflow Change for Lake Elsinore

KEY FINDINGS

How will important inland water bodies be impacted by climate change?

- Annual surface water inflows may increase over future periods relative to the 1990s, in contrast to CMIP3 results.
- Seasonal inflows will generally increase in the winter and decrease in the spring.
- Temperature will increase, which is likely to cause increased water demand and reservoir evaporation.

HOW WILL CLIMATE CHANGE IMPACT WILDFIRE PATTERNS IN THE WATERSHED?

Climate can be a strong influence on wildfire activity; primarily temperature and precipitation. Not only do these parameters change the atmospheric conditions and soil moisture, but also play a role in the species distribution of the area. With overall anticipated warmer and drier conditions in California, wildfire response has been shown to be a function of vegetation species and biomass (Lenihan et al. 2003). Jolly et al. (2015) indicates that the Santa Ana basin shows increasing trends in fire weather variables (temperature, rainfall, etc.) that influence wildfires, as well as upward trends in the frequency of years with anomalous mean annual weather conditions. Westerling et al. (2006) found a correlation of temperature, and subsequent earlier spring, to increases in wildfire activity in the western United States.

It is somewhat difficult to predict fire response just from meteorological parameters, because individual species will likely respond physiologically to increases in CO_2, which may change fire response and behavior (Davis and Michaelsen 1995).

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APPENDIX I

Santa Ana River Watershed
Vulnerability Assessment Checklist

Attachment B: SARW Vulnerability Assessment Checklist

✔ *"If Yes, Check the Box"*

Water Demand:

☑ *Are there major industries that require cooling/process water in the Santa Ana River Watershed?*

- As average temperatures increase, industrial cooling water needs may increase.
- Identify major industrial water users in your region and assess their current and projected needs for cooling and process water.

☑ *Does water uses vary by more than 50% seasonally in parts of the Watershed?*

- Seasonal water use, which is primarily outdoor water use, is expected to increase as average temperatures increase and droughts become more frequent.
- Where water use records are available, look at total monthly water uses averaged over the last five years (if available). If maximum and minimum monthly water uses vary by more than 25%, then the answer to this question is "yes".
- Where no water use records exist, is crop irrigation responsible for a significant (say >50%) percentage of water demand in parts of your region?

☑ *Are crops grown in the Watershed climate-sensitive? Would shifts in daily heat patterns, such as how long heat lingers before night-time cooling, be prohibitive for some crops?*

- Fruit and nut crops are climate sensitive and may require additional water as the climate warms. Landscape nurseries also exist and would require additional water under even a moderate climate change scenario.

☑ *Do groundwater supplies in the Watershed lack resiliency after drought events?*

- Droughts are expected to become more frequent and more severe in the future. Areas with an inelastic demand may be particularly vulnerable to droughts and may become more dependent on groundwater pumping.

☑ *Are water use curtailment measures effective in the Watershed?*

- Water conservation measures have been very effective in the SARW. Continued education and increased employment of efficient use technologies are still needed.

☑ *Are some instream flow requirements in the Watershed either currently insufficient to support aquatic life, or occasionally unmet?*

- Changes in snowmelt patterns in the future *may* make it difficult to balance water demands. Vulnerabilities for ecosystems and municipal/agricultural water needs may be exacerbated by instream flow requirements that are:

1. not quantified,
2. not accurate for ecosystem needs under multiple environmental conditions including droughts, and
3. not accepted by regional water managers.

Water Supply

☑ *Does a portion of the water supply in the Watershed come from snowmelt?*

- The snowmelt window is expected to shrink as the climate warms. Water systems supplied by snowmelt are therefore potentially vulnerable to climate change.
- Where watershed planning documents are available, refer to these in identifying parts of your region that rely on surface water for supplies.
-Where planning documents are not available, identify major rivers in the Santa Ana River Watershed with large users. Identify whether the river's headwaters are fed by snowpack.

☑ *Does part of the Watershed rely on water diverted from the Delta, imported from the Colorado River, or imported from other climate-sensitive systems outside your region?*

- The Watershed does depend on imported water from sensitive regions; however, it is also very dependent upon its own groundwater supply.

☑ *Does part of the Watershed rely on coastal aquifers? Has salt intrusion been a problem in the past?*

- Coastal aquifers are susceptible to salt intrusion as sea levels rise, and many have already observed salt intrusion due to over-extraction, such as the West Coast Basin in southern California. Afflicted districts constantly work to manage the salt intrusion problem.

☑ *Would the Watershed have difficulty in storing carryover supply surpluses from year to year?*

- Droughts are expected to become more severe in the future. Systems that can store more water may be more resilient to droughts.

☑ *Does the Watershed have invasive species management issues at your facilities, along conveyance structures, or in habitat areas?*

- Invasive species are an issue with California's water infrastructure, specifically the quagga mussel.

Water Quality:

☑ *Are increased wildfires a threat in the Watershed? If so, does the Watershed include reservoirs with fire-susceptible vegetation nearby which could pose a water quality concern from increased erosion?*

- Increased wildfires are a major risk due to the location of the SARW basin. Cal-Adapt lists the upstream areas of the Santa Ana River as a high risk for fire danger.

☑ *Does part of the Watershed rely on surface water bodies with current or recurrent water quality issues related to eutrophication, such as low dissolved oxygen or algal blooms? Are there other water quality constituents potentially exacerbated by climate change?*

- Warming temperatures will result in lower dissolved oxygen levels in water bodies, which are exacerbated by algal blooms and in turn enhance eutrophication. Changes in stream flows may alter pollutant concentrations in water bodies.

☑ *Are seasonal low flows decreasing for some water bodies in the Watershed? If so, are the reduced low flows limiting the water bodies' assimilative capacity?*

- In the future, low flow conditions are expected to be more extreme and last longer. This may result in higher pollutant concentrations where loadings increase or remain constant.

☑ *Are there beneficial uses designated for some water bodies in the Watershed that cannot always be met due to water quality issues?*
- Ocean pollution from storm water runoff creates a significant impediment to ocean recreation.

☑ *Does part of the Watershed currently observe water quality shifts during rain events that impact treatment facility operation?*
- While it is unclear how average precipitation will change with temperature, it is generally agreed that storm severity will probably increase. More intense, severe storms may lead to increased erosion, which will increase turbidity in surface waters. Areas that already observe water quality responses to rainstorm intensity may be especially vulnerable.

Sea Level Rise:

☑ *Has coastal erosion already been observed in communities in the Santa Ana River Watershed?*
- Coastal erosion is expected to occur over the next century as sea levels rise.

☑ *Are there coastal structures, such as levees or breakwaters, in Santa Ana River Watershed coastal communities?*
- Coastal structures designed for a specific mean sea level may be impacted by sea level rise.

☑ *Is there significant coastal infrastructure, such as residences, recreation, water and wastewater treatment, tourism, and transportation) at less than six feet above mean sea level in the Watersheds coastal areas?*
- Parts of Orange County are less than six feet above mean sea level. These areas contain significant water supply infrastructure as well as economic infrastructure.

☑ *Are there climate-sensitive low-lying coastal habitats in Watershed communities?*
- Low-lying coastal habitats that are particularly vulnerable to climate change include estuaries and coastal wetlands that rely on a delicate balance of freshwater and salt water.

☑ *Are there areas in the Watersheds coastal communities that currently flood during extreme high tides or storm surges?*
- Areas that are already experiencing flooding during storm surges and very high tides are more likely to experience increased flooding as sea levels rise.

☑ *Is there land subsidence in the coastal areas of the Watersheds coastal communities?*
- Land subsidence may compound the impacts of sea level rise.

☑ *Do tidal gauges along the coastal parts of the Watersheds communities show an increase over the past several decades?*
- Local sea level rise may be higher or lower than state, national, or continental projections.
- NOAA suggests that the mean sea level trend at Newport Beach is 2.22 millimeters per year.

Flooding:

☑ *Does critical infrastructure in the Watershed lie within the 200-year floodplain? DWR's best available floodplain maps are available at: http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/best_available_maps/.*

- While it is unclear how average precipitation will change with temperature, it is generally agreed that storm severity will probably increase. More intense, severe storms may lead to higher peak flows and more severe floods.
- Refer to FEMA floodplain maps and any recent FEMA, US Army Corps of Engineers, or DWR studies that might help identify specific local vulnerabilities for your region. Other follow-up questions that might help answer this question:

1. What public safety issues could be affected by increased flooding events or intensity? For example, evacuation routes, emergency personnel access, hospitals, water treatment and wastewater treatment plants, power generation plants and fire stations should be considered.
2. Could key regional or economic functions be impacted from more frequent and/or intense flooding?

☑ *Does aging critical flood protection infrastructure exist in the Watershed?*

- Levees and other flood protection facilities across the state of California are aging and in need of repair. Due to their overall lowered resiliency, these facilities may be particularly vulnerable to climate change impacts.
- DWR is evaluating more than 300 miles of levees in the San Joaquin and Sacramento Rivers Valleys and the Delta (http://www.water.ca.gov/levees/).

☑ *Have flood control facilities (such as impoundment structures) been insufficient in the past?*

- Reservoirs and other facilities with impoundment capacity may be insufficient for severe storms in the future. Facilities that have been insufficient in the past may be particularly vulnerable.
- Flood control has been an issue in the past. The Santa Ana River poses a significant flooding threat to areas in the basin.

☑ *Are wildfires a concern in parts of the Watershed?*

- Wildfires alter the landscape and soil conditions, increasing the risk of flooding within the burn and downstream areas. Some areas are expected to become more vulnerable to wildfires over time. To identify whether this is the case for parts of your region, the California Public Interest Energy Research Program has posted wildfire susceptibility projections as a Google Earth application at: http://cal-adapt.org/fire/. These projections are the results of only a single study and are not intended for analysis, but can aid in qualitatively answering this question. Read the application's disclaimers carefully to be aware of its limitations.

Ecosystem and Habitat Vulnerability:

☑ *Does the Watershed include inland or coastal aquatic habitats vulnerable to erosion and sedimentation issues?*

- Erosion is expected to increase with climate change, and sedimentation is expected to shift. Habitats sensitive to these events may be particularly vulnerable to climate change.

☑ *Does the Watershed include estuarine habitats which rely on seasonal freshwater flow patterns?*

- Seasonal high and low flows, especially those originating from snowmelt, are already shifting in many locations.

☑ *Do climate-sensitive fauna or flora populations live in the Watershed?*

- Some specific species are more sensitive to climate variations than others.

☑ *Do endangered or threatened species exist in the Watershed? Are changes in species distribution already being observed in parts of the Watershed?*
- Species that are already threatened or endangered may have a lowered capacity to adapt to climate change.

☑ *Does the Watershed rely on aquatic or water-dependent habitats for recreation or other economic activities?*
- Economic values associated with natural habitat can influence prioritization.

☑ *Are there rivers in the Watershed with quantified environmental flow requirements or known water quality/quantity stressors to aquatic life?*
- Constrained water quality and quantity requirements may be difficult to meet in the future.

☑ *Do estuaries, coastal dunes, wetlands, marshes, or exposed beaches exist in the Watershed? If so, are coastal storms possible or frequent in these areas of the Watershed?*
- Storm surges are expected to result in greater damage in the future due to sea level rise. This makes fragile coastal ecosystems vulnerable.

☑ *Are there areas of fragmented estuarine, aquatic, or wetland wildlife habitat within the Watershed? Are there movement corridors for species to naturally migrate? Are there infrastructure projects planned that might preclude species movement?*
- These ecosystems are particularly vulnerable to climate change.

Hydropower:

☑ *Is hydropower a source of electricity in the Watershed?*
- While hydropower is not a significant part of the energy production portfolio in the Watershed, drought implications for the Colorado River and its hydropower generators is worthy of attention in light of water conveyance energy needs.

☑ *Are energy needs in the Watershed expected to increase in the future? If so, are there future plans for hydropower generation facilities or conditions for hydropower generation in the Santa Ana River Watershed?*
- Energy needs are expected to increase in many locations as the climate warms. This increase in electricity demand may compound decreases in hydropower production, increasing its priority for a region.

APPENDIX J

Natural Resources

INTRODUCTION

The watershed historically contained an abundance of natural resources, including water captured from snowmelt in the local mountains, diverse wildlife populations, abundant aquatic life in streams and coastal waters, geological resources for building materials, and a wide range of plant communities from coastal sage, to wetlands, to evergreen forests. These assets were first used by Native Americans and then by European settlers, who began to change the land use in the watershed with irrigation and farming.

Over the past 200 years, human population has increased greatly in the watershed. Since the 1930s, controlling floods and providing a reliable water supply have taken precedence over other critical watershed issues. These priorities have changed the natural hydrology of the watershed, diminishing the once abundant natural water resources in the region. This strain on water resources and associated urbanization has left only remnants of isolated habitat in highly populated areas. Other factors including invasive plant species, frequent local fires, and rogue recreational uses also have contributed to a reduction or complete loss of available habitat in some areas.

The natural resources and habitat in the watershed are now a fraction of their historical values. Therefore, efforts must be made to sustain and conserve the remaining resources for the benefit of future generations of life in the ecosystems of the watershed, and even expand them where possible. The purpose of this chapter is to detail the current status of these natural resources, including their benefits as both habitat and recreational assets, and to identify opportunities to promote and implement sustainability followed by recommendations for solutions that maintain ecological balance and economic health.

FOREST

As home to the headwaters of the Santa Ana River, the San Bernardino and Cleveland National Forests, under the management of the U.S. Department of Agriculture Forest Service (Forest Service), encompass approximately 29% of the watershed's land area in their ~1.1 million acres (Figure 1). These forest areas also receive 90% of the watershed's annual precipitation. As water flows from the forests it affects the amount and quality of water received downstream. Fire is an ongoing risk faced by the Forest Service due to the proximity of development to forested areas and the economic and infrastructural corridors that cross through, as evidenced by the nearly 2,300 special use permits issued each year by the Forest Service. Weather conditions such as drought and high winds also contribute to fire risk, making very difficult predictions and planning for fire events. The forests experienced devastating fires in the early 2000s, teaching hard lessons—the aftermath of those fires directly impacted the quality of water downstream of the burn areas, and it took between 3 and 5 years for water quality to fully recover.

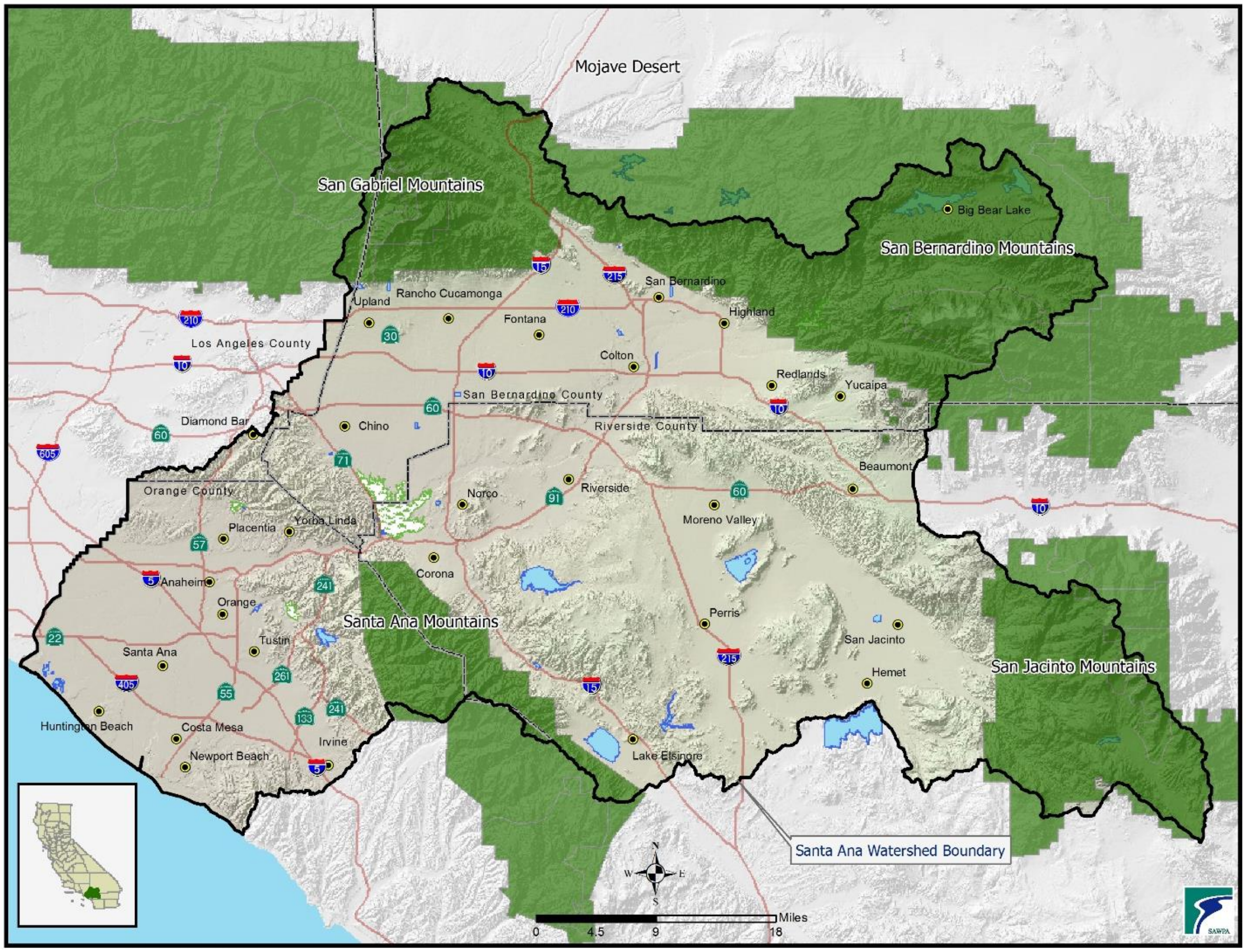

Figure 1. Forested Areas in the Santa Ana River Watershed

RESOURCES OF THE SANTA ANA RIVER

SURFACE WATER

Water is the key life-sustaining resource within the watershed. The river begins high in the San Bernardino Mountains, where it flows westward for approximately 18 miles and then picks up additional flows from Bear Creek, a major tributary. The river then runs southward and meets up with Seven Oaks Dam, which provides capacity for flood control and also serves as a reservoir, with a total capacity of 145,600 acre-feet (AF). The released flows from the Seven Oaks Dam continue westward with additional flows into the river contributed by Mill Creek, City Creek, San Timoteo Creek, Warm Creek, Twin Creek, Cajon Creek, and Lytle Creek before reaching the reservoir at Prado Dam. The Prado Basin also is fed by Chino Creek and another stream named Mill Creek, and occasionally by Temescal Creek in wetter years.

Water released from Prado Dam continues westward into Orange County, where the river then is diverted into spreading grounds for groundwater recharge in the north Orange County aquifer. Any remaining flows are confined to concrete channels between earthen levees, and additional flows are received from Santiago Creek, located near the city of Anaheim. The flows continue in a concrete flood control channel until crossing Interstate 5 near the City of Santa Ana, where the river again flows through a soft-bottom channel before reaching its mouth between Huntington Beach and Newport Beach. Most of California's coastal wetlands, including Anaheim Bay, Bolsa Chica and Upper Newport Bay in the watershed, are estuarine salt marshes with associated tidal channels and mudflats, formed where freshwater streams meet the sea. There was historically a vast web of wetlands in the area, including in the Upper Newport Bay, that once stretched across the San Diego Creek watershed (VanderKnyff 1988).

Much of the river's historical flows have been diverted for use along its path. The majority of water that currently flows in the Santa Ana River during the arid season now comes from wastewater treatment plant discharges.

The watershed has one natural and several manmade lakes that retain water for use as drinking supplies, irrigation, recreation, and habitat for aquatic species. Big Bear Lake resulted from the construction of a dam to retain runoff and snowmelt for the purpose of providing a reliable source of irrigation water for citrus growers near Redlands. Recreational boating and fishing are also beneficial uses of Big Bear Lake. Lake Perris, located in the eastern side of the watershed, is also manmade. Completed in 1973, Lake Perris is the terminus of the State Water Project and is used as a recreational amenity for the region. Lake Mathews, also manmade, is located in the foothills of the Santa Ana Mountains and functions strictly as a drinking water reservoir. It is the terminus of the Colorado River Aqueduct.

Lake Elsinore is a natural lake that offers recreational boating and fishing. In recent years, the lake has been replenished with recycled water. Mystic Lake, in the San Jacinto Basin, is an ephemeral lake that appears in wetter years, receiving waters from overflows from the San Jacinto River.

MINERALS

The geological composition in the watershed has developed over a long period of time by the forces of natural seismic events and climate changes that affected the course and volume of the Santa Ana River. As flows from tributaries carried and deposited sediment along its varied alignments, areas referred to as alluvial fans were created. Most of the watershed from the base of the San Bernardino Mountains and north of the Santa Ana River are comprised of marine and non-marine sedimentary rocks. On the south, in the area of the Cleveland National Forest, shale, sandstone, limestone, and slate dominate the geology. The San Bernardino Mountains' geology consists largely of a composite of Precambrian igneous and metamorphic rocks and Mesozoic granite.

The greatest mineral economic resource in the region is in aggregate, which can be in the form of natural sand and gravel or produced by crushing rock. It is valued for its many uses in construction such as in Portland cement concrete, asphaltic concrete, road base, railroad ballast, and riprap. The California Geological Survey estimates that current permitted mining for this resource in the watershed will meet only 25% of the estimated local demand. Importing this resource from other than local sources will result in higher project costs for all types of construction and have negative environmental impacts. However, mining also has been associated with negative environmental impacts, including noise, dust, and habitat destruction. Mitigation of these impacts results in a lengthy process of 5 to 10 years to acquire permits, which has greatly reduced the amount of aggregate mined in the region despite its abundance.

VEGETATION IN HABITAT AREAS

Habitat classifications can be very complex, and while complex information is available for interested parties, this document will refer to several generalized groups, including alluvial fan, riparian, wetland, coastal, chaparral, and forested habitats.

Alluvial fans are located where stream flows that originate in mountainous areas flatten and spread out. Fan-shaped deposits of sand and gravel sediment, brought down from higher elevations, are left in the wake of storm and flood events, building up over time. They also can be found in desert areas that are prone to flash floods. Alluvial fan areas create a unique habitat in the watershed, but most significantly, they are home to both endangered and threatened plants and animals. They also are in areas where historical groundwater recharge has occurred, increasing the importance for conservation of alluvial fan areas.

Riparian habitats are those areas that transition between land and rivers or streams, and sometimes are referred to as buffer zones. These riparian zones provide valuable wildlife habitat and serve as wildlife corridors, allowing for increased biodiversity by enabling wildlife, including aquatic species, to move freely along river systems. Keeping this connectivity intact is vital in avoiding development of isolated communities.

According to the Clean Water Act, wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands serve as vital habitats for a wide range of birds and aquatic creatures.

Coastal habitats consist of a combination of beaches and intertidal wetlands, which meet the definition of wetlands above.

Chaparral is composed of hard-leafed evergreen shrubs that grow 2 to 4 meters (approximately 7 to 13 feet) tall with deep roots. An understory layer rarely exists. Chaparral habitat occurs in different types of terrain including plains, rocky hills, and mountain slopes. Forested habitats exist mainly in the higher elevations of the watershed.

Upland Wildlife: Birds

Riparian ecosystems harbor the highest number of bird species in the watershed. Riparian habitat provides productive breeding grounds and offers vital over-wintering and migration stop-over areas for migrating birds. Loss and degradation of riparian habitat have negatively impacted bird populations throughout the watershed. Other factors affecting bird populations are brood parasitism by the brown-headed cowbird (*Molothrus ater*), and disruption of natural hydrological regimes from dams and levees.

The federally endangered least Bell's vireo (*Vireo bellii pusillus*) has experienced recent population growth within the watershed due to aggressive management activities that started within Prado Basin and spread to other riparian areas throughout the watershed. In 1986, only 16 pairs of vireos were reported breeding in the Prado Basin. With the management and restoration provided by the Santa Ana Watershed Association (SAWA) and its constituent agencies, more than 1,200 vireo territories were recorded throughout the watershed in 2012.

This stunning recovery is due to the provision of a high-quality habitat for the bird species, in part due to invasive species removal, a project that controls populations of the predatory cowbird, and other efforts on the part of the U.S. Fish and Wildlife Service (USFWS), Orange County Water District (OCWD), several resource conservation districts, and SAWA. The coastal California gnatcatcher (*Polioptila californica californica*) is a focal species under California's Natural Communities Conservation Planning program and is listed as a species of special concern in California. The USFWS listed it as threatened in 1993. Critical Habitat for the species was designated in 2000, but court-ordered review of the economic effects of this designation is underway (Mock 2004).

Both the least Bell's vireo and the federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*) are affected by cowbird brood parasitism. The implementation of cowbird management programs, in addition to preservation and restoration of riparian deciduous shrub habitat, is needed to reduce current populations. The bald eagle (*Haliaeetus leucocephalus*), listed by the USFWS as endangered in 1978, has experienced population growth over the past two decades. The bald eagle could be considered a USFWS success story: reclassified as threatened in 1995 and first proposed for delisting in 2000. Delisting of a species is the USFWS's ultimate goal and only happens when specific recovery goals have been met for a species. Unfortunately, delisting is an infrequent occurrence. In the case of the bald eagle, delisting has been delayed while the USFWS determines how the species would be managed once it is no longer classified as threatened.

Aquatic Life

Fishes

The Santa Ana River and its tributaries historically provided habitat for eight species of native fish (species have multiple forms). Only four native non-game freshwater fishes currently are found in non-estuarine waters: arroyo chub (*Gila orcuttii*), Santa Ana speckled dace (*Rhinichthys osculus* ssp.), Santa Ana sucker (*Catostomus santaanae*), and threespine stickleback (*Gasterosteus aculeatus*). All of these remaining fishes have limited distributions and face possible extirpation.

As previously mentioned, the Santa Ana sucker is listed by the federal government as a threatened species pursuant to the Endangered Species Act. Currently, the western brook lamprey (*Lampetra richardsoni*) is known to be extirpated from the watershed. The Pacific lamprey (*Entosphenus tridentatus*) has been observed once in the past 47 years and it likely is extirpated as well. Introduced forms of the rainbow trout (*Oncorhynchus mykiss*) have been extensively stocked in the watershed for sport fishing for over 100 years, and it is unknown if any genetically pure rainbow trout stocks endemic to the watershed remain. The partially armored threespine stickleback (*Gasterosteus aculeatus microcephalus*) was widely planted in the watershed for mosquito control in the early 1900s and now is found out of its natural historical range, e.g., in Big Bear Lake. There are three current known occurrences of threespine stickleback: in Shay Pond, Juniper Springs Pond, and Sugarloaf Meadow Pond. During high water conditions, Shay Creek and Baldwin Lake also are occupied. Historically, they extended up Caribou Creek (Van Dusen Canyon), but water diversions and rerouting of drainages currently have made that unlikely. Juniper Springs drains to Arrastre Creek, which drains to the Mojave Desert. Shay Pond and Shay Creek drain to Baldwin Lake. Baldwin is considered a mountain playa lake and historically did not have an outlet. The connection to Big Bear Lake is an artificial, man-made connection for flood control purposes, so now Baldwin Lake will drain to Big Bear Lake in an extreme flood event.

In contrast, at least 33 fishes have been introduced into the watershed and currently are present. New species can be expected to be found at any time due to inter-basin water transfers, ship ballast water hitchhikers, bait bucket introductions, and hobbyists disposing of unwanted fish. Many of the introduced fishes are widespread, while a few are restricted to specific locations or habitats. Of the current inventory of introduced fishes, most were introduced by government agencies to serve as a food resource, for insect control, for sportfishing, or to serve as forage for sport fish. A smaller number of fish have become established after arriving inadvertently via inter-basin water transfers or in ships' ballast water. For a detailed discussion of the introduction of fishes to California, the reader is directed to Dill and Cordone (1997). Additional information about introductions of fishes to Southern California is presented by Swift et al. (1993). Supplemental records can be found in Moyle (2002).

Oncorhynchus mykiss is one of six Pacific salmon in the genus *Oncorhynchus* that are native to the North American coast. *O. mykiss*, along with other species of Pacific salmon, exhibit an anadromous life history, which means that juveniles of the species undergo a change that allows them to migrate from freshwater to mature in saltwater before returning to their natal rivers or streams (i.e., rivers or streams where they were spawned) to reproduce.

Historically, these fish were the only abundant salmonid species that occurred naturally within the coast ranges of Southern California. Steelhead entered the rivers and streams draining the Coast Ranges from Point Sal to the U.S.–Mexican Border during the winter and spring, when storms produced sufficient runoff to breach the sandbars at the rivers' mouths and provided fish passage to upstream spawning and rearing habitats. These fish and their progeny were sought out by recreational anglers during the winter, spring and summer fishing seasons.

Steelhead are a highly migratory species. Adult steelhead spawn in coastal watersheds; their progeny rear in freshwater or estuarine habitats prior to migrating to the sea. Within this basic life history pattern, the species exhibits a greater variation in the time and location spent at each life history stage than other Pacific salmon within the genus *Oncorhynchus*.

The life cycle of steelhead generally involves rearing in freshwater for 1 to 3 years before migrating to the ocean, and spending from 1 to 4 years maturing in the marine environment before returning to spawn in freshwater. Adult steelhead do not necessarily die after spawning and may return to the ocean, sometimes repeating their spawning migration one or more times. It is rare for steelhead to spawn more than twice before dying, and most that do so are females.

This species may also display a non-anadromous life history pattern (i.e., a freshwater-resident strategy); non-anadromous individuals that complete their entire life history cycle (incubating, hatching, rearing, maturing, reproducing, and dying) in freshwater commonly are referred to as "rainbow trout." However, this terminology does not capture the complexity of the life history cycles exhibited by native *O. mykiss*. Rainbow trout, which have completed their life history cycle entirely in freshwater, sometimes produce progeny that become anadromous and emigrate to the ocean and return as adults to spawn in freshwater. Conversely, it has also been shown that steelhead may produce progeny that complete their entire life cycle in freshwater.

There is a third type of life history strategy displayed by *O. mykiss* fish that is referred to as "lagoon anadromous," in which the fish may spend a majority of the freshwater phase of their life moving back and forth between the estuary or lagoon at a river's mouth and upstream freshwater habitats before emigrating to the ocean. Steelhead populations in Southern California have not been investigated to determine whether or to what extent they may exhibit this life history strategy; however, steelhead smolts have been documented rearing in Southern California estuaries.

Within each of the three basic life history strategies (fluvial-anadromous, freshwater-resident, and lagoon-anadromous), there is additional variation, including examples of finer-scale habitat switching, such as multiple movements between lagoon and freshwater habitats in the course of a single summer in response to fluctuating habitat conditions; and also so-called "adfluvial" populations that inhabit freshwater reservoirs but spawn in tributary creeks.

Closely related to these various life history strategies is the use by steelhead of a wide variety of habitats over their lifespan, including river main stems, small montane tributaries, estuaries, and the ocean. Steelhead move between these habitats because each habitat supports only certain aspects of what the fish require to complete their life cycle. Different populations frequently differ in the details of the times and habitats that they utilize while pursuing the general pattern of the anadromous life cycle. These differences can reflect the evolutionary response of populations to environmental opportunities, subject to a variety of biological constraints that are also a product of evolution.

See the National Marine Fisheries Service (NMFS) Southern California Steelhead Recovery Plan (2012) for more details and supporting references, particularly Chapter 1, Introduction, and Chapter 2, Steelhead Biology and Ecology.

For the other native fish species, see Swift et al. 1993.

The decline of indigenous steelhead/rainbow trout (*Oncorhynchus mykiss*) populations in the watershed is the result of a multitude of anthropogenic activities that have degraded riverine and estuarine habitats, and fragmented riverine habitats through the construction of instream barriers such as dams, diversions, road-crossing, and flood control structures. The threats analysis conducted by NMFS as part of the recovery planning for the Southern California steelhead populations, identified dams and surface water diversions, flood control, groundwater extraction, levees and channelization, and urban development as the highest threats to the native trout/steelhead populations in the watershed.

Over-exploitation of rainbow trout/steelhead by recreational angling was not identified as a principal factor for the decline of this species in the Santa Ana River, or in Southern California generally. Stocking of *O. mykiss* to supplement an existing native freshwater recreational fishery was initiated and subsequently increased over the years in response to a variety of factors, including human population growth, increased accessibility to angling areas, expansion of leisure time, and to support expanding outdoor recreational activities as an important component in a developing tourist industry. The reported catches of large number of trout by anglers in local media (e.g., on July 17, 1982, the *Citrograph*, a Redlands newspaper, reported that three individuals took 592 trout in 3 hours from Bear Creek—a tributary to the Santa Ana River in San Bernardino County) provide an indication of the natural productivity of the native fishery of the watershed.

The California Legislature began regulating recreational angling (along with other forms of angling) in 1861, when the Southern California human population was a small fraction of its current levels. The increasing restrictions on recreational angling were prompted by the increasing human pressures on the indigenous fishery resources, but were not intended to address the underlying cause of the decline of the populations, nor to safeguard native fish populations or maintain natural ecosystem functions. While both the anadromous form and the freshwater resident forms of *O. mykiss* now have been reduced to critically low levels, remaining populations persist in the headwater tributaries above and below impassable barriers, and the lower reaches remain accessible to the anadromous form when hydrologic conditions permit upstream migration from the ocean.

In February 2012, the City of Riverside, showing community support for steelhead restoration, adopted Resolution 22351, "A Resolution of the City Council … Supporting Restoration Efforts for the Southern California Steelhead in the Santa Ana River." This resolution supports recommendations for restoring the Santa Ana River steelhead population through mitigation actions identified in the Southern California Steelhead Recovery Plan (NMFS 2012).

See the Southern California Steelhead Recovery Plan (NMFS 2012) for more details and supporting references, particularly Chapter 2, "Steelhead Biology and Ecology," and Chapter 12, "Mojave Rim Biogeographic Population Group."

Amphibians

During the past 50 years, population growth and urban development in Southern California have displaced many amphibian species and encroached upon much of the former amphibian habitat. These include the federally listed endangered arroyo toad (*Anaxyrus californicus*) and mountain yellow-legged frog (*Rana muscosa*) and the federally listed threatened California red-legged frog (*Rana aurora draytonii*). Several species are thought to be extinct, and many others have fragmented populations that are at risk of extirpation. Amphibians are especially sensitive to environmental changes that alter the hydrology, ecology, and geology of a region because they have evolved, highly specialized adaptations that have allowed them to exist in these relatively arid regions. Introduced species also have been a major contributor to the decline in amphibian populations in Southern California. These non-native species increase competition for food sources, as well as preying on many of the native amphibians.

Reptiles

The California Department of Fish and Wildlife (CDFW) considers the southwestern pond turtle (*Actinemys marmorata*) a species of special concern. Recent reports on *A. marmorata* in Southern California indicate that a few viable populations remain in the regions (see also Brattstrom 1988). Approximately six to eight viable populations of the turtle remain south of the Santa Clara River system in California. Droughts have exacerbated the negative effects of habitat alteration accumulated over many years in much of this region from changes in land and water use, and abusive grazing practices. In particular, most southwestern pond turtle populations examined in this region appear to show an age structure increasingly biased toward adults, indicating little or no recruitment is taking place. Recent surveys indicate that the southwestern pond turtle also is seriously threatened throughout most of its range outside of California.

CURRENT STATUS OF RESOURCES

WATER QUALITY AND QUANTITY

Water quality in the mountain portion of the watershed is good overall, with low concentrations of total dissolved solids, nitrates, and other pollutants. Although elevated levels of total coliform and silt have been identified with storm flows, water quality exceeds the state standards set for the identified beneficial uses of the water. The water quality generally decreases, and turbidity increases with distance from the mountains. Multiple water reuse becomes a more dominant factor. The river courses through a large dairy preserve. Treated municipal wastewater is discharged into the river at many points between Riverside and the Prado Basin.

Fortunately, water quality in the Santa Ana River has improved in recent years due to technological developments and water quality planning. Most of the native fishes of the watershed are adapted to clear, unpolluted water that can support food resources and provide the various habitat conditions necessary to complete their respective life cycles. While fish kills that are due to the spill of toxic substances into streams are dramatic examples of the effects of pollution, these instances are acute, or short-term, rather than chronic. More insidious, however, are the chronic effects on aquatic resources of non-lethal forms of pollution that decrease growth, inhibit reproduction, or impair movement. Chronic elevated water temperatures or high sediment loads are examples of this type of pollution, even though toxic chemicals are not involved. Other examples include elevated but non-toxic levels of ammonia, increases in salinity, and low levels of dissolved oxygen.

The flow through the alluvial scrub is seasonal. Between the cities of San Bernardino and Riverside, the river picks up enough urban discharge to support perennial flow and productive riparian habitat dominated by willows. The quality of the fish habitat also increases greatly and there are recent records for the occurrence of native fishes including the federally listed threatened Santa Ana sucker. The other native species recorded from several scattered localities are the arroyo chub and, more rarely, the speckled dace. Fish habitat will be particularly affected if flows are reduced because of less runoff and less water being discharged from treatment facilities.

SPOTTY CONSERVATION AREAS

Without a comprehensive, regional plan for water-oriented habitat conservation, independent efforts by various planners, regulators, and landowners can lead to fragmented habitat areas and fragmented management of those areas. In addition, a parcel-by-parcel, or piecemeal planning approach can lead to inconsistent, inequitable regulation of land development and unnecessary costs and delays. Broader planning and management approaches would benefit both the environment and development.

In general, the larger a habitat area, the healthier it is, with ample breeding, feeding and shelter opportunities for its inhabitants. Fragmented, small habitat areas can pose a threat to species diversity and the overall health of ecosystems.

Habitat fragmentation frequently is caused when native vegetation is cleared for activities such as agriculture or urbanization. Habitats, which were once continuous, become divided into separate fragments or islands. When habitat is fragmented, plants and animals lose their protective buffers around the fringes and access to each other, food, and water. Eventually the fragments become unable to support their natural diversity and species disappear.

The U.S. Army Corps of Engineers (Corps) promotes a watershed approach to placement of compensatory mitigation in implementing its 2008 Mitigation Rule. The following is its definition of that approach: "Watershed Approach means an analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a watershed. It involves consideration of watershed needs, and how locations and types of compensatory mitigation projects address those needs. A landscape perspective is used to identify the types and location of compensatory mitigation projects that will benefit the watershed and offset losses of aquatic resource conditions, past and projected aquatic resource impacts in the watershed, and terrestrial connections between aquatic resources when determining compensatory mitigation requirements for Corps permits."

However, compensatory mitigation and its restrictions can result in fragmented management, especially when mitigation providers are required by regulatory agencies to assign long-term real estate instruments, conservation easements, or other restrictive covenants to land before funding for compensatory mitigation can be directed to the mitigation provider. In many areas of the watershed where habitat has been significantly degraded, especially along the main stem where most of the invasive plants thrive, providing long-term protection through such instruments is not feasible. Much of this land is owned by cities, counties, flood control districts, water districts, park districts, and the Corps itself. These entities historically have not been willing to grant easements or other restrictive covenants to third parties, such as non-profit environmental organizations and resource conservation districts.

Fragmented management refers to piecemeal approaches to conservation and restoration of water-oriented habitat. When management is approached in a collective, comprehensive manner, overall costs can be reduced, funding can be pooled, and wasteful or harmful practices can be minimized or eliminated. When management is fragmented, there is a potential for duplication of effort, conflicting practices, and excessive costs.

SPECIAL-STATUS SPECIES

The State of California is home to one of the highest numbers of endangered species in the United States, second only to Hawaii. As defined within the federal Endangered Species Act of 1973, an endangered species is any animal or plant listed by regulation as being in danger of extinction throughout all or a significant portion of its geographical range. A threatened species is any animal or plant that is likely to become endangered within the foreseeable future throughout all or a significant portion of its geographical range. Federal law prohibits the take of any individuals or habitat of federally listed species without a special permit.

In addition to federal laws, the State of California has its own California Endangered Species Act, with a separate listing of species and separate laws governing take of listed species. The USFWS and the National Marine Fisheries Service enforce the federal Endangered Species Act, while the CDFW enforces the California Endangered Species Act. Figure 2 shows a map of critical habitat within the watershed.

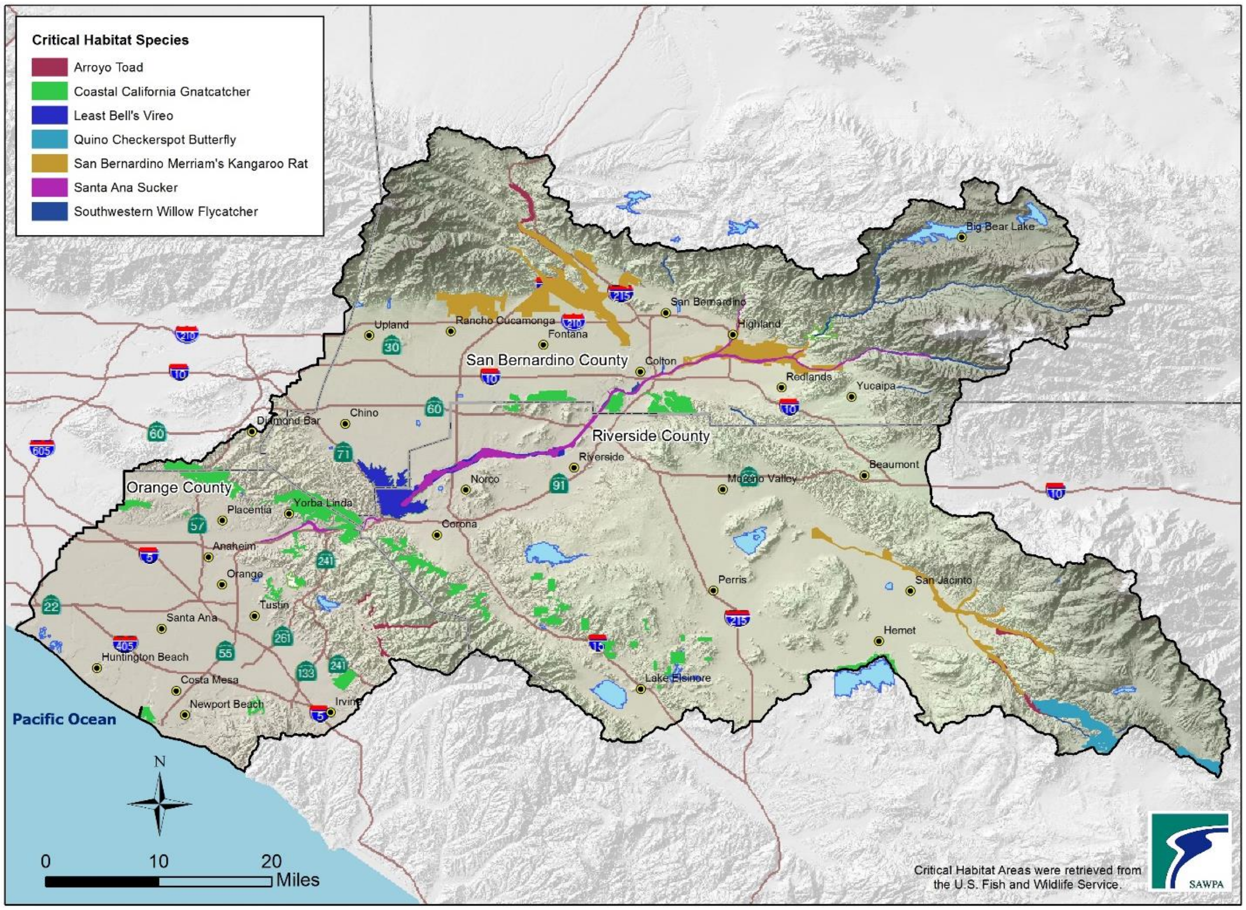

Figure 2. Critical Habitat in the Santa Ana River Watershed

The varied geography and natural features of the watershed provide habitat for a number of federally and/or state-listed species.

Though there are important species demanding careful management throughout the watershed, the listed species of concern below are those that occupy aquatic, wetland, riparian, or riparian-adjacent areas.[1] These species include the following:

- Plants
  - Santa Ana River woolly star (*Eriastrum densifolium*)
  - Slender-horned spineflower (*Dodecahema leptoceras*)
- Fish
  - Santa Ana sucker (*Catostomus santaanae*)
- Amphibians
  - Arroyo toad (*Anaxyrus californicus*)
  - Mountain yellow-legged frog (*Rana muscosa*)
  - California red-legged frog (*Rana aurora draytonii*)
- Birds
  - Least Bell's vireo (*Vireo bellii pusillus*)
  - Southwestern willow flycatcher (*Empidonax traillii extimus*)
  - Bald eagle (*Haliaeetus leucocephalus*)
- Mammals
  - San Bernardino kangaroo rat (*Dipodomys merriami parvus*)
  - Stephens' kangaroo rat (*Dipodomys panamintinus*)
- Insect
  - Delhi Sands flower-loving fly (*Rhaphiomidas terminatus abdominalis*)
- Invertebrate
  - Riverside fairy shrimp (*Streptocephalus woottoni*)

Reaches 4 and 5 of the Santa Ana River are federally designated critical habitat for the Santa Ana sucker. Reach 5 also is federally designated critical habitat for the San Bernardino kangaroo rat. Any project or policy recommended by the OWOW Program will need to assess potential impacts to listed species, and incorporate measures to avoid impacts to these species.

COASTAL CONDITIONS

Essential Fish Habitat areas exist in the coastal waters off Orange County. The Magnuson-Stevens Fisheries Conservation and Management Act defines Essential Fish Habitat as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." To clarify this

[1] It is recommended that future OWOW Plan updates consider how upland species should be considered.

definition, *waters* is defined as aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish. *Substrate* means "sediment, hard bottom, structures underlying the waters, and associated biological communities"; *necessary* means "the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem"; and *spawning, breeding, feeding, or growth to maturity* covers the full life cycle of a species.

An additional coastal resource is in the form of seagrasses, including eelgrass (*Zostera* spp.). They have great economic benefits by providing habitat, nursery grounds, and refuge that is essential for the continued replenishment of fish, a vital economic resource in the form of food. The economic value of sea-grass also is seen in its ability to filter nutrients such as phosphates and nitrates that come from fertilizers used in gardens and lawns. The economic value of global nutrient cycling by the world's seagrasses is an estimated $1.9 trillion per year (Waycott et al. 2009). Documented decline in the amount of seagrass areas globally has made their preservation a priority. Seagrasses are now federally protected under the Clean Water Act.

Marine habitat, in the form of eelgrass habitat, also is affected by human activity because of its location in the shallow subtidal zones of coastal areas. Coastal development, boating, aquaculture and fishing, and urban runoff are all contributing factors that have the potential for causing damage due to pollution. The health of this habitat is important as nursery grounds and refuge from predation for many species of fish and invertebrates including juvenile halibut, lobster, sharks, scallops, and oysters. It also provides protective shade to prevent overheating, and there are many species that actually lay eggs on the blades for protection until they hatch. Eelgrass is also a food source to both aquatic and waterfowl species.

AGRICULTURE AND DAIRIES: WATER QUALITY PROTECTION

Regulatory agencies in the watershed have taken a number of regulatory actions to address water quality impacts related to agricultural and dairy practices in the region, including impacts to both surface water and groundwater due to runoff from manure in dairy farm corrals, spreading of manure for fertilizer in agricultural fields, and use of pesticides.

In 2007, the Santa Ana Regional Water Quality Control Board (Regional Board) issued R8-2007-0001 (NPDES No. CAG018001): General Waste Discharge Requirements for Concentrated Animal Feeding Operations (Dairies and Related Facilities) within the Santa Ana Region (Santa Ana Regional Board 2007), prohibiting all dairies in the watershed from discharging process wastewater or stormwater runoff up to a 25-year, 24-hour rainfall event, and requiring each facility to develop an Engineered Waste Management Plan. This permit was amended with adoption of R8-2013-0001 (Santa Ana Regional Board 2013), which directed dairies in the San Jacinto Watershed to collaborate with Eastern Municipal Water District's Salinity Management Program.

The Riverside County Ordinance 427.2, passed by the Riverside Board of Supervisors in 2001, regulates safe transportation and application of manure in certain county districts by requiring operators and/or landowners to report manure application. The purpose of the ordinance is to minimize impacts to neighboring properties, local waterways, underground water supplies, and soil resources.

The San Jacinto Basin Resource Conservation District and the Western Riverside County Agriculture Coalition developed a multi-phased process for establishing and running a Manure Manifest System. The Manure Manifest System addresses nutrient and salt loadings by specifying that manure be applied to land at rates consistent with cropping practices and groundwater conditions. This will prohibit over-application at sites where potential impacts to groundwater basins are a concern.

THE VALUE OF UNDERSTANDING

The urban watersheds of the California coast provide a unique opportunity to explore the value of historical ecology research for developing contemporary wetland and riparian restoration plans. Studies have demonstrated that restoration and mitigation planning would be greatly improved if done within the context of ecosystem function (Kentula 1997, 2007; Kershner 1997; NRC 2001; White and Fennessy 2005). Unfortunately, in the urban environments of California, much of the current understanding of wetland and riparian ecology is derived from systems highly modified by human activities. Thus, identifying appropriate functional reference conditions or distinguishing natural processes from anthropogenic effects can be difficult. Recent historical ecology studies in California have provided new and surprising evidence of wetland resources previously not recognized, particularly in Southern California where evidence suggests wetland ecosystems were larger and more diverse than previously thought (Stein et al. 2010; SFEI and the Aquatic Science Center 2011). This suggests that historical ecology not only provides important information about functional reference conditions but also sheds light on previous misconceptions about the historical environment.

The value of historical ecology has been questioned in the urban coastal regions of Southern California where natural hydrologic processes are unlikely to be fully recoverable. Arguably, historical ecology may provide confusion in the face of a systematic incapability to return wetland ecosystems to their pre-development condition, often due to the permanent loss of natural hydrodynamic processes that were present prior to human contact. Understanding the historical template is as important as understanding the contemporary condition. Knowledge of historical ecosystem components is key to creating management and restoration plans that make sense relative to the contemporary landscape. The historical perspective provides an understanding of the relationship between physical settings that support natural wetland functions, the driving forces behind ecosystem degradation, and perhaps most important, the value of wetland ecosystems that remain intact (Stein et al. 2010). Considerable evidence supporting the importance of historical ecology in contemporary wetland management, even in highly urbanized areas, now exists (Kentula 1997; White and Fennessy 2005; Stein et al. 2010). In addition, new technical tools provide shared access to data collected for historical ecology projects, creating an opportunity for cross-disciplinary collaboration and ongoing discovery of historical reference conditions beyond traditional reports.

NATURAL RESOURCES RECREATIONAL OPPORTUNITIES

Most park and open space areas are local amenities, so the implementation of projects to develop them becomes a local decision intended to serve a focused, local population often residing within a few miles of a given developed park or open space area.

On the other hand, regional parks and open space areas tend to be larger, and provide more diverse amenities than those found in locally operated park facilities, and are managed to attract visitors from a wider area. Visitors come from within the watershed or from adjoining areas. The diversity of available facilities may enhance the region's attractiveness to visitors, and thereby provide economic growth through increased tourism. Most notably, parkland containing exceptional natural resources may attract eco-tourists looking for an opportunity to experience outdoor activities unavailable in their own areas. The wide variety of topography and natural resources within the watershed provide excellent opportunities for the development of this type of tourism.

Regional park facilities also may serve an important role in the continued economic development of the region. Businesses interested in attracting highly skilled workers often use the proximity to well-developed recreational resources in attracting and retaining talent. Among the amenities often considered by skilled professionals are culture and the arts, nightlife, and the availability of outdoor recreation opportunities. From the ocean to the mountains, the watershed provides numerous opportunities for such a population.

Running through the watershed is the Santa Ana River Trail and Parkway (Santa Ana River Trail), a regional recreational amenity linking open space areas throughout the watershed. Models such as the Santa Ana River Trail could be developed in other parts of the watershed, such as in San Timoteo Canyon, along Lytle Creek, and within the San Jacinto Watershed. Completion of these linear park amenities and their connection with the existing trail backbone could create a world-class recreation system available to millions of residents and visitors.

Funding for recreational projects vary on location and type of project. Typically, projects are funded by various grants from agencies within the benefiting area. Other sources of funding include the California Department of Parks and Recreation, and additional grants available through the federal government.

ANAHEIM PARK PROJECTS

OCWD and the City of Anaheim have forged a creative partnership to address the lack of open space and resources. On November 15, 2011, Anaheim opened a 14-acre nature park and a 1.5-mile bike path on public lands owned by OCWD near the City's urban core.

In the early 2000s, it became apparent that the City of Anaheim needed to find open space to provide an opportunity for nature and exercise. However, due to the built-out environment, lack of land, and high land prices, the City had few opportunities for large-scale nature parks. So, The City forged a relationship with the largest landowner in Anaheim, OCWD. OCWD's Burris Basin is a 116-acre groundwater replenishment facility on the west bank of the Santa Ana River. It is located only half a mile north of the Platinum Triangle, Honda Center, Angel Stadium, and the Anaheim Regional Intermodal Transportation Center, which is currently under construction.

In 2005, OCWD granted a 25-year lease to the City of Anaheim to open 14 acres of land for a public trail and nature park for an annual payment of $1. The agreement required the City to pay for the construction, maintenance, and security of the public park area. The City immediately began an intense public input process and funding campaign. The City of Anaheim received $6.3 million in grants from the Rivers and Mountains Conservancy, the California River Parkways Program, and the Recreational Trails Program.

Anaheim Coves at Burris Basin offers a resting spot for Santa Ana River Trail users and nearby neighborhoods. There are two parking lots and restrooms, along with ample seating and opportunities for bird watching. Integrated public art interprets the natural environment with bird images embedded in the concrete seating, and metal pelican shapes in the gates that welcome patrons. This is a place for people (including the elderly and young children) to exercise, socialize, commute, and enjoy nature at the same time. There also has been a drastic reduction in crime and calls for police service within the area.

The signs interpret OCWD's mission of groundwater recharge and the importance of water conservation; they also present local history and the native flora and fauna. All landscaping is composed of plants and trees indigenous to the watershed.

On April 30, 2013, a Memorandum of Understanding was ratified between OCWD and the City of Anaheim for an approximately 1-mile extension of the bike path to the north and an 11-acre nature park on the OCWD 5 Coves facility. Anaheim Coves at Burris Basin represents a great example of how cities and local water agencies can partner to further meet the needs of the community.

PARKS, RECREATION, AND OPEN SPACE

The former Parks, Recreation, and Open Space Pillar (now integrated into the Natural Resources Stewardship Pillar) brought together park, recreation, and open space advocates from the three counties, including cities, other governmental agencies, and citizens who are interested in public access relative to water resources in the watershed. This group focused attention on the larger picture of opportunities. However, they consider the Santa Ana River Trail as a model for the development of additional regional amenities where close cooperation across many areas and jurisdictions is necessary.

The general findings included a survey of current regional park and open space offerings and conditions. While there have been many accomplishments, especially with regard to river access, more planning, management and coordination are needed. Urban development patterns, high land prices, and low availability of land for recreation make expansion of opportunities difficult. Also, new parks or trails may impact habitat with limited land remaining for public access and recreation.

Possible future threats include availability of funding for new trails and parks within the watershed, a shortage of ongoing maintenance funds, and the ability to maintain a high level of security and care for the parks and trails.

Strategies for addressing existing threats include the following:

- Seeking more stable funding through assessments
- Increasing public awareness of park, recreation, and open space issues
- Developing a plan to leverage existing resources and expertise
- Forging and maintaining partnerships
- Improving resource mapping
- Curtailing vandalism by increased patrol presence
- Ensuring that regional park master plans include proper trail and open space protections

One of the most important regional strategies is to fund and complete the Santa Ana River Trail. It also is imperative to help local agencies find support for their recreation needs radiating from the backbone of the Santa Ana River Trail. The model developed on the main stem of the Santa Ana River to develop the Santa Ana River Trail can be adapted to tributaries such as San Timoteo Creek and the San Jacinto River.

Current recreation opportunities in the watershed include bicycling, hiking, walking, skiing, snowboarding, rock climbing, geocaching, bird watching, swimming, horseback riding, and organized team and individual sports. The availability and level of participation in such activities is dictated by terrain, the location within the watershed, and degree of urbanization. For example, approximately 18% of the watershed is within the San Bernardino National Forest. Recreational opportunities in this area are much different than in highly urbanized areas such as the cities of San Bernardino and Huntington Beach. In the upper watershed, hiking, rock climbing, and mountain biking are very popular on national forest lands. In the lower, more urbanized areas in the watershed, jogging and cycling are more common, as well as organized sports such as soccer and baseball. Sports fields are located adjacent to the river along its length.

The Santa Ana River Trail is the centerpiece of recreation in the watershed. The 100-mile trail is currently under development, and will extend from the crest of the San Bernardino Mountains to the Pacific Ocean. The trail runs through three counties, 15 cities, and multiple jurisdictions. The majority has been constructed with several gaps still remaining to be completed: 11 miles in San Bernardino County, 12 miles in Riverside County, and 3 miles in Orange County. It is projected that the remaining gaps can be completed by 2023.

The Santa Ana River Trail is a common thread through all three counties, and Figure 3 shows the locations of recreational opportunities available in the watershed. Table 1 presents each county's unique set of recreational resources.

Table 1. Regional Recreational Resources by County

County	Name and Location of Recreational Resource	Description of Resource and Available Activities
San Bernardino County	San Bernardino National Forest	• Approximately 672,000 acres • 352 miles of trails • Camping, fishing, hiking, equestrian, skiing, outdoor education, biking, target shooting, and motorized sports
	Chino Hills State Park, Chino Hills	• 6,000-acre park • Mostly open space • Hiking, bird watching, mountain biking
	Wildwood Canyon State Park Yucaipa	• Under development • 1,200 acres currently; plans to expand to 5,000 acres and to develop trails and campgrounds
	County Parks: Glen Helen, Prado Basin, Cucamonga Guasti, and Yucaipa	• Approximately 4,500 acres total • Camping, fishing, swimming, and general day use
	City Parks: Cities of Chino, Chino Hills, Redlands, San Bernardino, Colton, Highland and Loma Linda	• Various locations, facilities, and acreages with mostly urban uses
	Rails to Trails Upland and Fontana	
	Wildlands Conservancy Los Rios Rancho, Oak Glen	• 6,000 acres of open space with hiking and outdoor educational facilities
Riverside County	County Parks: Hidden Valley Wildlife Area, Martha McLean–Anza Narrows, Rancho Jurupa, and Louis Rubidoux Nature Center	• Hiking, bird watching, equestrian, camping, and outdoor education
	City Parks: City of Riverside, Norco River Trails, Mt. Rubidoux Park, Fairmount Park, and Butterfield	• Various locations, facilities, and acreages with mostly urban uses
Orange County	County Parks: 3 regional parks along SART	
	City Parks: 9 city parks along SART	
	Burris Basin currently under development	
	Existing equestrian facilities: Rancho Del Rio and Singletree Farms	
	SART bikeway: 27 miles complete Riding and hiking trail: 23 miles complete	
	Talbert Marsh	• Multipurpose trail on 25 acres. • Bird watching

Table 1. Regional Recreational Resources by County

County	Name and Location of Recreational Resource	Description of Resource and Available Activities
	Upper Newport Bay State Ecological Reserve/Interpretive Center	• Bird watching, outdoor education, biking, and walking
	Irvine Ranch Wildlands and Parks	• Hiking, equestrian, outdoor education, and mountain biking
	Bolsa Chica Ecological Reserve Bolsa Chica State Beach	• 300 acres • Outdoor education, hiking, biking, bird watching, and camping

SART = Santa Ana River Trail and Parkway.

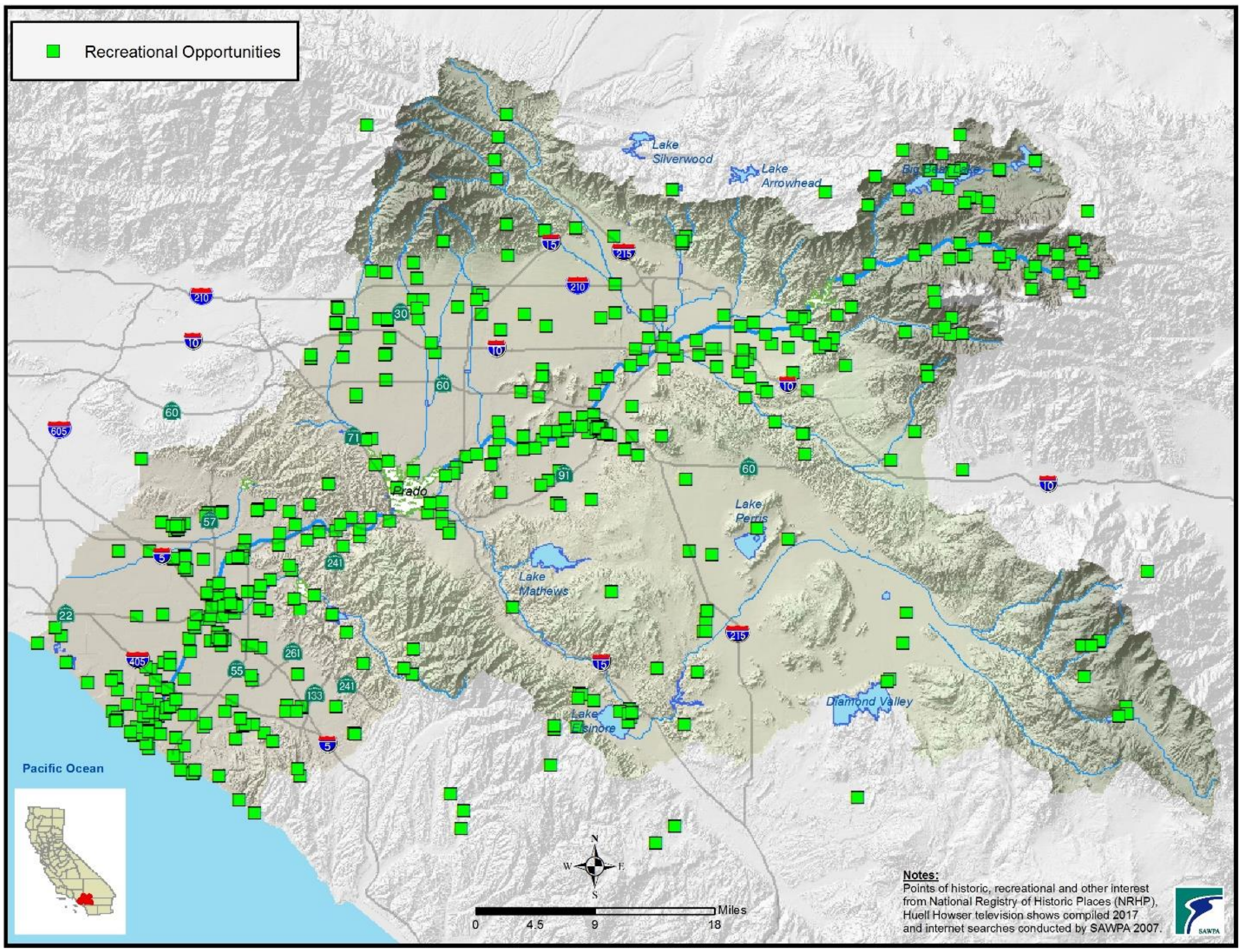

Figure 3. Recreational Opportunities in the Santa Ana River Watershed

REGIONAL STRENGTHS, THREATS, AND WEAKNESSES IN RECREATION

PHYSICAL

One of the great strengths of the region is that each county is geographically distinct, providing a variety of recreational opportunities. However, this diversity in topography also creates some threats and challenges. The biggest threat to recreation in the region is arguably patterns of urban development. The upper portion of the watershed, in San Bernardino County, is mountainous and relatively less populated than other areas in the watershed. The lower valleys are more urban, with a discernible pattern of higher density near the coast. However, recently, relatively lower land values inland have resulted in increasing urbanization in these areas. Open space is being converted at a rapid pace, reducing opportunities to establish large parks and natural recreational amenities. The result most likely will be the development of more urban parks, which will support more urban recreational activities.

The upper portion of the watershed, being mountainous, results in a diversity of activities associated with forested environments. These include skiing, camping, hiking, rock climbing, and fishing. The middle portion of the watershed is relatively flat, valley terrain and is more densely urbanized. Activities in these areas include walking, jogging, bike riding, and horseback riding. Also, activities associated with more urban environments, such as organized team sports played on developed fields, are more common in these areas.

The proximity of the ocean in the lower parts of the watershed is a draw for outdoor recreation in Orange County. The beach provides recreational opportunities found nowhere else in the watershed. This is a strength, in that unique activities are available, but also a weakness in that the area is heavily used and requires additional maintenance and management. Facilities require greater upkeep and the potential for conflicts among users is higher here than elsewhere.

The presence of the Prado Dam in the center of the watershed also creates some unique challenges and opportunities. The area behind the dam is a largely undisturbed wetland, habitat to a number of threatened and endangered bird species. Bird watching is popular in this area, but access is challenging. Additionally, the river below the dam has water year-round, providing recreational opportunities such as boating and fishing. The river upstream of the dam is more intermittent and does not offer these same opportunities.

The presence of the Santa Ana River Trail and various state and regional parks adjacent to the river along its course provide a ready-made infrastructure on which to build future trail linkages. There are few recreational trails adjacent to water in Riverside and San Bernardino Counties, but opportunities exist to develop recreational amenities at flood control facilities.

INSTITUTIONAL

All counties and cities in the watershed have some type of park and recreation management agency in place. These agencies provide an existing framework from which to plan and implement future projects. Several working groups currently exist to address specific issues that also provide forums from which to collaborate. Additionally, many agencies have developed management plans for various parks and resources under their purview. For example, most cities have master plans that reference recreation along the river. A major institutional strength is that most of the agencies currently cooperate and maintain good working relationships with one another as they endeavor to build trails. Most cities in the watershed have completed or are in the process of completing some type of vision document for the Santa Ana River Trail within their jurisdictions. Sponsored mainly by the Wildlands Conservancy, these "blue ribbon" committees have assembled stakeholders in each city to craft a vision for recreation adjacent to the river. Each city will have a document that can be used to guide future recreational development.

Private institutions, such as the Wildlands Conservancy, located in San Bernardino County, provide key private support and involvement. The Wildlands Conservancy has provided critical and substantial funding and works effectively with government agencies to further outdoor recreational and educational programs. Other groups, such as the Crafton Hills, Yucaipa Valley, San Bernardino Mountains, and Riverside land conservancies are working with their own contacts and partners to acquire lands, build connecting trails, and encourage elected officials to make recreation and open space a priority. The Santa Ana River Trail Partnership, a relatively new collaboration between public and private entities in the watershed also has been effective in bringing about funding and planning in the watershed. In 2006, the three counties, SAWPA, and the Wildlands Conservancy signed a Memorandum of Understanding to form the Santa Ana River Trail Collaborative Partnership. This group brings political will to bear and directs the agencies under its umbrella to coordinate, seek funding, and leverage resources to finish building the Santa Ana River Trail. This group has developed the first regionally adopted plan for completing the unfinished segments of the Santa Ana River Trail.

Many of the group's participants felt that lack of funding to implement management plans was a widespread problem. Much of the funding focused on non-native species removal, such as Arundo (*Arundo donax*). The group also expressed that funding was available for new park development, but not for maintenance and operations. Many stated the need for acquiring lands to expand or build new facilities.

CURRENT CONSERVATION MEASURES

There are several active, proposed, and inactive conservation plans in the watershed. The following is a list of some of the current plans. There are large gaps between these plans in the watershed, including in Western Orange County and in San Bernardino County.

UPPER SANTA ANA RIVER WASH LAND MANAGEMENT AND HABITAT CONSERVATION PLAN

The project is located in the eastern valley portion of San Bernardino County, mostly within the cities of Highland and Redlands, but also partially within County jurisdiction. The plan area is bounded by Greenspot Road to the north and east, Alabama street to the west, and the Santa Ana River Wash to the south.

The purpose of the proposed project is to allow the continued use of land and mineral resources while maintaining the biological and hydrological resources of the planning area in an environmentally sensitive manner. The Wash Plan is intended to coordinate and manage the present and future activities in the wash that are part of multiple jurisdictions, each with different needs. The goal of the project is to balance the ground-disturbing activities of aggregate mining, recreational activities, water conservation, and other public services with quality, natural habitat for endangered, threatened, and sensitive species (SBVWCD 2007).

WESTERN RIVERSIDE COUNTY MULTIPLE SPECIES HABITAT CONSERVATION PLAN

The Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) is a comprehensive, multi-jurisdictional Habitat Conservation Plan (HCP) focusing on the conservation of species and their associated habitats in Western Riverside County. The MSHCP is one of several large, multi-jurisdictional habitat-planning efforts in Southern California with the overall goal of maintaining biological and ecological diversity within a rapidly urbanizing region. Large-scale HCP planning efforts have been completed in San Diego and Orange Counties, and a similar effort is under way in the Coachella Valley. The MSHCP will allow Riverside County and its cities to better control local land use decisions and maintain a strong economic climate in the region, while addressing the requirements of the state and federal Endangered Species Acts.

Riverside County's population in 2000 was approximately 1.5 million people. Its population is expected to double by 2020, to reach approximately 3.5 million by 2030, and to be approximately 4.5 million by 2040, according to forecasts by the Southern California Association of Governments. This is nearly a 400% increase over the next 40 years. Most of Southern California's growth over the next 40 years is expected to occur in the Inland Empire (San Bernardino and Riverside Counties) (SCAG 2004).

Accommodating an increase in population of this magnitude will involve urbanizing thousands of acres of undeveloped land and result in significant conflicts with regulations protecting species and their habitats. Conflicts and delays will escalate costs for all development projects, uncoordinated mitigation efforts will fragment habitats, the region will miss opportunities to improve the quality of life, and economic development opportunities for the current and future residents of Riverside County also will not be realized.

The MSHCP plan area encompasses approximately 1.26 million acres (1,966 square miles). It includes all unincorporated Riverside County land west of the crest of the San Jacinto Mountains to the Orange County line, as well as the jurisdictional areas of the cities of Temecula, Murrieta, Lake Elsinore, Canyon

Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, and San Jacinto. This HCP is one of the largest plans ever attempted. It covers multiple species and multiple habitats within a diverse landscape, from urban centers to undeveloped foothills and montane forests, all under multiple jurisdictions. It extends across many bioregions as well, including the Santa Ana Mountains, Riverside Lowlands, San Jacinto Foothills, San Jacinto Mountains, Agua Tibia Mountains, Desert Transition, and San Bernardino Mountains. It will provide a coordinated MSHCP Conservation Area and implementation program to preserve biological diversity and maintain the region's quality of life. See Table 2 for conservation plans under the umbrella of the Western Riverside County MSHCP.

Table 2. Existing Conservation Plans under Western Riverside County MSHCP

Plan	Agency	Acres	Status
WRC MSHCP	WRC RCA	—	Underway
Cleveland NF	USDA Forest Service	—	Completed
San Bernardino NF	USDA Forest Service	—	Completed
Prado Basin	OCWD	—	Completed
Bureau of Land Management Lands	Bureau of Land Management	—	Fluctuates
Lake Perris SRA	California State Parks	—	Completed
San Jacinto WR	California State Parks	—	Underway
San Timoteo Creek SP	California State Parks	—	Underway
Mt San Jacinto Wilderness SP	California State Parks	10,000	Completed
Santa Margarita Ecological Reserve	—	—	Completed
Santa Rosa Plateau Nature Reserve	—	8,300	Completed
Motte Rimrock Reserve	UCNRS	—	Completed
Box Springs Reserve	UCNRS	1,155	Completed
Emerson Oaks Reserve	UCNRS	—	Completed
James San Jacinto Mountain Reserve	UCNRS	160	Completed
Kabian Park	Riverside County Parks	640	Completed
Norton Younglove/De Anza Reserve	—	—	Completed
Harford Springs Reserve	Riverside County	—	Completed
Lake Skinner Recreation Area	Riverside County Parks	—	Completed
Lake Mathews–Estelle Mountain Reserve	Metropolitan	—	Completed
SW Riverside County Multi Species Reserve	RCHCA	—	Completed
Metropolitan Water District Lands	Metropolitan	—	Completed
March ARB Reserve Lands	USAF	—	Completed
Southern California Edison Lands	SCE	—	Completed
San Diego Gas & Electric Company Lands	SDG&E	—	Completed
	Total acres	500,000	N/A

WRC MSHCP = Western Riverside County Multiple Species Habitat Conservation Plan; WRC RCA = Western Riverside County Regional Conservation Authority; NF = National Forest; USDA = U.S. Department of Agriculture; OCWD = Orange County Water District; SRA = State Recreational Area; SP = State Park; UCNRS = University of California Natural Reserve System; Metropolitan = Metropolitan Water District of Southern California; SW = Southwestern; RCHCA = Riverside County Habitat Conservation Agency; ARB = Air Reserve Base; USAF = U.S. Air Force; SDG&E = San Diego Gas & Electric Company; N/A = not applicable.

Existing Reserves within the Western Riverside County MSHCP

- Box Springs Reserve
- Bureau of Land Management Lands
- Cleveland National Forest
- Emerson Oaks Reserve
- Harford Springs Reserve
- Kabian Park
- Lake Mathews–Estelle Mountain Reserve
- Lake Perris Recreation Area
- Lake Skinner Recreation Area
- March Air Reserve Base Reserve Lands
- Metropolitan Water District Lands
- Mount San Jacinto Wilderness State Park
- Norton Younglove Reserve
- Orange County Water District Lands
- Prado Basin
- Riverside County Flood Control and Water Conservation District Lands
- San Bernardino National Forest
- San Diego Gas & Electric Company Lands
- San Jacinto Wildlife Refuge
- San Timoteo Creek State Park
- Santa Margarita Ecological Reserve
- Santa Rosa Plateau Nature Reserve
- Southern California Edison Lands
- Southwestern Riverside County Multi-Species Reserve
- Sycamore Canyon Wilderness Park
- James San Jacinto Mountain Reserve

ORANGE COUNTY NATURAL COMMUNITIES CONSERVATION PLAN

The purpose of this project is to create a subregional multi-habitat-based HCP that balances resource protection with reasonable economic growth. This effort provided an opportunity to preserve coastal sage scrub and oak woodland habitats that have nearly disappeared from Southern California. The remote canyons of the 13,000-acre northern boundary, east of the City of Orange, are notable for "The Sinks" area of Limestone Canyon, a huge, steep-walled sandstone ravine that resembles a mini-Grand Canyon. The land harbors some of Orange County's richest oak and sycamore woodlands, as well as streams and springs laced with blackberries (*Rubus* spp.) and monkeyflowers (*Mimulus* spp.) and shared by animals of all sizes – from mountain lions (*Puma concolor*) to rare lizards. The ranch's 12,000-acre Weir, Gypsum, and Fremont Canyons, adjacent to the Cleveland National Forest, are home to many native animals and plants. These include the rare Tecate cypress (*Cupressus forbesii*), found in only three other areas of California. The 14,000-acre southern boundary, with its hills, meadows, wooded canyons and sweeping views of the Pacific, connects Crystal Cove State Park and the Laguna Coast Wilderness Park. The Irvine Ranch Wildlands and Parks are home to bobcats (*Lynx rufus*), red-tailed hawks (*Buteo jamaicensis*), coyotes (*Canis latrans*), mule deer (*Odocoileus hemionus*), western meadowlarks (*Sturnella neglecta*), and an abundance of other wildlife (TNC 2008).

The Irvine Ranch Conservancy was established in 2005. It is a non-profit, non-advocacy organization, created to help care for the 50,000 acres of permanently protected wildlands and parks on the historic Irvine Ranch. The organization works with its partners to enhance the public's appreciation, understanding, and connection to the land, while helping other landowners and managers with all aspects of stewardship. The Irvine Ranch Conservancy contributes its resources, expertise, and energy to achieve the best possible balance of preservation and public participation. Nearly 50,000 acres of wildlands and parks have been designated as permanent open space on The Irvine Ranch. However, protecting the land is only the first step. Mediterranean ecosystems like these need extremely attentive stewardship. The rare plants, animals, and habitats found here are adapted to specialized conditions and need our long-term management to survive. The mission of the Irvine Ranch Conservancy is to make sure that these lands are cared for and enjoyed to the highest possible standards.

The wildlands of the North Ranch are connected to the Cleveland National Forest and are one of the few places where natural habitat ranges relatively unbroken from lowland scrub, grassland, and oak woodlands up to higher altitude montane chaparral and conifers. The Venturan and Diegan associations of coastal sage scrub and native grasslands of Southern California are all critically endangered, and the Irvine Ranch Wildlands and Parks and adjacent wildlands offer one of the last, best places to protect these ecosystems and many of the species associated with them.

This area also is sufficiently large and continuous to support native ecosystems that still benefit from the presence of large predators such as mountain lion, coyote, golden eagle, and bobcat. Their ecological role as top carnivores helps maintain a healthy and resilient ecosystem. The wildlands are some of the last and most extensive lower elevation habitat for these important predators. For all of these reasons, The Irvine Ranch Wildlands and Parks have been identified by The Nature Conservancy as one of the top 50 priority conservation landscapes in California.

Not only are these natural areas a globally important conservation priority, they are remarkably close to one of the world's largest urban regions. This offers an unparalleled opportunity for people to experience and enjoy these extraordinary native ecosystems in their own backyard, while enhancing understanding and support for their protection and stewardship. See Tables 3 and 4 for current conservation plans under the aegis of the Orange County and San Bernardino County MSHCPs.

Table 3. Existing Conservation Plans under Orange County MSHCP

Plan	Agency	Acres	Status
Cleveland National Forest	USDA Forest Service		Completed
Irvine Ranch Wildlands	TNC	50,000	Underway
Irvine Open Space Preserve – South	City of Irvine	4,000	Underway
	Total acres	54,000	N/A

MSHCP = Multiple Species Habitat Conservation Plan; USDA = U.S. Department of Agriculture; TNC = The Nature Conservancy.

Table 4. Existing Conservation Plans under San Bernardino County MSHCP

Plan	Agency	Acres	Status
San Bernardino National Forest	USDA Forest Service		
San Bernardino County MSHCP	County of San Bernardino		Hiatus
Upper Santa Ana River Land Management and Habitat Conservation Plan	SBVWCD		Draft

MSHCP = Multiple Species Habitat Conservation Plan; USDA = U.S. Department of Agriculture; SBVWCD = San Bernardino Valley Water Conservation District.

INNOVATIVE CONSERVATION ARRANGEMENTS

Restoring the Santa Ana River requires many partners, agencies, and landowners. Some of the key agencies involved include the following: The Corps has provided major funding through mitigation requirements and permits the wetland activities under Section 404 of the Clean Water Act. CDFW permits the wetland activities under Section 1601 of the California Fish and Game Code, has directed mitigation funds to SAWA, and contributes expertise to deal with some of the resource issues. The Santa Ana River Mitigation Bank offers mitigation credits to project proponents, providing needed revenue to Riverside County Regional Park and Open-Space District and SAWPA to remove Arundo. The Santa Ana Regional Board approves activities that could affect water quality and provides oversight of the recognized beneficial uses of the wetland resources. OCWD has provided major funding, provides personnel to manage wetlands and endangered species, and manages 2,400 acres in the Prado Basin, attempting to maximize wildlife resources. Other programs include the federal Safe Harbor Policy, which protects the ability of landowners to use their land responsibly in exchange for the setting aside of large land parcels for conservation of specific threatened or endangered species.

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APPENDIX K

Project Submittal Tool Instruction Packet

Online Form

General Items and Tips

The OWOW Plan Update 2018 portion of the form consists of 7 pages with approximately 30 questions (including some multi-part questions). The Prop 1 funding portion of the form consists of 5 pages with approximately 50 questions (including some multi-part questions). Projects that only want to be in the OWOW Plan just need to fill out that portion of the form. Projects seeking Prop 1 funding will also need to complete the Prop 1 portion. The questions on the Prop 1 form come from the DWR Project Information Form with a few questions specific to the Santa Ana River IRWM added. The Prop 1 pages are designated with orange tabs.

The Project form has been tested in Chrome and Firefox so we recommend you use either of these two browsers.

You need to register with the site using a valid email and password in order to add projects. Once you have registered you can add as many projects as you want as that user.

Navigate between pages by clicking the 'Save/Next >' or '< Back' button at the bottom of each page. Data is saved into the database each time you click the 'Save/Next > button. Do not use the back and forward buttons on your browser tool bar to navigate pages. Clicking the forward button will not save data to the database and the back button may not display the most recent version of information saved into the database.

The program checks that required questions are complete before saving information to the database and moving to the next page. If a required question is not answered (or is otherwise not valid), a pop-up will appear notifying you of the error, and you must complete that question before saving all the information on that page to the database and moving on to the next page.

After completing the first two pages of the form (Organization and General) you can come back and edit your project at any time.

In order for your project to be included in the OWOW Plan Update 2018 or request Prop 1 Funding you must complete all pages of the online form and click the 'Submit Project' button on the last page of the form. After you click 'Submit Project' you can still edit your project at any time. If you decide to withdraw your project from consideration you can do so by going to the Start Page, clicking the 'Edit Existing Project' radio button and then clicking the Active link in the grid for the project of interest. Active = True means the project will be considered, and Active=False means the project will not be considered. You can toggle back and forth between the two.

Owing to the length of the form and the detailed nature of the questions, it is recommended you complete your answers in the MS Word Form provided on the help page and then copy and paste your answers into the online form.

There are character count (including spaces) limitations on the questions requiring a text response. Maximum character counts are listed as a prompt or placeholder in the text boxes. You can get a character count in MS Word by highlighting the text and clicking the 'Words' button on the status bar at the bottom of the page. In the online form you can also click the info icon next to the text box to get a character count.

Help is available on each page of the form by clicking the help button located on the top of each page. Specific information regarding individual questions is available by clicking the info icon next to the question.

Login Page

Click the ‘Register’ button if you are a new user and fill out the form with a valid email and a 6-10 character password. Once you have registered you will be sent a confirmation email containing the email and password you used to register.

Click the ‘Login’ button on the upper right if you have already registered and you want to add more projects or edit any of your existing projects.

You need to be logged in to add projects, and you can add as many projects as you like using the same email and password.

If you forget your password, click the ‘Retrieve Password’ link on the form and fill in your user email address in the pop-up box. Your password will be emailed to you.

If you want to change your password, click the ‘Change Password’ link on the form and fill in your new password in the pop-up box. (Must be logged in)

If you want to change your user email, click the ‘Change User Email’ link on the form and fill in your new email in the pop-up box. (Must be logged in)

After you have logged in you can either enter a new project or edit an existing project by clicking the appropriate radio button.

Organization Page

This page contains information regarding the Organization or project proponent. All fields except Organization Twitter are required.

Click the ‘Save/Next >’ button to save information into the database.

General Project Page

This page contains General Project information including Project Name, Project Keywords, Project Abstract, Project Benefits, Total Project Cost, Local Contribution, Estimated Project Life and the Project Consideration Type.

Online Form

Descriptions of the Project Consideration Types are listed below:

OWOW Plan Update 2018:
Projects not seeking funding from Prop 1, but would like to be included in the OWOW Plan Update 2018.

Prop 1 IRWM Funding:
Projects seeking funding from Prop 1 and want to be included in the OWOW Plan Update 2018.

Click the 'Save/Next >' button to save information into the database.

Location Page

This page consists of an interactive map where you can draw your project or program benefit area using points, lines and polygons. You can draw as many features as necessary and can include a mix of points, lines and polygons. You need to draw at least one feature on the map. You will also need to type in a description of the project location in the 'Location Description' box.

Click the 'Save/Next >' button to save information into the database.

Project Partners Page

On this page you will insert information about Project Partner Organizations. In addition to organization name, organization type, address and contact information, you will also need to select a partner type for the organization (At least one). Partner types include:

Collaborative Planning - Helps in the planning of project.

Direct Funding - Provides funding for project.

In-Kind Services - Provides labor/services contributions to project.

Co-operator/Co-Manager - Co-manages or is an equal partner in the project

You can insert as many organizations as necessary using the 'Insert Partner' Button.

Click the 'Next >' button to move to the next page when you are done inserting organizations.

OWOW Plan Goals Page

Select the OWOW Plan Update 2018 Goals your project achieves and provide an explanation for how your project achieves them. The goals include:

- Achieve resilient water resources through innovation and optimization
- Ensure high quality water for all people and the environment
- Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function
- Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed

- Educate and build trust between people and organizations
- Improve data integration, tracking and reporting to strengthen decision-making

There is a link at the top of the page that opens a pdf document with a description of all the goals and objectives in the plan.

Click the 'Save/Next >' button to save information into the database.

Resource Management Strategies (RMS) Page

Select all the RMS that apply to your project.

Click the 'Save/Next >' button to save information into the database.

Inclusion Page

Select the items that apply to your project and explain how your project addresses these issues. The issues include:

- Project supports the strengths or needs of a disadvantaged community
- Project supports the strengths or needs of a Tribal community
- Project works to diminish environmental injustices
- Project supports achievement of the human right to water

Click the 'Save/Next >' button to save information into the database.

Eligibility Page (Prop 1 Funding Only)

This page includes DWR specified eligibility requirements for Prop 1 funding. There are also a few requirements specific to the Santa Ana River Watershed.

Click the 'Save/Next >' button to save information into the database.

Environment Page (Prop 1 Funding Only)

This page contains environment related questions required by DWR for Prop 1 funding. These questions include a CEQA timeline and permit acquisition plan.

Click the 'Save/Next >' button to save information into the database.

Work Plan Page (Prop 1 Funding Only)

This page contains questions related to your project work plan, preliminary budget, and tentative schedule as required by DWR for Prop 1 funding. These questions include a CEQA timeline and permit acquisition plan.

Click the ‘Save/Next >’ button to save information into the database.

Benefits Page (Prop 1 Funding Only)

Your **project will be scored and ranked** based on your responses to the benefit class questions on this page.

Click the ‘Save/Next >’ button to save information into the database.

Other Page (Prop 1 Funding Only)

This page covers other items required by DWR for Prop 1 funding. These include questions related to Disadvantaged Communities, Economically Distressed Areas, Native American Tribal Communities, Least Cost Alternatives, Safe Clean Affordable Water (AB 685), Innovative Technologies, AB 1249 Contaminants, and Property Access for the project.

Click the ‘Save/Next >’ button to save information into the database.

Finish Page

This is the final page where you submit your project to flag it as complete. After clicking the ‘Submit Project’ button you will receive an email notification that your project has been submitted with a link to a pdf report with your project details. You can make changes to the project at any time after submittal, just click the ‘Submit Project’ button after making the edits to update your project information report with the latest information.

Project Location Map

The Project Location Map can be accessed from the ‘Project Location Map’ link in the ‘Supporting Documents and Maps’ section of the Start Page. This map includes all projects submitted for the OWOW 2018 Plan Update and Prop 1 Funding Requests. Your project will be added to the map after you click the ‘Submit Project’ button on the final page. You can find your project (or any other submitted) by selecting the agency and project name using the drop downs on the left side of the map, or by zooming into the map directly in the area of your project. If you click your project location on the map, an info window will appear that will allow you to open and save a pdf copy of the report generated when the ‘Submit Project’ button was clicked.

1) Organization Information:

Note: all fields required except Organization Twitter

Org. Name:

Org. Address:

Org. City:

Org. Zip:

Org. Website:

Org. Twitter: (Optional)

Exec Mgr/GM First Name: Exec Mgr/GM Last Name:

Exec Mgr/GM Phone:

Exec Mgr/GM Email:

Contact First Name: Contact Last Name:

Contact Phone:

Contact Email:

2) General Project Information:

Note: all fields required

Project Name (250 chars):

To get a character count in MSWord, highlight the text and click the words tab below. Use the count with spaces included. Character counts also available on project form.

Project Keywords (3 words required. Limited to 50 chars for each):

Select keywords from the drop down on the form or type your own. Keyword can be a phrase. Keywords will be used for sorting and research, not for rating/ranking or grant seeking.

Project Abstract (2500 chars):

Provide a brief description of the project that can be understood by all readers. Max 2500 characters.

Project Benefits (2500 chars):

Provide a brief description of the benefits your project will provide the Santa Ana River watershed. Max 2500 characters.

Total Project Cost (numeric whole number): *Round to nearest $100 or greater*

Local Contribution (numeric whole number): *Round to nearest $100 or greater*

Estimated Project Life (years, numeric whole number):

Project submitted to:

OWOW Plan Update 2018

Prop 1 IRWM Funding

All projects are submitted by default to the OWOW Plan Update 2018.

3) Project Location

Note: all fields required

Use the map tools on the upper left portion of the map to draw your project location or program benefit area on the map. The features you draw can be polygons, lines or points. You can draw as many features as necessary and add different feature types.

You can view projects submitted to date by clicking the 'View All Submitted Project Concepts' checkbox.

You can view DAC tracts and census blocks from DWR by checking the 'View DAC Tracts from DWR' or 'View DAC Census Blocks from DWR' checkboxes.

Additional instructions on Online Project Form

The program will automatically calculate a center point of your project from all the features you add.

Project Location Description (500 chars):

4) Project Partners

(Project Partners are strongly encouraged, insert as many as necessary)

Note: all fields required

Org. Name:

Org Type: (Select One) *Education, Government, NGO, Private, Special District*

Contact First Name: Contact Last Name:

Address:

City:

Zip:

Email:

Phone:

Project Partner Type (select all that apply)

___ Collaborative Planning *Helps in the planning of project.*

___ Direct Funding *Provides funding for project.*

___ In-Kind Services *Provides labor/services contributions to project.*

___ Co-Operator/Co-Manager *Co-manages or is an equal partner in the project.*

5) OWOW Plan Update 2018 Goals

The One Water One Watershed Plan Update 2018 describes how collaborative watershed planning, water and land management, and project implementation supports improved sustainability, resilience, and quality of life throughout the Santa Ana River Watershed through 2040.

View Goals and Objectives Descriptions

(Select all that apply) Project must achieve at least one of the goals.

___ Achieve resilient water resources through innovation and optimization

Explanation: (500 characters)

___ Ensure high quality water for all people and the environment

Explanation: (500 characters)

___ Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function

Explanation: (500 characters)

___ Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed

Explanation: (500 characters)

___ Educate and build trust between people and organizations

Explanation: (500 characters)

___ Improve data integration, tracking and reporting to strengthen decision-making

Explanation: (500 characters)

6) Resource Management Strategies

The following list of Resources Management Strategies is drawn from the California Water Plan Update 2013. For more information about the RMS, click here to visit DWR's explainer page.

(Select all that apply) At least one is required

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance – Delta
- ☐ Conveyance – Regional/local
- ☐ Crop Idling for Water Transfers
- ☐ Irrigated Land Retirement
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives (Loans, Grants and Water Pricing)
- ☐ Ecosystem Restoration
- ☐ Flood Risk Management
- ☐ Forest Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Land Use Planning and Management
- ☐ Matching Quality to Use
- ☐ Outreach and Engagement
- ☐ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Area Protection
- ☐ Recycled Municipal Water
- ☐ Salt and Salinity Management
- ☐ Sediment Management
- ☐ Surface Storage – CALFED
- ☐ Surface Storage – Regional/local
- ☐ System Reoperation
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water and Culture
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☐ Watershed Management

7) Inclusion

(Select all that apply)

View Map of DACs prepared by DWR

___ Project supports the strengths or needs of a disadvantaged community

Explain, including a description of how the community was engaged in designing the project. Max 1000 characters.

___ Project supports the strengths or needs of a Tribal community

Explain, including a description of how the Tribal government was engaged in designing the project (N/A if project submitted by a Tribal government). Max 1000 characters.

___ Project works to diminish environmental injustices

Explain how your project fits this description from DWR 2016 IRWM Plan Standards: 'environmental justice [efforts seek] to redress inequitable distribution of environmental burdens (i.e. pollution, industrial facilities) and access to environmental goods (i.e. clean water and air, parks, recreation, nutritious foods, etc.). Max 1000 characters.

___ Project supports achievement of the Human Right to Water

Explain how your project fits Water Code Section 106.3 (a) It is hereby declared to be the established policy of the state that every human being has the right to safe, clean, affordable and accessible water adequate for human consumption, cooking and sanitary purposes. Max 1000 characters.

8) Eligibility (Prop 1 Funding Only)

Project Type and Watershed Approach
Applicant Type: (Select Applicant Type)

Select Project Type: ___ Construction ___ Program ___ Study/Investigation

Does the project have a minimum useful life of 15 years as required by Government Code 16727?
___ Yes ___ No
If no, please explain how the project is consistent with Government Code 16727
(50 words maximum)

This is a sustainable project resilient to changing conditions?
___ Yes ___ No

Describe in context of climate change, land use, population change, economic conditions, etc. If No, please explain why not.
(50 words maximum)

Project benefits are Not achieved at the expense or detriment of another?
___ Yes ___ No

Explain analysis conducted to assert this answer. How was your conclusion reached?
(50 words maximum)

Statewide Priorities from CA Water Action Plan
Does the project contribute to regional water self-reliance?
___ Yes ___ No

Describe: *(50 words maximum)*

Select additional Statewide Priorities that your project benefits meet. (See pages 8-10 of 2016 IRWM Grant Program Guidelines for priority descriptions). **At least one is required**

- ☐ Make Conservation a California Way of Life
- ☐ Identify Sustainable and Integrated Financing Opportunities
- ☐ Achieve the Co-Equal Goals for the Delta
- ☐ Protect and Restore Important Ecosystems
- ☐ Manage and Prepare for Dry Periods
- ☐ Expand water storage capacity and improve groundwater management
- ☐ Provide Safe Water for All Communities
- ☐ Increase Flood Protection
- ☐ Increase Operational and Regulatory Efficiency

8) Eligibility (Prop 1 Funding Only)

Project Partner – Resource Contribution Description

All the project partners you added on the 'Partners' Page are in the drop-down list below. For each partner in the list you need to provide a description of the resource contribution they provide. The types of resources provided by each partner are provided for reference to help answer the question.

Select Partner: (Select from list)

Describe Resource provided (50 words maximum)

Climate Change Adaptation and Mitigation

Water Code § 79742 (e) – Requires applicants seeking Proposition 1, Chapter 7, project funding to demonstrate that the applicant's project contributes to addressing the risks in the region to water supply and water infrastructure arising from climate change. Source: 2016 Prop. 1 IRWM Guidelines Pg. 11, further guidelines Pg. 40.

Does the project address and/or adapt to the effects of climate change?

___ Yes ___ No

If Yes, please select the climate change vulnerabilities that apply and explain

Adapt to Climate Change

- ☐ Identifies potential effects of climate change on the Region and considers adaptations to water management system
- ☐ Adapts to climate change vulnerabilities
- ☐ Considers change in amount, timing, intensity, quality and variability of runoff and recharge
- ☐ Considers effects of sea level rise on water supply conditions

Reduces greenhouse gas emissions (mitigation)

- ☐ Quantifies GHG emissions
- ☐ Ability to help the IRWM region reduce GHG emissions
- ☐ Reduces energy consumption (especially embedded in water use)

Describe how project addresses items selected: (50 words maximum)

8) Eligibility (Prop 1 Funding Only)

CEQA and Permitting Status

Will CEQA be completed within 6 months of the Final Award release?

- ☐ Yes
- ☐ NA, Project Exempt from CEQA
- ☐ NA, Not a Project under CEQA
- ☐ NA, Project benefits entirely to DAC/EDA/Tribe, or is a Tribe local sponsor
- ☐ No

Will all permits necessary to begin construction be acquired within 6 months of the Final Award release?

- ☐ Yes
- ☐ NA, Project benefits entirely to DAC/EDA/Tribe, or is a Tribe local sponsor
- ☐ NA, Project does not include construction
- ☐ No

9) Environment (Prop 1 Funding Only)

CEQA Timeline

Is CEQA applicable to your project? ___ Yes ___ No If yes, complete timeline below

CEQA Step	Complete	Estimated or Actual Complete Date
Initial Study		
Notice of Preparation		
Draft EIR/MND/ND		
Public Review		
Final EIR/MND/ND		
Adoption of Final EIR/MND/ND		
Notice of Determination		

Additional explanation of justification of CEQA timeline:
(50 words maximum)

Permit Acquisition Plan
Are permits required for your project? ___ Yes ___ No If yes, enter all permits below:

Type of Permit:

Permitting Agency:

Permit Acquired?: ___ Yes ___ No

Complete below for Permits **NOT** yet acquired:

Actions: *Describe actions taken to date (include dates of key meetings consultations, submittals, etc.) If none, enter 'None' (100 words maximum)*

Issues: *Describe any issues that may delay acquisition of permit. If none, enter 'None' (100 words maximum)*

10) Work Plan (Prop 1 Funding Only)

Work Plan

Work Plan Description: *Provide a brief description of the Project. List of deliverables is not required. (250 words maximum)*

Preliminary Budget (can be changed later)

Category	Grant Request	Cost Share [1]	Other Funds[2]	Total Cost
Direct Project Administration				
Land Purchase/Easement				
Planning/Design/Engineering/ Environmental Documentation				
Construction/Implementation				
Grand Total				

Upload documentation to support cost estimates and funding sources on the Attachments page

1 - Non-State funding sources (Local Contribution). You need to provide Cost Share equal to or greater than Grant Request

2 – Funds from sources other than Prop 1 Grant and local Cost Share

Describe source of Cost Share funds: *Describe the secured, eligible source of cost share funds. (100 words maximum)*

Identify the source of Other Funds: *List if Applicable*

Cost Share Waiver Requested (DAC or EDA): ___ Yes ___ No

Cost Share Waiver Justification*: Describe what percentage the proposed project area encompasses a DAC/EDA, how the community meets the definition of a DAC/EDA, and the water-related need of the DAC/EDA that the project addresses. In order to receive a cost share waiver, the applicant must demonstrate that the project will provide benefits (minimum 25% by population or geography) that address a water-related need of a DAC and/or EDA. (250 words maximum)*

Operations and Maintenance Funding Sources (Constructions Projects Only):

Describe the source of funding for operations and maintenance (25 words maximum)

10) Work Plan (Prop 1 Funding Only)

Tentative Schedule (can be changed later)

Check Task Categories that apply to your project and provide and estimated start and end date. Start and end dates for Direct Project Administration and Construction/implementation are required.

	Task Category	Start Date	End Date
☐	Direct Project Administration		
☐	Land Purchase/Easement		
☐	Planning/Design/Engineering/ Environmental Documentation		
☐	Construction/Implementation		

11) Benefits (Prop 1 Funding Only)

Benefit Classes

Select all benefit classes that apply to your project. At least two are required

Enter the quantity of benefit in Quantity column. Provide a short description of how you quantified the benefit in the Description column

Your Project will be scored and ranked based on your responses to the benefit class questions below (at least two required)

	Benefit Class	Indicator	Metric	Quantity	Description
☐	1) Water supply reliability, water conservation, water-use efficiency, water supply decision support tools	Acre feet per year of water supply made newly available in the watershed by the project	acre feet/year		*250 words maximum*
☐	2) Groundwater recharge and management, clean-up	Acre feet per year of new groundwater recharge from any source or new groundwater treated	acre feet/year		*If achieving recharge, clean-up and/or management, pick one to quantify. Indicate which one you used. 250 words maximum*
☐	3) Treat and convey wastewater/reclaim water	Acre feet per year of new reclaimed water treated or distributed	acre feet/year		*If both treatment and distribution, pick one to quantify. 250 words maximum*
☐	4) Multipurpose flood & Stormwater (monitor, capture, storage, cleanup, treat, manage, tools)	Acres of watershed managed by the project	acres		*250 words maximum*
☐	5)Watershed/ecosystem/wetland protection, restoration	Acres of watershed managed by the project	acres		*250 words maximum*

☐	6) Benefits to members of disadvantaged communities	Percent of benefits accruing to disadvantaged communities	acres		*250 words maximum*
☐	7) Benefits large area of watershed	Acres of the watershed receiving benefits from the program	acres		*250 words maximum*
☐	8) Drinking water treatment, distribution	Acre feet per year of water treated or distributed	acre feet/year		*If both treatment and distribution pick one to quantify. 250 words maximum*
☐	9) Contains public education component	Estimated number of person-contacts per year	contacts/year		*Describe how "person-contacts" were quantified. 250 words maximum.*
☐	10) Non-point source pollution: reduce, manage, monitor, tools	Acre feet per year managed (reduced, treated, monitored) by the project	acre feet/year		*250 words maximum.*
☐	11) Fisheries restoration / protection	Acres of the watershed managed by the project	acres		*250 words maximum.*
☐	12) Removal invasive non-native species	Acres of watershed managed by project	acres		*"Managed' means monitored, treated and maintained clean for performance period. 250 words maximum.*

Other Benefits

Other Physical Benefits: *Optionally describe additional project benefits not included in the Benefit Classes (50 words maximum)*

11) Benefits (Prop 1 Funding Only)

Benefits to Multiple IRWM Regions

Does the project provide physical benefits to multiple IRWM Regions (or funding areas)?

___ Yes ___ No

If Yes, list the names of the regions and provide a description of the impacts to each. *Click the 'IRWM Regions' link above to see a map of the regions (50 words maximum)*

12) Other (Prop 1 Funding Only)

Disadvantaged Communities (DAC), Economically Distressed Areas (EDA) and Native American Tribal Communities (NATC)

For details about DAC, EDA and NATC see Appendices C (NATC), E (DAC) and F (EDA) of the 2016 IRWM Guidelines.

The DWR DAC Mapping Tool and DWR EDA Mapping Tool can help answer questions about DAC and EDA.

Does the project provide direct water-related benefits to a project area entirely comprised of DAC or EDA? ___ Yes   ___ No

If yes, explain water-related need of DAC/EDA and how project will address the need. Explain how the area meets definition of DAC or EDA*. (150 words maximum)*

Is the Project Sponsor a Tribe, or does the project provide benefits entirely to a Tribe as defined by Proposition 1? ___ Yes   ___ No

If yes, explain water-related need of the Tribe and how project will address the need. *(150 words maximum)*

Least Cost Alternative
Provide a narrative on cost considerations
For example, were other alternatives to achieve the same types and amounts of physical benefits as the proposed project evaluated? If the proposed project is not the lowest cost alternative, why is it the preferred alternative? Are there any other advantages that the proposed project provides from a cost perspective? (150 words maximum)

Safe Clean Affordable Water (AB 685)
Does the project provide safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes consistent with AB 685 ? ___ Yes   ___ No

If Yes, please describe. *(50 words maximum)*

Innovative Technologies
Does the project employ new or innovative technologies or practices, including decision support tools that support the integration of multiple jurisdictions, including, but not limited to, water supply, flood control, land use, and sanitation? ___ Yes   ___ No

If Yes, please describe. *(50 words maximum)*

12) Other (Prop 1 Funding Only)

AB 1249 Contaminants

Does the project address a contaminant listed in AB1249 (nitrate, perchlorate, hexavalent chromium, arsenic) ___ Yes ___ No

If Yes:

Describe how the project helps address the contamination. *(50 words maximum)*

Does the project provide safe drinking water to a small disadvantaged community?
___ Yes ___ No

If Yes:

Explain how the project benefits a small disadvantaged community as defined in the updated 2018 IRWM Guidelines. *(50 words maximum)*

Property Access

Does the applicant have legal access rights, easements, or other access capabilities to the property to implement the project?

___ Yes Please describe

___ No Please provide a clear, concise narrative with schedule to obtain necessary access

___ NA Please describe why physical access to a property is not needed

Explain: *(50 words maximum)*

12) Attachments (Prop 1 Funding Only)

Attachments

Upload documents to support project submissions

Document Type: ☐ Project Partners ☐ Project Funding

Project Partners – Documents that demonstrate collaboration between agencies: Memorandums of Understanding, Funding Agreements, Letters of Support, Excerpt from Board Actions, etc.

Project Funding – Documents that support cost estimates and funding sources.

Choose File - select file from file system

Upload File – save file to database

There is an 8 MB file size limit. If you have larger files email Pete Vitt (pvitt@sawpa.org)

13) Finish

Click the 'Submit Project' button to submit your project. Projects designated as "OWOW Plan Update 2018" projects on the "General" page will be added to the OWOW Plan Update 2018. Projects designated as "Prop 1 Funding" projects on the "General" page will be submitted for Prop 1 Funding requests and added to the OWOW Plan Update 2018. A pdf report will automatically be generated with your project information. You and the project contact will receive an email confirming the project submission with a link to the project report. You can still make edits to the project at any time after the project is submitted. Click the 'Submit Project' button to update the project information report with the latest information.

The One Water One Watershed Plan Update 2018 describes how collaborative watershed planning, water and land management, and project implementation supports improved sustainability, resilience, and quality of life throughout the Santa Ana River Watershed through 2040.

The six goals of the OWOW Plan Update 2018 are to…

Achieve resilient water resources through innovation and optimization.

Objectives:

- Increase the reuse of water
- Innovate to increase water-use efficiency, conservation and interregional transfers
- Manage precipitation as a valuable watershed resource
- Reduce carbon emissions from water resources management
- Safely strengthen links between flood protection, storm water management and water conservation
- Sustainably manage groundwater basins
- Plan for OWOW implementation beyond state grants

Ensure high quality water for all people and the environment.

Objectives:

- Achieve and maintain salt balance in the watershed
- Ensure every human being in the watershed has safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes
- Protect and improve source water quality
- Protect beneficial uses and attain water quality standards in freshwater and marine environments
- Reduce water systems vulnerability to climate impacts
- Support alignment of regulatory action with watershed goals

Preserve and enhance recreational areas, open space, habitat, and natural hydrologic function.

Objectives:

- Conduct regional effort to remove and manage invasive species
- Preserve and restore beneficial hydrologic function of streams, arroyos, water bodies, and the coastal zone
- Protect and restore wildlife corridors and habitat connectivity
- Protect endangered and threatened species, and species of special concern
- Support healthy watershed policies with local land use authority

Engage with members of disadvantaged communities and associated supporting organizations to diminish environmental injustices and their impacts on the watershed.

Objectives:

- Adopt best-practices for environmental justice action throughout water management
- Analyze and confront unequal community vulnerabilities to climate impacts
- Ensure community voices help identify strengths and needs
- Strive to include community cultural values in watershed management decision-making
- Support broad-based collaboratives alleviating homelessness and its impact on the watershed.

Educate and build trust between people and organizations.

Objectives:

- Adopt policies strengthening transparency in water management decision-making
- Collaborate with educators to broaden youth knowledge about water
- Develop strong ongoing consultation and partnership with Native American tribes
- Ensure conservation is a way of life in the Santa Ana River Watershed
- Innovate communication strategies for diverse communities
- Maintain and grow watershed and sub-watershed collaborative water management efforts

Improve data integration, tracking and reporting to strengthen decision-making.

Objectives:

- Apply new technologies to maintain and enhance transparency and efficiency
- Collaborate to produce regular publicly-accessible watershed health reports
- Develop standard data formats and data fields for comparative analyses
- Increase appropriate access to data for decision-makers, managers, and the public
- Reduce redundancy in data collection in overlapping programs
- Streamline regulatory reporting requirements